MODULE 5
Applications of Electrical Engineering

Syllabus:
Electrical Appliances, Electric Locomotives, Smart Grid, Micro Grid, Vehicle to Grid (V2G) Technology, Case study on electrical wiring and estimation for a single storey building.

ELECTRICAL APPLIANCES:

In simple terms, an electrical appliance also known as domestic appliance, is a device that runs on electricity. An electric appliance can be any modern-day product that helps to do a job more easily. Having an electric appliance helps us run the daily chores without putting much effort, it also saves our time. An electric appliance can be used for one or many things. The technologies involved primarily to produce electric appliances are mechanical, electronics, electrical, instrumentation, etc.

An electric appliance can be used indoors or outdoors at our convenience. Some of them are portable, handy and can also be operated remotely or controlled by another device. For example, microwave ovens, toasters, dishwashers, refrigerators, etc run on electricity. We should use our electric appliances wisely and take care of them periodically.

1.CEILING FAN

Electric fans, which every one of us has seen at homes is need of summers when the atmospheric temperature goes above the comfort level of human body. An electric fan when rotates, blows away air around it towards the corners of room and thus speeds up the evaporation process resulting in the cooling of human body and room.

1.1 Components of Ceiling Fan:

The cross-sectional view of a ceiling fan is shown in Fig. 5.1.

1. **Capacitor:**

   Start Capacitor is used in electric fans, as we know capacitors stores energy and this stored energy is used to rotate the fan from rest state. This capacitor increases electric fan motor torque and allows the motor to rotate rapidly. This capacitor remains into circuit until only the electric fan reaches predetermined speed, this predetermined speed is usually the 75% of the full speed of fan and when fan reaches the predetermined speed this capacitor is taken out of the circuit and will again be incorporated into circuit when fan comes at rest state.

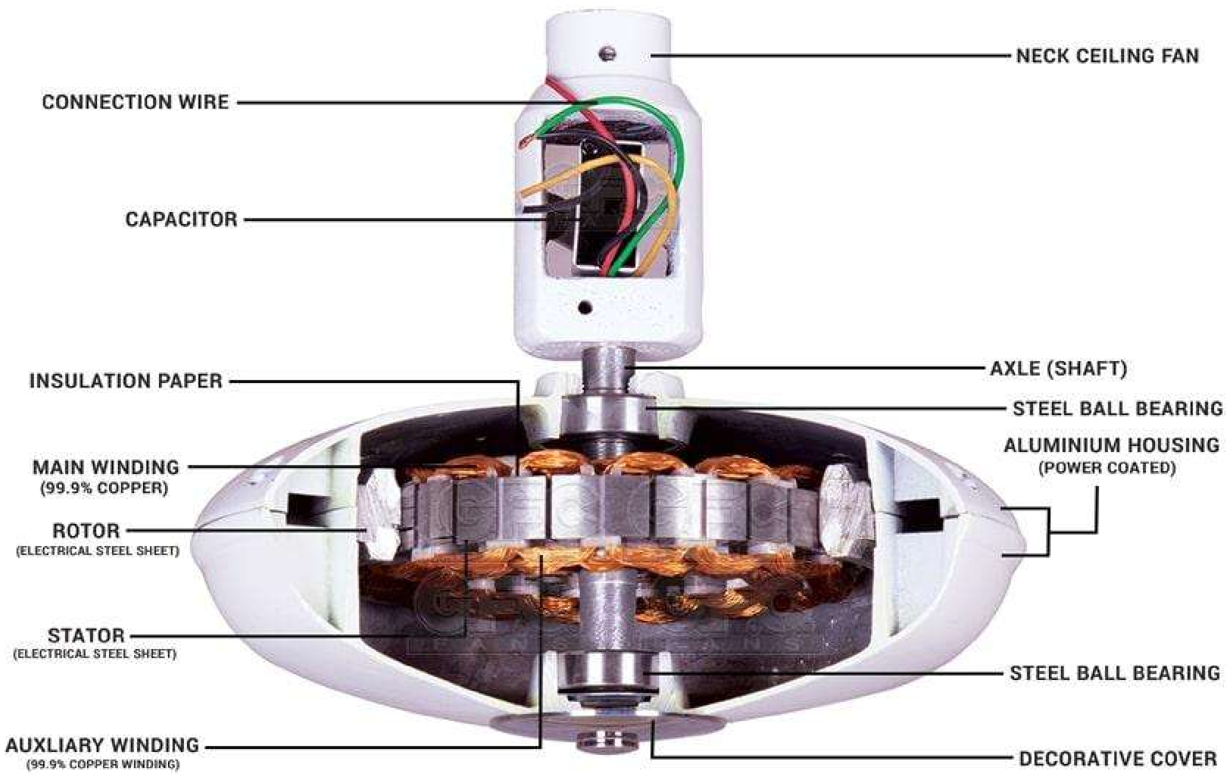

Fig. 5.1 Cross Sectional View of a fan

2. **Axle:**

   Axle or Shaft is a metallic rod mostly made up of mild steel. The axle is connected from ceiling to fan housing. It stays at rest motion while bearings supporting the housing over it rotates. It also has arrangements for transfer of current to the stator windings.

3. **Bearings:**

   Ball bearings are used in the electric fan. Two bearings which are link between housing and axle gives the rotary motion to the housing.

4. **Stator:** Stator winding is simply the stationary winding in the electric fan motor winding. Stator winding means thousands of turns of conducting wire on any non-conducting structure like a coil. This winding has very low resistance. Main purpose of stator winding is to convert electric current into magnetic field.

5. **Rotar:** Rotor in the electric motor is the permanent magnet in the shape of half circles. Usually, 2 pieces of magnets are used in Electric fan but this can change to 3 pieces or to single piece depending upon size and capacity of electric fan.

6. **Housing:** Housing is the outer part of the electric fan which carries stator, rotor and drive shaft bearing assembly on inside and blades on outer sides.

7. **Blades:** Blades or wings are the hanging part bolted on the outer area of housing. Three blades are mostly used, and their length and the angle of air throw depends upon the size and capacity of electric motor.

1.2 Working principle:

Electric fan works on the principle of conversion of electric energy into mechanical energy by means of magnetic fields and in this case converted mechanical energy is consumed as rotary motion of fan blades.

- Single phase Induction Motor is used in ceiling fan which is not self starting one
- Two windings are used namely starting and running winding, while a capacitor is used in the starting winding. (Fig. 5.2)
- When AC is supplied to electric fan both starting and running winding are energized by the same supply.
- As voltage in capacitor is lagging the current by 90 degrees, Induction Motor acts as a 2 phase machine
- When AC is supplied to electric fan it first reaches the capacitor and Capacitor delivers high energy to the stator windings. When stator winding energizes, it develops the rotating magnetic field and which forces the rotor to rotate in the direction of rotating magnetic field.
- When 75% of the rated full load speed is reached, a centrifugal switch acts and removes the starting winding from the circuit.
- Further the machine will run as a single phase Induction Motor (IM)

In this way electrical energy is converted into mechanical energy which causes the rotor and housing to spin and the blades attached to the housing throws away the air nearby it while creating cooling effect.

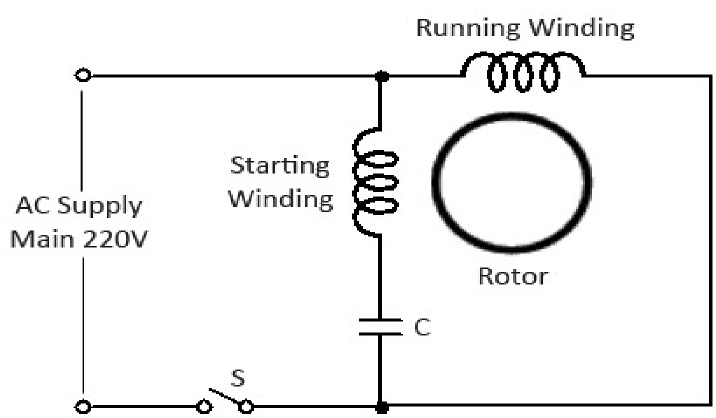

Fig. 5.2 Types of winding in a ceiling fan

2.HEATER/ GEYSER

The geyser converts electrical energy into heat energy using electric resistance. That heat is transferred to surrounding water in the geyser or water bucket. After heating the convection flow is formed in the water.

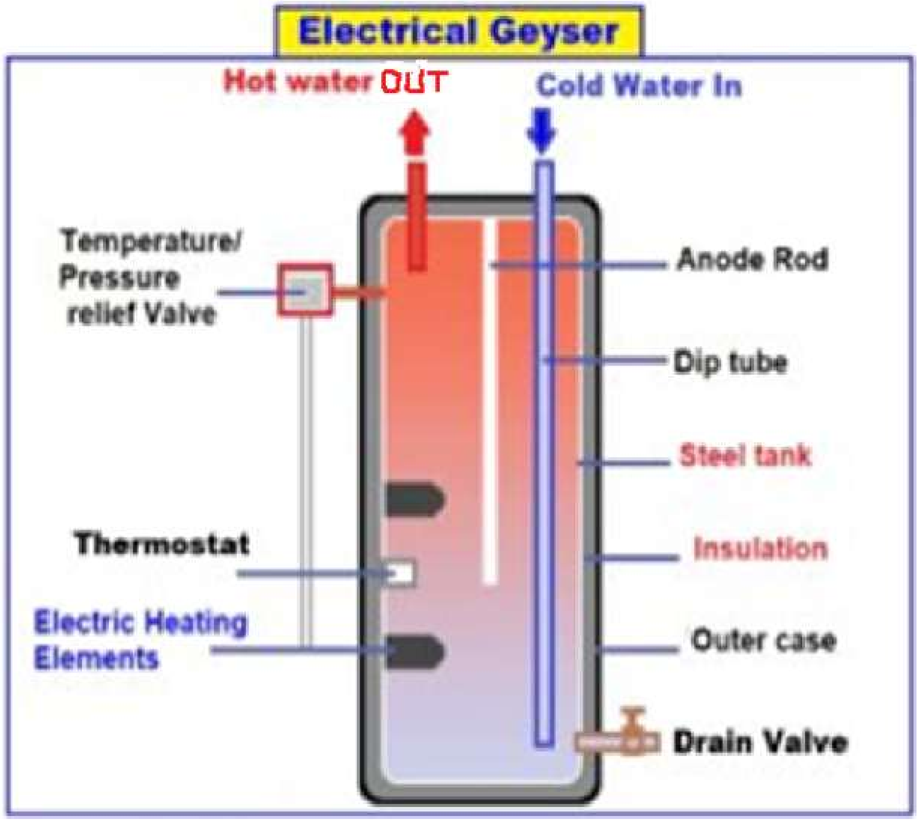

Fig. 5.3 Electric Geyser functional parts

Water geysers, also known as hot water heaters or simply heaters, are devices that are used to heat water for various domestic purposes such as bathing, cleaning, and cooking. These appliances have become an indispensable part of modern households, providing a constant supply of hot water at the turn of a tap.

The most common type of water geyser is the storage tank heater, which works by heating water in an insulated tank and maintaining the temperature of the water until it is needed. (Figure 5.3). The tank is typically mounted on the roof or on the wall of a building and can range in size from 20 to 80 gallons, depending on the needs of the household. The tank is usually made of stainless steel or glass-lined steel, which helps to prevent corrosion and extend the life of the heater. Its water temperature can easily be regulated automatically by a thermostat. It works on the principle of thermal storage i.e. the water is preheated by immersion water in a storage vessel and is kept for future use.

To get the hot water from time to time, the storing vessel is provided with thick insulation or it is properly legged to dissipate the heat. The heating element is fixed at the bottom horizontally or vertically. As the water heater is switched 'on' the cold water is heated up, becomes lighter and starts moving up while the cold water being heavier comes down. Thus, due to this circulation of water, we can get hot water from the outlet valve. If the element is fixed horizontally, the water above it is heated very slowly but when the element is fixed vertically, the water surrounding this is heated up very soon. So, the vertical fitting of the element in the water heater is more preferred.

However, it is important to keep in mind that water geysers can be expensive to purchase and install, and they also consume a significant amount of energy. Therefore, it is important to choose a water geyser that is both efficient and meets the needs of the household. Factors such as the size of the tank, the type of fuel source, and the type of heating element should all be considered when making a purchase.

2.1 Parts of Electric Geyser

The electric geyser consists of a water tank fitted with two pipes:

- Inlet pipe for cold water
- Outlet pipe of hot water

The water tank is fitted with heating elements that are controlled by thermostats. The thermostats ensure that water is not heated above a set temperature value. The tank is normally covered with some insulating material and enclosed inside a metal casing. An electric water heater works by using electrical resistance to heat water inside a tank.

1. **Cold Water Inlet**:
   - Cold water from your home's plumbing system enters the water heater through a pipe connected to the bottom of the tank.
   - This cold water is then stored in the tank until it's needed.
2. **Heating Elements**:
   - Inside the tank, there are one or two heating elements made of materials like stainless steel or copper.
   - These heating elements are connected to electrical wires and are submerged in the water.
3. **Thermostat Control**:
   - The water heater has a thermostat, which allows you to set the desired temperature for the hot water.
   - When the water temperature inside the tank drops below the set temperature, the thermostat signals the heating elements to turn on.

4. **Electric Resistance Heating:**
    - When the heating elements receive the signal from the thermostat, they start heating up.
    - Electric current flows through these elements, and they resist the flow of electricity, which generates heat.
    - This heat is transferred to the water in the tank, raising its temperature.
5. **Heat Distribution:**
    - The heating process begins at the bottom of the tank, where the heating elements are located.
    - As the water in the vicinity of the heating elements gets warmer, it rises to the top of the tank. This movement, known as convection, causes the cooler water at the top of the tank to move down to the bottom to be heated. This cycle continues until the entire tank reaches the desired temperature.
6. **Temperature and Pressure Regulation:**
    - To ensure safety, electric water heaters are equipped with a temperature and pressure relief valve. If the water temperature or pressure inside the tank exceeds safe levels, this valve opens to release excess pressure and prevent the tank from exploding.
7. **Hot Water Outlet**:
    - When you open a hot water tap or use a hot water appliance in your home, hot water is drawn from the top of the tank through a pipe connected to the hot water outlet.
    - This hot water is then delivered to the point of use, such as a faucet or showerhead.

Energy Efficiency:

- Many electric water heaters come with insulation to reduce heat loss from the tank.
- This insulation helps the heater maintain the water temperature efficiently, reducing energy consumption and heating costs.

Maintenance:

- Over time, sediment and minerals from the water can accumulate at the bottom of the tank.
- This can reduce the heater's efficiency. Periodic maintenance, like flushing the tank to remove sediment, is necessary to keep the water heater operating efficiently.
- Electric water heaters are relatively straightforward and reliable appliances, commonly used in homes to provide a continuous supply of hot water for bathing, washing dishes, laundry, and other domestic purposes.
- They are available in various sizes to meet the hot water needs of different households.

3. MIXER GRINDER:

Mixer grinder, as we all know that has made cooking easy. A mixer grinder is a very well-known and useful kitchen appliance. Nowadays, almost every house has a mixer grinder It helps in making a perfect mixture of spices.

The working of a mixer grinder is based on the principle, that whenever a current-carrying coil is placed in a magnetic field it experiences a force, which produces a torque that can rotate the coil. The direction of force is determined by the Fleming left-hand rule.

A motor is a machine that converts electrical energy into mechanical energy. Universal motor is a special type of motor which can work for both A.C (single-phase) and D.C current.

When the current passes through the field winding it produces an electromagnetic field, hence acts as an electromagnet. The rotor starts rotating as it acts as a current-carrying coil present in a magnetic field. The same current which passes through the field winding also flows through the rotor winding that’s why whenever AC current changes direction, the direction of current changes in both field winding and armature, and hence the movement of the rotor is not affected.

3.1 Component of A Mixer Grinder

The main component of a mixer grinder is a universal motor which consists of : rotor, carbon brushes, commutator, and field winding, rotary switch to alter the speed, indication lamp, and a plug. Whenever we switch on the mixer grinder, universal motor comes into action as current passes through both the field winding and armature winding and as a result, a torque is applied on the rotor, the rotor starts rotating which then rotates the blades of the grinder and thus it helps in mixing and grinding of the ingredients.

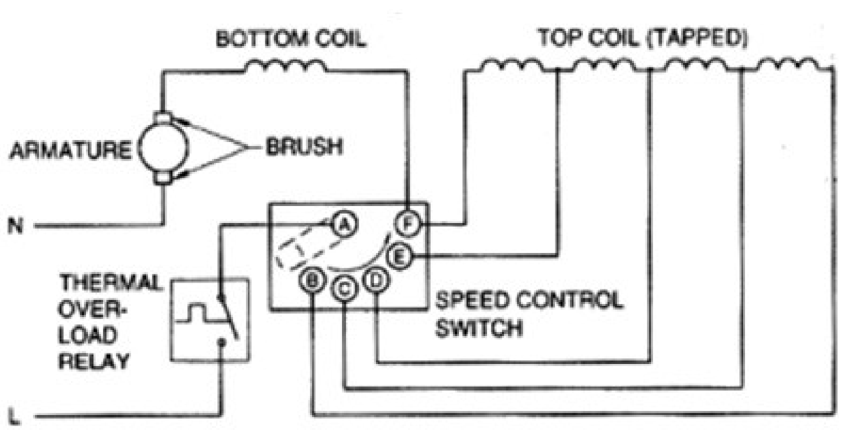

Fig. 5.4 Mixer Grinder speed control schematic

Generally, the mixer grinder is designed to operate with a 230V AC supply. The figure 5.4 shows the schematic connection in a mixer grinder. The internal parts of a mixer grinder as below:

- Universal Series Motor
- Three Position Speed Control Rotary Switch
- Thermal Overload Relay or overload switch
- Indicator Light
- Power Switch

1. **Universal Series Motor:**

   Universal series motors are those which are designed to operate with both AC and DC supply. Here the word 'series' used because its field windings are connected in series with the armature winding. In the above circuit diagram, there are two series windings. One of these is tapped in three positions. And those tapings are connected to the speed control switch. So, this arrangement is for speed control of the motor. So we can obtain three different speeds (low, medium, high) by rotating the switch.

2. **Thermal Overload Relay or overload switch**

   A thermal Overload Relay or overload switch is used to protect the device from overload or overcurrent fault. If the motor draws overcurrent due to any internal fault, or improper use, the overload relay will automatically disconnect the power supply to the motor. As the mixer grinder is a home appliance, so the thermal overload relay is very helpful to prevent accidents such as burning of motor, fire, and melting due to over current. The overload switch also helps to turn off the motor if you run it for a long time. After fully cool down it will be got automatically turned on. You can see the mixer grinder overload switch connection diagram below.

3. **Three-Position Rotary Switch**

   It has a total of four terminals. The first one is the input terminal and the other three are output terminals where the terminals of the motor are to be connected.

4. **Power Switch**

   Most of the mixer grinders have the function to switch on and off in their speed control switch but some mixer grinders come with a separate power switch to on and off.

ELECTRIC LOCOMOTIVES

An "Electric Locomotive" is a railway vehicle that can move along rails and push or pull a train attached to it using electric power drawn from an external source, usually from overhead cables or a third rail.

Electric Locomotives do not have a conventional "engine" in them as we have seen in a diesel locomotive, but use the electricity collected from the outside source to power traction motors which turn the wheels.

Types of Electric Locomotives

Electric Locomotives are of three types:

Those which can work on

- DC (Direct Current),
- AC (Alternating Current)
- AC and DC – Bi-current

Electric Locomotives, work on the principle of drawing current from external sources and then after sufficiently "modifying" it, feed it to the traction motors.The process of "modifying" the raw current drawn from outside into "usage" power includes a complicated process of conversion, reconversion, smoothening and transformation of the current to varying values of frequency, Voltage, Current etc.

Major Parts of AC Electric Locomotive

Fig, 5.5 shows the block diagram of an AC electric locomotive.

This involves a bank of many components like transformers, rectifiers, inverters, capacitors, thyristors, compressors, housed within the locomotive body or the "shell", and there is no central "Engine" or prime mover.

Bi-Current locomotives work according to the same principles, only they have more equipment packed inside them to enable them to work under both type of currents. The Pantographs are used to collect a specific type of current only. The electric locomotive draws power from the over head equipment (OHE) with the help of Pantograph and converts this electrical energy to mechanical energy, in controlled manner, through Traction Motors which drive the axles. To enable the locomotive to perform this task, it is equipped with suitable equipment, which enable loco pilot to control the speed of the train as per requirement by controlling the applied voltage to traction motors.

In conventional locomotives, 25KV, Single phase, AC supply is collected by a roof-mounted pantograph from the OHE and is stepped down by a transformer inside the locomotive. This supply is then converted to DC supply by a full wave silicon rectifier and associated smoothing filter before being fed to the traction motors. Torque / speed control is achieved by variation of the AC input voltage to the rectifier through an on-load tap changing arrangement on the primary winding of the loco transformer.

The equipment on electric locomotive, depending up on where it is located, can be classified in three different categories viz.

1. Roof equipment,
2. Inside equipment and
3. Under Frame equipment

Both the roof and the under-frame equipment are subjected to lot of dust and atmospheric pollution and are therefore designed to withstand these severe working conditions.

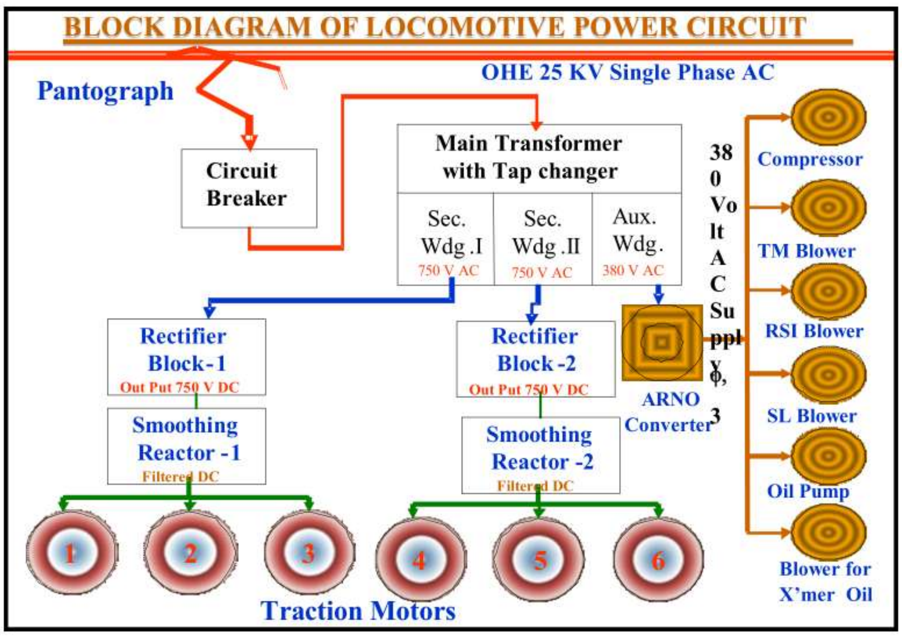

Fig. 5.5 Block diagram of an AC locomotive

1. Roof Equipment:

Pantograph

The High Tension current (25 kV) for feeding locomotive is taken from contact wire by means of current collecting device called pantograph. Each loco is provided with two similar pantographs on the roof. As a practice, the rear pantograph is generally used.

Circuit Breaker (Air blast circuit breaker, Vacuum circuit breaker)

When the Circuit breaker closed manually through remote control, OHE supply collected by pantograph is made available to the main transformer inside the locomotive. It opens automatically in case of over current or earth fault in the loco under the action of protective devices. Now, air blast circuit breakers are being replaced by vacuum circuit breaker (VCB) due to its superior qualities and less maintenance.

2. Inside Equipment:

Voltage regulating equipment:

The high OHE voltage is stepped down to low voltage by the main transformer comprising of an Autotransformer with 32 taps and a stepped down transformer with two separate secondary windings. The low voltage can be controlled from Zero to Maximum through on load tap changer which can be compared with a fan regulator used to control the fan speed.

Silicon Rectifiers

Since the traction motors are DC motors, alternating current supplied by secondary windings of main transformer is converted in to direct current by means of two silicon rectifiers (RSI), one each feeding to set of three traction motors.

ARNO converter:

ARNO converter converts the single-phase 380 Volt input from transformer auxiliary winding to 3 phase 380 Volt output. The three-phase output of ARNO converter is supplied to various auxiliary motors provided for supplying compressed air, creating a vacuum in train and cooling of electrical equipment such as Traction motors, smoothing reactor, rectifier block, main transformer etc.

3. Under frame equipment

Traction-Motors

In general, the locomotive is provided with six DC series type traction motors(TMs). These TMs are mounted in two under frame bogies coupled with wheels through pinion-gear arrangement.

Smoothing reactor

As output of rectifier is of undulating (Pulsating) nature, it is passed through an inductive choke called smoothing reactor (SL) to reduce the undulation of the current and to make current smoother.

4. Brakes

Loco is provided with following brakes:

1. Air brake system
2. Independent brake
3. Proportionate brake
4. Dynamic (Rheostatic) brake
5. Regenerating brake

Drawback of Electric Locomotive

Electric locomotives have this major drawback of being totally dependent on the power which has to be supplied for it to run. Any power outage, short circuit or breaking of Overhead Equipment (OHE) will cause trains to come to a standstill. Hence, even on fully electrified routes, diesel locomotives are kept on standby always. And on partly electrified routes, trains are run on diesel under the wire because it is more efficient than switching locomotives.

SMART GRID

A smart grid uses digital technology to improve reliability, security, and efficiency (both economic and energy) of the electric system from large generation, through the delivery systems to electricity consumers and a growing number of distributed-generation and storage resources.

Disadvantages of Existing Electric Grid

1. Over strained and interregional bulk power transfer is limited
2. Cannot fully support the integration of renewable energy
3. Low reliability of power and outages
4. Fluctuating Power quality
5. Lack of Consumer Discipline
6. Increasing levels of Green house gases
7. Almost Zero Customer Participation
8. Low billing and collection
9. Less Efficiency

Need for Smart Grid

A Smart Grid is an electricity Network based on Digital Technology that is used to supply electricity to consumers via Two-Way Digital Communication. This system allows for monitoring, analysis, control and communication within the supply chain to help improve efficiency, reduce the energy consumption and cost and maximize the transparency and reliability of the energy supply chain.

Smart grid is integration of an electric power system, communication network, advanced Sensing, metering, measurement infrastructure, complete decision support and human interfaces software and hardware to monitor, control and manage the creation, distribution, storage and consumption of energy. The areas of application of smart grids include, smart meters integration, demand management, smart integration of generated energy, administration of storage and renewable resources, using systems that continuously provide and use data from an energy network.

MICRO GRID

A microgrid is a small power system that has the ability to operate connected to the larger grid, or by itself in stand-alone mode. Microgrids may be small, powering only a few buildings; or large, powering entire neighborhoods, college campuses, or military bases. Microgrids are comprising of energy storage systems combined with renewable energy sources (solar, wind, small hydro), usually backed up by a fossil fuel powered generator.

Microgrid components

The block diagram of a microgrid is shown in Fig. 5.6

A microgrid has five key components:

- Energy sources (generators and storage)
- Energy sinks (loads)
- A means for connecting to/disconnecting from a larger power system
- Means for controlling ("regulating") the microgrid
- Appropriate safety-assurance systems ("protection")

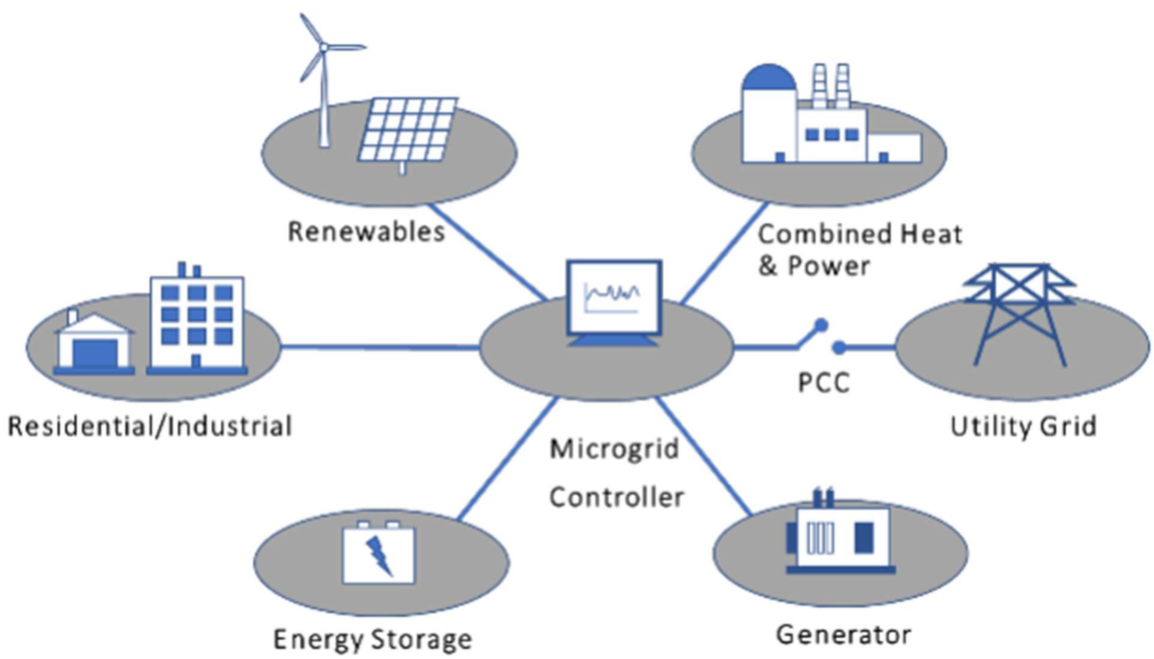

Fig. 5.6 Block diagram of a Microgrid

Advantages of microgrids:

- The main advantage of a microgrid is higher reliability. The microgrid has sources close to loads and is thus less vulnerable to disruption in transmission caused by storms or other natural disasters. Most microgrids installed commercially today were installed for reliability-enhancement reasons.

- Eventually, microgrids may be lower cost. Large-scale mass production of microgrid equipment, improvements in energy storage and renewable energy technology, and standardization of design and operations may eventually make microgrids a low-cost option.
- Other potential advantages: Can take advantage of local resources, such as the aforementioned "steam plant", a local hydropower resource, or strong solar resources.
- Power is produced locally, so losses in the transmission system are avoided.
- Microgrids can take maximum advantage of DC power, which could ultimately improve overall energy efficiency and simplify system control.

ELECTRIC VEHICLE

Electric vehicles are becoming increasingly important as not only do they reduce noise and pollution, but also, they can be used to reduce the dependence of transport on oil. Electric vehicles can also be used to reduce carbon emissions. Production of zero release of carbon dioxide requires that the energy for electric vehicles is produced from non-fossil-fuel sources such as nuclear and alternative energy.

An electric vehicle is a vehicle having the two features: (i) The energy source is portable and electrochemical or electromechanical in nature, and (ii) traction effort is supplied only by an electric motor. Figure shows the block diagram of an EV system driven by a portable energy source.

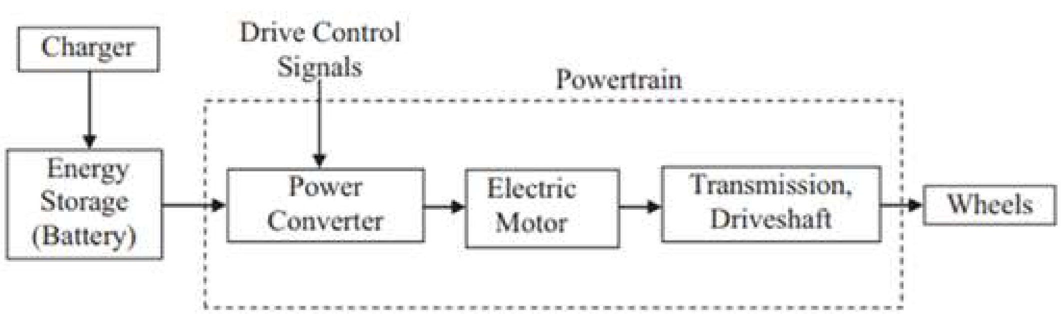

Fig. 5.7 Block Diagram of an Electric Vehicle

The electromechanical energy conversion linkage system between the vehicle energy source and the wheels is the powertrain of the vehicle. The power train has electrical as well as mechanical components. The fuel for EVs is stored in an energy storage device, such as a battery-pack, for energy delivery upon demand. The primary source of energy for electricity generation for these vehicles is varied ranging from fossil fuels to solar energy. The BEV requires fuel delivered in electrical form to the vehicle through the electric power transmission system. Solar EVs use solar panels and a power converter to charge the batteries on the vehicle. The special feature of these EVs is that these are zero-emission vehicles (ZEVs) as far as pollution within the vehicle is concerned.

The automobile is a complex system made of numerous hardware components and software algorithms interconnected through mechanical links and electrical communications network. The primary hardware components in the automobile are the energy conversion and power transmission devices; many secondary components are necessary for the functioning of the primary components The primary energy conversion devices in an electric vehicle are the electric machine and the energy storage device.

The electric machine can be used either as a motor or as a generator to convert mechanical power to electrical power or vice versa, respectively. With the introduction of electric machines for power and energy transfer in electric and hybrid vehicles, energy storage devices and electrical-to-electrical power/energy conversion devices have become essential. A high-energy capacity battery-pack is the most common energy storage device in these vehicles. An ultracapacitor-bank can also be used for energy storage in hybrid vehicles. Flywheels have also been used in prototype research hybrid vehicles for energy storage in mechanical form. The electric machines require an electric drive to control the machine and deliver the required power based on requested demands and feedback signals. The electric drives are made of power electronic devices and electronic controllers. The drives are electrical-to-electrical energy conversion device that converts steady voltages with fixed frequency into a variable voltage supply for the electric machine. The drives can also process electrical power in the other direction assisting the electric machine to convert mechanical power into electrical power when the electric machine operates as a generator. The DC/DC converter is another electrical power management device used for DC power conversion from high to low voltage levels or vice versa. The converter is made of power electronic devices and energy storage inductors; this device can be bidirectional as well. The DC/DC converter is a key component for the fuel cell interface with the electric motor drive. The energy flow in a vehicle starts from the source of energy and ends at the wheels with the delivery of propulsion power; the path for this power and energy flow is known as the powertrain of the vehicle. The energy source within the vehicle could be the stored energy in batteries. The flow of power and energy in the powertrain is controlled by a set of electronic controllers. In addition to the electronic controller units (ECUs) for each of the energy conversion and power transmission devices in the powertrain, there is a master controller for coordinating the system-level functions of the vehicle. This controller is termed as the vehicle supervisory controller (VSC).

VEHICLE TO GRID (V2G) TECHNOLOGY

Nowadays, the demand of electricity is increasing which requires the enhancement in power generation. The diminution of fossil fuels has also become a matter of concern to the world. The prolonged use of fossil fuels also leads to environmental hazards such as GHG and CO2 emissions. To promote sustainable, low emission development, many countries are adapting renewable energy sources to meet the load demand. Integration of renewable energy sources such as solar and wind has become possible but they are more variable and uncertain than conventional sources; also, it requires changes in the power system planning and operation. Therefore, it is necessary to build an energy storage system which will improve the power quality of the grid which leads to increase in the capital cost of the system. Electrification of Transportation sector assures a reduction in the environmental issues. It is an effective solution to reduce GHG emission caused by combustion engines. Additionally, electric companies can improve power quality by employing EV integration. Electric vehicles have become very popular in recent years and a continuation of this trend can be predicted in the near future until the day most of the transportation sector will comprise of EV. A big portion of vehicles are expected to be parked during a major part of the day. This idea can be used to facilitate V2G technology. During these idle times, plugged-in EVs can be used to support bidirectional power flow between utilities and EV batteries.V2G is the latest attraction in the field of EVs and their integration with the electric grid. According to this concept, bidirectional flow of electric power is taken into consideration, that is power can be taken from the grid to charge EV batteries during off-peak hours and power can be provided to the grid during peak hours from EV batteries to reduce utility load.

V2G technology facilitates to push back the energy to the power grid from the battery of an electric vehicle, also, it can be charged and discharged based on various signals such as energy production or consumption. It helps to mitigate climate change by allowing our energy system to balance more and more renewable energy. It is the one step forward of G2V, the idea is to develop the smart charging-discharging schedule where the vehicles will store the energy during off-peak hours and discharge it during the peak hours as required. This can be achieved through the use of a 'smart grid' concept which is an electrical network that can process information, controls the flow of electricity to fulfil the end users varying power demand and is able to provide communication between generation sources and end users. When a vehicle is in idle state, the on-board battery is connected to an electrical grid through appropriate communication devices to provide functions such as load-shedding, peak shaving etc. This concept works on the balance of the 'off-peak' and 'peak' demand. The block diagram of V2G technology is shown in the Figure 5.8

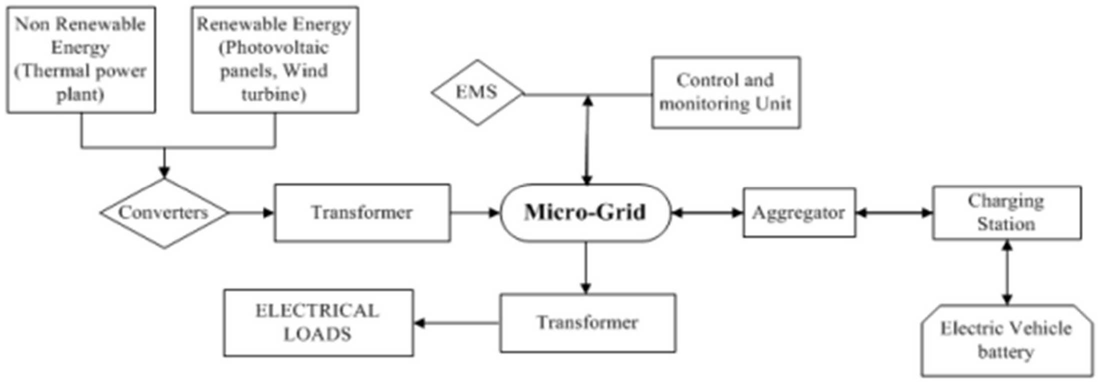

Fig. 5.8 Block diagram of a Vehicle to Grid technology

The components of the block diagram are explained below:

1. **Energy Sources**: It includes Renewable and Non-renewable energy sources. Renewables includes Photovoltaic panels (solar to electrical), Wind turbines (wind to electrical). Non-renewable includes any of the fossil fuel power plants, and is treated mostly as the base load power plant.

2. Electrical loads: The system that consumes electricity are known as electrical loads. It may be residential, commercial, industrial, etc.

3. Aggregator and charging system: Aggregator an intermediate between electric vehicle (EV) and operator of power grid. They are responsible for the management of EVs to provide owners with their own orders and to increase the profitability of the power grid in the electricity market. The aggregator, based on the information obtained, decides the set of EVs to charge / discharge command. These decisions are based on the regulation market price and regulation reference announced by the grid operator "TSO" and "DSO". There is only one aggregator which manages the various EVs from different charging stations. The command from the aggregator is followed by the charging station where the vehicles charge or discharge according to the requirements.

4. Control and monitoring Units: In order to integrate EVs into the power grid, the control devices have to be continuously monitored and controlled by the power system administrator. In addition, the administrator also has to constantly upgrade infrastructure to manage the charging and discharging of the vehicles. An energy management system (EMS) can be defined as a collection of computer-based tools that are used by grid operators in order to control, monitor and optimize the performance of the power generation and transmission system. Also, it can be used in small systems like micro-grids using SCADA/EMS or EMS/SCADA computer technology.

BRIEF ABOUT WIRING DESIGN AND ESTIMATION PROCEDURE FOR SIMPLE LAYOUT.

Task: Provide a simple layout with the dimensions of the rooms (only two rooms) and designing electrical wiring scheme and estimation (single storeyed building only)

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