Field Technician

Other Home Appliances

(Job Role)

Qualification Pack: Ref. Id. ELE/Q3104
Sector: Electronics

Textbook for Class XII

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NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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Other Home Appliances
Vocational Textbook for Class XII

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Foreword

The National Curriculum Framework (NCF) 2005 recommends bringing out work and education into the domain of the curricular, infusing it in all areas of learning while giving it an identity of its own at relevant stages. It explains that work transforms knowledge into experience and generates important personal and social values, such as self-reliance, creativity and cooperation. Through work, one learns to find one's place in the society. It is an educational activity with an inherent potential for inclusion. Therefore, an experience of involvement in productive work in an educational set up will make one appreciate the worth of social life and what is valued and appreciated in society. Work involves interaction with material or other people (mostly both), thus, creating a deeper comprehension and increased practical knowledge of natural substances and social relationships.

Through work and education, school knowledge can be easily linked to learners' lives outside the school. This also departs from the legacy of bookish learning and bridges the gap between the school, home, community and workplace. The NCF 2005 also emphasises Vocational Education and Training (VET) for all those children, who wish to acquire additional skills and/or seek livelihood through vocational education after either discontinuing or completing their school education. VET is expected to provide a 'preferred and dignified' choice rather than a terminal or 'last resort' option.

As a follow-up of this, the NCERT has attempted to infuse work across subject areas and also contributed towards the development of the National Skill Qualification Framework (NSQF) for the country, which was notified on 27 December 2013. It is a quality assurance framework that organises all qualifications, according to the levels of knowledge, skills and attitude. These levels, graded from one to ten, are defined in terms of learning outcomes, which the learner must possess regardless of whether they are obtained through formal, non-formal or informal learning. The NSQF sets common principles

and guidelines for a nationally recognised qualification system, covering schools, vocational education and training institutions, technical education institutions, colleges and universities.

It is under this backdrop that Pandit Sunderlal Sharma Central Institute of Vocational Education (PSSCIVE), Bhopal, a constituent of the NCERT has developed learning outcome-based modular curricula for vocational subjects from Classes IX to XII. This has been developed under the Centrally Sponsored Scheme of Vocationalisation of Secondary and Higher Secondary Education of the Ministry of Education, erstwhile Ministry of Human Resource Development. qaza

This textbook has been developed as per the learning outcome-based curriculum, keeping in view the National Occupation Standards (NOSs) for the job role and to promote experiential learning related to the vocation. This will enable the students to acquire the necessary skills, knowledge and attitude.

I acknowledge the contributions of the book development team, reviewers, and all institutions and organisations for supporting the development of this textbook.

The NCERT welcomes suggestions from students, teachers and parents, which would help us to further improve the quality of the material in subsequent editions.

Dinesh Prasad Saklani
Director
National Council of Educational
Research and Training

New Delhi
September 2022

About the Textbook

The electronics sector occupies an important position in our lives. There is an increasing demand for electronic products in the national and international markets. The modernisation of technology across all segments of this industrial sector is synonymous with the application of electronics systems to industrial processes and capital equipment.

The Consumer Electronics (CE) sector has been one of the fastest-growing industrial sectors during the past two or more decades. Consumer Electronics refer to any device containing an electronic circuit board that is intended for everyday use by individuals (Miao, 2007).

The service industry in the CE Sector is expected to be a major job creator in India. It is also the preferred choice as it offers a good pay package and an opportunity to climb up the corporate ladder. Most CE products are now coming out with new and advanced features. So essentially, the entire service networks, which have been addressing these products, need learning and skill development in new technologies.

In our day-to-day life, we deal with many electrical and electronic appliances, which make our life easier. These electronic appliances, such as water purifiers, mixers, geysers, and microwaves have become a part of every household. India's water purifier market is expected to reach 2.6 Billion USD by the end of 2021 as compared to 1.3 Billion USD in 2016. The market for Mixer Grinders stood at 9.5 Million Units in 2017 and it is expected to grow at a CAGR of 12 per cent by the end of 2021. These appliances not only uplift our living standards and health but also help in saving time. Thus, creating a huge opportunity in the manufacturing, installation, maintenance and repair of these gadgets.

The textbook for the job role of 'Field Technician—Other Home Appliances' has been developed to impart knowledge and skills through hands-on learning experience as part of the experimental learning. After taking hands-on learning, the student can choose a career as a Field Technician of various home appliances. A field technician undertakes periodic preventive maintenance activities and ensures effective fault management.

The textbook has been developed with the contribution of academic and industry experts to make it a useful and inspiring teaching-learning resource material for vocational students. Adequate care has been taken to align the content of the textbook with the National Occupational

Standards (NOSs) for the job role, so that the students acquire the necessary knowledge and skills as per the performance criteria mentioned in the NOSs of Qualification Pack (QP).

The textbook has been reviewed by experts to make sure that the content not only aligns with the NOSs but is also of high quality. The NOSs for the job role of Field Technician—Other Home Appliances covered through this textbook are as follows:

1. ELE/N3101 Engage with customer for service
2. ELE/N3118 Install the water purifier
3. ELE/N3120 Repair dysfunctional mixer/juicer/grinder
5. ELE/N3121 Repair dysfunctional microwave oven
4. ELE/N9901 Interact with colleagues

Unit 1 of the textbook covers the fundamentals of overload protection devices. It discusses the basic overview of circuit breakers. It describes the need for circuit breakers in the electrical system and various circuit protection devices, such as miniature circuit breakers, fuse, etc. It also covers the basics of electrical machines, such as electric motor, their types and parts.

Unit 2 of the textbook covers the tools and equipment required for the repair and maintenance of a mixer, geyser, and microwave oven. It also covers the practical activities, which will give hands-on learning for handling and operating the tools and equipment.

Unit 3 of the textbook covers the repair and maintenance of mixers and geysers. It covers the basics of mixer and juicer, and their parts, along with their assembling and disassembling. It also explains the way to test and repair the different parts of the mixer and juicer. It also includes the installation of a geyser and basic troubleshooting of it.

Unit 4 of the textbook covers the basics of microwave ovens and their parts, and their repair and maintenance. It also explains how to test and repair the different components of a microwave.

Unit 5 of the textbook deals with health and safety at a workplace. It covers the hazards related to handling mixers, geysers and microwave ovens, including fire hazards, electrical hazards, etc. The rescue techniques are also discussed.

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The Council also acknowledges the contribution of the Review Committee members Professor Shrivastava, *Retired Professor*, NCERT, New Delhi; and Professor Bhatiya, *Retired Professor*, Delhi University, New Delhi for carefully evaluating and giving suggestions for the improvement of this book.

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The Council is grateful to Saroj Yadav, *Retired Professor* and *Dean* (A), NCERT, and Ranjana Arora, *Professor* and *Head*, Department of Teacher Education for their sincere efforts in coordinating the review workshops for the finalisation of this book. The Council acknowledges the valuable contributions of J. P. Maithani, *Consultant* (Contractual); and Sneha Jha, *Proofreader* (Contractual) in shaping this book. The efforts of Pawan Kumar Barriar, *In charge DTP Cell,* and Bittu Kumar Mahato and Vivek Rajpoot, *DTP Operators* (Contractual), Publication Division NCERT for flawless layout design are also acknowledged.

The Council is grateful to the Ministry of Education for the financial support and cooperation in realising the objective of providing a quality textbook for the Indian vocational students.

Contents

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1]**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

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1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

Chapter 1

Fundamentals of Electrical Appliances and Electronics

171276CH01

One day Ram switched on the television set to watch the Swayam Prabha channel. Suddenly, smoke started to come out of the television. It appeared as if the television was burning. The situation terrified him. He immediately switched off the power button. Luckily, the situation was brought under control. He shared this incident with his father. He asked him about a possible solution to this problem.

After exploring the cause of this problem, he came to know that electrical circuit protection devices are used to protect heavy electrical machinery like electric motors. However, Ram wondered whether television sets have a circuit protection device. How do circuit breakers protect heavy machinery like electric motors? In this chapter, we will learn about circuit protection devices and different laws related to electrical systems and electric motors.

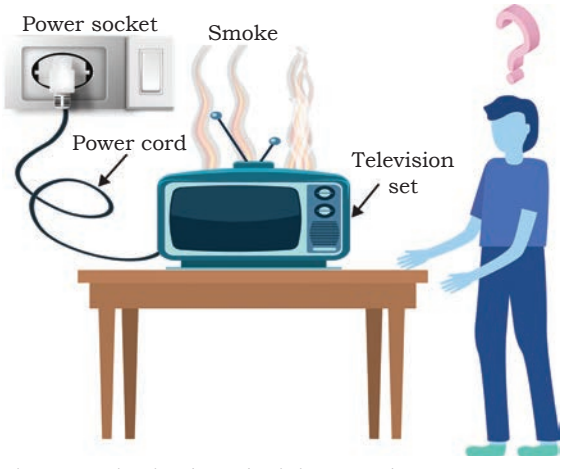


Fig. 1.1: Fire in the television set due to overcurrent

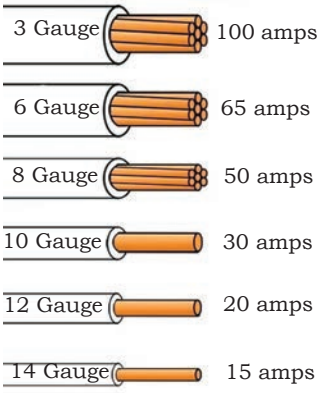


Fig. 1.2: Gauge of wire according to ampacity

Fig. 1.3: Different circuit breakers

Need for Overcurrent Protection Devices

When current flows in a conductor, it generates heat. The larger the amount of current flow, the hotter the conductor or metal of a wire gets. If there is excessive heat, it will damage the electrical and electronic components. For this reason, wires are rated according to their current carrying capacity. This current carrying capacity is called ampacity. Fig. 1.2 shows the different gauges of wires with their current carrying capacity.

Overcurrent protection devices, such as circuit breakers and fuses are used to protect circuit elements from excessive current flow. These devices are designed to keep the flow of current in a circuit at a safe level. This prevents the circuit elements from overheating.

Excess current is referred to as overcurrent. Overcurrent is when there is current more than the rated current of an equipment or the ampacity of a conductor. It may result from overload, short circuit or ground fault. Protection against excess current is termed as 'overcurrent protection.' Overcurrent is caused due to the following reasons:

1. Overload
2. Short circuit
3. Earthing fault

Overload

An overload occurs when multiple devices are operated using a single power socket, or an electrical equipment is made to work harder than it is designed for. For

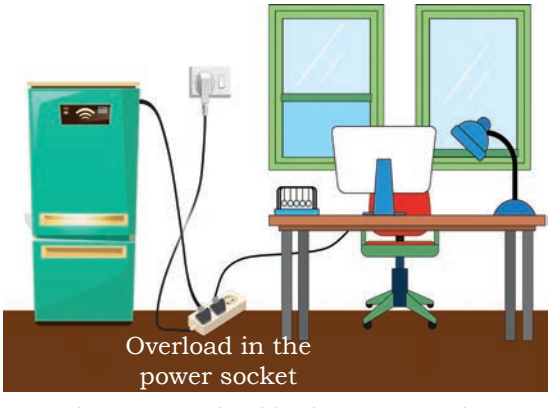


Fig. 1.4: Overload in the power socket

example, when a motor rated for 10 amps draws 20, 30 or more amps, it is considered an overload. Fig. 1.4 shows the overload of the power socket. It can happen when various electronic equipment are connected to the same energy meter. Fig. 1.5 shows a washing machine, refrigerator, electric kettle, microwave oven and juicer connected to the same energy meter. This shows the overload condition in the energy meter.

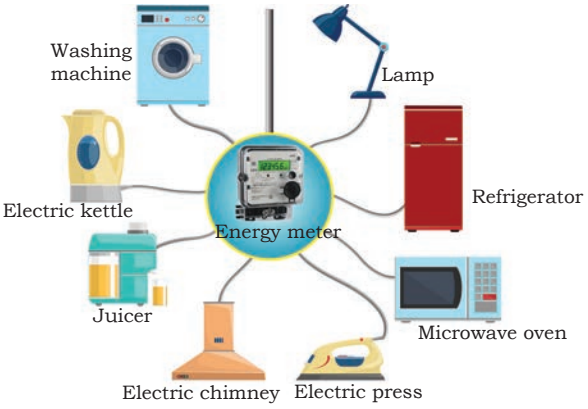


Fig. 1.5: Overload in energy meter

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. This leads to rise in temperature above the defined ratings. Fig. 1.6 shows that the bulb has a live wire and neutral wire. Due to damage to the insulation, a short circuit occurs between the two wires.

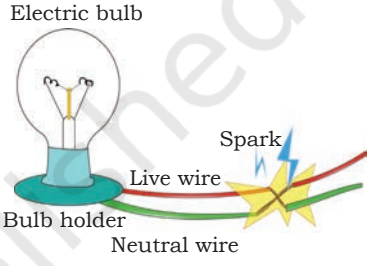


Fig. 1.6: Short circuit in wires

Due to cuts or damage in the wire, uninsulated portions of wires touch each other. This results in the formation of a least resistivity path or a short circuit path. Negligible resistance during a short circuit causes a large amount of current to flow from the source to the equipment. This may damage the wires due to excessive heat. In case of a short circuit, the bulb will not get any current.

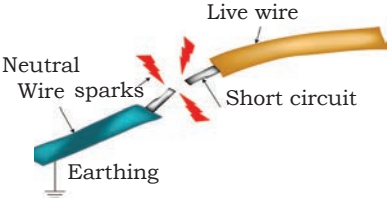


Fig. 1.7: Short circuit in live and neutral wires

Earthing fault

An earthing fault occurs when an electric current flows from a conductor to the earth through a conducting path. In Fig. 1.9, a person is drilling a hole in the wall using an electric drill machine. In the process, a conducting path is formed between the electric drill machine and metal object laid on the earth's surface. As we know, the human body acts as a good conductor of electricity. Hence, it will form a conducting path, and all the charges will pass through the body of the person. This will result in an electric shock. It can be rectified by providing proper earthing in the power socket.

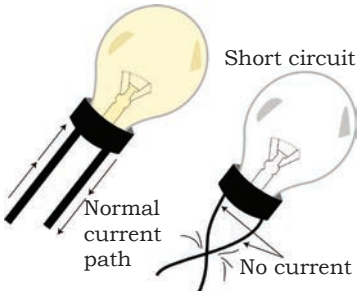


Fig. 1.8: Comparison between normal path and short circuit path

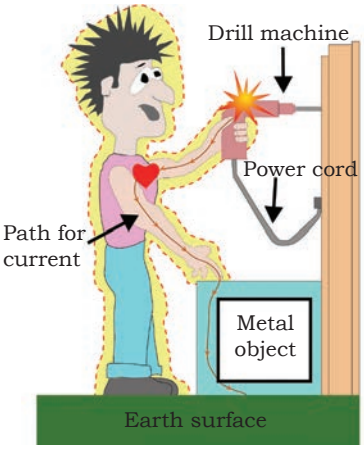


Fig. 1.9: Ground fault

Assignments

- Calculate the load at your home of electrical and electronic appliances.
- List out the devices in your home, which are earthed.
- Suppose you have an electric bulb with two wires—live wire and neutral wire. If the wires get shortened, what will happen to the bulb? Will it turn on or off? Find out the reason for the same.

Overcurrent Protection Device

Overload and short circuits are usual occurrences. So, it is necessary to install overcurrent protection devices to protect the circuit against overloads and short circuits. There are various types of overcurrent protection devices available in the market. The two most commonly used protection devices are Fuse and Miniature Circuit Breaker (MCB). The construction and working of Fuse and MCB are explained below. Their connection in the circuit is demonstrated through Practical Activity 1 and Practical Activity 2.

Fig. 1.10 (a): Mini fuse

Fig. 1.10 (b): SMD fuse

Fig. 1.10 (c): Cartridge fuse

Fig. 1.10 (d): Axial fuse

Fuse

A fuse is a single-use device. The heat produced by an overcurrent causes the current-carrying element to melt, thereby opening the circuit. In effect, it disconnects the load from the source voltage. It is used to protect the circuit from overcurrent or overload. It ensures the protection of an electric circuit. There are a variety of fuses available in the market, such as mini fuse, SMD fuse, cartridge fuse and axial fuse. Figures 1.10(a), 1.10(b), 1.10(c) and 1.10(d) show commonly used fuses.

More to Know

Electric fuse was invented by American scientist Thomas Alva Edison in 1890.

Construction of fuse

Generally, a fuse has two parts—a fuse element and a fuse body. A fuse element is made of a highly resistant material with a low melting point, whereas the fuse

body is made of non-combustible material. The fuse element is fitted on the fuse body. It is connected to a circuit to protect against short circuits and overcurrent. Otherwise, the appliance may get damaged.

Fig. 1.11 shows the construction of the kitkat fuse. It consists of a fuse carrier and fuse element. The fuse carrier and base body are made up of ceramics, glass, plastic or moulded mica laminates. The fuse element is made up of tin, lead, copper, zinc and aluminium.

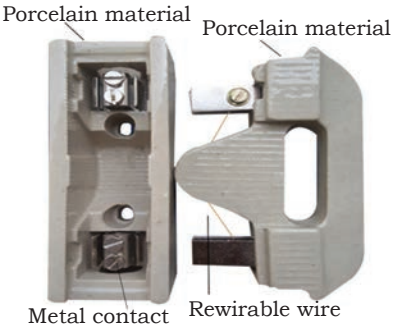


Fig. 1.11: Construction of kitkat fuse

Working principle of a fuse

The working principle of a fuse is based on the 'Heating effect of Current'—whenever a short circuit, overcurrent or mismatched load connection occurs, 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, a fuse wire is just one of the components with a low melting point that 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 categorised based on their purpose. The fuses are mainly classified into two types, depending on the input supply voltages:

1. DC fuse
2. AC fuse

Assignment

- List out the materials used in the manufacturing of fuse element and fuse carrier.

Practical Activities

Practical Activity 1

Demonstrate how to connect kitkat fuse in a simple electric circuit.

Material Required

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

Procedure

1. Take a kitkat fuse, open it and observe its parts, such as fuse carrier, fuse element and fuse base as shown in Fig. 1.12.

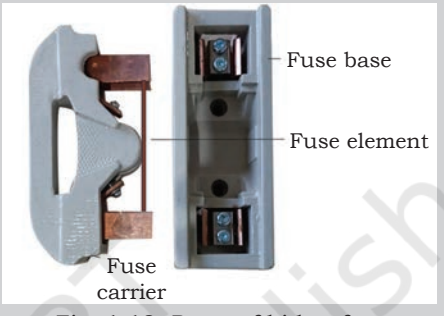


Fig. 1.12: Parts of kitkat fuse

2. Now, connect the kitkat fuse in the circuit. As soon as we connect the kitkat fuse in the circuit, it will turn on as shown in Fig. 1.13.

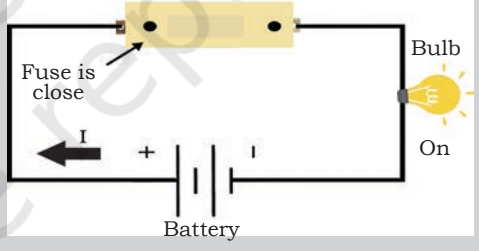


Fig. 1.13: Closed electric circuit with kitkat fuse

3. Now, remove the kitkat fuse from the circuit and it will turn off. Fig. 1.14 demonstrates the kitkat fuse acting as a circuit breaker.

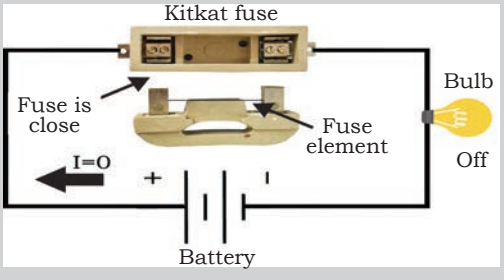


Fig. 1.14: Open electric circuit having kitkat fuse

Miniature Circuit Breaker (MCB)

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 circuit protection. It is one of the types of circuit breaker. It automatically turns off the electric circuit in case of an overcurrent or fault in the electrical supply. The manufacturer prescribes the value of the current beyond which the circuit will be turned off. A typical MCB is shown in Fig. 1.15.

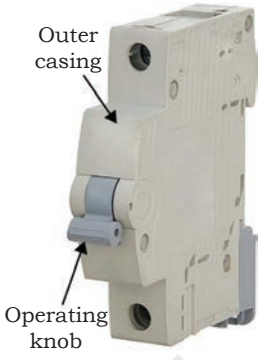


Fig. 1.15: Miniature circuit breaker

Internal parts of MCB

Fig. 1.16 shows the internal parts of an MCB design. The internal parts of an MCB are—

1. ***Incoming terminal:*** The incoming phase is connected at this terminal.
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, produced due to heavy current.
4. ***Magnetic coil*:** Magnetic coil is a part of thermal tripping arrangement. In case of heavy short circuit current, a magnetic field is formed.
5. ***ON/OFF switch:*** It is the switch which can be manually operated by the user.
6. ***Bimetallic strip:*** 'Bi' means two, 'strip' means metallic plate, meaning two metal plates are used in a bimetallic strip. For example, a bimetallic plate made up of steel and brass is shown in Fig. 1.17. Each metal has a different rate of thermal expansion. This concept can be beneficial for mechanical change. If we heat the bimetallic strip, it will bend up or down, depending

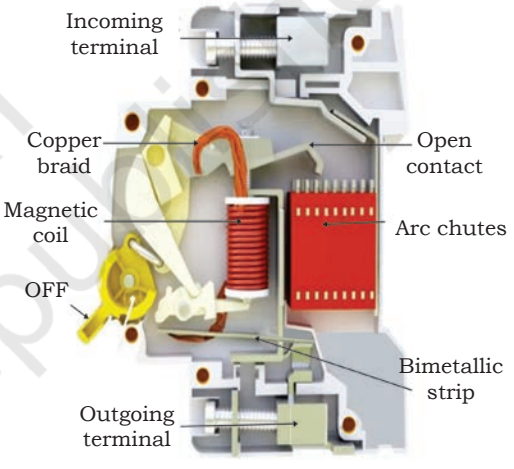


Fig. 1.16: Internal parts of MCB

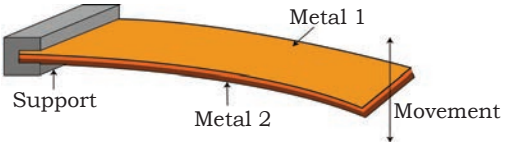


Fig. 1.17: Bend in bimetallic strip

upon the two metal strips and the way they have been joined.

7. ***Outgoing terminal:*** The phase that enters through the incoming terminal will leave the miniature circuit breaker through the outgoing terminal.

Practical Activities

Practical Activity 2

Demonstrate how to connect MCB in a simple electric circuit.

Material Required

Miniature Circuit breaker (MCB), screwdriver and line tester.

Procedure

1. Take a MCB and screwdriver. Place the MCB on a plain surface.
2. Use a screwdriver to open the cover of MCB and observe its internal parts as shown in Fig. 1.18.

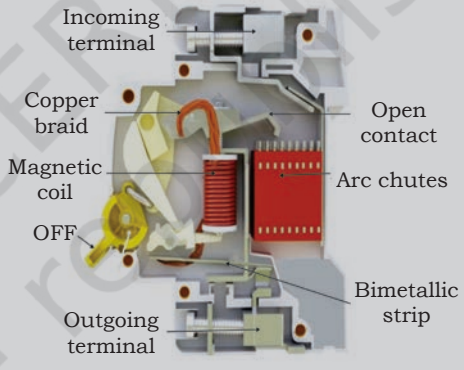


Fig. 1.18: Internal parts of MCB

3. Now, connect the MCB in an electric circuit as per the circuit diagram as shown in Fig. 1.19.

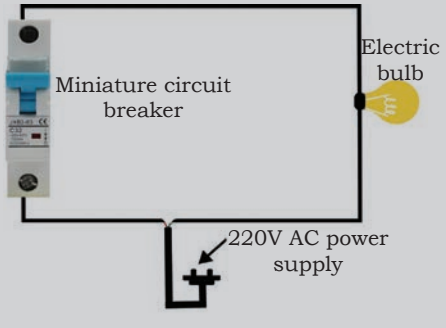


Fig. 1.19: MCB in the electric circuit

4. Trip the MCB to understand its role in the electric circuit and observe the load.

Practical Activity 3

To demonstrate the bending of a bimetallic strip.

Material Required

Two bimetallic strips, ice-cube and burner.

Procedure

1. Take a bimetallic strip made up of steel and brass as shown in Fig. 1.20 (a). Material 'A' is made up of steel and material 'B' is made up of brass. Steel and brass have different rates of thermal expansion. 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.

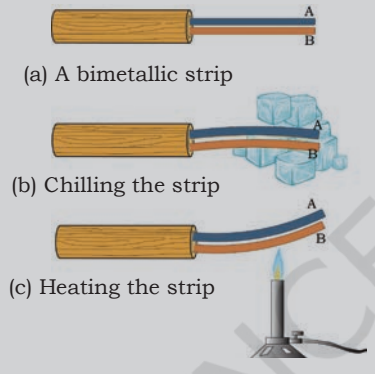


Fig. 1.20: Steps to show bending in a bimetallic strip

2. Cool the bimetallic strip using ice as shown in Fig. 1.20 (b). Observe that material 'A' shrinks less when cooled.
3. Heat the bimetallic strip as shown in Fig. 1.20 (c). Observe that material 'A' expands when heated as compared to material 'B'.
4. As brass has a higher coefficient of thermal expansion than that of steel, the brass expands more when heated.
5. This shows the nature of the bimetallic strip used in MCB.

Practical Activity 4

To demonstrate the tripping mechanism of MCB.

Material Required

Miniature Circuit Breaker (MCB)

Procedure

1. Take an MCB and identify if it's on/off. Initially, the MCB is in an off state. Observe the internal components in MCB in off state as shown in Fig. 1.18.

2. Now, switch on the MCB and observe its internal mechanism as shown in Fig. 1.21. Observe that in ON state, the movable contact touches the fixed contact.

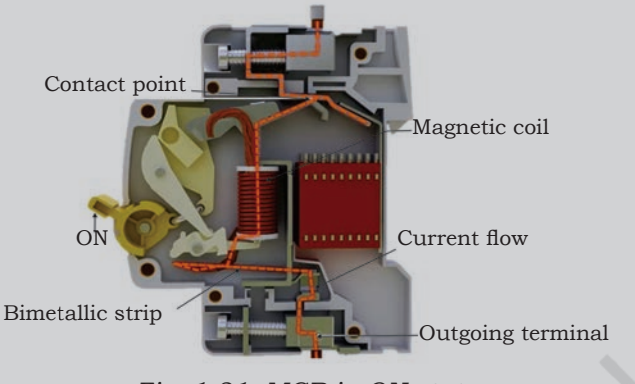


Fig. 1.21: MCB in ON state

3. In Fig. 1.21, observe that the path of the current is in the ON state.
4. The live or phase wire is screwed at the input terminal.
5. From the input terminal the current flows to the fixed contact which is touching the input terminal.
6. The current then moves towards the moving contact.
7. The moving contact is connected to the electromagnetic coil of the solenoid by means of a thick wire.
8. The current from the moving contacts enters the electromagnetic coil.
9. The current from the coil goes to the bimetallic strip by means of another thick wire.
10. Finally, current reaches the output terminal, where it is collected by the neutral wire.

More to Know

A solenoid is a coil of wire that generates a magnetic field when electric current passes through it, effectively acting as an electromagnet. It converts electrical energy into linear motion, making it useful in devices like switches, actuators and relays.

Assignments

- What is the rating of commonly used MCB for single-phase supply used in house wiring?
- List the different types of MCB used for commercial purposes.
- Collect the specifications of single phase and three phase MCB based on the rating of power supply.

Motor

An electric motor is a rotating device that converts electrical energy into mechanical energy. Electric motor is used as an important component in electric fans, refrigerators, mixers and washing machines. Mechanical energy transformation in a motor is shown in Fig. 1.22.

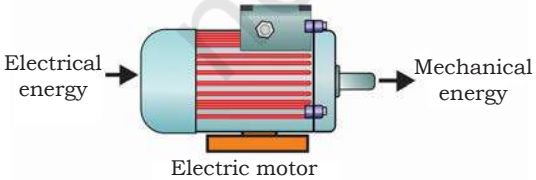


Fig. 1.22: Energy conversion in an electric motor

Parts of a motor

Motor is an electrical machine, which includes stationary and rotary parts. The various parts of electric motor are armature, stator and outer body. Each part has further internal circuitry with various parts. Fig. 1.23 shows the core of the armature. It is made of magnetic material. Armature winding is placed on the core to generate the magnetic field. The commutator provides the electric current to the armature winding. The shaft is the metal rod on which the armature assembly is mounted. The bearing helps in the rotation of the shaft. The cooling fan is used to radiate the heat generated in the armature winding.

The stator is another part of an electric motor. The armature assembly resides inside the core of the a stator. The stator consists of a stator body, stator winding and insulation cap as shown in Fig. 1.24.

The external body of the electric motor is shown in Fig. 1.25. The stator and armature are housed inside the cover of the motor body. A carbon brush is fixed on the body cover. It provides the electric current to the commutator. The adjustable nut fixed on the body is used to adjust the armature assembly.

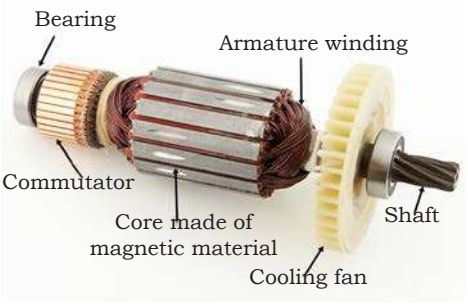


Fig. 1.23: Parts of armature

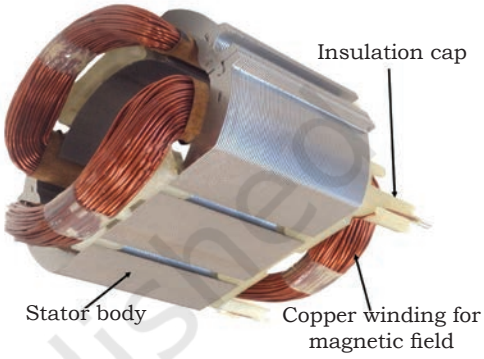


Fig. 1.24: Parts of stator

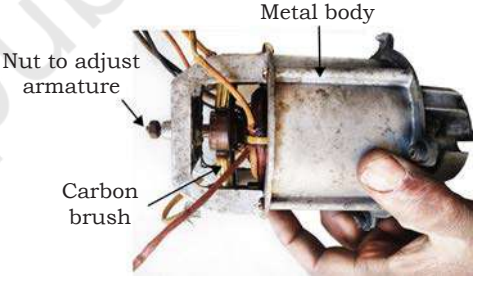


Fig. 1.25: External body parts of a motor

Assignments

- Disassemble the electric motor. Identify and list the different parts of electric motor.
- Read the specifications of electric motor mentioned on the body of the motor. Write the parameters mentioned on the plate of electric motor.

More to Know

An armature, sometimes called coil, is the movable coil of wire that rotates through the magnetic field of stator. Armature is the rotating part of motor or generator. Armature slots are made to wound the conductors in the slots. The axle on which the armature is formed is known as shaft. An armature may consist of many coils.

Practical Activities

Practical Activity 5

To identify the parts of an electric motor.

Material Required

Electric motor, screwdriver, combination plier, spanner, line tester, hand gloves and rubber shoes.

Procedure

1. Make sure that the motor is not connected to the power supply. Also, discharge the capacitor of the motor. In case of start or run type motor, it is necessary to discharge the capacitor to prevent the movement of charges in the motor.
2. Dismantle the body of the motor using a screwdriver and combination plier or spanner.
3. Open the body of the motor and observe the various parts.
4. Identify and name the various parts inside the motor.

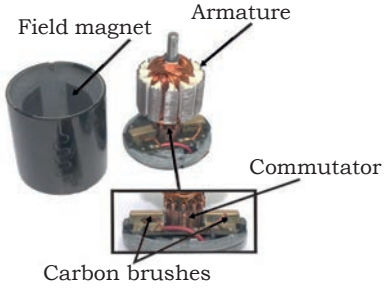


Fig. 1.27: Brushed DC motor

Fig. 1.28: Brushless DC motor

Types of motor

A motor operates on the AC or DC power supply. Hence, the motor is classified based on the operating power supply, i.e., AC motor and DC motor. A special motor is designed to operate on both AC and DC power supply. Hence, based on the input power supply to electric motors, they are classified into DC motor, AC motor and special motor.

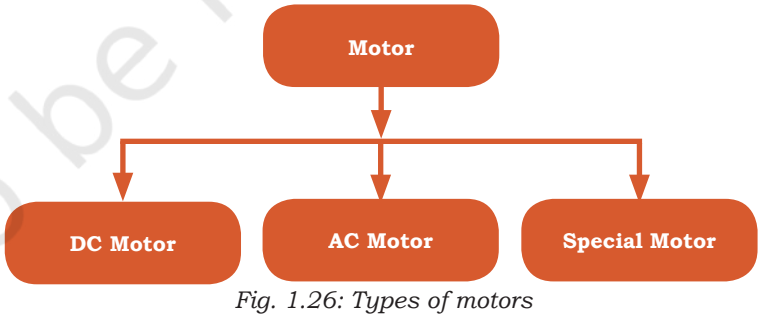


Fig. 1.26: Types of motors

DC motor

DC motors require DC supply for their operation. They work on the principle—'when a current carrying conductor is placed in a magnetic field, this current carrying conductor experiences a force.' This rotating force is called torque. DC motors can be classified into Brushed DC motor and Brushless DC motor as shown in Fig. 1.27 and Fig. 1.28.

AC motor

AC motors require an AC supply for their operation. They work on the principle—that 'when a current-carrying conductor is placed in a magnetic field, this current-carrying conductor experiences a force.' This rotating force is called torque. AC motors are classified into synchronous motors and asynchronous motors.

Synchronous motor

A synchronous motor is a type of motor in which the rotating speed of the rotor is same as the rotating speed of magnetic field. Let's suppose the a magnetic field is rotating at a speed of 1000 rotations per minute (RPM) and the rotor is rotating at a nearly equal speed of 998 rotations per minute (RPM). In this case, the motor is said to be synchronised. Fig. 1.29 shows the internal structure of synchronous motor.

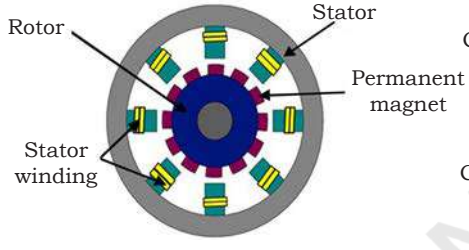


Fig. 1.29: Synchronous motor

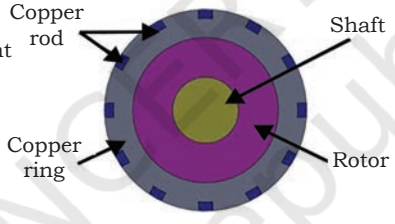


Fig. 1.30: Asynchronous motor

Asynchronous motor

An asynchronous motor is a type of motor in which the rotating speed of the rotor is less than the rotating speed of the magnetic field. Let's suppose the magnetic field is rotating at a speed of 1000 rotations per minute (RPM) and the rotor is rotating at 800 rotations per minute (RPM), then the motor is said to be asynchronised. An asynchronous motor is also known as an induction motor. Fig. 1.30 shows the internal structure of the asynchronous motor.

Special motor

These motors are designed for specific tasks such as in the field of robotics. Some special motors can run on both AC and DC power supply. Some examples of special motors are universal motor, stepper motor, and servomotor.

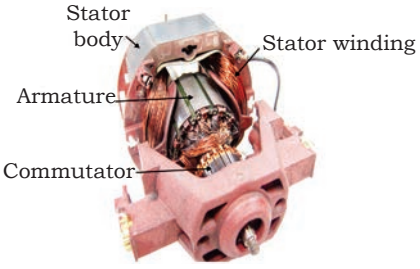


Fig. 1.31: Universal motor

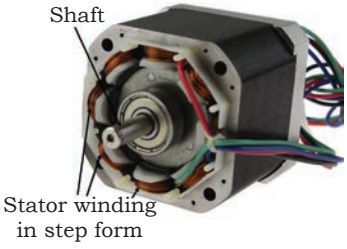


Fig. 1.32: Stepper motor

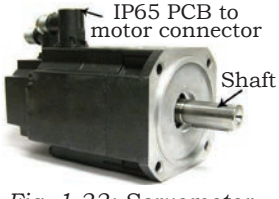


Fig. 1.33: Servomotor

- Universal Motor works on both AC and DC as shown in Fig. 1.31. It is used in a mixer grinder and hand drill machine.
- Stepper motor is used in robots and in cases where an angular rotation of the motor shaft is needed. Fig. 1.32 shows the internal parts of the stepper motor.
- A servomotor is used in robots and in cases where we require accurate rotation of a motor shaft. Fig. 1.33 shows a servomotor.

Assignment

Identify and name the following electrical equipment.

Fig. 1.34

Fig. 1.35

Fig. 1.36

Fig. 1.37

Fig. 1.38

Working principles of motor

Motor works 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 in a conductor is perpendicular to the magnetic field, then the conductor experiences a force. This force causes the conductor to move.

A conceptual working mechanism of an electric motor is shown in Fig. 1.39. It consists of a rectangular coil ABCD of insulated copper wire and two magnets. The coil is placed in a magnetic field such that its arms 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.

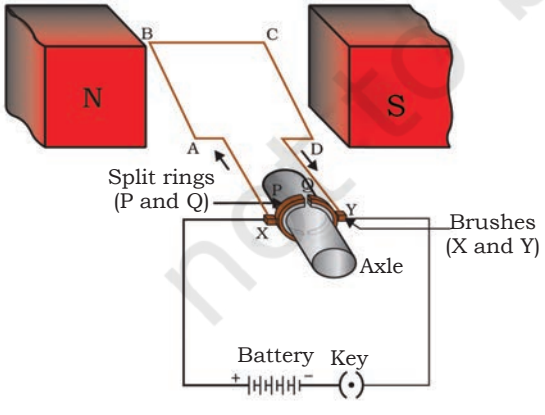


Fig. 1.39: Working principle of motor

The 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 the arm AB of the coil flows from A to B and the current in the arm CD flows from C to D, which is opposite to the direction of current flowing through the arm AB. On applying Fleming's left-hand rule in our set-up, we can find the direction of force on a current-carrying conductor in a magnetic field, i.e., ABCD.

We find that the force acting on the arm AB pushes it downwards, while the force acting on the arm CD pushes it upwards. Thus, the coil and the axle O are free to turn about an axis, rotating anti-clockwise. After completing half rotation, Q makes contact with 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 which was 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 after each half-rotation, giving rise to a continuous rotation of the coil and axle.

Assignments

- Differentiate between AC, DC and special motors?
- Which type of motor is used in electric locomotives?
- Which type of motor is used in lift and escalator?
- Which type of motor is used in Indian robot *Mitra*?

More to Know

Fleming's left hand rule

If we stretch our left hand in such a way that the forefinger, middle finger and thumb are perpendicular to each other as shown in Fig. 1.40, then the forefinger represents the magnetic field, middle finger represents the direction of current and the thumb represents the direction of force.

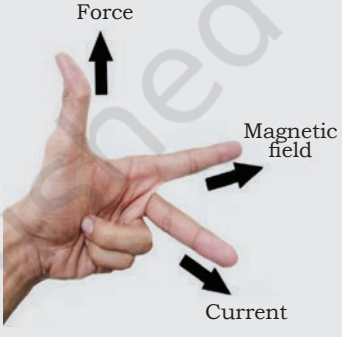


Fig. 1.40: Fleming's left hand rule

Rotation per Minute (RPM) of motor

Rotation per Minute (RPM) of a motor defines the rotating speed of an electric motor. It is a speed-measuring unit for all the rotating machines. In the case of a motor, it is used to measure the speed of the rotor or armature. RPM is the number of times a rotor or an armature rotates in one minute. Tachometer is a device, which is used to measure the speed of a rotor or an armature in an electric motor.

Practical Activities

Practical Activity 6

To measure the rotating speed of a motor using a tachometer.

Material Required

Optical tachometer, contact tachometer and a reflecting tape.

Procedure

Measuring the speed using an optical tachometer

1. First, unplug the electric motor, and stick the reflector tape on the shaft of the electric motor as shown in Fig. 1.41.

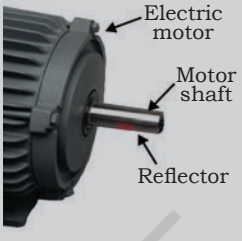


Fig. 1.41: Reflecting tape on motor shaft

Fig. 1.42: Optical tachometer

2. Turn ON the power supply of an electric motor and press the test button of the optical tachometer as shown in Fig. 1.42.
3. When we press the test button, an optical ray will come out from the end of the tachometer as shown in Fig. 1.43

Fig. 1.43: Tachometer light on motor shaft

Fig. 1.44: Reading on tachometer's display

Fig. 1.45: Connecting the motor shaft and tachometer's knob

4. Focus the light ray on the reflector tape. Observe the rotating speed of the shaft on the display of the tachometer as shown in Fig. 1.44. Take the reading after it gets stabilised.
5. Take three to four readings for accuracy.

Measuring the speed a using contact tachometer

1. Turn on the power supply of an electric motor. Touch the contact of the tachometer to the shaft of an electric motor as shown in Fig. 1.45.

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

2. Press the test button of the tachometer. Observe the rotating speed of shaft on display of tachometer. Take the reading after it gets stabilised.
3. Take three to four readings for accuracy.

Practical Activity 7

To demonstrate the working principle of an electric DC motor.

Material Required

Small magnet (fridge magnet), wood glue, copper wire, knife, stapler and a battery.

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

Procedure

1. The assembly of a motor starts 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 Fig. 1.46.

Fig. 1.46: Copper wire winding

Fig. 1.47: Tie the coil

Fig. 1.48: Removing insulation

2. Tie the coil ends carefully and leave them outwards, as shown in Fig. 1.47.
3. Now, remove the insulation from the tip of the copper wire as shown in Fig. 1.48. Remember to remove the insulation coating from half of the total diameter of a copper wire.
4. Now, fix safety pins and a magnet using rubber bands, as shown in Fig. 1.49. Insert two ends of the prepared coil into holes of safety pins to showcase the principle of motor.

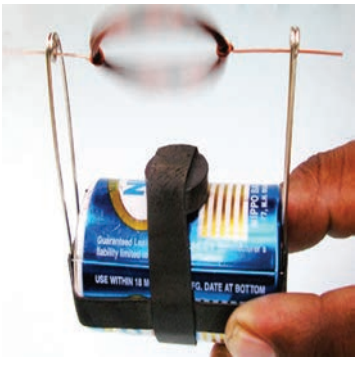


Fig. 1.49: Place coil between the loops and see the rotation of the coil

5. If you hold one more magnet on the top of the rotating coil as shown in Fig. 1.50, it will control the rotating speed of coil.

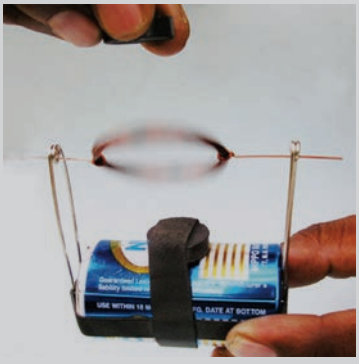


Fig. 1.50: Hold one more magnet on the top of the coil and see speed changes.

CHECK YOUR PROGRESS

A. Choose the Correct Option in the Following Questions

1. Which motor works on AC as well as DC power supply?
   (a) Stepper motor
   (b) Universal motor
   (c) Servomotor
   (d) Induction motor
2. Which motor is used in robots?
   (a) Stepper motor
   (b) Universal motor
   (c) Servomotor
   (d) Induction motor
3. Which motor provides accurate 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. What 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 a type of fuse?
   (a) Mini fuse
   (b) SMD fuse
   (c) Cartridge fuse
   (d) Paper fuse
7. Which of the following motors work on asynchronous speed?
   (a) Stepper motor
   (b) Universal motor
   (c) Servomotor
   (d) Induction motor
8. Which of the following is not a 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 a circuit protection device?
    (a) Relay
    (b) Fuse
    (c) Miniature circuit breaker
    (d) Switch

B. Fill in the Blanks

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's _____ rule is used for electric motors.
5. Motors works on the principle of _____.
6. Motors convert the _____ energy into _____ energy.
7. Kitkat fuse is made up of _____.
8. Rotating part of a motor is _____.
9. Static part of a motor is _____.
10. Path of an electric circuit having least resistance is said to be _____.

C. State whether 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 only on DC power.
4. In a circuit, rise in temperature can occur due to short circuit.
5. Mixer, grinder, and juicer use 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's 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. Answer in Brief

1. What is the role of brush in an 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 the different parts of a 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 does a Miniature Circuit Breaker trip the circuit?
10. What is the role of a bimetallic strip in MCB?

Chapter 2

Tools and Equipment

All of us have seen the meter on a vehicle which measures its speed. This meter is known as a speedometer. In the same way, there are various meters to measure the electrical quantities, such as voltage, current and resistance. Although we cannot see electricity, the meter is designed to gauge these electrical quantities, which we can then read on the calibrated scale of a meter. An ammeter measures current, a voltmeter measures the potential difference or voltage between two points, and an ohmmeter measures resistance. A multimeter combines these functions and some additional ones into a single instrument. Apart from this, various tools are used in the repair and maintenance of mixer, juicer, geyser and microwave. These tools help in assembling and disassembling home appliances. Some of the commonly used tools are screwdrivers, phase testers, stripper, pliers, etc. In this chapter, we will learn and practise the use of basic tools and equipment.

Multimeter

Multimeter is a useful measuring instrument. It has a multi-position switch which can be easily set to be a

voltmeter, an ammeter or an ohmmeter. It has various options for settings called 'parameter' and the choice of AC or DC. Each parameter has a range. Some multimeters have additional features, such as transistor testing, and ranges for measuring capacitance and frequency. Multimeters are available in digital and analogue forms.

Practical Activities

Practical Activity 1

To measure the various electrical quantities using multimeter.

Material Required

Digital multimeter, resistor, AC and DC power source and connecting cords

Procedure

Measuring the resistance using digital multimeter

1. Digital multimeter has two probes as shown in Fig 2.1. Measurement of resistance can be done using these probes. Insert the black probe into the common terminal and the red probe into the terminal marked for measuring volts and ohms as shown in Fig 2.2. The terminal may also be marked for testing diodes.

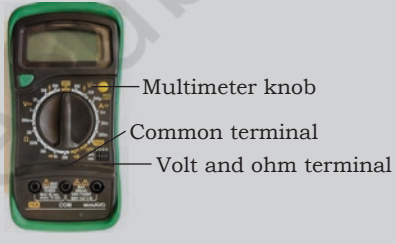


Fig. 2.1: Volt ohm terminal and common terminal of multimeter

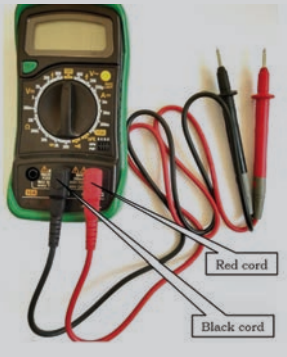


Fig. 2.2: Red and black cord which is connected to the volt-ohm and common terminals of multimeter respectively

2. Twist the selector knob to set the multimeter to measure resistance. This may be represented by the Greek letter Omega (Ω), which stands for ohms—the unit for measurement of resistance.

3. To measure the resistance of resistor, touch the resistor terminals to the red and black probes as shown in Fig. 2.3.

Fig. 2.3: Measuring the resistance of resistor

4. Read the display, taking care to note the units. A reading of 10 may indicate 10 ohms, 10 kiloohms or 10 megaohms, as shown in Fig. 2.4.

Fig. 2.4: Resistance value in Kiloohm

Measuring AC and DC voltage using digital multimeter

5. Digital multimeter has two probes used to measure voltage. Put the black probe in the common terminal and the red probe in the terminal marked for measuring volts and ohms.
6. Set the multimeter for the voltage you are measuring. You can measure volts DC, millivolts DC or volts AC. If your multimeter has an auto-range function, it is not necessary to select the voltage you are measuring.

Fig. 2.5 (a): Turning the knob to measure the DC voltage

Fig. 2.5 (b): Turning the knob to measure the AC voltage

7. Measure AC voltage by placing the probes across the component. In case of AC, it is not necessary to observe polarity.

Fig. 2.6: Measuring AC voltage using multimeter

8. Observe polarity when measuring DC voltage. Place the black probe on the negative side of the DC source and the red probe on the positive side of the DC source.

Fig. 2.7: Measuring DC voltage using multimeter

9. Read the display, taking care to note the units. You can use hold button to note down the reading on the screen of the multimeter.

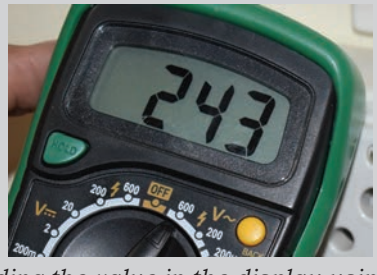


Fig. 2.8: Holding the value in the display using hold button

Measuring AC and DC current using multimeter

10. Choose either the terminal marked for measuring 10 amps or the one marked for measuring 300 milliampere (mA). If you are not sure about the amount of current, start in the 10 ampere (A) terminal until you are sure the current is less than 300 milliampere (mA).

11. Set the multimeter to measure current. This may be represented by the letter A.
12. Turn off power to the circuit.

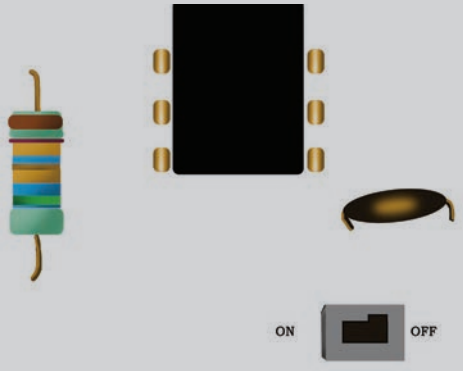


Fig. 2.9: Turn off the circuit

13. Break the circuit. To measure current, place the multimeter in series with the circuit. Place the probes on either side of the break, observing polarity with black probe on negative side and red probe on positive side.

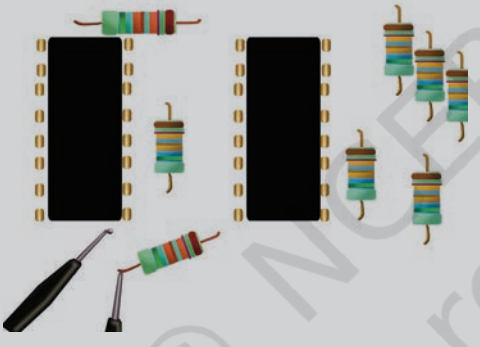


Fig. 2.10: Break the circuit in order to connect ammeter in series with the components

14. Turn ON the power so that the current flows through the circuit. Current first enters through the red probe of the multimeter, then it passes through the multimeter, after which it enters into the circuit and returns through the black probe.

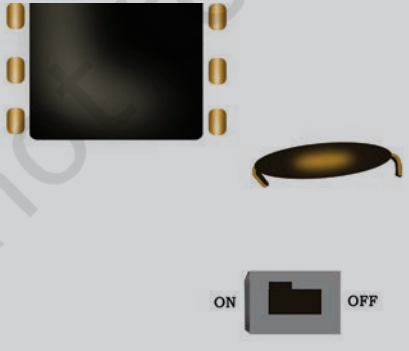


Fig. 2.11: Turning ON the circuit

15. Read the display, remembering whether you are measuring in amps or milliamps. You can use the touch-hold feature if required.

Practical Activity 2

To demonstrate the continuity test in the electrical circuit using a multimeter.

Material Required

Multimeter and electrical circuit

Procedure

1. Turn ON the multimeter.
2. Turn the knob of the multimeter in continuity test mode as shown in Fig. 2.12. The continuity test mode is shown by the symbol of sound.

Fig. 2.12: Continuity mode in multimeter

3. Insert the black probe into the COM port.
4. Insert the red probe into the V, Ω port.
5. Now, touch the probes with each other. If the meter beeps, it means that the multimeter is working properly.
6. Now, connect the probes to both ends of the component or wire that you want to test.
7. If the multimeter beeps, it means the path is complete (close) or the component allows the flow of current.

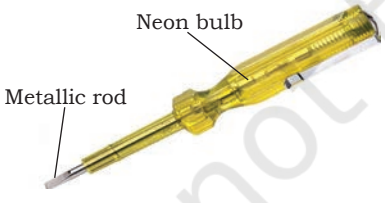


Fig. 2.13: Phase tester

Line or Phase Tester

A phase or line tester is a tool used to identify or test the phase or live wire conductor. Phase or line tester is also called neon screw-driver or test pin. (Phase, line, and live are the same terms). A typical phase tester is shown in the Fig. 2.13.

The phase or line tester consists of various parts as shown in Fig. 2.14.

Fig. 2.14: Internal components of a phase tester

Following are the main parts of a typical phase or line tester:

1. ***Metallic rod and mouth:*** It is a cylindrical metal rod. The flat end is used as a screwdriver. It can also be used to touch conductors or wires to find phase or live wires.
2. ***Body and insulation:*** The internal parts of a phase tester, such as a resistor, neon bulb, metallic spring, and metallic cap screw are covered in a transparent insulated body which is made of plastic. The flat end of a cylindrical metal rod is also covered with transparent insulated plastic (except the mouth) for insulation purposes.
3. ***Resistor:*** It is an element which opposes the flow of current through it. In a phase or line tester, the resistor is used to connect a cylindrical metal rod and neon bulb to prevent the passing of high current. The high current can be reduced using this resistor.
4. ***Neon bulb:*** It is used as a phase indicator bulb. When a small amount of current flows through it, then it glows.
5. ***Element (Metallic spring):*** It is used to connect neon bulbs with metallic cap screws.
6. ***Metallic cap screw and clip:*** It is used for tightening all the components inside the phase tester slot. The metallic cap screw is connected to the spring and the spring is connected to the neon bulb. Moreover, the clip is used for holding the phase tester in a pocket.

Fig. 2.15: Parts of screwdriver

Screwdriver

A screwdriver is a basic tool used in electrical panel installation. A typical simple screwdriver, as shown in Fig. 2.15, has a handle and a shaft. The screwdriver is used to tighten and loosen the screw. Putting the end tip of the screwdriver in the screw and moving the handle in a clockwise direction will tighten the screw, while moving the handle in an anticlockwise direction will loosen the screw. The shaft is usually made up of tough steel. It is used to resist bending or twisting. The tip of the screwdriver must be hard enough to bear applied pressure. Handles are made up of wood, metal or plastic and are usually hexagonal, square or oval in cross-section to improve grip. Some manual screwdrivers have detachable tips that fit into a socket on the end of the shaft and are held magnetically. These often have a hollow handle that contains various types and sizes of tips.

Tong Tester or Clamp Meter

Fig. 2.16: Clamp meter

A clamp meter is a tool for measuring current flowing in a wire. It does not require cutting the wire to measure current as required in a multimeter. It does not need to be connected to the circuit to read current. The clamp on the device is simply placed around a live wire by opening the jaws of the clamp meter. This helps to measure the amount of current flowing in the wire without interrupting the operation of the electrical appliance. A clamp meter uses digital technology to bring instantaneous readings. A typical clamp meter is shown in Fig. 2.16.

Practical Activities

Practical Activity 3

To measure AC or DC current using clamp meter.

Material Required

Clamp meter and electric wire

Procedure

1. To measure AC or DC current, first set the rotary selector on the clamp meter to the correct function and range.

Fig. 2.17: Clamp meter showing rotary selector

2. Set the clamp meter to the ampere symbol 'A' to read the amperage in the metal wire as shown in the Fig. 2.18.

Fig. 2.18: Knob of clamp meter is set to measure the current

3. Push the trigger on the device to open the jaw. Clamp the device around the conductor and close it as shown in Fig. 2.19; make sure that the electrical conductor is connected to a power source.

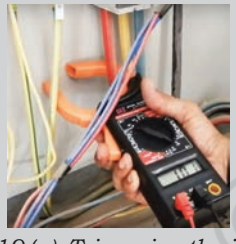


Fig. 2.19 (a): Triggering the jaws of a clamp meter (b): Measuring the current in the wire

4. Note the reading on the display of clamp meter.

Combination Plier

A combination plier is used both for cutting and gripping. Some combination pliers have additional features which can be used in industries for specific tasks. The various parts of a combination plier are shown in Fig. 2.20.

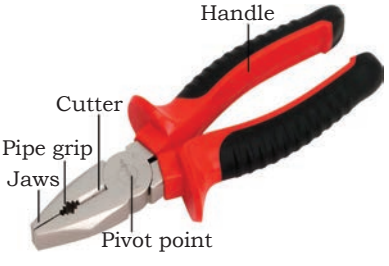


Fig. 2.20: Combination plier

1. ***Handle:*** It usually has a plastic coating for insulation, and for improving comfort and grip.

2. ***Jaws:*** They have flat edges for general gripping, which are often serrated for extra grip, however, sometimes they are smooth. They usually have

squared tips. The jaws close on pressing the handle and open on stretching the handle.

3. ***Cutter:*** The cutters built into the jaws of combination pliers are usually designed to cut cables and wire.
4. ***Pipe grip:*** The pipe grip has saw-like jaws used to grip pipes and cables.
5. ***Pivot point:*** The pivot point is a kind of hinge that allows the handles and tips to open and close, so the jaws can grip or cut and then be opened again.

Drill Bits

Drill bits are cutting tools used to drill holes. Drill bits are used in circular motion. Drill bits come in many sizes and shapes. Different sizes of holes can be made using different sizes of bits. Drill bits get the power from the rotation of the drill machine for making holes. Following are the steps for using drill bits:

Fig. 2.21: Inserting the key in order to loosen the chuck

Fig. 2.22: Turn the chuck key in anticlockwise direction

Fig. 2.23: Pull the bit to remove from the chuck

1. ***Step 1:*** Insert the chuck key as shown in Fig. 2.21. If your drill comes with a chuck key, you will need to use it to loosen the chuck. To insert the chuck key, line up the teeth, so that they match the teeth on the chuck and insert the tip into one of the holes on the side of the chuck.
2. ***Step 2:*** Turn the chuck key anticlockwise as shown in Fig. 2.22. As you turn the key, the jaws on the chuck will begin to open. Continue turning it until the chuck opens wide enough to easily slide the drill bit. The jaws are the three or four pieces in the mouth of the chuck that extends to hold the bit in place.
3. ***Step 3:*** Remove the bit. Pull the bit out using your thumb and index finger once the chuck is loosened as shown in Fig. 2.23. If the chuck is opened wide and you turn the drill face down, it may just fall away.
4. ***Step 4:*** Inspect the bit. Check for damage. If the bit is dull, replace it. If it is bent or shows signs of cracking, then change the bit. While the jaw on the

chuck is open wide, insert a new bit as shown in Fig. 2.24 (a). Tighten the drill by rotating the chuck key in a clockwise direction as shown in Fig. 2.24 (b).

Fig. 2.24 (a): Replace the bit, if required

(b): Insert the bit and tighten it using chuck

Soldering

Soldering is done to join the electronic components on Printed Circuit Board (PCB). It is the common process for connecting electronic components to PCB. For soldering, we require soldering iron, soldering wire and soldering paste. The soldering iron is heated and dipped in the soldering paste. The soldering wire is melted by applying the heat from a soldering iron. The component is joined using the soldering wire and pasted on the PCB. After cooling the mixture, it gets stuck on the PCB. Soldering is a different process than welding. In welding, the component pieces are melted together, while in soldering only soldering wire is melted by heating to join the components on the PCB. The purpose of soldering is to bind two components. Solder can be thought of as a sort of 'metal glue.' It can be used to fill up the gaps or hold the components in their places. Since soldering wire is a metal, it helps to conduct electricity. The soldering kit, consisting of soldering iron, its stand, soldering wire and soldering paste, is shown in Fig. 2.25.

Fig. 2.25: Soldering kit

Megger Meter

It is the instrument used to measure the resistance of insulation and earth. It is also used to measure the degraded insulation of electric wires. It is necessary to check the insulation resistance of the equipment frequently. This will save the user from electrical shock. There are two types of megger meters—Electronic megger meter and Manual megger meter.

Fig. 2.26: Electronic megger meter

I. ***Electronic megger* meter:** It is operated using a battery. The parts of an electronic megger meter are shown in Fig. 2.26. The parts of the electronic megger meter are—

1. ***Digital display:*** A digital display to show insulation resistance value in the digital form.
2. ***Wire leads:*** Wire leads are used to connect megger and electrical circuits which are to be tested.
3. ***Selection switch:*** Switch is used to select electrical parameters range.
4. ***Indicator:*** Indicator is used to indicate the status of various parameters, i.e., ON and OFF, power, hold and warning.

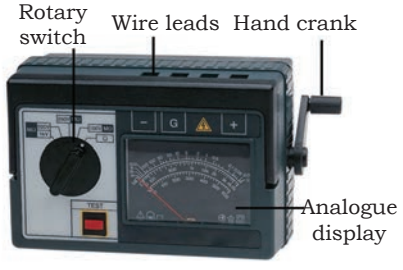


Fig. 2.27: Manual or analogue megger meter

II. ***Manual or analogue megger meter:*** It is manually operated. The parts of a manual megger meter are shown in Fig. 2.27. The parts of a manual megger meter are—

1. ***Analogue display:*** It provides an analogue value of insulation resistance.
2. ***Hand crank:*** Hand crank is used to achieve desired RPM (rotation per minute) and are required to generate a voltage which runs through the electrical system.
3. ***Wire leads:*** Wire leads are used the same way as in electronic tester, i.e., for connecting the tester to the electrical system.

Fig. 2.28: Different shapes of wire lugs

Wire Lugs

Wire lugs are connecting terminals used to connect the conductors wire to the external circuit. The wire terminals can be terminated using wire lugs. The crimping process is used to fix the wire lugs on the wire terminals. The wire lugs come in different shapes and sizes according to the gauge of wire as shown in Fig. 2.28.

Wire Stripper

A wire stripper is a portable handheld tool used by electricians for removing the protective coating of an

electric wire. It is capable of stripping the end portions of an electric wire to connect them to other wire terminals. It is also used as a wire cutter. A typical wire stripper is shown in Fig. 2.29.

Wire strippers are available in various shapes and sizes and are usually made of steel. The handle can either be straight or curved, and in most cases are covered with rubber coating to provide a secure grip. A rivet is the bolt used to hold the two blades of the stripper together. Blades have sharp edges to cut the insulation of the wire.

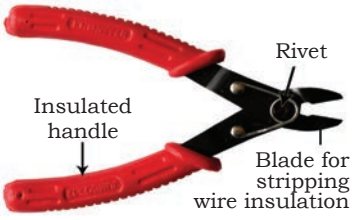


Fig. 2.29: Different parts of wire stripper

Wrench

The pipe wrench is an adjustable wrench or spanner used for gripping the iron pipes and fittings with a rounded surface. The adjustable nut is used to tighten or loosen the jaws of the wrench. Pipe wrenches are classified based on length of the handle and jaws. The jaws of wrenches are available in the sizes ranging from 2 inches to 48 inches. The body of the wrench is made up of steel or aluminium, whereas the teeth and jaws are made of steel. A typical wrench is shown in Fig. 2.30.

Fig. 2.30: Different parts of wrench

Hammer

It is a tool consisting of a piece of metal with a flat end that is fixed onto the end of a long, thin and usually wooden handle used for hitting things and shaping of metal sheets. A commonly used hammer is shown in Fig. 2.31.

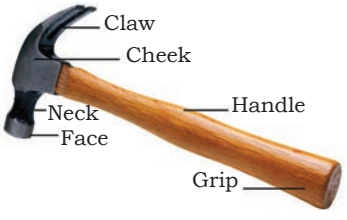


Fig. 2.31: Different parts of hammer

Ladder

A ladder is a vertical or inclined set of steps. There are two types of ladders:

1. ***Rigid ladders:*** They can be self-supporting or can be leaned against a vertical surface such as a wall. A typical rigid ladder is shown in Fig. 2.32.
2. ***Rollable ladder:*** It is made up of rope and aluminium that can be hung from the top. Rolling ladders are portable and can be moved easily to any

Fig. 2.32: Parts of rigid ladder

Fig. 2.33: Rollable ladder made of aluminium

workplace. They are typically constructed of light-weight, corrosion resistant and non-magnetic metals such as aluminium. A typical rollable ladder is shown in Fig. 2.33.

CHECK YOUR PROGRESS

A. Multiple Choice Questions

1. Which direction should you move the handle of a screwdriver to loosen a screw?
   (a) Clockwise
   (b) Anticlockwise
   (c) Forward
   (d) Backward
2. Which tool is used for shaping the metal into a sheet?
   (a) Hammer
   (b) Screwdriver
   (c) Stripper
   (d) Wrench
3. Which characteristic makes the pipe wrench suitable for gripping rounded surfaces?
   (a) Its lightweight design
   (b) Its adjustable jaw mechanism
   (c) Its serrated blade edge
   (d) Its spring-loaded handle
4. Wire strippers are available in various shapes and sizes and are usually made of _____.
   (a) aluminium
   (b) copper
   (c) steel
   (d) iron
5. Which of the following is used as a wire connector?
   (a) Lugs
   (b) Screwdriver
   (c) Stripper
   (d) Hammer
6. Which of the following meter is used for insulation resistance testing?
   (a) Ammeter
   (b) Voltmeter
   (c) Wattmeter
   (d) Megger meter
7. Which of the following equipment is used to measure the AC voltage?
   (a) Tachometer
   (b) Multimeter
   (c) Ammeter
   (d) Megger meter

8. Which of the following meters is used to measure resistance?
   (a) Tachometer
   (b) Megger
   (c) Ammeter
   (d) Multimeter
9. Which of the following tool is used for turning soft iron pipes and fittings with a rounded surface?
   (a) Wrench
   (b) Plier
   (c) Wire stripper
   (d) Screwdriver
10. Insulation of wire is removed by using _____.
   (a) Plier
   (b) Wrench
   (c) Wire stripper
   (d) Hammer

B. Fill in the Blanks

1. Combination plier is used for _____ and _____.
2. Pipe wrench is classified by the length of the handle; they can be available in size from _____ inches up to _____ inches.
3. The process of melting a metal onto other metal components in order to bind them is called _____.
4. Tong meter is also known as _____ meter.
5. Megger meter is classified as _____ and _____.
6. Soldering is also known as _____.
7. Ladder is classified as _____ and _____.
8. In line tester, _____ bulb is used for the indication of live wire.
9. In drilling, _____ is used for making a hole on the wall or wood.
10. Multimeter is used for the measurement of resistance, voltage and _____.

C. State whether True or False

1. Solder is also known as glue.
2. Clamp meter is used to measure the current flowing inside the wire.
3. Multimeter is used for the testing of diode.
4. Combination plier is used for the stripping of the insulation in the wire.
5. Line tester is used for testing diode.

6. Multimeter can measure AC and DC voltage.
7. Lugs are used as a wire connector.
8. Wrench is used to cut the wire.
9. Wire lugs are used to terminate the wire terminals.
10. Megger is used to find the insulation resistance of a wire.

D. Answer in Brief

1. How does a screwdriver tighten or loosen the screw?
2. Does the screwdriver have insulator and conductor? Mention the parts which act as insulator or conductor.
3. What are the electrical quantities that can be measured using multimeter?
4. What are the different parts of combination plier and their specific uses?
5. What is the use of line tester in electrical network?
6. What material is required to solder a wire?
7. How is clamp meter different from multimeter?
8. How will you find anode and cathode of the diode using multimeter?
9. What are the precautions to be taken while soldering?

Chapter 3

Repair and Maintenance of Mixer and Geyser

171276CH03

One day Avika was helping her brother in the kitchen. Her brother asked her to turn ON the juicer. As soon as she turned it on, it stopped working. Then, her brother asked her to push the overload protector switch, which is at the bottom of the base unit of the juicer. This made her curious about the internal parts of the juicer and mixer. In this chapter, we will understand the various parts of a mixer and juicer, and their testing, which can be performed to diagnose faults and their reassembling.

Fig. 3.1: Avika with her brother operating mixer in the kitchen

Mixer Grinder

In our day-to-day lives, we use various appliances, which makes our work easy. Various electrical and electronic appliances, such as juicers, mixer grinders and geysers are used at home. A mixer grinder is a useful home appliance, which is commonly used in the kitchen. It is used for mixing and grinding food, flour, liquid, and other such things. 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. The high-speed spinning blade grinds the material while mixing

Fig. 3.2: Mixer grinder and its main parts

(a) (b)

(c) (d)

(e)

Fig. 3.3 (a): Stand mixer
(b): Hand mixer
(c): Spiral mixer
(d): Planetary mixer
(e): Dough mixer

it. A commonly used household mixer grinder is shown in Fig. 3.2.

Types of mixers

There are many types of mixers depending on their usage. They are—

1. ***Stand mixer:*** It contains attachments, such as whisk, beater and dough hook to mix different types of ingredients. A typical stand mixer is shown in Fig. 3.3(a).
2. ***Hand mixer:*** It is a handheld mixing device. A handle is mounted on an enclosed motor, which drives the beaters. A typical hand mixer is shown in Fig 3.3(b).
3. ***Spiral mixer:*** It consists of a stationary spiral-shaped stir and rotating bowl. A typical spiral mixer is shown in Fig. 3.3(c).
4. ***Planetary mixer:*** It contains a stationary bowl and rotating agitator to mix and blend ingredients. A typical planetary mixer is shown in Fig. 3.3(d).
5. ***Dough mixer:*** It is used for mixing of flour and dough, i.e, a paste of a large quantity of flour. A typical dough mixer is shown in Fig. 3.3(e).

Assignment

Identify and name the different mixers.

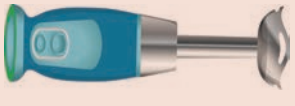
Picture of Mixer	Name of mixer	
 *Fig. 3.4*	 *Fig. 3.5*	 *Fig. 3.6*

Fig. 3.7: Lid of jar

Parts of a mixer

Different parts of a mixer grinder are as follows—

I. ***Lid:*** It is a covering cap of a jar. It is usually made of plastic material.

II. ***Jar:*** It is a container where the raw material to be grinded is put. The jars are of two types based on the material they grind—liquidising jar and dry grinding jar:

1. ***Liquidising or blending jar:*** This jar grinds the raw material, producing liquid such as fruit juice.

Fig. 3.8: Different types of jars

Fig. 3.9: Dry grinding jar and its parts

2. ***Dry grinding jar:*** This jar grinds the dry raw material, which produces powdered form of the supplied ingredients such as spices.

Fig. 3.10: Dry grinding blade

III. ***Blades*:** The blades are commonly made of steel with sharp edges. They are used to crush the raw materials. They are fitted at the bottom of the jar. Blades are connected to the jar using a screw. They rotate at their own vertical axis. Electric motor in the base unit helps the blade to rotate inside a jar. These blades can be dry grinding blade or wet grinding blade.

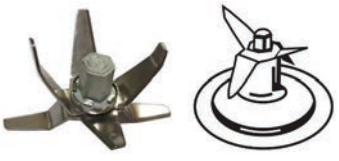


Fig. 3.11: Wet grinding blade

1. ***Dry grinding blade:*** It is used with dry grinding jar to grind the dry raw materials, such as spices and grains.

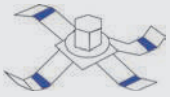
2. ***Wet grinding blade:*** It is used with liquidising jar to grind the wet raw materials, such as fruits and curd, producing the liquid, such as fruit juice and lassi.

Fig. 3.12: Base unit of a mixer grinder

IV. ***Base unit:*** It is the assembly of parts situated at the bottom of the mixer usually made up of plastic or fibre. It has an electric motor overload switch and power chord.

Assignment

Identify and name the different parts of mixer grinder in the table below.

 *Fig. 3.13*	 *Fig. 3.14*	 *Fig. 3.15*

Checklist

Check the following points 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 a soft cloth.
5. Ensure that the motor shaft rotates freely and smoothly.
6. Ensure that the jar shaft rotates freely and smoothly.

Practical Activities

Practical Activity 1

To demonstrate the use of a mixer grinder.

Material required

Mixer grinder, power supply and user manual

Procedure

1. First, select the required size of jar as per the type of the ingredient.

Fig. 3.16: Different sizes of jars

2. Fill the jar with ingredients.

Fig. 3.17: Jar filled with ingredients

3. Close the jar using lid.

Fig. 3.18: Closing the jar using lid

4. Place the jar on the base unit of the mixer.

Fig. 3.19: Positioning the jar on the base unit

5. Turn the jar in clockwise direction to lock it on the base unit of the mixer.

Fig. 3.20: Locking of jar on the base unit

6. Plug in the power cord of base unit into the socket.

Fig. 3.21: Plugging power cord into the socket

7. Before switching ON the base unit of the jar, put your hand on the lid applying pressure as shown in Fig. 3.22.

Fig. 3.22: Placing hand on the lid

8. Rotate the regulator to turn ON the base unit of the mixer as shown in Fig. 3.23; start with the slowest speed,

then increase the rotating speed of motor by turning the regulator in clockwise direction.

Fig. 3.23: Rotating the regulator

9. After a few seconds, turn off the motor by gradually reducing the speed of motor, this time rotation of regulator will be in anticlockwise direction.
10. To unlock the jar from the base unit, turn the jar in anticlockwise direction.

Fig. 3.24: Unlocking of jar from base unit

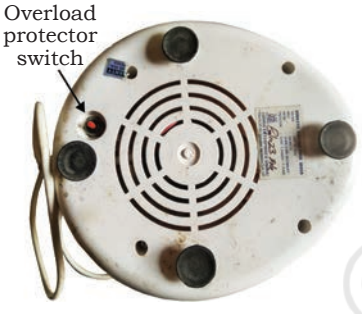


Fig. 3.25: Overload protection button at the bottom of mixer base unit

Overload Protector (OLP)

Overload protectors are used for the safety of the mixer grinder by protecting it from overloading. In the case of overload, the OLP trips resulted in the shutting down of the mixer grinder. This protects the mixer unit from getting burnt. In addition to this, it also increases the life of the electric motor in the base unit of a mixer grinder. The OLP button is located at the bottom of the unit. Fig. 3.25 shows the red-coloured push button used as an overload protector in a mixer grinder.

Practical Activities

Practical Activity 2

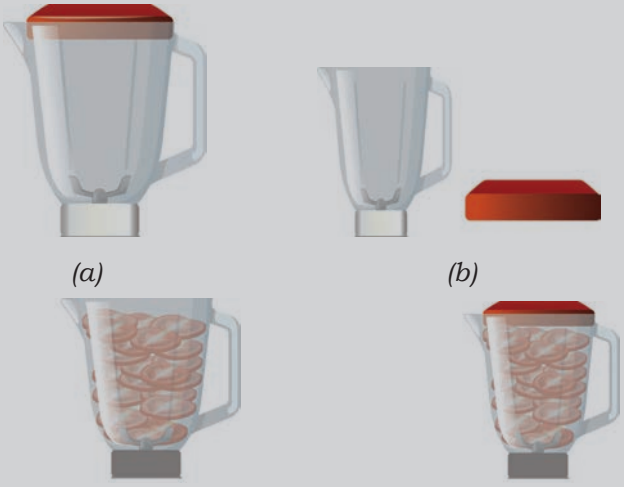
To demonstrate the operation of overload protector button in the mixer grinder.

Material Required

Mixer grinder, base unit, jar and ingredients

Procedure

1. Open the jar and fill it with ingredients and put the lid onto the jar.

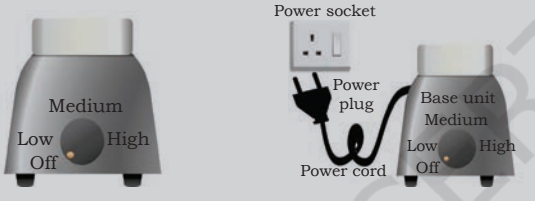


(a) (b)

(c) (d)

Fig. 3.26 (a): Jar (b): Opened lid of the jar
(c): Ingredients in the jar (d): Lid on the jar

2. Connect the power cord of the base unit to the power socket.



(a) (b)

Fig. 3.27 (a): Base unit of a mixer grinder
(b): Connecting power cord of base unit to the socket

3. Place and fix the filled jar on the base unit.

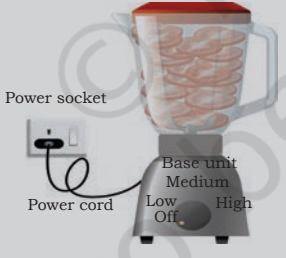


Fig. 3.28: Placed jar on the base unit

4. Place your hand on the lid and press it.

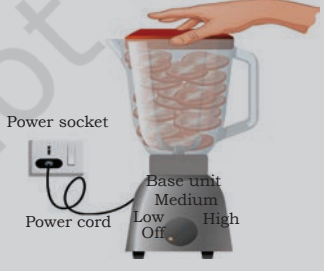


Fig. 3.29: Hold the lid of jar tightly

5. Turn ON the mixer grinder using regulatory knob on the base unit.

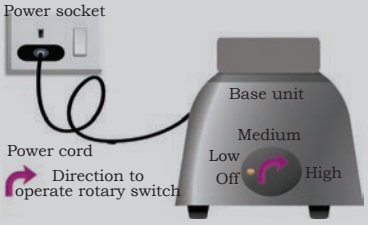
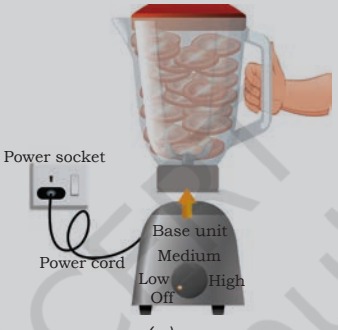


Fig. 3.30: Speed regulator of base unit

6. As soon as we turn ON the mixer grinder, it will turn OFF due to extra load.
7. If this happens, immediately switch off the mixer grinder.
8. Wait for the motor to cool down.
9. Unlock the jar from the base unit and remove some ingredients.



(a)

Fig. 3.31 (a): Unlocking the jar from the base unit

(b)

(b): Reducing ingredients in the jar

10. Now, put the base unit upside down, and press the overload protector button.
11. Restart the unit.

Practical Activity 3

To demonstrate the cleaning of mixer grinder's parts.

Material required

Parts of a mixer grinder, such as jars blades, base unit and piece of cloth.

Procedure

A. Cleaning the jars

1. Take a messy jar. Open the lid of the jar and pour mild soap water into it. Then, close the lid.

Fig. 3.32 (a): Messy Jar (b): Jar with opened lid (c): Filling with soap water (d): Lid on the jar

2. Now, place and fix the jar onto the base unit.
3. Plug in the power cord into the socket.
4. Using speed regulator on the base unit, turn ON the mixer grinder for 2–3 seconds.
5. Unlock the jar from the base unit of a mixer grinder.
6. Open the lid of the jar. Drain out the soap water present inside the jar.
7. Now, turn ON the fresh water tap and wash the jar.

Fig. 3.33: Washing the jar

8. After proper cleaning, keep the jar inverted for drying. Once it is dried, clean it using soft cloth.

Fig. 3.34 (a): Wet inverted jar (b): Cleaning the dried jar using clean cloth

B. Cleaning the base unit

1. Take the messy base unit of a mixer grinder. Unplug the base unit, if it is connected to an electric socket.

2. Unlock and remove the jar, if it is locked onto the base unit.
3. Take a soft clean cloth and clean the base unit thoroughly.

Fig. 3.35: Cleaning the base unit

4. At the time of cleaning the base unit of a mixer grinder, do not immerse the base unit in water, otherwise motor and other components will be damaged.

Fig. 3.36: Do not use water to clean the base unit

C. Cleaning the blades

1. Turn the jar upside down.

Fig. 3.37 (a): Jar (b): Upside down view of a jar

2. Observe the screw at the bottom of the jar. Take a correct screwdriver according to the size of screw at the bottom of jar. Then, loosen the screw.

Fig. 3.38: Loosening the screw of a jar

3. Detach the blade assembly, which includes sealing ring and blade.

Fig. 3.39: Detaching blade assembly

4. Clean the blade in water.

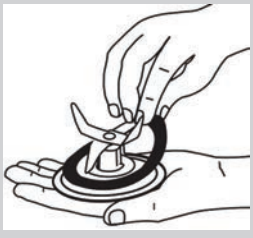


Fig. 3.40: Cleaning the blades

5. Let the blade dry completely before assembling the blades in the jar.

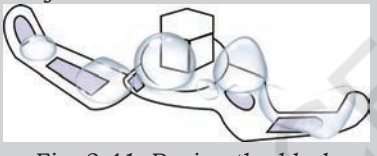


Fig. 3.41: Drying the blade

6. Once it gets dry, fix the blades in the jar using a screwdriver.

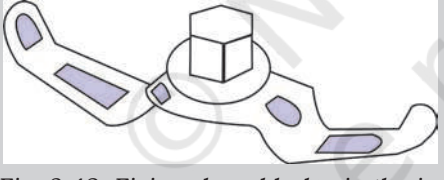


Fig. 3.42: Fixing clean blades in the jar

Practical Activity 4

To identify the parts of a blender.

Material Required

Blender, Screwdriver, Notebook and Pen

Procedure

1. Take a blender.
2. Dismantle the blender using a screwdriver.
3. Remove the centre cap of the blender.

Fig. 3.43: Centre cap or measuring cap of a blender

4. Remove the cover of the blender. It covers the liquidiser jar and is airtight.

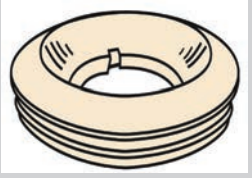


Fig. 3.44: Cover of a jar

5. Remove the liquidiser jar of the blender.

Fig. 3.45: Liquidiser jar

6. Remove the rubber packing. It ensures leak-free packing of the cutter assembly.

Fig. 3.46: Rubber packing or washer

7. Remove the cutter assembly. It ensures the crushing and blending of liquidised ingredients.

Fig. 3.47: Cutter assembly

8. Remove the rubber packing. It again ensures leak-free wet jar.
9. Remove the socket from the blender. It has threads wounding around the bottom of the liquidiser jar. It ensures the locking of the blender to the base unit.

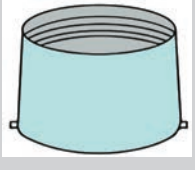


Fig. 3.48: Socket with lock

Practical Activity 5

To identify the parts of a mixer grinder.

Material Required

Grinder, Screwdriver, Notebook and Pen

Procedure

1. Take a mixer grinder.
2. Dismantle the grinder using a screwdriver.
3. Remove the centre cap of the grinder.
4. Remove the cover of the blender. It covers the grinding jar. It makes the jar airtight.
5. Grinding jar is made of stainless steel. It is used as a container for ingredients.
6. Remove the rubber packing.
7. Remove the cutter assembly.
8. Remove the socket from the grinder. It has threads wounding around the bottom of the grinder jar. It ensures the locking of grinder on the base unit of the mixer.

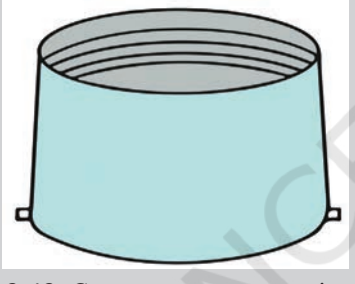


Fig. 3.49: Centre cap or measuring cap

JUICER

A juicer is a commonly used electrical kitchen appliance, which is used to extract juice from fruits and vegetables. It crushes and cuts the fruits and vegetables, and then extracts the juice using the filter. This filter separates the pulp from the liquid. A typical household juicer is shown in Fig. 3.50.

Fig. 3.50: Juicer set

Types of juicer

There are many types of juicers depending on their juice extraction method. They are—

1. Centrifugal juicer: It is a common juicer found in the market. These type of juicers are powered by electricity. Fruits and vegetables are fed via feed tube. After that, they are shredded into small pieces by a

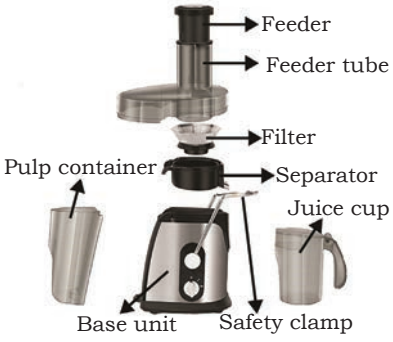


Fig. 3.51: Centrifugal juicer

spinning blade. These pieces are then moved into the chamber, where centrifugal force separates the juice from the pulp. Pulp is then collected by mesh and then moved into the pulp cup. It flows down the chute and is collected by a juice cup.

2. Masticating juicer: It is one of the common juicers, which is available in the market. This type of juicer is powered by electricity. These juicers rely on a rotating auger to crush, produce and squeeze out the juice. These juicers are also known as cold juicers. Their rotating speed, i.e., RPM (Rotation per Minute) is much lower than that of centrifugal juicer. In this way, they generate less heat than that produced by the centrifugal juicer. As a result, the juice produced by these juicers can be preserved for a long time.

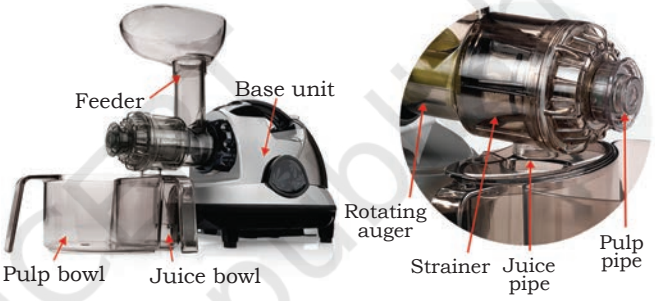


Fig. 3.52: Masticating Juicer

3. Citrus juicer: It is one of the common juicers in the market. These juicers are manually operated. They use mechanical force to extract the juice from fruits or vegetables. They use levels to maximise the force applied by the user. Juice passes through the mesh filter, after which it can be collected.

Fig. 3.53: Citrus juicer

Parts of juicer

The different parts of juicers are plunger, hopper, drum lid, juicing screw, rotation wiper, strainer, base unit, pulp cup and juice cup:

1. ***Plunger:*** This is used to push the fruits and vegetables into the drum lid.
2. ***Hopper:*** It is a funnel-shaped device used to move material from the large beaker into a tiny tube.


Fig. 3.54: Plunger

3. ***Juicing bowl:*** It is a container for fruits and vegetables.
4. ***Juicing screw:*** It is fitted inside the drum lid. It is used to crush the fruits and vegetables, which are fed into the drum lid.
5. ***Rotation wiper:*** It is a stand used to hold the strainer.
6. ***Strainer:*** It acts as a filter. It separates the solid matter from the liquid.
7. ***Base unit:*** It is a casing used to cover the different internal components of the juicer.
8. ***Pulp cup:*** It is used to collect all the waste or pulp of fruits and vegetables.

Fig. 3.58: Pulp cup

9. ***Juice cup:*** It is used to collect the juice of fruits and vegetables.

Fig. 3.61: Juice cup

Fig. 3.55: Hopper

Fig. 3.56: Drum lid

Fig. 3.57: Juicing screw

Fig. 3.59: Rotation wiper

Fig. 3.60: Strainer

Fig. 3.62: Base unit

Practical Activities

Practical Activity 6

To demonstrate the assembling of juicer.

Material Required

Juicer set and screwdriver

Procedure

10. Take the base unit of a juicer.

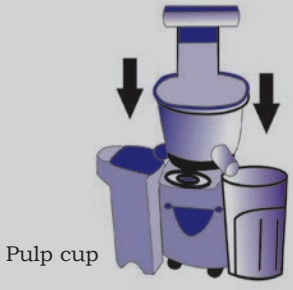


Fig. 3.63: Base unit of a juicer

11. Take a juicing bowl and place it onto the base unit of the juicer as shown in Fig. 3.64.

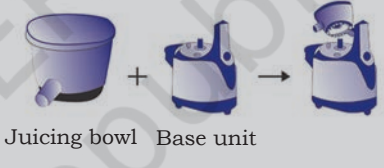


Fig. 3.64: Fixing the juicing bowl

12. Now, take the juicing screw and strainer, fix them onto the rotation wiper as shown in Fig. 3.65.

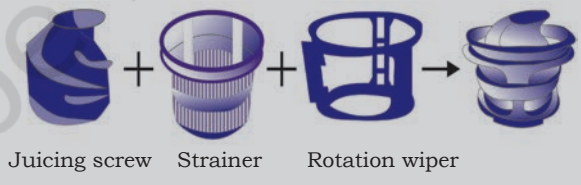


Fig. 3.65: Fixing the juicer and strainer in the rotation wiper

13. Place the set of rotation wiper and strainer inside a juicing bowl as shown in Fig. 3.66; this juicing bowl is fixed onto the base unit.

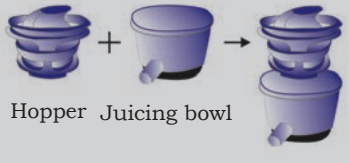


Fig. 3.66: Placing the strainer and rotation wiper set onto the juicing bowl

14. Place the hopper over the fitted assembly of juicing bowl.

Fig. 3.67: Hopper fitted in the juicing bowl

15. Position the juice cup and pulp cup in their places as shown in Fig. 3.68.

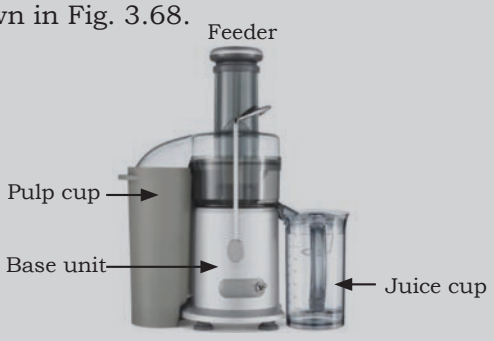


Fig. 3.68: Placing juice cup and pulp cup in their respective places

16. Now, our juicer is ready to use.

Practical Activity 7

To demonstrate the disassembling of juicer.

Material Required

Juicer kit and screwdriver

Procedure

1. Firstly, separate the rotation wiper from the juicing bowl as shown in Fig. 3.69.

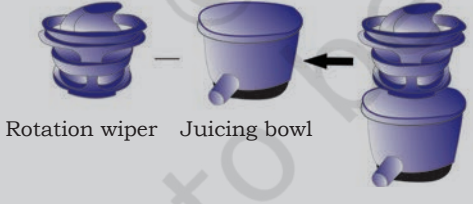


Fig. 3.69: Separating the rotation wiper from the juicing bowl

2. Disassemble the juicing screw and strainer from the rotation wiper as shown in Fig. 3.70.

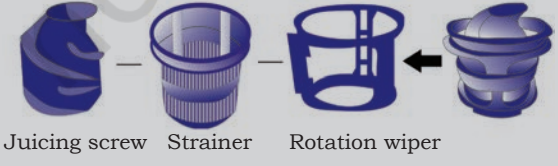


Fig. 3.70: Detaching the juicing screw and strainer from the rotation wiper

3. Detach the juicing bowl from the base unit by turning it in an anticlockwise direction.
4. Now, lift the juicing bowl off the base as shown in Fig. 3.71.

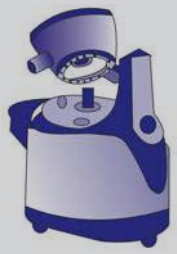


Fig. 3.71: Lifting the juicing bowl

Practical Activity 8

To demonstrate the way to operate juicer.

Material Required

Juicer, juicer jar, and vegetables and fruits

Procedure

1. Wash and clean the fruits or vegetables as shown in Fig. 3.72.

Fig. 3.72: Washing the fruits

2. Plug in the power cord of juicer as shown in Fig. 3.73.

Fig. 3.73: Plugging the power cord in the socket

3. Place the juice cup and pulp cup in their respective positions as shown in Fig. 3.74.

Fig. 3.74: Place the pulp and juice cup in their respective positions

4. Switch ON the juicer using the power button as shown in Fig. 3.75.

Fig. 3.75: Power button in the base unit of a juicer

5. Insert fruits or vegetables (one piece at a time) into the chute as shown in Fig. 3.76.

Fig. 3.76: Inserting the fruit into a chute

6. After completion of juicing process, turn off the juicer's base unit using power button as shown in Fig. 3.77.

Fig. 3.77: Turning off the juicer's base unit

Cleaning juicer

It is very important to take proper care of the juicer. It should be properly cleaned after every use. The steps for cleaning the juicer set are as follows:

1. ***Step 1:*** Switch off the power and unplug the juicer.
2. ***Step 2:*** Follow the disassembly process.
3. ***Step 3:*** Properly wash and clean the small parts with water.
4. ***Step 4:*** Clean the holes of the strainer with a brush and mild soap solution.

(a)

(b)

Fig. 3.78 (a): Cleaned or unwashed juicer set (b): Uncleaned or washed juicer set

5. ***Step 5:*** Swipe the base with a soft damp cloth.
6. ***Step 6:*** Clean all the metal parts.
7. ***Step 7:*** Make sure that all the parts are dry before storage.

Assignment

Match the following parts of the juicer with their respective images

Column A	Column B
Pulp Cup	 *Fig. 3.79*
Rotation wiper	 *Fig. 3.80*
Hopper	 *Fig. 3.81*
Juicing screw	 *Fig. 3.82*

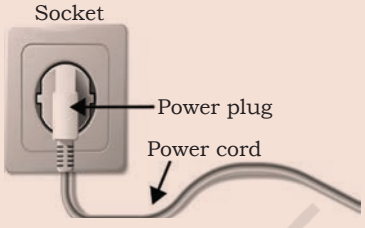
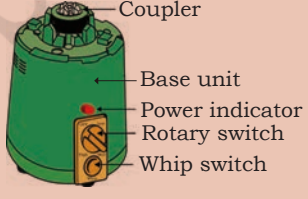
REPAIRING MIXER GRINDER AND JUICER

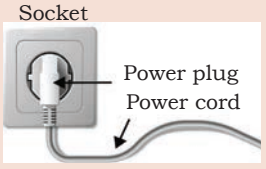
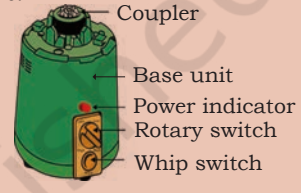
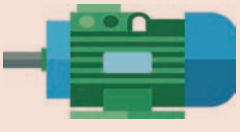
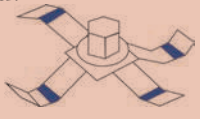
Mixer Grinder and Juicer consist of various parts, such as a motor, overload switch, power indicator and rotatory switch. One of the main parts of a mixer is the motor. The motor takes in the electrical energy and converts it into mechanical energy. The mechanical energy generated by the motor will then rotate the blades of the jar. This will mix the ingredients in the jar. The rotatory switch varies the electrical current, which is to be delivered to

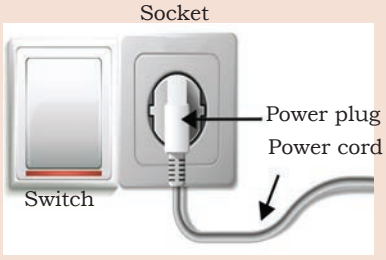
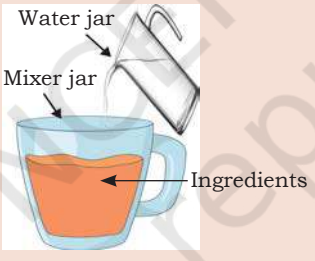
the electric motor in the base unit, thus allowing the speed of the beaters to be controlled.

Some common problems that occur in mixers are listed in Table 3.1.

Table 3.1: Problems in the Mixer Grinder and Juicer, and Their Solutions

Problems	Solution
If the base unit fails to start	• Ensure cord is plugged in properly.  *Fig. 3.83: Plugged the power cord of the mixer in the socket*
	• Ensure the power supply is active. Check the power supply indicator on the switchboard.  *Fig. 3.84: Power supply indicator on the switchboard* • Ensure that the power indicator located at the base unit is switched on.  *Fig. 3.85: Power indicator on the base unit* • Ensure that the jar is not overloaded.

If a motor stops working	• Ensure cord is plugged in properly.  *Fig. 3.86: Plugged power cord of mixer in the socket* • Switch off the unit from electric socket and let the juicer cool down.
If a mixer does not function at any speed	• Check the speed controller, i.e., rotary switch mounted on the base unit.  *Fig. 3.87: Rotary switch on the base unit* • If found defective, replace the rotary switch
If a motor hums but blades do not rotate	• Check the motor, if found defective, replace it.  *Fig. 3.88: Electric motor*
If there's excessive vibration in a mixer	• Check and replace blades, if required.  *Fig. 3.89: Jar blades* • Check and replace motor, if required.

If a mixer is noisy	• Switch off the mixer.  *Fig. 3.90: Switch off the power supply* • Stir the ingredients in the jar.  *Fig. 3.91: Stirring the ingredients in the jar* • Add water into the jar and start the mixer again.  *Fig. 3.92: Adding water into the jar*
If the jar is overflowing	• Check and reduce excess liquid from jar. • Check and fit the cap properly.  *Fig. 3.93: Fit the jar cap properly*
If the jar is leaking from below	• Check the rubber packing or washer

Servicing and repairing the different parts

While servicing a mixer grinder or juicer, if any fault is found, then it should be repaired at the same time. If we perform timely servicing, it will expand its life.Repairing of a mixer grinder or juicer includes servicing or repairing rotary switch and motor. The following section illustrates the way these services can be performed.

Servicing the speed control switch

A switch is a simple and useful component of a mixer. It is used to start or stop the motor present inside the base unit. A speed control switch has three levels of motor speed. If we rotate the speeds control knob of a motor, it will switch to any one of the speed, i.e., low, medium or high speed. The speed of the mixer is controlled by varying currents passing through the motor. Continuity testers are used to check the operation of the speed control switch. If the speed control switch is not working properly, it must be replaced. If the mixer is not operating, first check the plug and power cord; if they are working properly, only then test the speed control switch.

Practical Activities

Practical Activity 9

To demonstrate the test of the rotary switch of a mixer grinder or juicer.

Material Required

Screwdriver set and rotary switch

Procedure

1. Remove the housing of a mixer using a screwdriver. Observe the terminals of rotary switch.

Fig. 3.94: Removing the housing of a mixer

2. Check the terminals of the switch to ensure that the wires are properly connected.

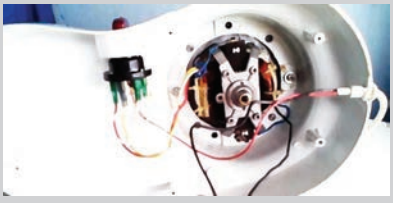


Fig. 3.95: Inspect the wiring of a mixer

3. Next, mark the position of the wires and then disconnect them.

Fig. 3.96: Rotatory switch

4. Use a continuity tester to determine if the switch is faulty. If it is, replace it and reconnect the terminal wires as shown in Fig. 3.97.

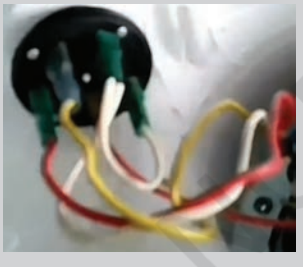


Fig. 3.97: Reconnect the wire to the rotary switch

Replacing a fuse

A fuse is a 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 points should be followed while replacing a fuse:

1. Remove the housing and access the motor.

Fig. 3.98: Remove the housing

2. Disconnect the overload switch from the motor.

Fig. 3.99: Disconnecting the overload switch

3. Use a continuity tester to test the overload switch as shown in Fig. 3.100. On pressing the overload button, if the bulb glows, we can say that the overload switch is operating properly.

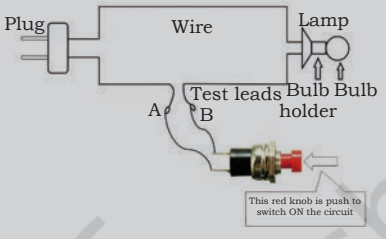


Fig. 3.100: Circuit diagram of an overload switch

4. If the bulb does not glow, replace the overload switch.

Fig. 3.101: Overload switch

5. Reassemble the mixer's housing using a screwdriver.

Fig. 3.102: Reassembling the motor's housing

Practical Activity 10

To demonstrate the process of replacing an electric motor.

Material Required

Mixer and Screwdriver

Procedure

1. Remove the housing of a mixer using screwdriver. And then observe the different parts, such as motor, overload switch, rotary switch and their connectivity in the base unit as shown in Fig. 3.103.

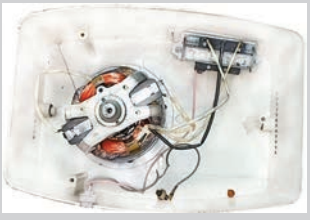


Fig. 3.103: View of connectivity of different components in the mixer

2. Disconnect the overload switch at the motor base unit as shown in Fig. 3.104.

Fig. 3.104: Overload switch at the bottom of the mixer

3. Use a continuity tester to test the motor winding as shown in Fig. 3.105. If the bulb is glowing, it means that the winding is correct.

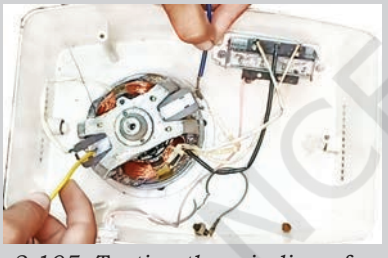


Fig. 3.105: Testing the winding of motor

4. Replace an electric motor in the mixer's housing, if it is defective.

Fig. 3.106: Universal motor used in the mixer

5. Reassemble the housing of the base unit. A base unit after getting reassembled is shown in Fig. 3.107.

Fig. 3.107: Reassembled mixer's base unit

Repairing the Juicer

Fig. 3.108 shows the steps of repairing a juicer.

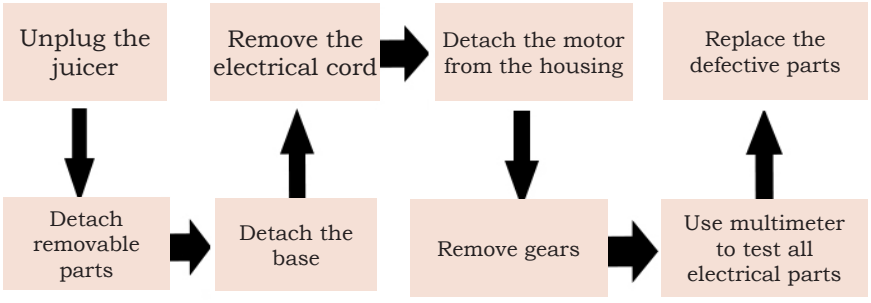


Fig. 3.108: Flow chart of repairing a juicer

Fig. 3.109: Serviced juicer set

Practical Activities

Practical Activity 11

To demonstrate the repairing of the jammed blade of a jar.

Material Required

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

Procedure

1. Unlock the screw of the base unit of an electric mixer and remove the mixer's housing as shown in Fig. 3.110.

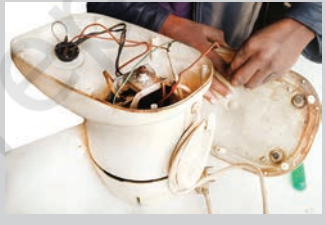


Fig. 3.110: Removing the mixer's housing

2. Unlock the nut of an electric motor as shown in Fig. 3.111 and carefully remove the electric motor, so that connection is not damaged.

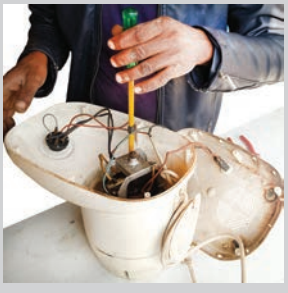


Fig. 3.111: Removing the nut of an electric motor

3. Lubricate the shaft of the armature using oil. A typical shaft of mixer motor is shown in Fig. 3.112.

(a)

(b)

Fig. 3.112 (a): Shaft of the mixer motor (b): Armature of the mixer motor

4. Keep it for some time and then using hand or plier, twist the motor shaft as shown in Fig. 3.113.

Fig. 3.113: Rotating the shaft of motor using hand

5. Reassemble an electric motor using screwdriver in the mixer's housing as shown in Fig. 3.114.

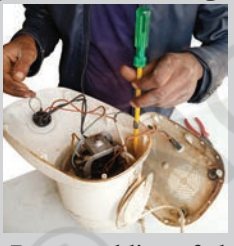


Fig. 3.114: Reassembling of electric motor

Practical Activity 12

To disassemble an electric mixer and identifying its various components

Material Required

Mixer, screwdriver and combination plier

Procedure

1. Unlock the screw of an electric mixer to remove the mixer's housing.

Fig. 3.115: Unlocking the housing of the motor

2. Remove the overload switch, rotary switch, motor and indicator from the motor housing.

Fig. 3.116: Different parts in the base unit of an electric mixer

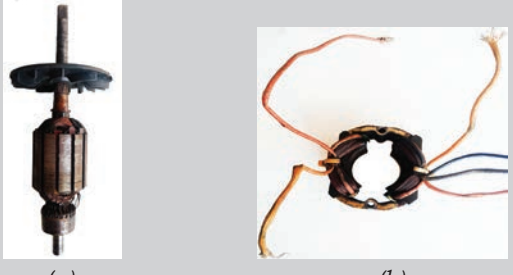
3. Identify the overload switch. It has two terminals and push button. A typical overload switch is shown in Fig. 3.117.

Fig. 3.117: Overload switch

4. Identify the rotary switch. It has five terminals. A typical rotary switch is shown in Fig. 3.118.

Fig. 3.118: Rotary switch of an electric mixer

5. Identify an electric motor. It has two types of winding, i.e., armature winding and field winding. An armature winding and stator winding is shown in the Fig. 3.119(a) and 3.119(b).



(a) *(b)*

Fig. 3.119 (a): Armature winding (b): Stator winding

6. Field winding of stator has two terminals at one side and four terminals on the other side as shown in Fig. 3.120.

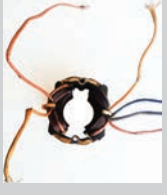


Fig. 3.120: Two and four terminals of the stator winding

7. Identify the indicator. It has two terminals. A typical power indicator is shown in Fig. 3.121.

Fig. 3.121: Power indicator of a mixer

Practical Activity 13

To test the field winding of a dysfunctional motor.

Material Required

Motor, mixer, screwdriver, tester and combinational plier

Procedure

1. Unlock the screw of an electric mixer to remove the mixer's housing.

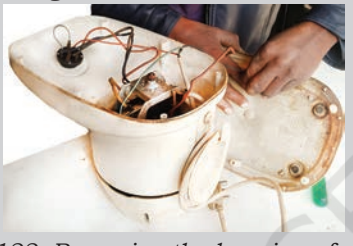


Fig. 3.122: Removing the housing of a mixer

2. Remove the motor.

Fig. 3.123: Unlocking the AC series motor

3. Use continuity test lamp to check whether an electric motor winding is short or having some other problem. While checking the motor, observe two points:
   - In the case the bulb in continuity testing lamp turns ON with full intensity, it means an electric motor winding is short.
   - In the case the bulb in continuity testing lamp is OFF, it means that an electric motor winding is open.
4. Identify the different speed control terminals of an electric motor as shown in Fig. 3.124.

Fig. 3.124: Identification of terminals of the motor

5. Check the stator winding of AC series motor. There are two types of winding—field winding and armature winding. Speed of the motor can be controlled using field winding. Terminals of field winding or stator winding of an electric motor are shown in Fig. 3.125.

Fig. 3.125: Speed control terminals of the stator winding

6. Now, connect the rotary switch to these terminals of field winding. Terminal 1 of the speed control winding is connected to point 0 of the rotary switch, and terminal 2 and terminal 3 of stator winding are connected to points 1 and 2 of the rotary switch. Wiring diagram of an electric motor is shown in Fig. 3.126.

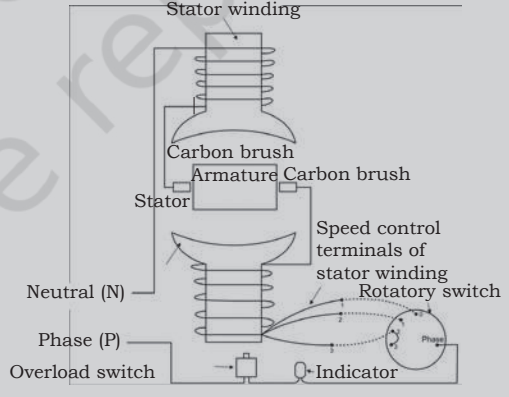


Fig. 3.126: Wiring diagram of an electric mixer

7. Connect the phase terminal of the rotary switch to the phase wire of the input power supply as shown in Fig. 3.127. A typical wiring diagram to test field winding is shown in Fig. 3.127.

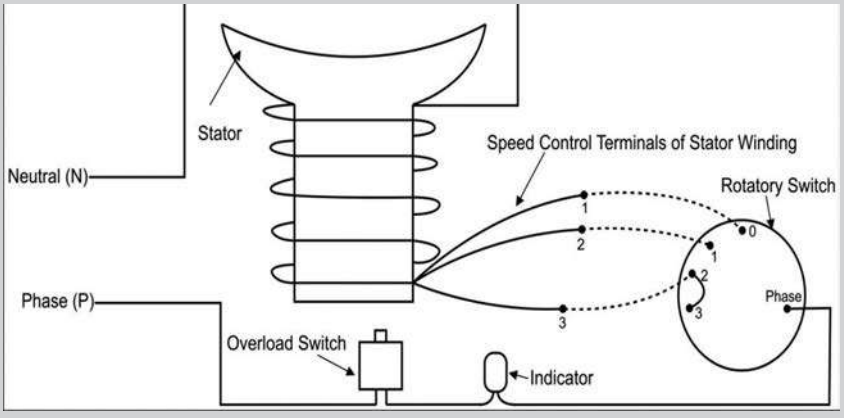


Fig. 3.127: Wiring diagram to test field winding

Practical Activity 14

To demonstrate the assembling of various parts of an electric mixer using the circuit diagram.

Material required

Circuit diagram of an electric mixer, different parts of a mixer and AC power supply

Procedure

1. Connect the phase of the power supply to one end of the overload switch.
2. Connect the other end of the overload switch to one end of the indicator lamp.
3. Connect the other end of the indicator lamp to the phase point of the rotary switch.
4. Connect the speed control terminals of the stator winding to the points of the rotary switch.
5. Connect terminal 1 of the speed control winding to point 0 of a rotary switch.
6. Connect terminal 2 of the speed control winding to point 1 of a rotary switch.
7. Short circuit the points 2 and 3 of a rotary switch using a wire.
8. Connect terminal 3 of the speed control winding to point 2 of a rotary switch.
9. Connect the stator and armature winding using a carbon brush as shown in Fig. 3.128.
10. One part of the stator is connected to the rotary switch, which we have discussed in the previous steps. Now, connect the other parts of the stator to the neutral winding of the power supply. The mixer is now completely assembled.

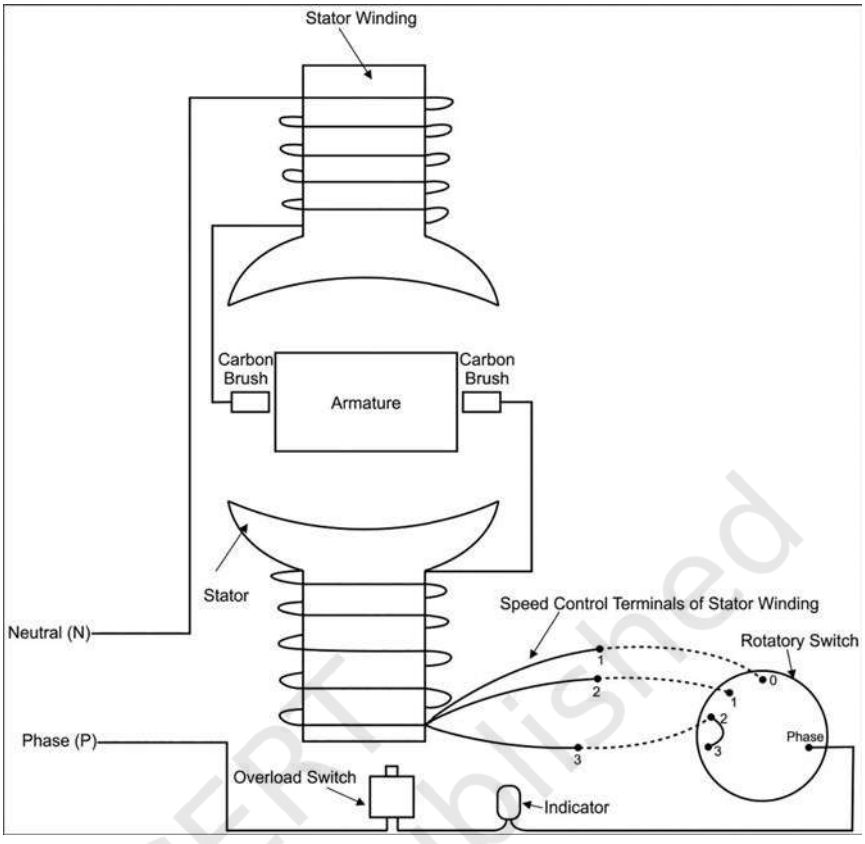


Fig. 3.128: Wiring diagram of an electric mixer

Safety measures before using a mixer grinder or juicer

Mixer grinder and juicer are usually used in every household. These appliances must be properly stored in the house. Some points that must be considered while storing the mixer grinder or juicer in the house are:

1. Keep the appliance on an even platform at a convenient height.
2. Ensure that the appliance is at least 6 inches away from the wall.
3. Leave sufficient space around the appliance.
4. Keep appliances away from heat and sunlight.
5. Do not use an extension cord to give a power supply to the mixer grinder or juicer.
6. Remove the power cord from the socket when you are cleaning the mixer's base unit.

Safety measures for operating mixer grinder or juicer

While operating the mixer grinder or juicer, there are some points that need to be followed by the user. These are:

1. Read all instructions, operating procedures and safety precautions before using the mixer grinder or juicer.
2. Do not put the appliance in water.
3. Unplug the appliance when not in use, before cleaning or removing any part.
4. Do not operate if the cord or plug is damaged.
5. Outdoor use of the appliances should be avoided.
6. Do not let the cord hang from the edge of the table or counter.
7. Ensure that the appliance cover is securely clamped.
8. Do not unfasten clamps while the appliance is running.
9. Do not leave the appliance unattended around children.

Electric Water Heater or Geyser

A geyser is an electrical appliance used to heat water in our households. Geyser provides real-time heating of water. If we compare a natural geyser with an electric geyser, we can say that both heat water. But, in the case of a natural geyser, hot water will come out from the surface of the earth due to the natural heat present inside the earth, whereas an electric geyser uses electric power to heat the water. In this section, we will learn about the installation and repair of an electric geyser.

Fig. 3.129 (a): Natural geyser (b): Electric geyser

An electric water heater or geyser is the most commonly used home appliance to heat water. Geyser consists of a water tank fitted with two pipes—one for an inlet of cold water and the other for an outlet of hot water. Heating rods are used to heat the water. These heating rods are fitted with thermostats. Thermostats ensure that water is not heated above a preset temperature. The tank is

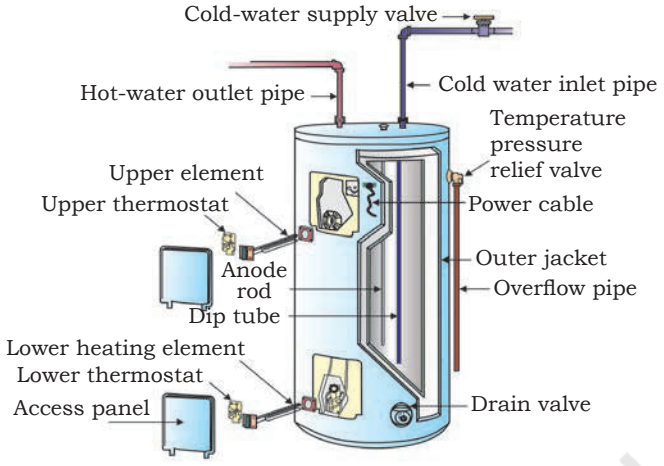


Fig. 3.130: Cut section of an electric geyser

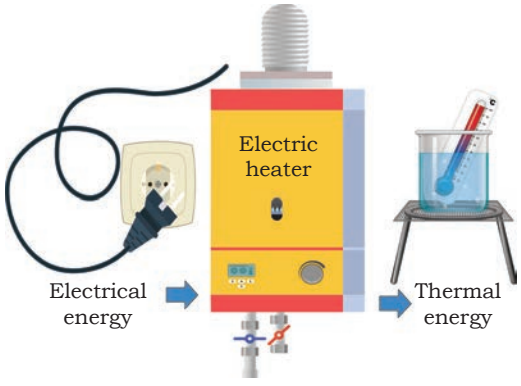


Fig. 3.131: Conceptual view of energy transformation

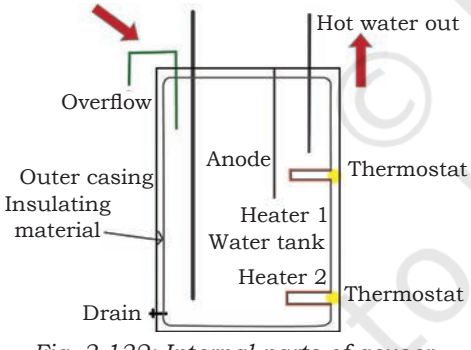


Fig. 3.132: Internal parts of geyser

normally covered with some insulating material and enclosed inside a metal casing.

Working principle of geyser

Geyser simply converts electrical energy into thermal energy. This conversion is done using heating elements to raise the temperature of water by conducting heat through water.

The heating elements do not function simultaneously. First, the top heating element functions until the upper tank becomes hot. After that, the function is transferred to the bottom heating element. These heating elements have their own thermostats. The thermostat switches the heating system on and off accordingly. It detects the temperature when the temperature of the geyser falls below the preset temperature, it switches on the thermostat and switches off when the temperature reaches the value of preset temperature. The internal parts of the geyser are shown in Fig. 3.132. Geyser has a number of parts, such as thermostat, heater, inlet, outlet and outer casing:

1. ***Thermostat:*** It is a device that automatically regulates temperature in the system or appliance. It deactivates an appliance, when the temperature reaches a preset temperature.

2. ***Heater:*** It is a metal rod used to heat the water in the geyser's water tank. The water tank is fitted with heating elements, which are controlled by thermostats.
3. ***Inlet:*** It is a metal pipe used for putting the cold waterin the geyser.
4. ***Outlet:*** It is a metal pipe used for releasing the hot water from the geyser.
5. ***Outer casing:*** It is an outer case used to protect the geyser from the external environment.
6. ***Overflow:*** An overflow pipe is used for releasing extra water into the geyser's water tank.
7. ***Drain:*** It is a metal pipe used to empty the water tank of the geyser at the time of cleaning.

Types of geysers

Water heater is of three types, which are as follows:

1. Normal plate heater

It is used for heating a small amount of water for some minor purposes. Its construction is very simple; it consists of two round nickel plates joined together with just an insulator between them. The outer surface is insulated by a plastic round plate. Both the round nickel plates are set with a gap of 2 mm with the help of an insulator. A typical normal plate heater is shown in Fig. 3.133.

Fig. 3.133: Normal plate heater

2. Immersion heater

The heater which needs to be immersed in water to heat the water is called an immersion heater. 250 watts to 2 kilowatts immersion heaters are available in markets. The body is made of a metallic substance. The heating element is made of copper which is installed inside the capillary tube. The tube is formed in a coil shape. The capillary tube is filled with magnesium oxide which works as an insulator. A typical immersion plate heater is shown in Fig. 3.134.

Fig. 3.134: Immersion plate heater

3. Geyser heater

The basic principle of water geyser is simple. In this

heater, an electric heating element is used to heat the water stored in a storage tank. The only difference is that, unlike normal immersion-type water heaters, it can automatically control the temperature of water by

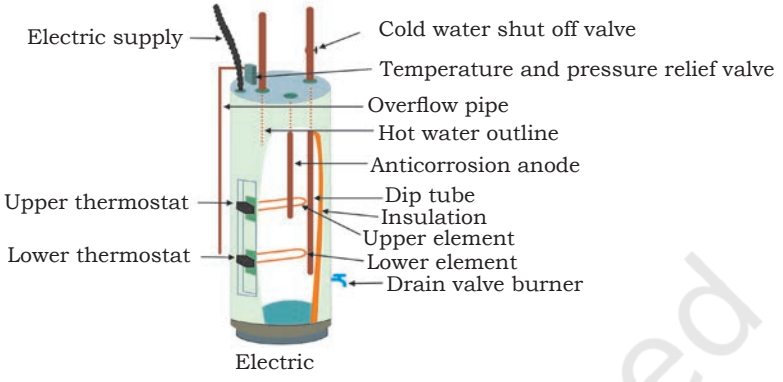


Fig. 3.135: Electric water heater

controlling the operating period of the heating elements in the geyser, which is not possible in a normal immersion-type water heater. A typical geyser heater is shown in Fig. 3.135.

Note: Safety is extremely important during the installation, operation and servicing of this water heater. Safety while working will reduce the potential hazard.

Pre-installation checklist

It is the cross-checking of location, water pipe layout, wiring diagram and required tools:

I. Location

1. Make sure that the water heater is not located close to a power supply.
2. Do not install the geyser in an open area.
3. Make sure that the geyser is not installed near flammable substance.

II. Water piping

1. Make sure that the inlet of a geyser is connected to a cold water supply.
2. Make sure that temperature and Pressure Relief Valves (PRV) are installed.
3. Make sure that all plumbing connections are free from water leakage.

4. Make sure that water heater rods are completely immersed in a geyser's water storage tank.

III. Wiring

1. Make sure that the input power supply from the socket matches the voltage requirement of the geyser.
2. Make sure that the correct size of wire and circuit breakers are used to supply power to the water heater.
3. Make sure that the geyser is electrically grounded.
4. Cross-check the electrical connection to avoid an electric shock.

Parts required for installation

Check the available parts of the geyser which is to be installed. The parts required are:

1. Thermostat
2. Thermostat switch
3. Dip tube
4. Insulation
5. Upper heating element
6. Lower heating element
7. Inlet cold water pipe

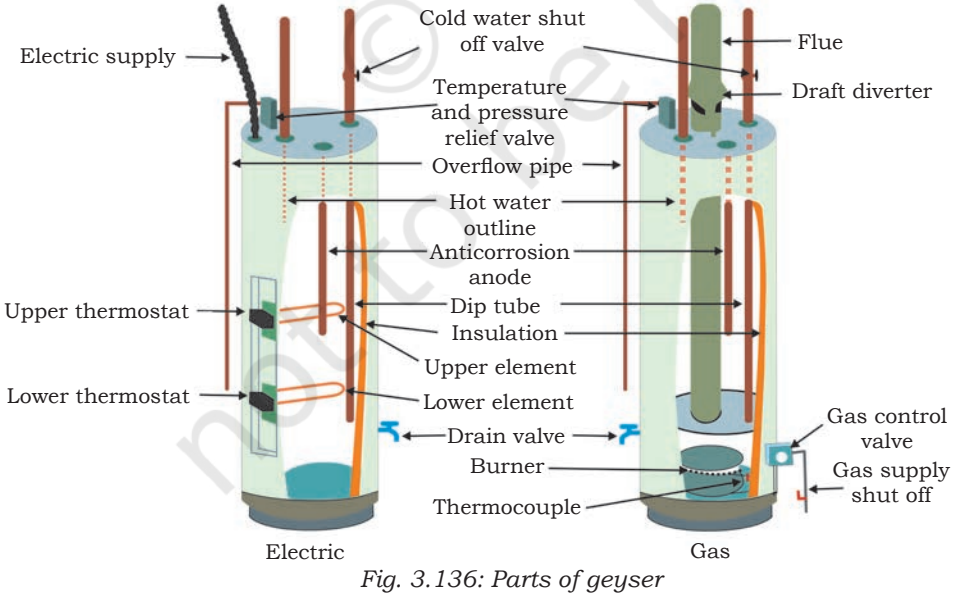


Fig. 3.136: Parts of geyser

8. Outlet hot water pipe
9. Cold water supply valve
10. Overflow pipe

Tools required for installation

The required tools are:

1. Pipe wrench
2. Spanner
3. Drill machine and drill bits
4. Hammer
5. Teflon tape
6. Fasteners
7. Nails
8. Self-tapping screw

Table 3.2: Some Common Problems, their Causes and Remedies

Condition	Cause	Remedy
No hot water	Main power supply is 'OFF'	Turn 'ON' main power supply
	Burnt fuse	Replace with new fuse
	Circuit breaker has tripped	Reset circuit breaker
	Circuit breaker is defective	Replace with new circuit breaker
	Defective thermostat	Replace with new thermostat
	Defective heating element	Replace with new heating element
Not able to provide enough hot water	Water heater is undersized	Install the size of water heater that meets demand
	Demand for high temperature of water	Increase the temperature of the thermostat
	Cold water supply	Increase the temperature of the thermostat
	Wrong piping connections	Install correct piping
	Sediment or lime accumulation at the bottom of water heater	Drain water heater. Check to see if water treatment is necessary
	Hot water plumbing system leaks	Check hot water plumbing system for leaks and repair
	Thermostat was adjusted too low	Increase the temperature of the thermostat
	Defective thermostat	Replace with new thermostat
	Defective element	Replace with a new element. In 90 per cent of all cases, it is the bottom element
	Long runs or exposed piping	Insulate piping
	Hot water piping on an outside wall	Insulate piping

Continuous heating is not performed by a water heater	Water heater is undersized	Install the size of water heater that meets demand
	Element wattage too small	Replace with a higher element wattage
	Thermostat is not in contact with water heater	Position it properly. Be sure that insulation is not interfering with thermostat
	Thermostat temperature set too low	Increase the temperature of the thermostat
	Defective thermostat	Replace with new thermostat
Heating element failure	Wiring connections are wrong	Perform correct wiring
	Wiring connections are loose	Locate, clean carefully and reconnect properly
	Lightning or Power surge	Inspect or replace fuse, element and thermostat
	High voltage	Check with electrical utility and correct
	Short circuit	Locate the short circuit and repair
Thermostat failure	No power	Inspect fuse or circuit breaker, replace or reset
	Loose wiring connection	Locate, clean carefully and reconnect properly
	Lightning or Power surge	Inspect or replace fuse, element and thermostat
	Low or High voltage	Check with electrical utility and correct
	Short circuit	Locate short circuit and repair
Blown fuse or circuit breaker	Wiring connections are wrong	Perform correct wiring
	Wiring connections are loose	Locate, clean carefully, reconnect properly
	Lightning or Power surge	Inspect or replace fuse, element and thermostat
	High voltage	Check with the electrical utility and correct
	Short circuit	Locate short circuit and repair
	Power supply wiring is undersized	Use correct wiring size
Fuse burns instantly	Short-circuit	Locate short circuit and repair
Burning of wire	Lightning or Power surge	Inspect or replace fuse, element and thermostat
	Low or High voltage	Check with electrical utility and correct
	Power supply wiring is undersized	Use correct wiring size

Service wires are hot	Wiring connections are wrong	Perform correct wiring
	Water heater not properly grounded	Properly ground the water heater
	Lightning or Power surge	Inspect or replace fuse, element and thermostat
	High voltage	Check with electrical utility and correct
	Short circuit	Locate short circuit and repair
	Power supply wiring undersized	Use correct wiring size
Drain valve leaks	Drain valve is open	Close the drain valve
	Defective drain valve	Replace with new drain valve
Water drips from the relief valve	Excessive water pressure	Install a pressure reducing valve
	Thermal expansion in a closed water system	Install a suitable expansion tank on the cold water supply line
	Improperly seated relief valve	Check whether relief valve works properly and replace, if necessary
	Defective thermostat	Replace with a new thermostat
	Defective relief valve	Replace with a new relief valve
Water on the floor or drain pan	Water discharge from the relief valve	See pressure build-up in a water system
	Element leakage	Replace with a new element
	Water heater leakage	Replace with a new water heater
Condensation	Water heater filled for the first time	Let water heater warm up. Problem should be solved. If it persists, check all plumbing connections for leaks.
	Heavy draws of hot water with very cold refill water	Let water heater warm up. Problem should be solved. If it persists, check all plumbing connections for leaks.
	Water heater is undersized	Install the size of water heater that meets demand
Wet insulation	Leaking plumbing connections	Locate leak and repair
	Leakage around heating element	Tighten, clean and smooth face of tank flange and element gasket
	Water discharge from the relief valve	See pressure build-up in a water system
Traces of rust in the hot water	Anode has been eaten away	Replace with a new anode
Rusty water	Water corrosion	Replace with a new water heater
Rotten egg smell	High sulphate or mineral content in water	Change magnesium anode to an aluminium anode and bleach in the water heater
Tank bulged	No relief valve installed	Install a proper relief valve
	Excessive water pressure	Install a pressure reducing valve
	Thermal expansion in a closed water system	Install a suitable expansion tank on the cold water supply line

CHECK YOUR PROGRESS

A. Multiple Choice Questions

1. Which of the following is not a 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) Overload Protector
3. OLP stands for:
   (a) Automatic Over Protector
   (b) Overload 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
   (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 used to control the temperature of the heating element in a water tank?
   (a) Metal rod
   (b) Thermostat
   (c) Coupler
   (d) Heater
7. Geyser converts the _____ energy into _____ energy.
   (a) Chemical to electrical
   (b) Electrical to chemical
   (c) Electrical to thermal
   (d) Thermal to electrical
8. Which of the following is used to control the speed of mixer?
   (a) Overload switch
   (b) Rotary switch
   (c) Power switch
   (d) Control switch
9. Which of the following is not a type of water heater?
   (a) Normal plate water heater
   (b) Immersion water heater

(c) Geyser water heater
(d) Round plate water heater

10. Which of the following is a type of mixer?
(a) Planetary mixer
(b) Stand mixer
(c) Spiral mixer
(d) All of the above

B. Fill in the Blanks

1. Rotten eggs smell in the water is due to _____ or mineral content in water.
2. In geyser, heating element is made of _____ which is installed inside the capillary tube.
3. In case of more load, _____ switch will get activated.
4. To make a hole on the wall, _____ machine is used.
5. Motor converts the electrical energy into _____ energy.

C. State whether 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. Thermostat is a temperature controller in mixer.
6. Overload protection device is used in the geyser.
7. Rotary switch regulates the speed of the mixer motor.
8. Armature is a part of motor.
9. Stator is a dynamic part of motor.
10. In a normal plate heater, both the round nickel plates are set with a gap of 2 mm with the help of an insulator.

D. Answer in Brief

1. What are the types of mixer?
2. Name the parts of a mixer.
3. Write the steps of assembling and disassembling of motor.
4. Write down the steps of using juicer.
5. List out the parts of the electric geyser.
6. What is the role of auto load switch?
7. Write down the steps to clean the juicer.

Chapter 4

Repair and Maintenance of Microwave Oven

171276CH04

The process of cooking has slowly evolved with time. During the Stone Age, when there was a scarcity of fuel and humans had not yet learned how to light a fire, it was not easy to consume food. However, with the introduction of new technologies, cooking food has become easier, healthier and faster. A Microwave Oven is one such technology that has made our lives easier. In this chapter, we are going to understand the need, operation and troubleshooting of a microwave oven.

(a) (b)

Fig. 4.1 (a): Traditional technique of cooking food (b): New technique of cooking food

Microwave as a Source of Energy

These days high-tech devices are an integral part of our daily lives. One of the high-tech cooking devices is the microwave oven. Microwaves are one of the forms of energy, namely electromagnetic energy. It is a natural phenomenon. Today, in the world of technology, microwave energy is being used in the microwave oven.

It transforms the electrical energy into heat. In a microwave oven, a part known as magnetron is the heart of the oven. It uses electrical energy to produce microwaves in the cooking cavity of the oven. Microwaves have a large amount of heat-carrying capacity. This heat evenly cooks the food.

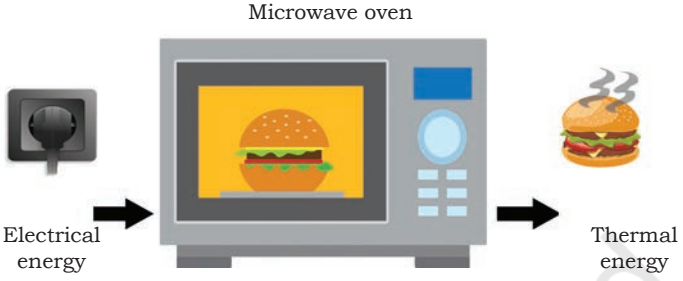


Fig. 4.2: Conceptual view of energy transformation in microwave oven

Microwave ovens cook food by emitting microwaves, a type of electromagnetic radiation, which penetrates the food and causes water molecules to vibrate. This molecular movement generates heat, cooking the food from the inside out.

Microwave oven composition

In general, microwave oven consists of the following sections:

1. ***Heating room:*** The heating chamber or 'oven cavity' is specifically designed to focus microwave energy onto the food placed inside. It has a turnable tray system and a fire door. A typical heating room is shown in Figure 4.3.
2. ***Microwave source:*** It is mainly composed of magnetron, transformer, high-voltage capacitor and high-voltage diode. Some components of a microwave oven are shown in Figure 4.4.

Fig. 4.3: Food in the heating room of microwave oven

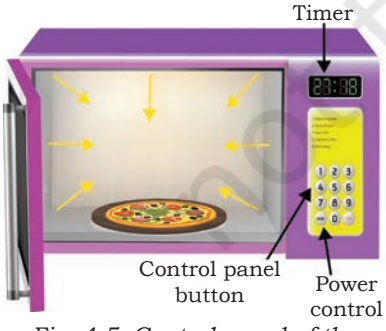


Fig. 4.5: Control panel of the microwave oven

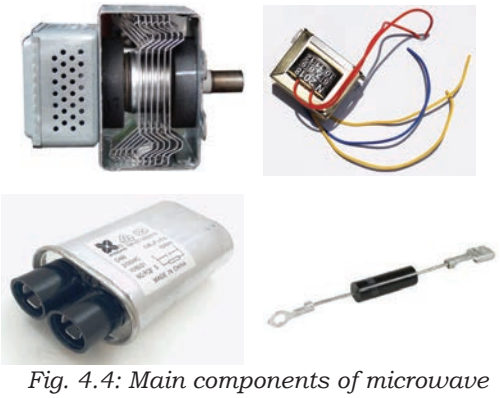


Fig. 4.4: Main components of microwave

3. ***Control panel:*** It is composed of a timer, a power selector and different operating buttons. A typical control panel is shown in Figure 4.5.

External parts of a microwave oven are shown in Figure 4.6.

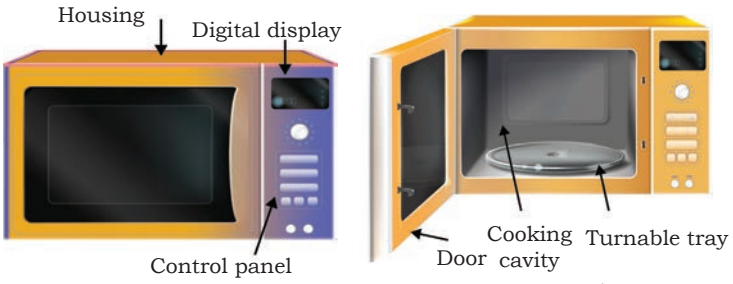


Fig. 4.6: External parts of microwave oven

The major internal parts of a microwave oven are:

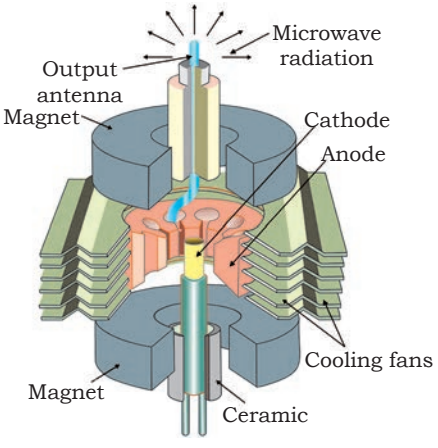


Fig. 4.7: Internal parts of magnetron

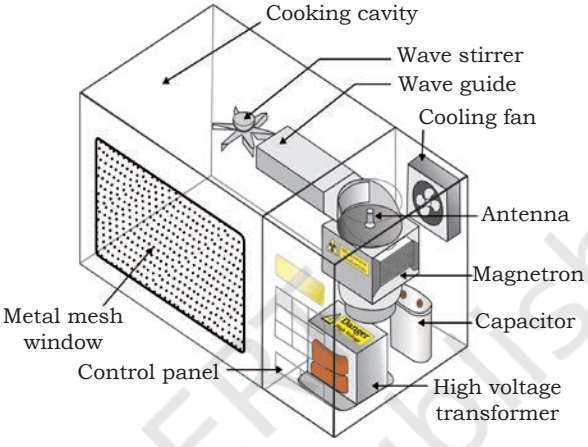


Fig. 4.8: Internal parts of microwave oven

1. ***Magnetron:*** It is the component through which microwaves are produced in the microwave oven. For this reason, it is also known as the heart of a microwave oven.
2. ***Thermostat:*** It is a device that activates when the oven reaches the preset temperature.
3. ***Input power supply:*** It is the electrical power supply of 230 V AC to the microwave oven.
4. ***High voltage transformer:*** A high voltage transformer is used to step up and step down the input voltage in the microwave unit.
5. ***High voltage capacitor:*** It is used to provide a large amount of charge in the microwave unit.
6. ***Relay:*** It is used to provide protection against the high amount of current in the microwave unit.
7. ***Printed circuit board:*** In these, active and passive components are soldered on a circuit board.
8. ***Fuse:*** It is used for the overcurrent protection in the microwave unit.

Fig. 4.9: Thermostat

Fig. 4.10: High voltage transformer

Fig. 4.11: High voltage capacitor

Fig. 4.12: Relay

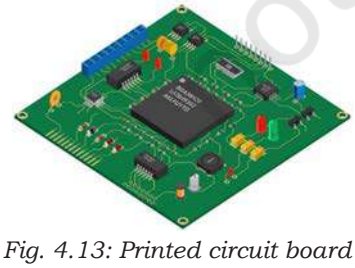


Fig. 4.13: Printed circuit board

Fig. 4.14: Fuse

Fig. 4.15: Cooling fan

9. ***Cooling fan:*** It is used to radiate the heat produced in the microwave unit.

Assignment

- List out the areas where microwaves are used.
- What is the frequency range of a microwave?
- Do an online research on why microwaves are able to heat up or cook the food.

Microwave oven operating principle

Microwave ovens use microwaves for cooking food, where a magnetron acts as the heart of the microwave oven. It is the source of microwaves. Magnetron supplies constant and reliable energy in the form of microwaves to the oven. To monitor and control the temperature, a control system is used. This control system regulates the multi-voltage regulation circuit. Microwaves produced by the magnetron are 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.

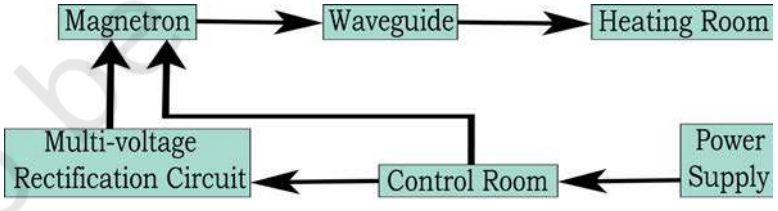


Fig. 4.16: Block diagram of microwave oven operation

Working in a microwave oven

The 230 V AC input power is supplied through the power cord. The power circuit board has some components. Pre-filter is used to filter the noise elements present in the power supply. The power board also has a fuse for overcurrent protection. From there, the power will pass to the printed circuit board via the thermostat. A 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 the printed circuit board, relays are used to prevent the flow of excessive current. From these relays, power is transferred to the high-voltage transformer. High voltage transformer has one primary winding and two secondary windings. One secondary winding is used to step down the applied 230 V, while the other secondary winding is used to step up the applied 230 V. Step-down secondary winding will reduce the applied voltage to 3.3 V. Step-up secondary winding will increase the applied voltage to 2000 V. High voltage capacitor is charged by the transformer's step up secondary winding. This will form approximately 4000 V, which is the sum of 2000 V of the transformer and 2000 V of a capacitor. This 4000 V AC is converted into DC using a high voltage diode. Magnetron has a cathode and anode. 4000 V DC and 3.3 V DC at the cathode and anode are applied respectively. After taking a large amount of applied voltage, the magnetron starts working.

Assignment

- What is the specific role of transformer in the microwave?
- What is the role of magnetron?

Caution: Microwave ovens work on high voltage and current. Technicians should be cautious while installing and repairing these parts, as these parts can result in an electric shock. The following parts of a microwave oven operate on high voltage and current:

- High voltage capacitor
- High voltage transformer
- Magnetron
- High voltage rectifier assembly
- High voltage wires

Practical Activities

Practical Activity 1

To demonstrate the dismantling of microwave oven.

Material required

Multipurpose screwdriver and microwave oven

Procedure

1. Take a microwave oven. Fix a driver on the screws of microwave housing.

2. Unscrew the screws fixed on the microwave oven's housing.

Fig. 4.17: Unscrewing the microwave oven housing

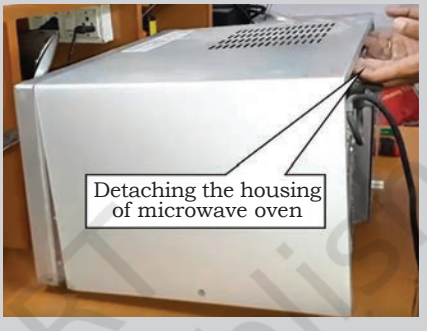


Fig. 4.18: Slide to remove the housing

3. Slide and detach the microwave oven's housing as shown in Figure 4.18.
4. To install the microwave oven housing, carefully push and slide it inward, ensuring both sides align properly with the assembly, and lift the turn-up edge to fit securely into the cavity.

Practical Activity 2

To test the thermostat of the microwave oven.

Material Required

Multipurpose screwdriver, continuity tester and a microwave oven.

Procedure

1. Detach and unscrew the housing of a microwave oven.
2. Detach the thermostat from the magnetron.

Fig. 4.19: Thermostat on magnetron

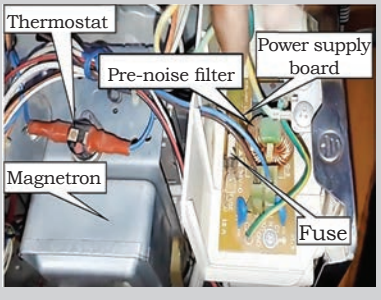


Fig. 4.20: Power supply board and magnetron with the thermostat

3. Test the thermostat using continuity tester. If the light is glowing, that means relay is working properly as shown in Figure 4.21.

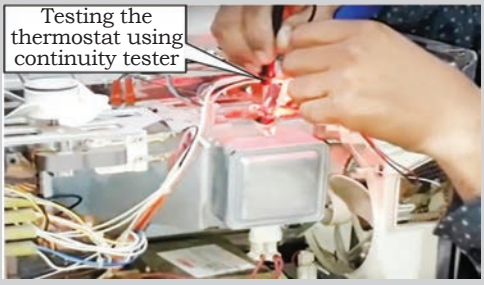


Fig. 4.21: Testing the thermostat using continuity tester

4. If during continuity testing the thermostat is found to be damaged, replace it.

Practical Activity 3

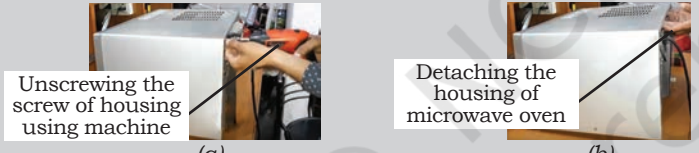
To test the relays in the Printed Circuit Board (PCB) of microwave oven.

Material Required

Multipurpose screwdriver, continuity tester and microwave oven.

Procedure

1. Detach the housing of the microwave oven as shown in Figure 4.22.



(a) *(b)*

Fig. 4.22 (a): Unscrewing the microwave oven's housing (b): Slide to remove the housing

2. Pull relay plug out of PCB. A typical relay on printed circuit board is shown in Figure 4.23.

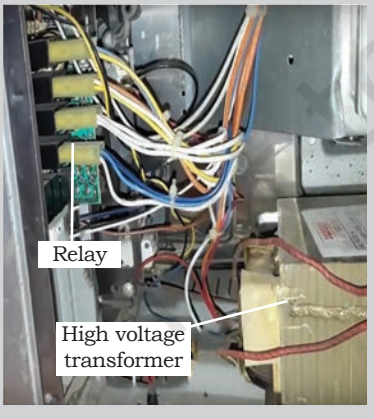


Fig. 4.23: Printed circuit board with relay

Fig. 4.24: Relay mounted on the PCB

3. Test the continuity of the relays using continuity tester.

Practical Activity 4

To test the transformer fixed in the microwave oven.

Material Required

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

Procedure

1. Detach the housing.
2. Identify the transformer, fuse and high voltage capacitor on the baseboard of a microwave oven.

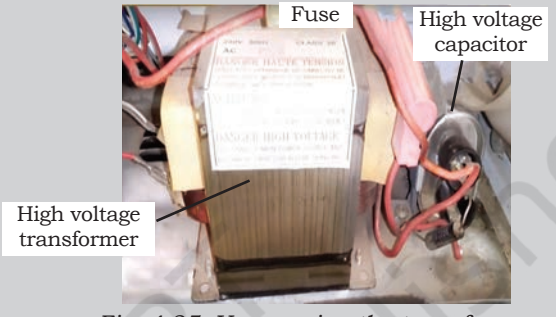


Fig. 4.25: Unscrewing the transformer

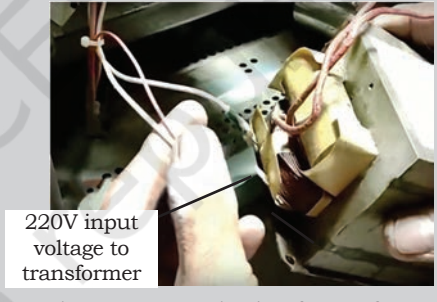


Fig. 4.26: Terminals of transformer

3. Pull out the wiring plug of the primary and secondary winding of transformer as shown in Figure 4.27.

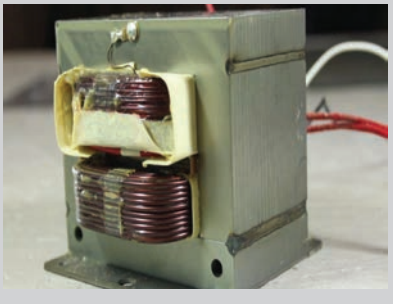


Fig. 4.27: Microwave oven transformer

4. Now, cautiously turn ON the power supply and check the electromagnetic field on the transformer using screwdriver as shown in Figure 4.28.

Fig. 4.28: Checking the electromagnetic field of transformer using transformer

5. If there is a magnetic field on the core of the transformer, it means that the transformer is working properly.

Practical Activity 5

To assemble and dismantle the magnetron and its testing.

Material Required

Multipurpose screwdriver, continuity tester, microwave oven and simple screwdriver

Procedure

1. Detach the housing of a microwave oven.
2. Unscrew and pull out the wiring plug of the magnetron as shown in Figure 4.29.

Fig. 4.29: Unscrew the magnetron from the microwave oven housing

3. Dismantle the magnetron from the housing as shown in Figure 4.30.

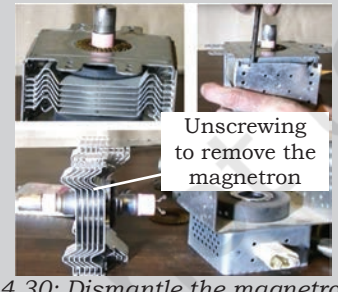


Fig. 4.30: Dismantle the magnetron from its housing

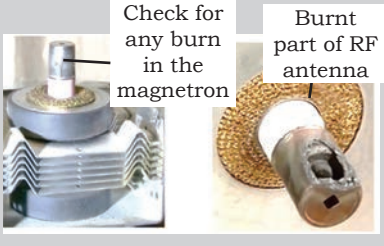


Fig. 4.31: Check for any burn in the magnetron

4. Check the magnetron for any burn or damage in the anode and cathode as shown in Figure 4.31 and 4.32. Use continuity tester to test the anode and cathode

terminal of the magnetron. If there is continuity between the anode and cathode that means magnetron is working properly.

5. Check any breakage or crack in the magnet of the magnetron as shown in Figure 4.33.

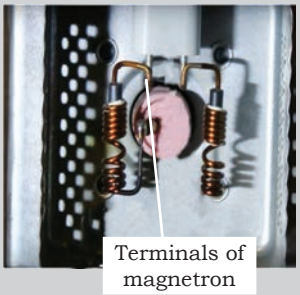


Fig. 4.32: Anode and cathode of magnetron

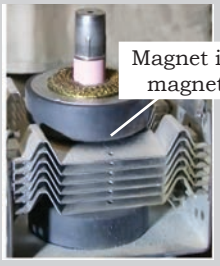


Fig. 4.33: Magnet in magnetron

Practical Activity 6

To test the fuse of microwave oven.

Material Required

Multipurpose screwdriver, microwave oven and a simple screwdriver.

Procedure

1. Detach the housing of microwave oven.
2. Identify and pull out the fuse connecting transformer and high voltage capacitor as shown in Figure 4.34. Test it using continuity tester; if it is found to be discontinuous in the continuity testing, replace the fuse.

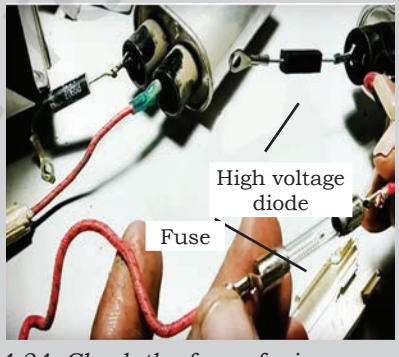


Fig. 4.34: Check the fuse of microwave oven

Practical Activity 7

To test the high voltage capacitor.

Material Required

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

Procedure

1. Remove the housing of a microwave oven.
2. Identify the high voltage capacitor and diode as shown in Figure 4.35.

Fig. 4.35: High voltage capacitor and diode

3. Take a nose plier and use it to discharge the capacitor. Carefully, short the terminals of capacitor using nose pliers as shown in Figure 4.36.

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

Fig. 4.36: Discharging capacitor using nose plier

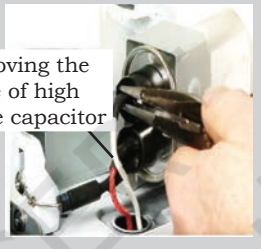


Fig. 4.37: Removing wire using nose plier

4. After discharging the capacitor, remove the wires connected to the capacitor terminals using nose pliers as shown in Figure 4.37. Check the capacitor using continuity tester.

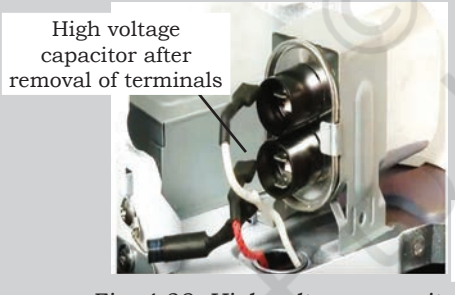


Fig. 4.38: High voltage capacitor after removal of terminals

Fig. 4.39: Removal of high voltage capacitor

5. If the capacitor is found to be shorted, replace it. Remove the bracket of the capacitor mounted on the body of microwave oven as shown in Figure 4.39.
6. Replace the capacitor with same parameters, such as capacitance value and voltage rating.

Fig. 4.40: Capacitor parameters printed on the body of high voltage capacitor

7. Mount the capacitor on the body of the microwave oven, connect the wire to the terminals of the new capacitor as shown in Figure 4.41.

Fig. 4.41: Replacing the high voltage capacitor

Assignment

- List out the hand tools required in repairing microwave oven.
- Search on the internet about the ratings of high voltage capacitors used in microwave ovens.

Assignment

Identify and name the following parts.

				
Fig. 4.42	*Fig. 4.43*	*Fig. 4.44*	*Fig. 4.45*	*Fig. 4.46*

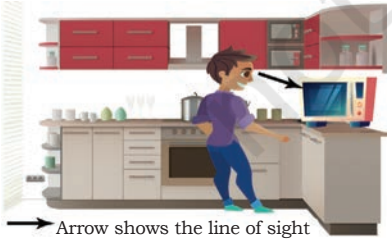


Fig. 4.47: Line of sight lower than eye level

Safety measures before using microwave oven

Nowadays, microwave ovens are used in every household, but only a few people are aware of the correct way of storing them. A microwave oven:

1. Should be kept at an eye level or below.
2. Should be kept at least at a distance of three feet from any combustible material. Figure 4.48 shows

the wrong practice of keeping the microwave oven near a gas burner.

3. Should be kept at a distance from all such objects that block air vents or prevent air circulation. Figure 4.49 shows the wrong practice of placing the microwave oven in a wooden box.

Fig. 4.48: Microwave oven kept near the burner

Some safety measures which need to be followed, while operating the microwave oven are:

1. Read any warning messages, instructions, operating procedures and safety precautions.

Fig. 4.49: Microwave oven kept in a wooden box

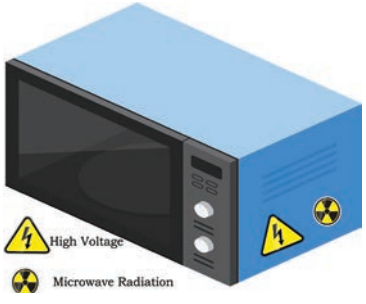


Fig. 4.50: Caution mentioned on the housing of microwave oven

2. Do not operate the unit when it is empty. Figure 4.51 shows the wrong practice of operating an empty microwave oven.

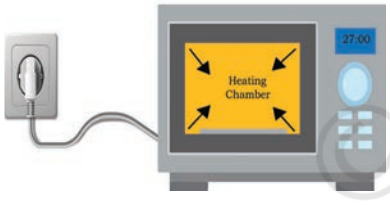


Fig. 4.51: Do not operate empty microwave oven

Fig. 4.52: Storage in microwave oven cavity

3. Do not use it for storage. Figure 4.52 shows the wrong practice of storing in a microwave oven's cavity.
4. Do not operate if the door does not close.
5. Report if the microwave oven is defective.
6. Do not stand directly against or in front of an oven for a long period of time.
7. Do not leave food unattended.

Fig. 4.53: Microwave with open door

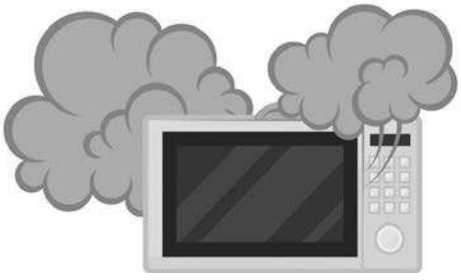


Fig. 4.54: Lack of monitoring can result in a fire

8. Any uncooked egg (with or without shell) or nut should not be heated in a microwave oven. Figure 4.55 shows the wrong practice of putting an egg into the oven.

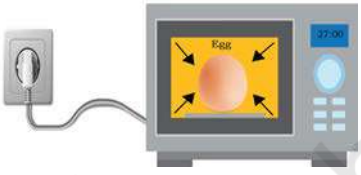


Fig. 4.55: Putting an egg into the microwave

9. Any sealed cans or bottles of food should not be kept in the microwave oven.

Before cooking in a microwave oven, follow the precautions given below:

1. Check if utensils are suitable.
2. Check the voltage of the microwave oven.
3. Check if the food is suitable for heating in a microwave oven.
4. Carefully read the instructions written on the food package before heating.
5. Wear gloves while removing food from the microwave oven to avoid getting scalded.

CHECK YOUR PROGRESS

A. Multiple Choice Questions

1. Which of the following parts produce microwaves 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 a high-voltage capacitor?
   (a) By making the terminals of the capacitor open
   (b) By making the terminal capacitor short
   (c) By leaving the capacitor for a few seconds
   (d) By connecting a diode to the capacitor
4. How far should a microwave oven be kept from any combustible material?
   (a) One foot
   (b) Two feet
   (c) Three feet
   (d) No specific distance
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 a high voltage capacitor?
   (a) Side cutter plier
   (b) Electrician knife
   (c) Nose plier
   (d) Plier
7. Which of the following components is 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 ovens?
   (a) Magnetron increases the voltage
   (b) Transformer steps up the direct current (DC)
   (c) Thermostat restricts the excessive heat in a microwave oven
   (d) Capacitor has a 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 a high heat-carrying capacity
   (d) Microwaves have a high wavelength
10. Which of the following is not a part of a microwave oven?
    (a) Control panel
    (b) Cooking cavity
    (c) Turntable
    (d) Variable frequency controller

NOTES

B. Fill in the Blanks

1. Magnetron is called the _____ of a microwave oven.
2. Magnetron converts the _____ energy into heat.
3. Microwaves have high _____ carrying capacity.
4. Microwaves produced by magnetron is guided by the _____ towards the cooking chamber.
5. In microwave ovens, thermostats are used to protect the circuit from excessive _____.
6. Relays are used in microwave for protection against _____.
7. Magnetron has two terminals _____ and _____.
8. In the printed circuit board, _____ are used to prevent the flow of excessive current.
9. Transformer works on _____ voltage.

C. State whether True or False

1. Relays are used to generate the microwaves in microwave ovens.
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 tray system and fire door.
6. Magnetron is the part which acts as the source of microwaves.
7. Thermostat is a device which turns the microwave oven off, if it reaches the preset temperature.
8. While replacing high voltage capacitor in microwave, one should discharge the capacitor first.
9. Breakage in the permanent magnet of transformer can also be a possible error.

D. Answer in Brief

1. Explain the term microwave as a source of energy.
2. Make a block diagram of how a microwave oven works.
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 a thermostat in microwave ovens.
6. What are the precautions needed to be taken while dealing with high voltage capacitor?
7. What issue will occur in a microwave, if magnetron stops working?
8. Which material is used in the manufacturing of microwave oven? Search on the Internet.

Chapter 5

Workplace Health and Safety Measures

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Safety is important in any workplace. Workplace safety 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 potentially harm the technicians and other workers at the workplace. 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. Technicians must first recognise hazards at their workplaces.

When technicians install or assemble any machine, they may have to face hazards which are related to the workplace. These hazards are associated with the installation and assembly process of electronics. Technicians should be aware of the hazards associated with the installation of electrical and electronic devices such as water purifiers. Many of the hazards can be avoided by being aware and taking appropriate precautions.

Fig. 5.1: Electrical hazards

Electrical Hazards

An electrical hazard is a dangerous condition related with electrical systems such as energised equipment or a conductor at a workplace. If a technician comes

in contact with these equipment, then they may get injured. There is a possibility of getting the shock, receiving an arc flash burn, thermal burn or blast injury while 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 the workplace.

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

I. ***Watch out for cords and wires:*** Loose cords and wires can cause various electrical hazards as shown in Fig. 5.2. If a cord or wire crosses a pathway it should be marked with hazard tape as shown in Fig. 5.3.

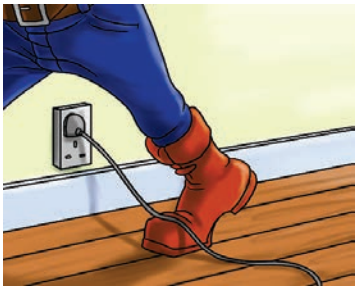

Fig. 5.2: Loose cord can be hazardous

II. ***Wear proper personal protective equipment:*** The kind of Personal Protective Equipment required around a machine will depend upon the machine and the task that an employee is performing. Nevertheless, safety gloves, safety helmets, safety glasses, earplugs and other gear are important to use where necessary. For safety, signs can be posted near panels reminding employees to wear PPE.

Fig. 5.3: Hazard tape

Fig. 5.4: Personal protective equipment

Fig. 5.5: Flame resistant clothing

III. ***Practice caution around heat sources:*** Some panels and equipment get hot while operating. Everyone should be aware of these areas and practice caution when nearby. PPE like gloves or flame–resistant clothing may be required in these areas.

IV. ***Be careful when cleaning:*** When cleaning around a panel or equipment, one should note other possible hazards such as:

Fig. 5.6: State of mind in workplace

1. Fire and explosion hazards
2. Risk of electric shock

V. Follow visual and written instructions: There should be panels and equipment with signs and labels on them alerting employees to possible hazards.

VI. Practise caution while testing or replacing the components in the panel: All voltage ranges are equally dangerous. Even the low voltage, which cannot produce electrical shock, can be dangerous for human health. It should not be ignored, otherwise a person may get an electric shock because of poor earthing. A person should first ensure that the circuit which is to be checked or operated must be OFF. Some other cautions that need to be followed are:

1. 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, resulting in an electrical shock.

Fig. 5.9: Do not plug in the cable directly into a socket

Fig. 5.10: Avoid water while working with electricity

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

Fig. 5.11: Damage on the conductor

Fig. 5.12: Miniature circuit breaker

3. If you are repairing an electrical device, always turn off the main supply.
4. Always use insulated tools while working.

Fig. 5.7: Equipment cleaning spray

Fig. 5.8: Different warning signs and instructions

Fig. 5.13: Insulated tools

Fig. 5.14: Phase tester

Fig. 5.15: Colour code of wires

5. Never try repairing energised equipment. Always check if it is de-energised by using a tester.
6. Be aware of the wire codes of your country.

Chemical Hazards

1. If chemicals are improperly stored, there can be a chemical leak.
2. If the technicians do not take safety measures, these chemicals may cause damage.
3. As shown in Fig. 5.17, the oil should be carefully filled in the transformer.

Fig. 5.16: Improper storage of chemical

Fig. 5.17: Manual filling of oil in transformer

Fig. 5.18: Replacing oil in transformer

Fig. 5.19: Filling oil in the transformer using oil filling machine

4. Mishandling of chemicals due to inadequate training or negligence can cause severe problems.

Fig. 5.20: Mishandling of chemicals

Fig. 5.21: Exposure to toxic substance can cause illness

5. Diseases and environmental issues can be caused by exposure to toxic substances in the workplace.

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

1. Chemical burns
2. Itchy or burning eyes
3. Nausea, vomiting and diarrhoea
4. Headache
5. Fever
6. Rapid heart rate

Fig. 5.22: Read all labels for work safety

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. It has an agent which is discharged to extinguish a fire. A fire extinguisher should always be available at a workplace. Different parts of a fire extinguisher are shown in the Fig. 5.23.

Fig. 5.23: Parts of fire extinguisher

Practical Activities

Practical Activity 1

To demonstrate the operation of a fire extinguisher in case of a fire emergency.

Material required

Fire extinguisher and burning emergency setup

Procedure

The steps to use a fire extinguisher are shown in Fig. 5.24.
Step 1: Identify the safety pin of the fire extinguisher, which is generally present in its handle.
Step 2: Break the seal and pull the safety pin from the handle.
Step 3: Use the fire extinguisher by squeezing the lever.
Step 4: Sweep it from side to side.

Fig. 5.24: Steps to open the seal and safety pin of a fire extinguisher

Practical Activity 2

To demonstrate various types of fire extinguishers and their extinguishing material.

Material required

Different types of fire extinguishers

Procedure

Depending upon the cause of fire, different fire extinguishers are used:

1. Class A: Used to extinguish burning of paper, wood, cloth, and plastic.

2. Class B: Used to extinguish burning of gasoline, grease, oil, and petrol.

3. Class C: Used to extinguish burning of electrical cables, wires, and equipment.

4. Class D: Used 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 for Electrical Emergencies

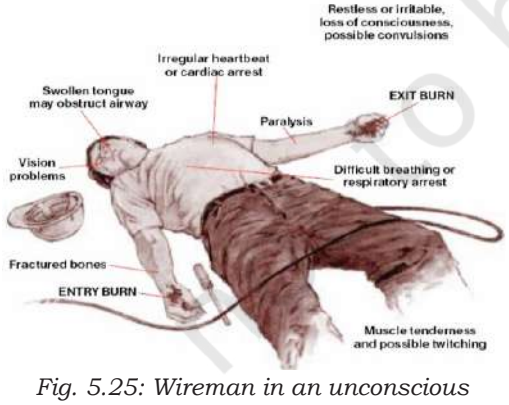

Fig. 5.25: Wireman in an unconscious state due to electrical shock

Electrical accidents cause countless injuries. If correct rescue techniques and treatments are used, many lives can be saved from the effect of an electric shock. The risk of electric shock is always present closer to the electrical appliance, thus a person should be alert around such appliances. Timely response and treatment of victims are major concerns. When an electrical accident occurs, a victim is often incapable of moving or releasing the electrical conductor due to the effect of muscle cramping. During any accident or emergency, caution should be the

first priority. Proper planning and scheduling have to be done while going for electrical maintenance or work.

Rescue techniques

I. Approaching the accident

1. Never rush into an accident scene.
2. Call 108 as soon as possible.
3. Approach the accident scene cautiously.

II. Examining the scene

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

Fig. 5.26: Victim in contact with energised conductor

2. Metal surfaces or objects near the victim themselves may be energised.
3. 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.
4. Switch off the electrical circuits, if possible.

III. Hazards and solutions

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

Fig. 5.27: Use of non-conductive material to rescue the victim

Fig. 5.28: Gloves and shoes for safety

IV. High voltage rescue

1. In case of high voltage, special training is required for rescues.
2. Protective equipment, such as gloves and shoes must be worn.

V. First aid

1. A victim may require Cardio pulmonary Resuscitation (CPR). The steps to perform CPR are shown in the Fig. 5.29, 5.30 and 5.31.

Fig. 5.29: Chest compression

Fig. 5.30: Open mouth for airway

Fig. 5.31: Rescue breathing

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

Assignment

Identify and name the activities shown in the following picture.

Fig. 5.32

Fig. 5.33

Fig. 5.34

CHECK YOUR PROGRESS

A. Multiple Choice Questions

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 items is not essential for a technician while working on electrical appliances?
   (a) Safety boots
   (b) Gloves
   (c) Helmet
   (d) Belt
4. Class B type of extinguisher is used to extinguish the fire which is caused due to _____.
   (a) Gasoline, grease and oil
   (b) Plastic, paper and cloth
   (c) Combustible metal
   (d) Kitchen material
5. Class A type of extinguisher is used to extinguish the fire which is caused due to _____.
   (a) Gasoline, grease and oil
   (b) Plastic, paper and cloth
   (c) Combustible metal
   (d) Kitchen material

6. Class C type of extinguisher is used to extinguish the fire which is caused due to _____.
   (a) Gasoline, grease and oil
   (b) Plastic, paper and cloth
   (c) Combustible metal
   (d) Electrical cable and wire
7. Class D type of extinguisher is used to extinguish the fire which is caused due to _____.
   (a) Gasoline, grease and oil
   (b) Plastic, paper and 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. 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

1. While working with electricity, the technician must wear _____ gloves and shoes.
2. Defective or inadequate insulation may result in _____.
3. The class C type of fire extinguisher is used in case of burning of _____.
4. CPR stands for _____
5. The steps to perform CPR are Chest Compression, Open mouth for airway and _____.
6. The class A type of fire extinguisher is used in the burning of _____.
7. Suppose a computer system starts burning due to overload in that case _____ fire extinguisher is preferred.
8. If the burning is caused due to petrol, it will require a class _____ type of extinguisher.
9. Improper storage of chemicals may increase the risk of _____
10. While working near a heated machine, which is operating for a long time, one must wear _____.

C. State whether 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 heat to the electrical system.
6. Use non-conductive material to remove a victim from the conductor.
7. Electric wires have different colour codes.
8. When a technician repairs an electrical device, he or she should always turn off the main supply.
9. Do not touch the victim or conductive surfaces while they are energised.
10. Class K fire extinguisher is used when a fire occurs due to materials like wood, paper, and plastic.

D. Answer in Brief

1. What are the factors that result in a hazard?
2. List out the various precautions to be taken in a workplace.
3. What are the precautions to be taken for preventing electric shock while on the job?
4. How can CPR be performed?
5. Write down the steps necessary for correctly operating a fire extinguisher in case of a fire emergency.
6. What are the potential hazards of installing an electrical panel?
7. Compare the different types of fire extinguishers.
8. Brief the different classes of fire.
9. What first aid measures must be taken in case of an electrical shock?
10. In India, what is the specific colour code for wire?

ANSWER KEY

Chapter 1: Electrical Machines and Overcurrent Protection Device

A. Choose the Correct Option from those Given Below.

1.(b) 2.(a) 3.(c) 4.(b) 5.(a)
6.(d) 7.(d) 8.(d) 9.(b) 10.(d)

B. Fill in the Blanks with Correct Word.

1. Mixer
2. Stepper
3. Synchronous and asynchronous
4. Left
5. Electromagnet induction
6. Electrical and mechanical
7. Porcelain base
8. Rotor
9. Stator
10. Short circuit

C. State whether the Statement Given Below is True or False

1.(F) 2.(T) 3.(F) 4.(T) 5.(F)
6.(T) 7.(F) 8.(T) 9.(F) 10.(F)

Chapter 2: Tools and Equipment

A. Choose the Correct Option from those Given Below.

1.(b) 2.(a) 3.(b) 4.(c) 5.(a)
6.(d) 7.(b) 8.(d) 9.(a) 10.(c)

B. Fill in the Blanks with Correct Word

1. Cutting and gripping
2. 2 inch and 48 inch
3. Soldering
4. Clamp
5. Analog and digital
6. Electric glue
7. Rigid and rollable
8. Neon
9. Drill machine
10. Current

C. State whether the Statement Given Below is True or False

1.(T) 2.(T) 3.(T) 4.(F) 5.(F)
6.(T) 7.(T) 8.(F) 9.(T) 10.(T)

Chapter 3: Repair and Maintenance of Mixer and Geyser

A. Choose the Correct Option from those Given Below.

1.(d) 2.(d) 3.(b) 4.(d) 5.(d)
6.(b) 7.(c) 8.(b) 9.(d) 10.(d)

B. Fill in the Blanks

1. High sulphate
2. Copper
3. Overload
4. Drill
5. Mechanical energy

C. State whether the Statement Given Below is True or False

1.(F) 2.(T) 3.(T) 4.(F) 5.(T)

6.(T) 7.(T) 8.(T) 9.(F) 10.(T)

Chapter 4: Repair and Maintenance of Microwave Oven

A. Choose the Correct Option from those Given Below.

1.(a) 2.(b) 3.(b) 4.(c) 5.(d)
6.(c) 7.(c) 8.(c) 9.(a) 10.(d)

B. Fill in the Blanks with Correct Word

1. Heart
2. Electrical
3. Heat
4. Waveguide
5. Heat
6. High amount of current
7. Anode, cathode
8. Relays
9. 230V

C. State whether the Statement Given Below is True or False

1.(F) 2.(T) 3.(F) 4.(T) 5.(T)

6.(T) 7.(T) 8.(T) 9.(F)

Chapter 5: Workplace Health and Safety Measures

A. Choose the Correct Option from those Given Below.

1.(d) 2.(c) 3.(d) 4.(a) 5.(b)

6.(d) 7.(c) 8.(d) 9.(d)

B. Fill in the Blanks with Correct Word

1. Rubber
2. Electrical Shock
3. Electrical equipment
4. Cardiopulmonary Resuscitation
5. Rescue breathing
6. Paper, wood, plastic and cloth
7. Class C
8. B
9. Chemical leak
10. Rubber gloves and shoes

C. State whether the Statement Given Below are True or False

1.(F) 2.(F) 3.(T) 4.(F) 5.(F)

6.(T) 7.(T) 8.(T) 9.(T) 10.(F)

GLOSSARY

Alternating Current (AC): *It refers to an electric current that reverses direction at regular intervals. The abbreviation AC is commonly used.*

Ammeter: *It is a meter which is used to measure the amount of electric current flowing in an electric circuit.*

Amperage: *It refers to the strength of an electrical current. It is measured in amperes.*

Amplitude: *It is the maximum absolute value reached by a voltage or current waveform.*

ANSI: *It stands for American National Standards Institute. It is an institute for the development of technology standards in the United States.*

Architecture: *In computing, it is the description of basic components and basic operations of a chip. Each processor family has its own architecture. Assembly language is a programming language used in a particular processor.*

Armature: *It is a rotating part of a motor which is used to generate the magnetic field in the motor.*

Automation: *It is the creation and application of technologies to produce and deliver goods and services with minimal human intervention.*

Bearing Ball: *It is a rolling element, which is used to reduce the friction in a rotating part of a machine.*

Cabinet: *It is a closed box, which acts as a safety box for the electrical and electronic components.*

Cable: *Alternatively referred to as a cord, connector or plug, a cable consists of one or more wires covered with plastic. It transmits power or data to devices or locations.*

Capacitance: *It is the property of a capacitor to hold charge. It is measured in Farad.*

Capacitor: *It is a device used in electrical circuits. A capacitor stores an electrical charge for a short duration, and then, returns it to the circuit. Common types of capacitor include tantalum, electrolytic, ceramic and film capacitors.*

Cathode: *It is a type of electrode through which electrons move.*

Charging: *It is the time required to charge the capacitor.*

Clamp Meter: *It is an electrical test tool that combines a basic digital multimeter with a current sensor. It is also called tong tester.*

Coil: *It refers to a series of circles formed by the winding of an insulated wire, which creates a magnetic field when an electric current passes through the circles.*

Conductor: *It is a substance that allows electricity or heat to pass through it.*

Conduit: *It is a pipe, channel, tube or trough for protecting electrical wires or cables from environmental effects.*

Conveyor: *It is a system in which mechanical devices or assemblies are used to transport material with minimal effort.*

CPU: *It is the processor of a computer. It also acts as a heart of the computing system.*

Direct Current (DC): *It refers to electric current flowing in one direction only (i.e., current produced using a battery). The abbreviated form DC is commonly used.*

Discharging: *It is the time required for the discharging of a capacitor.*

Drill Machine: *It is a handheld tool primarily used for making round holes.*

Driver: *In computing, a device driver is a computer program that operates or controls a particular type of device that is attached to a computer.*

Earth: *It is the connection between electrical installation systems via a conductor to the buried plate in the ground.*

Earthed: *When an electrical device, appliance or wiring system is connected to the earth through an earth electrode, it is known as an earthed device or 'earthed'.*

Electricity: *It is a form of energy produced from charged elementary particles, usually, supplied as electric current through cables, wires, etc., for lighting, heating, driving machines, etc.*

Electric Motor: *It is an electrical machine that converts electrical energy into mechanical energy.*

Electromagnet: *It is a coil of wire, usually, wound on an iron core, which produces a strong magnetic field when current is passed through the coil.*

Electro Motive Force (EMF): *It is the measurement of energy that causes current to flow through a circuit. It can also be defined as the potential difference in charge between two points in a circuit.*

Enclosure: *It is an area that is surrounded by a barrier*

Fault Current: *It is the electrical current, which flows through a circuit during an electrical fault condition.*

Filter: *It is a circuit, which allows a particular range of frequency signals.*

Frequency: *It is the rate at which a sound or electromagnetic wave vibrates per unit of time. It is expressed in Hertz (Hz).*

Fuse Box: *It houses the fuse used in the control panel.*

Galvanized Steel: *It is a manufacturing process where a coating of zinc is applied to steel or iron to offer protection and prevent rusting*

Ground Fault: *It refers to inadvertent contact between an energised conductor and ground or equipment frame.*

Notes

IEEE: *It is the abbreviated form of the Institute of Electrical and Electronic Engineers.*

Indicator: *It is used to indicate the state or level of something.*

Insulator: *It is a material or device used to prevent heat, electricity or sound from escaping something. In other words, it is a material whose internal electric charges do not flow freely. Little electric current will flow through it under the influence of an electric field. This is opposite to other material, semiconductors and conductors, which conduct electric current easily.*

Inverter: *It is a power electronic device or circuitry that changes Direct Current (DC) to Alternating Current (AC).*

kWh: *It is a measure of electrical energy equivalent to power consumption of one watt for one hour.*

LED: *It stands for Light Emitting Diode. A semiconductor material is used in their manufacturing.*

Load: *It is an electrical component or portion of a circuit that consumes (active) electric power.*

Lug: *It is used to connect electrical devices and cables. This ensures the safe handling of cables and wires. Usually one end of the electrical lug is used for connecting a cable to an electrical device.*

Magnetic Flux: *It is defined as the number of magnetic field lines passing through a given closed surface.*

Microcontroller: *It is a compact integrated circuit designed to execute a specific operation in a system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.*

Microprocessor: *It is an electronic component that is used by a computer to do its work. It is a central processing unit on a single integrated circuit chip containing millions of very small components including transistors, resistors, and diodes that work together.*

Multimeter: *It is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter can measure voltage, current and resistance.*

Mutual Induction: *It is a phenomenon in which an EMF is induced across a coil, due to the rate of change current in adjacent coil.*

NEC: *It is a standard for safe installation of electrical wiring and equipment.*

NEMA: *It stands for National Electrical Manufacturers Association.*

Power Supply: *It is an electrical device that supplies electric power to electrical and electronic loads.*

Pulley: *It is a wheel on an axle or shaft that is used to transfer the power between the shaft and cable or belt.*

Push Button: *It is a simple button which is used to control the switch mechanism in a machine or a process*

Rectifier: *It is a device that converts AC power supply to DC power supply.*

Relay: *It refers to an electrically controlled device that opens and closes electrical contacts to affect the operation of other devices in the same or another electrical circuit.*

Rotor: *It is the rotating part of an electric generator and motor.*

RS-232: *It is a standard connector used for the transmission of data. It is widely used in industrial communication devices. It is used for point to point transmission of data.*

RS-485: *It is a standard connector used for transmission of data. It is widely used in industrial communication devices. It is used for point-to-multipoint transmission of data.*

Semiconductor: *It is a solid material, whose electrical conductivity at room temperature is between that of a conductor and an insulator. The most common semiconductor material is silicon.*

Sensor: *It is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure and many more.*

Silicon: *It is a chemical element with the symbol 'Si' and atomic number 14. It is a hard, brittle crystalline solid with a blue-grey metallic lustre. It is a tetravalent metalloid and semiconductor.*

Sinewave: *Also called sinusoid, sine wave is a mathematical curve that describes smooth periodic oscillation. A sine wave is a continuous wave.*

Single-phase: *In electrical engineering, single-phase electric power is the distribution of alternating current electric power. It is a two-wire system. It has one phase and one neutral.*

Stator: *It is a stationary part of a rotary system found in electric generators and motors.*

Surge: *It is the sudden rise in the flow of charge due to thundering and lightning effects.*

Test Lamp: *It is a portable lamp with free leads to connect to various points of a faulty circuit to locate a defect.*

Three phase: *In electrical engineering, three-phase electric power is the distribution of alternating current electric power. It is a four-wire system. It has three phases and one neutral. It is used for high-voltage requirements.*

Toggle: *It is defined as the unstable state of a device, circuit and network.*

Torque: *It is the measure of the force that can cause an object to rotate about an axis.*

Transistor: *It is a small electronic device, containing a semiconductor and at least three electrical contacts used in a circuit as an amplifier, detector or switch.*

Transmission Towers: *These are large structures that support the high-voltage transmission lines. Transmission lines carry electricity over long distances.*

Trip: *It refers to the automatic opening (turning off) of a circuit by a circuit breaker*

Turbine: *It is a device that extracts thermal energy from pressurised steam or kinetic energy of fluid and uses it to do mechanical work on a rotating output shaft.*

USB: *It stands for Universal Serial Bus. It also establishes specifications for cables and connectors and protocols for connection, communication and power supply between computers, peripherals and other computers.*

Volt: *It is the unit of electric potential and its symbol is 'V'.*

Voltmeter: *It is a meter used to measure the supply voltage.*

LIST OF CREDITS

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