13
Electromagnet And Electromagnetic Induction

AN ELECTROMAGNET

An electromagnet consists of a soft iron piece on which an insulated copper wire is wound or an electromagnet is a current carrying coil of insulated wires wrapped around a piece of iron.

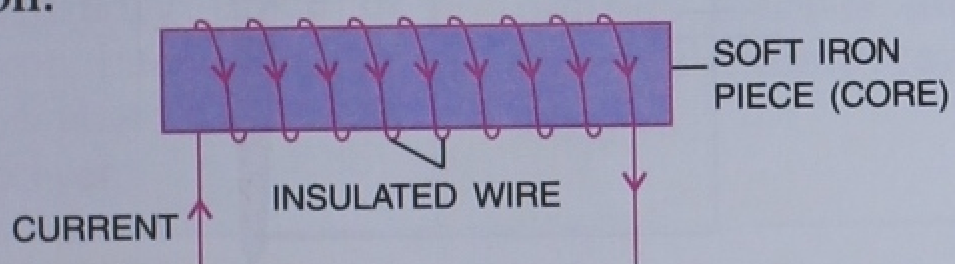


Fig. 13.1 An electromagnet

The arrangement behaves like a magnet when an electric current is passed through the insulated wire and it loses its magnetism when current is stopped.

An electromagnet is a temporary magnet. The soft iron piece used in it is called a core. An insulated wire is an ordinary wire coated with some insulating material such as : varnish, rubber, plastic, etc. The insulation of the wire prevents the different turns of the wire from coming in contact with each other.

MAKING ELECTROMAGNETS

In general, the electromagnets are of two shapes :

1. Bar magnet
2. U-shaped or horse-shoe type magnet.

1. Bar Magnet

In a bar shaped electromagnet, an insulated copper wire is wound over a soft iron bar. The two ends of the wire used are connected to a source of electricity through a key as shown in Fig 13.2.

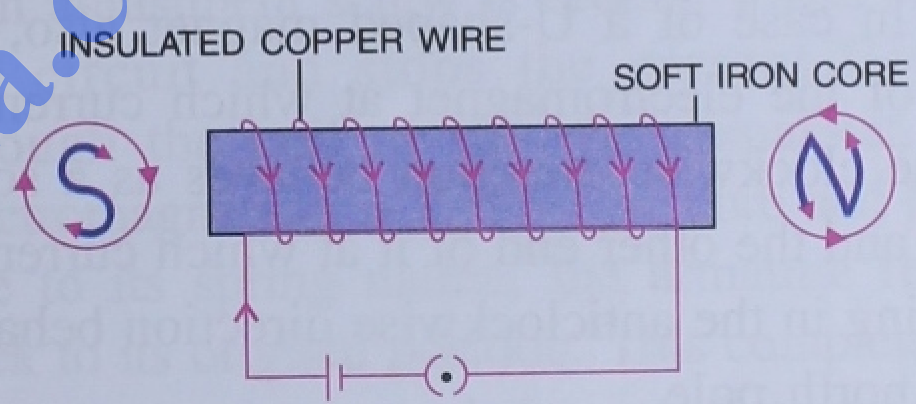


Fig. 13.2 Bar electromagnet

When key is pressed, current flows through the wire and the system starts behaving like a magnet. Here, the soft iron bar behaves like a bar magnet. The end of this electromagnet at which current is in the clockwise direction behaves as a south pole and the other end of it at which the current is in the anticlockwise direction behaves as a north pole.

When key is opened, it stops the flow of current through the coil, with the result, the electromagnet demagnetises.

2. U-shaped Magnet

In a U-shaped electromagnet, an insulated copper wire is wound over a U-shaped soft iron core. The two ends of the wire used are connected to a source of electricity through a key as shown in Fig. 13.3.

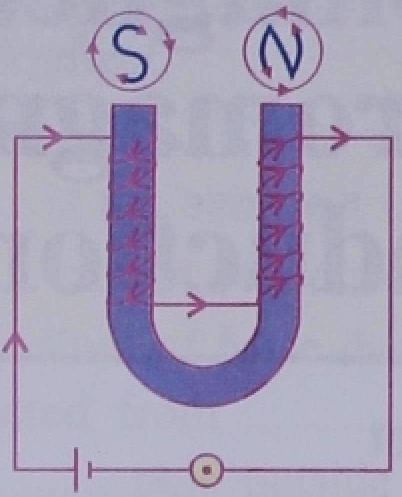


Fig. 13.3 U-shaped electromagnet

When key is pressed, current flows through the coil and it starts behaving like a magnet. On stopping the current, it will get demagnetised.

In case of a U-shaped magnet also, the end of the electromagnet at which current is in the clockwise direction behaves as a south pole and the other end of it at which current is flowing in the anticlockwise direction behaves as a north pole.

The strength of an electromagnet depends on :

(i) The number of turns in its coil :

A stronger electromagnet will be obtained on increasing the number of turns in its coil and on decreasing the number of turns, a weaker electromagnet is obtained.

(ii) The amount of current passed through the coil :

On increasing the amount of current in the coil, a stronger electromagnet is obtained and on decreasing the amount of current in the coil, a weaker electromagnet is obtained.

ACTIVITY 1

To make an electromagnet.

- Take an iron nail of about 6-10 cm in length and wind an insulated copper wire on it as shown in Fig 13.4.
- Now connect the ends of the copper wire to the two terminals of a dry cell via a switch.
- Switch on the current through the circuit and bring a few pins near the wounded nail.
- Now switch off the current and see what happens.

The iron nail behaves like a magnet as long as current flows through the circuit. The pins cling to the nail when the switch is 'on' while they drop as soon as the switch disconnects the electric circuit.

You can see an enhanced magnetic field (more pins cling to the nail) if you use a battery in place of a cell.

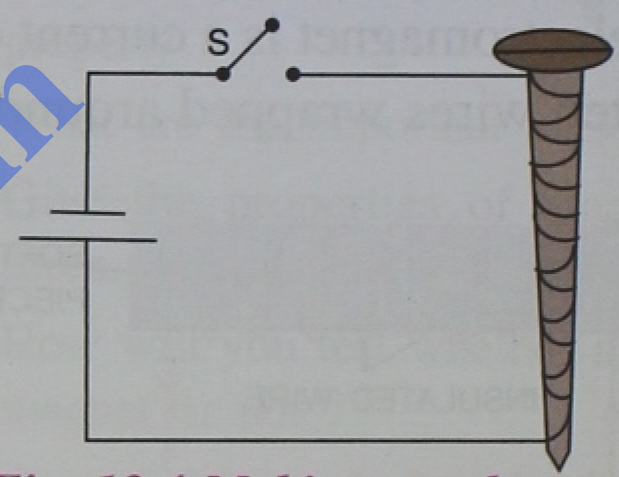


Fig. 13.4 Making an electromanget

USES OF ELECTROMAGNETS

Electromagnets are used at different places in our daily life.

- In electrical appliances such as electric bell, electric fan, electric motors, *etc*.
- In lifting heavy loads of iron scrap.
- To remove tiny particles of iron from wound.
- In loading furnaces with iron.
- In the separation of iron ores (magnetic substances) from impurities (non-magnetic substances).
- Electromagnets are also used in medical science to cure certain ailments.
- They are used for the preparation of strong, permanent magnets.

Difference between permanent magnet and temporary magnet/electromagnet

Permanent magnet	Temporary magnet/ electromagnet
1. Magnetic properties are retained permanently.	1. It behaves as a magnet as long as current flows in coil of insulated wire around it.
2. Its strength cannot be changed.	2. Its strength can be changed by changing the amount of current flowing through the coil around it.
3. North pole and south pole are fixed.	3. The position of north pole and south pole can be interchanged by reversing the direction of current through the coil.
4. It cannot convert an ordinary piece of iron into a magnet because of its weak power.	4. It can convert an ordinary piece of iron into a temporary magnet.

Do You Know ?

— An electromagnet is not a permanent magnet. The soft iron core demagnetises as soon as electric current stops.

— Several turns of wire around a nail makes a coil; when electric current passes through the coil, a magnetic field is induced in the coil.

ELECTRIC BELL

An electric bell involves one of the most common use of an electromagnet.

Figure 13.5 shows the essential components of an electric bell. It works on the principle of magnetic effect of current. When the switch is pressed, the circuit gets closed and the current starts flowing through the U-shaped electromagnet. The core turns into an

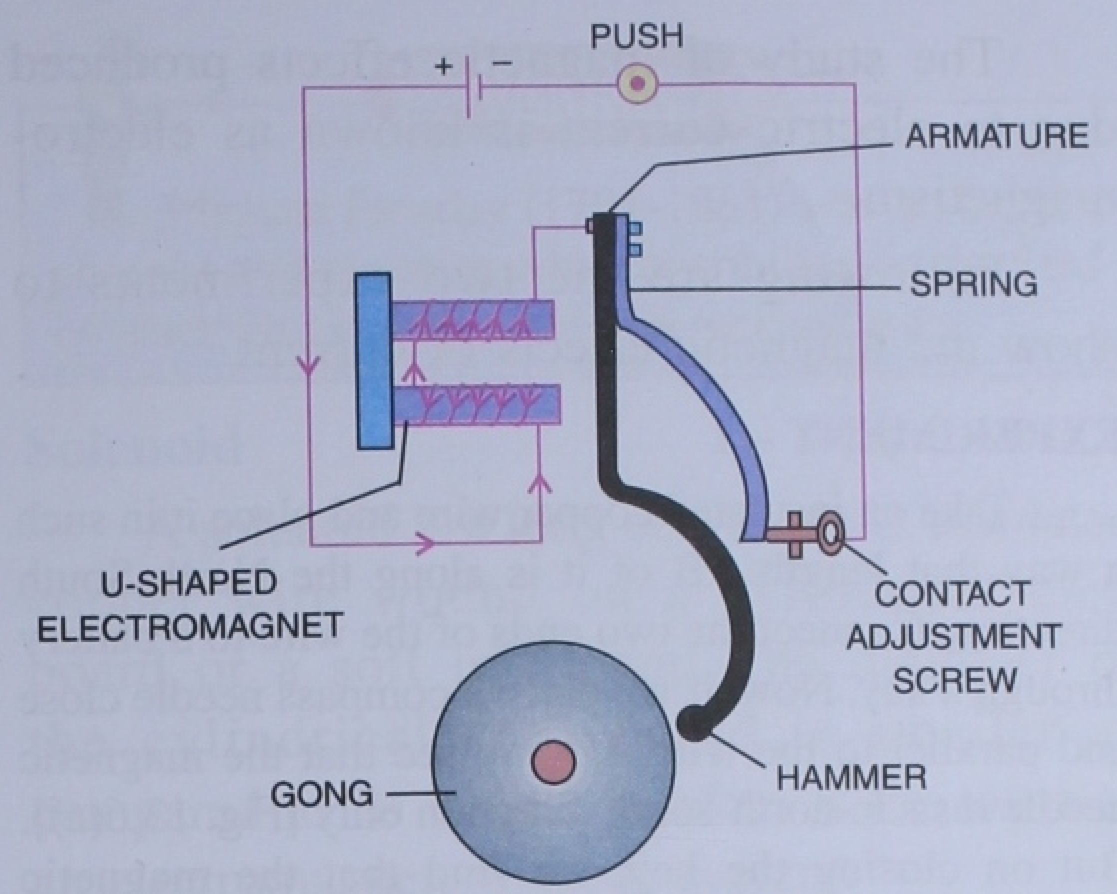


Fig. 13.5 An electric bell

electromagnet and attracts the armature made of iron. Due to the movement of the armature towards the electromagnet, the hammer strikes the gong and the bell rings. As the armature moves towards the electromagnet, its contact with adjustment screw is broken which breaks the circuit and stops the current flowing through the coil of the electromagnet. The electromagnetism is lost by the core and hence due to its spring nature, the armature returns back to its original position. This completes the circuit once again and the action is repeated. This making and breaking of the circuit of the electromagnet continues as long as the bell switch remains pressed.

Magnetic Field Associated With a Straight Current Carrying Conductor

In 1820, a Dutch scientist, Hans Christian Oersted discovered that if an electric current is passed through a conductor, a magnetic field is developed around it. This brought the concept that electricity and magnetism are not separate entities but are closely associated with each other. When electricity flows through a conductor, a magnetic field is produced around it.

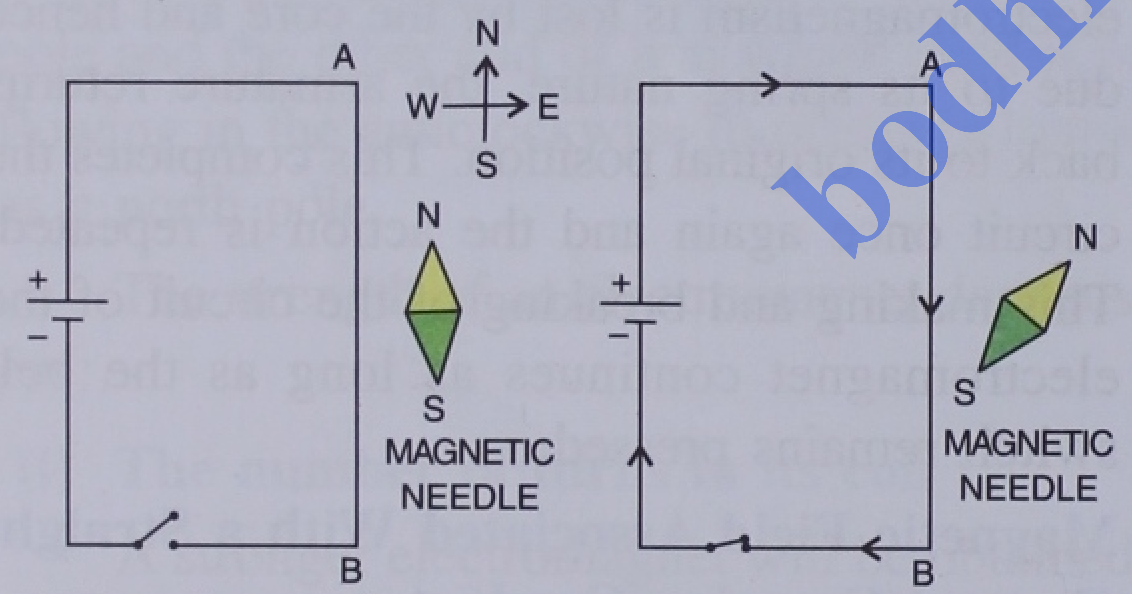
The study of magnetic effects produced due to electric current is known as electro-magnetism.

Following are the two experiments to show the magnetic effects of current.

EXPERIMENT – 1

Take an insulated copper wire and place it in such a way that length AB of it is along the North-South direction. Connect the two ends of the wire to a battery through a key. Now, if we place a compass needle close and parallel to the wire AB, we see that the magnetic needle rests in north-south direction only [Fig. 13.6(a)]. But on closing the key, we find that the magnetic needle gets deflected from its North-South direction [Fig. 13.6(b)].

When the key is open, no current flows through the wire and hence the needle rests in its original position in the north-south direction. But on closing the key, the magnetic needle gets deflected from its original position. This experiment shows that flow of electricity produces magnetic field around it. The magnetic field so produced is represented by a well defined pattern of magnetic lines of forces which can be observed in the following experiment.



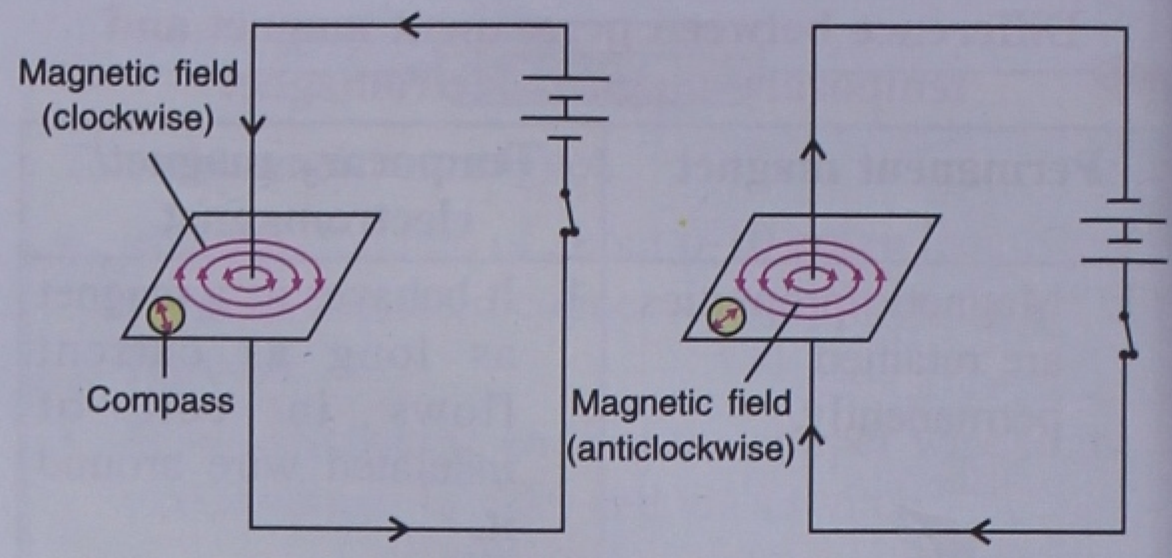
(a) Current is not flowing – no deflection of magnetic needle

(b) Current is flowing – magnetic needle gets deflected

Fig. 13.6 To show the magnetic effect of current

EXPERIMENT – 2

Take a plane cardboard and fix it in a horizontal position. Make a small hole at its centre. Through the hole, pass a vertical wire. Connect a battery and a key to the wire. Spread some iron filings on the cardboard and also place a small compass needle any where on the board.



(a) Downward flow of current

(b) Upward flow of current

Fig. 13.7 Lines of force due to a current carrying straight conductor

Press the key and tap the board. You will notice two things. Firstly, the iron filings will get set into a definite pattern. Secondly, the compass needle is deflected in a particular direction.

Now reverse the terminal connections of the battery. You will notice that the direction shown by the magnetic needle of the compass gets reversed. From this, we conclude that :

- An electric field is set up around a wire as long as current flows through it.
- If electric current flows downwards, the direction of magnetic field is clockwise [Fig. 13.7(a)] from above.
- If electric current flows upwards, the direction of magnetic field is anticlockwise [Fig. 13.7(b)] from above.
- Magnetic lines of forces are more concentrated near the current carrying wire.

> It is important to use electrical appliances with ISI mark on them. ISI mark ensures the safety of the appliance and also minimum electrical energy wastage.

Methods to Find The Direction of Magnetic Field

The direction of magnetic field due to a straight current carrying conductor is obtained by any of the two right hand rules shown below:

(1) Right hand thumb rule : When we hold current carrying straight conductor in the right hand in such a way that the thumb points in the direction of the current, then the direction of fingers holding that conductor gives the direction of magnetic lines as shown in Fig. 13.8. In this case, the direction of current in the conductor is upwards. The magnetic lines around the conductor are anticlockwise (from above) around the conductor as shown in the figure.

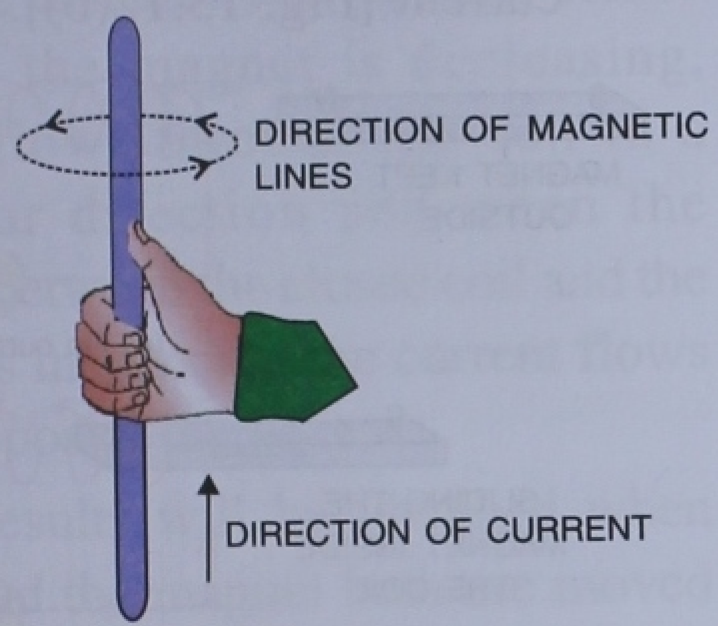


Fig. 13.8 Right hand thumb rule

(2) Right hand cork screw rule : Hold a cork screw in your right hand and rotate its handle in such a way that the screw moves in the direction of current flowing in the straight conductor. The direction in which the thumb rotates gives the direction of magnetic lines of forces, as shown in Fig. 13.9. The direction of current in the conductor is towards the right and the magnetic field lines are clockwise, as observed from the side of holding the screw.

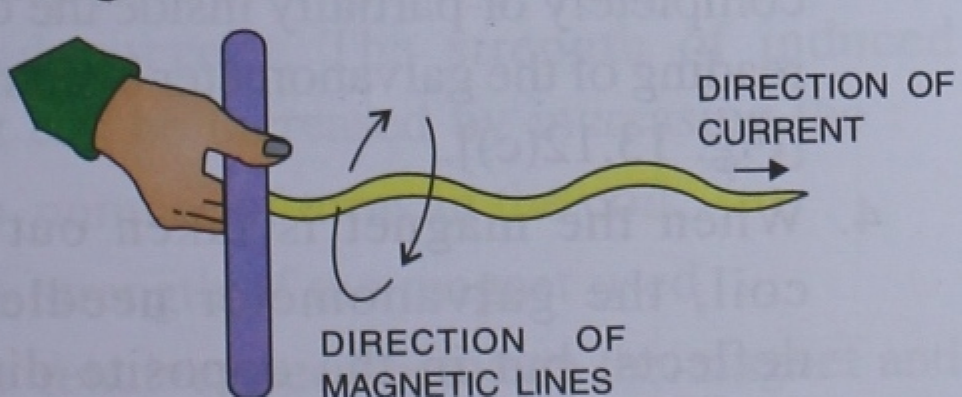


Fig. 13.9 Right hand cork screw rule

Do You Know ?

Michael Faraday (1791-1861) was an English chemist and physicist who contributed to the field of electromagnetism and electrochemistry.

Solenoid

A solenoid is a long coil made of insulated copper wire wound on a cylindrical card board or a soft iron core. The diameter of the cylindrical card board is smaller as compared to its length. It infact is the same as an electromagnet, without current.

Magnetic Field Due to a Current Carrying Solenoid

The magnetic field developed due to current in the coil of a solenoid is same as in the case of an electromagnet. The magnetic polarities at the ends of a solenoid depend on the direction of the current in its coil and is determined by the clock rule described below :

Clock rule : The end of the solenoid where the direction of current is anticlockwise, becomes the north pole and the end where the direction of current is clockwise, becomes the south pole. Figure 13.10 will help in understanding the flow of direction.

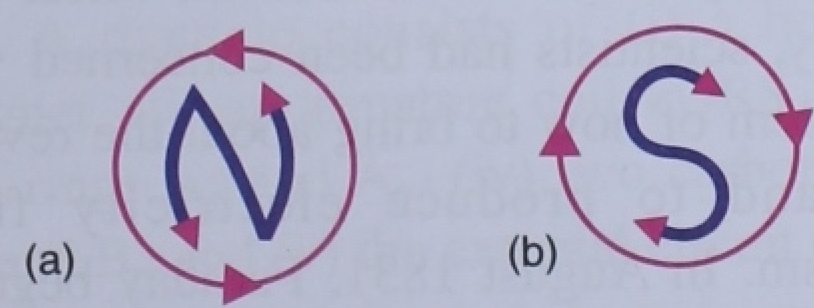


Fig. 13.10 (a) Anticlockwise north pole
(b) Clockwise south pole

In order to understand this concept with more clarity, see Fig. 13.2 and Fig. 13.3.

Force on a Current Carrying Conductor in a Magnetic Field

When a current carrying conductor is placed in a magnetic field, whose direction is perpendicular to the direction of current in the conductor, the conductor gets a force acting on it and if the conductor is free to move, it begins to move in the direction of force. This force is normal (perpendicular) to both, the direction of current as well the direction of magnetic field (Fig. 13.11).

If the direction of magnetic field is parallel to the direction of current, the conductor does not experience any force.

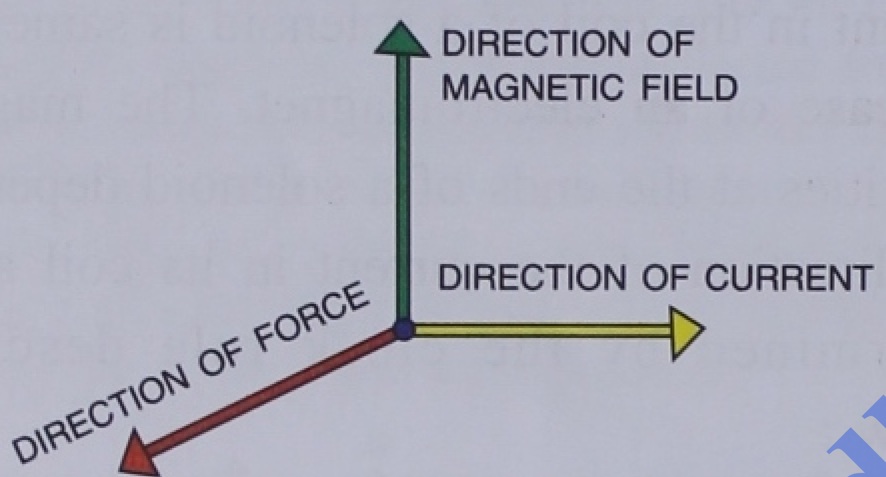


Fig. 13.11 Direction of force on a current carrying conductor in a magnetic field

ELECTRICITY FROM MAGNETISM

In the previous topics of this chapter, we have studied that how magnetism could be produced by an electric current. After this discovery, scientists had been concerned with the problem of how to bring about the reverse effect and to produce electricity from magnetism. In August 1831, Faraday began a series of experiments in which he demonstrated the principle of electric generator.

EXPERIMENTS

1. Make a cylindrical coil of insulated copper wire and connect its ends with a sensitive galvanometer. (Galvanometer is an instrument which detects the presence of current in a circuit and its direction). Now place a bar magnet near the coil. The initial reading of the galvanometer is zero [Fig. 13.12(a)].
2. When the magnet is moved inside the coil, the needle of the galvanometer deflects to one side. This indicates the presence of current [Fig. 13.12(b)].

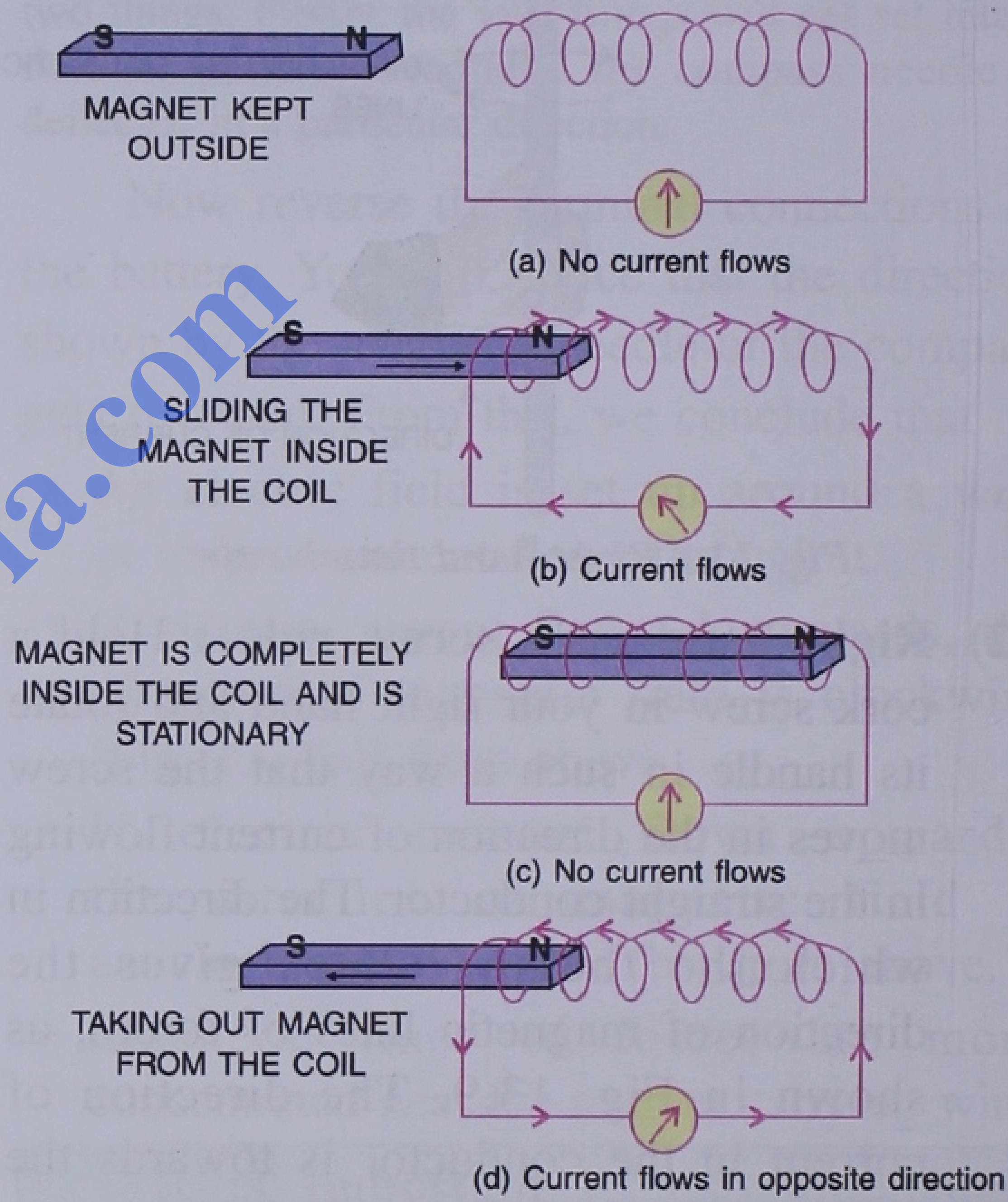


Fig. 13.12

3. When the magnet is stationary, whether completely or partially inside the coil, the reading of the galvanometer becomes zero [Fig. 13.12(c)].
4. When the magnet is taken out of the coil, the galvanometer needle again deflects, but in the opposite direction [Fig. 13.12(d)]. This again shows the

presence of current in the coil but in the reverse direction.

In this series of experiments, we moved the magnet but kept the coil at rest. Now keep the magnet at rest and move the coil, you will find the same results.

1. When the distance between the closed coil and the magnet is same (whether magnet is in the coil or out of it), no current flows through the coil.
2. When the distance between the closed coil and the magnet is decreasing, current flows through the coil in a particular direction and when the distance between the closed coil and the magnet is increasing, the current flows in the opposite direction.

The same results will be obtained when the closed coil and the magnet both are moved towards each other or away from each other.

In other words, we can say; as long as there is a relative motion between a closed coil and a magnet, current is induced in the coil. This effect is called electromagnetic induction.

ELECTROMAGNETIC INDUCTION

The property due to which a changing magnetic field within a closed conducting coil induces electric current in the coil is called **electromagnetic induction**. The current produced in a closed coil, when magnetic lines of force rapidly change within it, is called the **induced current**. The strength of induced current can be increased by increasing the :

(1) number of turns in the coil

(2) strength of the magnet used

(3) relative speed between the magnet and the closed coil.

If the magnet is continuously moved in and out, the current keeps changing its direction. This type of current which changes its direction at fixed intervals of time is called **alternating current** or A.C. The symbol which represents its source is ⏦. The positive and negative terminals of an A.C. source are not fixed. The electric current which is supplied to our homes from the electricity board through the mains is the alternating current.

The current of which the strength and direction do not change with time is called the direct current. The symbols used to represent its source is ⊣⊢ or ⊣⊢⊣⊢ The positive and negative terminals of a direct current source are fixed. The current obtained from a cell or a battery is direct current.

DYNAMO

A dynamo is a device which converts mechanical energy into electrical energy. It is also known as the electric generator.

Principle : The working of a dynamo is based on the theory of electromagnetic induction. When an armature coil is rotated in a magnetic field, the number of magnetic lines passing through the coil change due to which electricity is produced.

A dynamo consists of (i) a horse-shoe magnet, (ii) an armature coil PQRS, (iii) two slip rings A_1 and A_2, (iv) two carbon brushes B_1 and B_2 and (v) the external circuit (or load).

Construction : The armature coil PQRS is a cylindrical soft iron frame on which a coil of insulated copper wire is wound. It is fixed to an axle by which it can be rotated between the poles N and S of a horse-shoe magnet (Fig. 13.13).

The ends P and S of the armature coil are connected to the metallic rings A_1 and A_2 with their axes along the axle. Carbon brushes B_1 and B_2 are in contact with slip rings A_1 and A_2 respectively. When the coil rotates, the slip rings A_1 and A_2 also rotate but carbon brushes B_1 and B_2 do not rotate. They just remain touching A_1 and A_2 respectively. The ends of brushes B_1 and B_2 are connected to an external circuit containing a load (*e.g.*, an electric bulb) which is to be operated.

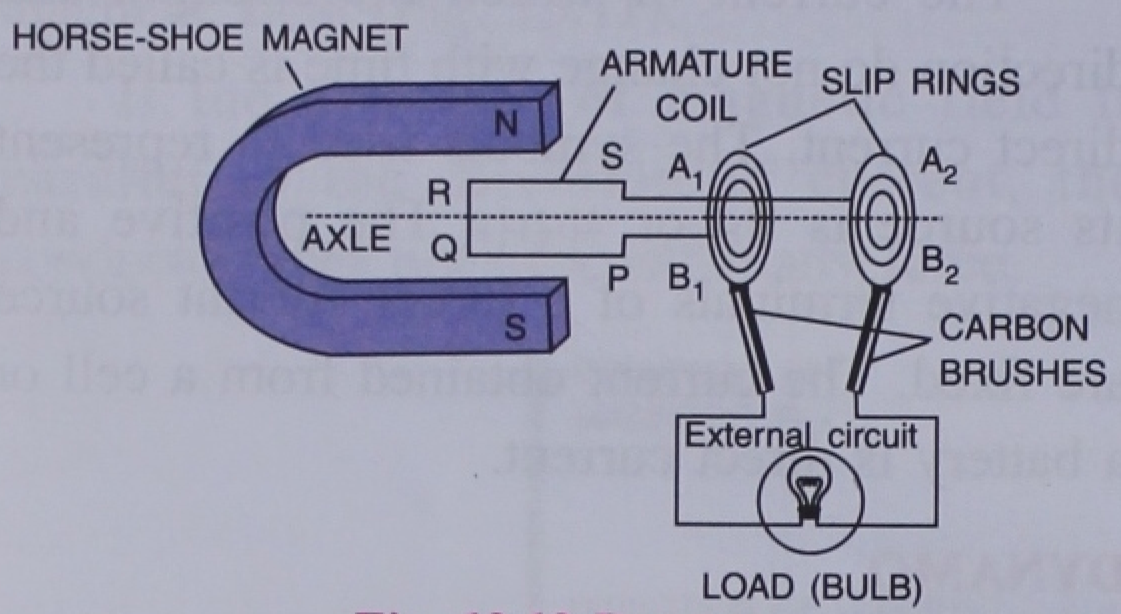


Fig. 13.13 Dynamo

Working : When the armature coil is rotated, the magnetic field lines of the horse-shoe magnet which passes through the coil gets changed. Due to this reason, electricity flows in the external circuit and the bulb gets lighted.

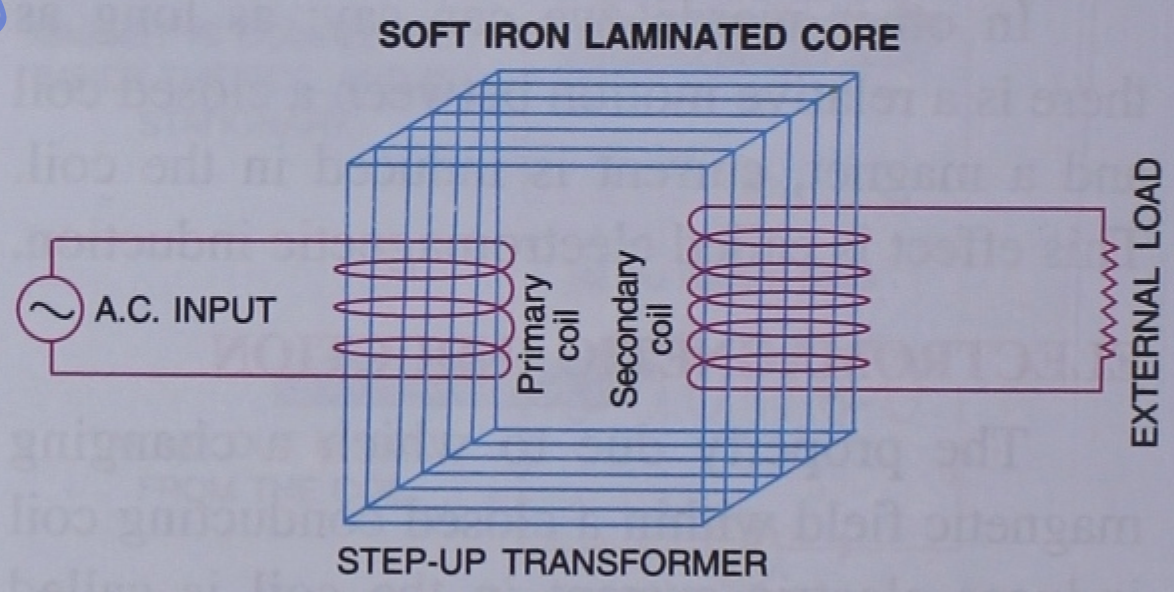
Uses : A dynamo is used to produce electricity. It is used in houses and business places as an alternative source of electricity.

TRANSFORMER

A transformer is a common electrical device used to increase or decrease the voltage of an alternating current source. There are two kinds of transformers, (i) step-up transformer and (ii) step-down transformer. The step-up transformer is used to increase the voltage of an A.C. source, whereas the step-down transformer is used to decrease the voltage of an A.C. source.

Principle : A transformer works on the principle of electromagnetic induction.

Construction : It consists of several rectangular frames made up of soft iron, placed one above the other. These frames are painted to make them insulated from each other. In this way, we get a thick rectangular frame called the core. On one arm of the core, a coil of insulated wire is wound. This coil is connected to the given A.C. source and is called the primary coil. On the opposite arm of the core, another coil of insulated copper wire is wound. Across the ends of this coil, we get the output alternating voltage. This is the secondary coil. In a step-up transformer, the number of turns in the secondary coil are more than the number of turns in the primary coil, while it is exactly opposite in the case of a step-down transformer. Figure 13.14 shows both the transformers.



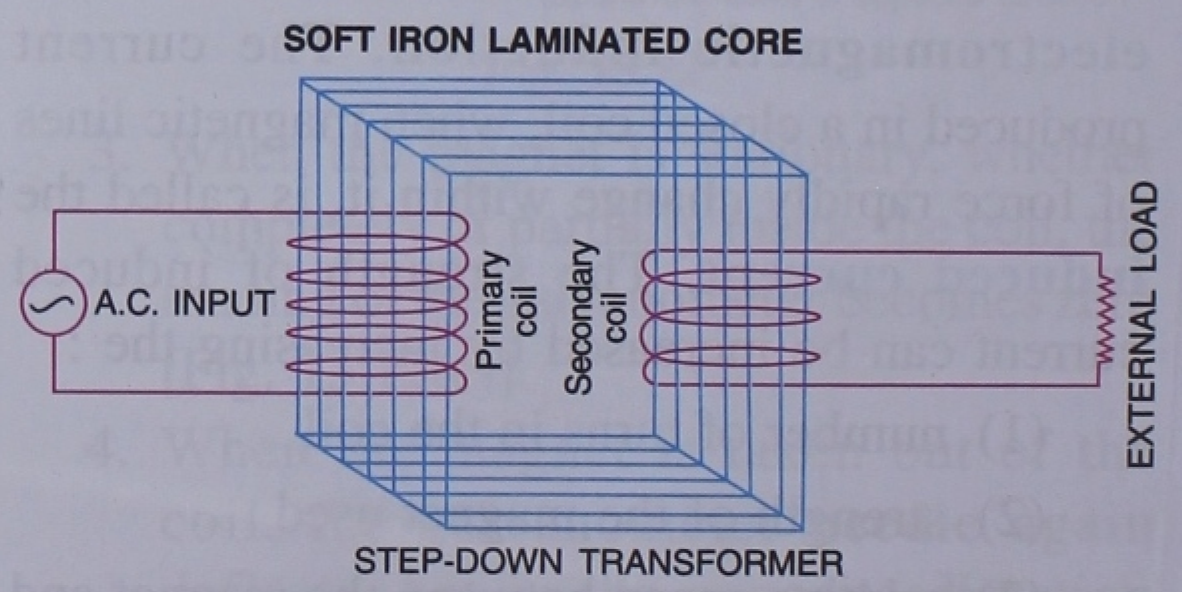


Fig. 13.14

The magnitude of induced e.m.f. in the secondary coil depends on :

(a) The magnitude of input e.m.f. put into the primary coil.

(b) The ratio of the number of turns in the secondary coil to the number of turns in the primary coil *i.e.* $\frac{N_S}{N_P}$ = (transformer ratio).

For a given transformer

$$\frac{\text{e.m.f. across secondary coil } (E_S)}{\text{e.m.f. across primary coil } (E_P)} = \frac{\text{No. of turn in the secondary coil } (N_S)}{\text{No. of turn in the primary coil } (N_P)}$$

$$\frac{E_S}{E_P} = \frac{N_S}{N_P} = n$$

Where n is called the transformer ratio or turns ratio

Example 1 :

The primary coil of a transformer has 44,000 turns and is connected to A.C. input source of 220 V. The secondary coil has 1,100 turns. Find the output voltage (e.m.f.).

Solution :

N_P = 44,000, N_S = 1,100, E_P = 220 V , E_S = ?

$$\frac{E_S}{E_P} = \frac{N_S}{N_P} \Rightarrow \frac{E_S}{220} = \frac{1{,}100}{44{,}000}$$

$$\Rightarrow E_S = \frac{1{,}100}{44{,}000} \times 220$$

$$E_S = \frac{\cancel{11} \times 22}{\cancel{44}\ 4} = \frac{22}{4} = 5{\cdot}5 \text{ volts}$$

Example 2 :

A toy train requires 12 volt to operate. It is converted from main supply of 230 volt. What should be the turns ratio for the step down transformer used ?

Solution :

$$E_P = 230 \text{ volt}, E_S = 12 \text{ volt}, n = \frac{N_S}{N_P} = ?$$

$$\frac{E_S}{E_P} = \frac{N_S}{N_P} \Rightarrow \frac{N_S}{N_P} = \frac{230}{12}$$

$$\therefore \quad n = 230 : 12$$

Uses : A step-up transformer is used at the power generating station to transmit electricity to the city at a high voltage. Further, the step-down transformer is used at an electric sub-station to distribute electricity to houses at a low voltage. You must have seen such transformers fixed in your locality. A voltage stabiliser that we use with our refrigerator, T.V. or other appliances is an example of a transformer. This keeps the voltage at normal level (or within certain limits) so that there is no fluctuation in voltage (or electric current) and the electrical appliances are thus not damaged. In mobile phone charger, step-down transformers are used whereas in a X-ray machine, step-up transformers are used.

ELECTRIC MOTOR

An electric motor is a mechanical device which converts the electrical energy into mechanical energy.

Principle : When an electric current is passed through a rectangular coil placed in a magnetic field, in such a way that the coil is perpendicular to the magnetic field applied, two equal and opposite forces act on two opposite arms of the coil. Due to these equal and opposite forces, the coil starts rotating in the direction of force and thus, the mechanical energy is produced.

An electric motor consists of (i) an armature coil PQRS, (ii) two semi circular split rings A_1 and A_2 (iii) a pair of carbon brushes B_1 and B_2 (iv) a horse-shoe magnet.

Construction : The armature coil PQRS is a cylindrical soft iron piece on which a coil of insulated copper wire is wound. It is connected to an axle, which is free to rotate about the axle between the poles N and S of a horse-shoe magnet. The ends P and S of the armature are connected to the split rings A_1 and A_2. A carbon brush B_1 touches the split ring A_1, while another carbon brush B_2 touches the split ring A_2. The other ends of the brushes B_1 and B_2 are connected to a battery.

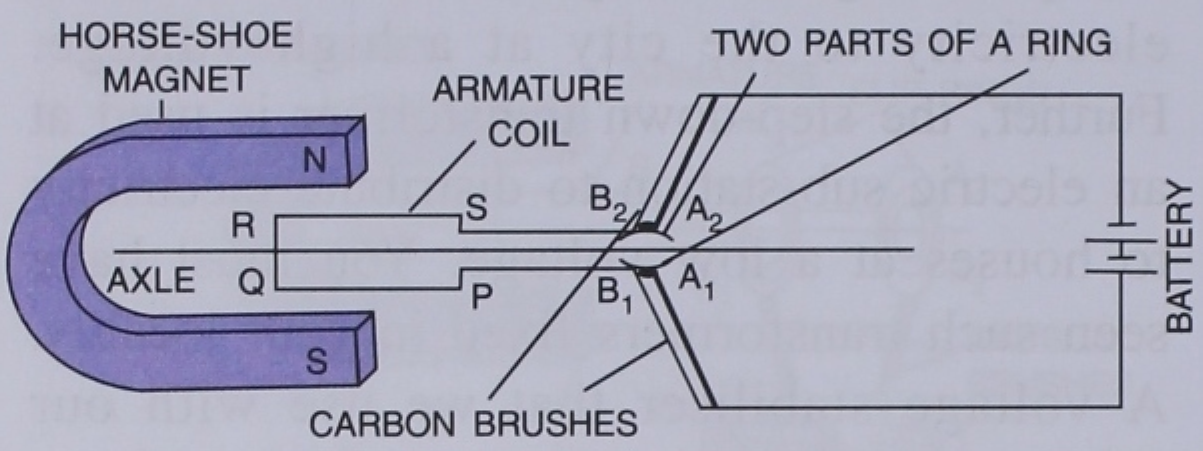


Fig. 13.15 An electric motor

Working : When current from the battery passes in the armature coil PQRS, it begins to rotate due to the effect of forces acting on its arms PQ and RS in opposite directions. When the coil rotates, the split rings rotate, but there is no movement in the brushes.

Uses : An electric motor is used in washing machine, electric mixer, electric fan, hair dryer, *etc*. In all these devices, a wheel is mounted on the axle of the armature coil which rotate the desired part of the machine where the electric motor has to be used.

RECAPITULATION

- Electromagnets are the temporary magnets made of soft iron core with a winding of insulated copper wire.
- An electric bell is a simple application of electromagnet.
- A current carrying conductor is associated with a magnetic field around it.
- Freely suspended current carrying solenoid (coil) always rests in north-south direction.
- An electric motor is a device which converts electrical energy to mechanical energy.
- An electric current of which direction reverses periodically with time is called alternating current.
- The current obtained from mains in our houses is alternating current. It is supplied at a voltage of 220 volts.
- A direct current source has the fixed positive and negative terminals *e.g.*, a cell, a battery, *etc*.
- The current obtained from a cell or a battery is the direct current.
- A dynamo is a device which converts the mechanical energy into the electrical energy.
- A transformer is a device which is used to increase or decrease the alternating voltage.
- Transformers are of *two* types — (a) a step-up transformer used to increase the alternating voltage and (b) a step-down transformer used to decrease the alternating voltage.
- The direction of magnetic field developed due to current in a conductor depends on the direction of current and its magnitude depends on the strength of current.
  - (a) On reversing the direction of current through the conductor, the direction of magnetic field developed will also be reversed.
  - (b) On increasing the current through the conductor, a strong magnetic field will develop around it.
- A solenoid is a helical coil made of insulated copper wire. On passing current through it, it behaves like a bar magnet. The end of it at which current flow in the anticlockwise direction works as north pole and the other end of it at which current flows in the clockwise direction works as south pole.

- When a current carrying conductor is placed in a magnetic field (not parallel to it), the conductor experiences a force which is in the direction perpendicular to direction of current and direction of magnetic field both.
- If the direction of current in the conductor and direction of magnetic field are parallel to each other, no force acts on the conductor.
- In an electric motor, electric current is passed through a rectangular coil placed in a strong magnetic field. Because of this, forces act on opposite arms of the coil in opposite directions hence it rotates.
- An electric motor is used in washing machine, electric mixer, etc.
- When a closed coil is placed in a changing magnetic field, a current is induced in the coil. This is the phenomenon of electromagnetic induction.
- An electric current can be induced in a closed coil if :
  (a) the distance between the coil and the magnet is changing *i.e.* the coil and the magnet have some relative motion.
  (b) a closed coil is rotated in a strong magnetic field. This is done in a dynamo (electric generator).
- In a step-up transformer, the number of turns in secondary coil is more than the number of turns in the primary coil. Whereas, in a step-down transformer, the number of turns in the secondary coil is less than the number of turns in the primary coil.

TEST YOURSELF

A. Short Answer Questions :

1. Write *true* or *false* for each statement. Rewrite the false statement correctly.
   (a) To make an electromagnet, a coil of insulated copper wire is wound over a soft iron rod.
   (b) In a U-shaped electromagnet, north pole and south pole cannot be obtained.
   (c) An electromagnet cannot be used to separate iron from the mixture of copper, iron and stainless steel.
   (d) Electric bell is the most common example in which magnetic effect of current is used.
   (e) Charge at rest has a magnetic field developed around it.
   (f) The end of a current carrying coil, which has current in the clockwise direction, acts as north pole.
   (g) When a closed coil and a magnet move together in such a way that the distance between them does not change, then no current will be induced in the coil.
   (h) In an electric motor, a closed coil is rotated speedly in a magnetic field to get current.
   (i) In a transformer, the primary coil converts electrical energy into magnetic energy and the secondary coil converts magnetic energy into electrical energy.

2. Fill in the blanks :
   (a) On passing electric current through a wire, ... field is developed around it.
   (b) The direction of magnetic field developed around a current carrying conductor depends on ...., whereas its strength depends on .... of current.
   (c) A freely suspended current carrying coil behaves like a .... and always rests in .... direction.
   (d) A transformer works on the principle of ....
   (e) The direction of magnetic field developed around a straight current carrying conductor can be obtained by .... rule.
   (f) The right hand screw rule is used to find ....
   (g) .... converts electrical energy into mechanical energy.
   (h) .... transformer is used to convert 230V into 180V.

3. Tick the most appropriate answer :

(a) Around a current carrying conductor, there is :
(i) a magnetic field
(ii) an electric field
(iii) both magnetic field and electric field
(iv) no magnetic field

(b) The end of a current carrying coil at which the current is in anticlockwise direction, behaves as :
(i) north-pole (ii) south-pole
(iii) neutral point (iv) none of these

(c) If one end of a current carrying coil behaves as south pole, the current in the coil is in :
(i) anticlockwise direction
(ii) clockwise direction
(iii) straight line
(iv) direction cannot be known

(d) An electric motor converts :
(i) potential energy into kinetic energy
(ii) kinetic energy into electrical energy
(iii) electrical energy into mechanical energy
(iv) potential energy into mechanical energy.

(e) A dynamo works on the principle of :
(i) magnetic effect of current
(ii) electromagnetic induction
(iii) force on a current carrying conductor placed in a magnetic field
(iv) none of these.

(f) The primary coil of a transformer :
(i) is connected to an A.C. source
(ii) connected to a D.C. source
(iii) coverts A.C. into D.C.
(iv) none of the above

(g) If the number of turns in the primary coil of a transformer is more than the number of turns in its secondary coil, then the transformer gives out :
(i) higher voltage (ii) lower voltage
(iii) same voltage (iv) none of these

(h) In order to covert 160 volt into 220 volt, we use :
(i) step-down transformer
(ii) a dynamo
(iii) an electric motor
(iv) step-up transformer

4. Write in short on
(a) an electromagnet (b) an electric motor
(c) a dynamo (d) a transformer
In each case, draw a labelled diagram also.

5. What energy change does take place in :
(a) an electric motor (b) a dynamo.

B. Long Answer Questions :

1. Explain an electromagnet. What are the materials used for making its core and its coil ?
2. Draw a labelled diagram of a U-shaped electromagnet.
3. Name two factors on which the strength of magnetic field of an electromagnet depends.
4. By drawing a labelled diagram of an electric bell, explain its working.
5. How will you use the right hand thumb rule to find the direction of magnetic field developed around a current carrying conductor ?
6. A current carrying solenoid is freely suspended. In which direction will it rest ? Give reason for your answer.
7. Why does a freely suspended magnet always rests in north-south direction ?
8. What is the use of a transformer ? Name two types of transformer.
9. How is alternating current different from direct current ?
10. Why does a compass needle placed near a current carrying conductor show deflection?