Field Technician – Other Home Appliances

(Job Role)

Sector: Electronics and Hardware

Textbook for Class X

Index

1.0 INTRODUCTION

Suppose one-day Ram turned 'ON' the television set to watch the SWAYAM PRABHA channel for learning. As soon as he turned it, 'ON' fumes and smoke began to come out of it. Moreover, suddenly it appeared as if television is burning. The situation terrified Ram. He immediately switched 'OFF' the power button. Luckily, the situation came under control. He shared this incidence with his father. His father asked him about what will be the solution for such a problem?

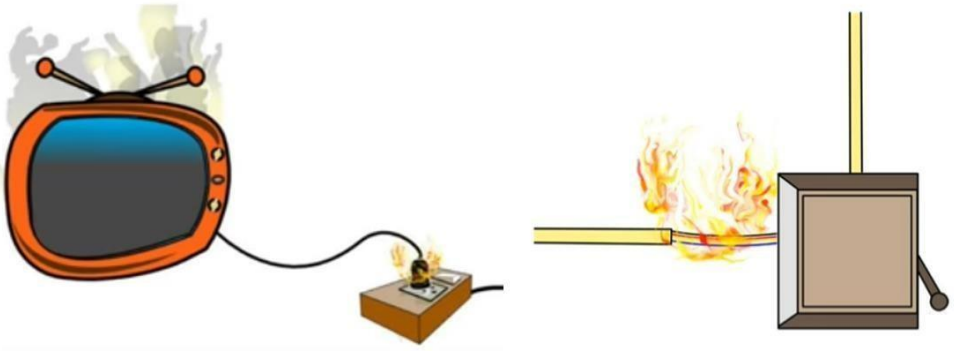


Fig.1.1 Burning in the television set and socket due to overcurrent

In order to find a solution, he studied from different source. Meanwhile he came to know about the term electrical circuit protection device that are used to protect the heavy electrical machine like electric motor. However, Ram wondered whether television sets have a circuit protection device. How circuit breakers protect the heavy machine like electric motor? In this chapter, we will learn about the circuit protection devices, different laws in electrical system and electric motor.

1.1 NEED FOR OVERCURRENT PROTECTION DEVICES

Current and temperature current flow in a conductor always generates heat. Greater the current flow, hotter the conductor. Excess heat is damaging to electrical components. For that reason, conductors are rated for a definite continuous current carrying capacity for longer durations or ampacity. Overcurrent protection devices, such as circuit breakers, are used to protect circuit elements from excessive current flow. These protective devices are designed to keep the flow of current in a circuit at a safe level to prevent the circuit elements from overheating.

Fig.1.2 Circuit protection device

Excessive current is referred to as overcurrent. Overcurrent is defined as any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault. Protection against excessive temperature is termed “overcurrent protection.” Overcurrent are caused due to following reasons:

1. Overload
2. Short circuit
3. Ground fault

1. OVERLOAD

An overload occurs when too many devices are operated on a single circuit, or a piece of electrical equipment is made to work harder than it is designed for. For example, a motor rated for 10 amps may draw 20, 30, or more amps in an overload condition. In the following illustration, a package has become jammed on a conveyor, causing the motor to work harder and draw more current. Because the motor is drawing more current, it heats up. Damage will occur to the motor in a short time if the problem is not corrected or the circuit is not shut down by the overcurrent protector.

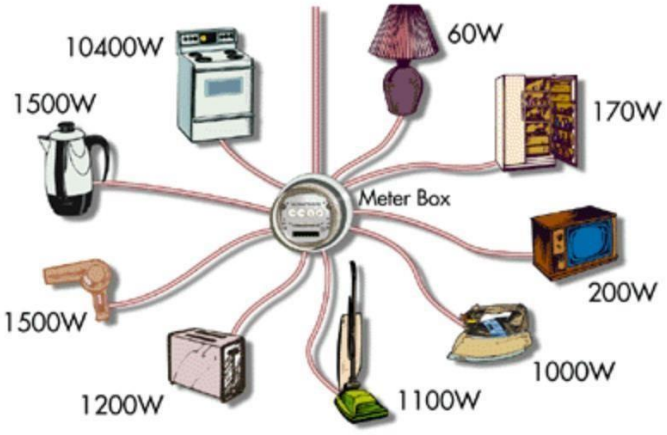


Fig.1.3 Overload in energy meter

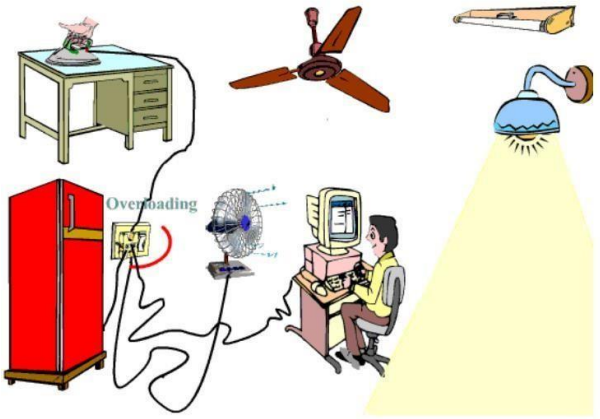


Fig.1.4 Overload in socket

2. SHORT CIRCUIT

A short circuit occurs when there is a direct but unintended connection between line-to-line or line-to-neutral conductors. Short circuits can generate very high current and there by lead to rise in temperatures thousands of degrees above defined ratings. Fig.1.5, 1.6, 1.7 shows that bulb having two wires. Due to cut or damage in the wire, say, unintentional removal of insulation may occur, uninsulated portion of wires touch each other which results in negligible resistance or a short circuit. Negligible resistance during a short circuit cause large amount of current from the source to flow in the equipment, which may damage the wires due to excessive heat. Note- In case of short circuit bulb will not get any current.

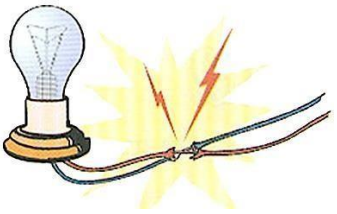


Fig.1.5 Short circuit in wires

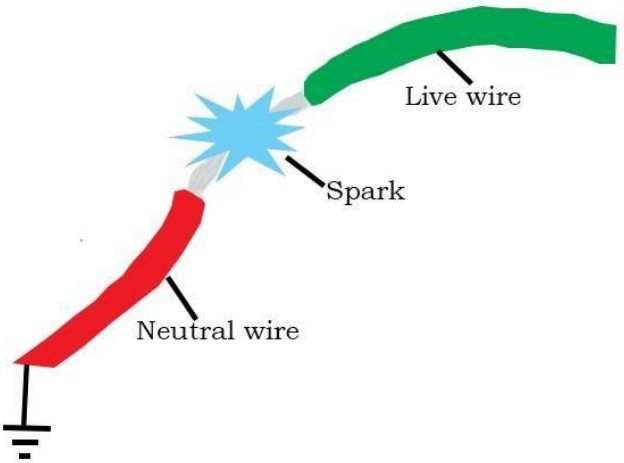


Fig.1.6 Short circuit in live and neutral wire

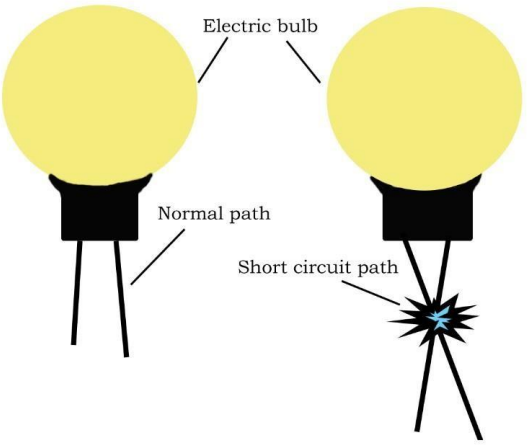


Fig.1.7 Comparison between normal path and short circuit path

3. GROUND FAULT

A ground fault occurs when electrical current flows from a conductor to uninsulated metal that is not designed to conduct electricity. Figure 1.8 shows the ground fault in a drilling machine.

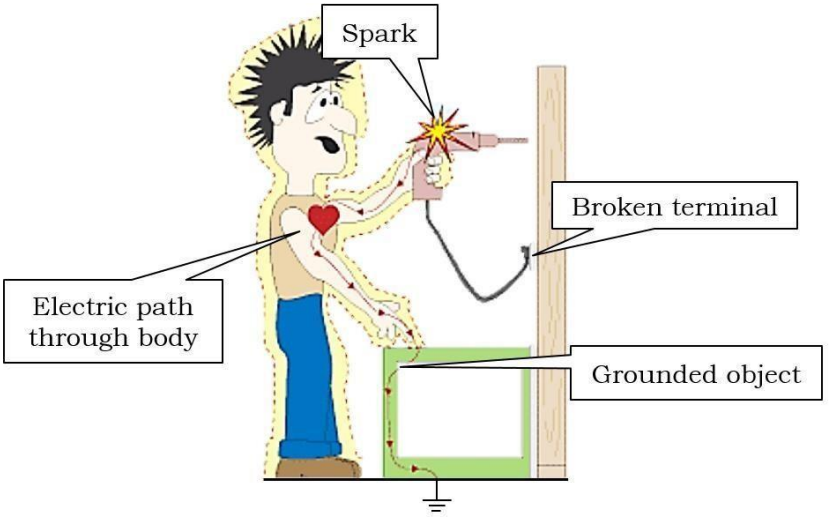


Fig.1.8 Ground fault

Assignment

1. Calculate load at your home by adding up the wattage of all electrical and electronic appliances.
2. List out the devices in your home, which are grounded. What is the need of ground?
3. Suppose, you have made a circuit in which you used a MCB for protection. If short circuit occurs between the live wire and neutral wire, what will happen to the MCB? Will it be trip?

4. Suppose, you have an electric bulb in which two wire i.e. live wire and neutral wire. If wires get shorten, what will happen to the bulb? Will it be ON or OFF? Mention the reason.

1.2 OVERCURRENT PROTECTIVE DEVICES

In electrical and electronic market various types of overcurrent protective devices are available. The two most common are fuses and circuit breakers. Many circuit breakers are also known as miniature circuit breaker or MCBs.

1.2.1 Types of overcurrent protective devices

Circuit protection would be unnecessary if overloads and short circuits could be eliminated. Unfortunately, overloads and short circuits do occur. To protect a circuit against these currents different types of overcurrent protection devices are used. Some of which are discussed as follows:

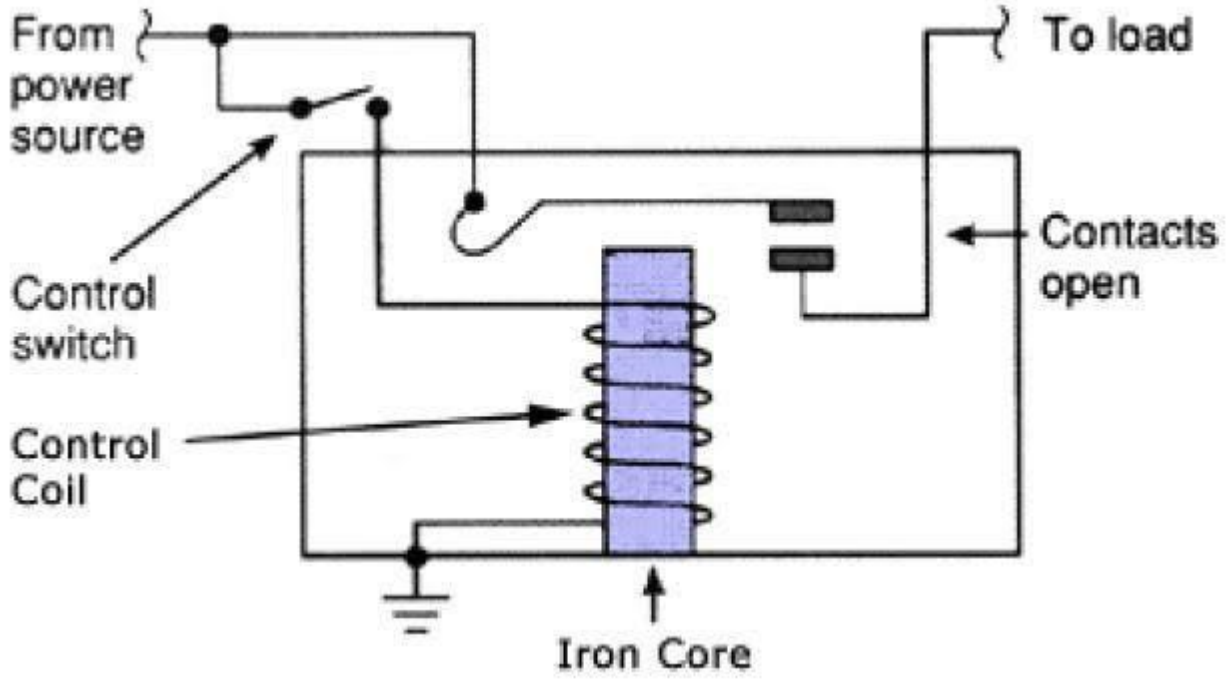
RELAY

What is relay?

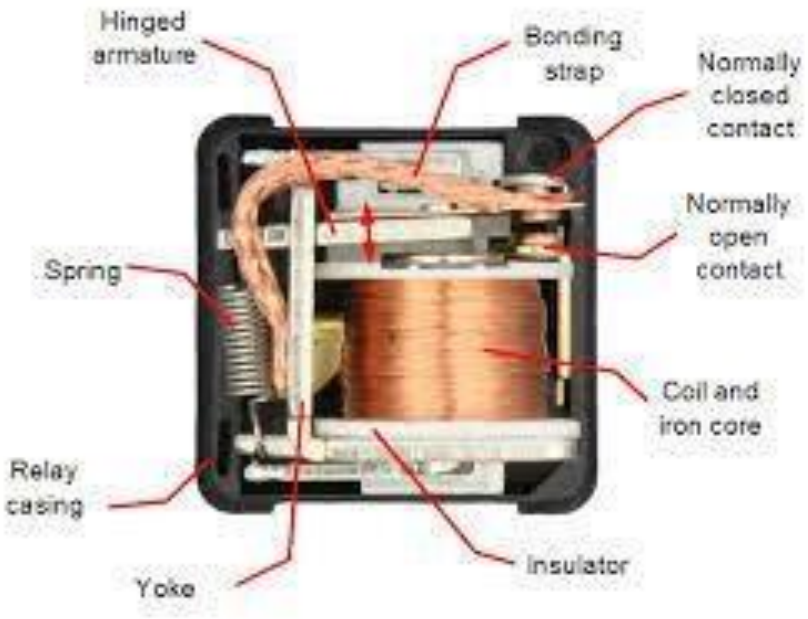
A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

Working principle of Relay

It works on the principle of an electromagnetic attraction. When the circuit of the relay senses the fault current, it energises the electromagnetic field which produces the temporary magnetic field. This magnetic field moves the relay armature for opening or closing the connections.



Internal Look of Relay

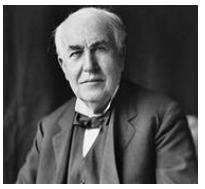


External Look of Relay

Fuse

A fuse is an electric / electronic or mechanical device, which is used to protect circuits from over current, overload and make sure the protection of the circuit. There are many types of fuses, but function of all these fuses is same.

Electric fuse was invented by Thomas Alva Edison in 1890. He was an American inventor.



A fuse is a one-shot device. The heat produced by overcurrent causes the current carrying element to melt there by making the circuit open. In effect, it disconnects the load from the source voltage.

Fig.1.9(a) Mini fuse

Fig.1.9(b)SMD fuse

Fig.1.9(c) Cartridge fuse

Fig.1.9 (d) Axial fuse

Construction of fuse

A general fuse consists of a low resistance metallic wire enclosed in a non-combustible material. It is used to connect and install in series with a circuit and device, which needs to be protected against short circuit and over current, otherwise, electrical appliance may be damaged.

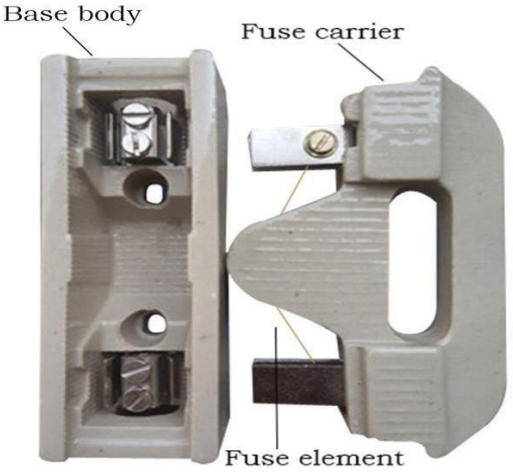


Fig.1.10 Construction of Kitkat fuse

More to know: Fuse consist of two main parts: • Fuse casing

• Fuse elements

Fuse casing may be made up of:

• Ceramics
• Glass
• Plastic
• Molded mica laminates

Working principle of a fuse

The working principle of a fuse is based on the "*Heating effect of Current*" i.e. Whenever a short circuit, over current or mismatched load connection occurs, then the thin wire inside the fuse melts because of the heat generated by the heavy current flowing through it. Therefore, it disconnects the power supply from the connected system. In normal operation of the circuit, fuse wire is just a very low resistance component and does not affect the normal operation of the system connected to the power supply.

More to know:	
Metal	Melting point in ^{0}C
Silver	980
Tin	240
Zinc	419
Lead	328
Copper	1090
Aluminium	666

Types of Fuses

There are different types of fuses available in the market and they can be categorized on the basis of different purpose.

The fuses are mainly classified into two types. Depending on the input supply voltages they are:

1. DC fuses
2. AC fuses

Assignment

1. Name the materials, which are used in the manufacturing of fuse element.
2. Make a search on the internet, the properties of fuse element.
3. Make a search on the internet, using which material kitkat fuse is manufacture.

Practical activity 1

Demonstrate the parts and connection of Kitkat fuse in simple electric circuit.

Material required

Kitkat fuse, Fuse element, Combinational plier, Line tester.

Procedure

Follow the following point to understand the operation of Kitkat fuse.

1. Taken a kitkat fuse, open the fuse carrier of fuse and observe the parts of kitkat fuse.
2. Parts you are going to see are fuse carrier, fuse element, fuse base, heat resistant padding as shown in figure 1.11.

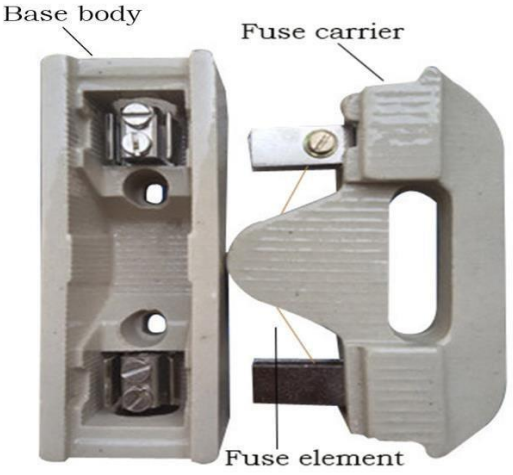


Fig.1.11

3. Now, connect the circuit as per the circuit diagram shown in the figure 1.12.

Fig.1.12

4. Understand the role of Kitkat fuse in electric circuit.

Miniature Circuit Breaker

The word '*miniature*' means '*very small*', and '*circuit breaker*' means a protection device designed to open and close a circuit. Therefore, we can define it as a small device, which is used for the circuit protection. It is another type of circuit breaker. It automatically turns off the electric circuit in case of overcurrent or any fault in the electrical supply. The manufacturer prescribes the value of current beyond which circuit will be turned off.

Fig.1.13 Miniature Circuit Breaker

Miniature circuit breaker internal parts

The fig. 1.14 shows internal parts of miniature circuit breaker design. Name of internal parts of MCB are as follows:

1. Incoming terminal
2. Copper Braid
3. Arc chute
4. Magnetic coil
5. ON/OFF switch
6. Bimetal strip
7. Outgoing terminal

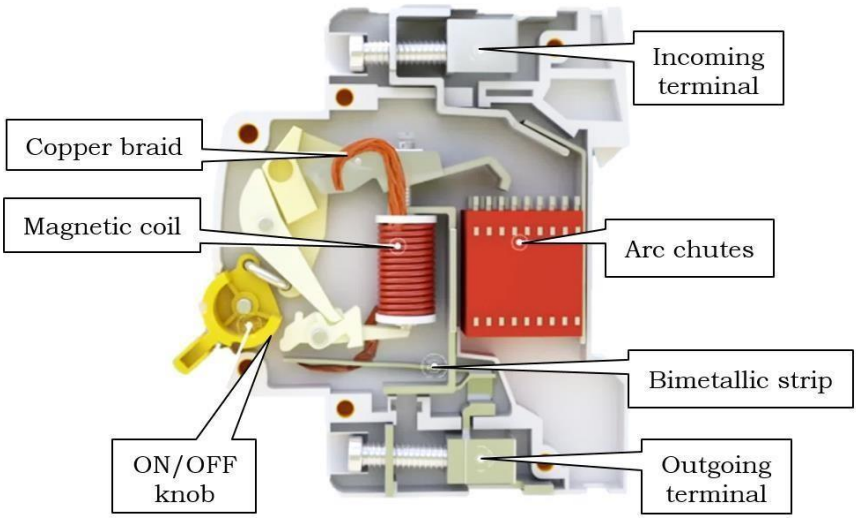


Fig.1.14 Internal parts of MCB

1. Incoming terminal

At this terminal incoming phase is connected.

2. Copper Braid

It connects the moving element with the static element.

3. Arc chute

It is a set of insulating barriers on a circuit breaker arranged to confine the arc and prevent it from causing damage. Arc chute extinguishes the arc which is produced due to heavy current.

4. Magnetic coil

Magnetic coil is part of thermal tripping arrangement. In case of heavy short circuit current magnetic field is formed.

5. ON/OFF switch

It is switch which can be manually interrupted by the user.

6. Bimetal strip

'Bi' means two, strip means metallic plate. So, two metal plates are used. For example, bimetallic made up of steel and brass as shown in fig. 1.15. Each metal has a different rate of thermal expansion. This concept of different rate of expansion can be beneficial for mechanical change. If we heat up the bimetallic strip it will bend up or down depending upon the two metal strips and the way these have been jointed.

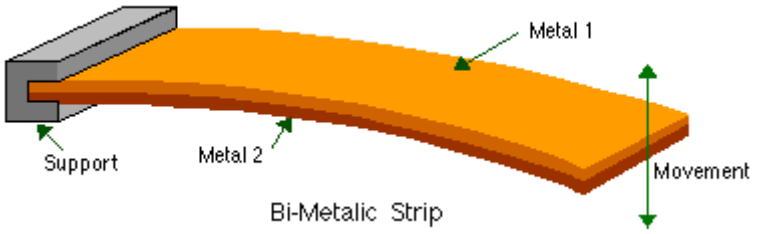


Fig.1.15 Bend in bimetallic strip

7. Outgoing terminal

The phase which enters through the incoming terminal will leave the miniature circuit breaker through the outgoing terminal.

Practical activity 2

Demonstrate the parts and connection of miniature circuit breaker in simple electric circuit.

Material required

Miniature circuit breaker, screwdriver, line tester.

Procedure

Follow the following point to understand the operation of miniature circuit breaker.

1. Taken a miniature circuit breaker, observe the parts of MCB externally first, then open the MCB using screwdriver to see the internal parts as shown in figure 1.16.

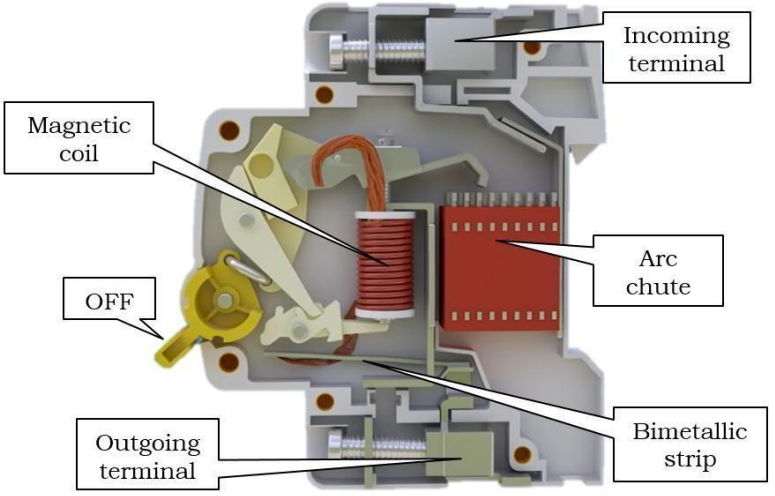


Fig.1.16 Internal parts of MCB

2. Now, connect the MCB in an electric circuit as per the circuit diagram as shown in figure 1.17.

3. Trip the MCB to understand its role in the electric circuit. And also observe the load.

Practical activity 3

Perform the bending of bimetallic strip.

Material required

Two Bimetallic strips, ice-cube, burner.

Procedure

Follow the following procedure to perform the bending of bimetallic strip.

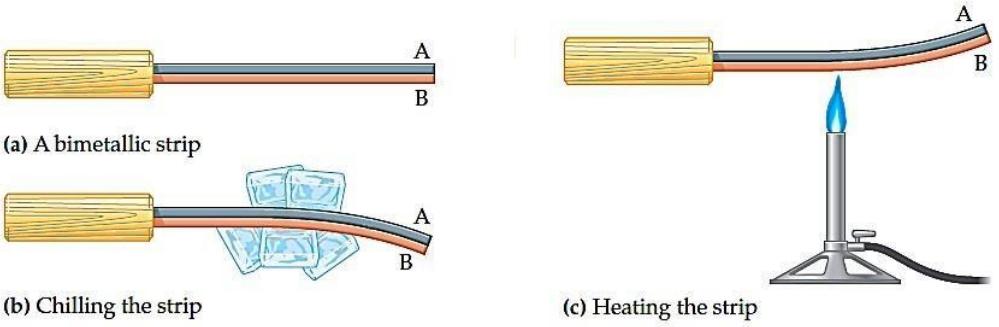


Fig.1.18 Steps to show bending in strip

1. In figure 1.18 (a) bimetallic strip is taken, which is made up of steel and brass.
2. Material 'A' is made up of steel and material 'B' is made up of brass.
3. We know that steel and brass are two different materials. Each of them have different rate of thermal expansion.
4. A material with a higher coefficient of thermal expansion will respond more to temperature changes than a material with a lower coefficient of thermal expansion.
5. In the figure 1.18 (b) we see that material 'A' shrinks less when cooled. Expands less when heated than does material 'B' as shown in figure 1.18 (c).
6. Brass has more coefficient of thermal expansion than that of steel.
7. Perform these steps to understand the nature of bimetallic strip in MCB.

Practical Activity 4

Learn and understanding tripping mechanism of miniature circuit breaker.

Material required

Miniature circuit breaker

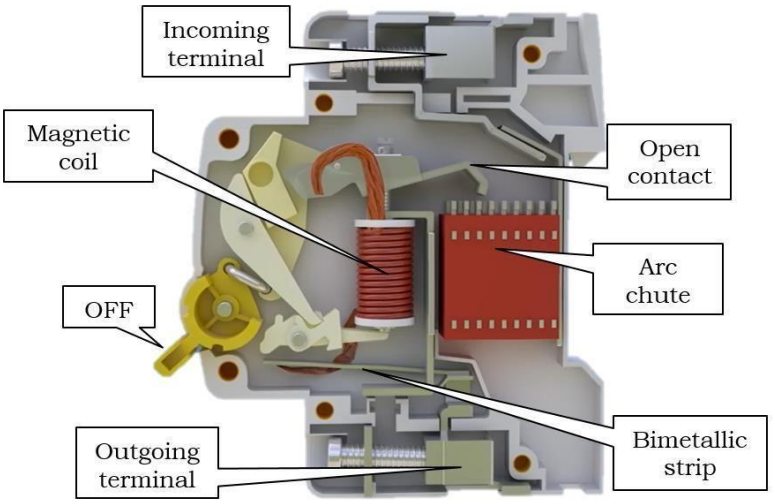
Procedure

Follow the following steps in tripping of MCB.

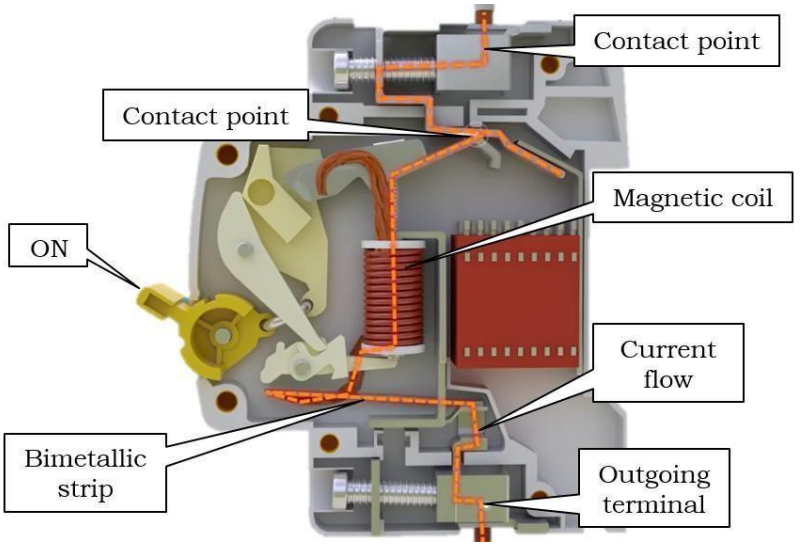
The fig. 1.19 illustrates the tripping mechanism of the MCB.

a) The circuit breaker contacts (i.e. contact is open or close)and the position of the knob can easily be seen in both, OFF and ON, state as shown in fig. 1.19(a), fig. 1.19(b)

b) In the ON state, the moveable contact touches the fixed contact as shown in the fig. 1.19(b).



(a)



(b)

Fig.1.19 (a)OFF state of MCB, (b)ON state of MCB

The path of the current in the ON state as shown in the fig. 1.20.

a) The live/phase wire is screwed at the input terminal as shown in fig. 1.20.
b) From the input terminal the current flows to the fixed contact which is touching the input terminal as shown in fig. 1.20.
c) The current then moves to the moving contact (since in the ON state it is touching the fixed contact) as shown in fig. 1.20.
d) The moving contact is connected to the electromagnetic coil of the solenoid by means of a thick wire as shown in fig. 1.20.
e) The current from the moving contacts enters the electromagnetic coil.
f) The current from the coil goes to the bimetallic strip by means of another thick wire as shown in fig. 1.20.

g) Finally to the output terminal where it is collected by the neutral wire of the line as shown in fig. 1.20.

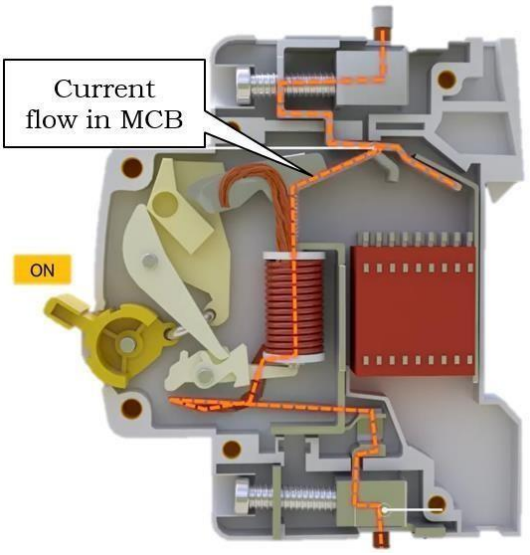


Fig.1.20 Path of current flow in MCB

Assignment:

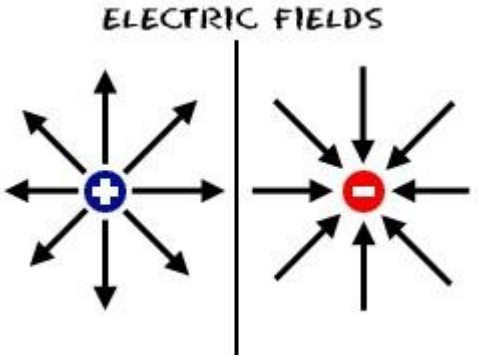
1. Make a search on the internet, what is the rating of commonly use MCB for single-phase supply, for example in house wiring?

2. Suppose you went to the electrical shop for purchasing the MCB. What question shopkeeper is going to ask you? What you will reply to him/her?

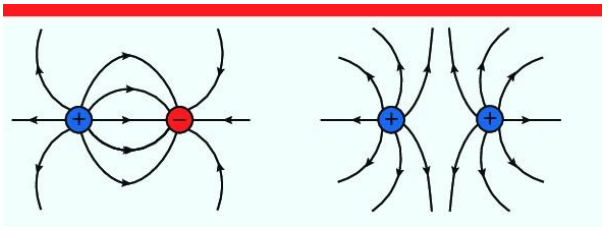
3. Name the different MCB which are used for commercial purposes?

1.3 What is an Electric field?

An Electric field is a field or space around an electrically charged object where any other electrically charged object will experience a force.



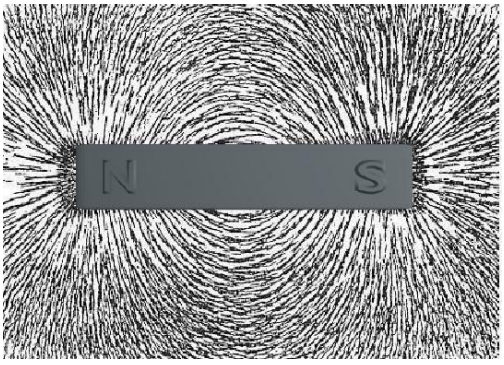
We know that electrical charge is either negative or positive in nature. Here we can see that the field lines of a positively charged particle goes outside and the field lines of a negatively charged particle comes inside.



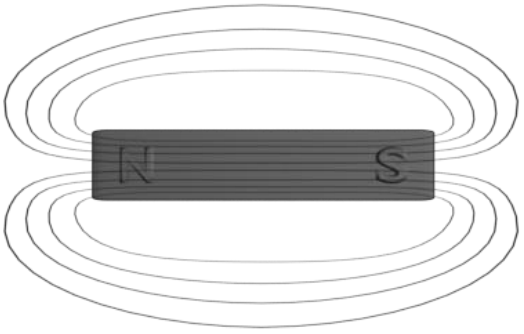
We also know that opposite charges attract each other and similar charges repel each other. This is shown by the field lines in the above picture.

What is a magnetic field?

A magnetic field is the space or field around a magnet in which the force of attraction and repulsion due to the magnet can be detected.



In this picture we can see the pattern formed by the scattered iron filings when a bar magnet is kept. These are the paths formed between the two poles namely, North and south pole of a magnet. These are called magnetic field lines.



In this picture we can see the field lines clearly. We can see the direction of the field lines inside and outside the bar magnet. Outside the magnet, the field lines originate from North pole and move towards South Pole and inside the magnet, the field lines move from south pole to North pole.

Also, we can make artificial magnets using electricity. These are called
'Electromagnets'. As we have already studied about inductors in class 9, we know how the electromagnet works.

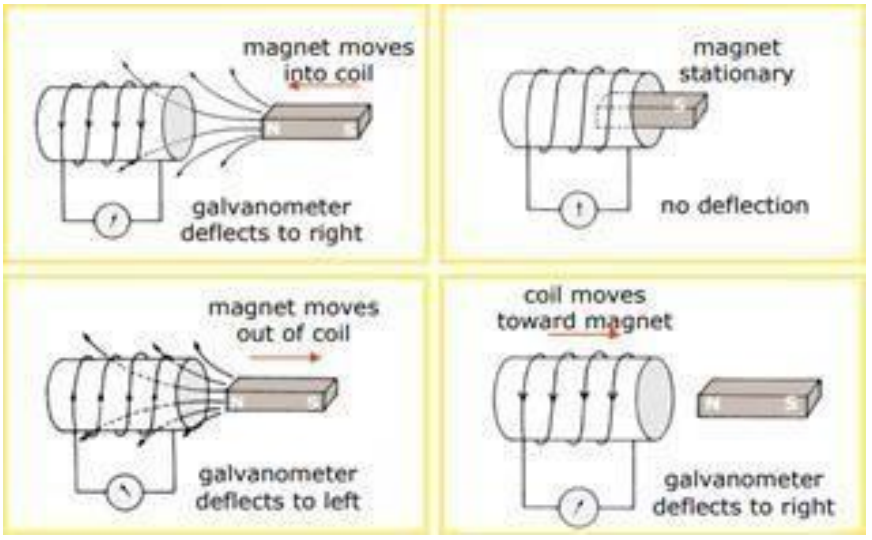
This is a simple electromagnet for your reference. We can see that it attracts the iron piece.

Electromagnetic induction:

Electromagnetic induction was discovered by Michael Faraday in 1831. It is defined as below:

'Electromagnetic induction is the production of electric current because of voltage or electromotive force, which is in turn formed due to a changing magnetic field.'

That is when the magnetic field keeps changing, a voltage is produced in a circuit. This voltage produces electric current.



In this image, we can see four situations.

In the first situation, the bar magnet is moved towards the coil. And we see that the galvanometer deflects to right. This indicates that electricity is flowing in the circuit.

In the second situation, the magnet is held inside the coil without any movement. The galvanometer doesn't deflect. So, there is no current in the circuit.

In third situation, when the magnet is moved away from the coil, the galvanometer deflects, but in opposite direction, i.e. left.

In fourth situation, the magnet is not moved. It is stationary. The coil is moved towards the magnet. And we see deflection in the galvanometer, in the same manner as in the first situation.

So, we can say that whenever there is a relative motion between the coil and the magnet, electricity is induced in the coil.

Thus, Electromagnetic induction is created by moving a conductor through a magnetic field. When the magnet moves back and forth, a current will be induced in the wire. Also, if the magnetic field changes when the conductor stays still, same effect is produced.

Fleming's Left Hand rule and Fleming's Right Hand rule:

Whenever a current carrying conductor comes under a magnetic field, there will be a force acting on the conductor. The direction of this force can be found using Fleming**'s** Left hand Rule.

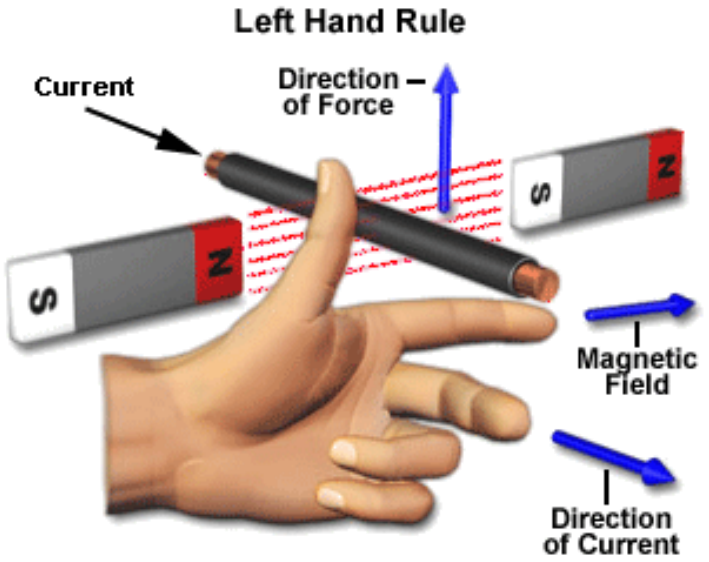
Similarly, if a conductor is moved under a magnetic field, there will be current induced in the conductor. The direction of this force can be found using Fleming**'s** Right hand rule.

These rules show the direction of any of the three parameters (magnetic field, current or force) when the direction of the other two is given.

The Left hand rule is associated with motors and the right hand rule with generators.

Fleming's left hand rule:

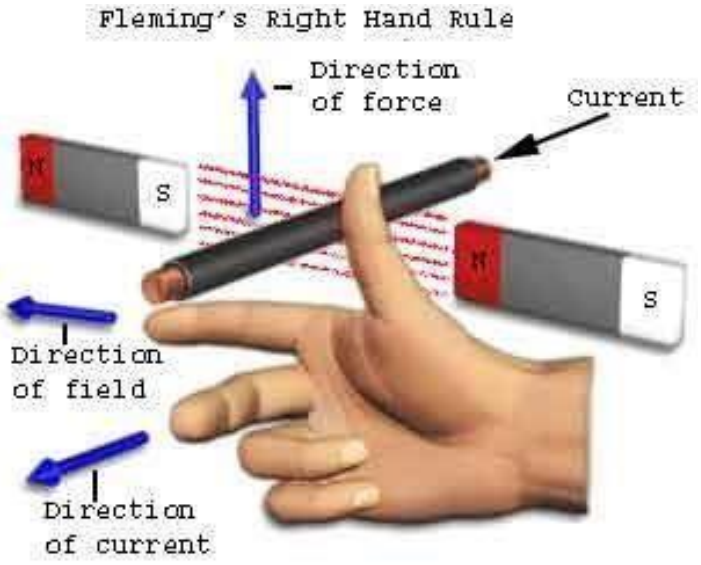
It is found that when a current carrying conductor is placed inside a magnetic field, a force acts on the conductor, in a direction perpendicular to both the directions of the current and the magnetic field.



So, we can see that if we hold out our left hand with the fore finger, second finger and thumb at 90 degrees to one another, if the fore finger gives the direction of magnetic field and second finger gives the direction of current, then the thumb gives the direction of the force.

Fleming's right hand rule:

As we have already studied about Electromagnetic induction, we know that whenever a conductor is moved in a magnetic field, current is induced in it. Fleming's right hand rule finds the relation between the direction of movement of conductor, magnetic field and the direction of induced current.



This rule says that, when we hold our right hand with the fore finger, second finger and the thumb at 90 degrees to each other, if the fore finger represents direction of magnetic field and thumb represents the direction of force, then the second finger points in the direction of induced current.

Lorentz Force:

Lorentz force is a law in electromagnetism. It states that if a charged particle moves with a velocity in the presence of an electric field and a magnetic field, then it will experience a reactive force. This reactive force is known as the Lorentz force.

When the charge on the moving particle is negative, the left hand rule is used.

And when the charge on the moving particle is positive, the right hand rule is used.

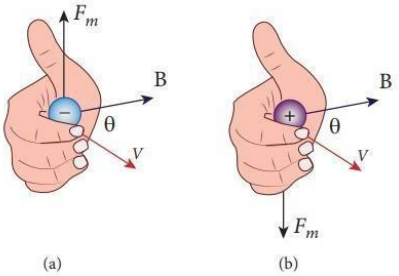
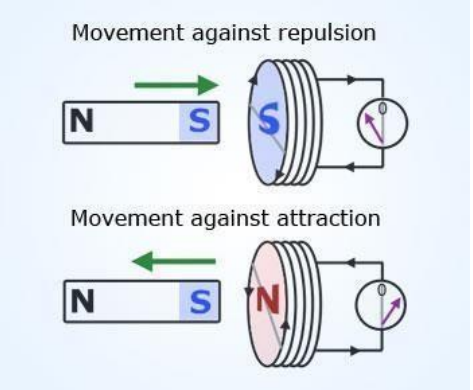


Figure 3.49 Direction of the Lorentz force on (a) positive charge (b) negative charge

Lenz's Law of Electromagnetic induction:

This law states that an induced electromotive force(emf) i.e. the induced voltage gives rise to a current whose magnetic field opposes the original magnetic field.
This can be confusing, so let us discuss in detail.
When we change magnetic field around a conductor, current is induced in it. This current will create its own magnetic field. This magnetic field will be opposing the original magnetic field that created it.

We can understand it well with the diagram given.



In this picture we can see that when the south pole of the magnet is moved towards the coil, the upper face of the coil becomes South Pole. Now, this south pole starts to repel the south pole of the magnet. Therefore, work is to be done in moving the magnet towards the coil.

Again, when the south pole of the magnet is moved away from the coil, the upper face of coil becomes north pole. Now, this north pole starts to attract the south pole of the magnet. Therefore, work is to be done in moving the magnet away from the coil.
The work done in both the cases is converted into electrical energy.

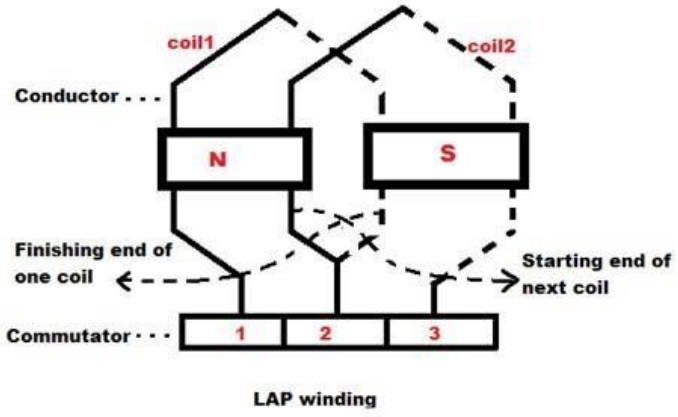
Winding Types- Wave Winding and Lap winding

LAP winding and WAVE winding:

Armature coils can be connected to the commutator to form either LAP or WAVE winding.

LAP winding:

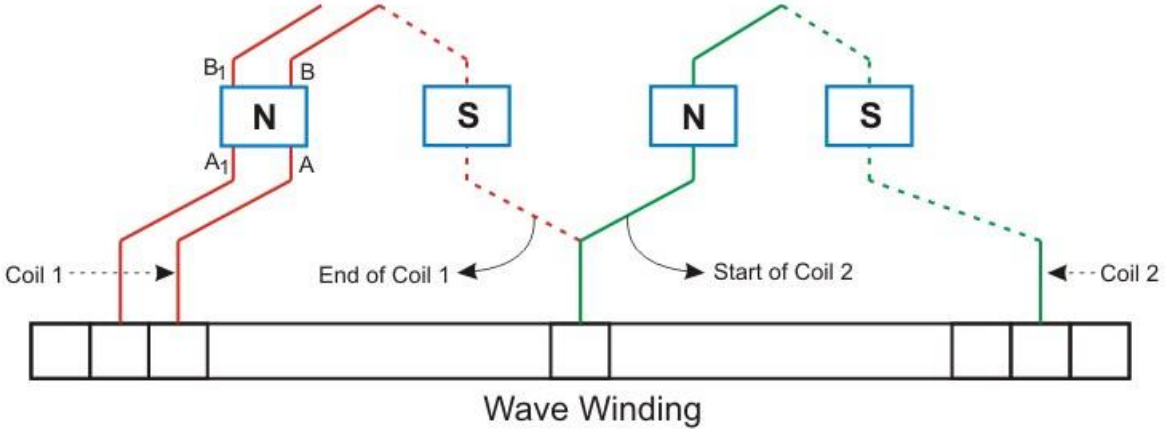
Lap winding is the winding in which successive windings overlap each other. In this winding the finishing end of one coil is connected to one commutator segment and the starting end of the next coil is connected with same commutator segment.



LAP winding

WAVE winding:

In this winding, we connect the end of one coil to the starting of another coil of the same polarity as that of the first coil. This winding forms a wave with its coil, since we connect the coils in series here, we also call it series winding.



Wave Winding

1.4
MOTOR

An electric motor is a rotating device that converts electrical energy to mechanical energy. Electric motor is used as an important component in electric fans, refrigerators, mixers, washing machines, computers, MP3 players etc.

1.4.1 Parts of motor

Motor is an electrical machine, which includes stationary and rotatory parts. Armature, Stator, outer body cover are the main parts of an electric motor.

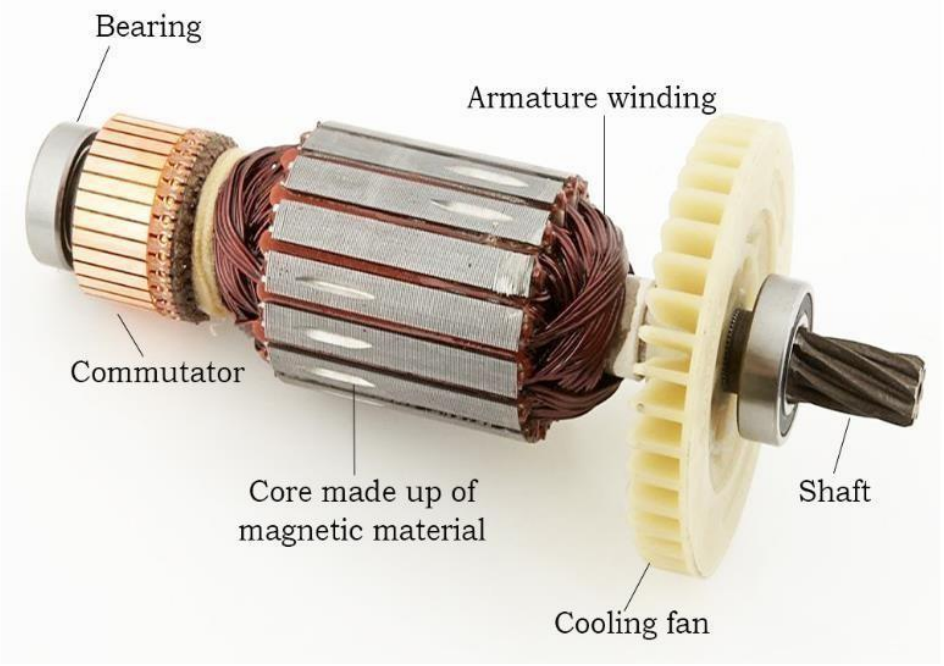


Fig.1.21 Parts of armature

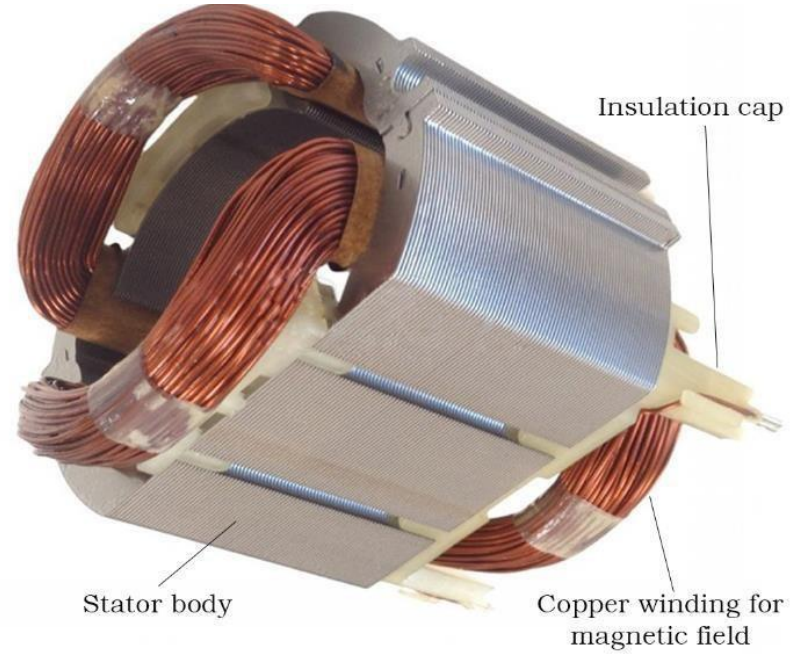


Fig.1.22 Parts of stator

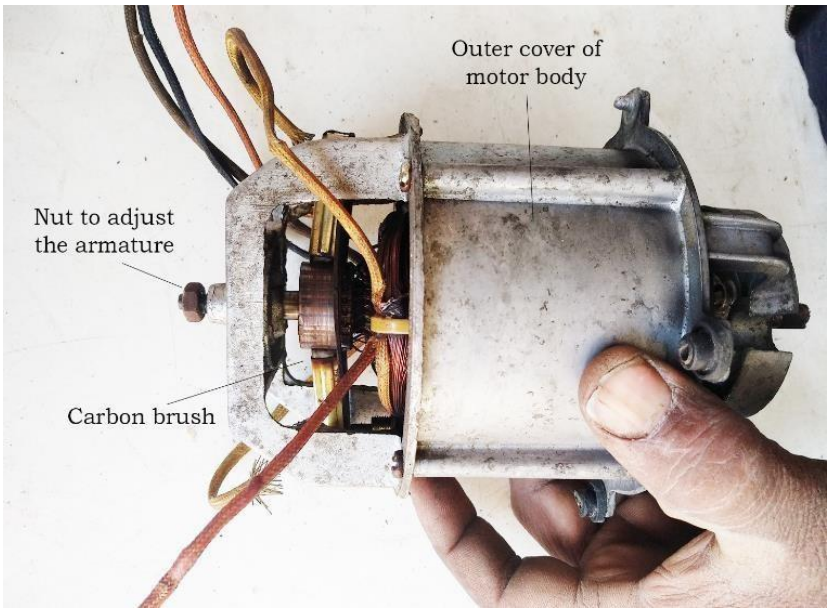


Fig.1.23 External body parts of motor

More to know

Armature is the rotating part of motor or generator, on armature slots are made to wound the conductors in the slots. Axle on which the armature is formed is known as shaft. An Armature (Coil) is the movable coil of wire that rotates through the magnetic field. An Armature (Coil) may consist of many coils (similar to the armature in a DC generator).

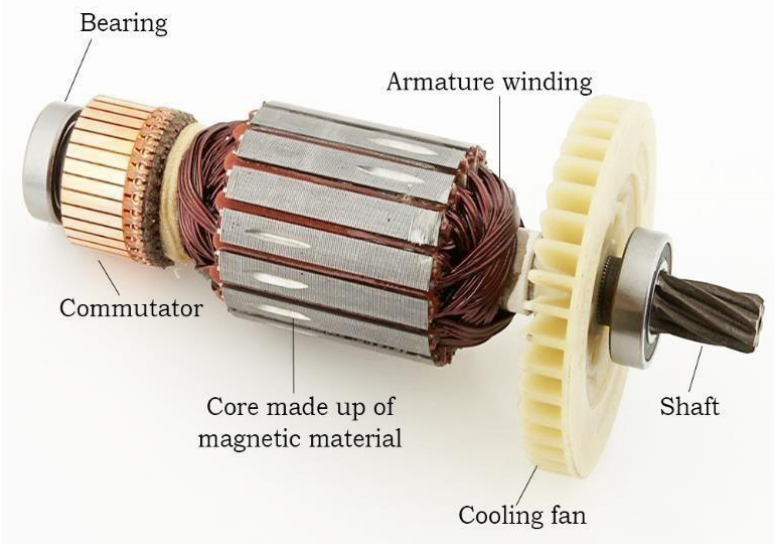


Fig.1.24 Armature

Assignment

1. Name the tools required for disassembling of motor.
2. Perform the disassembling of an electric motor, list out the different parts, which you have seen.

3. Write down the parameters which are mentioned on the plate of electric motor. What is the need of those specification.

Practical activity 5
Demonstrating the parts of electric motor.
Material required
Electric motor, screwdriver, combination plier, spanner, line tester, hand gloves, rubber shoes.
Procedure
Follow the following steps for dissembling an electric motor.

1. Firstly, turn OFF the power supply to the motor. If suppose motor is of capacitor start or run type motor. In that case, discharge the charges of the capacitor.
2. Now, using screwdriver and combination plier or spanner. Dismantle the body of the motor.
3. Cautiously, open the body of motor, and observe its various part.

1.3.2 Types of motor
Based on operating power, motor can be classified as alternating current (AC) or direct current (DC). Following tree diagram will clarify the types of motors.

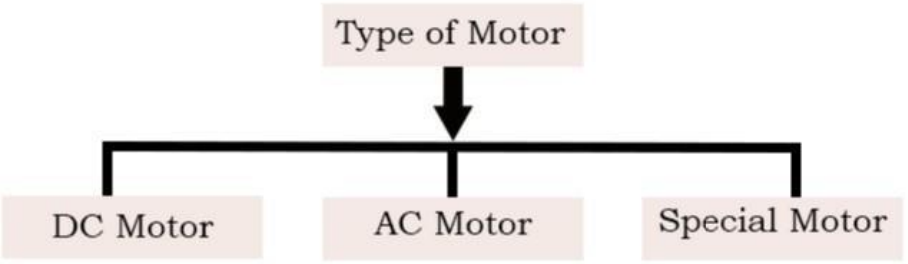


Fig.1.25 Types of motor

DC motor

As we know that motor converts the electrical energy into mechanical energy. DC motor required DC supply for their operation. It works on the principle that *"when a current carrying conductor is placed in a magnetic field, that current carrying conductor experiences a force"*. This rotating force is called *torque*. DC motors can be classified as:

a) Brushed DC motor
b) Brushless DC motor

AC Motor

As we know that motor converts the electrical energy into mechanical energy. AC motor required AC supply for their operation. It works on the principle that *"when a current carrying conductor is placed in a magnetic field, that current carrying conductor experiences a force"*. This rotating force is called torque. AC motors are classified as follows:

a) Synchronous motor

b) Asynchronous motor

a) Synchronous motor:

Synchronous motor is the type of motor in which the rotating speed of rotor is same as the rotating speed of magnetic field. Suppose, if the magnetic field is rotating at a speed of 1000 rotation per minute (RPM) and rotor is rotating at nearly equal say 998 rotation per minute (RPM). In such case, motor is said to be synchronized.

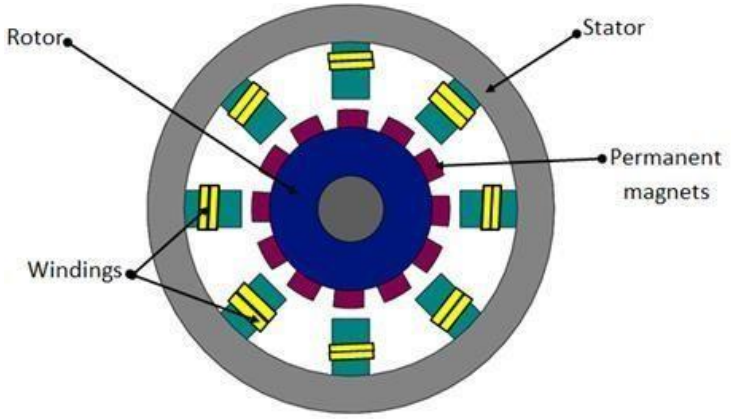


Fig.1.28 Permanent magnet on rotor in synchronous motors

b) Asynchronous motor: Asynchronous motor is the type of motor in which the rotating speed of rotor is less than the rotating speed of magnetic field. Suppose, if the magnetic field is rotating at a speed of 1000 rotation per minute (RPM) and rotor is rotating at 800 rotation per minute (RPM). In such case motor is said to be asynchronized. Asynchronous motor is also known as induction
motor.

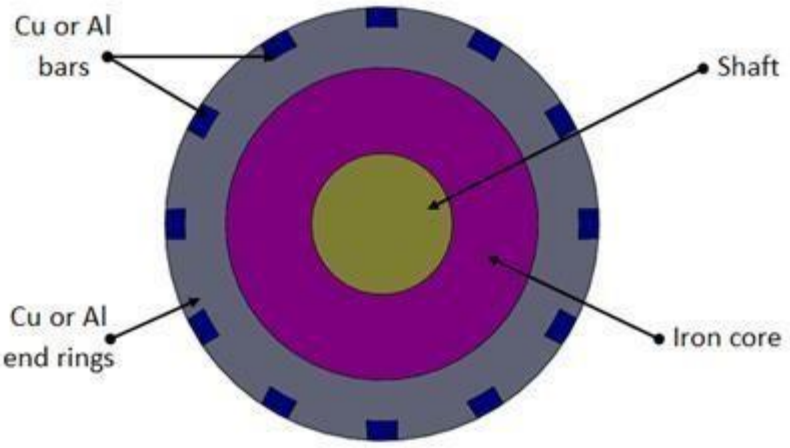


Fig.1.29 Asynchronous motor

Special motor

These are the motor, which are designed for some specific task. Some of the special motor can run on both AC and DC power supply. Examples of special motors are universal motor, stepper motor, servomotor, etc.

- Universal motor is used in mixer, grinder, juicer, hand drill machine etc.
- Stepper motor is used in robots and in those places where we want angular rotation of motor shaft.
- Servomotor is used in robots and in those places where we require accurate rotation of motor shaft.

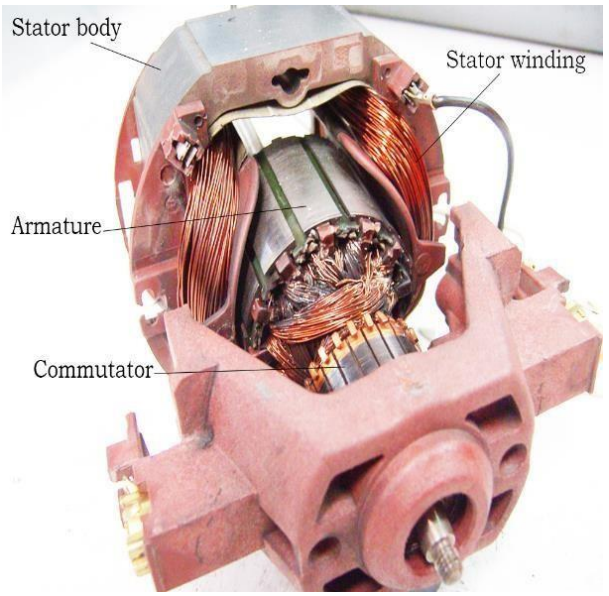


Fig.1.30 Parts of universal motor

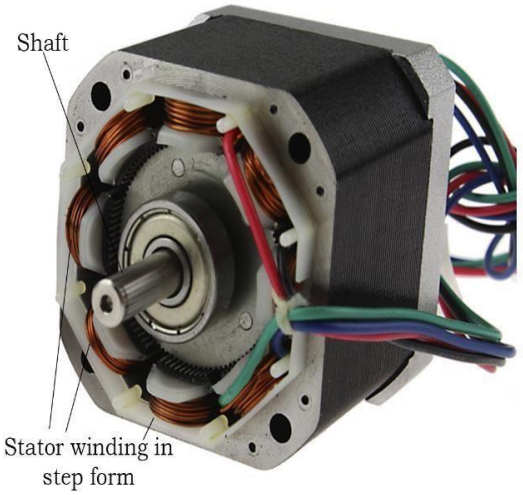


Fig.1.31 Stepper motor

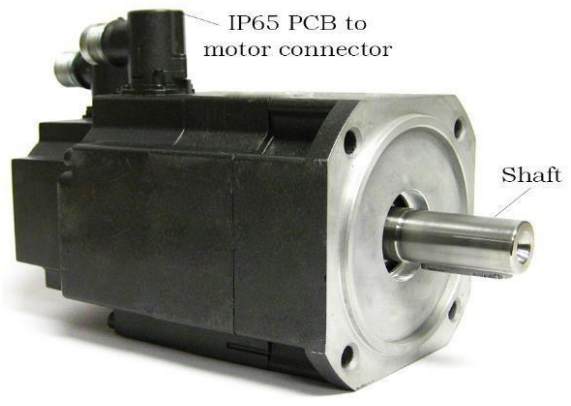


Fig.1.32 Servomotor

Assignment

Pictorial representation of some electrical equipment	Name of equipment
 Fig.1.33	
 Fig.1.34	
 Fig.1.35	
 Fig.1.36	

Fig.1.37

1.4.3 Working principle of motor

Motor work on the principle of electromagnetic induction. Electromagnetic induction implies that, when a current-carrying conductor is placed in a magnetic field such that the direction of current is perpendicular to the magnetic field, it experiences a force. This force causes the conductor to move. Do you know how an electric motor works? An electric motor, as shown in Fig. 1.31 consists of a rectangular coil ABCD of insulated copper wire. The coil is placed between a magnetic field such that the its arm AB and CD are perpendicular to the direction of the magnetic field. The ends of the coil are connected to the two halves P and Q of a split ring. The inner sides of these halves are insulated and attached to an axle. The external conducting edges of P and Q touch two conducting stationary brushes X and Y, respectively. As shown in the Fig. 1.39 current in the coil ABCD enters from the source battery through conducting brush X and flows back to the battery through brush Y. Notice that the current in arm AB of the coil flows from A to B. In arm CD it flows from C to D, that is, opposite to the direction of current through arm AB. On applying Fleming's left hand rule for the direction of force on a current-carrying conductor in a magnetic field as shown in Fig. 1.38.

More to know:

Fleming Left Hand Rule

If we stretch our left hand in such way that forefinger, middle finger, and thumb are perpendicular to each other, then forefinger represent magnetic field, middle finger represent direction of current, then thumb represent the direction of force.

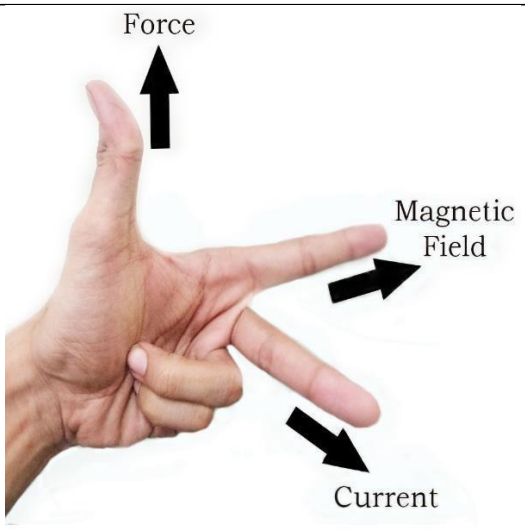


Fig.1.38 Fleming left hand rule

We find that the force acting on arm AB pushes it downwards while the force acting on arm CD pushes it upwards. Thus the coil and the axle O, mounted free to turn about an axis, rotate anti-clockwise. At half rotation, Q makes contact with the brush X and P with brush Y. Therefore, the current in the coil gets reversed and flows along the path DCBA. A device that reverses the direction of flow of current through a circuit is called a commutator. In electric motors, the split ring acts as a commutator. The reversal of current also reverses the direction of force acting on the two arms AB and CD. Thus, the arm AB of the coil that was earlier pushed down is now pushed up and the arm CD previously pushed up is now pushed down. Therefore, the coil and the axle rotate half a turn more in the same direction. The reversing of the current is repeated at each half rotation, giving rise to a continuous rotation of the coil and to the axle.

Fig.1.39 Working principle of motor

Assignment

1. What is difference between AC motor, DC motor, and special motor.
2. Search on the internet, which motor is used in electric locomotives.
3. Search on the internet, which motor is used in lift and escalator.
4. Which motors are used in Indian robot “Mitra”?

1.4.4 Rotation per minute (RPM) of motor

Rotating per minute defines the rotating speed of the electric motor. It is a unit for all the rotating machines, in case of motor it is use to measure the speed of the rotor or armature. RPM provides the information that, how many times does a rotor or armature is rotating in one minute. Tachometer is used to measure the speed of rotor or armature.

Practical activity 6

Measuring the rotating speed of motor using tachometer.

Material required

Optical tachometer, contact tachometer, reflecting tape.

Procedure

Follow the following steps to measure the speed of motor.

A. Measuring the speed using optical tachometer.

1. Firstly, unplug the electric motor, stick the reflecting tape on the shaft of the electric motor as shown in figure 1.40.

   Fig.1.40

2. Turn on the supply of electric motor. As shown in figure 1.41, press the test button.

   Fig.1.41

3. Soon we press test button, an optical ray will comes out from the end of tachometer as shown in figure 1.42.

   Fig.1.42

4. Focus the light ray on the reflecting tape. You will observe the reading in RPM on the display of tachometer as shown in figure 1.43.

   Fig.1.43

5. Wait for the reading to get stabilizes. Take three to four reading for accuracy.

   Fig.1.44

B. Measuring the speed using contact tachometer.

1. Turn on the supply of electric motor. Now, touch the contact of tachometer to the shaft of electric motor as shown in figure.

   Caution: Do not apply too much pressure on the tachometer contact, which is touching the shaft of electric motor.

2. Press the test button of the tachometer. You will observe the reading in RPM on the display of tachometer as shown in figure 1.45.

   Fig.45

3. Wait for the reading to get stabilizes. Take three to four reading for accuracy.

Practical activity 7

Simple DC motor for understanding the principle behind motor.

Material required

Small square piece of wood, small magnet (fridge magnet), Wood glue, Copper wire, Knife & stapler, Battery.

Note: Commutator and brushes are not needed in this model.

Procedure

- The assembly of a motor start from winding the coil of copper wire. The coil should have 10 – 16 turns. For winding the wire you can use a battery cell, as shown in figure 1.46.

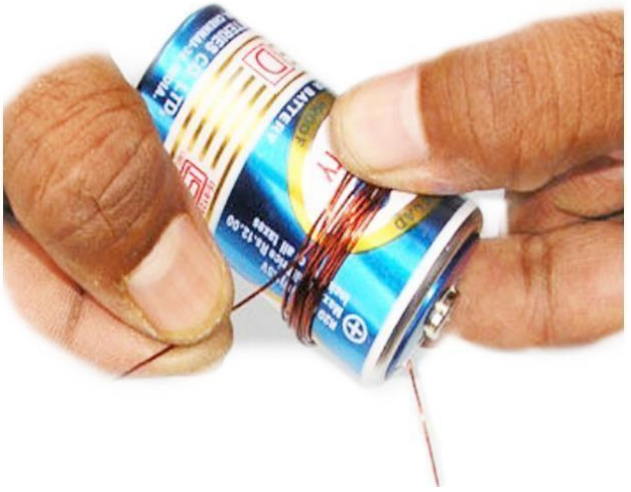


Fig.1.46 Copper wire winding

- Tie the coil ends carefully and leave them outwards, as shown in the figure 1.47.

Fig.1.47 Tie the coil

- Now, remove the insulation from the ends of copper wire. When removing the insulation coating, one must remember that insulation removal must be in half of diameter of a copper wire.

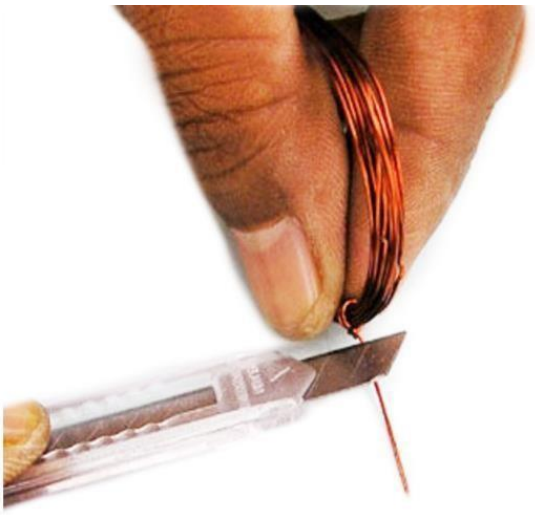


Fig.1.48 Remove the insulation

- Now, fix safety pins and a magnet using rubber bands, as shown in figure 1.49. Insert coil ends into holes of safety pins and motor is ready.

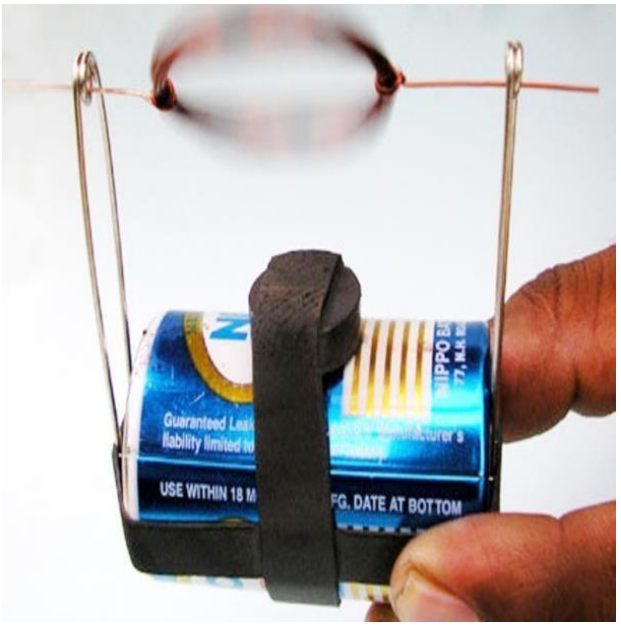


Fig.1.49 Place the coil between the loops and see the rotation of the coil

- If one more magnet, you can hold it on the top of the rotating coil. This will control the rotational speed of coil.

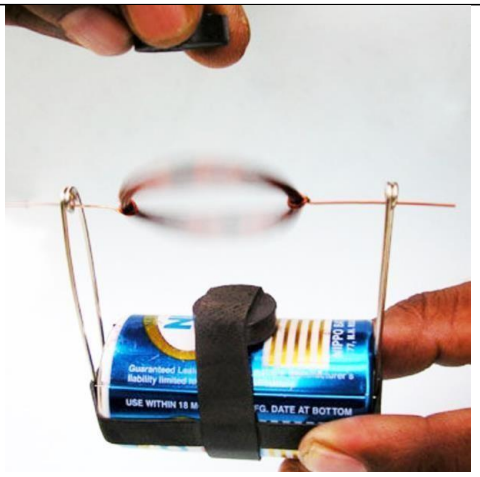


Fig.1.50 Hold one more magnet on the top of the coil and see speed changes.

CHECK YOUR PROGRESS

A. Choose the correct option in the following questions

1. Which of the following motor works on AC as well as DC power supply?
   a) Stepper motor
   b) Universal motor
   c) Servomotor
   d) Induction motor
2. Which of the following motor is used in robots?
   a) Stepper motor
   b) Universal motor
   c) Servomotor
   d) Induction motor
3. Which of following motor provide angular rotation of shaft?
   a) Stepper motor
   b) Universal motor
   c) Servomotor
   d) Induction motor
4. Which of the following motor is used in a mixer?
   a) Stepper motor
   b) Universal motor
   c) Servomotor
   d) Induction motor
5. Which of the following is the full form of MCB?
   a) Miniature circuit breaker
   b) Miniature circuit break
   c) Motor circuit break
   d) Motor control break
6. Which of the following is not the type of fuse?
   a) Mini fuse

b) SMD fuse
c) Cartridge fuse
d) Paper fuse

7. Which of the following motor work on asynchronous speed?
   a) Stepper motor
   b) Universal motor
   c) Servomotor
   d) Induction motor
8. Which of the following is the not the part of electric motor?
   a) Armature ‘
   b) Brush
   c) Stator
   d) Fuse
9. Which of the following is not the part of MCB?
   a) Bimetallic strip
   b) Trip
   c) Solenoid
   d) Arc-chutes holder
10. Which of the following is not the circuit protection device?
   a) Relay
   b) Fuse
   c) Miniature circuit breaker
   d) Switch

B. Fill up the correct word in the following statements

1. In …… universal motor is used for mixing.
2. In robotic arm designing …… motor is commonly used.
3. Types of AC motors are……. And …….
4. Fleming ……. rule is used in motor.
5. Motor work on the principle of ……
6. Motor convert the …… energy into …… energy.
7. Kitkat fuse is made up of…….
8. Rotating part of motor is……
9. Static part of motor is ……
10. Path of electric circuit which is having least resistance is said to be ……

C. State which of the following statement are true or false

1. Synchronous motor is also known as induction motor.
2. Bimetallic strip in MCB is made up of two different metals.
3. Universal motor works on DC power only.
4. In circuit, rise in temperature can be occur due to short circuit.
5. In mixer, grinder, juicer uses stepper motor for mixing.
6. RPM stands for ‘rotation per minute’.

7. Tachometer is a handheld device used to measure the electric field of the electric motor.
8. Fleming left hand rule is used for electric motor.
9. Bimetallic strip is an important part of kitkat fuse.
10. MCB stands for Miniature current breaker.

D. Short answer type Question

1. What is the role of brush in electric motor?
2. State Fleming's left-hand rule.
3. What is the principle of an electric motor?
4. What is the role of the split ring in an electric motor?
5. List down different parts of motor.
6. Define the term rotation per minute in motor.
7. List the special type of motor.
8. What are the types of fuse?
9. How miniature circuit breaker trip the circuit?
10. What is the role of bimetallic strip in MCB?

Unit -2: Repair and Maintenance of Mixer/Juicer/Grinder

Introduction:

One day Ram was helping his mother in kitchen. His mother asked him to turn on the juicer. Ram starts filling up fruits in the jar, as soon as he started the juicer it stopped suddenly. Then his mother asked him to push the button under the juicer. His mother tells him about overload switch. This incidence makes him curious about internal parts of the juicer, mixer and grinder. In this chapter, we will learn about the mixer juicer grinders, their parts and different test which one can perform to diagnose faults and reassembled them.

MIXER/GRINDER

In our day-to-day life we use various appliance which easy our work. Various electrical and electronic appliances such as juicer mixer grinder, geyser etc. are used. Mixer/Grinder is a useful home appliance, which is commonly used in kitchen. It is used for mixing and grinding food, flour, liquid etc. Different types of jars are used for mixing, wet grinding and dry grinding. It uses gears to rotate a set of beaters to mix food contained in a bowl. The high-speed spinning blade grinds the material while mixing it. A common household mixer/grinder is shown in *figure 3.1*.

Fig. 3.1: Mixer/Grinder

Types of Mixers

There are many types of mixers depending on their usage, which are discussed as follows:

1. Stand mixer: It contains attachments such as whisk, beater and dough hook to mix different type of ingredients. It is shown in fig. 3.2(a).
2. Hand Mixer: It is a Hand-held mixing device. The handle is mounted on enclosed motor which drives the beaters. It is shown in fig. 3.2(b).
3. Spiral mixer: It consists of a stationary spiral shaped stir and rotating bowl. Spiral mixer is shown in fig. 3.2(c).
4. Planetary mixer: It contains a stationary bowl and rotating agitator to mix, blend ingredients. Planetary mixer is shown in fig. 3.2(d).
5. Dough mixer: It is used for mixing of flour. It also used to make a paste of large quantity of flour. Dough mixer is shown in fig. 3.2(e).

Fig.3.2 (a) Stand mixer

Fig.3.2 (b) Hand mixer

Fig.3.2 (c) Spiral mixer

Fig.3.2 (d) Planetary mixer

Fig.3.2 (e) Dough mixer

Fig. 3.2: Types of mixers

Parts of Mixer

Different parts of a mixer /grinder are illustrated as follows:

S.no.	Image	Part
1.	 *Fig. 3.3*	Lid

2.	 *Fig. 3.4*	Liquidizing jar
3.	 *Fig. 3.5*	Dry grinding jar
3.	 *Fig. 3.6*	Wet grinding blade
5.	 *Fig. 3.7*	Blender grinding blade
6.		Dry grinding blade

	 *Fig. 3.8*	
3.	 *Fig. 3.9*	Wet grinding blade
8.	 *Fig. 3.10*	Base unit

Check points before using mixer/grinder

Following points must be checked before using the mixer/grinder:

1. Check that all parts are present.
2. Check for any damage to the unit or attachments.
3. Wash the jars, lids and blades with warm water.
4. Clean the body with soft cloth.
5. Ensure that the motor shaft rotates freely and smoothly.
6. Ensure that the jar shaft rotates freely and smoothly.

Practical Activity 1 Steps to use Mixer/Grinder Material required Mixer grinder, power supply, user manual.

Procedure

A mixer/grinder is very simple and easy to use. Following steps illustrate the procedure of using mixer/grinder:

1. Select the required jar.

Fig. 3.11 Different jars

2. Fill the jar with ingredients.

Fig. 3.12 Jar filled with ingredients

3. Close the jar with lid.

Fig. 3.13 Closing the jar with lid

4. Position the jar on the base unit.

Fig. 3.14 Positioning the jar on the base unit

5. Turn the jar clockwise to lock it in position.

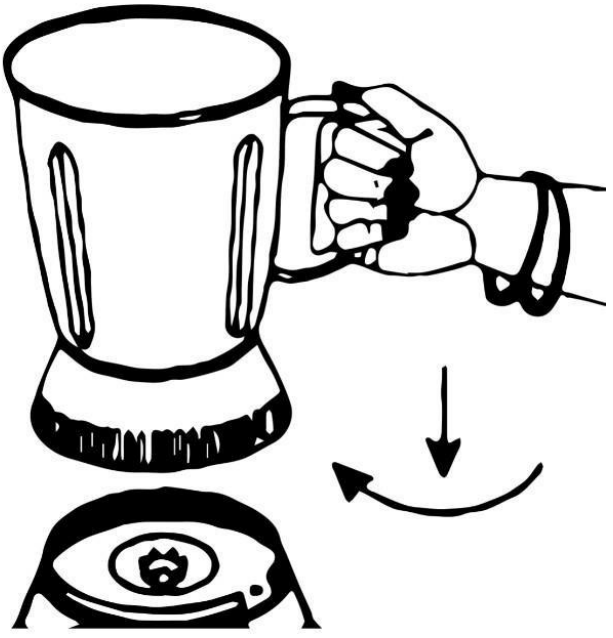


Fig. 3.15 Locking of jar on base unit

6. Plug in the power cord.

Fig. 3.16 Plugging into the socket

7. Place a hand over the lid and switch-on as shown in Fig. 3.17.

Fig. 3.17

8. Start with the slowest speed as shown in Fig.3.18.

Fig. 3.18

9. To unlock the jar, turn it anticlockwise as shown in Fig.3.19.

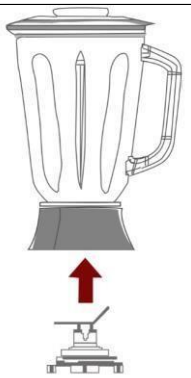


Fig. 3.19

Auto Overload Protector (OLP)

Overload protector is used for safety. It protects the mixer from sudden overload. In overload situations, the OLP trips and the mixer/grinder shuts-off immediately. This protects the mixer unit from burning and enhances the motor life. The OLP button is located at the bottom of the unit. Figure 3.20 shows the location of OLP in a mixer/grinder:

Fig. 3.20: Overload protection button in a mixer/ grinder

Following points illustrate the steps in case the mixer/grinder stops due to OLP:

- Switch-off the mixer/grinder
- Wait for the motor to cool down
- Reduce the ingredient load
- Press the OLP button
- Restart the unit

Practical Activity 2

Cleaning the mixer/grinder.

Material required

All the parts of a mixer/grinder such as jars, blades and base unit should be cleaned thoroughly after every use, cleaning cloth.

Procedure

Follow the following steps to clean the mixer / grinder.

Cleaning the jars

Step 1-Pour mild soap water into the jar.

Step 2-Place the jar on the base unit and run for some time.

Step 3-Remove and wash the inside of the jar with water.

Step 4-Run the jar for 2-3 seconds.

Step 5-Keep the jar inverted to dry.

Cleaning the base unit

Step 1-Unplug the unit.

Step 2-Separate it from the jar.

Step 3-Clean thoroughly with a soft cloth.

Step 4-Do not immerse the unit in water.

Cleaning the blades

Step 1-Turn the jar upside down.

Step 2-Loosen the threaded bottom disc by turning it anti-clockwise.

Step 3-Remove the disc, sealing ring and blade.

Step 4-Clean the blade under running water.

Step 5-Let the blade dry completely before storing.

JUICER

Juicer is an electrical kitchen appliance used for extracting juice out of fruits and vegetables. It crushes or cut the fruits and vegetables. These crushed fruit or vegetable are filtered to separate pulp from liquid content. The figure 3.21 shows a common household juicer.

Fig. 3.21: Juicer set

6.1.5 Types of Juicers

There are many types of juicer depending on their juice extraction method. Different types of juicer are as follows:

1. Centrifugal juicer
2. Masticating juicer
3. Citrus juicer or Reamer

Fig. 3.22: Different juicers

6.1.6 Parts of Juicer

The following table illustrates the different parts of juicer:

S.no.	Image	Part

1	 *Fig. 3.23*	Plunger
2	 *Fig. 3.24*	Hopper
3	 *Fig. 3.25*	Drum lid
3	 *Fig. 3.26*	Juicing screw
5		Rotation wiper

	 *Fig. 3.27*	
6	 *Fig. 3.28*	Strainer
3	 *Fig. 3.29*	Juicing bowl
8	 *Fig. 3.30*	Base

9	 *Fig. 3.31*	Pulp cup
10	 *Fig. 3.32*	Juice cup

Practical Activity 3

Assembling the Juicer.

Material required

Juicer set, screwdriver.

Procedure

Follow the following table that includes step to assemble different parts of juicer.

Step 1: Assemble the juicing bowl on to the base unit as shown in Fig.3.33.

Fig. 3.33

Step 2: Position the strainer into the rotation wiper as shown in Fig.3.34.

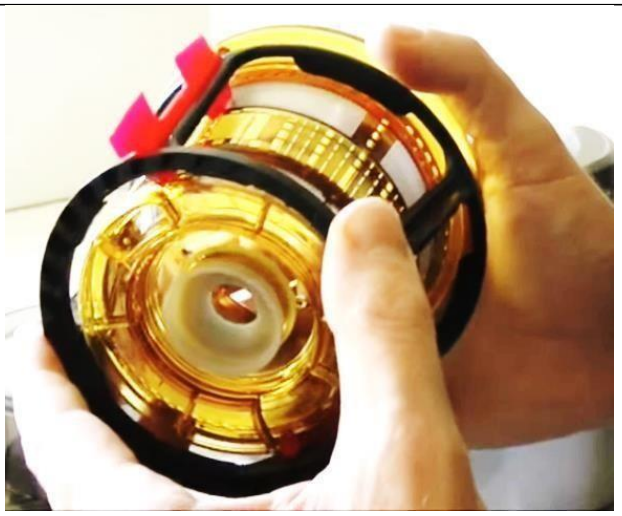


Fig. 3.34

Step 3: Place the set of rotation wiper and strainer on to the base unit. Push the strainer down the juicing bowl until it clicks into position as shown in Fig.3.35.

Fig. 3.35

Step 4: Put the juicing screw into strainer. Turn until the juicing screw clicks into position as shown in Fig.3.36.

Fig. 3.36

Step 5: Position the juice cup and pulp cup into their place as shown in Fig. 3.37.

Fig. 3.37

Practical Activity 4
Disassembling the juicer
Material required
Juicer kit, screwdriver, line tester.
Procedure

Following table illustrates the step to dissemble different parts of juicer:
Step 1: Open the drum lid by turning it in anti-clockwise direction as shown in Fig.3.38.

Fig. 3.38

Step 2: Lift the juicing bowl off the base by turning it in anti-clockwise direction as shown in Fig.3.39.

Fig. 3.39

Step 3: Separate the bowl from the set of rotation wiper, strainer and juicing screw as shown in Fig.3.40.

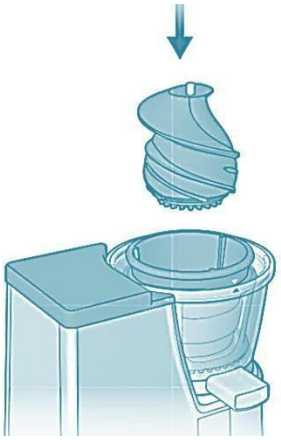


Fig. 3.40

Step 4: Disassemble the juicing screw and strainer from the rotation wiper as shown in Fig.3.41.

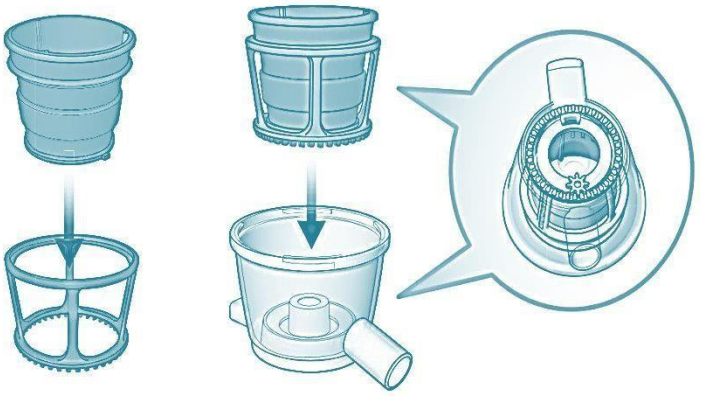


Fig. 3.41

Practical Activity 5

Steps of using a juicer.

Material required

Juicer, juicer jar, vegetable and fruits.

Procedure

A juicer is very simple and easy to use appliance. The following steps illustrate the use of a juicer.

- Wash and prepare the required fruits and vegetables as shown in Fig.3.42(a).

Fig. 3.42(a)

- Plug in the juicer as shown in Fig.3.42(b).

Fig. 3.42(b)

- Place the juice cup and pulp cup into position as shown in Fig.3.42(c).

Fig. 3.42(c)

- Switch-on the juicer as shown in Fig.3.42(d).

Fig. 3.42(d)

- Insert the fruit/vegetable one piece at a time into the chute as shown in Fig.3.42(e).

Fig. 3.42(e)

- Turn off the juicer after the juicing process is complete as shown in Fig.3.42(f).

Fig. 3.42(f)

Cleaning juicer

It is very important to take proper care of juicer. It should be properly cleaned after every use.

Fig. 3.43: Cleaning a juicer

Following are the steps for cleaning of juicer:

Step 1-Switch-off the power and unplug the juicer.

Step 2-Follow the dissembling process.

Step 3-Wash the parts in water.

Step 4-Clean holes of strainer with a brush and mild soap solution.

Step 5-Swipe the base with a soft damp cloth.

Step 6-Clean all metal parts.

Step 7-Let all the parts dry completely before storing.

Assignment: Identification Game

Match the following parts of the juicer with their respective images:

1. Pulp cup	a.  *Fig. 3.44*
2. Rotation wiper	b.  *Fig. 3.45*
3. Hopper	c.  *Fig. 3.46*
4. Juicing screw	d.  *Fig. 3.47*

Repairing Mixer/Grinder/Juicer

Mixer/Grinder/Juicer is an electrical appliance. Mixer/Grinder/Juicer consists of number of components and parts. One of the main parts is motor. It is responsible for mixing of ingredient. Gears translate the motor's rotation to the rotation of the beaters. A speed controller varies the electrical current delivered to the motor, thus allowing the speed of the beaters to be controlled. There are two types of food mixers:

Portable (or hand) mixers: Portable mixers are lightweight, with small motors for easier mixing and blending jobs

Stationary (or stand) mixers: Stand mixers use larger motors and components to manage bigger jobs.

Troubleshooting Mixer/grinder/juicer

Sr. No.	Problems	Solution
1	If base unit fails to start	⬩ Ensure cord is plugged-in properly ⬩ Ensure power supply is active ⬩ Ensure the unit is switched-on ⬩ Ensure that the jar is not overloaded
2	If motor stopped	⬩ Ensure cord is plugged-in properly ⬩ Ensure that the grinder safety knob is not loose ⬩ Switch-off the unit and unplug ⬩ Let the juicer cool down from overheating
3	If mixer does not function at all speeds	⬩ Check the speed control ⬩ Replace if defective
3	If motor hums but beaters do not rotate	⬩ Check motor ⬩ Replace if defective
5	If Excessive vibration in mixer	⬩ Check and replace beaters if defective ⬩ Check and service gears if broken or misalig ned ⬩ Check and replace motor if defective
6	If mixer is noisy	⬩ Switch-off the mixer and unplug ⬩ Stir the contents into middle of jar from the walls ⬩ Add water and start
3	If overflowing jar	⬩ Check and reduce excess liquid from jar ⬩ Check and fit the cap properly
8	If Jar leaking from below	⬩ Check blade shaft/ jar brush ⬩ Replace if worn-out

Servicing and repairing parts of Mixer/grinder/juicer

Repairing of mixer/grinder/juicer includes servicing or repairing speed controls, servicing or repairing gears, servicing or repairing motor. The following sections will show the way these services can be performed.

Servicing the speed control switch

A switch is a simple component. It is used to stop or start the operation of any motor. A speed control switch commonly has three stages. These stages define speed of motor. Rotating knob is used to select low, medium or high speed. The speed is controlled by providing varying current to the motor of the mixer/grinder. Mixer speed is controlled by varying the current to the motor. Smaller hand mixers use a speed switch that includes a number of electrical contacts, each increasing current to the motor. Larger units use a variable resistor to control current. Continuity testers are useful for checking the operation of either type of speed control switch. In some cases, contacts can be cleaned to improve function. However, in many cases, problems caused by speed controls can only be solved by replacing the controller. If mixer does not operate, first check the plug and cord whether they are working properly, only then test the switch.

Practical Activity 6

To test and replace a switch

Material required

Screwdriver set, rotatory switch.

Procedure

Follow the following steps for there placement of rotatory switch.

Step 1: Carefully remove the housing around the switch to expose the back side of the switch.

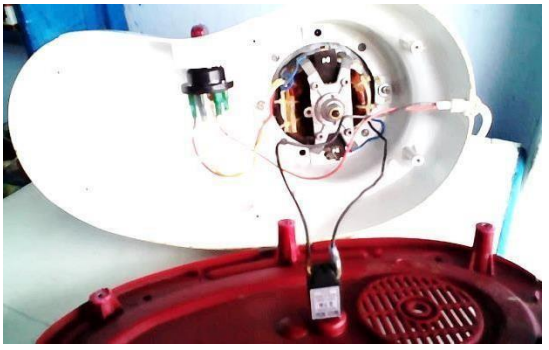


Fig. 3.48: Removing the housing of mixer

Step 2: Check the terminals on the switch to ensure that the wires from the appliance are fully attached to the switch.

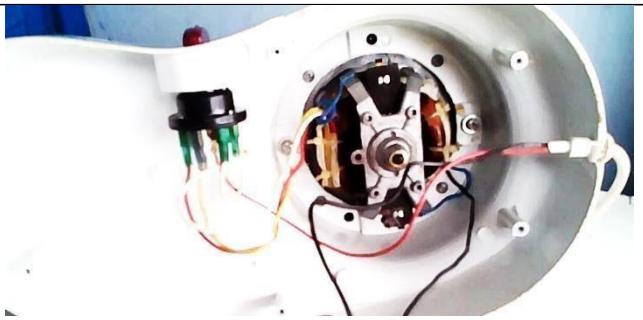


Fig. 3.49: Inspect the wiring of mixer

Step 3: Mark the terminal wires for position and disconnect them.

Fig. 3.50: Rotatory switch

Step 3: Use a continuity tester or multi tester to determine if the switch is faulty. If it is, replace it and reconnect the terminal wires as shown in Fig.3.51.

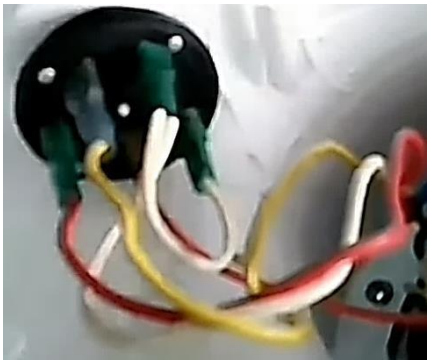


Fig. 3.51

Replacing a fuse

A fuse is device used to protect the wiring of an electrical appliance from overheating and catching fire due to overload or short circuit. If the motor of the mixer/grinder stops working, its fuse may be blown. The following steps listed replacing a fuse:

1. Remove the housing and access the motor

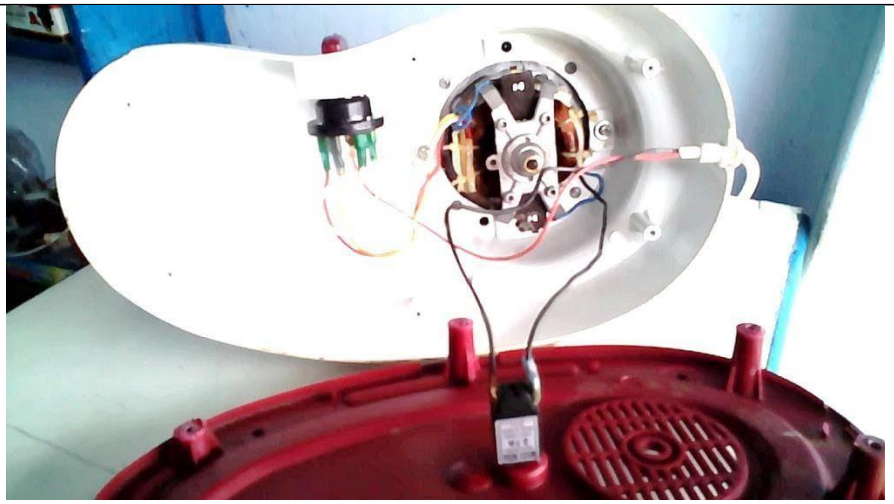


Fig. 3.52 Remove the housing

2. Disconnect the overload switch from the motor.

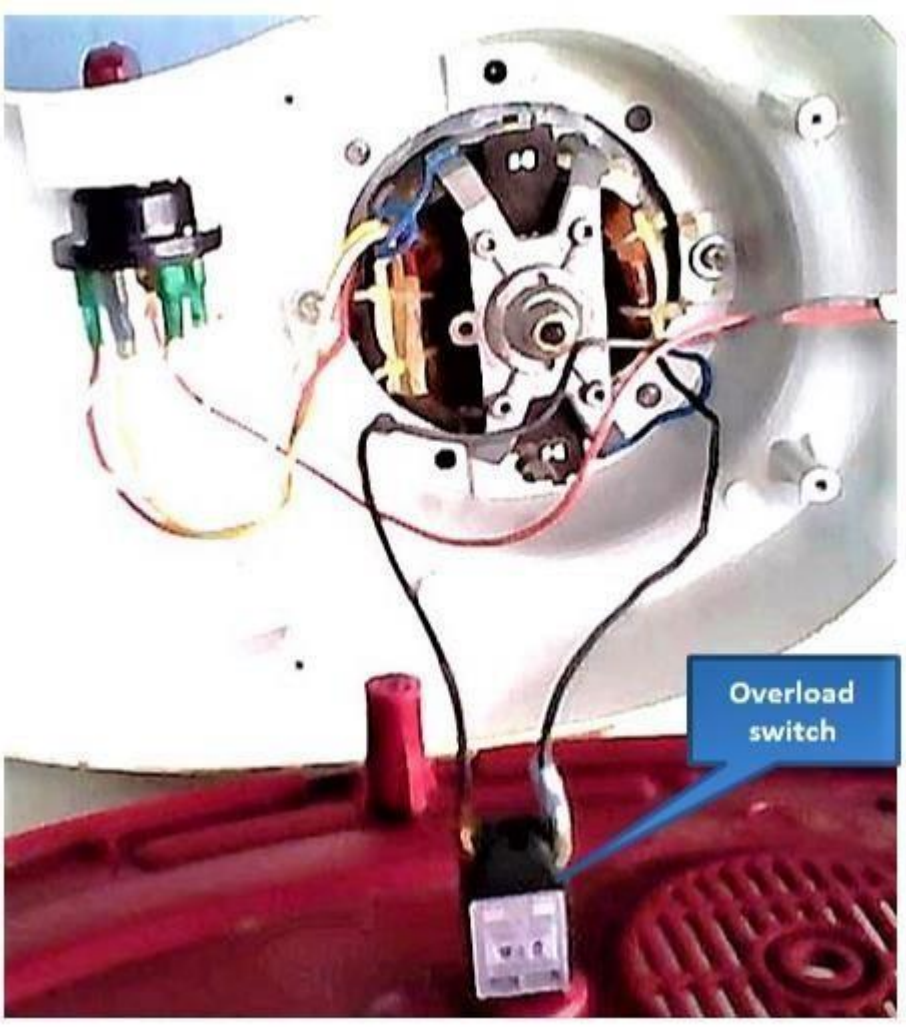


Fig. 3.53 Disconnecting the overload switch

3. Use a continuity tester to test the overload switch as shown in Fig.3.54.

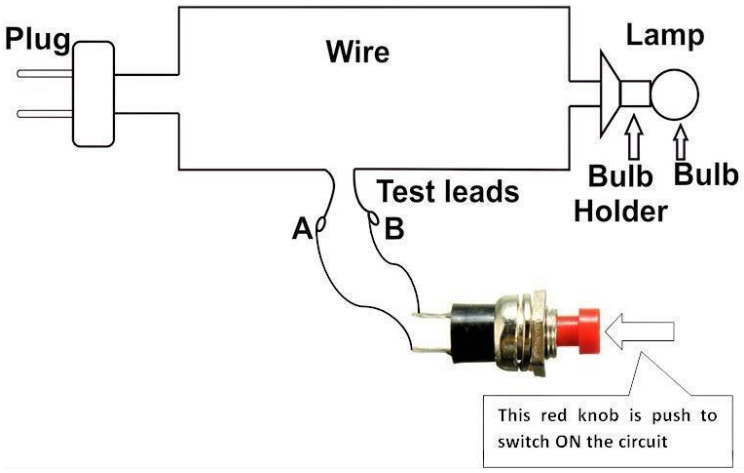


Fig. 3.54

4. Replace if defective.

Fig. 3.55 Over load switch

5. Reassemble the housing

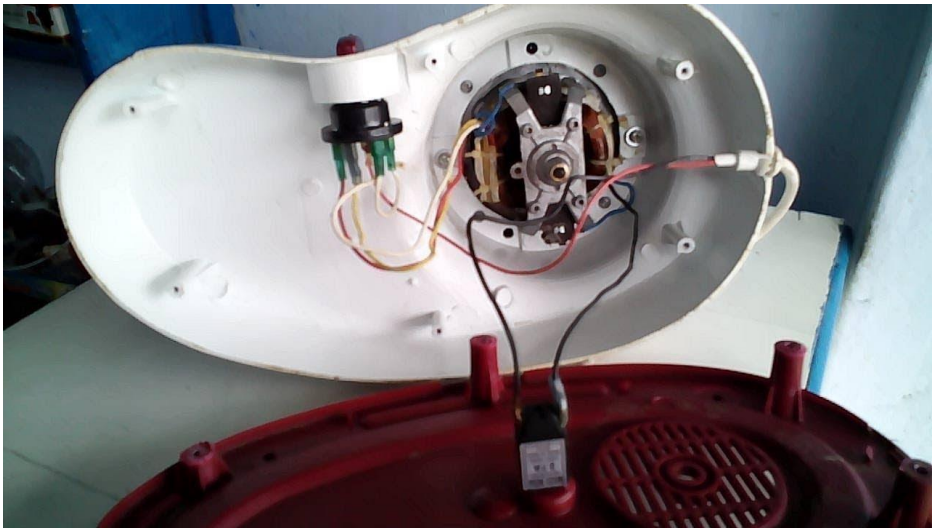


Fig. 3.56 Reassembling the motor housing

Practical activity 3: Replacing a motor

The mixer/grinder/juicer runs on a single-phase induction motor. The following figure lists the steps of replacing the motor:

1. Remove the housing and access the motor as shown in Fig.3.57.

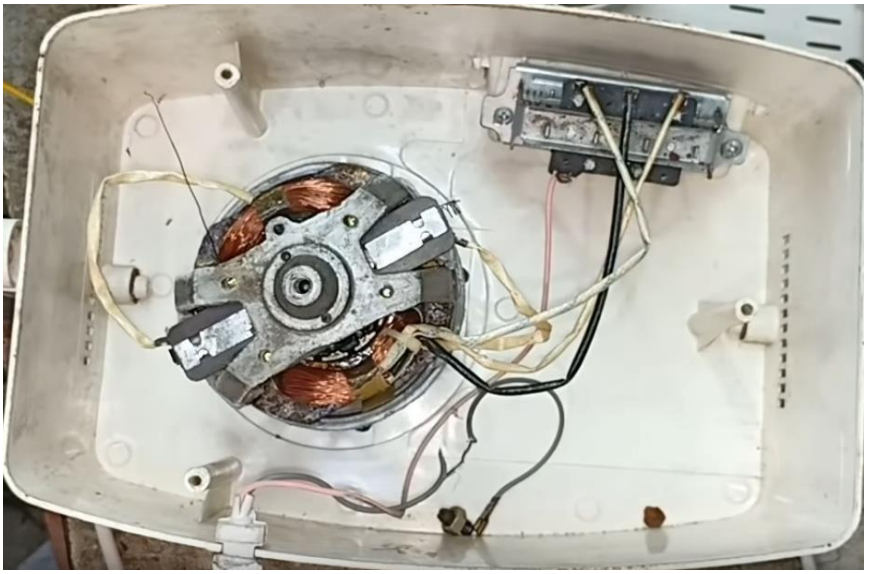


Fig. 3.57

2. Disconnect the fuse from the motor as shown in Fig.3.58.

Fig. 3.58

3. Use a continuity tester to test the motor winding as shown in Fig.3.59.

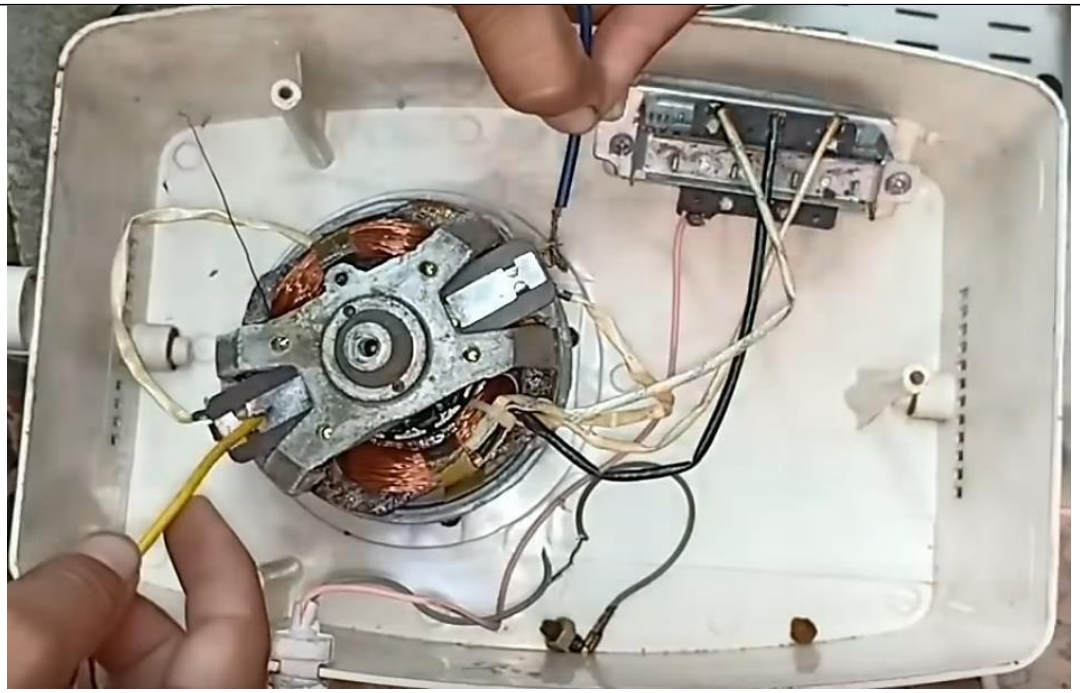


Fig. 3.59

4. Replace the motor, if it is defective.

Fig. 3.60: Universal motor

5. Reassemble the housing as shown in Fig.3.61.

Fig. 3.61

Troubleshooting juicer problems

Some frequently occurring juicer problems and their solutions are discussed below:

Repairing/Servicing the Juicer

The figure 3.62 lists the steps of repairing a juicer.

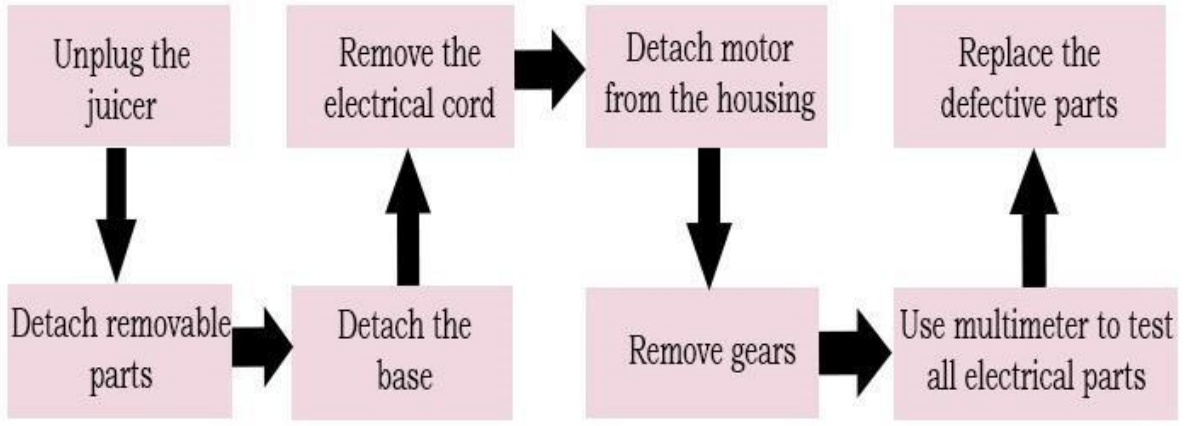


Fig. 3.62 Repairing a juicer

Servicing the juicer drive system

The following figure lists the steps of servicing the juicer drive system:

1. Dissemble the juicer
2. Access the gear assembly
3. Detach the gears and spindle
4. Clean the gears
5. Check for damaged parts
6. Replace damaged parts
7. Apply silicon lubricant to the gears
8. Reassemble the unit

Fig. 3.63 Servicing the juicer drive system

Practical Activity 8

Blade of a jar is jammed and is not turning. Perform the steps required to correct the problem.

Material required

Mixer, screwdriver, line tester, wire stripper, combination plier, lubricating oil.

Procedure

Follow the following steps to repair the jar.

Step1: Unlock the screw of an electric mixer to remove the mixer housing as shown in Fig.3.64.

Fig.3.64

Step2: Remove the motor as shown in Fig.3.65.

Fig. 3.65

Step3: Lubricate the shaft of armature using oil as shown in Fig.3.66.

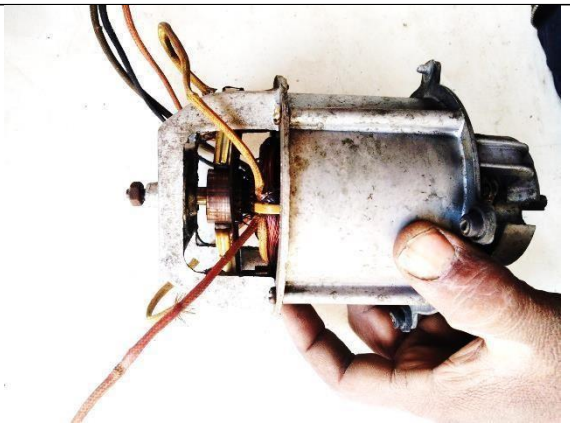


Fig. 3.66(a)

Fig.3.66(b)

Step3: Keep it for some time, and then using hand or plier twist the motor shaft.

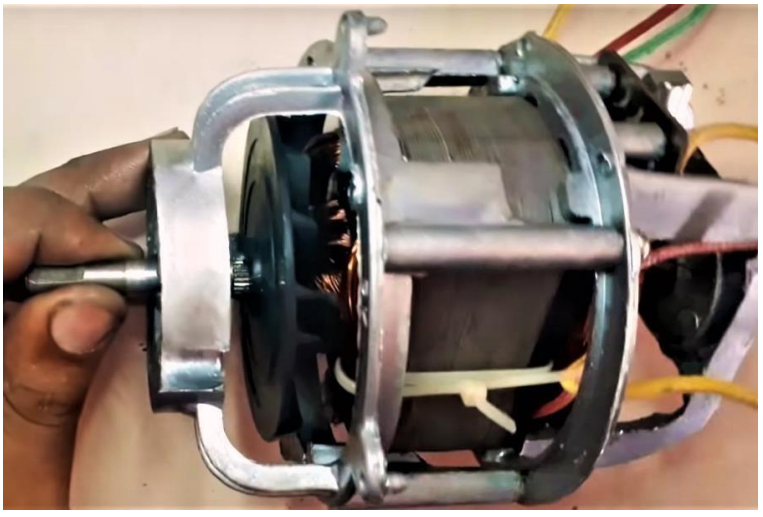


Fig. 3.67: Rotating the shaft of motor using hand

Step5: Reassemble the motor in the mixer housing as shown in Fig.3.68.

Fig. 3.68: Reassembling of motor

Practical Activity 9

Disassembling the mixer, identification of different components of mixer.

Material required

Mixer, screwdriver, combination plier.

Procedure

Follow the following steps to identify different components

Step1: Unlock the screw of an electric mixer to remove the mixer housing.

Fig. 3.69 Unlocking the housing of motor

Step2: Remove the overload switch, rotatory switch, motor, indicator from the motor housing.

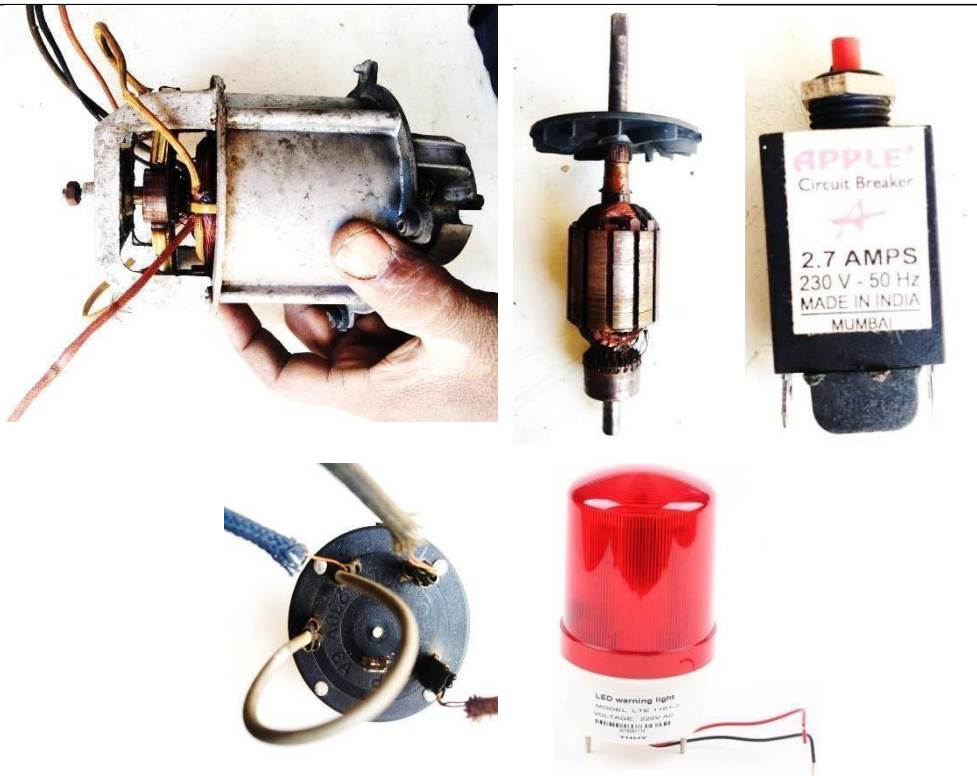


Fig. 3.70 Different parts of in the motor housing Step3: Identify and study the overload switch it has two terminals as shown in the figure 3.71.

Fig. 3.71 Overload switch

Step3: Identify and study the rotatory switch it has five terminals as shown in the figure 3.72.

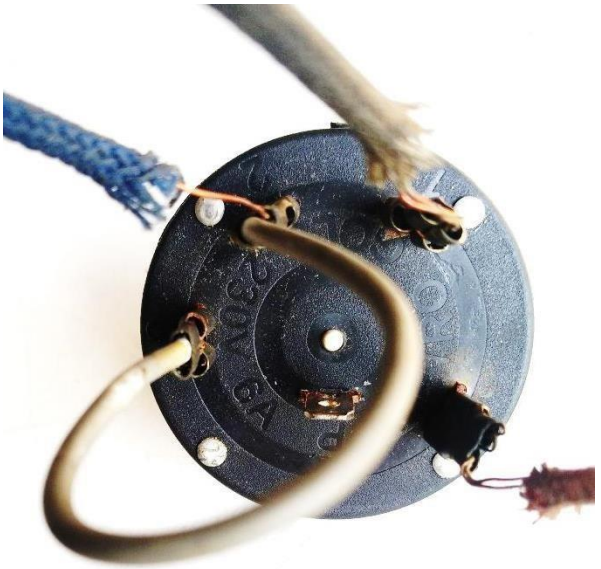


Fig. 3.72 Rotatory switch

Step5: Identify and study the motor it has two type of winding i.e. armature winding and field winding as shown in the figure 3.73.

Fig. 3.73 (a) Armature winding (b) Stator winding

Step6: Field winding has two terminals at one side and four terminals at other side as shown in figure 3.74.

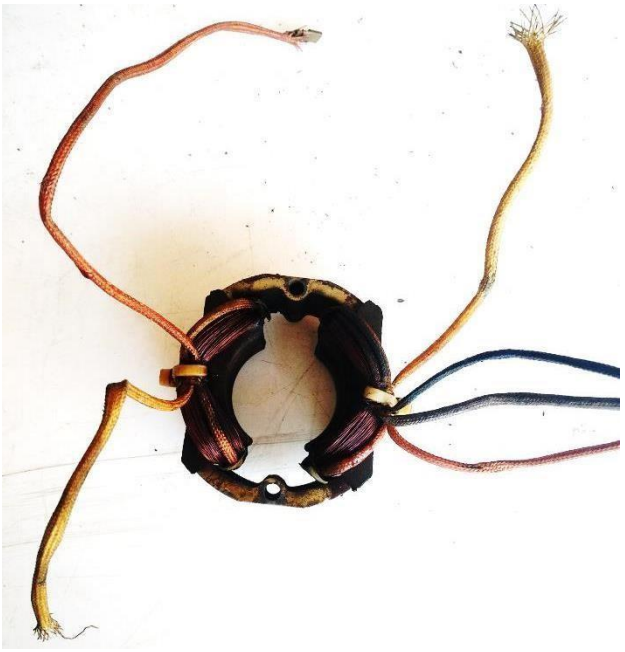


Fig. 3.74 Two and four terminals of the stator winding

Step3: Identify and study the indicator it has two terminals as shown in the figure 3.75.

Fig. 3.75 Two terminals of indicator

Practical Activity 10

Repair dysfunctional motor of a mixer grinder.

Material required

Motor, mixer, screwdriver, tester, combinational plier.

Procedure

Follow the following steps to perform the repairing of dysfunctional motor.

Step1: Unlock the screw of an electric mixer to remove the mixer housing as shown in Fig.3.76.

Fig. 3.76

Step2: Remove the motor as shown in Fig. 3.77.

Fig. 3.77

Step3: Check whether the motor winding is short or has work problem, using continuity testing lamp. While checking the motor observe two points
1. Bulb of test lamp is glowing brighter or at full intensity that means that the motor winding is short.
2. Bulb of test lamp is not glowing or OFF that means that the motor winding is open.
Step4: Identify the different speed control terminals of the motor as shown in Fig.3.78.

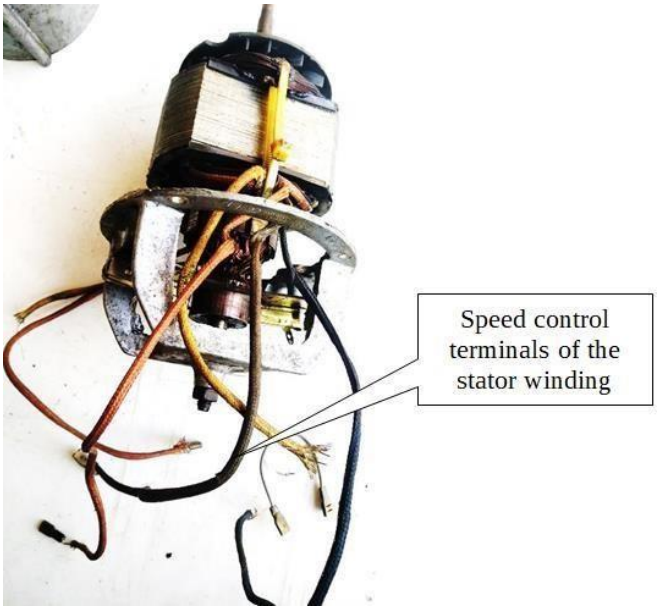


Fig. 3.78 Identification of terminals of the motor

Step5: If mixer series motor is used which is having field winding and armature winding. Speed control field winding as shown in the figure 3.79.

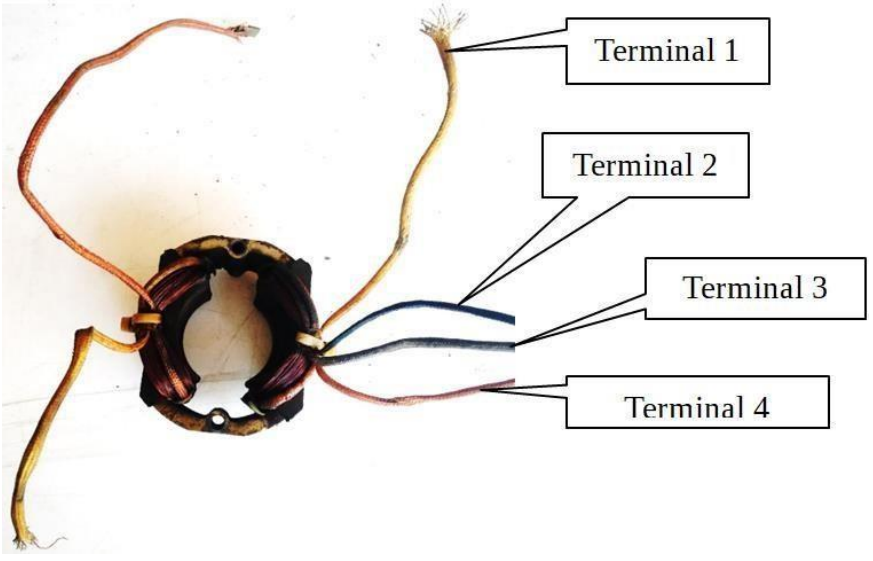


Fig. 3.79 Speed control terminals of the stator winding

Step6: These winding terminals are connected to the rotatory switch point i.e. terminal 1 of the speed control winding is connected to point 0 of rotatory switch, in the same way terminal 2 and terminal 3 of stator winding are connected to the point 1 and point 2 of the rotatory switch as shown in Fig.3.80.

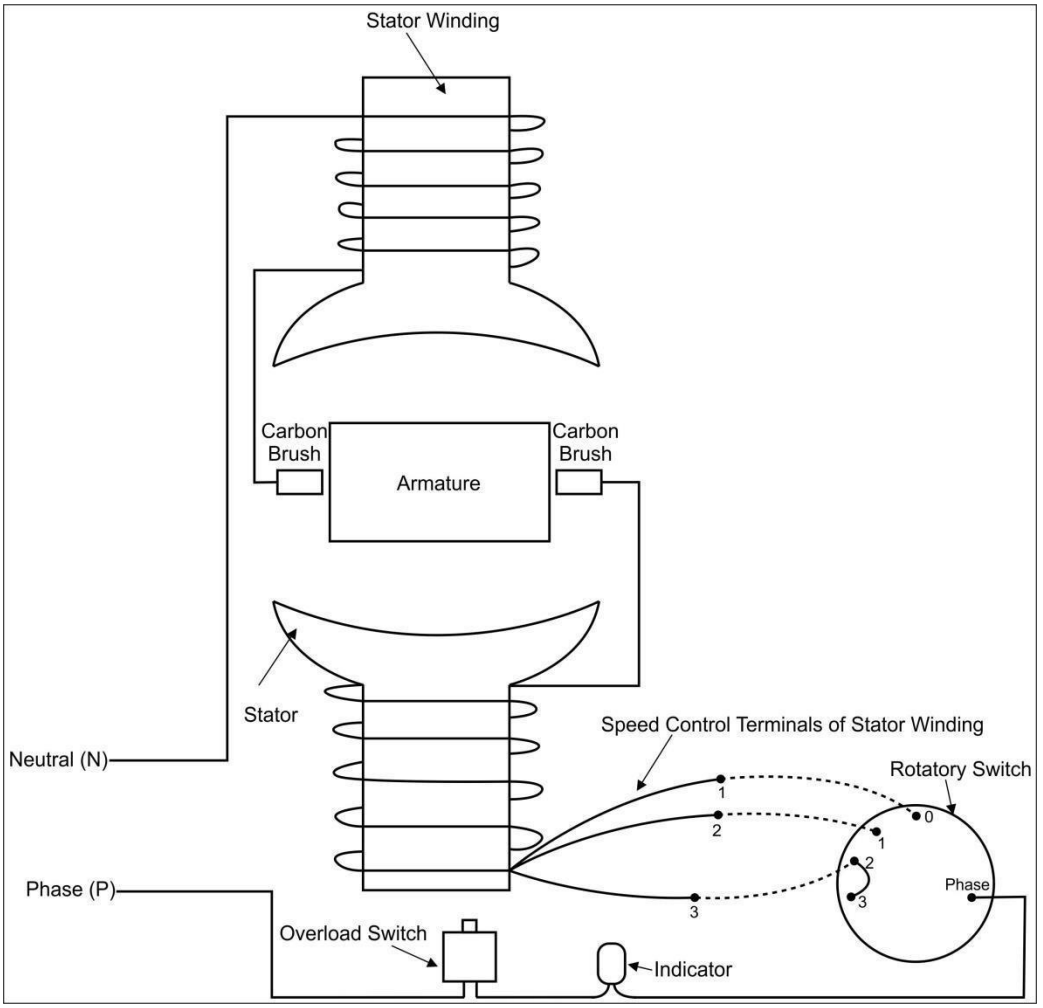


Fig. 3.80 Circuit diagram of mixer

Step 7: Connect the phase terminal of the rotatory switch to the phase of the input supply as shown in Fig.3.81.

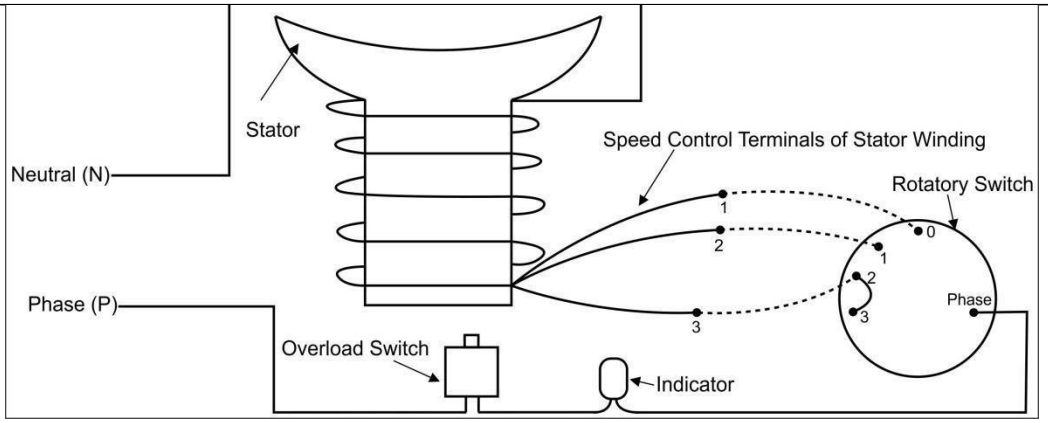


Fig. 3.81

Practical Activity 5

Assemble different parts of mixer using the circuit diagram.

Material required

Circuit diagram, different parts of mixer, power supply.

Procedure

Following steps illustrate the steps to connect different parts of mixer as shown in figure 3.82.

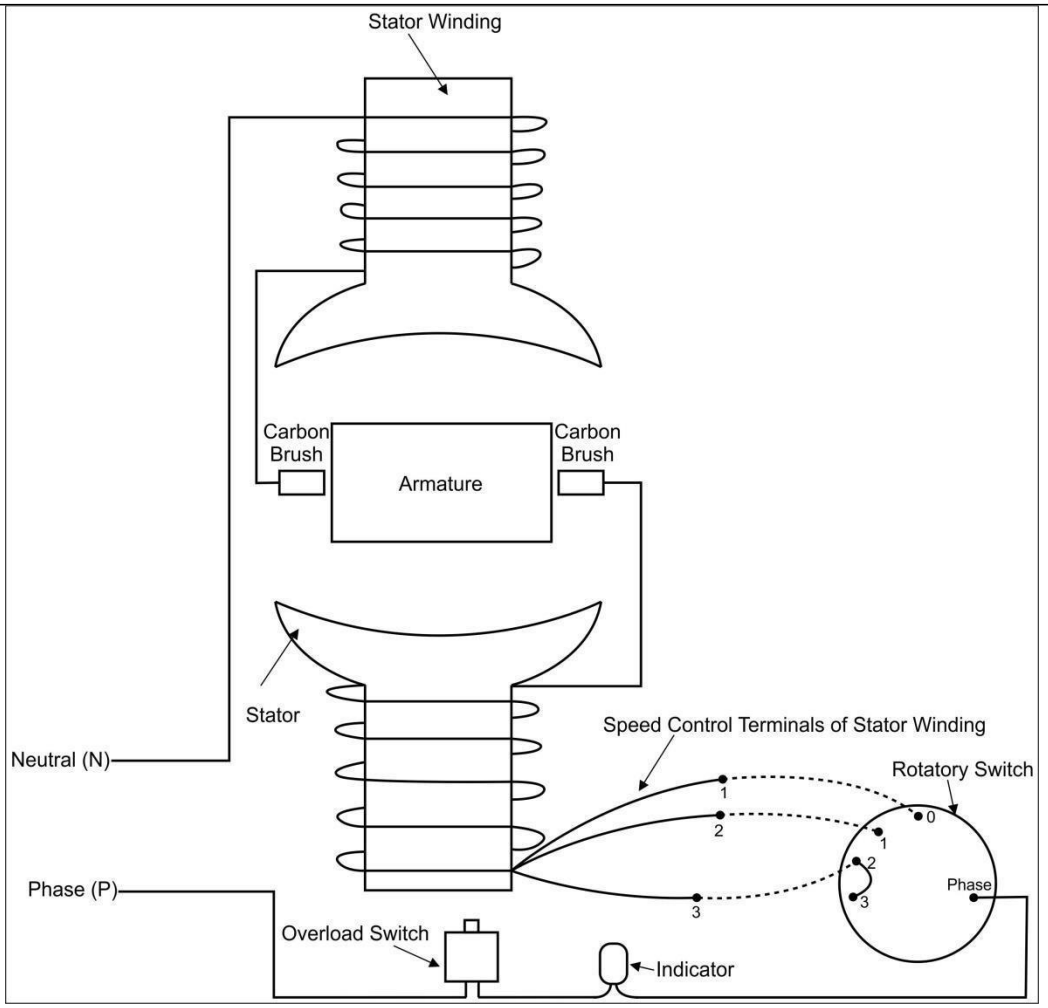


Fig. 3.82 Circuit diagram of mixer

Step1: Connect the phase of the power supply to one end of overload switch.
Step2: Connect other end of overload switch to one end of indicator lamp.
Step3: Connect the other end of indicator lamp to the phase point of the rotatory switch.
Step4: Connect the speed control terminals of the stator winding to the points of the rotatory switch.
Step5: Connect terminal 1 of speed control winding to point 0 of rotatory switch.
Step6: Connect terminal 2 of speed control winding to point 1 of rotatory switch.
Step7: Short the point 2 and 3 of rotatory switch using a wire.
Step8: Connect terminal 3 of speed control winding to point 2 of rotatory switch.
Step9: Connect the stator and armature winding using carbon brush as shown in figure 3.82.
Step 10: As we know in the construction of motor, it has stator winding in two parts. Between stator winding armature is placed.

Step11: One part of stator is connected to the rotatory switch which we have discussed in the previous steps. Now connect other part of stator to the neutral of the power supply as shown in the figure 3.82.

CHECK YOUR PROGRESS

A.Choose the correct option from the following.

1. Which of the following is not the type of mixer?
   a) Stand mixer
   b) Dough mixer
   c) Spiral mixer
   d) Planet mixer
2. Which part protects the mixer from overload?
   a) Auto Switch
   b) Automatic Protector
   c) Overload Switch
   d) Auto Overload Protector
3. OLP stands for:
   a) Automatic over protector
   b) Over load protector
   c) Over level protection
   d) Over line protection
4. Which of the following are the types of juicer?
   a) Centrifugal juicer
   b) Masticating juicer
   c) Citrus juicer or Reamer
   d) All of the above
5. Which of the following is not the part of juicer?
   a) Plunger
   b) Drum lid
   c) Hopper
   d) Straight Wiper
6. Which of the following is to control the speed of mixer.
   a) Overload switch
   b) Rotatory switch
   c) Power switch
   d) Control switch

7. Which of the following is not the type of mixer
    a) Planetary mixer
    b) Stand mixer
    c) Spiral mixer
    d) Pipe mixer

B. Fill in the blanks with correct word

1. Rotten egg smell in the water is due to …….. or mineral content in water.
2. In case of more load ……. switch will get activate.
3. To make hole on the wall …… machine is used.
4. Motor convert the electrical energy into …… energy.

C. State whether the statement given below are true or false

1. If the jar of a mixer/grinder is leaking from the bottom, it can be due to worn out blade shaft.
2. A defective motor leads to an excessive vibration in the mixer/grinder.
3. To remove the discoloration of plastic parts of a juicer, clean them with bleach.
4. If the juicer is placed on an uneven surface, it will not start.
5. Rotatory switch regulates the speed of the mixer motor.
6. Armature is a part of motor.
7. Stator is a dynamic part of motor.

D. Short answer type question

1. What are the types of mixer?
2. Name the parts of mixer.
3. Write the steps of assembling and disassembling of motor.
4. Write down the steps of using juicer.
5. Write down the steps to clean the juicer.
6. List the parts of motor. Also specify the type of motor used in mixer.

Unit 3

REPAIR AND MAINTENANCE OF MICROWAVE OVEN

Introduction

In the past, cooking food was a tough task for human beings. At that time, sources of heat were limited, such as wood, coal etc. With the introduction of new technologies, cooking food became easier and fast. Today, we can cook easily by using a microwave oven. For heating food products, we just push a button. In this chapter, we are going to understand the need, operation and troubleshooting of a microwave oven.

Microwave as a source of energy

These days, high-tech devices are integral part of our daily life. One of the hi-tech cooking device is the microwave oven. Microwave energy is a natural phenomenon and exists ever since the beginning of the universe. Today microwave oven utilises this form of energy. It convert the electrical energy into heat. In microwave oven, a part known as magnetron is used which utilizes the electrical energy to produce microwaves into the cooking cavity of the oven. Microwaves have large amount of heat carrying properties. This heat will evenly cook the food.

Microwave Oven Composition

In general, microwave oven consist of following sections:

a. Heating room
b. Microwave source
c. Control panel

a. Heating room: It is composed of cavity combination, turntable system and fire door.

b. Microwave source: It is mainly composed of magnetron, transformer, high-voltage capacitor and high-voltage diode.

c. Control panel: It is composed of timer, power selector, and different operating buttons.

External parts of microwave oven as shown in Fig.3.1.

Fig.4.1 External parts of microwave oven

Major internal parts of microwave oven are as follows:

1. Magnetron
2. Thermostat
3. Input power supply
4. High voltage transformer
5. High voltage capacitor
6. Relay
7. Printed circuit board
8. Fuse
9. Colling fan

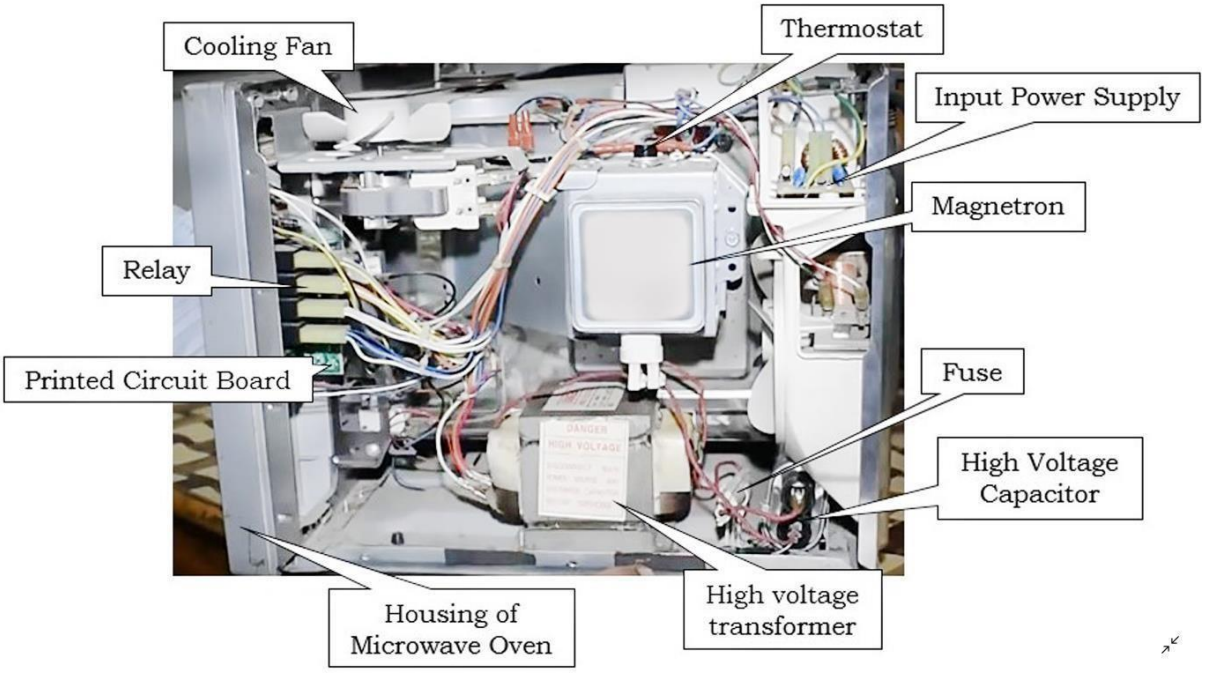


Fig.4.2 Internal parts of microwave oven

Assignment

1. List out the areas where microwave are used.
2. What is the frequency range of microwave?
3. Search on the internet, what is reason that microwave are able to heat up or cook the food.

Microwave oven operating principle

Microwave oven uses microwave for cooking food. In microwave oven, magnetron act as a heart of microwave oven. It is the source of microwaves. Magnetron supplies constant and reliable energy in the form of microwave to the oven. In order to monitor and control the temperature, a control system is used. This control system regulates the multi-voltage regulation circuit. Microwave that is produced by the magnetron is guided by the waveguide towards the cooking chamber. In the cooking chamber, these microwaves are absorbed by the food. After absorbing the microwaves, the food gets evenly cooked. Microwave oven operating principle block-diagram is as follows:

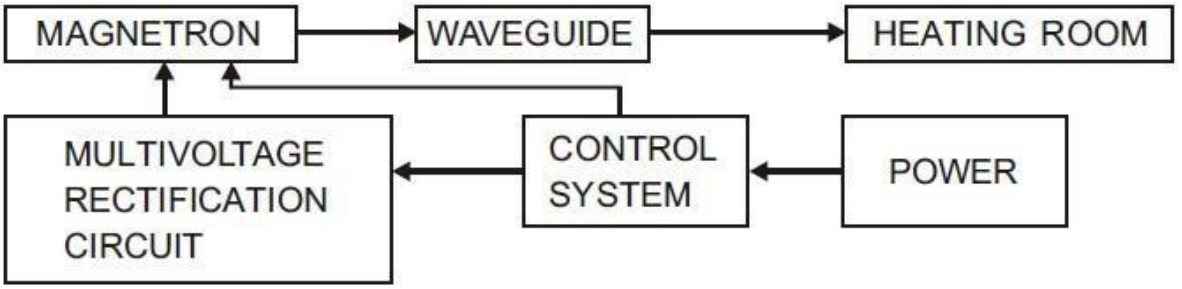


Fig.4.3 Block diagram of microwave oven operation

Working of microwave oven

The 230 V AC input power is applied through the power cord. This power will get into the power circuit board, which has number of components. Pre-filter is used to filter the noise elements present in the supply. Power board also has a fuse for overcurrent protection. From there, the power will pass to the printed circuit board via the thermostat. Thermostat will protect the oven from excessive heat development. Thermostat will turn OFF the oven, in case of excessive heat in the cooking chamber cavity. In printed circuit board, relays are used which prevent the flow of excessive current. From these relays power is transferred to the high voltage transformer. High voltage transformer has one primary winding but two secondary windings. One secondary winding is use to step down the applied 230V, while the other secondary winding is used to step up the applied 230V. Stepdown secondary will reduce the applied voltage to 3.3V. Step up voltage will increase to 2000 V. High voltage capacitor is charged by the transformer. This will form approximately 4000V (addition of 2000V of transformer and 2000V of capacitor). This 4000V AC is converted into DC using high voltage diode. Magnetron has cathode and anode. At the

cathode 4000V DC and 3.3V DC at the anode is applied. After taking large amount of applied voltage magnetron, starts working.

General information of microwave oven.

Assignment

1. What is the specific role of transformer in the microwave?
2. What is the role of magnetron?

Points to remember: Microwave ovens work on very high voltage and current. Technician should be cautious while installing and repairing these parts, as these parts can result in an electric shock. Following parts of microwave oven operates on high voltage and current:

a. High voltage capacitor
b. High Voltage transformer
c. Magnetron
d. High voltage rectifier assembly
e. High voltage wires

Practical activity 1

Microwave oven parts assembling and disassembling process.

Material required

Multipurpose screwdriver, microwave oven.

Procedure

Follow the following steps to assemble and disassemble the housing of microwave oven.

a) Unscrew fixed screw of housing as shown in figure 4.4.

Fig. 4.4

b) Push the housing backward to detach it as shown in figure 4.5.

Fig.4.5 Slide to remove the housing

c) Installation is reverse to the above illustration. Make housing turn-up edge slip forward along cavity combination. Pay attention to fit both sides of the housing, raise turn-up edge to cavity combination.

Practical activity 2

Testing the thermostat of the microwave oven

Material required

Multipurpose screwdriver, continuity tester, microwave oven.

Procedure

Follow the following steps to test the thermostat of microwave oven.

a) Detach and unscrew the housing of microwave oven as shown in figure 4.6.

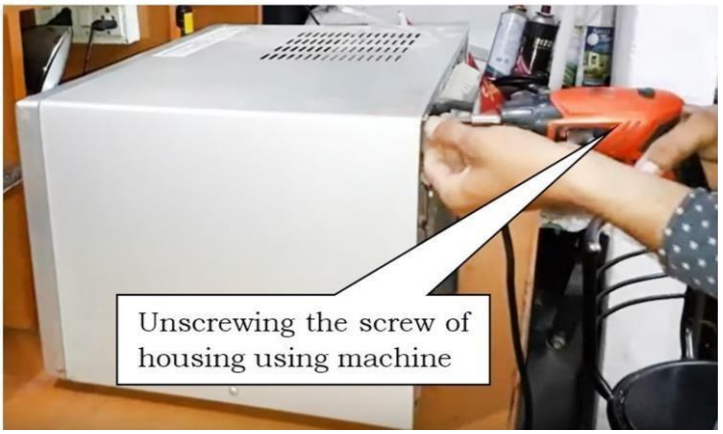


Fig.4.6

b) Detach the thermostat from the magnetron as shown in figure 4.7.

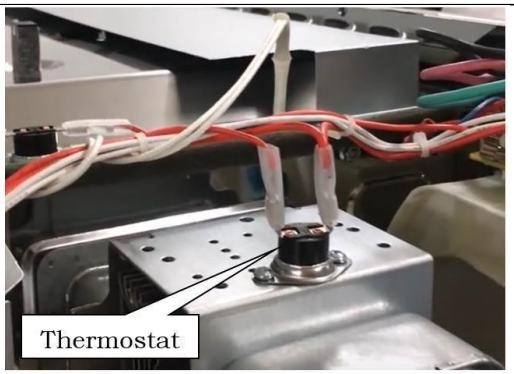


Fig.4.7 Thermostat on magnetron

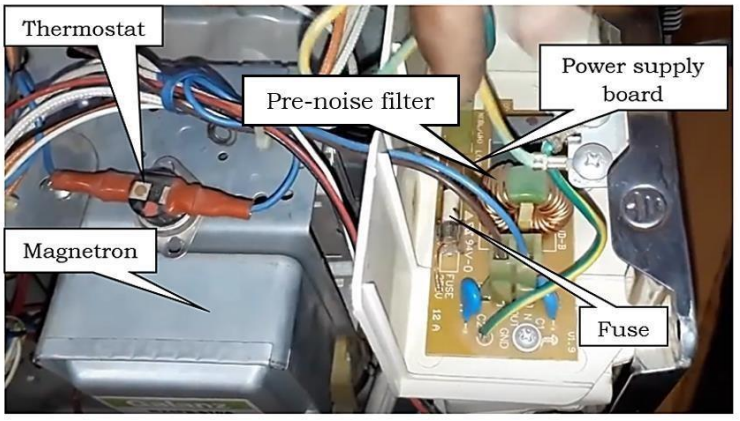


Fig.4.8 Power supply board and magnetron having thermostat

c) Test the thermostat using continuity tester. If the light is glowing, that means that the relay is working properly as shown in Fig. 4.9.

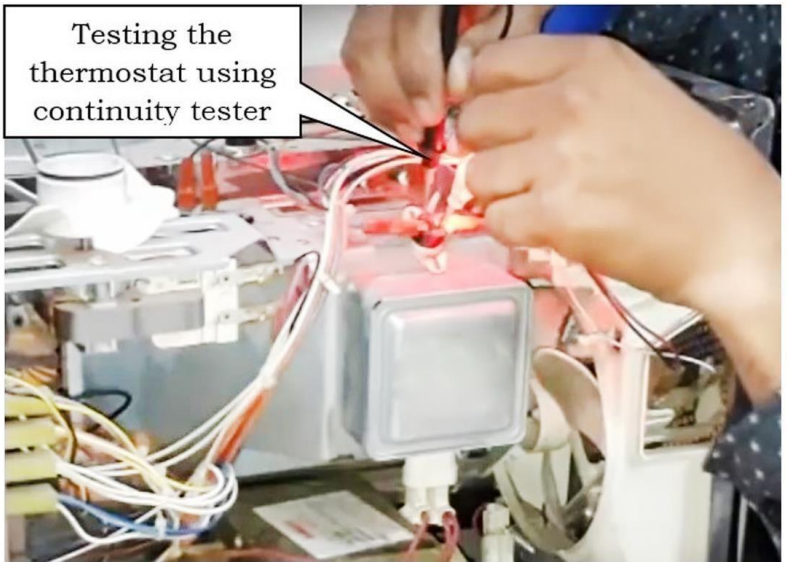


Fig.4.9 Testing the thermostat using continuity tester

Practical activity 3

Assembling and disassembling of relay in the printed circuit board (PCB).

Material required

Multipurpose screwdriver, continuity tester, microwave oven.

Procedure

Follow the following steps to test the relay of microwave oven.

a) Detach the housing of the microwave oven as shown in figure 4.10.

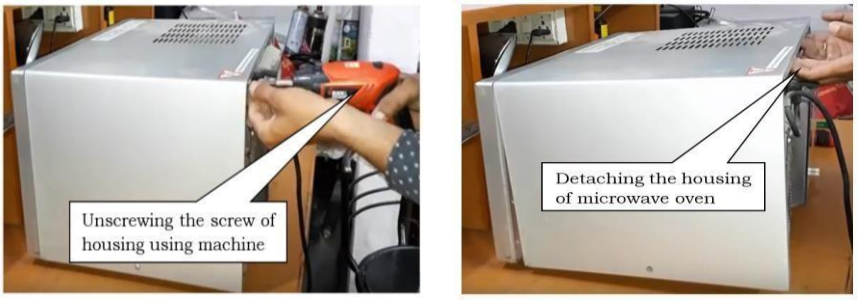


Fig.4.10

b) Pull relay plug out of PCB as shown in figure 4.11.

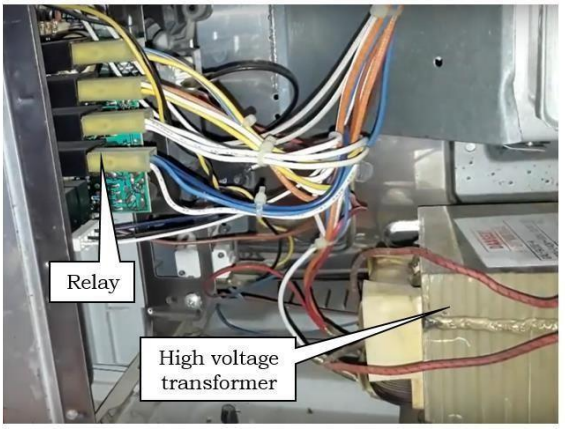


Fig.4.11 Printed circuit board having relay

c) Test the continuity of the relays using continuity tester.

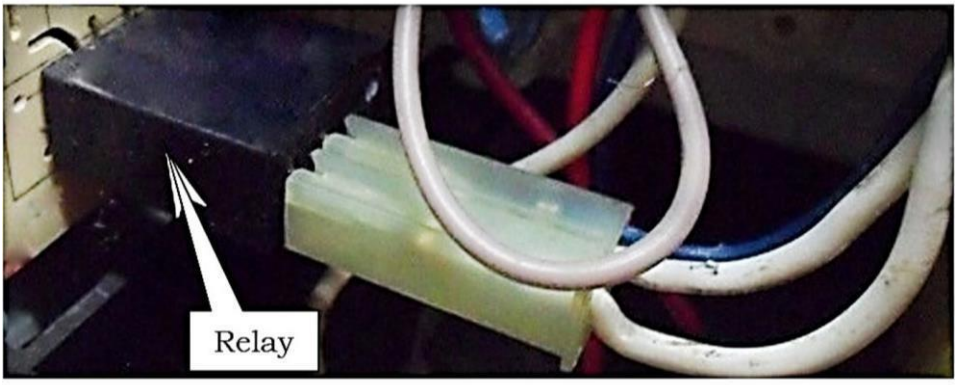


Fig.4.12 Relay mounted on the PCB

Practical activity 4

Assembling and disassembling of transformer.

Material required

Multipurpose screwdriver, continuity tester, microwave oven, simple screwdriver.

Procedure

Follow the following steps to disassemble and test the relay of microwave oven.

a) Detach the housing as shown in figure 4.13.

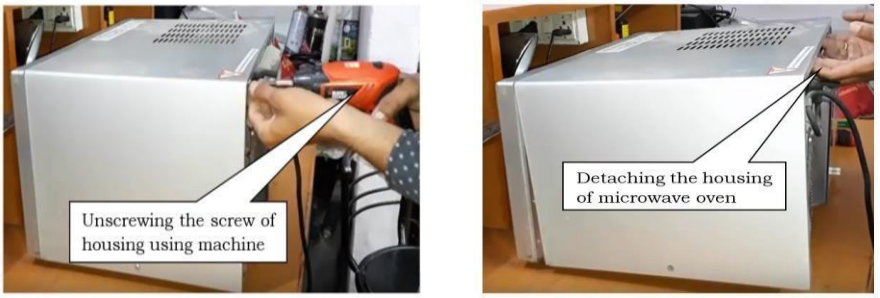


Fig.4.13

b) Unscrew four screws fixed in baseboard and take them out together with the transformer.

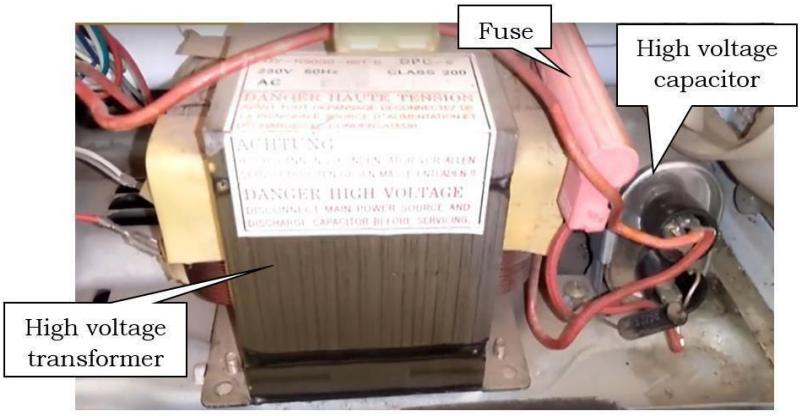


Fig.4.14 Unscrewing the transformer

c) Pull out the wiring plug of the primary, secondary and high voltage filament of transformer as shown in figure 4.15.

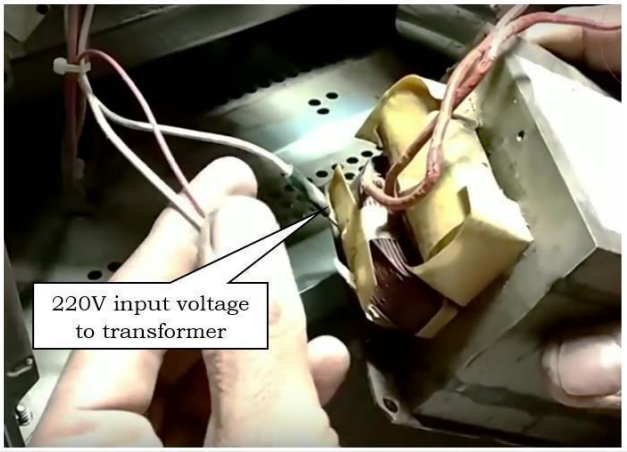


Fig.4.15 Terminals of transformer

d) Check the electromagnetic field on the transformer using screwdriver as shown in figure 4.16.

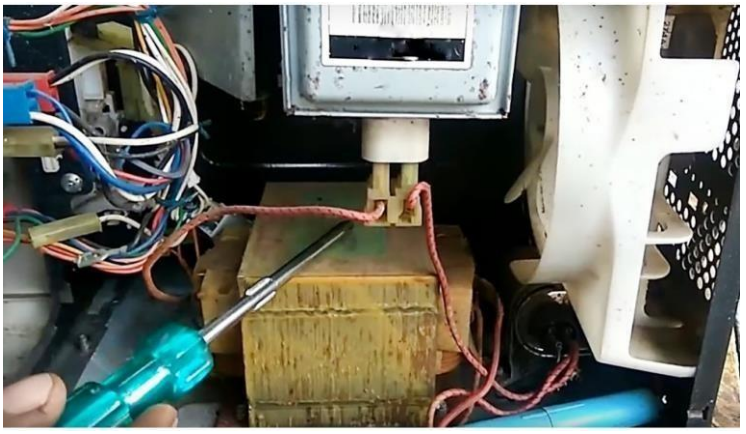


Fig.4.16 Checking the electromagnetic field of transformer using transformer

Practical activity 5

Assembling and disassembling of magnetron and testing of magnetron

Material required

Multipurpose screwdriver, continuity tester, microwave oven, simple screwdriver.

Procedure

Follow the following steps to disassemble and test the magnetron of microwave oven.

a) Detach the housing of microwave oven as shown in figure 4.17.

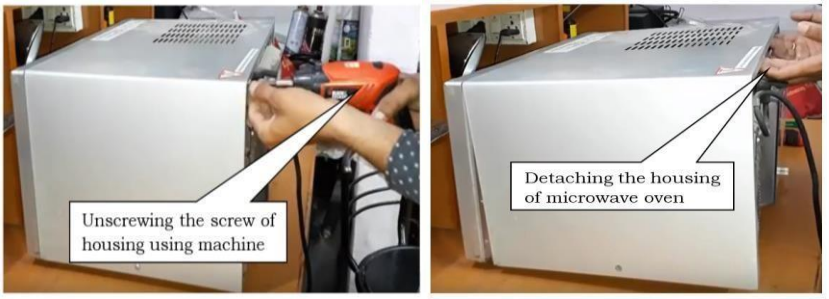


Fig.4.17

b) Pull out the wiring plug of the magnetron as shown in Fig.4.18.

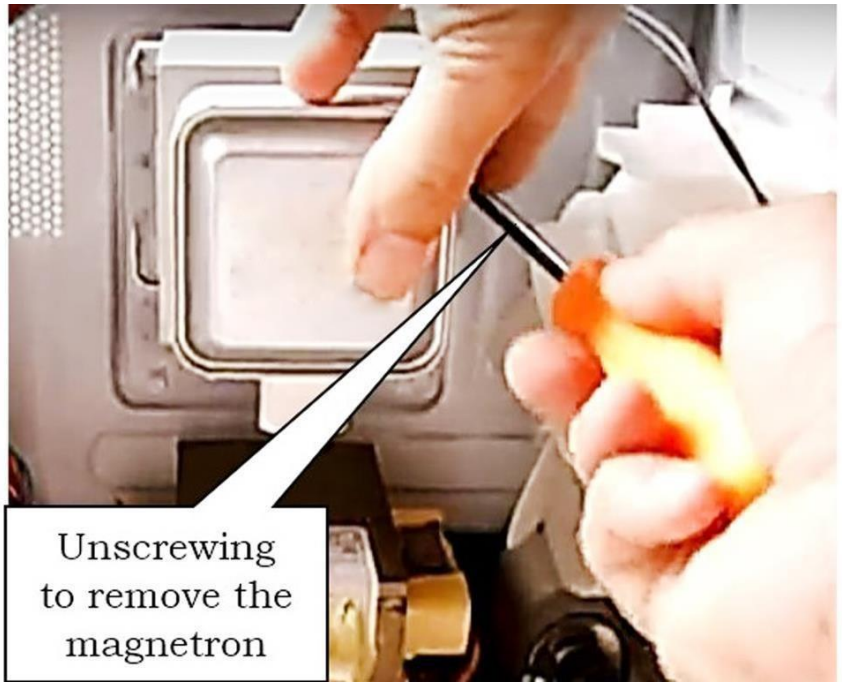


Fig.4.18

c) Disassemble the magnetron from the housing as shown in figure 4.19.

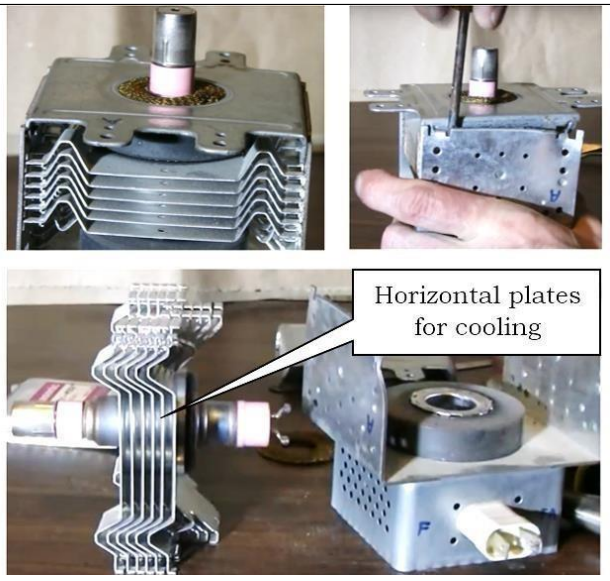


Fig.4.19 Dismantle magnetron housing

d) Check the magnetron for any burn or damage in the anode and cathode as shown in figure 4.20 and 4.21. Use continuity tester to test the anode and cathode terminal of the magnetron. If there is continuity between the anode and cathode that defines magnetron is working properly.

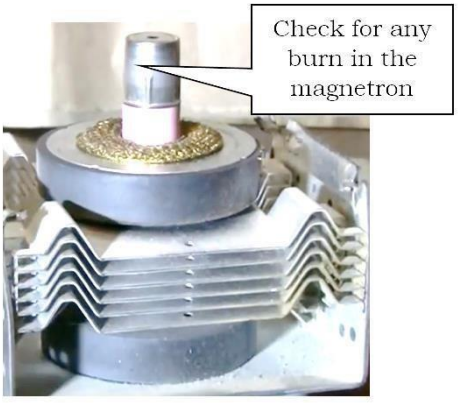


Fig.4.20

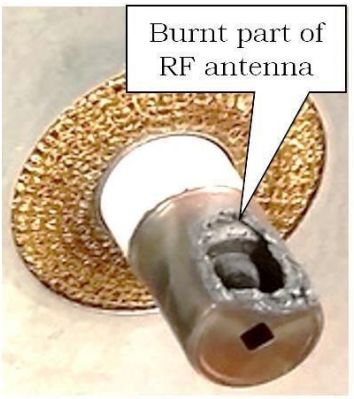


Fig.4.21

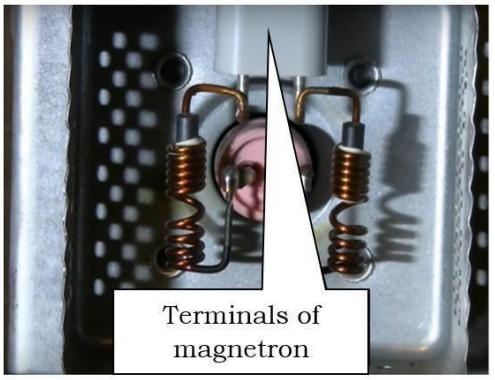


Fig.4.22 Anode and cathode of magnetron

e) Check any breakage or crack in the magnet of the magnetron as shown in figure 4.23.

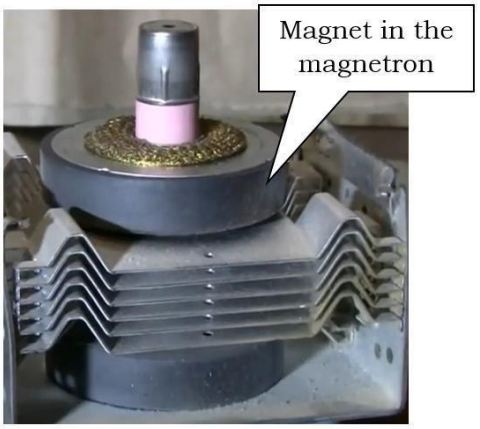


Fig.4.23 Magnet in magnetron

Practical activity 6

Testing of the fuse of microwave oven.
Material required

Multipurpose screwdriver, microwave oven, simple screwdriver.
Procedure

Follow the following steps to disassemble and test the fuse of microwave oven.

a) Detach the housing of microwave oven as shown in figure 4.24.

Fig.4.24

b) Pull out fuse present between the transformer and the high voltage capacitor as shown in figure 4.25. Test it using continuity tester, if it is found fused then replace the fuse.

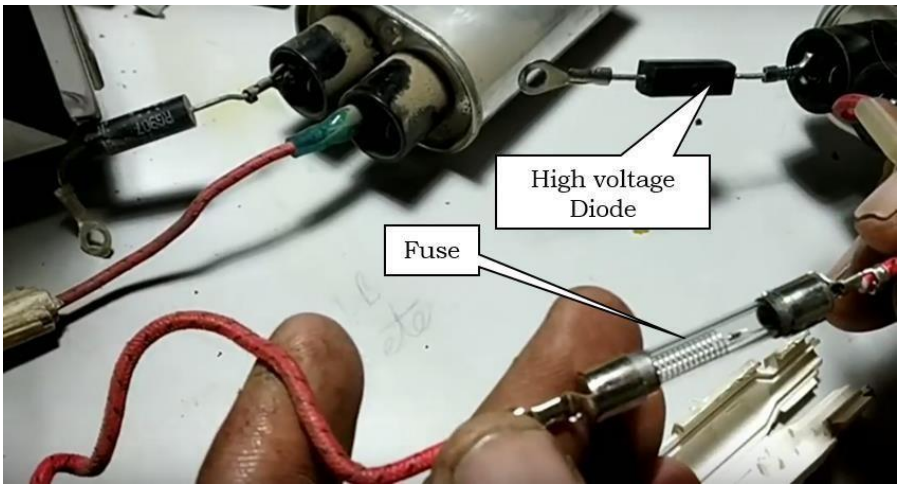


Fig.4.25 Check the fuse of microwave oven

Practical activity 7

Test the high voltage capacitor.

Material required

Multipurpose screwdriver, continuity tester, microwave oven, simple screwdriver, nose plier.

Procedure

Follow the following steps to disassemble and test the high voltage capacitor of microwave oven.

a) Remove the housing of microwave oven. High voltage capacitor with high rating diode is shown in Fig. 4.26.

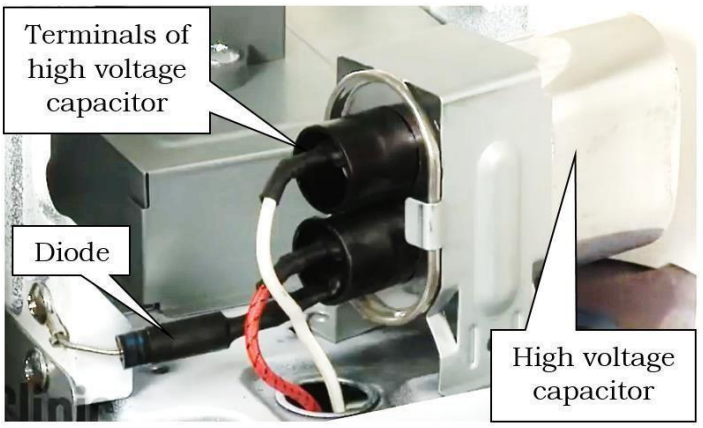


Fig.4.26 High voltage capacitor and diode

b) Discharge the capacitor using nose plier. Carefully short the terminals of capacitor using nose pliers as shown in Figure 4.27.

Caution: Do not touch any metallic part while discharging the capacitor.

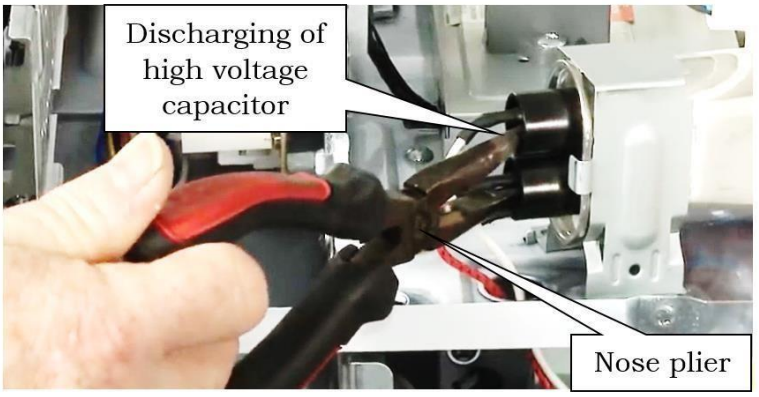


Fig.4.27 Discharging of capacitor using nose plier

c) After discharging the capacitor, remove the wires connected to the capacitor terminals using nose pliers as shown in figure 4.28. Check the capacitor using continuity tester.

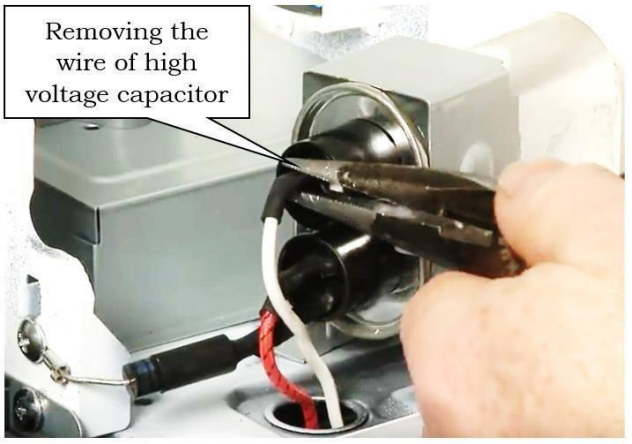


Fig.4.28 Removing the wire using nose plier

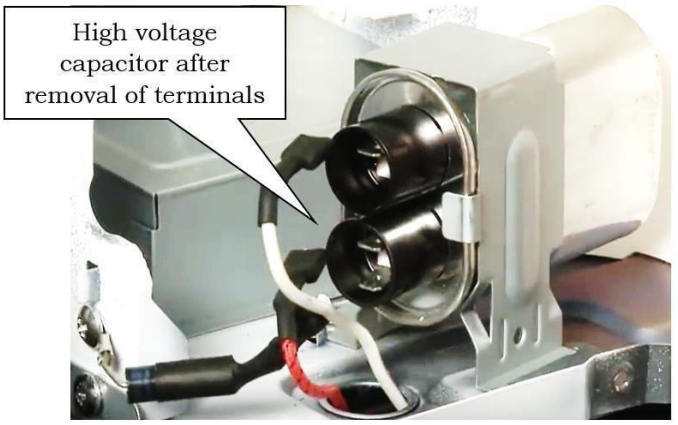


Fig.4.29

d) If the capacitor is found to be shorted, replace the capacitor. Remove the bracket of the capacitor mounted on the body of microwave oven as shown in Fig. 4.30.

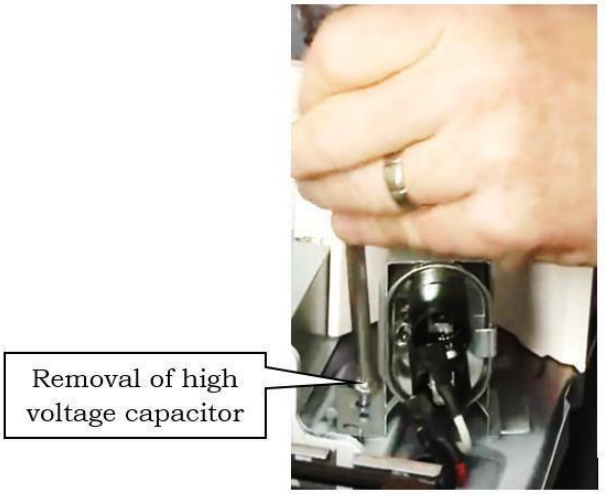


Fig.4.30

e) Replace the capacitor with the same parameters, like capacitance value, voltage rating, etc.

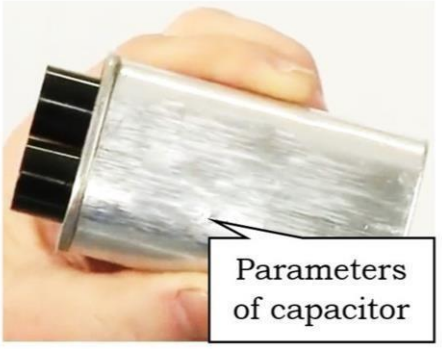


Fig.4.31 Capacitor parameters printed on the body of high voltage capacitor

f) Mount the capacitor on the body of microwave oven, connect the wire to the terminals of new capacitor as shown in Fig. 4.32.

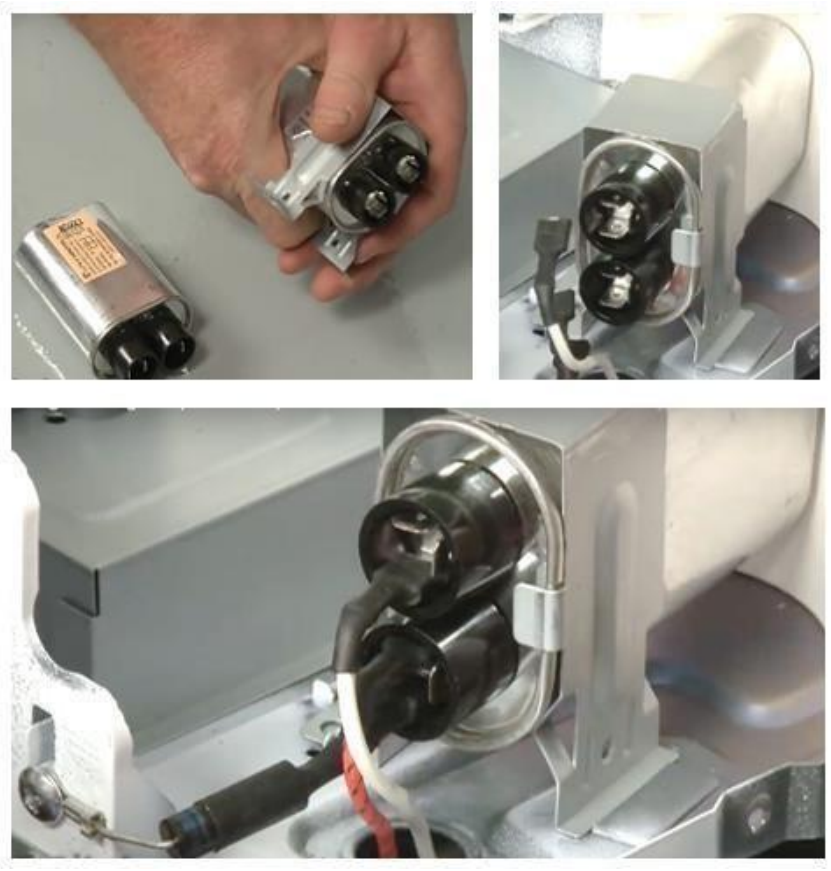


Fig.4.32 Replacing the high voltage capacitor

Assignment

1. List out the hand tools required in the repairing of microwave oven.
2. Search on the internet about the rating of high voltage capacitor used in the microwave oven.

Assignment

Identify and name the following picture.	
 Fig.4.33	.....

 Fig.4.34	.....
 Fig.4.35	.....
 Fig.4.36	.....

CHECK YOUR PROGRESS

A. Choose the correct option from the following

1. Which of the following parts produce microwave in a microwave oven?
   a) Magnetron
   b) Transformer
   c) High voltage capacitor
   d) Diode
2. Which of the following parts respond when there is increase in heat?
   a) Pre-filter
   b) Thermostat
   c) High voltage capacitor
   d) High voltage transformer
3. What will be the procedure to discharge the pre-stored charge of high voltage capacitor?

a) By making the terminals of capacitor open
b) By making the terminals capacitor short
c) By leaving capacitor for few seconds
d) By connecting a diode the capacitor

4. Which of the following parts use permanent magnet?
a) High voltage transformer
b) Magnetron
c) High voltage capacitor
d) Relay

5. Which of the following devices is used for overcurrent protection?
a) Diode
b) High voltage capacitor
c) High voltage transformer
d) Fuse

6. Which of the following tools is used to discharge high voltage capacitor?
a) Side cutter plier
b) Electrician knife
c) Nose plier
d) Plier

7. Which of the following components are used in microwave oven assembly?
a) Magnetron
b) Transformer
c) Relay
d) All of the above

8. Which of the following is true for microwave oven?
a) Magnetron increase the voltage
b) Transformer step-up direct current (DC)
c) Thermostat restrict the excessive heat in microwave oven
d) Capacitor has low voltage rating

9. Which of the following is true regarding the microwave?
a) Microwaves are invisible to human eyes
b) Microwaves are visible to human eyes
c) Microwaves do not have high heat carrying capacity
d) Microwave have high wavelength

10. Which of the following is not the part of microwave oven?
a) Control panel
b) Cooking cavity
c) Turntable
d) Variable frequency controller

B. Fill in the blanks with correct word
1. Magnetron is called as …….of microwave oven.
2. Magnetron converts the …….. energy into heat.

3. Microwaves have high …… carrying properties
4. Microwave that is produce by the magnetron is guide by the ……. towards the cooking chamber.
5. In microwave oven thermostat are used to protect the circuit from excessive ……
6. To disconnect the high voltage capacitor …… plier is used.
7. Relay are used in microwave for …….
8. Magnetron has two terminals …… and ……
9. Horizontal plates are use for…… magnetron.
10. Transformer works on …… voltage

C. State whether the following statements are true or false.
1. Relays are used to generate the microwaves in microwave oven.
2. Transformers are used to step-up or step-down the voltage.
3. Microwaves have low heat carrying property.
4. Relay and fuse are used for overcurrent protection.
5. Heating room is composed of cavity combination, turntable system and fire door.
6. Magnetron generate the microwave.
7. Thermostat is a device which turn the microwave oven off, if it reaches the defined voltage.
8. While replacing high voltage capacitor discharging it is the primary step which one need to flow.
9. Microwave have low heat carrying property.
10. Breakage in the permanent magnet of transformer can also be a possible error.

D. Short answer type question
1. List out the needs of microwave in our daily life.
2. Make a block diagram of microwave oven.
3. Write down the steps to replace the high voltage capacitor.
4. Write down the steps to test magnetron.
5. Briefly describe the role of thermostat in microwave oven.
6. What are the precaution need to be taken while dealing with high voltage capacitor?
7. What will the issue occur in microwave, if magnetron stop working?
8. Search on the internet, which material is used in manufacturing of microwave oven.

Unit 4: WORKPLACE HEALTH AND SAFETY MEASURES

Introduction:
Workplace hazardous system is designed to protect the health and safety of workers. Information must be provided about the safe handling, use, storage, and disposal of hazardous items. Workplace hazard is something that can have potential to harm the technician. There are hazards in every type of job and every type of workplace. Everyone at the workplace shares the responsibility to identify and control hazards. Technician must first recognize hazard at the workplace.
When a technician installs or assemble the components, she/he may have to face hazards which are related to workplace. These hazards are associated with the installation and assembly process of water purifier. Technicians should be aware of the hazards associated with installation of the water purifier. Many of the hazards can be avoided by being aware and taking appropriate precautions.

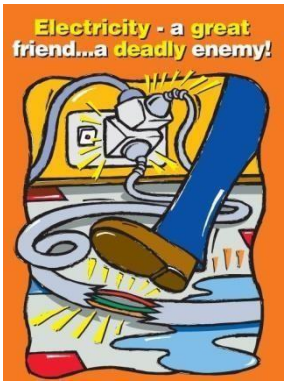
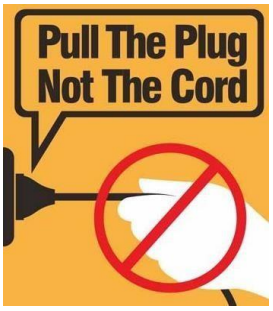
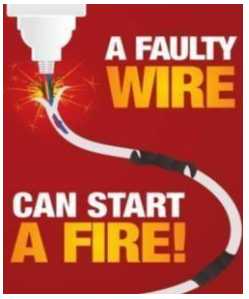


Fig.4.1 Safe work in electrical system

ELECTRICAL HAZARD

An electrical hazard defines a dangerous condition. This dangerous condition is related to energized equipment or a conductor at workplace. If a technician comes in contact with these energized equipment, these equipment may injure the technician. There is a possibility of getting the shock or receive an arc flash burn, thermal burn, or blast injury. When assembling the components in a unit. Many of the hazards can be avoided by being aware and taking appropriate precautions. This will ensure safety at workplace.





Points that have to be remembered for working safely around an electrical panel and cabinet are as follows:

1. Watch out for cords and wires

Loose cords and wires can cause hazard and even electrical hazards as shown in figure 4.2.

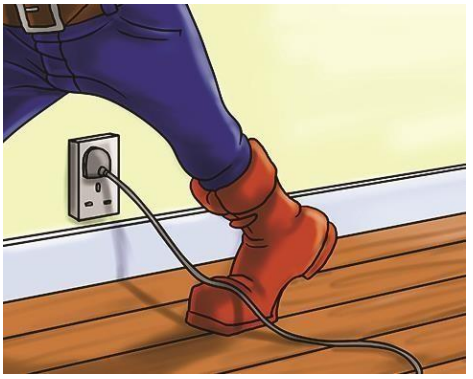


Fig.4.2 Loose cord that can be hazardous

If a cord or wire will cross a pathway safety it should be mark it with hazard tape as shown in figure 4.3.

Fig.4.3 Hazard tape

2. Wear proper Personal Protective Equipment

The kind of personal protective equipment required around a machine will depend up on the machine and the task employee is performing. Nevertheless, safety gloves, safety helmets, safety glasses, earplugs and other gears are important to use where necessary. For safety, signs can be post near panels reminding employees to wear PPE.

Fig.4.4 Personal protection equipment

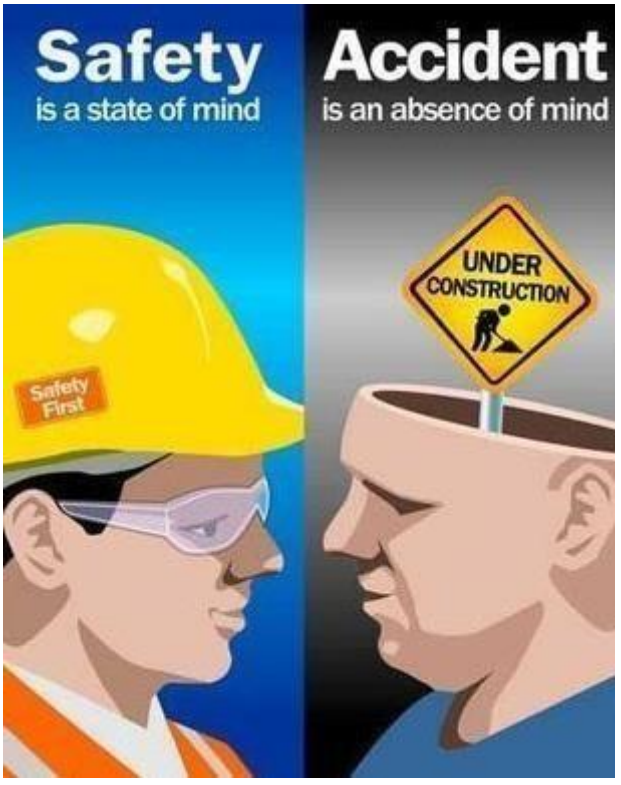


Fig.4.5 State of mind in workplace

3. Use caution around heat sources

Some panel and equipment get hot while operating. Everyone should be aware of these areas and use caution when nearby. PPE like gloves or flame– resistant clothing may be required in these areas.

Fig.4.6 Flame resistant clothing

4. Be careful when cleaning

When cleaning around a panel or equipment, one should note other possible hazards too:

- Fire and explosion hazards
- Need for PPE during cleaning
- Risk of electric shock

Fig.4.7 Equipment cleaning spray

Fig.4.8 Warning instruction for cleaning

Follow visual and written instructions
Panel, equipment has signs and labels on them alerting employees to hazards.

Fig.4.9 Written and warning instruction on the control panel

Fig.4.10 Written and warning instruction on the control panel

5. Cautious while testing, replacing the components in the panel

All levels of voltage should be considered equally dangerous. Even the voltage levels which cannot produce electrical shock should also not be ignored. We shall first confirm the circuit is dead before touching it for repairing maintenance and any others works.

Fig.4.11 Warning of electric shock

6. Avoid water at all times when working with electricity. Never touch or try repairing any electrical equipment or circuits with wet hands. It increases the electrical conductivity of the body for the flow of electric currents.

Fig.4.12 Do not plug in the cable directly in socket use proper plug

Fig.4.13 Avoid water while working with electricity

7. Never use equipment with damaged insulation or broken plugs.

Fig.4.14 Damage on the conductor

8. If you are repairing electrical device always turn off the mains supply.

Fig.4.15 Miniature circuit breaker

9. Always use insulated tools while working.

Fig.4.16 Insulated tools

10. Never try repairing energized equipment. Always check that is de energized first by using a tester.

Fig.4.17 Phase tester

11. Know the wire code in our country.

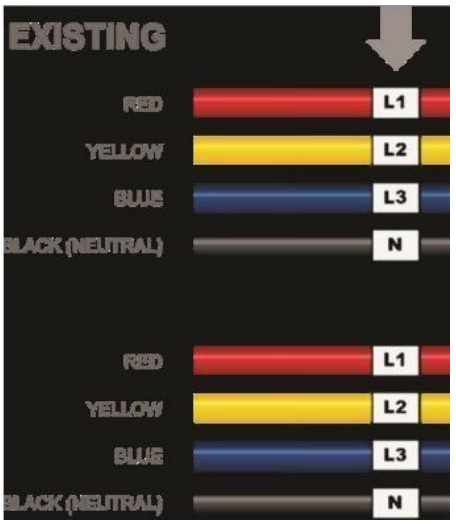


Fig.4.18 Colour code on the wire

Chemical Hazards

1. If chemicals are improperly stored, there can be a chemical leak.

Fig.4.19 Improper storage of chemical

2. If the technicians do not take safety measures, these chemical may cause damage. As shown in Fig. 4.20, fill the oil carefully in the transformer.

Fig.4.20 Filling of oil in the transformer using oil filling machine

Fig.4.21 Manual filling of oil in the transformer

Fig.4.22 Replacing of oil from transformer

3. Mishandling of chemicals due to inadequate training or negligence.

Fig.4.23 Mishandling of Chemicals

4. Diseases and environmental illnesses can be caused by exposure to toxic substances in the workplace.

Fig.4.24 Exposure of toxic substance can cause illness

5. After a person has been exposed to chemical hazards in the workplace, some of the symptoms of exposure to toxins can include:

- Chemical burns
- Itchy burning eyes
- Nausea, vomiting and diarrhoea
- Headaches
- Fever
- Rapid heart rate

Fig.4.25 Read all labels to work safe

FIRE EXTINGUISHER

A fire extinguisher is a protection device used to extinguish fires. It is the equipment which can be effectively used for controlling fires. A fire extinguisher is a cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire. It is shown in Fig. 5.26. A fire extinguisher should always be available in areas where persons work with electrical equipment.

Fig.4.26 Fire extinguisher

Different parts of fire extinguisher are shown in the Fig. 4.27.

Fig.4.27 Parts of fire extinguisher

Practical activity 1 Demonstrate the operation of a fire extinguisher in case of a fire emergency. Material required Fire extinguisher, burning emergency setup.

Procedure

The following steps as shown in Fig. 4.28.

Step1: Identify the safety pin of the fire extinguisher, which is generally present in its handle.

Step2: Break the seal and pull the safety pin from the handle.

Step3: Use the fire extinguisher by squeezing the lever.

Step4: Sweep it from side to side.

Fig.4.28 Steps to open the seal and safety pin

Assignment

Practical activity 2

Demonstration of various types of fire extinguisher and their extinguishing material.

Material required

Different types of fire extinguisher.

Procedure

Depending up on the cause of fire, different fire extinguishers are used. Various causes of fire which are grouped in the different class.

Class A - Use to extinguish burning of paper, wood, cloth, plastic.

Class B - Use to extinguish burning of gasoline, grease, oil, petrol.
Class C - Use to extinguish burning of electrical cables, wires, equipment.
Class D - Use to extinguish burning of magnesium, sodium, and potassium.

Select the suitable type of fire extinguisher					
	Water CO_2	Dry chemical powder	Carbon dioxide	Mechanical foam	ABC dry powder
Class A	Suitable	Not suitable	Not suitable	Suitable	Suitable
Class B	Not suitable	Suitable	Suitable	Suitable	Suitable
Class C	Not suitable	Suitable	Suitable	Not suitable	Suitable
Class D	Not suitable	Suitable	Not suitable	Not suitable	Suitable

FIRST AID FIRST AID FOR ELECTRICAL EMERGENCIES

Electrical accidents cause countless injuries. Injury could be minimised and many lives saved if proper rescue techniques and treatment are used. Electrical accidents may occur at any time or place. Timely response and treatment of victims is a major concern. When an electrical accident occurs, due to the effect of muscle cramping, a victim is often incapable of moving or releasing the electrical conductor. Caution should be the primary consideration during any electrical accident or emergency. There should always be an emergency response plan for scheduled electrical maintenance or work.

Fig.4.29 Wireman in an unconscious state because of an electrical shock

Electrical Rescue Techniques

a) Approaching the accident

- Never rush into an accident situation.
- Call 108 as soon as possible.
- Approach the accident place cautiously.

b) Examining the scene

- Visually examine victims to determine if they are in contact with energised conductors.

Fig.4.30 Victim in contact with energized conductor

- Metal surfaces, objects near the victim itself may be energised.
- You may become a victim if you touch an energised victim or conductive surface. Do not touch the victim or conductive surfaces while they are energised.
- Switch Off the electrical circuits if possible.

c) Hazards and solutions

- Be alert for hazards, such as heated surfaces and fire etc.
- In case you cannot switch off the power source, take extreme care.
- Ensure that your hands and feet are dry.
- Wear protective equipment, such as gloves and shoes. Stand on a clean dry surface.
- Use non-conductive material to remove a victim from the conductor.

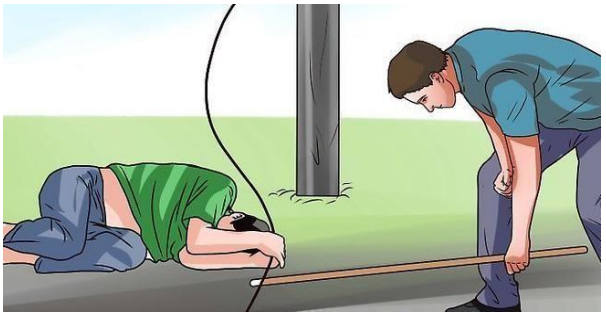


Fig.4.31 Use of non- conductive material to rescue the victim

d) High voltage rescue

- Special training is required for rescues if high voltage is present.

Fig.4.32 Beware of high voltage

- Protective equipment, such as gloves and shoes must be worn.

Fig.4.33 Gloves and shoes for safety

e) First Aid

- A victim may require Cardio-Pulmonary Resuscitation (CPR). Steps to perform in CPR are shown in the Fig. 4.34, 4.35, 4.36.

Fig.4.34 Chest Compression

Fig.4.35 Open the mouth for airway

Fig.4.36 Rescue breathing

- If the victim is breathing and has a heartbeat, give first aid for injuries and treat for shock.
- Ensure the victim gets medical care as soon as possible.
- Physician attending the victim must have detailed information to properly diagnose and care for the victim.

Assignment

Identify and name the step, which is mention in picture.	
 Fig.4.37	.....
 Fig.4.38	.....

 Fig.4.39	……

CHECK YOUR PROGRESS

A. Choose the correct option from the following

1. What are the steps necessary for operating a fire extinguisher?
   a) Identify the safety pin of the fire extinguisher which is generally present in its handle
   b) Break the seal and pull the safety pin from the handle
   c) Use the fire extinguisher by squeezing the lever
   d) All of the above
2. When do we use a fire extinguisher?
   a) In case of flood
   b) In case of electric shock
   c) In case of fire
   d) In case of burn injury
3. Which of the following safety item is not essential for a wireman while working?
   a) Safety boots
   b) Gloves
   c) Helmet
   d) Belt
4. Class B type of extinguisher is used to extinguish the fire which is cause due to …….
   a) Gasoline, grease, oil
   b) Plastic, paper, cloth

c) Combustible metal
d) Kitchen material

5. Class A type of extinguisher is used to extinguish the fire which is cause due to …….
   a) Gasoline, grease, oil
   b) Plastic, paper, cloth
   c) Combustible metal
   d) Kitchen material
6. Class C type of extinguisher is used to extinguish the fire which is cause due to …….
   a) Gasoline, grease, oil
   b) Plastic, paper, cloth
   c) Combustible metal
   d) Electrical cable and wire
7. Class D type of extinguisher is used to extinguish the fire which is cause due to …….
   a) Gasoline, grease, oil
   b) Plastic, paper, cloth
   c) Combustible metal
   d) Kitchen material
8. Which of the following steps are required to perform CPR?
   a) Chest compression
   b) Open airway
   c) Rescue breathing
   d) All of the above
9. Steps to use fire extinguisher involves:
   a) Squeeze the handle
   b) Pull the pin
   c) Aim the nozzle
   d) All of the above
10. Which of the following is the emergency number in case of electrical shock?
   a) 101
   b) 102
   c) 105
   d) 108

B. Fill in the blanks with the correct word

1. While working on electricity, the technician must wear …….. gloves and shoes.
2. Defective or inadequate insulation may result in ……..
3. Burning cause of class C due to …….
4. CPR stands for ……..
5. Electrical tools have two parts: conductors and …….
6. Burning cause of class A due to…….
7. Suppose a computer system starts burning due to overload in that case ……. fire extinguisher is preferred.
8. If in certain place burning is cause due to petrol, this will cause a class ……. type fire.
9. Improper location of chemical may increase the risk of ……..
10. While working near heated machine which is operating for long time one must wear …….

C. State whether the following statements are true or false

1. Rubber is a good conductor of electricity.
2. Fire extinguisher is used in case of an earthquake.
3. Copper is a good conductor of electricity.
4. When a wireman touches an electric panel his or her hands should be wet.
5. Fire extinguisher is used to provide the heat to the electrical system.
6. Use non-conductive material to remove a victim from the conductor.
7. Electric wires have a different colour code.
8. When wireman repair an electrical device he or she should always turn off the mains supply.
9. Do touch the victim or conductive surfaces while they are energised.
10. K-type fire extinguisher is used when fire is due to materials like wood, paper, plastic.

D. Short Answer Questions

1. What are the factors that result in an hazard?
2. List out the various precaution to be taken in workplace.
3. What are the precautions to be taken for preventing electric shock while on the job?
4. How can the CPR performed?
5. Write down the steps necessary for correctly operating a fire extinguisher in case of a fire emergency.
6. What can be the various hazards while installing an electrical panel?

7. Compare the different type of fire extinguisher.
8. Brief the different class of fire.
9. What first aid measure must be taken in case of electrical shock.
10. In India, what can be specific colour code for wire.