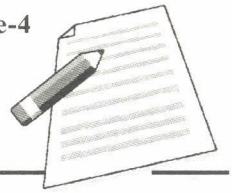


the exposed metal cleaned. In removing the insulation from the wire, a sharp knife is used in much the same manner as in sharpening a pencil. That is, the knife blade is moved at a small angle with the wire to avoid "nicking" the wire. This produces a taper on the cut insulation, as. The insulation may also be removed by using a pliers like hand operated wire stripper. After the insulation is removed, the bare wire ends should then be scraped bright with the back of a knife blade or rubbed clean with fine sand paper, when you removing insulation you should be take care of do not cut insulation near at right angle this will be very bad practice. Probably it causes nicking of insulation and conductor. A nicked conductor became so weak, after be in bend a few times, it will almost certainly break.

6.6 TERMINATING

The entry of a cable end into a accessory is known as a termination. In the case of a stranded conductor, the strands should be twisted together with pliers before terminating. Care must be taken not to damage the wires.

Types of terminal

There is a wide variety of conductor terminations. Typical methods of securing conductors in accessories are pillar terminals, screwheads and nuts, washers.

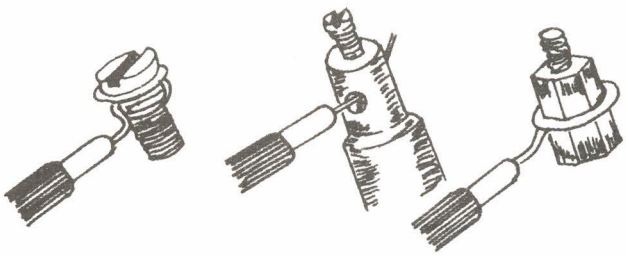
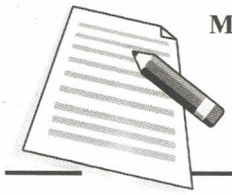


Fig: 6.3 Types of termination

A pillar terminal has a hole through its side into which the conductor is inserted and then secured by a set screw. If the conductor is small in relation to the hole, it should be doubled back when two or more conductors are to go into the same terminal, they should first be tightly twisted together. In the case of flexible cord terminations, the strands must be twisted up (and then bent back if room permits) before being entered into the terminal.

When fastening conductors under screwheads or nuts, it is best to form the conductor end into an eye by means of the roundnosed pliers. The eye should be slightly larger than the screw shank, but smaller than the outside diameter of the screwhead, nut or washers. The eye should be placed in such a way that rotation of the screwhead or nut tends to close the joint in the eye. If the eye is put the opposite way round the motion of the screw or nut will tend to untwist the eye, and will probably result in inperfect contact.



Module-4

Notes

6.7 WHAT YOU HAVE LEARNT

In this lesson we read conductors and insulators as well as wire and cable. Now we have known the types of conductors and can classify them and also use them. Wires and cables are being used in house wiring, home appliances, and in electrical Instuements, apperatus etc in our daily life. Since we are living in Modern era or Science's era So Eleetricity and its appliances play an important role in our life.

6.8 TERMINAL QUESTION

1) Describe the uses of following materials

   a) Conductor

   b) Cable

   c) Standard Wire Gauge

6.9 ANSWER TO INTEXT QUESTIONS

6.1

Fill in the blanks

   i) Good conductor

   ii) Bad Conductor

6.2

Match the pair

i) b ii) d iii) c iv) a

7

ELECTRICAL WIRING ACCESSORIES

7.1 INTRODUCTION

In previous lesson, we have studied mainly about wire & cables. In this lesson, we are going to discuss an electrical controlling, holding safety, outlet & general accessories.

7.2 OBJECTIVES

After reading this lesson, you will be able to:

- Understand the Electrical Accessories.
- Learn about Identify & use of the Switches, Bell push, Double Pole Switch, Plug Socket, Pin Socket, Ceiling Rose, Adaptor, Connector, Fuse etc.

7.3 ELECTRICAL ACCESSORIES

An electrical domestic accessory is a basic part used in wiring either for protection & adjustment or for the control of the electrical circuits or for a combination of these functions.

Rating of accessories

The standard current ratings of the accessories are 6, 16 & 32 ampere. The voltage rating is 240V AC as per B.I.S 1293–1988.

Construction of accessories

These accessories should be provided with complete enclosures, which shall afford adequate protection against accidental contact with all live parts. The parts & the materials normally used are shown in the following Table:

Parts	Materials
1. Base	Vitrified Ceramic material or non-ignitable, molded insulating material e.g. Bakelite
2. Covers, Cover plate & actuating member	Tough non ignitable insulating materials e.g. Bakelite
3. Springs	Corrosion – resistance metal
4. Terminals	Plated Brass terminal posts & screws
5. Attachment fitting screws & other non current carrying parts	Mild Steel, aluminum alloy or insulating material.

7.4 SWITCHES

A manually operated device for closing & opening a circuit is known as switch. It may be categorised as following.

Switches

Single Pole Switch Two way Switch Bill Pus DoublePole Switch

One way switch (single pole), two way switch, Bell push, double pole switch.

(1) Single Pole Switch

Flush, will mounting or switches is the most popular switches in domestic wiring. The flush (piano) switch must be fixed on a PVC gang box or on wooden box. The gang boxes ate available in 1gang 2, 3, 4, & 6 gang according to no. of switches. Standard gang boxes are designed so that the switch is fixed by screw directly or indirectly.

One way switch have current rating 6amperes. These are used for light & fan point rating of power switches is 16 amperes & are used for freeze, mixer, washing machine, geezer, etc.

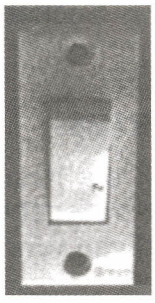


Fig:7.1 S.P. switch

(2) Two-way switch

This type of switch have 3 terminals. Centre terminal is known as common terminal (c). Above terminal of common terminal is Upper terminal (u) & below of the common terminal is Lower terminal (L). Two way switch has current rating 6 amperes only. These are used for stair case wiring, godown wiring, hospital wiring.

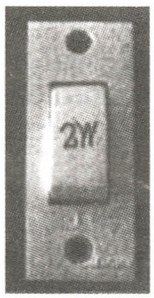


Fig: 7.2 Two-way switch

(3) Bell push

This type of switch having two terminals with spring loaded push button. When we push it makes the circuit temporarily & attends break position when released. It is used in call bell circuit, current rating is 6 ampere & suitable for 250V only.

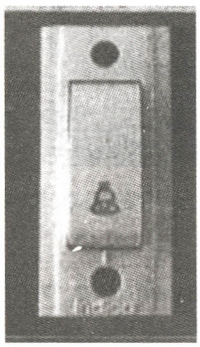


Fig: 7.3 Bell push

(4) D.P. Switch (Double Pole Switch)

This switch is consisting of double pole switch, fuse, fuse link & neon indicator. These switches are used as main switches to controlled main or branch circuit in domestic installation. They are available in 10 ampere, 16 ampere & 32 ampere & suitable for 250V only.

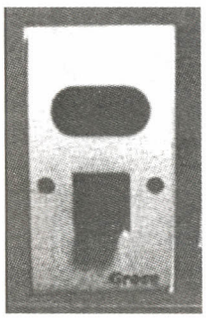


Fig: 7.4 D.P. switch

7.5 PLUG SOCKET

Two pin plug socket having only two pins without earth connection. These are suitable only for double insulated appliances. Current rating of two pin plug socket is 6 ampere & suitable for 250V only.

Three pin plug socket has 3 terminals marked as L(Line), N(Neutral) & E(Earth). The L terminal is always on the right hand side, The N terminal of left hand side, & the top is the earth terminal which is larger in diameter & heavy. Dear student you must have connected earth wire to the earth terminal of the socket. This sockets are rated 6 ampere & 16 ampere & suitable for 250V only.

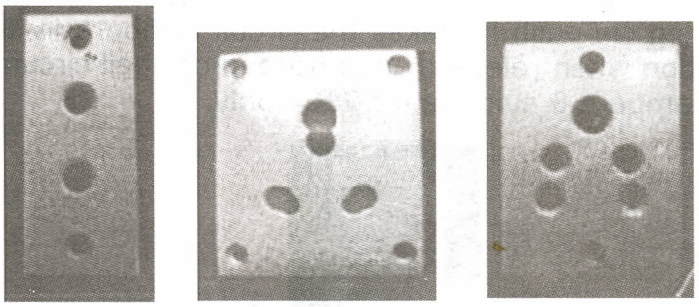


Fig: 7.5 Plug socket

Multi pin sockets are also available, which are suitable for 2 pins & 3 pins having 5 holes in one unit.

7.6 PLUG PIN TOP

Two pin plug to is used for taking the supply from the socket. It has got two pins of the same size. It is suitable for 6 amperes & 250V only.

Three pin plug top also used for taking a supply from the socket. It has 3 pins, two are smaller in size & third one is bigger & longer which is for earth. These are rated as 6A 250V or 16A, 250V.

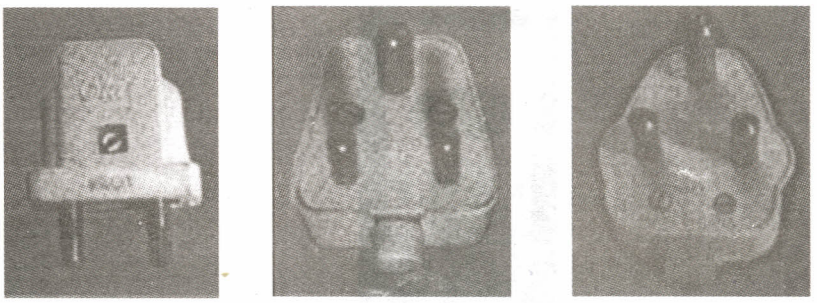


Fig: 5.6 Plug pin top

7.8 CEILING ROSE

Two plate ceiling rose is made of PVC & it has two terminals or plates which are separated from each other by a bridge. Each of the terminal plates is provided with a metallic bar & a binding screw on one side through which the circuit wire from the back via the mounting block enters them. The other side of the terminal plate is provided with washer & screw for tap wire connection. It is used for 6A, 250V.

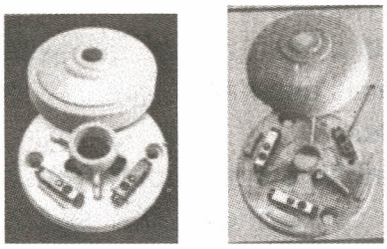


Fig: 5.7 Ceiling Rose

Three plate ceiling rose is also available in market. It has 3 terminals which are separated from each other by a bridge.

7.9 ADAPTOR

It is used for taking a supply from a lamp holder for small appliances. They are made of PVC or bakelite material.

7.10 IRON CONNECTOR

It is used as female connectors to supply current to electric cettels electrical irons, hot plates, heaters and it is made up of bakelite or PVC. The wires are connected with a twin nickel spring. The cable entry has a rubber protection type.

7.11 FUSE

There are the ones mostly used in domestic installations. This Fuse consists of a Porcelain base having two fixed contacts, for connecting the incoming & outgoing cables. The bottom part of the fuse is called the base & the top is called the Fuse-carrier. The line & load wires are connected in the base terminals & the carrier is provided with a fuse. The base is fixed but the carrier is removable.

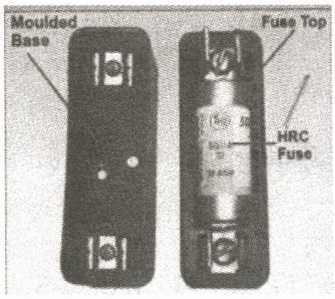


Fig: 5.8 Fuse

INTEXT QUESTIONS 7.1

a) Fill in the blanks:

1. A manually operated device for closing & opening a circuit is known as _____.
2. Single pole switch fixed on _____.
3. Two way switch has 3 Terminals i.e. _____, _____, _____, terminals.
4. To control main circuit _____ switch is used.
5. Iron connector is used as _____ connectors.

b) State True or False-

1. Adaptor is used for giving supply from small appliances.
2. D.P. Switch is consisting of D.P. switch, Fuse, Fuse link, & neon indicator.
3. Three pin plug socket has 2 terminals.
4. Bell push used in call bell circuit.

5. Electrical accessories use for the protection & adjustment.

7.12 WHAT YOU HAVE LEARNT

In this lesson you have learnt about electrical accessories which is a basic part and used in wiring either for protection & adjustment or for the control of the electrical circuits or for a combination of these functions. Such as switches used for on or off a lamp, Single pole or one way switches are used for light & Fan point, stair case wiring, godown wiring etc.

7.13 TERMINAL QUESTIONS

1. State the name of electrical accessories. Write a short note on them.
2. Write a short note on Fuse.
3. Write a short note on D.P. Switch.

7.14 ANSWER TO INTEXT QUESTIONS

7.1 (a)

1. Switch
2. Gang box
3. Common, Upper, Lower
4. Double pole
5. Female connectors

(b) 1. False 2. True 3. False 4. True 5. True

8

FUSE & EARTHING

8.1 INTRODUCTION

In previous lesson, you have seen electrical accessories which are used in electrical field. You also know that in simple circuit fuse are used as a safety device. Now in this lesson, we will discuss about their characteristics & uses.

Earthing is also a safety device as a fuse. It prevents to minimize the risk of shock to human beings. In this lesson we are also going to study about purpose of earthing, its functions & types of earthing.

8.2 OBJECTIVES

After reading this lesson, you will be able to:

- Explain the purpose of fuse in the circuits.
- Identify the different types of fuses & their uses.

8.3 FUSE

A Fuse is a safety device. It is connected in series with the circuit & protects the electrical apparatus & equipments from damage, when excess current flows.

There are several types of Fuses used in electrical field, but the Kitkat type fuse is commonly used in domestic installation. While specifying fuses in general, their type, current capacity & working voltage should also be specified.

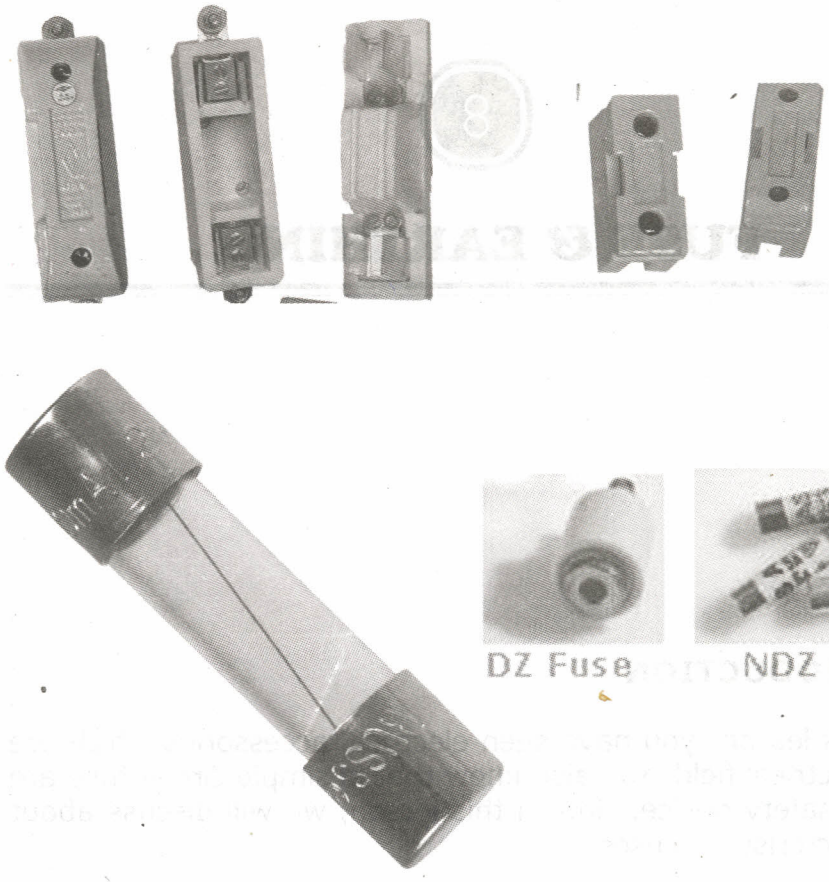


Fig: 8.1 Types of Fuses

A fuse is a safety device used for the purpose of protecting a circuit against excess current. In the event of excessive current, the Fuse element melts & opens up the circuit, there by protecting it from damage.

The fuses can interrupt automatically a circuit with an over current in it for a fixed time. They are mainly used against the short-circuits. They limit the peak value of the fault current.

Placement of fuses

In electrical installations, fuses are always connected into the live wires & never into the neutral nor into the protective earth line.

Types of Fuse

(1) Rewirable type fuse

This type of Fuses are is simple in construction & the initial cost as well as the renewal cost is very low. The fuse element will melt

after approximately 2 minutes when carrying a current rating. Kitkat & Piano type of fuses are the example of rewirable fuses.

(2) Construction of Kitkat & Piano type fuse

These are mostly use in domestic installation. The fuse base consist of a porcelain or polycarbonate material plastics. Base having silvered heavy brass terminals. The incoming & outgoing positive wire is connected to these terminals. Inside the fuse, carrier two contact terminals are provided. Fuse comer is made up of porcelain or polycarbonate material. It has two brass fuse carrier terminals, having a screw for connecting a fuse element.

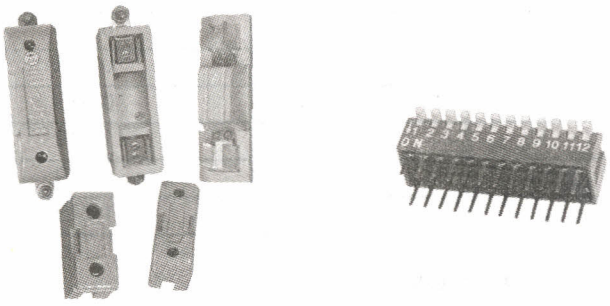


Fig: 8.2 Construction of Kitkat and Piano fuse

In modern type fuse, base contact terminals are made of silver coated brass & fuse carrier also made of tined copper & having a silver fuse.

Fuse element

Generally, Fuse elements are made of tined copper wire.

Function / Working of fuse

During normal operations fuse element acts as a conductor and it provides complete path of current. When a short circuit occurs the current flowing through fuse increases sharply. This causes the heating of the fuse element. Fuse element has a low melting point so that it melts at a lower temperature than that of ordinary conductor, when the heat caused by the short circuit current reaches the melting point of the fuse element the element melts & opens the circuit.

Fuse Rating

The maximum current a fuse can carry before it melts & opens the circuit is called 'fuse rating'. Fuse rating are normally expressed in rated current. The rating of fuse is usually marked on fuse.

The minimum current required to fuse element is called a 'fusing current'.

Placement of a fuse

Fuse is always connected in series with line. It is always connected to phase wire for safety so that you can work on circuit with security after removing the fuse. When the heavy current passes through the fuse it blows & protects the installation and appliances.

My Dear Friends! always remembe hat fuse should not be connected on neutral wire because it is unsafe & dangerous. The current carrying capacity of the Fuse wire depends on its cross sectional area or SWG. Following table shows capacity of tinned copper wire & its gauge is given below:

Current Rating (in Ampere)	SWG	Tinned Copper wire (dia. mm)
20	23	0.610
24	22	0.711
30	21	0.813
37	19	1.219
46	18	1.219
53	18	1.219

Precautions while repairing fuse:

1. Always use a fuse wire of proper capacity of current
2. Always use single fuse wire.
3. Never connect multi strand wire as a Fuse.
4. Keep proper length of Fuse element.
5. Connect Fuse wire properly.
6. Do not use unrecommended metal wires i.e. G.I., Nichrome.

INTEXT QUESTIONS 8.1

(a) Fill in the blanks:

1. A Fuse is a _____ device.
2. A Fuse is used for protecting a circuit against _____ .
3. _____ & _____ type of Fuses are the examples of rewirable Fuses.
4. Fuse rating is usually marked on _____.
5. Fuse are always connected _____.

(b) State True or False:

1. In electrical installations, Fuses are connected to the neutral.
2. Fuse is connected in series with the circuit.

3. Fuse carrier has two contact terminals.
4. Fuse rating is expressed in current carrying capacity.
5. Fuse connected on phase wire for safety & security.

8.4 EARTHING

What do you mean by earthing?

The earthing is a safety device which ensures that a person can not get shock.

Necessity of Earthing:

The necessity for earthing is to ensure that the metalwork of electrical equipment, other than current carrying parts, cannot have a potential above earth in the event of a fault which might otherwise cause danger of an electric shock.

If a fault is developed, causing unearthed metalwork of a piece of electrical equipment; it is charged to a level of dangerous potential. Any person touching the metal & at the same time comes in contact with earth will receive a severe electric shock. Had the metal been effectively earthed, the very low resistance of the circuit would result in a flow of current sufficient to blow the Fuse or to operate the protective device.

In an earth metalwork of a piece of electrical equipment becomes a zero potential due to this; a person does not get a shock.

Types of Earthing

1) Plate Type Earthing
2) Pipe Type Earthing

1) Plate type earthing

A pit is dug in the ground. A copper plate or G.I. plate is buried vertically in the pit. An earth wire is bolted to the earth wire with the help of nut, bolt & washer. The earth wire & the nut, bolts &

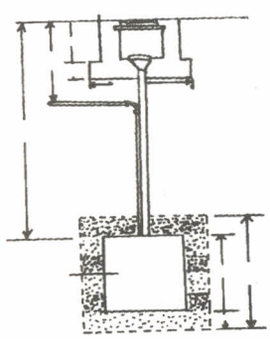


Fig: 8.3 Plate type earthing

washer should be of the same metal that of the plate used. A thick layer of salt & charcoal is placed around the earth plate, so as to reduce the earth resistance & to maintain dampness.

A G.I. Pipe is fitted over the plate. A funnel with a wire mesh cover is placed at the top of the pipe, & the whole arrangement is covered with a cast iron cover. In order to maintain the moistness around the earth plate, 3 or 4 buckets of water are poured in the pipe through the funnel.

2) Pipe Type Earthing

In this method a cast iron pipe of 30 – 75 mm diameter and 3meter length is buried in the pit along with the salt and charcoal as shown in Fig. 4 . The pipe should have sufficient holes at its surface, so as to maintain the dampness inside the pipe. An earth wire is tied near the top of the pipe with the help of a clamp. In order to have an effective earth, one or two buckets of water may be poured in the pipe, especially in the summer season.

This method has an advantage that the earth wire can't break easily from the pipe, while in plate earthing method the wire can break due to slight carelessness.

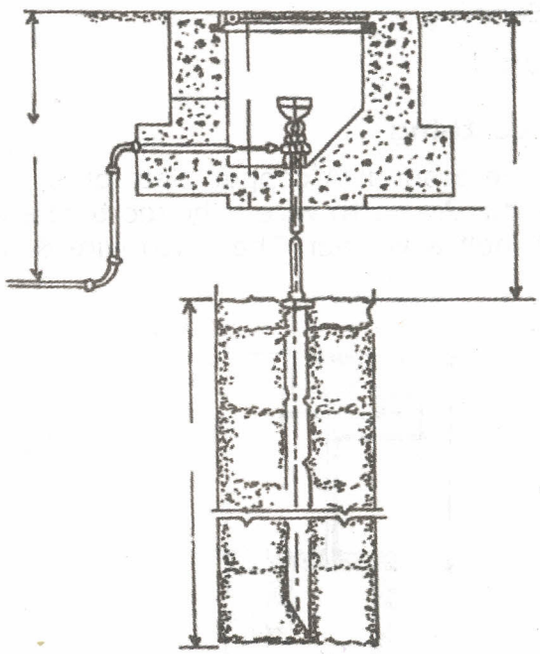


Fig: Pipe 8.4 type earthing

INTEXT QUESTIONS 8.2

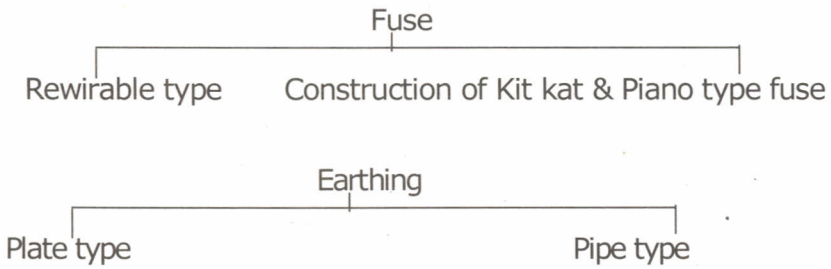
a) Fill in the blanks:

1. Earthing is a _____ device.
2. Earthing ensures that a person cannot get a _____.
3. Eathing prevents the risk of _____ to human beings.

8.5 WHAT YOU HAVE LEARNT

In this lesson, You studied the 'Fuse' as well as 'earthing' , their uses and importance also. You know very well now that fuse is a safety device which is connected in series with circut. It protect our electrical apparatus & equipment from excess current. It is two types:

Earthing is also safety device Which ensures that a preson cannot get shock. This is also two types:



8.6 TERMINAL QUESTIONS

1. Write a note on fuse & its importance.
2. What do you mean by earting? Describe the pipe type earthing with appropriate figure.

8.7 ANSWER TO INTEXT QUESTIONS

8.1 (a)

1. Safety
2. Excess current
3. Kitkat & Piano type Fuse
4. Fuse
5. Series with line

8.1 (b)

1. False 2. True 3. True 4. False 5. True

8.2 (a)

1. Safety
2. Shock
3. Shock

9

CELLS & BATTERIES

9.1 INTRODUCTION

In the previous lesson, we have discussed about fuses and earthling and their uses. We have understand their importance also. In this lesson, we are going to study about Cells and Battery. This source of electricity is commonly used through chemical reaction, housed in electric cells and batteries.

Battery is usually used for emergency and portable electric power. Batteries are the main source of power at present. These are used as emergency equipments.

9.2 OBJECTIVES

After reading this lesson, you will be able to:

- Understand the Meaning of cell, principle of a primary cell.
- Know the Properties of cell and remedies of primary cell.
- Learn about Dry cell, its uses.
- Define the electrodes, electrolyte, electrolysis.
- Explain the Battery, its internal construction, chemical reaction of lead-acid cell.
- Charging equipment and Battery testing instruments.

9.3 CELL

A cell is an electrochemical device consisting of two electrodes and an electrolyte. The chemical reaction between the electrodes and the electrolyte produces the voltage.

Generally two types of Cell are found:

(a) Primary Cell

(b) Dry Cell

(A) Primary cells

The cell, in which e.m.f. is produced on account of chemical actions, is called a primary cell;

It has two electrodes of different metals such as copper and zinc, immersed in a suitable electrolyte, such as dilute sulphuric acid. If the two electrodes are connected to a torch bulb with two pieces of wires, then a current flows from positive to negative terminal of cell.

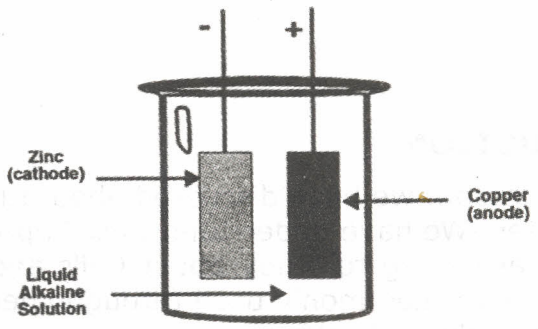


Fig: 9.1 Primary Cell

Principle of a Primary cell

The first cell was made by Volta, therefore, a primary cell is called a voltaic cell also. It consists of a glass container containing dilute sulphuric acid (H_2SO_4) with copper and zinc rods as electrodes. When two pieces of wires to a torch bulb (or any other load), then the current starts to flow. Sulphuric acid decomposes into hydrogen and sulphate ion. Negative ions of Sulphate travel towards the zinc rod and make it negative by forming zinc sulphate.

Positive ions of hydrogen travel towards the copper rod and make it positive by forming hydrogen bubbles. In this way, the current flows from zinc to copper to zinc in the external circuit other types of primary cells are made on the above principle using different electrolysis and electrodes.

Properties of Primary cell:

1. It is an instant e.m.f. supplying device.
2. A cell once discharged fully cannot be recharged again.
3. It is cheap in cost.
4. It is portable.
5. It is suitable for intermittent uses such as bells etc.

Defects of primary cell and their remedies

There are two main defects in a Primary cell:

1. Local action.
2. Polarization.

1) Local action

Normally, zinc consists of many, impurities such as copper iron etc. When a zinc rod is used as an electrode in a primary cell, its circuit becomes complete even current is set up from zinc to copper or iron particles. In this way, it causes a loss of zinc and electrical power. This action is known as local action.

This action can be minimized by amalgamating the zinc rod. i.e. coating the rod with mercury . By this remedy, the impurities are covered by amalgam of zinc and mercury and do not take part in the chemical action. Another remedy is to use a pure zinc rod.

2) Polarization

In the working of a cell hydrogen as is produced in the form of bubble, which is collected around the copper electrode. Hydrogen is a bad conductor of electricity and thus it increases the internal resistance of the cell. Therefore, the voltage drop and power loss of the Cell is increased. Sometimes, the flow of current is completely e.m.f. which opposes the flow of current. This effect is known as Polarization.

This action is minimized by using a depolarizer. The common depolarizer. The Common depolarizer is manganese dioxide (MnO_2). Which converts the hydrogen bubbles into water. Another remedy is to clean the rod with a brush every now and then, which is a difficult task.

There are so many primary cells available in market but we are going to study only Dry Cell.

(B) DRY CELL

It is a modification of Lechlanche Cell. It consist of a cylindrical zinc pot, which works as the cathode. A carbons rod is placed in centre

Fig: 9.2 Dry cell

of the pot which is surrounded by a mixture of manganese di-oxide, carbon powder, ammonium chloride and zinc chloride mixed in a ratio of 10.10, 2&1. The paste is surrounded by a canvas or fabric sack. Between the sack and the zinc pot, a zinc chloride and Plaster of Paris is filled. Plaster of Paris makes the paste tough and strong. The cell is sealed with a pitch compound is shown in figure. A brass cap is fitted at the top of Carbon rod. The zinc pot is covered with cardboard etc.

Ammonium chloride acts with zinc and produces hydrogen, which in turn acts with manganese di-oxide and produces water. The pitch compound has a small hole to work as an outlet for the ammonia evolved during the chemical actions. An over dried cell can be given a life by dropping a few drops of water at the outlet.

Use of Dry Cell

It is used in torches, toys, transistor (radio).

Definitions

Electrode

The conductor or terminals through which an electric current enters or leaves is called an electrode. The electrode through which the current enters the linguine is called a positive electrode or anode through which current leaves the liquid is called a positive electrode or cathode.

Electrolyte

The liquid or solution which undergoes a chemical changes in it on account of the passage of electric current this called an electrolyte salted water, acidic water and a basic solutions are examples of electrolyte.

Electrolysis

The process of chemical changes due to the passage of an electric current through a liquid or a solution is called electrolysis.

9.4 BATTERY

A battery is a group of cells which produce electrical energy from their internal chemical reaction. The battery is a source of steady DC voltage. Where heavy current are necessary, the lead-acid cell is used.

Construction

The lead-acid cell contains container, plates, cell connecter, sealing compound and electrolyte.

1) Container

The container is made of hard rubber bituminous compounds which accommodate plates, separators, electrolyte etc. In it there are ribs at the bottom of the of the cell chamber or mud house the plates rest on these ribs or bridges.

2) Plates

Positive and negative these are two types.

a) Plate type.

b) Frame type

Plate type - Plates are formed from pure lead by repeated charge and discharge in case of fare type plates are made by paste process active material is passed in lead made grids in the form of paste of red

lead (Pb_3O_4) on the positive plates and immured in dilute H_2SO_4 electrolysis takes place when current posses red lead (Pb_3O_4) is oxidized to lead peroxide (Pb_3O_2) forming the positive plate and negative with age (PbO) is reduce to spongy lead.

3) Separators

These are made from especially treated wood performed rubber or cell void and used to insulate the active plates from one another separator should be able to pass through these separators.

4) Vent Plug

These are obtained by moldings hard rubber and are used to for easy escape for gas formed in the cell during charge.

5) Cell connectors

Cells are connected in series to form battery plates in the cells are so arranged that negative terminal of one cell is to positive terminal of next cell and so on the adjustment terminal posts are then welded.

6) Plate Connectors

They are made from pure lead positive and negative plates are welded separated with it forming positive group and negative group post terminals.

7) Sealing Compound

It is made from bitumen compound and is used to form and avoid tight joint between the cover and containers so that may not come out while cell is seal.

8) Electrolyte

For lead acid cell the electrolyte used is dilute solution of sulphuric acid these usually consists of three parts of sulphuric acid and thus has a specific gravity of 1250 approximately.

Chemical reaction

The newly battery is not charged so it is necessary to charge before using. A secondary cell is charged by passing direct current through it from positive terminal to negative terminal.

On charge, the reversed direction of the ions flowing in the electrolyte results in a reversal of the chemical reactions. Now the lead sulfate on the positive plate reacts with the water and sulfate ions to produce lead peroxide and sulfuric acid. This action reforms the positive electrode and strengthens the electrolyte by adding sulfuric acid. At the same time, charging enables the lead sulfate on the negative plate to react with hydrogen ions, which also sulfuric acid while reforming lead on the negative electrode.

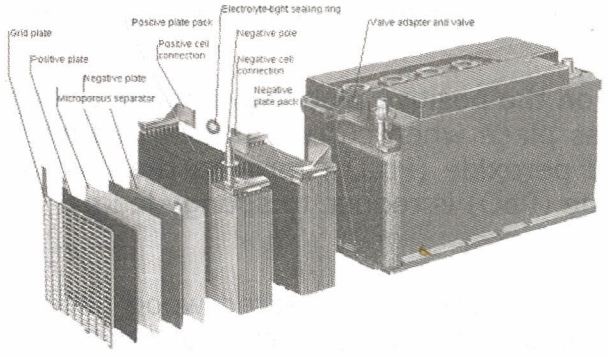


Fig: 9.3 Construction of lead acid cell.

As a result, the charging current can restore the cell to full output with lead peroxide on the positive plates spongy lead on the negative plates and the required concentration of sulfuric acid in the electrolyte. The chemical formula for the lead acid cell is -

On discharge the lead (Pb) and lead peroxide (PbO_2) electrodes supply Pb ions that combine with the sulfate ions (SO_4) to form lead sulfate ($PbSO_4$) and water (H_2O). On charge, with reverse current through the electrolyte, the chemical action is reversed. Then the Pb ions from the lead sulfate reform the lead peroxide electrode. Also the SO_4 ions combine with the H_2 ions to produce more sulfuric acid.

$$= Pb + PbO_2 + 2H_2SO_4 \xrightarrow[\text{Discharge}]{\text{Charge}} 2PbSO_4 + 2H_2O$$

Indications of charged and discharged conditions

A) Full charged condition

1. The colours of the positive and negative plates become dark brown and grey respectively.

2. The electrolyte becomes saturate and its specific gravity lies between 1.26 and 1.28.
3. The e.m.f. of the cell becomes 2.1 volt.
4. Plates of the cell evolve gases in the form of bubbles.

B) Discharged Condition

1. The colors of the positive and negative plates become white comparatively due to formation of lead sulphate.
2. The electrolyte becomes dilute and its specific gravity lies between 1150 and 1180.
3. The e.m.f. of the cell becomes 1.8 volts.

INTEXT QUESTIONS 9.1

a) Fill in the blanks:

1. A cell is an _____ device.
2. _____ and _____ are two main defects in primary cell.
3. A group of cells is called as _____.
4. _____ cells once discharged cannot be recharged again.

b) State True or False:

1. Primary cell is also known as voltaic cell. ( )
2. Dry cells can be charged. ( )
3. Battery is a source of steady D.C. voltage. ( )
4. Vent Plug used to cover for easy escape for gas. ( )

Charging

The battery should be charged as soon as possible after each discharge is completed and the charge should be continued until all the plates are gassing well and the specific gravity and voltage readings remain constant.

Necessity of charging

After using battery it discharge. After discharging cannot deliver power that's why it is necessary to charge the battery for delivering power again. For this purpose 230 A. C. Volt supply is not suitable. You know that for battery charging low voltage D.C. Supply is required. An instrument which converts A. C. Voltage into required low D.C. Voltage is Known as battery charger.

9.5 BATTERY TESTING INSTRUMENTS AND CHARGER

For checking the battery voltage high rate discharge cell tester is used and for checking a gravity of electrolyte hydrometer is used.

In that High rate discharge Cell tester is to give the correct terminal voltage on full load of the battery cell.

Hydrometer is used to test the specific graving of the electrolyte.

Battery charging equipment consists of a step down transformer to convert 230V A. C. into low voltage A. C. This voltage is fed to a bridge rectifier which converts it into low voltage d.c. This d.c. voltage is used for battery charging. Ammeter is used to indicate current and voltmeter indicates battery voltage. Fuse is used as safety device.

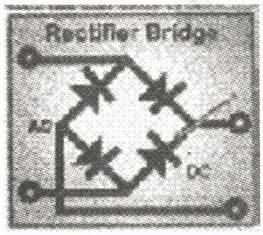


Fig: 4 Bridge rectifier

INTEXT QUESTIONS 9.2

a) Fill in the blanks:

1. An instrument which converts A.C. Voltage into D.C. Voltage is called _____.
2. Ammeter is used to indicate _____.
3. Voltmeter indicates battery _____.
4. _____ is used for battery charging.

9.6 WHAT YOU HAVE LEARNT

In this lesson you have learnt about Cells and Batteries, their types and their uses in our daily life.

Cell is an electrochemical device consisting of two electrodes and an electrolyte. Two types of Cell are generally found:

(1) Primary Cell; and

(2) Dry Cell.

While Batery is a group of Cells which produce electrical energy from their internal chemcal reaction. It is a source of steady DC voltage

9.7 TRMINAL QUESTIONS

1. What do you mean by cell. Describe the Dry cell.
5. Write a Method of construction of battery?

9.8 ANSWER TO INTEXT QUESTIONS

9.1

a)

1. Electrochemical
2. Local action and polarization
3. Battery
4. Primary
5. Set of cells

b) True or False.

1. True
2. False
3. True
4. True

9.2

a) Fill in the blanks:

1. Battery charger
2. Charging Current
3. Voltage
4. Battery charger

10

D.C. GENERATORS & MOTORS

10.1 INTRODUCTION

In previous lesson, we studied the cell & batteries its types, indications of charged & discharged cell/ batteries, meaning of charging, its necessity etc. You are all, familiar with flashlights, portable radios & emergency batteries, all of which use the batteries as their source of power. In these applications, the current drawn from the battery is comparatively small & therefore, a battery can supply the current for a long period of time, even without recharging.

Many electrical equipment requires large current at low medium voltage. For example, electric lights & motors require high voltage & current, that cannot be supplied by the battery as a result. We require source of power other than batteries. These large sources of power are supplied by rotating electrical machines called D.C. generator.

10.2 OBJECTIVES

After reading this lesson, you will be able to:

- Understand the Electricity generation from magnetism, Principle or operation of generator.
- Describe the Self-excited generator.
- Know the D.C. Motor.
- Classify the D.C. Motors.
- Understand the necessity of starter, 3 point starter.

10.3 ELECTRICITY FROM MAGNETISM

Do you know that electricity can be generated by moving a wire through a magnetic field. As long as there is relative motion between the conductor & the magnetic field, electricity is generated. If there is no relative motion between the conductor & the magnetic field, electricity is not generated. The generated electricity is actually a voltage, called an " Induce Voltage", & the method of generating this voltage by cutting a magnetic field with a conductor is called " Induction".

Principle of operation of generator

You already know that you can generate electricity by having a conductor cut through a magnetic field. This is essentially the principle of operation of any generator from the smallest to the giants which produce kilowatt of power.

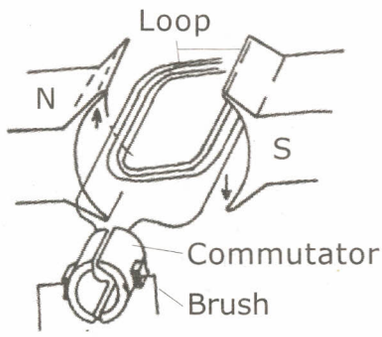


Fig: 10.1 operation of generator

An elementary generator consists of a loop of wire placed so that it can be rotated in a stationary magnetic field to cause an induced current in the loop. Sliding contacts are used to connect the loop to an external circuit in order to use the induced e.m.f.

The pole pieces are the north & south poles of the magnet which supplies the magnetic field. The loop of wire which rotates through the field is called the armature. The ends of the armature loop are connected to rings called "slip rings", which rotate with the armature. Brushes ride up against the slip rings to pick up the electricity generated in the armature and carry it to the external circuit.

Self - excited DC generator

Self excited generators use part of the generators output to supply excitation current to the field. These generators are classified according to the type of field connection used.

In a "series" generator, the field coils are connected in series with the armature, so that the whole armature current flows through both the field & the load.