Chapter 11

Effects of Electric Current

Points to Study:

11.1 Heating effect of electric current
11.2 Fuse
11.3 Magnetic effect of electric current
11.4 Electromagnet
11.5 Electric bell
11.6 Chemical effect of electric current
11.7 Electroplating

There are many apparatus for daily use in our homes . These are based on electric e.g - electric press, electric heater, electric oven, electric bulb, electric bell, electric toaster, etc. In modern days, our life without electric based appliances is not convenient. You may see that electric appliances become hot when electric flows through it. whereas electric bell produces sound when electric flows through it.

How does sound, heat, etc. produced due to electric flow?

Let us understand. What are the effects of electric current

11.1 Heating effect of electric current

Lets perform the following activity to understand the heating effect of electric current.

Activity-1

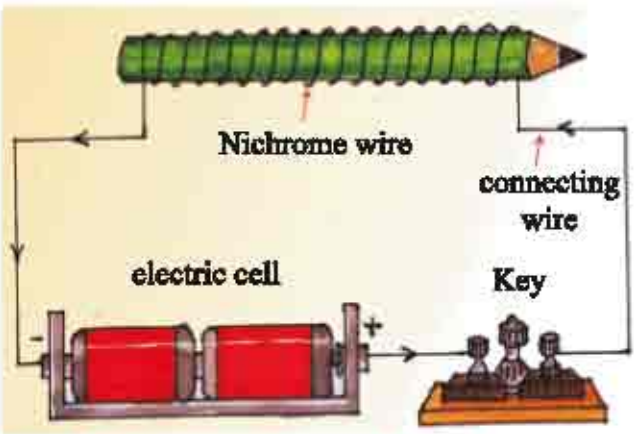

Fig 11.1 Heating effect of electric current

Take thin nichrome wire and wrap it on pencil as shown in fig 1.1. You can get nichrome wire from electric repair shop or you may use electric heatrer wire element. Connect the one end of nichrome wire with cell and other end with key. Connect the electric circuit as in fig.

After plug in key , the electric current flows through the circuit. Now, touch the wire.

Why does the wire heat up?

Now, stop the electric current in the circuit. And wait for some time and touch the electric wire. The wire becomes cool.

"The wire gets hot when an electric current passes through it. This is the heating effect of the electric current."

All the appliances are shown in fig 11.2 are based on heating effect of electric current.

Explain the use of each appliances and make a list of other appliances based on the heating effect of electric current.

Fig 11.2 Appliances based on heating effect of electric current

11.2 Fuse

Fig 11.3 Electric socket

Three types of wire are used to supply electricity in our homes. Whenever the electricity supply does not comes in our homes we call the electrician to rectify it. You must have seen that mechanic check the electric supply by a tester. There are three holes in socket. The socket's end in which tester is inserted and lighted is called **electric** live wire or **phase**. Normally, red coloured plastic wrapped wire is used as phase wire in household electric circuits. The socket's end near the phase socket in which tester is inserted and does not produced light is called **neutral wire.** The neutral wire is at zero voltage. Normally, black coloured plastic wrapped wire is used as neutral wire. There is 220V electric supply between these two wires. The third wire is used for **Earthing** wire and green coloured plastic wrapped on it. Earthing wire is connected with copper plate underground the earth. The earthing wire is safety measure to protect the person form electric shock during use of it in the case of phase wire is touching in metallic body of appliances.

Short circuit: The phase wire and neutral wire connect to each other directly by any mechanism is called short circuit. High electric current flows in circuit during short circuit. Due to over-heating, the appliances may catch fire or burn. The excess connections into socket may cause of the high flow of electric current in circuit. It is called overloading of circuit. So, we should not plug in more devices into a single socket.

Causes of short circuit:

1. When the electric current flows excess to safety limit through the circuit then wire becomes hot and plastic around the phase wire melts. Due to that phase wire and neutral wire come into contact and short circuit happen.
2. In addition of it, when the wires are too old , then its plastic envelop becomes weak and break. It may cause for short circuit.

Losses of short circuit:

The excess electric current passes through electric circuits due to short circuits. As a result the appliances are become hot and catch fire and may be cause for fire accident.

What do we do to protect from an accident or damage to an appliances?

To protect the damage to an electric appliances, a device is connected in series which melts when electric current exceeds the safety limit and electric currents flow stops in circuit. The device is called **Fuse.**

Normally used fuse are shown in fig 11.4. Nowadays, TV, fridge, and other. costly electric appliances have special fuse with internal circuits (as fig. 11.4 (b)).

How does fuse works?

If there is flow of excess electric current to specified value in circuit, then fuse wire may get increase in temperature. Due to that fuse wire becomes melt and electric circuit broke. Normally fuse wire ends kept in porcelain or similar insulator material cartridge.

Fig 11.4 (a) Normal fuse

Fig. 11.4(b) Special fuse

Normally fuse wire is made of mixed metals e.g. copper, zinc and tin. It has low melting point compared to wires used in electric appliances and electric circuits. Whenever electric currents exceed the safe limit due to overloading or short-circuit, the fuse wire melts and breaks. The resultant, the flow of electric current in circuit is stopped.

Why does the fuse wire connect after electric meter and before electric circuits? Explain it.

Precautions:

Do not make an effort to check the fuse wire connected in main line on yourself. It may be dangerous. To know about it. You may visit to electric circuit repair shop and compare the damage fuse wire with new fuse wire. We should use ISI marked fuse wire. Do not use any metal strip or wire in place of fuse wire. It may big danger to catch fire in home.

Also know about it.

Miniature circuit breakers (MCBs)

These days Miniature circuit breakers (MCBs) are used in place of fuses. These are switches which automatically turn off when current in a circuit exceeds the safe limit. when you turn ON them, then circuit is once again completed.

Fig. 11.5 Miniature circuit breakers (MCBs)

11.3 Magnetic effect of electric current

Take a magnetic needle and make rest in position. Now, bring magnet bar near to it. does magnetic needle deflect?

Can magnetic needle being deflected by an electric current?

Activity-2

Take the cardboard piece and make two holes at a few distance to each other. Put a magnetic needle or compass as shown in fig 11.6.

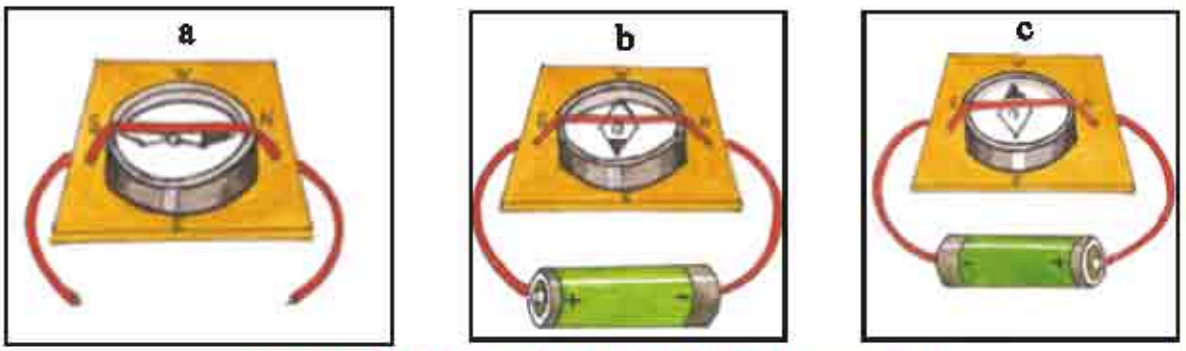

Fig. 11.6 Magnetic effect of electric current.

Now, adjust the cardboard in such a way that we see the compass needle beneath the wire from top view. As shown in fig. 11.6 (a). Now, you observe the deflection in magnetic needle in following situations-

1. Connect the free ends of wire to cell as in fig 11.6 (b). what do you observe? Does the magnetic needle deviate?
2. What do you observe when the wire connections are reversed ? Does the magnetic needle deviate in other direction?
3. What do you observe when the wire connections are disconnected in both above situations ? Does the magnetic needle come again in its initial position ?

You will find that magnetic needle deflects when it put nearby the electric current passing through wire. By these observations, **Oersted** discovered the magnetic effect of electric current.

" When electric current passes through a wire, it acts like a magnet. This is the magnetic effect of the electric current."

electric bell, electric crain, telephone, telegraph, etc are working on it. The electromagnet are used in these appliances.

How do we construct the eletromagnet? Let us do it.

11.4 Electromagnet

Activity-3

According to fig. 11.7 , take approximately 10 to 15 cm long iron nail and 50 cm long thin copper wire covered in insulation (enamelled) .

Remove the enamel from the both the ends of wire by scrubbing it with sand paper. Now, wrap the wire on nail with two ends are open and connect to battery and key as shown in figure to complete the electric circuit. If there is no pressed key and you move allpin near to nail. What do you see? Does the allpin attract towards nail?

In this situation, when there is no current passing through the electric circuit then there is no attraction force feel by the nail and allpin.

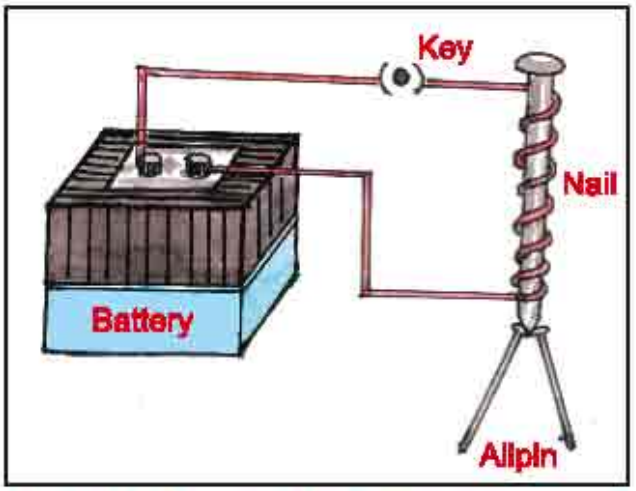

Fig. 11.7 Magnetic effect of electric current.

Now, press the key and electric current passes through the circuit. Take allpin near to nail. What do you see? Why does the allpin stick with nail?

The electric current is passing through the copper wire wrapped nail then it behaves like magnet. It is called electromagnet. What will happen on allpins attached to nail if we remove the key from circuit? and why?

The electromagnet is used in electric bell. How does electric bell work?

Let's know about it.

11.5 Electric bell

The electric bell has following elements as shown in fig 11.8.

1. Coil 2. Iron strip 3. contact screw 4. hammer 5. bell

The coil has wrapped the many number of insulation covered copper wire turns on iron core. An iron strip attached with hammer at the one end is attached nearby coil. There is a contact screw near the iron strip.

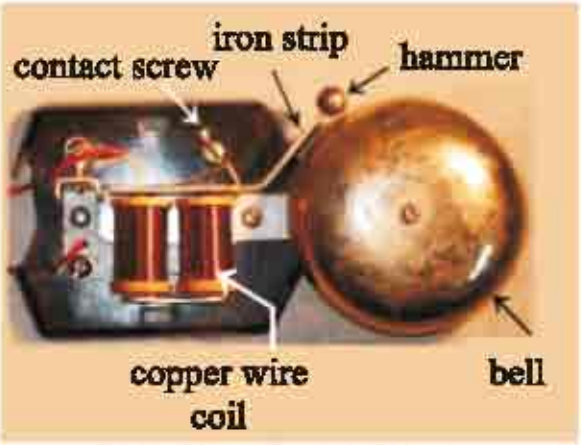

Fig. 11.8 Electric bell.

When electric switch is on, the electric current flows through the coil. Due to magnetic effect of electric current, it becomes an electromagnet. Then it attracts the iron strip. In the process, the hammer at the end of the strip strikes the gong of the bell to produce a sound. When the electromagnet attracts the iron strips then screw does not remain in contact to it and the circuit breaks. The current through the coil stops flowing. The coil does not remain an electromagnet.

The iron strip comes back to its original position and touches the contact screw again. This completes the circuit. The current flows in the coil and the hammer strikes the gong again. This process is repeated in quick succession.

Application of electromagnet:

1. Electromagnet is used to collect the magnetic materials from the scrape.
2. Electromagnet is used by the doctor to draw pieces of magnetic material fallen into eye accidentally.
3. Electromagnetic cranes are used to lift heavy iron objects.

Electric conductivity in liquids:

We have learnt that the solids materials are good electric conductor e.g. copper, aluminium, iron, silver, etc. whereas, the other solids which do not flow the electric current easily are called electric insulator e.g rubber, plastic, wood, etc. Does the liquid solutions also electric conductor?

Activity-4

Take empty match boxes as tray and put a magnetic needle. Now wrap the enamelled copper wire on on it. As fig 11.9 Connect the one end of wire with one battery terminal and leave other end free. Connect the second terminal of battery with another wire and leave it end free too. Now, connect these two free ends then magnetic needle deflects. Similarly a tester has two free ended wires.

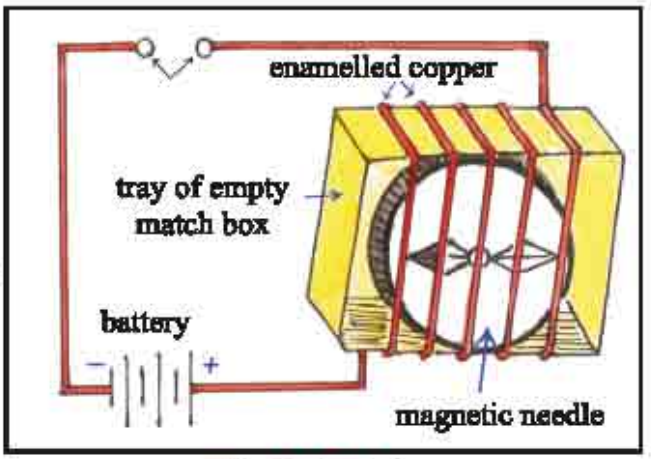

Fig 11.9 Tester

Now fill the pure water in dry plastic cap and immerse these two wires into it. Does the pure water conduct electric? Now pour a little amount salt in pure water. again test it what do you conclude?

Repeat the similar process with different liquid solutions and see the deflection of magnetic needle in each situation. Does magnetic needle deflects or not?

Put your observation into following table.

Table 11.1

S.N.	Matter	Magnetic needle deflects or not?	Conductor or Insulator
1	Pure water	No	insulator
2	Juice of lemon	YES	conductor
3	Sirka (vinegar)		
4	Tap water		
5	Vegetable oil		
6	Milk		

We see that most of liquids, which are easily conduct electric current, are solutions of acids, bases, and salts.

11.6 Chemical effect of electric current

When a electric current passes through the conducting solution then does it produce any effect in solution?

Let us do an experiment.

Activity-5

Take out carbon rods carefully from two discarded cells. Clean their metal caps with sand paper. Wrap copper wires around the metal caps of the carbon rods and join them to a battery. We call these two rods electrodes.

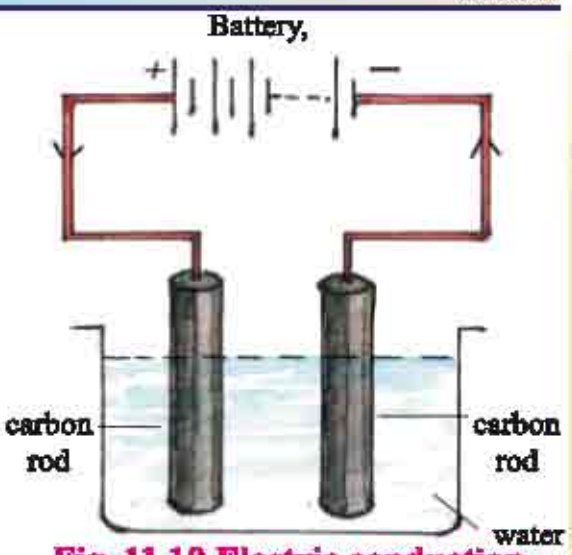

Fig. 11.10 Electric conduction in liquid

The plate connected to positive terminal of battery is called anode whereas the plate connected to negative terminal of battery is called cathode. In the symbol of electric cell, long line represents positive terminal and small line represents negative terminal.

Now immerse the electrodes in glass/plastic bowl filled with water - lemon juice or water salt solution as shown in fig. 11.10 . Make sure that the metal caps of the carbon rods are outside the water. Wait for 3-4 minutes. Observe the electrodes carefully. Do you notice any gas bubbles near the electrodes?

The changes are taking place in the solution. Can we call it a chemical change?

The passage of an electric current through a conducting solution causes chemical reactions. As a result, bubbles of a gas may be formed on the electrodes. Deposits of metal may be seen on electrodes. Changes of colour of solutions may occur. The reaction would depend on what solution and electrodes are used. These are some of the chemical effects of the electric current.

11.7 Electroplating

Due to chemical effect of electric current, the conducting solution dissociates into its constituent elements. It is used in electroplating. Let us understand it by an experiment.

Activity-6

Take copper sulphate solution into clean and dry beaker. Take two 10cm × 4cm copper plates. Clean these plates by scrubbing the sand paper and wash with clean water. put these for drying. Now connect these plates to the terminals of battery via connecting wires and immerse them in copper sulphate solution as shown in fig. 11.11.

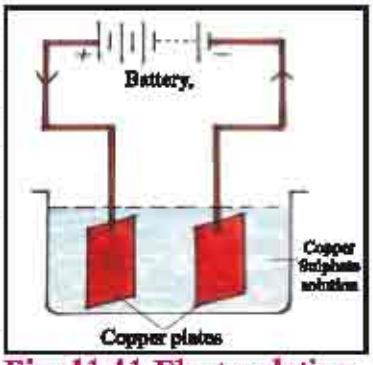

Fig. 11.11 Electroplating

Allow the current to pass for about 15 minutes. Now remove the electrodes from the solution and look at them carefully. Do you find any difference between

negative terminal of battery.

Do you find any layer over negative terminal plate?

When copper sulphate is dissolve into water, copper sulphate dissociates into copper and sulphate. The free copper gets drawn to the electrode connected to the negative terminal of the battery and gets deposited on it. But what about the loss of copper from the solution?

From the positive terminal electrode, a copper plate, an equal amount of copper gets dissolved in the solution. Thus, the loss of copper from the solution is restored and the process keeps going. This means that copper gets transferred from positive terminal plate to negative terminal plate during the process of electroplating.

> " The process of deposition a desired metal on any material by electric is called electroplating."

It has wide application in industries. For examples- to deposit a layer of silver or gold on ornaments, chromium platting on few portion of car, bathing tap, gas burner, cycle's handle and rim, etc., to protect from rusting and corroding the iron, the zinc layer is deposited on iron.

What have you learnt

- When the electric current passes through the conducting wire. It becomes hot. It is called heating effect of electric current.
- The high electric current is passing through the special mixed materials wires e.g. copper, zinc, lead, tin etc. it becomes hot and start to melt and breaks. These materials are used in making fuse wire which protect to damage and fire in electric circuit.
- When an electric current flows through the conductor, then conducting wire behaves like magnet. It is called the magnetic effect of electric current.
- The insulation covered conducting copper wire wrapped in circular form on any piece of iron is called electromagnet.
- Few liquids are good electric conductor and few are bad electric conductors.
- The most of liquids, which are electric conductors, are acid solutions, base solutions and salts solutions.
- When electric current passes through any conducting solution. It dissociates into its constituents. It is called chemical effect of electric current.
- The process of deposition a desired metal on any material by electric is called electroplating.

□□□

Exercises

Choose the correct answer.

1. Electric bell is based on which electric current effect ?
   (A) thermal effect (B) magnetic effect
   (C) chemical effect (D) Joule effect ( )
2. Which is the object used to collect the magnetic matter from scrape?
   (A) electric magnet (B) electric cell
   (C) Fuse (D) Immersion rod ( )
3. Which is the following solution not pass electric current?
   (A) Copper sulphate (B) Silver nitrate
   (C) pure water (D) salted water ( )
4. Which is not a component of electric bell ?
   (A) strip of iron (B) coil
   (C)contact nut (D) magnetic niddle ( )

Fill in the blanks with suitable words.

1. The long line represents.....and short line represents..... terminal of electric battery's symbol.
2. The saftey device based on heating effect of electric is called .....
3. In battery, the plate connected to positive terminal is called ..... and to negative terminal is called.....
4. The magnetic effect of electric current is discovered by .....

Short answer questions

1. What is the fuse?
2. Write any three applications of electromagnet.
3. What is thermal effect of electric current? Write down the names of any four appliances based on this effect.

Long answer questions:

1. Make a diagram of electric bell and explain its working system.
2. What is the chemical effect of electric current? Explain the process of electroplating.

Activity work:

1. Try to stop the electric misuse in our household appliances and make public awareness about the saving of electric in street or villages, etc.
2. Make a model which represent the magnetic/ chemical/ thermal effects of electric current.

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