HOME MECHANICS

KENNETH UGO UDEZE

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By

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Preface

This book originates from notes used in teaching Home Mechanics courses at the third-year level of Home and Rural Economics of Federal Polytechnic Oko, Anambra State, Nigeria. With other materials gathered by the author following reading and research.

The content of each chapter was designed to accommodate undergraduate students in HND level of Polytechnics as the information presented were all made comprehensive enough to cover both classes of programs at their mid-course level.

Chapter 1 covers the basic knowledge and unit of measurement of Energy and Power as well as the conservation of energy principles. Chapter 2 covers simple tools such as Hammers, Spanners, Chisels with their applications. Chapter 3 talks about home appliances such as Electric Iron, Electric Heater with their maintenance.

Chapter 4 and 5 cover further home appliances like Blenders, Electric Stove and Washing Machines including their principles of operation and maintenance. Chapter 6, 7 and 8 further show the working principles of electric heaters such as Boiling Ring and Water Heaters, Refrigerator, Cooking Heating Systems like Gas Stove and Electric Stoves.

Chapter 9 and 10 cover household plumbing and voltage-water pressure, analogous their working related principles and general domestic water supply. Also, at the end of the chapters are enough review problems designed to help student exercise their level of comprehension of the treated matters, and by so doing internalize the underlying principles of lessons taught.

About the Author

Udeze Kenneth Ugo hails from Onicha Ugbo in Aniocha North Local Government Area in Delta State, Nigeria. He attended his primary school at Aniemeke Primary School Onicha Ugbo, Delta State, Nigeria and attended his secondary education at Model Secondary School Maitama, Abuja, FCT, Nigeria where he obtained his Senior School Certificate in 2003.

Between 2005 and 2010, he obtained his National Diploma (ND) and Higher National Diploma (HND) in Electrical and Electronics Engineering (Telecommunication and Electronics Options) with a CGPA of 3.68/4 i.e., Distinction Honors from Federal Polytechnic Oko, Anambra State, Nigeria. He also obtained his first degree in Electrical and Electronics Engineering (Power, Telecommunication and Electronics Options), in 2013 from the prestigious University of Ibadan, Oyo State, Nigeria with a CGPA of 5.8/7 i.e., a Second-Class Upper Division (2.1).

After his one year mandatory National Youth Service Corp (NYSC) in Electrical and Electronics Engineering Department in Federal Polytechnic Oko, Anambra State, Nigeria in 2015, he proceeded to obtain his Masters degree in Offshore Engineering in 2016, majored in Offshore Design and installations, Subsea umbilical cables designed, Installation and maintenance of offshore facilities, Submarine power cable design and maintenance, Subsea instrumentation and control system (E&I) from Offshore Technology Institute, School of Advance Engineering, University of Port-Harcourt, Rivers State, Nigeria. Then a second Masters degree in Electrical and Electronics Engineering and majored in Power System Engineering, from University of Lagos, Lagos State, Nigeria in 2023. He graduated with a CGPA of 4.7/5 i.e., Distinction Honors.

He is currently a staff of Federal Polytechnic Oko, Anambra State, Nigeria attached to Electrical and Electronics Engineering Department. He teaches Mathematics and Electrical Engineering courses.

He is presently prospecting for PhD admission overseas for researches in Renewable Energy.

1

INTRODUCTION

1.0 What is energy?

Your body gets energy from the food that you eat. This energy gives you the ability to do lots of work. You need energy to cut the lawn or dig a hole. Athletes who compete in marathons need to get lots of energy from their food to help them through the event. Machines also need energy for them to do work. A car would not go if it could not get energy from its fuel. A blender needs to get energy from the electricity it uses in order to work in the kitchen. Energy is the capacity to do work.

If a living thing has lots of energy, it can do lots of work. When it does the work, it transforms energy from one form to another. If a machine has lots of energy in its fuel, it can do lots of work. When it does the work, it transforms the energy into other forms.

1.1 Concept of Energy

Energy is the capacity or ability to do or perform work. It is denoted by E measured in Joules (J) and a scalar Quantity (all forms).

An example of energy, is a palm-wine tapper climbing tress who expends energy while lifting his weight.

However, anything that is capable of doing work has energy. A person pushing a car along a road is doing work on the car. The person is said to possess energy which he exercises by making the car move some distance. A student running around the school field has energy. A football player, a farm labourer and a mango falling from the top of the tree all possess energy. Work and energy are measured in the same unit, the joule.

1.2 Forms of Energy

i. Mechanical energy
ii. Heat or thermal energy
iii. Light energy
iv. Chemical
v. Electrical energy
vi. Atomic energy
vii. Solar energy
viii. Electromagnetic wave energy
ix. Sound Energy

a. *Electromagnetic wave energy:* The energy we get from the Sun travels through space as electromagnetic waves. These waves include light, ultraviolet (UV) light and infrared. Other examples of electromagnetic wave energy include radio waves, which carry radio, television and mobile telephone messages, X-rays and gamma rays. Electromagnetic waves carry energy in the form of electric and magnetic fields. We can see light with our eyes and we can feel the infrared energy by the warmth it produces. The UV light energy causes sunburn and skin cancer.

Sometimes the electromagnetic wave energy from the Sun is referred to as solar energy. Solar energy is just a mixture of several types of electromagnetic energy, namely light, UV and infrared.

b. *Heat energy:* When solar energy is absorbed by your skin or by any other material, the surface layer of that material gets warmer. The electromagnetic wave energy is absorbed by the material it hits, and is converted into heat energy. Some appliances produce heat energy that we do not want. Most television sets get warm because they produce some unwanted heat energy. When we do a lot of physical activity our body tends to produce more heat than we want and we start to perspire to help us cool. Heat energy is caused by the vibration of the atoms and molecules in a material. The hotter a material becomes the greater the vibrations of the atoms and molecules. When electromagnetic wave energy is absorbed by a material it makes the atoms in that material vibrate more strongly, thus making it warmer.

c. *Chemical energy:* The energy that is stored in the food we eat is stored as chemical energy. For example, sugar and fat both have a lot of chemical energy stored in them. You can look up how much chemical energy is stored in many foods by reading the labels on the packets. The amount of energy is measured in kilojoules (kJ). Many other chemicals contain lots of energy. The head of a match contains chemical energy. When it is struck the match, head burns brightly giving out heat and light energy.

Explosives contain large amounts of chemical energy, which can be released very quickly and cause great destruction if detonated. Fuels such as coal, oil and petrol contain chemical energy that we can use to generate electricity or to run machines and vehicles.

d. *Sound energy:* When you turn on a CD player you can dance to the music. The music travels as sound energy through the air from the speaker to your ears. Sound energy is produced by vibrating objects. If you gently touch the loud speaker, you can feel it vibrating with the music. The vibrating speaker causes the air to vibrate and these vibrations travel through the air as sound waves. When the sound waves reach your ear, they cause your ears to vibrate and your brain interprets these vibrations as music. Hitting a nail with a hammer or using a blender also produces sound waves, which travel through the air to your ear. Sound waves also travel through liquids such as water and through solids such as wood or metal. However, sound waves cannot travel through space because there is no matter in space to vibrate.

e. *Electrical energy:* A torch battery has chemical energy stored in it. When the battery is connected in a circuit, this chemical energy is changed into electrical energy, which is then carried by the electricity from the battery to a light globe where it can be changed into light. Electrical energy can also be produced by a generator, which is a which is used in power stations. Electrical energy can be used to drive an electric motor or make a hair dryer work. Electrical energy is carried by the electrons through a circuit.

f. *Mechanical energy:* There are two types of mechanical energy: stored energy (potential energy) and motion energy (kinetic energy). *Stored energy (potential energy)* When you stretch a rubber band you are storing energy in the rubber. You can feel this stored energy when you let it go. It can sting your fingers or it can zoom across the room. You can store energy in lots of other stretchy and squeezy materials, such as elastic, springs and stretch fabrics. When you jump on a trampoline, as you go down some of your energy is stored in the stretched springs around the edge of the mat. This energy is then used to help lift you high into the air on the rebound. Many old-fashioned clocks had a large metal spring inside them. When you wind the clock, you store energy in the spring. This energy is then used to keep the clock going for days. Another example of stored energy is when an object has been lifted. For example, when a brick is lifted above the ground it has stored energy in it. If it is let go, it will fall and do damage when it hits the ground. A high diver has lots of stored energy when they are on the diving platform. When they dive this stored energy helps make the splash when they hit the water. Stored energy is also called potential energy. Motion energy (kinetic energy) When a ball is bowled in a bowling alley it moves down the lane until it hits the pins at the other end. With a bit of skill, it will knock over many pins. The bowling ball had lots of motion energy which it used to knock the pins over. Any moving object has motion energy. A moving cricket ball has the energy to knock over the stumps. The motion energy in a moving car can do great damage if it hits another car. The wind has a lot of motion energy, and this can be used to turn windmills or wind generators. Motion energy is also called kinetic energy.

Potential energy/kinetic energy if an object is able to work, it is said to have energy. The spring of a watch has energy when wound up because it moves gear wheels as it thrown at the wicket has energy because it can knock down the stumps.

1.2.1 How to measure energy

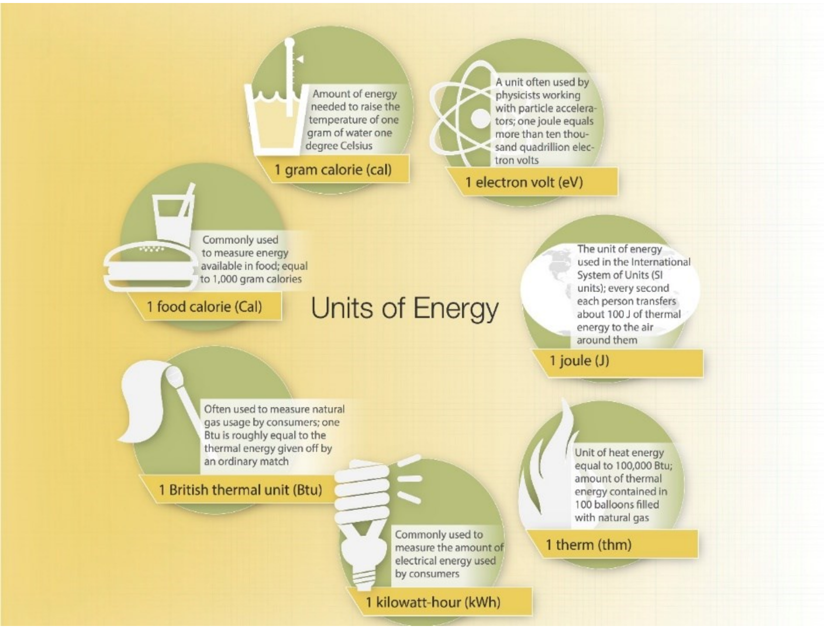


Figure 1.1 unit of energy

We measure energy in many different ways and for many different purposes. Quantities of energy given in one unit can always be converted to any other unit of energy. For example, 1gram calorie is equivalent to 4.186 joules, which is used to measure heat energy.

Many people are familiar with kilogram calories, which are often used to measure the energy available in food. One calorie is the amount of energy needed to raise the temperature of one kilogram of water by one degree Celsius. When you see calories on the back of a package, they indicate the total amount of food energy in that item.

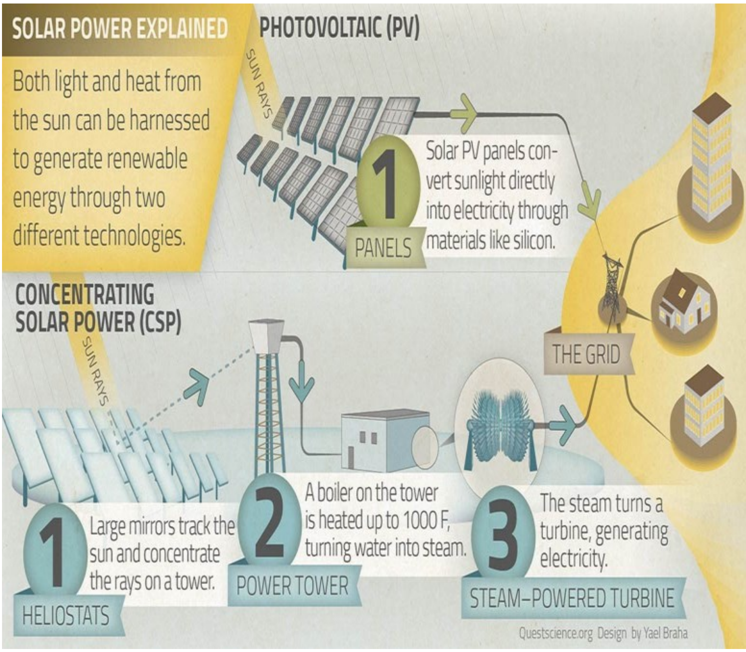


Figure 1.2 Solar Power Energy

Solar power is energy that comes from the sun. This energy can be captured and stored in many different ways. It is the ultimate source for most energy resources. It is also used directly to generate electricity.

One common solar energy technology is the solar panel. Solar panels are composed of a series of solar cells. Each cell is able to transform light energy into electrical energy — a technology called photovoltaics (PV). “Photo” means light and “voltaic” refers to the generation of electricity.

Concentrating solar power (CSP) technologies use mirrors and lenses to reflect and refract sunlight onto collectors where it is transformed into thermal energy. It can then be used to generate electricity.

Passive solar technologies make use of the sun’s energy without the need for active mechanical systems like lighting or furnaces. Buildings can be designed to make use of sunlight for heat and light, reducing the amount of electricity or gas needed to maintain a comfortable living or working environment.

Today many large-scale solar projects exist around the world including the Ivanpah solar thermal plant in the Mojave Desert. The biggest challenge for solar energy is making it affordable. Current projects, like the Ivanpah plant, cost billions of dollars making construction extremely expensive.

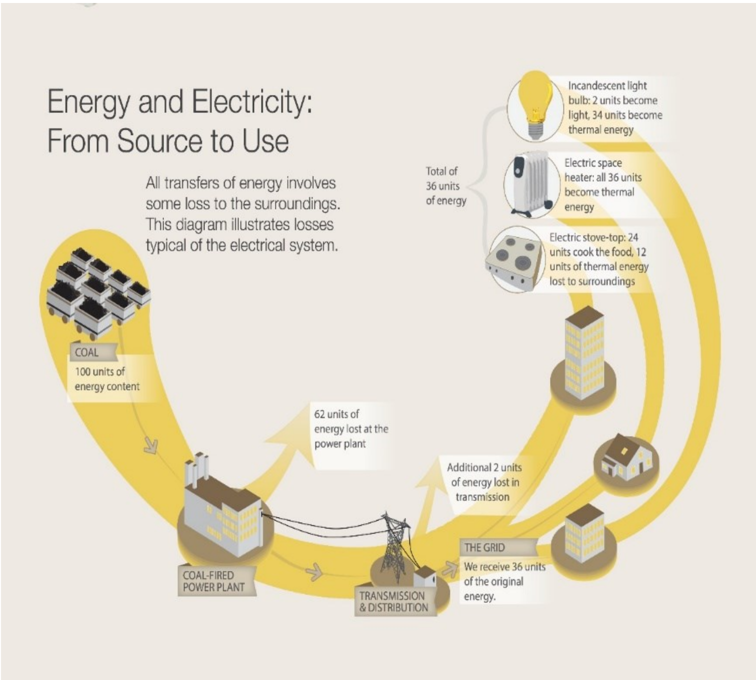


Figure 1.3 How Energy from Electricity is Generated

Energy can be transferred from one object to another. Energy can also be transformed from one form to another. As these actions happen, some of the energy is “lost” to the surroundings. This lost energy becomes thermal energy. This fact is known as the Second Law of Thermodynamics, which says that it is not possible to transfer or transform energy with 100 percent efficiency. The diagram above illustrates losses typical of the electrical system.

Another law of physics, the law of conservation of energy, says that energy can't be created or destroyed. It can only be transferred and transformed. This can be confusing when you think about how often you're asked to conserve energy — turn off lights, drive less, insulate buildings and so on. If there is a law of physics that says energy will be conserved no matter what we do, then why worry? The amount of energy in the universe isn't going to change.

It turns out that although the total amount of energy in the universe remains constant, the total amount available for human activities isn't constant. Humans transfer and transform energy from resources in the environment in very intentional ways for very specific purposes.

These energy resources can be nonrenewable resources, such as fossil fuels and nuclear energy, or renewable resources, such as solar, wind, water, geothermal, and biomass energy. Nonrenewable energy resources are available in limited supply. Using less of, or conserving, these energy resources mean they will be available for use for a longer period of time.

1.3 Power

Power is defined as the rate of doing work.

If two boys of the same weight climb a flight of steps of the same weight climb a flight of steps of the same height, the boy that gets to the top first is said to have the greater power. This is because he has done the work of moving his weight through that height at a shorter time. If the work (W Joules is done in time t seconds, then

$$Power = \frac{Workdone}{Time}$$

Two boys of the same weight each set out from the bottom of a hill to reach the top walking at a steady speed. One, X, is strong and athletic. The other, Y, is the opposite type, weak and not athletic X can reach the top in a much shorter time than Y. walking steadily, each overcome the same frictional forces at the ground, and each has raised the same weight through the same height. So, each has done the same amount of work. X, however, has down it in a shorter time than Y we say that X has a greater power than Y. in the same way, a large engine can work faster than a small engine of the same kind and is said to have a greater power.

1.4 Principles of Conservation of Energy

The scientific meaning of energy grew slowly over the centuries. Among famous scientist who helped to make clear its meaning were Kelvin of Scotland, Joule of England, and Claudius and Helmholtz of Germany, all of whom lived in the 19th century.

Energy means the capacity for doing work. Today, many different forms of energy are recognized. A steam engine uses heat energy to do work. An electric motor uses electrical energy to drive an electric rain. Light energy, falling on a light meter used in photography, makes a pointer move across a scale. sound energy causes a microphone plate to vibrate chemical energy is the energy in our food which makes us grow and also gives us muscular energy to move object. Nuclear energy is the energy in the nucleus of atoms/produces heat energy which can be used to generate electrical power.

So, by suitable machines or appropriates, energy can be changed from one form to another. This is illustrated in the diagram shown below. It is important to note that in a given or closed system, the total amount of energy is always constant, although energy may be transformed from one form to another.

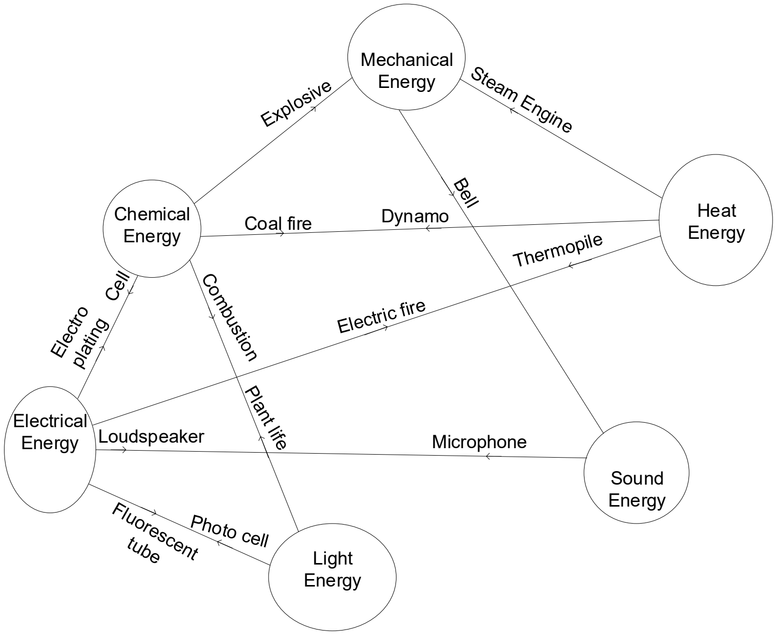


Figure 1.4 Energy conversion cycle

1.5 Energy Transformations

The main forms of energy are:

- electromagnetic waves (e.g., light, infrared, ultraviolet and solar)
- heat
- sound
- electrical
- mechanical
- stored or potential and motion or kinetic energy.

Any of the above forms of energy can be changed into other forms of energy. However, no energy is ever lost, nor can it be created from nothing. This can be stated as a law so that it can be applied to new situations as they are encountered: *Energy is never created or lost; it can only be converted from one form of energy to other forms of energy*. When a matchstick is lit, the chemical energy in the match changes into heat energy and light energy. This can be represented by an energy flow diagram.

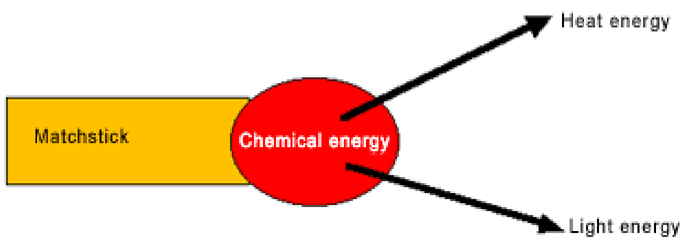


Figure 1.5 Energy flow diagram of matchstick

A diver on a high diving platform has stored (potential) energy. When they dive, this stored energy is converted to motion energy as they accelerate downwards. When they hit the water this motion energy is transformed into the sound energy of the splash and the motion energy of the water.

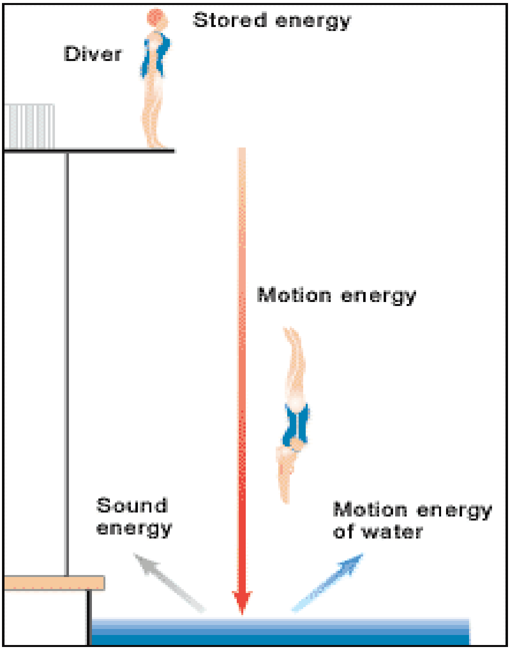


Figure 1.6 Energy flow diagram of a diver

A CD player uses the electrical energy in a battery to produce sound energy. This can be represented by an energy flow diagram.

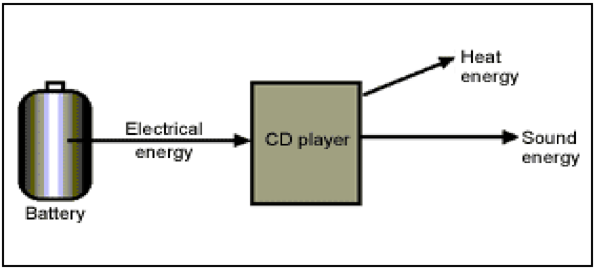


Figure 1.7 Energy flow diagram of CD player

A small amount of heat energy may also be produced, but this is usually unwanted, wasted energy. An appliance is more efficient if less energy is changed into the unwanted forms of energy.

1.6 Sources of Energy

There are many natural substances that contain lots of energy. Most of these are called fuels or foods. Coal, oil and natural gas all contain chemicals that can supply lots of energy. Many foods contain chemicals that can supply lots of energy. Fatty foods contain large amounts of energy. Sugary foods (called carbohydrates) also contain lots of energy. The energy in the fuels and foods originally came from the Sun. The Sun is producing huge amounts of energy all the time. Some of this energy comes to the Earth in the form of heat energy and light energy. The plants use some of the light energy from the Sun to make their own food in the process called photosynthesis. This energy is stored in the plants. When we eat the plants, we consume this energy. Animals also get their energy by eating the plants. Some animals get their energy by eating the animals that ate the

plants.
Oil and coal come from the decayed and buried remains of ancient plants and animals. So, the energy in oil and coal originally came from the Sun.

1.7 Energy Flow Diagram

Energy flow diagrams can illustrate how energy is transformed from one form of energy to other forms of energy. There is often branching where one form of energy can be transformed into two or more other forms at the same time. The diagram shows a mobile phone in use.

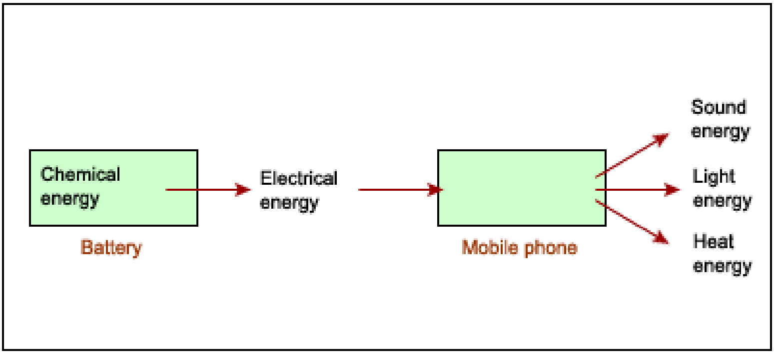


Figure 1.8 energy flow diagram of mobile phones

1.8 Energy Conversions

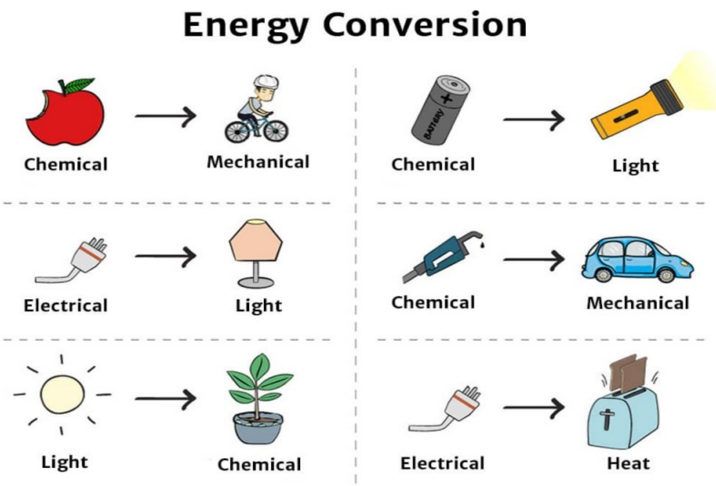


Figure 1.9 Energy conversion processes

1.9 Exercise

1. Explain the basic concepts of energy, power and their measurement
2. Explain the conversion of energy from one form to another
3. Explain the conversion of electrical energy to heat, motion, sound and light.
4. Discuss the basic concepts of energy, power and their measurement
5. What are the main forms of energy transformation?
6. Discuss different forms of energy.
7. Sketch energy flow diagrams for the following:

a. Matchstick that has just been struck
b. Portable laptop computer

c. Person running up a staircase
d. Gun being fired
e. Electric knife cutting bread
f. Netball player shooting a goal
g. A television set.

2

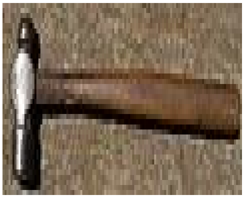
SIMPLE TOOLS

2.0 Hammers

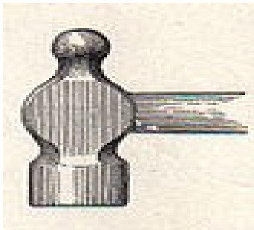
A hammer is a tool consisting of a weighted "head" fixed to a long handle that is swung to deliver an impact to a small area of an object. This can be, for example, to drive nails into wood, to shape metal (as with a forge), or to crush rock. Hammers are used for a wide range of driving, shaping, and breaking applications.

The modern hammer head is typically made of steel which has been heat treated for hardness, and the handle (also called a haft or helve) is typically made of wood or plastic.

The claw hammer has a "claw" to pull nails out of wood, and is commonly found in an inventory of household tools in North America. Other types of hammers vary in shape, size, and structure, depending on their purposes. Hammers used in many trades include sledgehammers, mallets, and ball-peen hammers. Although most hammers are hand tools, powered hammers, such as steam hammers and trip hammers, are used to deliver forces beyond the capacity of the human arm. There are over 40 different types of hammers that have many different types of uses. Examples are:



Ball-peen hammer

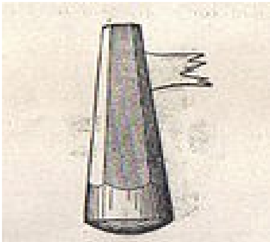


Ball peen hammer

Bush hammer

Claw hammer

Cross-peen hammer

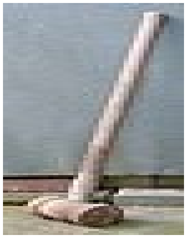


Dog-head hammer (blacksmith)

Framing hammer

Geologist's hammer

Hammer for aftertreatment of weld transitions

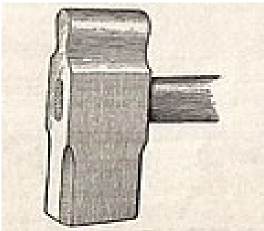


Post maul

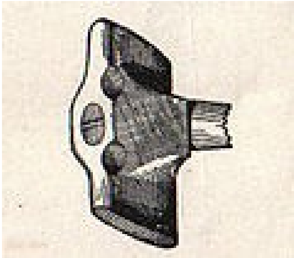
Long cross-face hammer (blacksmithing)

Rock climbing hammer

Sledgehammers

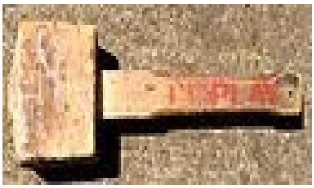


Straight pane sledgehammer



Twist hammer (blacksmithing)

Upholstery hammer



Wooden mallet

Rubber mallet

2.0.1 Effect of the Hammer Handle

The handle of the hammer helps in several ways. It keeps the user's hands away from the point of impact. It provides a broad area that is better-suited for gripping by the hand. Most importantly, it allows the user to maximize the speed of the head on each blow. The primary constraint on additional handle length is the lack of space to swing the hammer. This is why sledgehammers, largely used in open spaces, can have handles that are much longer than a standard carpenter's hammer. The second most important constraint is more suitable. Even without considering the effects of fatigue, the longer the handle, the harder it is to guide the head of the hammer to its target at full speed.

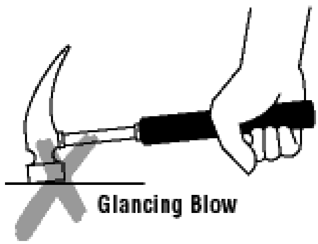
Most designs are a compromise between practicality and energy efficiency. With too long a handle, the hammer is inefficient because it delivers force to the wrong place, off-target. With too short a handle, the hammer is inefficient because it doesn't deliver enough force, requiring more blows to complete a given task. Modifications have also been made with respect to the effect of the hammer on the user. Handles made of shock-absorbing materials or varying angles attempt to make it easier for the user to continue to wield this age-old device, even as nail guns and other powered drivers encroach on its traditional field of use. As hammers must be used in many circumstances, where the position of the person using them cannot be taken for granted, trade-offs are made for the sake of practicality. In areas where one has plenty of room, a long handle with a heavy head (like a sledgehammer) can deliver the maximum amount of energy to the target. It is not practical to use such a large hammer for all tasks; however, and thus the overall design has been modified repeatedly to achieve the optimum utility in a wide variety of situations

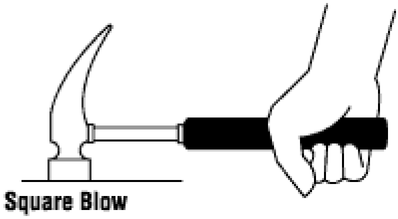
2.0.2 What are some safety tips to know when using a hammer?

Hammers and other striking tools are widely used and often abused. Hammers are made for specific purposes in various types and sizes, and with striking surfaces of varying hardness. For example, hammers are used for general carpentry, framing, nail pulling, cabinet making, assembling furniture, upholstering, finishing, riveting, bending or shaping metal, striking masonry drill and steel chisels, and so on. Hammers are designed according to the intended purpose.

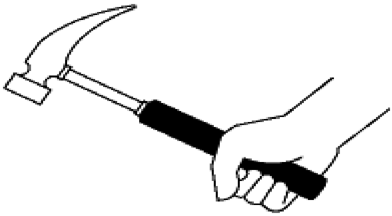
- Select a hammer that is comfortable for you and that is the proper size and weight for the job. Misuse can cause the striking face to chip, possibly causing a serious injury.
- Choose a hammer with a striking face diameter approximately 12 mm (0.5 inches) larger than the face of the tool being struck (e.g., chisels, punches, wedges, etc.).
- Choose a hammer with a cushioned handle to protect you from vibration, impact, and squeezing pressure.

- Use hammers with electrically insulated handles for work on or around exposed energized parts.
- Ensure that the head of the hammer is firmly attached to the handle.
- Replace loose, cracked or splintered handles.
- Keep the work area clear of debris.
- Discard any hammer with mushroomed or chipped face or with cracks in the claw or eye sections.
- Wear safety glasses or goggles, or a face shield (with safety glasses or goggles).
- Strike a hammer blow squarely with the striking face parallel to the surface being struck. Always avoid glancing blows and over and under strikes. (Hammers with beveled faces are less likely to chip or spall.)





- Look behind and above you before swinging the hammer. Keep enough clearance from fellow workers.
- Maintain a secure footing and keep good balance while using a hammer.

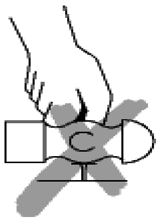


A Claw Hammer

2.0.3 What should I avoid doing when handling a hammer?

- Do not use a hammer with a loose or damaged handle.
- Do not use handles that are rough, cracked, broken, splintered, sharp-edged or loosely attached to head.
- Do not use hammers with sharp edges as they can cut off circulation in your finger after long periods of use.
- Do not use any hammer head with dents, cracks, chips, mushrooming, or excessive wear.
- Do not use a hammer for any purpose for which it was not designed or intended.

- Do not use one hammer to strike another hammer, other hard metal objects, stones or concrete.
- Avoid awkward positions when using the hammer to prevent strains.
- Do not redress, grind, weld or reheat-treat a hammer head.
- Do not strike with the side or cheek of the hammer.



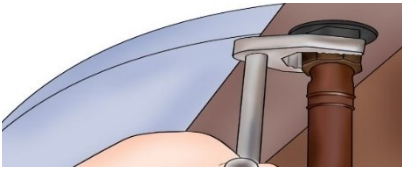
2.1 Spanner

There is a huge range of spanners. Some are designed for general jobs, others for specific tasks. Here are the main types:

(i) Open-ended spanners

Open-ended spanners have U-shaped jaws with an opening the width of the nut or bolt head. They have two flat sides which grip opposite sides of a fastener in order to loosen or tighten it.

(ii) Basin tap wrenches or spanners

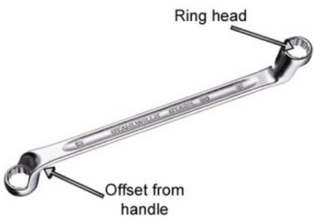


Basin tap wrenches or spanners are designed for use during plumbing on hard-to-reach back nuts or compression fittings in deep recesses, such as those under sinks, that cannot be reached with any other spanner type.

(iii) Compression fitting spanners

Specifically designed for plumbing work to join two pipes together, compression fitting spanners have the correct profiles to tighten compression nuts. They come in two sizes to fit the nuts used on standard 15mm or 22mm copper piping.

(iv) Ring Spanners

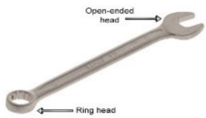


Ring spanners are simple spanners with a profile that is enclosed in a ring. The heads are usually offset from the handle so it is easier to reach the fastener.

(v) Immersion heater spanners

Immersion heating spanners are very specialized tools designed to fit or remove immersion heating elements in an immersion heater. They have an octagonal profile with an 86mm diameter.

(vi) Combination Spanners



Combination spanners are a simple spanner made up of a shaft and two spanner heads: one open-ended head and one ring head. The heads are usually at a 15-degree angle to the shaft to allow better access to the nuts or bolts.

(vii) Flare nut spanners

Flare nut spanners are designed for turning fasteners that attach pipes to another component, for example, vehicle brake pipes. The jaws of the head curve around so there is only a small opening between them. The pipe can fit through this opening and then the spanner can be moved over the fastener.

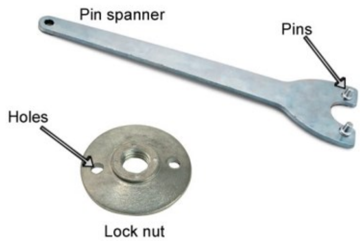
(viii) Podgers

Podgers are spanners with a profiled head at one end and a spike on the other. The spike or 'drift pin' is pushed through the bolt holes of two workpieces to line them up so the bolt can fit them through easily.

(ix) Ratchet spanners

Ratchet spanners use a ratchet system allowing the fastener to be turned in one direction but not the other. This means the user can turn the spanner back and forth to perform the task without having to remove and replace the spanner on the fastener every time an obstacle is reached.

(x) Pin Spanners



Pin spanners are designed for fitting and removing lock nuts. The nuts have two holes on opposite edges of the nut. Two corresponding pins on the pin spanner fit into the holes in order to grip and turn the lock nut.

(xi) Insulated spanners

Insulated spanners protect the user from electric shocks when working on live wires. Any spanner type can be insulated.

(xii) Box Spanners Are Made from Metal Tubing

They usually have two profiles, one at each end. Because the profiles are at right-angles to the shaft, the tool can reach into confined spaces easily. A 'tommy bar' is usually used to turn them.

(xiii) Spark Plug Spanners

Spark plug spanners are specialized box spanners for fitting spark plugs in confined spaces in an engine. They may have a fixed or removable tommy bar.

2.2 Screwdriver

Figure 2.1 A slotted or "flat-blade" screwdriver

A **screwdriver** is a tool, manual or powered, for screwing (installing) and unscrewing (removing) screws. A typical simple screwdriver has a handle and a shaft, ending in a tip the user puts into the screw head before turning the handle. The shaft is usually made of tough steel to resist bending or twisting. The tip may be hardened to resist wear, treated with a dark tip coating for improved visual contrast between tip and screw or ridged or treated for additional 'grip'. Handles are typically wood, metal, or plastic and usually hexagonal, square, or oval in cross-section to improve grip and prevent the tool from rolling when set down. Some manual screwdrivers have interchangeable tips that fit into a socket on the end of the shaft and are held in mechanically or magnetically. These often have a hollow handle that contains various types and sizes of tips, and a reversible ratchet action that allows multiple full turns without repositioning the tip or the user's hand.

A screwdriver is classified by its tip, which is shaped to fit the driving surfaces slots, grooves, recesses, etc. on the corresponding screw head. Proper use requires that the screwdriver's tip engage the head of a screw of the same size and type designation as the screwdriver tip. Screwdriver tips are available in a wide variety of types and sizes (List of screw drives). The two most common are the simple 'blade'-type for slotted screws, and Phillips, generically called "cross-recess".

A wide variety of power screwdrivers range from a simple 'stick'-type with batteries, a motor, and a tip holder all inline, to powerful "pistol" type VSR (variable-speed reversible) cordless drills that also function as screwdrivers. This is particularly useful as drilling a pilot hole before driving a screw is a common operation. Special combination drill-driver bits and adapters let an operator rapidly alternate between the two. Variations include impact drivers, which provide two types of 'hammering' force for improved performance in certain situations, and "right-angle" drivers for use in tight spaces. Many options and enhancements, such as built-in bubble levels, high/low gear selection, magnetic screw holders, adjustable-torque clutches, keyless chucks, 'gyroscopic' control, etc., are available.

Figure 2.2 Screwdriver with rubber handle

Figure 2.3 A jeweler's screwdriver

Figure 2.4 Screwdriver with magnetic tip

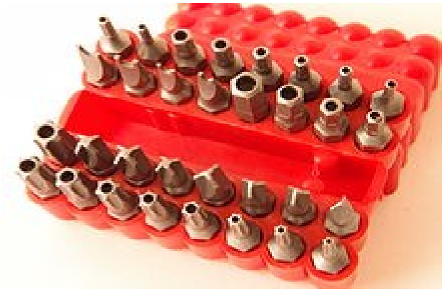


Figure 2.5 A set of Allen keys

A set of "secure" or otherwise less common screwdriver bits, including secure Torx and secure hex or "Allen" variants.

A variety of Robertson sizes

Phillips and Pozidriv compared

2.2.0 Torque screwdrivers

Screwdrivers are available in manual, electric, and pneumatic with a clutch that slips at a preset torque. This helps the user tighten screws to a specified torque without damage or over-tightening. Cordless drills designed to use as screwdrivers often have such a clutch.

2.2.1 Powered screwdrivers

Interchangeable bits allow the use of powered screwdrivers, commonly using an electric or air motor to rotate the bit. Cordless drills with speed and torque control are commonly used as power screwdrivers.

Figure 2.6 A rechargeable battery-powered electric screwdriver

Figure 2.7 Driving a screw with a cordless drill

2.2.2 Ratcheting screwdrivers

Some manual screwdrivers have a ratchet action whereby the screwdriver blade locks to the handle for clockwise rotation, but uncouples for counterclockwise rotation when set for tightening screws—and vice versa for loosening.

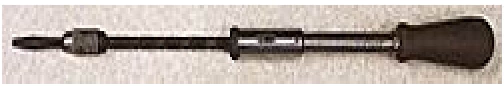


Figure 2.8 Stanley Yankee No 130A, spiral or ratchet screwdriver

Spiral ratchet screw drivers, often colloquially called *Yankee screwdrivers* (a brand name), provide a special mechanism that transforms linear motion into rotational motion. The user pushes the handle toward the workpiece, causing a pawl in a spiral groove to rotate the shank and the removable bit. The ratchet can be set to rotate left or right with each push, or can be locked so that the tool can be used like a conventional screwdriver. One disadvantage of this design is that if the bit slips out of the screw, the resultant sudden extension of the spring may cause the bit to scratch or otherwise damage the workpiece.

Once very popular, versions of these spiral ratchet drivers using proprietary bits have been largely discontinued by manufacturers such as Stanley. Some companies now offer a modernized version that uses standard 1/4-inch hex shank power tool bits. Since a wide variety of drill bits are available in this format, the tool can do double duty as a "push drill" or Persian drill.

2.3 Chisel

Figure 2.9 Neolithic stone chisels around 4100 to 2700 BCE

A chisel is a tool with a characteristically shaped cutting edge (such that wood chisels have lent part of their name to a particular grind) of blade on its end, for carving or cutting a hard material such as wood, stone, or metal by hand, struck with a mallet, or mechanical power. The handle and blade of some types of chisel are made of metal or of wood with a sharp edge in it.

Chiseling use involves forcing the blade into some material to cut it. The driving force may be applied by pushing by hand, or by using a mallet or hammer. In industrial use, a hydraulic ram or falling weight ('trip hammer') may be used to drive a chisel into the material.

A gouge (one type of chisel) serves to carve small pieces from the material, particularly in woodworking, woodturning and sculpture. Gouges most frequently produce concave surfaces. A gouge typically has a 'U'-shaped cross-section.

Figure 2.10 Reconstruction chisel made from a robust cow's cannon bone, cutting a mortise

Chisels are common in the archeological record. Chisel-cut materials have also been found.

Figure 2.11 A sharp wood chisel in combination with a forstner wood drill bit is used to form this mortise for a half-lap joint in a timber frame.

Figure 2.12 A worker uses a chisel to put the finishing touches on a dovetail joint for a timber frame.

Woodworking chisels: This ranges from small hand tools for tiny details, to large chisels used to remove big sections of wood, in 'roughing out' the shape of a pattern or design. Typically, in woodcarving, one starts with a larger tool, and gradually progresses to smaller tools to finish the detail. One of the largest types of chisel is the slick, used in timber frame construction and wooden shipbuilding. There are many types of woodworking chisels used for specific purposes, such as:

Firmer chisel: Has a blade with a thick rectangular cross section, making them stronger for use on tougher and heavier work.

Bevel edge chisel: Can get into acute angles with its beveled edges.

Mortise chisel: Thick, rigid blade with straight cutting edge and deep, slightly tapered sides to make mortises and similar joints.

Paring chisel: Has a long blade ideal for cleaning grooves and accessing tight spaces.

Skew chisel: Has a 60-degree cutting angle and is used for trimming and finishing across the grain.

Dovetail chisel: Made specifically for cutting dovetail joints. The difference being the thickness of the body of the chisel, as well as the angle of the edges, permitting easier access to the joint.

Butt chisel: Short chisel with beveled sides and straight edge for creating joints.

Carving chisels: Used for intricate designs and sculpting; cutting edges are many; such as gouge, skew, parting, straight, paring, and V-groove.

Corner chisel: Resembles a punch and has an L-shaped cutting edge. Cleans out square holes, mortises and corners with 90-degree angles.

Flooring chisel: Cuts and lifts flooring materials for removal and repair; ideal for tongue-and-groove flooring.

Framing chisel: Usually used with mallet; similar to a butt chisel, except it has a longer, slightly flexible blade. Slick a very large chisel driven by manual pressure, never struck.

Lathe tools: A lathe tool is a woodworking chisel designed to cut wood as it is spun on a lathe. These tools have longer handle for more leverage, needed to counteract the tendency of the tool to react to the downward force of the spinning wood being cut or carved. In addition, the angle and method of sharpening is different; a secondary bevel would not be ground on the tool.

Metalworking chisels: Used in metal work can be divided into two main categories: hot chisels and cold chisels.

2.3.0 Cold Chisel

Figure 2.13 Top: Bull point chisel; Bottom: Cold chisel

A cold chisel is a tool made of tempered steel used for cutting 'cold' metals,[2] meaning that they are not used in conjunction with heating torches, forges, etc. Cold chisels are used to remove waste metal when a very smooth finish is not required or when the work cannot be done easily with other tools, such as a hacksaw, file, bench shears or power tools.

The name cold chisel comes from its use by blacksmiths to cut metal while it was cold as compared to other tools, they used to cut hot metal. Because cold chisels are used to form metal, they have a less-acute angle to the sharp portion of the blade than a woodworking chisel. This gives the cutting-edge greater strength at the expense of sharpness.

Cold chisels come in a variety of sizes, from fine engraving tools that are tapped with very light hammers, to massive tools that are driven with sledgehammers. Cold chisels are forged to shape and hardened and tempered (to a blue colour) at the cutting edge.

The head of the chisel is chamfered to slow down the formation of the mushroom shape caused by hammering and is left soft to avoid brittle fracture splintering from hammer blows.

There are four common types of cold chisels. These are the **flat chisel**, the most widely known type, which is used to cut bars and rods to reduce surfaces and to cut sheet metal that is too thick or difficult to cut with tin snips. The **cross-cut chisel** is used for cutting grooves and slots. The blade narrows behind the cutting edge to provide clearance. The **round nose chisel** is used for cutting semi-circular grooves for oil ways in bearings. The **diamond**

point chisel is used for cleaning out corners or difficult places and pulling over centre punch marks wrongly placed for drilling.

Although the vast majority of cold chisels are made of steel, a few are manufactured from beryllium copper, for use in special situations where non-sparking tools are required.

2.3.1 Hot Chisel

A hot chisel is used to cut metal that has been heated in a forge to soften the metal. One type of hot chisel is the *hotcut hardy*, which is used in an anvil hardy hole with the cutting edge facing up. The hot workpiece to be cut is placed over the chisel and struck with a hammer. The hammer drives the workpiece into the chisel, which allows it to be snapped off with a pair of tongs. This tool is also often used in combination with a "top fuller" type of hotcut, when the piece being cut is particularly large.

Figure 2.14 A toothed stone chisel

Stone chisels are used to carve or cut stone, bricks or concrete slabs. To cut, as opposed to carve, a brick bolster is used; this has a wide, flat blade that is tapped along the cut line to produce a groove, then hit hard in the centre to crack the stone. Sculptors use a *spoon chisel*, which is bent, with the bevel on both sides. To increase the force, stone chisels are often hit with club hammers, a heavier type of hammer.

Figure 2.15 A bolster chisel

Masonry chisels are typically heavy, with a relatively dull head that wedges and breaks, rather than cuts. Often used as a demolition tool, they may be mounted on a hammer drill, jack hammer, or hammered manually, usually with a heavy hammer of three pounds or more. These chisels normally have an SDS, SDS-MAX, or 1-1/8" Hex connection. Types of masonry chisels include the following:

- Moil (point) chisels
- Flat chisels
- Asphalt cutters
- Carbide bushing tools
- Clay spade
- Flexible chisels

- Tamper

Plugging chisel: It has a tapered edge for cleaning out hardened mortar. The chisel is held with one hand and struck with a hammer. The direction of the taper in the blade determines if the chisel cuts deep or runs shallow along the joint.

2.4 Gouge

Figure 2.16 Different gouges and a wooden mallet

A modern gouge is similar to a chisel except its blade edge is not flat, but instead is curved or angled in cross-section. The modern version is generally hafted inline, the blade and handle typically having the same long axis. If the bevel of the blade is on the outer surface of the curve the gouge is called an 'out-cannel' gouge, otherwise, it is known as an 'in cannel' gouge. Gouges with angled rather than curved blades are often called ‘V-gouges’ or ‘vee-parting’ tools.

In addition to varying blade sweeps, bevels, and widths, blade variations include:

- 'Crank-neck' gouges, in which the blade is offset from the handle by a small distance, to allow working flat to a surface
- 'Spoon-bent' gouges, in which the blade is curved along its length, to allow working in a hollow not otherwise accessible with a straight bladed gouge
- 'Fishtail' gouges, in which the blade is very narrow for most of its length and then broadens out near the working edge, to allow working in tight spaces.

All of these specialized gouges allow a craftsperson to cut into areas that may not be possible with a regular, straight-bladed gouge.

The cutting shape of a gouge may also be held in an adze, roughly as the shape of a modern-day mattock.

Gouges are used in woodworking and arts. For example, a violin luthier uses gouges to carve the violin, a cabinetmaker may use it for running flutes or paring curves, or an artist may produce a piece of art by cutting some bits out of a sheet of linoleum (see also Linocut).

2.5 Exercise

1. What is a Hammer?
2. List different types of Hammer
3. Explain effect of Hammer handle
4. What are the safety tips in using Hammer?
5. What is a Spanner?
6. List and explain the different types of Spanner
7. (a) What is a Screwdriver?

(b) List different types of Screwdriver

(c) Explain power driving Screwdriver

8. (i) What is a Chisel?

(ii) Explain different types of wooding Chisel used for specific purposes

(iii) What are the differences between cold and hot Chisel?

(iv) List types of cold Chisel and their application?

3

ELECTRIC IRON

3.0 Introduction

Figure 3.0 Picture of Electric Iron

An electric iron is a general household appliance used to press the wrinkles out of the clothes. This works on the basis that the combination of heat and pressure removes wrinkles. The principle of the electric iron is that when current is passed through a coil, the coil gets red hot and transfers the heat to the base plate of the electric iron through conduction.

In the earlier days steam irons were used, but now the electric iron is preferred over the steam ones. Steam irons have some maintenance issues due to clogging. Steam irons usually have vents through which the water passes.

As the steam iron gets used, slowly the minerals from the water accumulate at the vents and blocks the water from passing through. Thus, the efficiency of the steam iron is compromised. So, the steam iron has to be cleaned and maintained regularly to ensure its proper working. If you live in an area where hard water is used, then clogging is a major problem.

This drawback is eliminated in electric iron as it uses a heating element and there are no vents in it. There is considerably less maintenance in an electric iron when compared to a steam iron.

There are basically two types of electric irons:

- Automatic
- Non-Automatic

There is not much difference between the two types. The former has one regulator to control the temperature of the element and in-turn the temperature of the iron.

3.1 Why We Need to Control the Temperature of the Iron

The answer is simple. Now-a-days we use various types of fabrics such as cotton, silk, linen, etc. So, to suit the temperature required for different kinds of fabrics, we use the temperature control.

3.2 Parts of an Electric Iron

(i) Sole Plate

The sole plate is the thick, triangular-shaped slab of iron that forms the base over which the electric iron is built up. The bottom surface and edges are heavily chromium plated, to prevent it from rusting. The base plate should hold the iron pressure plate and cover plate in position. For this purpose, we can see two or sometimes three studs in the base plate. These studs aid in holding the position of cover plate and pressure plate.

(ii) Pressure Plate

This plate is generally called the top plate as it follows the shape of sole plate. The pressure plate has some holes through which the studs form the base plate passes through. We should tighten the nuts on the studs in such a way that the pressure plate and sole plate are pressed tight against each other. In some iron the pressure plate is heavy and made of cast iron while in some other cases, it is a thin sheet of steel, about ¼cm thick.

In automatic type of electric iron, the pressure plate has a rectangular or circular hole for locating the thermostat.

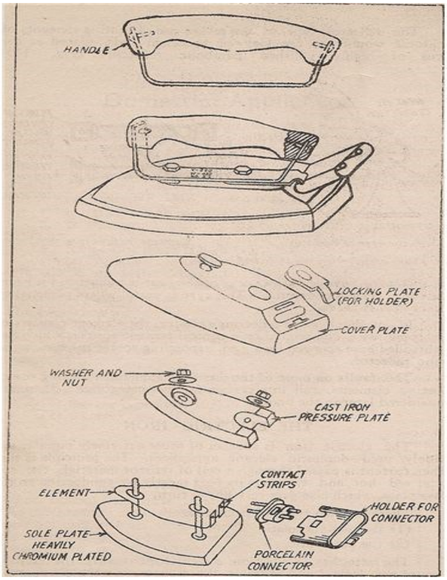


Figure 3.1 Electric Iron heating elements

(iii) The Heating Element

The heating element is present between the sole plate and pressure plate. It is pressed hard between the two plates. The heating element consists of nichrome wire wound around a sheet of mica. The two ends of the nichrome wire are connected to the contact strips. The contact strips are connected to the terminals of the iron. There are two reasons for which mica is chosen in the heating material. Mica is a very good insulating material. Besides that, mica can also withstand very high temperatures. The entire assembly of mica sheet, nichrome wire and contact strips are riveted together resulting in a mechanically sound and robust construction.

There is an asbestos sheet, which separates and thermally insulates the top plate from the heating element.

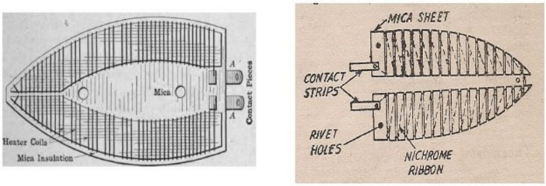


Figure 3.2 electric iron heating plate

(iv) The Cover Plate

The cover plate is made of thin sheet of iron. It is placed on top of the base plate and it covers all the internal parts of the iron. The handle and connector are only attached to the cover plate.

(v) Handle

The handle can be made either with wood or with plastic. The handle is attached to the cover plate with the aid of screws. Studs can also be used for this purpose.

(vi) Pilot Lamp

The pilot lamp is housed in the cover plate of the electric iron. One end of the pilot lamp is connected to supply, while the other end is connected to the heating element. A shunt resistance is provided across the pilot lamp which assists in providing a voltage drop. The shunt is designed to provide a voltage drop of 2-5 volts.

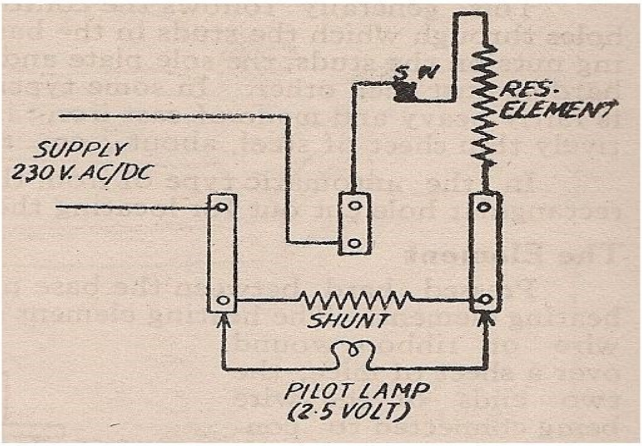


Figure 3.3 Electric iron Heating Circuit Diagram

(vii) Thermostat

When it comes to an automatic electric iron, the thermostat is the most important item. It uses a bimetallic strip to operate the switch which is connected in series with the resistance (or) heating element.

The bimetallic strip is a simple element which converts a temperature change into mechanical displacement. A bimetallic strip consists of two different metals bonded together. The two metals should have a different coefficient of expansion. If such a strip is heated, it starts to curve towards the metal having the lower co-efficient of expansion. On cooling, it straightens and comes back to the normal position.

Now we might wonder why such an element is used in iron. What is the purpose of this element in an electric iron?

The bimetallic strip is attached to a contact spring through small pins. The contact point between the strip and contact points remains closed. When the temperature rises significantly, the unusual expansion causes the strip to curve and the contact between strip and contact spring opens. Thus, the supply to heating element is temporarily stopped (until the temperature goes down to normal). A special device called the cam is placed is placed near the contact spring, with which we specify the amount of curving of bimetallic strip required to separate the contact.

Thus, using bimetallic strip, the temperature is kept constant within certain limits.

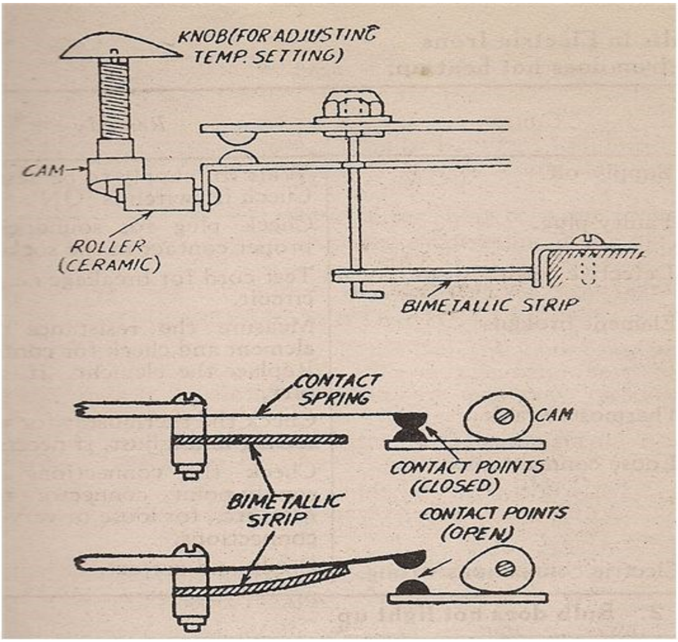


Figure 3.4 Thermostat circuit gigagram

The thermostat helps in maintaining the temperature within limits. But frequent making and breaking of circuit damages the contact points and it may also result in interference with radio reception. To avoid this, a capacitor of certain range is connected across the two contact points.

3.2.1 Working Principles of the Electric Iron

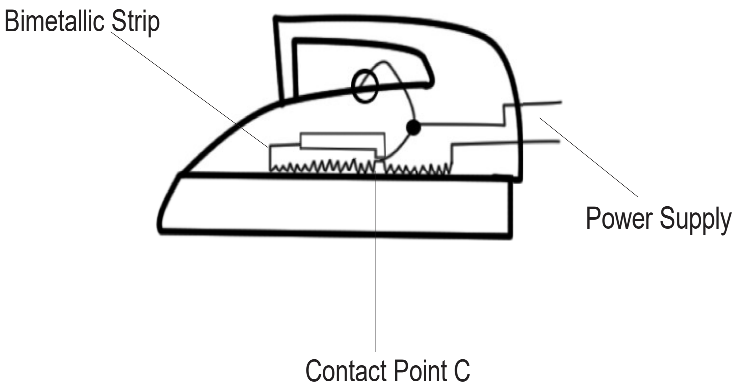


Figure 3.5 Circuit diagram of electric iron

The bimetallic strip of an electric thermostat is used to control the temperature of an electric laundry iron.

The electric iron is one of the electrical appliances with simple electric circuit, it has a very simple working principle which obeys the law of conservation of energy by simply converting electrical energy into heat energy through a heating element (conductor). The automatic switching of the pressing iron when overheating or otherwise is however done by a sensor known as a thermostat

The thermostat of a pressing iron is usually made of bimetallic strips-metals with slight difference in thermal property, the thermostat like I said earlier acts like a switch thus the only a single live wire is connected to it thus, a thermostat has one input and one output just like a single switch, depending on the manufacturer, the input from the electrical source can be connected to the bimetallic strips and the output connected to a separate connector vice-visa, hence, when turned on and regulated to max, the bimetallic strip move to close circuit, when the temperature increases with respect to the thermal property of the bimetallic strip it moves away from the connector thus, opening the circuit.

When the power supply is switch ON, the thermo stat Knob is set to the desired temperature. Current will flow through the circuit of the electric iron through terminal a & b and then produces heat in the heater coils. As the coil heat up, the bimetallic strip bends away from the contact point C, until at the required temperature, the contact is completely broken thereby switching of the glow of circuit. As the laundry iron cools, the strip straightens up again and remakes contact at C, thus switching on the electric current once more. This make and break device regulates the temperature of the electric iron.

Hence when electric current flows through a conductor, the resistance of the conductor will change electrical energy into heat energy just as friction changes mechanical energy into heat. It is this heating effect of an electric current that is utilized in such devices as electric pressing iron, electric toaster, electric coil, hair dryer and incandescent lamps.

When electric power is converted heat the greater the value of current the greater the heat generated. The heat generated is proportional to the square of the current, the resistance and the time during which current flows according to the relation $H= I^2Rt$

Examples: find the heat in joules produces in an electric coil of resistance 15 ohms when a current of 5 amperes flows through it for 30minutes

$$H=I^2Rt = 5^2 \text{ X } 15 \text{ X } 30 \text{ X} 60 \text{ Joules}$$
$$=675000J$$
$$=6.75 \text{ X} 10^5 J$$

3..2.2 How to Adjust the Thermostat to Desired Span

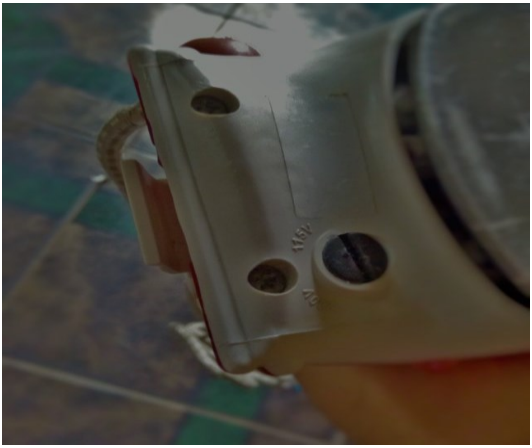
It eventually gets to a point where your pressing iron doesn't get as hot as required or it doesn't stay hot for long before reducing in temperature vice-visa, this challenge is usually common with people in areas where low/high voltage is supplied. Well, if this is your challenge then you are viewing right post, the solutions to all challenges mentioned above is simply the reduction or increase in space between the bimetallic strip and the contactor. So, for it to remain hot for a long period of time (those in low voltage AREA), you simply increase the distance between the bimetallic strip and the contactor, and if you desire otherwise (those in high voltage area) simply reduce the distance.

3.2.3 How do you locate the thermostat of a pressing iron?

Like I said earlier the electric pressing iron has a very simply electric circuit thus, I am going to be using my personal pressing iron to explain how to locate the thermostat so that you can do your necessary adjustment.

Steps:

Gently unscrew the screws of the pressing iron

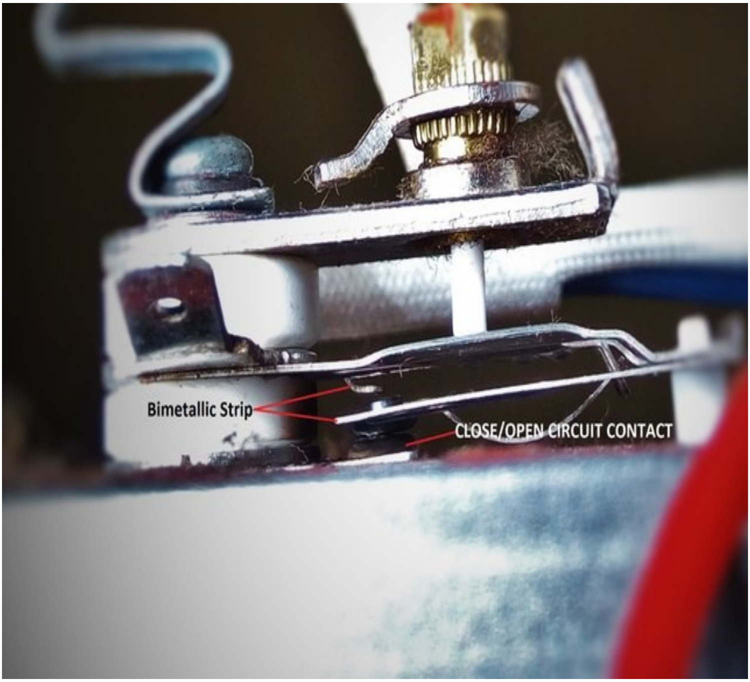


Remove the outer case

Remove the second case to get access into the main panel

Ensure you keep all screws removed from the pressing iron in a can to keep it save

The thermostat



3.3 Exercise

1. (a) What is an Electric Iron?

(b) List and explain two types of Electric iron

2. (a) Why do we control the temperature of an Electric iron?

(b) List and explain component of an electric iron

(c) Draw the electric iron heating circuit diagrams

3. (a) Explain the working principles of an electric iron

(b) How do you adjust the thermostat of an electric iron?

(c) Explain the steps to locate the thermostat of an electric iron?

4

THE BLENDER

4.0 Introduction

Figure 4.1 Picture of an Electric Blender

A blender (sometimes called a liquidiser in British English) is a kitchen and laboratory appliance used to mix, purée, or emulsify food and other substances. A stationary blender consists of a blender jar with a rotating metal blade at the bottom, powered by an electric motor in the base. Some powerful models can also crush ice. The newer immersion blender configuration has a motor on top connected by a shaft to a rotating blade at the bottom, which can be used with any container.

4.1 Characteristics of a Blender

Different blenders have different functions and features but product testing indicates that many blenders, even less expensive ones, are useful for meeting many consumer needs. Features which consumers consider when purchasing a blender include the following:

- large visible measurement marks
- ease of use
- low noise during usage
- power usage (typically 300–1000 watts)
- ease of cleaning
- option for quick "pulse" blending

4.2 Component of Blenders

A blender consists of housing, motor, blades, and food container. A fan cooled electric motor is secured into the housing by way of vibration dampers, and a small output shaft penetrates the upper housing and meshes with the blade assembly. Usually, a small rubber washer provides a seal around the output shaft to prevent liquid from entering the motor. Most blender today have multiple speeds. As a typical blender has no gear box the multiple speeds are often implemented using a universal motor with multiple stator winding and/ or multi-tapped stator windings in a blender with electro mechanical controls the button (or other electrical switching device or position) for each different speed connects a different stator winding/tap or combination of energized windings produces a different tongue from the motor which yields different equilibrium speed in balance against the drag (resistance to rotation) of the blade assembly in contact with the material inside the food container.

Blender uses an electric motor which is an electrical machine that converts the electrical energy into mechanical energy. The reverse conversion of mechanical energy into electrical energy is done by an electric generator. The electric motor operates through the interaction between an electric motors magnetic field and current to generate force within the motor. The electric motors in the blenders are used to produce rotary force (torque) and should be distinguished from devices such as loudspeaker that convert electricity useable mechanical powers which are refereed as transistor. A notable exception from the mid-1960s is the Oster Model 412 Classic VIII (with the single knob) providing the lowest speed (Stir) using the aforementioned winding tap method but furnishing higher speeds (the *continuously* *variable* higher speed range is marked Puree to Liquify) by means of a mechanical speed governor that balances the force provided by flyweights against a spring force varied by the control knob when it is switched into the higher speed range. With this arrangement, when not set to the Stir speed, motor speed is constant even with varying load up to the point where power demanded by the load is equal to the motor's power capability at a particular speed. The more modern version of this arrangement is electronic speed control found on some units.

4.3 Principles of Operation of Blender

Let's see how it works. Suppose you drop a strawberry in the blender. You push a button to start the blender, and the motor begins to turn the blades. The circular whirring motion creates a vortex or a spiral movement in the fluid. In the blender, the fluid includes both liquid ingredients and air. The vortex causes a vacuum at the centre of the jar, which pulls the strawberry toward the middle, much as a tornado does.

As the strawberry combines with the other ingredients and begins to liquify, the liquid follows the blade in a whirling motion around the container, forming a well near its centre. The well in the centre of a blender's vortex is shallow, so it displaces the contents as they're drawn toward the axis at the centre of the blade. The whirling motion and lack of space below the blades forces the liquified strawberry up and on the sides. This circular pattern continues, whipping air into the contents, which helps mix the ingredients more quickly, until you stop the blender. The final result is a frothy strawberry smoothie with a homogenised blend of ingredients and a consistent texture.

4.4 Uses of Blenders

Blenders are used both in home and commercial kitchens for various purposes, including to:

- Grind semi-solid ingredients, such as fresh fruits and vegetables, into smooth purées
- Blend ice cream, milk, and sweet sauces to make milkshakes
- Mix and crush ice in cocktails such as the Zombie, piña colada and frozen margarita
- Crush ice and other ingredients in non-alcoholic drinks such as Frappuccino's and smoothies
- Emulsify mixtures
- Reduce small solids such as spices and seeds to smaller solids or completely powder or nut butter
- Blend mixtures of powders, granules, and/or liquids thoroughly
- Help dissolve solids into liquids

Blenders also have a variety of applications in microbiology and food science. In addition to standard food-type blenders, there is a variety of other configurations of blender for laboratories.

4.5 Blender Repair

Blenders make chopping, pureeing, liquifying, and mixing food easier — when they work. This Fix-It Guide on blender repair tells how a blender works, what often goes wrong, how to identify a blender problem, and what parts and tools you will need to fix it. It then gives simple step-by-step instructions for how to disassemble a blender and how to tighten a blender's drive stud. This Fix-It Guide also refers to electrical cord repair, fuse repair, appliance controls repair, and motor repair for more information.

4.6 How Does a Blender Work?

Turn the blender over to access screws holding the baseplate.

A food blender uses a motor to power blades that chop, and grate food. A blade inside a jar is connected to a motor shaft inside the unit. The blade's speed is controlled by varying electric current to the motor using one or more switches. Blenders come in countertop and hand-held models.

4.7 Wattage of a Blender

When purchasing a blender, look for one with the strongest motor, measured in watts (W). The wattage should be noted on the underside of the unit. A better blender has at least 250W.

4.8 What Can Go Wrong with a Blender?

Because blenders are simple motorized small appliances, the things that can go wrong also are simple. The electrical cord, motor, switches, or fuse may fail. Parts may become loose or worn and seals may leak. (To avoid spills, don't fill the blender jar more than two thirds full when in use.)

4.9 How Can I Identify a Blender Problem?

- If the blender doesn't work at all, make sure power is on at the outlet. Check the electrical cord. Test the fuse with a multimeter. Test the multi-speed switch (see the Appliance Controls Fix-It Guide). If all this fails you'll need to test the universal motor.
- If the blender runs intermittently, check wire connections and replace any that are faulty; check the motor and replace if needed.
- If the blender doesn't run at some speeds, check the multi-speed switch (see the Appliance Controls Fix-It Guide) and clean or replace it if it is faulty; check wire connections and repair any that are faulty.
- If the motor runs, but the blade doesn't turn, check the drive stud and tighten or replace as necessary.

Also, check the blade and clean and lubricate or replace it if damaged.

- If the jar leaks (a common blender problem), check the base and tighten if needed. Check the seal and replace the seal, blade assembly, or jar as needed.

4.10 Washing or Cleaning a Blender

To wash a blender jar in a dishwasher, first disassemble it and remove the rubber seals. If it is too difficult to disassemble jar, you can wash it by hand. Fill the jar half full with warm water and add a drop of liquid detergent. Cover and blend the mixture at low speed for five seconds. Run the blender with clean water to rinse, then run it empty to dry the blades. Finally, remove the blades and wipe them with a cloth to get rid of any residue.

4.11 What Do I Need for Blender Repair?

Replacement parts are available from the manufacturer or aftermarket supplier. These are the tools you'll need for disassembly and repair:

- Screwdrivers
- Pliers

4.12 What are the Steps to Blender Repair?

Wear a leather glove to hold the fan in place as you disconnect it from the motor shaft.

Disassembly steps depend on what model blender you own. The following steps work for most standard blenders.

To disassemble a blender:

- Unplug the blender and remove the jar. Undo the screws securing the baseplate. Separate the baseplate and attached motor collar from the base housing.
- To remove the switch housing, remove the decorative facing to get at the top screws. Remove the lower screws from inside the blender base.
- Hold the fan to keep the motor shaft from turning as you unscrew the drive stud. Remove the shield and any washers. Unscrew the fan nut to remove the fan.

- Disengage the strain-relief fitting from the housing. Remove the wire connector joining the power cord and the lead to the brush housing.
- Label and disconnect the lead wires from the switch block. Remove the motor mounting bolts and lift out the motor if necessary.
- To free brushes, remove the leads attached to the brush housing. Use a screwdriver to press lead terminal through the slot in housing. The brush spring may pop out (don't lose it!).

4.13 Inspecting a Blender

Inspect a blender's base, jar, and lid before each use to ensure that the jar base is tightly sealed.

You now can access and remove the motor and other components as needed.

Tighten a blender drive stud:

1. Remove the base and turn the blender over to expose the motor's drive shaft.
2. Grip the drive shaft with a wrench or pliers, then turn the blender on its side to attach a wrench to the drive stud.
3. Hold the drive shaft steady as you turn the drive stud clockwise.
4. If the drive stud is too worn to tighten, simply reverse the instructions for tightening the stud, install the new part, and tighten it.
5. If the drive stud turns but the blade assembly doesn't, inspect the assembly socket into which the drive stud fits. It may be worn and require replacement. This is a common problem on blenders with metal drive studs and plastic blade-assembly sockets.

Wear a leather glove to get a grip on and loosen the blender's base.

4.1.1 Electric Stove

Figure 4.2 An electric stove uses electricity to provide heat.

An **electric stove** or **electric range** is a stove with an integrated electrical heating device to cook and bake. Electric stoves became popular as replacements for solid-fuel (wood or coal) stoves which required more labor to operate and maintain. Some modern stoves come in a unit with built-in extractor hoods.

Electric stove "electric coil" may be controlled by a rotary switch with a finite number of positions (for example, six), each of which engages a different combination of resistances and hence a different heating power, or may have an "infinite switch" called a *simmer-stat*. Some may have a thermostat.

4.1.1.0 How Do Gas and Electric Stove Work?

When you use a gas stove, natural gas enters your stove from the main gas supply to your house. It's carried to the burner, where it combines with air inside a mixer tube. As that gas-air mixture is released through holes in the burner, it mixes with even more air. The ignition system lights the gas-air mixture, creating a blue flame. As you turn the burner control knob, you control exactly how much gas reaches the burner. The higher you turn it; the more gas is released.

4.1.1.1 How Gas and Electric Stoves Get Hot

Gas stoves contain one of two types of ignition systems: a pilot light or an electronic ignition system. A pilot light is a constantly burning blue flame near the burner. Because it’s always on, a pilot light uses a lot more gas than an electronic ignition system. An electronic ignition system creates a spark (you'll hear this as a clicking noise) only when you turn the burner on.

When you use an electric stove, electricity runs to a wire inside the coils on the cook top. Smooth top stoves have an internal coil that sits underneath the cooking surface. When you turn the dial on the stove, the electricity flows to the coil and heats up the metal. You can tell that electricity is flowing to the cook top when it turns a bright orange color. The more you turn the dial, the more electricity flows to the burner and the hotter it gets but the control isn’t as precise as it is with a gas stove.

4.1.2 Electric Hot Plate Principle and Usage

Figure 4.3 Hot Sale Best Quality Portable Stainless Steel Foldable Outdoor Charcoal Grill and

Durable Smokeless Stainless-Steel Heating Elements Nonstick Grill

Figure 4.4 Single Coil Stove and Kitchen Tool Electric Coil Hot Plate

Electric heating plate is a kind of electric equipment, it is to electrothermal alloy wire as a heating material, MICA soft plate and other materials as insulating materials, the outer layer covered with stainless steel and other materials of the heat conductive plate. Electric heating board is one of the most common electric heating equipment, such as electric thermos is a typical example of the application of electric heating board.

4.1.3 Principle of Electric Heating board

Electrothermal Plate heating material is mainly electric alloy wire, its working principle is very simple, simple is the electric effect. Electric heating plate work, electric current through the electric alloy wire, electric alloy wire will be hot, energy conversion to heat, and conduction to the outer shell. Electric heating board design has insulating materials, to ensure that the electric heating alloy wire when the current does not use the safety hazard.

4.1.4 The Advantages of Electric Board

The electric plate is flat and thin plate design, the structure is simple, the heat dissipation is uniform, easy to install and easy to use. Heating plate using stainless steel, ceramics and other materials as the outer shell, electric heating alloy wire is closed in the interior of the electric plate, so for closed heating, no open flame, no odor, good security, applicable to a variety of working conditions.

4.1.5 Classification of Electric Heating board

At present, the electric heating board does not have the clear classification, in the market Common electric heating board has the stainless steel electric heating board, ceramic heating board, silicone rubber Electric Board, carbon-crystal heating plate and carbon fiber heating board, the main difference is in the outer shell material different or the inner layer of heating materials different, such as stainless steel electric heating plate and ceramic heating board is different from the shell material, The remaining several are different for the heating material.

4.1.6 The Use of Electric Plate

Electric board has many advantages, so in the production of life has a very common application, from ordinary heating, electric thermos, to the laboratory environment to maintain the temperature, all the use of electric panels. At present, electric heating board has been widely used in industry, agriculture, civil, national defense, science and technology and medical and health fields.

4.2 Exercise

1. (a) What is a Blender?

(b) What are the characteristics of a Blender?

(c) List components of a Blender.

2. (a) Explain in details the principles of a blender.

(b) Explain the uses of blender.

3. What is an Electric Stove?

4. How does Gas stove and Electric stove work? What are their similarities and how do they get hot?

5. (a) Explain in details the principles of electric heating board

(b) What is the advantage of electric heating board?

(c) Classify electric heating board. What is electric plate?

5

WASHING MACHINE

5.0 Introduction

Figure 5.1 A typical front-loader washing machine

A washing machine (laundry machine, clothes washer, or washer) is a home appliance used to wash laundry. The term is mostly applied to machines that use water as opposed to dry cleaning (which uses alternative cleaning fluids, and is performed by specialist businesses) or ultrasonic cleaners. The user adds laundry detergent, which is sold in liquid or powder form, to the wash water.

A washing machine is found in almost every household. In this fast age, a washing machine is highly popular quite fast, saving a lot of time and labor. It manages to do so, quite effectively and efficiently, as it follows a set wash process. A brief overview of how different parts, is mentioned below.

BASIC STRUCTURES: The elementary components of a washing machine are agitator, inner and outer wash tub electric motor and drain tube. A washing machine is also equipped with valves, switches timers to smoothen it's working. Valves enable the passage of hot and cold water to the washing machine. The timer enables time functioning. A typical washer has switches to adjust and control various functions. The speed of spinning the special settings for different fabrics and the passage of hot and cold water are the functions mentioned by the switches. Valves switches and timers differ from model to model. These components have to be present top-loading or front-loading. Different models of washer differ only in the positioning of these parts. There is a specific function assigned to each part.

INNER WASH TUB: The process of washing starts in the inner wash tub. It involves the adding of water and detergent mixture to the clothes. The detergent contains many enzymes that work on clothes to clean them. Some such enzymes are protease, lipase, catalase and amylase. In inner wash tub, the clothes are tumbled and moved to all sides by the agitator.

AGITATOR: Agitator enhances the action of enzymes on clothes. An agitator is a plastic cylinder positioned at the center of the inner tube. Generally, an agitator is finned. It finned structure aids it in its function. The function of an agitator is to move the clothing up, down, back and forth so that the clothing mixes well with the detergent. The inner wash tub also moves along with the agitator. This motion is repeated for a determined period of time. The agitator ensures thorough cleaning of the clothing. This cycle is known as the wash cycle. The inner tub has numerous holes. The centrifugal force pulls out water from the clothes and makes it move through these holes to the outer tub. The water gets drained out through the drain tube.

MOTOR: In the wash cycle, the agitator and the inner tub are moved rhythmically by a powerful electric motor. In fact, it is the motor which accelerates the process of washing. Therefore, it is a very important component of a washer.

OUTER WASH TUB: The outer wash tub is stationery. Water gets pumped out from here. After the wash water has left, the inner tub is again filled with clean water. Agitator again works to tremble the clothing. This is the second cycle and is called the rinse cycle. The aim of this cycle is to discharge the detergent particles trapped in the washed fabric. On completion of rinsing, the machines again drain outer water.

DRAIN TUB: The purpose of the third cycle, which is called the spin cycle, is to remove out as much water as possible from the wet clothes. In all the steps, draining is carried out by the drain tubes. Once the water has been drained out, another electric motor comes to play. It agitates the inner tub at extremely high speeds. The centripetal force spins out remaining water from the fabric and expels it through the drain tube. This is a timed process. The clothing gets reduced from saturated to merely wet. The cleaning of the fabric is done and it is ready to dry.

POWER PART: Electric motors can reach high speeds quickly. In order to smoothen the start-up effect, washers are provided with a clutch. This clutch is similar to car clutches as it has the same standard drum and pad construction and functioning. Some units use a simpler method. They make use of drive belts. The drive belts slip on a pulley and fix gradually.

5.0.1 Wash cycles

Figure 5.2 Laundry Centrifuge

The earliest washing machines simply carried out a washing action when loaded with clothes and soap, filled with hot water, and started. Over time machines became more and more automated, first with very complex electromechanical controllers, then fully electronic controllers; users put clothes into the machine, select a suitable program via a switch, start the machine, and come back to remove clean and slightly damp clothes at the end of the cycle. The controller starts and stops many different processes including pumps and valves to fill and empty the drum with water, heating, and rotating at different speeds, with different combinations of settings for different fabrics.

5.0.2 Washing

Many front-loading machines have internal electrical heating elements to heat the wash water, to near boiling if desired. The rate of chemical cleaning action of the detergent and other laundry chemicals increases greatly with temperature, in accordance with the Arrhenius equation. Washing machines with internal heaters can use special detergents formulated to release different chemical ingredients at different temperatures, allowing different type of stains and soils to be cleaned from the clothes as the wash water is heated up by the electrical heater.

However, higher-temperature washing uses more energy, and many fabrics and elastics are damaged at higher temperatures. Temperatures exceeding 40 °C (104 °F) have the undesirable effect of inactivating the enzymes when using biological detergent.

Many machines are cold-fill, connected to cold water only, which they heat to operating temperature. Where water can be heated more cheaply or with less carbon dioxide emission than by electricity, cold-fill operation is inefficient.

Front loaders need to use low-sudsing detergents because the tumbling action of the drum folds air into the clothes load that can cause over-sudsing and overflows. However, due to efficient use of water and detergent, the sudsing issue with front-loaders can be controlled by simply using less detergent, without lessening cleaning action.

5.0.3 Rinsing

Washing machines perform several rinses after the main wash to remove most of the detergent. Modern washing machines use less water due to environmental concerns; however, this has led to the problem of poor rinsing on many washing machines on the market, which can be a problem to people who are sensitive to detergents. The Allergy UK website suggests re-running the rinse cycle, or rerunning the entire wash cycle without detergent.

In response to complaints, many washing machines allow the user to select additional rinse cycles, at the expense of higher water usage and longer cycle time.

5.0.4 Spinning

Higher spin speeds, along with larger tub diameters, remove more water, leading to faster drying. On the other hand, avoid ironing can be obtained not using spin cycle in the washing machine.

If a heated clothes-dryer is used after the wash and spin, energy use is reduced if more water has been removed from clothes. However, faster spinning can crease clothes more. Also, mechanical wear on bearings increases rapidly with rotational speed, reducing life. Early machines would spin at only 300 rpm and, because of lack of any mechanical suspension, would often shake and vibrate.

Separate spin-driers, without washing functionality, are available for specialized applications. For example, a small high-speed centrifuge machine may be provided in locker rooms of communal swimming pools to allow wet swimsuits to be substantially dried to a slightly damp condition after daily use.

5.0.5 Maintenance wash

Many home washing machines use a plastic, rather than metal, outer shell to contain the wash water; residue can build up on the plastic tub over time. Some manufacturers advise users to perform a regular maintenance or "freshening" wash to clean the inside of the washing machine of any mold, bacteria, encrusted detergent, and unspecified dirt more effectively than with a normal wash.

A maintenance wash is performed without any laundry, on the hottest wash program if there is a heater, adding substances such as white vinegar, 100 grams of citric acid, a detergent with bleaching properties, or a proprietary washing machine cleaner. The first injection of water goes into the sump so the machine can be allowed to fill for about 30 seconds before adding cleaning substances.

5.0.6 Efficiency and Standards

Capacity and cost are both considerations when purchasing a washing machine. All else being equal, a machine of higher capacity will cost more to buy, but will be more convenient if large amounts of laundry must be cleaned. Fewer runs of a machine of larger capacity may have lower running costs and better energy and water efficiency than frequent use of a smaller machine, particularly for large families. Running a large machine with small loads is wasteful.

For many years energy and water efficiency were not regulated, and little attention was paid to them. From the last part of the twentieth century increasing attention was paid to efficiency, with regulations enforcing some standards, and efficiency being a selling point, both to save on running costs and to reduce carbon dioxide emissions associated with energy generation, and waste of water.

As energy and water efficiency were regulated, and a selling point, but effectiveness of rinsing was not, manufacturers tended to reduce the degree of rinsing after washing, saving water and motor energy. This had the side-effect of leaving more detergent residue in clothes. Insufficient rinsing can leave enough detergent in clothes to affect people with allergies or sensitivity.

5.1 How to Repair your Washing Machine

Figure 5.3 Inspecting a washing machine

One day your washing machine was faithfully cleaning your clothes, and you barely even gave its operation a second thought. Then, any number of scenarios occurred. Perhaps the machine's basin fills with water but it will not drain. Or it drains but does not spin. Or the clothes are washed but are not very clean. In short, your washing machine does not work at its peak performance or has entirely stopped working.

For a machine that works so hard, it is hardly surprising that your clothes washer will occasionally break down or its performance will degrade to the point where the clothes are not getting sufficiently clean. Instead of calling in an expensive appliance technician, you can repair your washing machine by yourself. Most of these repairs require only simple tools and can be performed by homeowners who have only limited appliance repair skills.

5.1.1 Washing Machine Will Not Start

It is the most basic of all washing machine breakdowns: the machine will not start. You have put the clothes in the washing machine basin, pressed the "On" button or turned the dial, and then nothing happens.

- Check the power cord behind the washer to make sure that it is plugged in. Due to washers' vigorous movements, especially when the load is imbalanced, machines may move. When a machine moves, it may inadvertently unplug the power cord. Cords that have been shortened with ties have no give. In this case, untie the cord to allow for more flexibility.
- Is the circuit breaker to the washer flipped off? To reset a circuit breaker, find the electrical service

panel. Locate the correct circuit breaker, flip it in the "Off" direction, and then back to the "On" position.

- Your front loader washer's lid switch strike may be faulty. This is the area of the door frame that communicates to the machine that the door is properly closed and it is okay to begin filling with water. Close the lid and watch as the part on the door connects with the part on the machine. The top part should seat into the bottom part.
- Your top loader washer's lid switch may be faulty. You can test this by setting the machine to "On" and then pushing into the hole with the blunt end of a pen. If working correctly, the water should begin filling even though the lid is open.

5.1.2 Washing Machine Does Not Adequately Clean the Clothes

This may be one of the more frustrating clothes washer problems because you notice it only after running the clothes through a full cycle. After washing your clothing, you remove it and find your supposedly clean clothes covered in lint, hair, and other light debris.

- Avoid overloading your washer. An overly full washer does not have enough space for the clean rinse water to pull out the detergent and debris. Consult your owner's manual for specific load maximums.

- Use less detergent. Too much detergent can redeposit lint and other debris back on the clothing, rather than pulling it out.
- Wash pet-related items such as blankets, cat and dog beds, and chew toys separately from the rest of the clothing. If the pet load is especially dirty, clean the washing machine tub by hand after the wash.

5.1.3 Washing Machine Will Not Spin

With this all-too-common washing machine problem, the basin has drained of water but it refuses to spin. Spinning at a high rate of speed is the action that squeezes water out of the clothing so that it can be dried in the dryer.

- Try to redistribute the clothing within the washing machine tub. When the washer is out of balance, it will automatically stop until you can get the clothing back in balance. After redistributing the clothing, close the lid again. The machine should start spinning automatically if the load distribution is correct. Loads that include high-absorption materials like towels, sheets, and thick clothing like jeans and sweaters often become imbalanced.
- Check the machine's level on the floor. An out-of-level machine will stop spinning; this action is programmed into your clothes washer for safety. Check the machine's level with a bubble level and bring the machine back to level by adjusting the legs.

- Check the drainage and the drain hose. Small items may clog up the machine's drainage system. You may be able to check the washer's drain pump without removing it. Finally, the drainage hose that leads from the back of the machine to a drainage point may be clogged.

5.1.4 Washing Machine Makes Loud Noises

One of the more annoying washing machine problems is when the washer makes thumping, grinding, or thunking (flat hollow) noises during the agitation or spin cycles. Repair this problem as soon as possible, since the errant movement can damage the washer and create new problems.

- The tub bearings, located directly below the tub, may be worn out and in need of replacement.
- If the washing machine is making a squeaking sound, the tub bearings may need lubrication.
- The washing machine motor drive belt or pulley may be worn out. This is a rather involved repair, where you need to take apart a significant section of the machine in order to get to the motor.
- The pump pulley belt may be cracked, frayed or otherwise out of shape. Often the belt will smell like burning rubber, too.

5.1.5 Washing Machine Will Not Agitate

One common problem associated with washing machines: The machine's basin or tub fills with water but the central agitator does not move.

- Agitation is the back and forth motion that cleans the clothing. This action is performed by the central plastic cone-shaped device called the agitator. Small plastic directional cogs (also known as "dogs") connect the upper portion of the agitator with the bottom portion. Open the lid while the machine is in agitation mode. Depress the lid switch with the blunt end of a pen so that the machine does not stop while the lid is open. If the machine is making normal sounds of agitation or even a grinding noise, yet the agitator is not moving, the cogs may be worn down or broken and in need of replacement.
- Your machine's washer motor may have been affected by a power spike and needs to be reset. All brands have different reset procedures; check your owner's manual for possible information about motor resetting. For example, many General Electric washing machines require you to unplug the machine, plug it back in, then lift and lower the lid six times within 12 seconds, raising the lid a minimum of two inches in order to break the lid switch magnetic connection.

5.1.6 Washing Machine Fills with Water but Will Not Drain

Many homeowners have had the unpleasant experience of lifting the washing machine lid, only to discover clothes floating in a tub filled with murky gray water. If you catch the machine early enough, the water is still hot or lukewarm.

- Your machine's pump may be clogged with a piece of fabric or some other item related to washing. Bail the water out with a kitchen measuring cup and then unplug the machine. Take off the screws on the front panel. Tilt the machine up and prop the front of the machine on two-by-fours or bricks for easier access. Your machine's pump housing may be easily visible, making it simple to assess whether you have a clog in the pump. If so, use pliers to gently untwist the clog from the pump.
- Alternatively, the clog may be located in the corrugated tube that leads to the pump. Unclamp the tube. Have a bucket or bin nearby, because this tube will be filled with water. Drain the water. If there is a clog in the hose, it will usually be at the end of the hose. Pull it out by hand or with pliers.

5.1.7 Washing Machine Vibrates and Shakes Too Much

When your washing machine is running, particularly during the spin cycle, it may violently shake or vibrate, often so much that the machine "walks." This may be pronounced if you have a high-efficiency machine, which has a faster spin cycle than top loading machines.

- Your machine may need to be rebalanced. Use a bubble level to assess the level of the machine from side-to-side and front-to-back. Readjust the machine's level by turning the machine's legs up or down. Unlike the dryer, which has just two front adjustable legs, most washing machines have four adjustable legs.
- With stacking washer-dryer combinations, the connection straps may have loosened, causing the unit to shake violently. This can be a dangerous situation, since the dryer may fall off of the washer. Tighten the connection straps or replace if necessary.
- The classic and most easily fixable cause of a shaking clothes washer is an unbalanced load. Drape long, heavy items around the central agitator so that they are not grouped on one side. Move large items to the other side of equally large items.
- Consider purchasing an anti-vibration pad. Independently testing has shown that pads that are three inches thick do an excellent job of deadening the shaking and vibration. While not inexpensive, these pads can be a valuable tool for reducing the transmission of washer vibration to your home.

5.2 Exercise

1. (a) Explain the principle of washing machine

(b) Explain the functions of each part in a washing machine

2. Write short notes on the following as related with washing machine

- ✓ Wash cycle
- ✓ Washing
- ✓ Rising
- ✓ Spinning
- ✓ Maintenance wash

3. What is water efficiency?
4. What is the function of white vinegar?
5. (a) What are Enzymes?

(b) Explain basic structure of washing machine

6. What type of soap is used in a washing machine and why are they used?

6

HEATERS

6.0 Electric Heating

Figure 6.1 30 kW resistance heating coils

Electric heating is a process in which electrical energy is converted to heat energy. Common applications include space heating, cooking, water heating and industrial processes. An **electric heater** is an electrical device that converts an electric current into heat. The heating element inside every electric heater is an electrical resistor, and works on the principle of Joule heating: an electric current passing through a resistor will convert that electrical energy into heat energy. Most modern electric heating devices use nichrome wire as the active element;

the heating element, depicted on the right, uses nichrome wire supported by ceramic insulators.

6.0.1 How Do Heaters Work?

The primary component common to all electrical heaters is the electrical resistor.

When you turn a heater on, the electrical current that is produced heats up the nichrome wire components — better known as the heating coils — in the unit. Electrical energy is turned into heat as the current passes through the resistor. That’s why electric heaters are also known as resistance heating units.

The next step in the heating process depends on whether or not the heater has a built-in electric fan or not. If there is a fan, it will help draw cold air into the heater. The air passes over the heating elements and then is pushed out into the room — this is similar to how hair dryers work. This is also known as convection heating because the warmth is transferred through the air. Convection heaters are a good way to warm a space quickly by getting hot air to circulate around the room.

If there is no fan in the heater, air enters the unit from below. The air flow passes over the coils, is heated and finally finds its way out through the top of the device. This style of electric heating is known as radiant heating — think of a conventional electric stove with a heating element. It’s a good choice for small spaces and areas where you can be near the heat source while it's in use. Electric baseboards are radiant heaters and provide an effective way of introducing thermal energy to a room without changing the infrastructure of your home.

6.1 Electric Hot Water Heaters

I am sure you enjoy taking a shower in hot water after a hard day's work. But have you ever thought about the technology that goes behind a typical electric hot water heater? Well surely this is not rocket science and if you read this article with concentration for 5 minutes, I am sure you will understand the basic working theory of electric hot water heaters. This will not only increase your knowledge but also give you a solid background to troubleshoot common problems without having to call your electrician.

6.1.1 Basic Working Principle of Electric Hot Water Heaters

If you want to go into the very basic principle, it is simply the conversion of electrical energy into heat through the use of heating element/s to raise the temperature of water to a certain degree.

Obviously, this is not much different from a common immersion rod which you can dip into your bucket, plug into the power socket and get going. The only difference is the level of sophistication and slight automation in the geyser.

Of course, different heaters of different companies and brands can have slightly different arrangement but the basic concept behind all of them remains the same. You can take a look at the diagram below to understand the construction of a typical heater.

6.1.2 Construction and Working

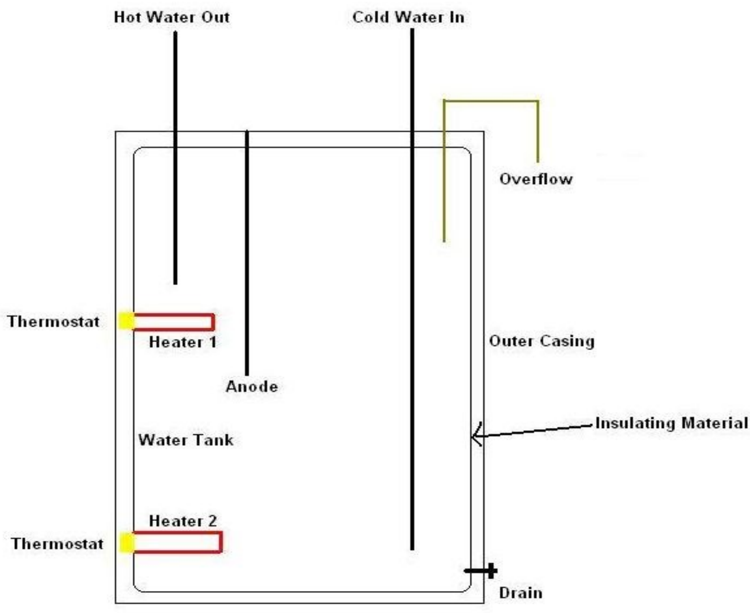


Figure 6.2 Hot water flow processes

As you can see from the image in fig 6.2, there are two pipelines, one for inlet of cold water and the other for outlet of the hot water. The water tank is fitted with heating element/s which is/are controlled by thermostats. The function of the thermostat is to set the temperature to a certain value so that water is not heated above that value.

The tank is normally covered with some insulating material such as glass wool and entire assembly is enclosed inside a metal casing which can be hanged on the wall or wherever required.

The sacrificial anode is used to protect the tank from corrosion by sacrificing itself and helps to prolong the life of the tank.

6.1.3 Common Troubleshooting

Understanding the working principle of any device is the first step towards common troubleshooting measures. It is not possible to list each and every trouble and its root cause but some of the commonly occurring problems have been discussed.

Warning – Please be warned that electric heaters and similar devices can be dangerous if you try to repair them unless and until you know what you are doing. So, I would advise you that if you are having any doubts or not clear about anything, do not try to tamper around with the device. This could not only lead to further damage but more importantly it could lead to a severe electric shock which could be fatal for life.

6.2 Water Heater

Figure 6.3 water heater

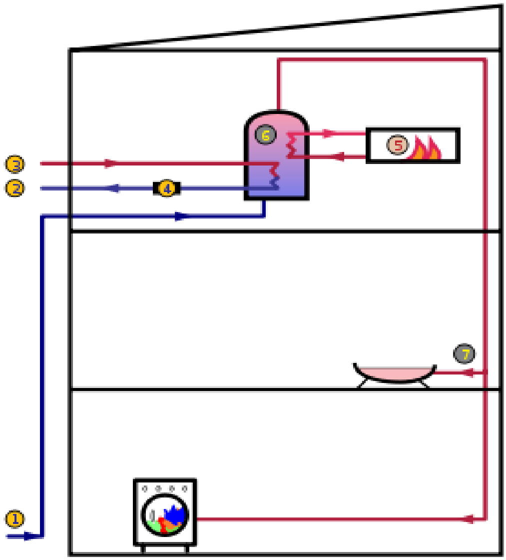


Figure 6.4 water heater cycle

1: Municipal water feed
2: Fluid from water storage tank to external (passive) heat source; passive heat source can be the ground (soil or groundwater), sun or air via heat pump, or thermodynamic solar panel
3: Fluid from heat pump, or thermodynamic solar panel to water storage tank
4: Pump, actuator, controller and other parts
5: Water heater
6: Water storage tank
7: Hot water to domestic appliances

Water heating is a heat transfer process that uses an energy source to heat water above its initial temperature.

Typical domestic uses of hot water include cooking, cleaning, bathing, and space heating. In industry, hot water and water heated to steam have many uses.

Domestically, water is traditionally heated in vessels known as *water heaters*, *kettles*, *cauldrons*, *pots*, or *coppers*. These metal vessels that heat a batch of water do not produce a continual supply of heated water at a preset temperature. Rarely, hot water occurs naturally, usually from natural hot springs. The temperature varies with the consumption rate, becoming cooler as flow increases.

Appliances that provide a continual supply of hot water are called *water heaters*, *hot water heaters*, *hot water tanks*, *boilers*, *heat exchangers*, *geysers* (Southern Africa only), or *calorifiers*. These names depend on region, and whether they heat potable or non-potable water, are in domestic or industrial use, and their energy source. In domestic installations, potable water heated for uses other than space heating is also called *domestic hot water* (*DHW*).

Fossil fuels (natural gas, liquefied petroleum gas, oil), or solid fuels are commonly used for heating water. These may be consumed directly or may produce electricity that, in turn, heats water. Electricity to heat water may also come from any other electrical source, such as nuclear power or renewable energy. Alternative energy such as solar energy, heat pumps, hot water heat recycling, and geothermal heating can also heat water, often in combination with backup systems powered by fossil fuels or electricity.

Densely populated urban areas of some countries provide district heating of hot water. This is especially the case in Scandinavia, Finland and Poland. District heating systems supply energy for water heating and space heating from combined heat and power (CHP) plants, waste heat from industries, incinerators, geothermal heating, and central solar heating. Actual heating of tap water is performed in heat exchangers at the consumers' premises. Generally, the consumer has no in-building backup system, due to the expected high availability of district heating systems.

In the United States today, domestic hot water used in homes is most commonly heated with natural gas, electric resistance, or a heat pump. Electric heat pump hot water heaters are significantly more efficient than electric resistance hot water heaters, but also more expensive to purchase. Some energy utilities offer their customers funding to help offset the higher first cost of energy efficient hot water heaters.

6.2.1 Types of water heating appliances

Figure 6.5 Electric tank-type storage water heater

Hot water used for space heating may be heated by fossil fuels in a boiler, while potable water may be heated in a separate appliance. This is common practice in the urban area especially when warm-air space heating is usually employed.

6.2.2 Storage water heaters (tank-type)

Figure 6.6 Gas furnace (top) and storage water heater (bottom)

These may use electricity, natural gas, propane, heating oil, solar, or other energy sources. Natural gas heaters are most popular in the US and most European countries, since the gas is often conveniently piped throughout cities and towns and currently is the cheapest to use.

This is a popular arrangement where higher flow rates are required for limited periods. Water is heated in a pressure vessel that can withstand a hydrostatic pressure close to that of the incoming mains supply. A pressure reducing valve is sometimes employed to limit the pressure to a safe level for the vessel. In North America, these vessels are called *hot water tanks*, and may incorporate an electrical resistance heater, a heat pump, or a gas or oil burner that heats water directly.

Where hot-water space heating boilers are installed, domestic hot water cylinders are usually heated indirectly by primary water from the boiler, or by an electric immersion heater (often as backup to the boiler). Additionally, if these cylinders form part of a sealed system, providing mains-pressure hot water, they are known as unvented cylinders.

Compared to tankless heaters, storage water heaters have the advantage of using energy (gas or electricity) at a relatively slow rate, storing the heat for later use. The disadvantage is that over time, heat escapes through the tank wall and the water cools down, activating the heating system to heat the water back up, so investing in a tank with better insulation improves this standby efficiency.

Additionally, when heavy use exhausts the hot water, there is a significant delay before hot water is available again. Larger tanks tend to provide hot water with less temperature fluctuation at moderate flow rates.

Volume storage water heaters in the United States and New Zealand are typically vertical, cylindrical tanks, usually standing on the floor or on a platform raised a short distance above the floor. Volume storage water heaters in Spain are typically horizontal. In India, they are mainly vertical. In apartments they can be mounted in the ceiling space over laundry-utility rooms.

Tiny *point-of-use* (POU) electric storage water heaters with capacities ranging from 8 to 32 liters (2 to 6 gallons) are made for installation in kitchen and bath cabinets or on the wall above a sink. They typically use low power heating elements, about 1 kW to 1.5 kW, and can provide hot water long enough for hand washing, or, if plumbed into an existing hot water line, until hot water arrives from a remote high capacity water heater. They may be used when retrofitting a building with hot water plumbing is too costly or impractical. Since they maintain water temperature thermostatically, they can only supply a continuous flow of hot water at extremely low flow rates, unlike high-capacity tankless heaters.

6.3 Tankless Heaters

Figure 6.7 Tankless heater circuit

The inside of a hydraulically operated two-stage tankless heater, heated by 3-phase electric power. The copper tank contains heating elements with 18 kW maximum power.

Tankless water heaters—also called *instantaneous*, *continuous flow*, *inline*, *flash*, *on-demand*, or *instant-on* water heaters—are gaining in popularity. These high-power water heaters instantly heat water as it flows through the device, and do not retain any water internally except for what is in the heat exchanger coil. Copper heat exchangers are preferred in these units because of their high thermal conductivity and ease of fabrication.

Tankless heaters may be installed throughout a household at more than one point-of-use (POU), far from a central water heater, or larger centralized models may still be used to provide all the hot water requirements for an entire house. The main advantages of tankless water heaters are a plentiful continuous flow of hot water (as compared to a limited flow of continuously heated hot water from conventional tank water heaters), and potential energy savings under some conditions. The main disadvantage is their much higher initial costs.

Though on-demand heaters provide a continuous supply of domestic hot water, the rate at which they can produce it is limited by the thermodynamics of heating water from the available fuel supplies.

6.4 Electric Shower Heads

Figure 6.8 Electric shower head

An electric shower head has an electric heating element which heats water as it passes through. These self-heating shower heads are specialized point-of-use (POU) tankless water heaters, and are widely used in some countries.

Electric showers have a simple electric system, working like a coffee maker, but with a larger water flow. A flow switch turns on the device when water flows through it. Once the water is stopped, the device turns off automatically. An ordinary electric shower often has three heat settings: high (5.5 kW), low (2.5 kW), or cold (0 W) to use when a central heater system is available or in hot seasons.

6.4.1 Energy usage

The power consumption of electric showers in the maximum heating setting is about 5.5 kW for 120 V and 7.5 kW for 220 V. The lower costs with electric showers compared to the higher costs with boilers is due to the time of use: an electric shower uses energy only while the water flows, while a boiler works many times a day to keep a quantity of standing water hot for use throughout the day and night. Moreover, the transfer of electric energy to the water in an electric shower head is very efficient, approaching 100%. Electric showers may save energy compared to electric tank heaters, which lose some standby heat.

6.5 Boilling Ring

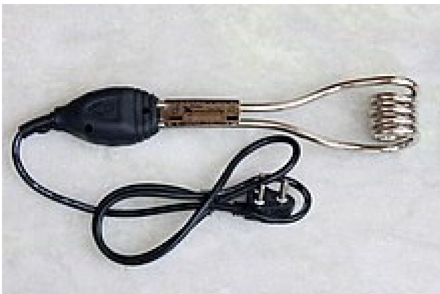


Figure 6.9 1500W Immersion Rod

There is a wide range of electric showers, with various types of heating controls. The heating element of an electric shower is immersed in the water stream, using a nichrome resistance element which is sheathed and electrically isolated, like the ones used in oil heaters, radiators or clothes irons, providing safety. Due to electrical safety standards, modern electric showers are made of plastic instead of using metallic casings like in the past.

6.6 Exercise

1. (a) What is Electric heating?
   (b) How do heaters work?
2. (a) Explain what you understand about electric hot water heater.
   (b) What are the basic working principles of electric hot water heaters?
3. Draw and explain the construction and working principle of electric hot water
4. How do you troubleshoot a faulty electric hot water heater? What precautions must be taken during troubleshooting process?
5. Draw and explain the structure of water heater cycle
6. (a) What is water heating
   (b) List and explain difference types of water heating appliances?

7

THE REFRIGERATOR

7.0 Introduction

Refrigeration is defined as simply the cooling of food below the temperature of the surrounding atmosphere for the purpose of preserving the food. By preserving food, one can delay the growth of bacteria. keep fresh appearance for perishable food items and eventually save time and energy of homemaker in meal preparation.

Initially cooling was done by ice boxes or by keeping things on moist surfaces. Now, with the advancement of technology cooling is entirely replaced by refrigerating mechanisms, the energy of which is supplied by an electric motor or gas

Figure 7.1a A modern home refrigerator

Figure 7.1b Commercial refrigeration

Refrigeration this can also be seen as the process of cooling a space, substance, or system to lower and/or maintain its temperature below the ambient one (while the removed heat is rejected at a higher temperature). In other words, **refrigeration** means artificial (human-made) cooling. Heat is removed from a low-temperature reservoir and transferred to a high-temperature reservoir. The work of heat transfer is traditionally driven by mechanical means, but can also be driven by heat, magnetism, electricity, laser, or other means. Refrigeration has many applications, including, but not limited to: household refrigerators, industrial freezers, cryogenics, and air conditioning. Heat pumps may use the heat output of the refrigeration process, and also may be designed to be reversible, but are otherwise similar to air conditioning units.

Refrigeration has had a large impact on industry, lifestyle, agriculture, and settlement patterns. The idea of preserving food dates back to at least the ancient Roman and Chinese empires. However, mechanical refrigeration technology has rapidly evolved in the last century, from ice harvesting to temperature-controlled rail cars.

As quite similar criteria shall be fulfilled by working fluids (refrigerants) applied to heat pumps, refrigeration, and organic Rankine cycles; several working fluids are applied by all these technologies. Ammonia was one of the first refrigerants. Refrigeration can be defined as "The science of providing and maintaining temperature below that of surrounding atmosphere". It means continuous extraction of heat from a body whose temperature is already below the temperature of its surroundings.

To put it simply there are 3 steps by which a refrigerator or a fridge works:

1. Cool refrigerant is passed around food items kept inside the fridge.
2. Refrigerant absorbs heat from the food items.
3. Refrigerant transfers the absorbed heat to the relatively cooler surroundings outside.

Most people wouldn’t know what to do without a refrigerator, as there are few things that can soothe your parched throat the same way a glass of chilled water does.

7.1 Refrigerator Working Principle

The working principle of a refrigerator (and refrigeration, in general) is very simple: it involves the removal of heat from one region and its deposition to another. When you pass a low-temperature liquid close to objects that you want to cool, heat from those objects is transferred to the liquid, which evaporates and takes away the heat in the process.

You may already know that gases heat up when you compress them and cool down when they are allowed to expand. That’s why a bicycle pump feels warm when you use it to pump air inside a tire, while sprayed perfume feels cold.

An aerosol air freshener feels cold to the touch because the gas is allowed to expand suddenly, which brings down its temperature.

The tendency of gases to become hot when compressed and cold when expanded, along with the help of a few nifty devices, helps a refrigerator cool the stuff being kept inside it.

The working principles of the refrigerator utilize the cooling effect of evaporation. The volatile liquid used is called the refrigerant. Example of such liquid or liquefied gas are ammonia, and ethyl-chloride (Freon).

The volatile liquid is contained inside coiled copper pipes or tube which surrounds the freezing chamber. As the liquid evaporates, it absorbs the necessary latent heat of (vaporization is the process in which a substances changes from the liquid to the gaseous state) from its surrounding thereby cooling the inside of the refrigerator and its contents. The vapour is removed by the pump which compresses it into a condenser attached outside the refrigerator and fixed with metal cooling fins. The compressed vapour condenses and gives out latent heat. This heat is removed by conduction into the cooling fins and thence by convection and radiation to the surrounding. The condensed vapour goes back into circulation around the freezing chamber, where it again evaporates thus setting up a continuous circulation of liquid and vapour. A thermostat inside the refrigerator switches the pump motor ON and OFF at intervals at a power supply. In this way it controls the rate of vaporization and the consequent degree of cooling.

7.2 Parts of A Refrigerator

A refrigerator consists of a few key components that play a vital role in the refrigeration process:

(i) Expansion valve

Also referred to as the flow control device, an expansion valve controls the flow of the liquid refrigerant (also known as 'coolant') into the evaporator. It's actually a very small device that is sensitive to temperature changes of the refrigerant.

(ii) Compressor

The compressor consists of a motor that ‘sucks in’ the refrigerant from the evaporator and compresses it in a cylinder to make a hot, high-pressure gas.

Figure 7.2 Compressor of Refrigerator

(iii) Evaporator

This is the part that actually cools the stuff kept inside a refrigerator. It consists of finned tubes (made of metals with high thermal conductivity to maximize heat transfer) that absorb heat blown through a coil by a fan. The evaporator absorbs heat from the stuff kept inside, and as a result of this heat, the liquid refrigerant turns into vapor.

(iv) Condenser

The condenser consists of a coiled set of tubes with external fins and is located at the rear of the refrigerator. It helps in the liquefaction of the gaseous refrigerant by absorbing its heat and subsequently expelling it to the surroundings.

Figure 7.3 Condenser coils

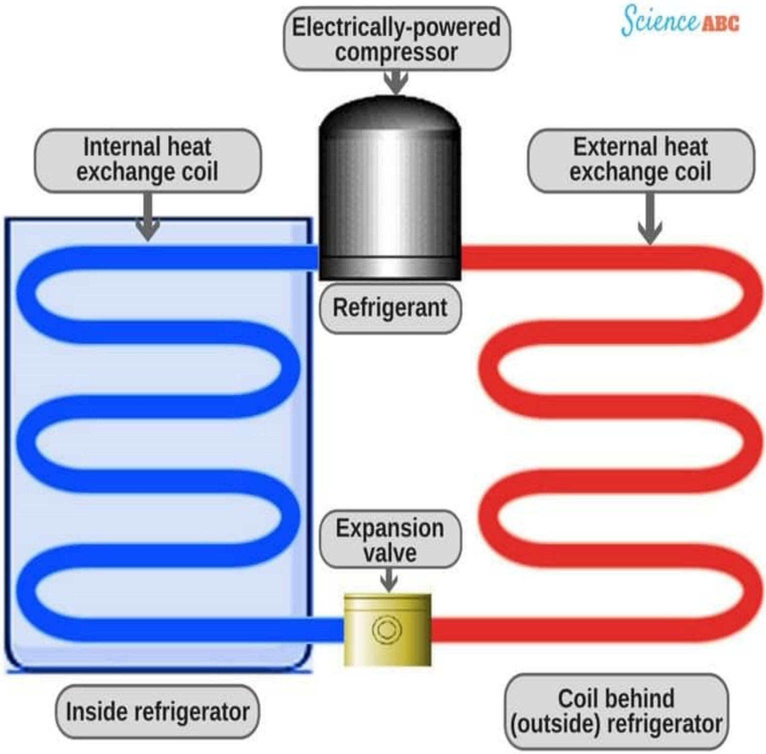


Figure 7.4 Internal component of the Refrigerator

The refrigerant, which is now in a liquid state, passes through the expansion valve and turns into a cool gas due to the sudden drop in pressure.

As the cool refrigerant gas flows through the chiller cabinet, it absorbs the heat from the food items inside the fridge. The refrigerant, which is now a gas, flows into the compressor, which sucks it inside and compresses the molecules together to make it into a hot, high-pressure gas.

Now, this gas transports to the condenser coils (thin radiator pipes) located at the back of the fridge, where the coils help dissipate its heat so that it becomes cool enough to condense and convert back into its liquid phase. Because the heat collected from the food items is given off to the surroundings via the condenser, it feels hot to the touch.

After the condenser, the liquid refrigerant travels back to the expansion valve, where it experiences a pressure drop and once again becomes a cool gas. It then absorbs heat from the contents of the fridge and the whole cycle repeats itself.

The most common types of refrigeration systems use the reverse-Rankine vapor-compression refrigeration cycle, although absorption heat pumps are used in a minority of applications.

Cyclic refrigeration can be classified as:

1. Vapor cycle, and
2. Gas cycle

Vapor cycle refrigeration can further be classified as:

1. Vapor-compression refrigeration

2. Sorption Refrigeration
3. Vapor-absorption refrigeration
4. Adsorption refrigeration

7.3 Vapor-Compression Cycle

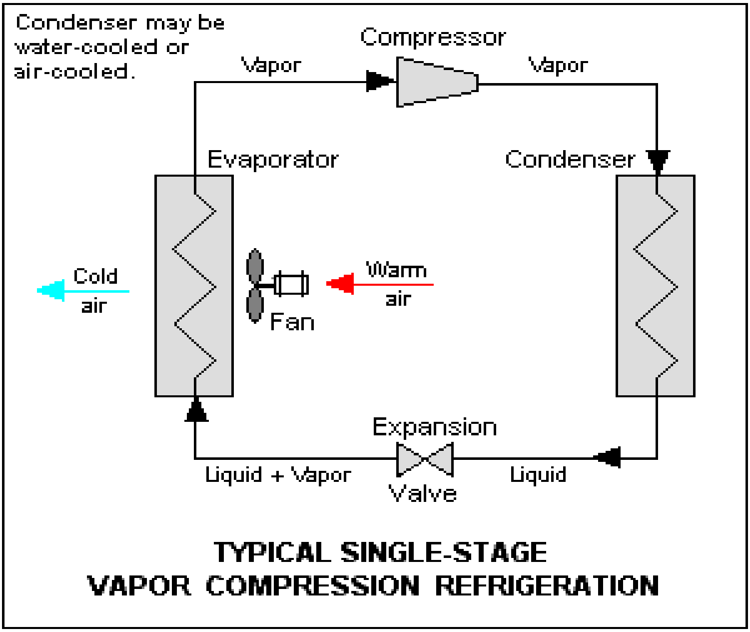


Figure 7.5 Vapour compression refrigeration

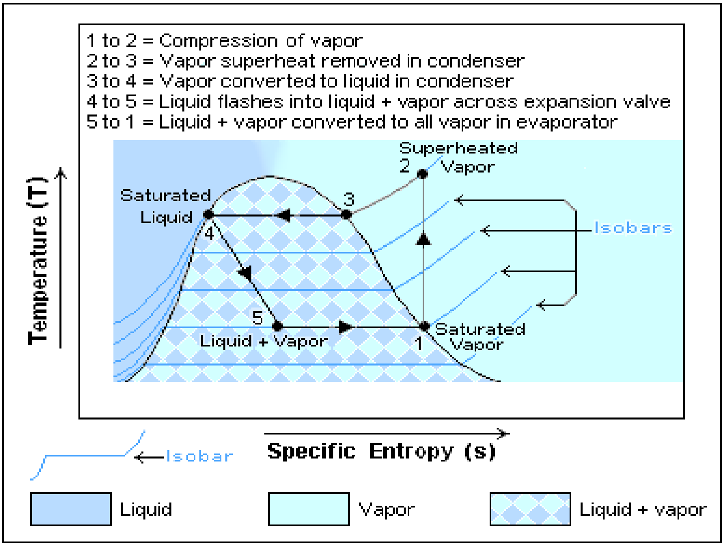


Figure 7.6 Temperature-Entropy diagram

The vapor-compression cycle is used in most household refrigerators as well as in many large commercial and industrial refrigeration systems. Figure 7.5 provides a schematic diagram of the components of a typical vapor-compression refrigeration system.

The thermodynamics of the cycle can be analyzed on a diagram as shown in Figure 7.6. In this cycle, a circulating refrigerant such as Freon enters the compressor as a vapor. From point 1 to point 2, the vapor is compressed at constant entropy and exits the compressor as a vapor at a higher temperature, but still below the vapor pressure at that temperature. From point 2 to point 3 and on to point 4, the vapor travels through the condenser which cools the vapor until it starts condensing, and then condenses the vapor into a liquid by removing additional heat at constant pressure and temperature. Between points 4 and 5, the liquid refrigerant goes through the expansion valve (also called a throttle valve) where its pressure abruptly decreases, causing flash evaporation and auto-refrigeration of, typically, less than half of the liquid.

7.4 Exercise

1. (a) What is refrigeration?

   (b) Enumerate the 3 steps by which a refrigerator or fridge work.

2. Explain the working principle of refrigeration
3. List and explain the parts of a refrigerator
4. (a) Draw and explain the internal component of the refrigerator

   (b) Name the 2 cycles a refrigerator can be classified

   (c) Explain (b) above with a vapour-compressor cycle.

5. Analyzed the thermodynamics of the refrigerator cycle.

8

GAS EQUIPMENT

8.0 Introduction

Gas stoves are popular cooking appliances used today in many homes. They use the gaseous fuels which have the advantage of extreme flexibility, that is, they can be burned under a great variety of conditions almost instantaneously by manipulation of a valve. They are miscible in all proportions with the air required for combustion.

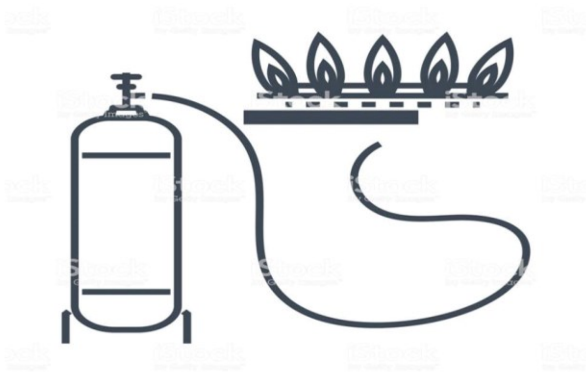


Figure 8.1 Cooking Gas Stove

For domestic use, liquefied petroleum gas is generally supplied in steel cylinders which are delivered and fitted to the burners by means of rubber tubing. The burners are specially designed for efficient burning of the gas. The burner head has a number of small holes around it to provide primary air for the combustion. The appliance has a tap in front of the burner which can be adjusted to 'ON' 'OFF' or 'MEDIUM' position. There is a valve on top of the cylinder. The gas is released from the cylinder to the burner by opening this cylinder valve. The pressure regulator brings down the pressure of this gas to a working level. The regulator is located next to the gas outlet of the cylinder

To Operate, the cylinder valve is first opened and then lighted matches applied to the burner, while the appliance valve is opened simultaneously. The gas ignites and the flame could be adjusted medium or high as desired by adjusting the appliance tap. While cooking, the tap is turned on full to begin with and as soon as the contents of the utensil boil the dame is reduced such that the contents just remain boiling.

To extinguish the name, the appliance is turned off. The cylinder valve also must be closed whenever the gas is not in use for safety reasons.

Selection of gas burners is purely based on its high efficiency and heating rate. The burners are simple, attractive and easy to clean. They are made of steel chromium plated or enamel painted or stainless steel well designed, durable and neatly constructed burners ensures complete combustion with no smoke. Appliance is durable, needs servicing every year for cleaning the burner heads and checking leakage. Heat output can be rapidly adjusted over a wide range and any number of intermediate positions are possible. No attention is required except keeping away draughts. The gas is nontoxic under ‘normal conditions. Gas burner saves time and energy since it cooks fast. It is clean and convenient. Cost of fuel is high, but hardly there is any maintenance cost.

8.1 Smokeless Cooker

Figure 8.2 Smokeless cooker

Women’s activities in the house revolve around the kitchen stove and the family happiness can be increased with improvements in the design of the stove by reducing the fuel intake and nuisance of smoke and soot. Smokeless cooker relieves women from eye and headache due to smoke and even uses less fuel than average cooker.

Three vessels could be placed on it simultaneously. The heat can be controlled with the draft system and damper. Smoke is controlled and regulated through a chimney provided at the other end of oven right up to outside of the roof of the kitchen.

8.2 Pressure Cooker

Figure 8.3 Pressure pot

Pressure cookers are designed so that steam is held within the pan, creating pressure. This raises the temperature to above the normal boiling point and shortens the cooking time. Foods are cocked at approximately 121°C, the steam pressure of 15Lbs' per square inch is approximately maintained.

There are two types of pressure cookers available in the market. One type has flexible cover that can he slipped under the rim of the pan pressed into position, and held there by a hook attachment on the handle others have an outside cover that slides into grooves on the rim of the pan and locks into position. A rubber gasket aids in' sealing the cover tightly.

8.2.1 Structure

Pressure cookers are pans made of aluminum, cast or pressed and of stainless steel. They vary in size from 4 to 12 liters capacity depending upon the manufacturer.

The steam escapes through a vent tube. A weight gauge placed over the vent controls the pressure. The pressure is maintained by regulating the amount of heat. A safety device in the cover, a plug of fusible alloy or of synthetic rubber automatically releases excess pressure or reacts if the cooker goes dry. This is designed to melt or blow out if the pressure becomes too high.

8.2.2 Principles of Operation of pressure pot

The raw food with a little water is placed in the cooker, the lid is clamped in place and the heat turned on. Soon the water boils into steam. The steam pushes the air out of the cooker through a small hole in the cover. When all the air is expelled, the equipment is ready for pressure cooking. A small valve in the cover closes the hole and prevents steam from escaping. Since there is no way for the steam to escape the temperature is raised above

100^{o}C. In a, few minutes the food is cooked. But the cooker has to be cooled by pouring cold water over the lid

which will cause the steam to be cooled into water again. Now the pot can be opened safely. The pressure must always be completely down before the cover is removed. Some menu fractures caution against cooking in a pressure cooker any foods that form or thicken since it might clog the vent.

8.2.3 Maintenance

1. It is important to keep the air vent clean. Any obstruction in it may cause the pressure to build up without a means for the steam to escape.

2 The rubber gasket should also be kept clean free from food particles and grease.

3 The gasket needs to be replaced when it can no longer make a tight seal.

4 Due to constant use, the cooker may become discolored. these stains can be easily removed by boiling a weak solution of vinegar and thoroughly cleaning it after using it every time.

8.3 Simple Cooker

A simple cooker is a simple device, but is very effective in saving energy by cooking items simultaneously with the same amount of heat input.

A simple cooker has three parts.

1. A tall vessel with a lid.

2. A perforated disc which is placed at the bottom of the vessel.

3. Three compartments which fit one on top of the other.

Rice, Pulses and vegetable could be cooked simultaneously in this cooker. Wash rice and add sufficient water in the first container. The same way, wash the Pulses and add two measures of water to it. Place cut vegetable in the top container. There is no need to add any water for vegetables, since they contain enough water and is cooked by the steam generated from the water placed at the bottom of the cooker. Place the three compartments in the box one on top of the other. Close the lid and place on the stove. After boiling the hammy be reduced.

Advantages

1. The total cooking time is reduced. It takes only about 30-40 minutes depending on the amount cooked.
2. Constant attention is not required.
3. The fuel requirement is reduced to about half compared to the situation when everything is cooked separately.

8.4 Hay Box Cooker

Hay box is a fuel less cooker which can be effectively used by the rural women. It depends on the principle that materials which entangle air in their meshes allow very little heat to escape and are bad conductors of heat. A box lined with such material, therefore will retain the heat of anything put into it. If Food at boiling point is immediately placed in the box it will remain practically at that temperature for a very long time. A large wooden box of 60cm x 45cm x 45cm or any convenient size available could be used for this purpose. The box is tilled with hay forms a hay box Prepare a pillow of jute almost of the size of the box and till it up with the hay which Will work as a perfectly insulated box. Take care that pillow is well fitted on the box. When a good foundation has been made. Place a vessel or vessels preferably without long handles in the positions they will occupy. The pot of re-boiled food is firmly placed in the hay and covered with the pillow of hay. The food will cook within one to two hours with the retained heat. Two or three items can be cooked together in this box depending upon its size. First of all, take any food item you wish to cook like rice or Pulses wash and clean it up for rice and khichdi, just double the amount of water required for the item to be cooked. In order to cook rice, boil the required amount of water separately. When water starts boiling, add the rice and a pinch of salt and cover it. After 4 minutes, remove the utensil from the fire and make space for it in the hay box and put the utensil. Keep the lid of the utensil closely tight, otherwise the steam will pass out and the item will remain uncooked. After putting the utensil in the box, place the pillow over it and shut the box. It takes 15 minutes for vegetables 30 minutes for rice and about 1 hour for Pulses to cook.

This method is very useful for cooking rice, porridge and anything requiring slow cooking. A hay box is most useful when gas is used for cooking as it will continue to cook things otherwise requiring a small gas to keep them going. It saves fuel as no fuel is required in the hay box. The food remains warm for 5 to 6 hours. There are no chances of burning and 'boiling over' of the food.

8.4.1 The Following Points Should Be Kept in Mind for Effective Working of the Box

1. Less water should be used since it is not boiled away.

2. The food should boil for several minutes before being placed in the box. This ensures that all the food is at boiling temperature.

3. Care should be taken to see that steam should not be allowed to leak from the utensil.

4. The boxes perform best at low altitudes where boiling temperature is highest.

5. Good insulating materials should be used. Suggested wall thickness for box cookers are

Cork	**5 cm.**
Sawdust/wood shavings	**13 cm.**
Raw cotton	**10 cm.**
Fibre glass	**10 cm.**
Chaff of rice	**15 cm.**
Hay	**15 cm.**

6. My box should be kept in the sun frequently So the moisture to the straw is removed.

8.5 Pressure Stoves

Figure 8.4 Pressure Stove

Pressure stoves arc an improvement over the wick stoves. This appliance consists of a burner tap and a tank at the bottom for the kerosene. The tank is fitted with pump, a lid and an air key. There is spirit cup at the center of the stove and a nipple on top of it. In general, pressure stoves consume less of kerosene and produce a hotter flame than the wick stove. To operate the stove, the tank is tilled with diesel oil to about two thirds of its capacity. Then tighten the tank lid and release the air key. Place an asbestos soaked in kerosene in the spirit cup and light it. When the lighter is almost burnt out, lighten the air key and the stove is pumped 4 to 6 full strokes till the flame is intense enough for cooking. The kerosene oil passing through the previously heated burner is gamified and is mixed with air as it passes through the nipple.

The air mixed gas is burned with an intense heat and blue atmospheric flame Some of the heat generated is conducted down the vaporizing tubes of the burner to the bass ensuring adequate vaporization prior to combustion. The roaring sound associated with this burner can be eliminated by fitting an outer cap over the nipple. The cap has a number of small holes through which the air vapor mixture can pass and get ignited. The flame can be regulated and therefore the heat output can be varied within limits. To increase the name more air is pumped in and to reduce the flame, air is released by opening the pressure release valve to the required extent. If the valve is kept open for some time, the flame gets extinguished. While not in use, the valve must always remain Open. The fuel tank must not be filled to the brim any time. Adequate space must be let on the top for air pressure. The stove should not be operated with less than approximately 250c.c of kerosene in the tank.

The pressure stoves are not easy to keep clean. Vapourisers and washers on pressure stoves require occasional replacement. Pressure stoves need pricking, priming and pumping, before they enable it causes soot on lighting. The heat Cannot be controlled minutely. It is too hot for simmering purposes. It needs to be pumped up from time to time. The Game can be put off rapidly. Faulty use produces smoke and soot.

8.6 Wick Stoves

Figure 8.5 Wick stove

Wick stoves are basically like kerosene lamps they are of three types.

1. Single wick,

2. Multiple prick and

3. Gravity type.

in all cases the oil rises by capillary action from the container to the burner through a wick, preferably of asbestos. Short wicks are better than long ones to draw up the kerosene. The wick can be a circular wick or a strand of multiple wicks which can be raised or lowered as desired to light, extinguish or regulate the name.

Wick stove consists of a brass tank at the bottom with a central tube and two perforated sleeves surrounding the wick carrier. This is covered with an enamel burner cover and on top there is an aluminum grate to hold the utensil. There is a regulator just above the tank to adjust the flame. The tank is first filled with kerosene oil and then the regulator is moved to the extreme left. The burner is slightly lifted and the wick is lighted and then the burner is lowered. A high level of oil should be maintained in the container to ensure efficient blue flame. To extinguish the flame, the regulator is turned to the extreme right and the burner is removed. In this type the flame is controlled as required.

In the multi wicks stoves, the wick disc carrying a number of wicks fits into the fuel carrier so that the lower ends of the wicks dip into the kerosene. There are two perforated sleeves, one inside and the other outside the wicks. These serve to admit the necessary air for the combustion particularly the primary air. Just above the chamber, there is a wick control to adjust the flame and, on the tap, a metallic grate is placed to hold the utensil.

To operate, the whole burner is removed and the wick control adjusted to raise the wicks. The wick(s) is lighted and the burner firmly replaced. The flame is regulated by operating the wick control. The kerosene oil on the wick first burn with a luminous flame but soon the kerosene vapours formed pick up enough oxygen from the air in the burner and the mixture burn: with a blue flame. The wicks need constant trimming

and cleaning and frequent replacement. it is easy to light the stove but requires some time to give the proper flame. Heat output can be varied but only to a small extent, all too often pan bottoms become black. Wick stoves are slow for boiling. it can be put off easily but sometimes it produces smoke and soot.

8.7 Mixers

Figure 8.6 Mixers

Mixers consist of a base which houses the motor and controls, a glass or plastic food container that fits on the base and a cover for the container. The cutting assembly has several sharp steel blades. It is either attached to the bottom of the food container or is removable. Sticky or thick foods are particularly difficult to remove from the blades. When blades are permanently attached, cleaning is done by adding warm water, some detergent and turning on the blender. A removable cutting assembly simplifies cleaning somewhat. On sonic of the models, the provision for speed control is also made winch helps in avoiding over blending. The motor is of speed 30hp. motor which operates both on A.C. and D.C. Some containers are provided with a pouring lip and with a graduated scale. In some containers, there is a hole which could be opened and closed to facilitate the addition of the food without removing the lid. Some containers have a comfortable handle to hold.

8.8 Egg Beaters

There are two types of beaters commonly found in the market.

1. Whisk.

2. Rotary beater.

Figure 8.7 Whisk

Whisks are used chiefly for introducing air into egg whites. The whisk is effective in incorporating large amount of air and giving maximum volume through a somewhat coarse texture. It may be made of many fine wires, each wire forming a long oval and all the wires brought together at the top to make a handle. The number and fineness of the wires determines the effectiveness of the whisk. Beating with Wisk takes longer and requires more physical effort. Hence the handle should be comfortable.

8.9 Rotary Beater

Rotary beater is generally used for making dough for the cakes, ice cream, and for churning milk. A good rotary beater has sturdy yet relatively thin sharp blades which fit close to the bottom of the bowl. Eight blades are more efficient than four blades.

Figure 8.8 Rotary Beater

A drive wheel, centrally supported is preferable. This makes contact with the two pinion wheels that turn the shafts and cutting blades. Nylon bearings make beating quieter and easier. With each complete turn of the drive wheel, the blades should make four or five revolutions, thus the beater is doing four or five times as much work as the user. A single shaft extending from the top of each set of blades to the gears makes the beater easier to keep clean than if the blades extend to the gears.

Since heaters are difficult to wash and dry thoroughly. a rust resistant material such as stainless steel should be used for the blades. The handle should be of moisture resistant materials that will not break and chip. The top handle should be comfortable to grasp and operate for some time. The handle on the drive wheel should be long enough so that lingers and knuckles will not come in contact with the drive wheel.

In some boaters, the joints are not tight enough. The crevices in the joints accumulate dirt, and they make it difficult to clean. The gears may not be covered and hence are unhygienic because of the accumulation of dirt. Sometimes the heaters are not operated smoothly.

8.10 Non-Stick Cooking Vessels

A coating is now being used for the interiors of cooking utensils. Nipple is the trademark for the nonstick fluorocarbon resin finish that is used for cookware. The finish is applied in two coats over a specially treated metal. It is used for pans fry pans, kadais and also on baking utensils. This finish is available brown and black color. The finish makes a pan so slick that most foods will not stick to it and food residue is easily removed by water and a soft Sponge or dish cloth. Fat or grease can be used but they are not required to keep food from sticking. The soft finish can be damaged rather easily and metal forks or spatulas should be used with care. Securing pads and abrasives should not be used.

8.11 Exercise

1. What is a gas stove?
2. What is a smokeless cooker?
3. (a) Explain the principles of operation pot
(b) How do you maintain pressure pot?
4. (a) What is a simple cooker?
(b) Enumerate the 3 parts of pressure pot
(c) what are the advantages of pressure pot?
5. What is a pressure stove?
6. (a) what is a wick stove
(b) What are the basic parts of wick stove
7. Explain the 2 egg beaters you know.

9

HOUSE HOLD PLUMBING AND VOLTAGE-WATER PRESSURE ANALOGOUS

9.0 Working Principle of Water Circuit

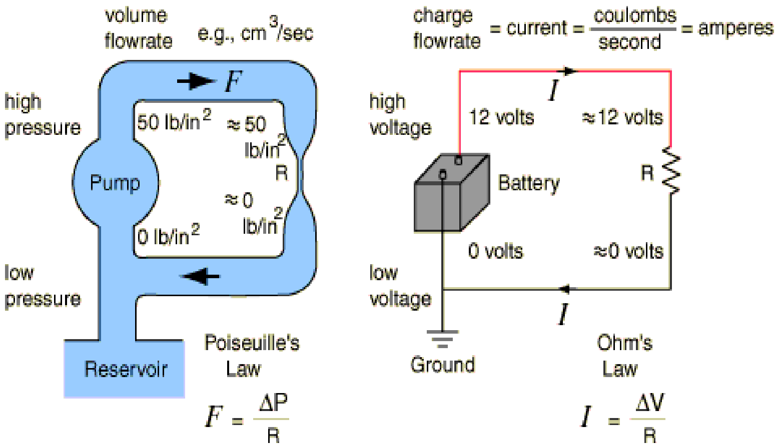


Figure 9.1 Voltage-Pressure Analogy circuit

This like in electric circuit; the electric current is the charge flow rate and is it must be the same at any cross-section of the circuit. This is a general principle called current flow law. In water circuit, with the continuous circulation around the pipe system, the volume flow rate must be the same at any cross-section of the pipe system. Flow any circuit, fluid or electric, which has multiple branches and parallel element, the flow rate through any cross-section, must be the same. This is sometimes called the principle of continuity.

9.0.1 Voltage-Pressure Analogy

A battery is analogous to a pump in a water circuit. A pump takes in water at low pressure and does work on it, ejecting it at high pressure. A battery takes in charge at low voltage, does work on it and ejects it at high voltage.

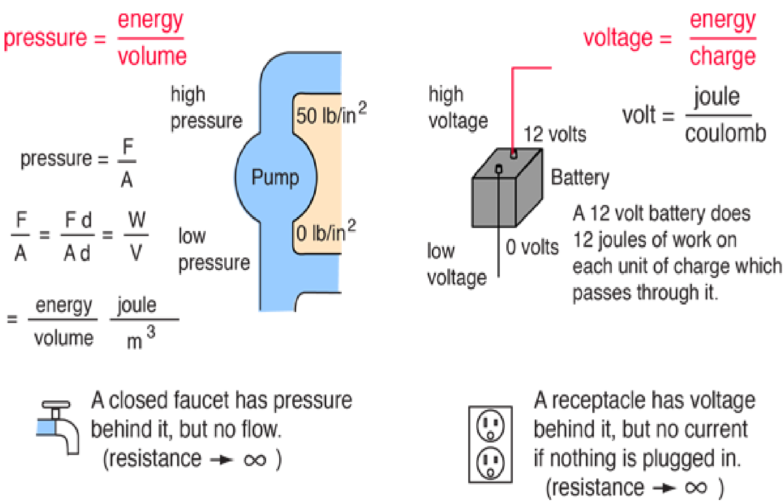


Figure 9.2 Pump-Battery Equivalent circuit

In a direct current (DC) electrical circuit, the voltage is an expression of the circulated energy per unit charge which drives the electric current (I in amperes) around a closed circuit. Increase the resistance R will proportionally decrease the current which may be driven through the circuit by the voltage. Each quality and each operational relationship in a battery-operated DC circuit has a direct analog in the water circuit. The nature of the analogies can help develop an understanding of the quantities in basic electric circuits. In the water circuit, the presume P drives the water around the closed loop of pipe at a certain volume flow rate F. if the resistance to flow R is increase, then the volume flow rate decreases proportionally.

The battery in the circuit above is like a pump in a water circuit. A pump takes in water at low pressure and does work on it, ejecting it at low voltage, does work on it and ejecting it high voltage.

Connecting a battery to an appliance through a wire is like using a large pipe for water flows. Very little voltage drop occurs along the wire because of its small resistance. You can operate most appliances at the end of an extension cord without noticeable effects on performance.

The severe constriction will have motor resistance than the remainder of the pipe system. Likewise, a resistor in an electric circuit will generally have much more resistance than the wire off the circuit. If the single elements represented are the only resistances in the circuit, then essentially all the pressure or voltage will drop across these single elements.

The reservoir provides a pressure reference but is not part of the functional circuit. Likewise, the battery can circulate electric current without the ground wire.

9.0.2 Resistance to Flow

The resistance to flow represented by a severe constriction in a water pipe is analogous to the resistance to electric current represented by a common electric "resistor".

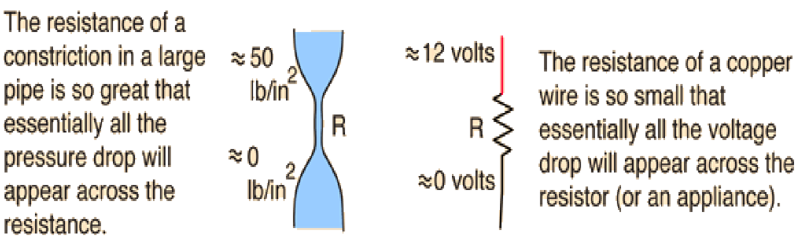
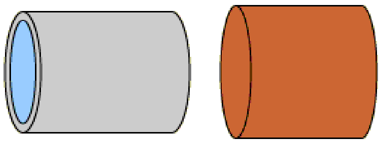


Figure 9.3 Resistance flow circuit

The severe constriction will have more resistance than the remainder of the pipe system. The fact that essentially all the voltage drop appears across a resistor or an ordinary electrical appliance makes possible the operation of such appliances from an extension cord, or the operation of several appliances in parallel on a single circuit in your home.

9.0.3 Current-Flowrate Analogy

Volume flowrate in liters/min, cm^3/sec, m^3/sec, etc.



Electric current flow in coulombs/sec = amperes.

A large pipe offers very little resistance to flow, as shown by Poiseuille's law.

A wire offers very little resistance to charge flow according to Ohm's law.

Connecting a battery to an appliance through a wire is like using a large pipe for water flow. Very little voltage drop occurs along the wire because of its small resistance. You can operate most appliances at the end of an extension cord without noticeable effects on performance.

9.0.4 Ground-Reservoir Analogy

The function of a ground wire in an electric circuit is in many ways analogous to the reservoir attached to the water circuit. Once the pipe is filled with water, the pump can circulate the water without further use of the reservoir, and if it were removed it would have no apparent effect on the water flow in the circuit.

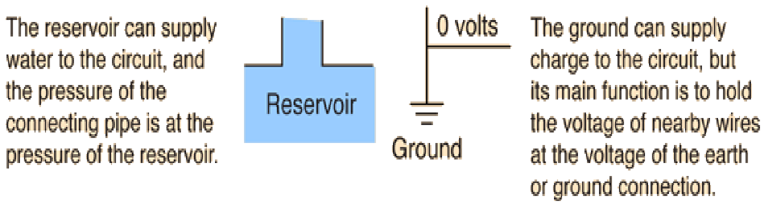


Figure 9.4 Reservoir-Grand equivalent circuit

The reservoir provides a pressure reference, but is not part of the functional circuit. Likewise, the battery can circulate electric current without the ground wire. The ground provides a reference voltage for the circuit, but if it were broken, there would be no obvious change in the functioning of the circuit. The ground wire protects against electric shock and in many cases provides shielding from outside electrical interference.

This view of a ground is not adequate to explain the function of an appliance ground wire because just a connection to the earth is not sufficient to trip a circuit breaker in case of an electrical fault. To be effective in preventing shock hazards, an appliance ground must connect back to the supply through the neutral wire.

Nevertheless, the image of the earth as a charge reservoir is helpful in understanding the energetics of the entire electrical supply system. At a power plant, charge can be drawn from the earth and the generation process does work on the charge to give it energy. This energy is described by stating its voltage (1volt = 1joule/coulomb = energy/charge). The energy can be transported cross-country at high voltages and then supplied to end users at lower voltages with the use of step-down transformers. The energy can then be used and the charge discharged to the earth. The charge upon which the work is done at the power plant does not have to be transported cross-country, and the "spent" charges do not have to be transported back to the power plant, but just dumped into the "reservoir".

9.1 Flush Toilet

Public toilet

Toilet (room)

A **flush toilet** (also known as a **flushing toilet**, **water closet** (**WC**) is a toilet that disposes of human excreta (urine and feces) by using water to flush it through a drainpipe to another location for disposal, thus maintaining a separation between humans and their excreta. Flush toilets can be designed for sitting (in which case they are also called "Western" toilets) or for squatting, in the case of squat toilets. The opposite of a flush toilet is a dry toilet, which uses no water for flushing.

Flush toilets are a type of plumbing fixture and usually incorporate an ‘S’ ‘U, ‘J’ or ‘P’ shaped bend called a trap that causes water to collect in the toilet bowl and act as a seal against noxious gases. Most flush toilets are connected to a sewerage system that conveys waste to a sewage treatment plant; where this is not available, a septic tank may be used. When a toilet is flushed, the wastewater flows into a septic tank, or is conveyed to a treatment plant.

9.1.1 Working Principles of Flush Toilet

Toilets don’t operate simply on the principle of gravity in sweeping water and waste materials down plumbing pipes. Toilets also use a siphoning (bent pipe) system. Toilets are more functional than they are complex and more functional than they are complex and understanding the basic design behind a flush toilet is pretty simple.

A typical flush toilet is a fixed, vitreous ceramic bowl (also known as a pan) which is connected to a drain. After use, the bowl is emptied and cleaned by the rapid flow of water into the bowl. This flush may flow from a dedicated tank (cistern), a high-pressure water pipe controlled by a flush valve, or by manually pouring water into the bowl. Tanks and valves are normally operated by the user, by pressing a button, pushing down on a handle, pulling a lever or pulling a chain. The water is directed around the bowl by a molded flushing rim around the top of the bowl or by one or more jets, so that the entire internal surface of the bowl is rinsed with water.

Figure 9.5 A flush toilet bowl during the flushing action

9.1.1.1 Mechanical flush from a cistern

A typical toilet has a tank fixed above the bowl which contains a fixed volume of water, and two devices. The first device allows part of the contents of the tank (usually in the 3-6 liters range) to be discharged rapidly into the toilet bowl, causing the contents of the bowl to be swept or sucked out of the toilet and into the drain, when the user operates the flush. The second device automatically allows water to enter the tank until the water level is appropriate for a flush.

The water may be discharged through a "toilet flapper valve" (not to be confused with a type of check valve), or through a siphon. A float usually commands the refilling device.

9.1.1.2 Mechanical flush from a high-pressure water supply

Toilets without cisterns are often flushed through a simple flush valve or "Flushometer" connected directly to the water supply. These are designed to rapidly discharge a limited volume of water when the lever or button is pressed then released.

9.1.1.3 Manual flush (pour flush)

A toilet need not be connected to a water supply, but may be pour-flushed.[4] This type of flush toilet has no cistern or permanent water supply, but is flushed by pouring in a few litres of water from a container. The flushing can use as little as 2–3 litres. This type of toilet is common in many Asian countries. The toilet can be connected to one or two pits, in which case it is called a "pour flush pit latrine" or a "twin pit pour flush pit latrine". It can also be connected to a septic tank.

SIPHON FUNCTION: The toilet siphons a curved tube that is actually molded into the bowl. The siphon curves up and then back down, a sort of dam, where the bowl water level reset near the top of the curve without tipping over it. To test for yourself how the siphon system operates, pour a small amount of water into the toilet bowl. Pour cup after cup of water into the bowl. You will notice that the water level does rise regardless of the number of cups fills you pour in, nor does the toilet flush. The extra water simply spilled over the siphon tube edge and down the drain. Next, pour a 2-gallon bucket of water quickly into the bowl. The suction (a force over area produced by a pressure difference) out of the water flowing out of the bowl and the toilet flushes and leaves a small amount of water behind in the bowl.

INSIDE THE TANK: The handle itself rest on the front of the tank, but inside the tank are the guts of a toilet flush lever, which is connected by a chain to the flapper valve. The flapper is seated in an openi8ng between the tank and the bowl. The rubber flapper has ears that the hook onto the over flow tube, a vertical pipe that stands in the middle of the tank. The bottom of the fill valves, where threaded shank rests through a hole in the tank bottom, attaches as to the water supply hose.

WHEN YOU FLUSH: When you depress the handle, it raises the chain to life the flapper. This allows the tank water to quickly drain through the opened flapper seat down into the bowl. The float on the fill valve will also drop with the tanks declining water level until, after about 1inch or so of drop the fill valve will open to allow more water into the tank, arriving from the water supply hose connected beneath the toilet. The flapper will settle back into the seat, shutting off the water draining into the bowl, and the tank water level will rise again to a predetermined level. The fill valve also diverts a small amount of water replenish the water in the bowl below.

WHAT HAPPENS IN THE BOWL: Inside the bowl under the lip of the rim, are a series of angled small holes on many toilets. The water from the flapper seat enters the bowl through these holes, creating the swirling action. The action, coupled with the speed and volume of the incoming water creates a certain of water in the passage way. As the incoming water from the tank into the bowl continues to accelerate, more air within the downward portion of the passage way is displaced until a good flush, or siphon action, is generated. As soon as the bowl's water level drops to the level where air is again allowed into the passage way, the siphon is broken.

9.1.2 Flushing Systems

The flushing system provides a large flow of water into the bowl. They normally take the form of either fixed tanks of water or flush valves.

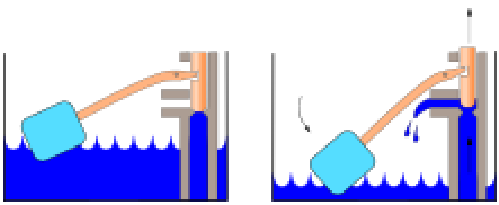
(i) Flush tanks

Flush tanks or cisterns usually incorporate a mechanism to release water from the tank and an automatic valve to allow the cistern to be refilled automatically.

This system is suitable for locations plumbed with $^1/_2$-inch (13 mm) or $^3/_8$-inch (9.5 mm) water pipes which cannot supply water quickly enough to flush the toilet; the tank is needed to supply a large volume of water in a short time. The tank typically collects between 6 and 17litres (1.3 and 3.7 imp gal; 1.6 and 4.5 US gal) of water over a period of time. In modern installations the storage tank is usually mounted directly above and behind the bowl.

Older installations, known as "high suite combinations", used a high-level cistern (tank), fitted above head height, activated by a pull chain connected to a flush lever on the cistern. When more modern close-coupled cistern and bowl combinations were first introduced, these were first referred to as "low suite combinations". Modern versions have a neater-looking low-level cistern with a lever that the user can reach directly, or a close-coupled cistern that is even lower down and fixed directly to the bowl. In recent decades the close coupled tank/bowl combination has become the most popular residential system, as it has been found by ceramic engineers that improved waterway design is a more effective way to enhance the bowl's flushing action than high tank mounting.

(ii) Tank fill valve



a b

Figure 9.6 Tank fill valve

The ballcock or float valve is often used to regulate the filling of a tank or cistern. When the fluid level drops, the float descends, levering the valve opening and allowing more fluid to enter. Once the float reaches the 'full' position, the arm presses the valve shut again.

Tank fill valves are found in all tank-style toilets. The valves are of two main designs: the side-float design and the concentric-float design. The side-float design has existed for over a hundred years. The concentric design has only existed since 1957, but is gradually becoming more popular than the side-float design.

The side-float design uses a float on the end of a lever to control the fill valve. The float is usually shaped like a ball, so the mechanism is often called a ball-valve or a ballcock (cock in this context is an alternative term for valve; see, for example, stopcock). The float was originally made from copper sheet, but it is now usually plastic. The float is located to one side of the main valve tower or inlet at the end of a rod or arm. As the float rises, so does the float-arm. The arm connects to the fill valve that blocks the water flow into the toilet tank, and shuts off the water when the float reaches a set height. This maintains a constant level in the tank.

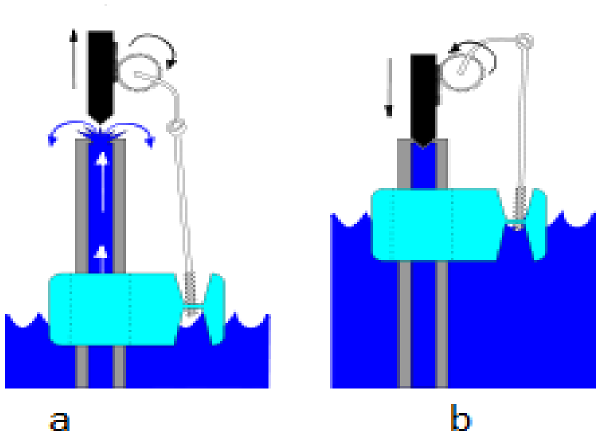


Figure 9.7 Float valve

One type of concentric float valve. The concentric float valve opens when the fluid level is low, allowing more fluid to enter (Figure 9.7a). When the fluid level returns to the full level, the valve is shut (Figure 9.7b).

The newer concentric-float fill valve consists of a tower which is encircled by a plastic float assembly. Operation is otherwise the same as a side-float fill valve, even though the float position is somewhat different. By virtue of its more compact layout, interference between the float and other obstacles (tank insulation, flush valve, and so on) is greatly reduced, thus increasing reliability. The concentric-float fill valve is also designed to signal to users automatically when there is a leak in the tank, by making much more noise when a leak is present than the older style side-float fill valve, which tends to be nearly silent when a slow leak is present.

(iii) Flapper-flush valve

In tanks using a flapper-flush valve, the outlet at the bottom of the tank is covered by a buoyant (plastic or rubber) cover, or flapper, which is held in place against a fitting (the *flush valve seat*) by water pressure. To flush the toilet, the user pushes a lever, which lifts the flush valve from the valve seat. The valve then floats clear of the seat, allowing the tank to empty quickly into the bowl. As the water level drops, the floating flush valve descends back to the bottom of the tank and covers the outlet pipe again. This system is common in homes in the US and in continental Europe. Recently this flush system has also become available in the UK due to a change in regulations. Dual flush versions of this design are now widely available. They have one level of water for liquid waste and a higher level for solid waste.

(iv) Siphon-flush mechanism

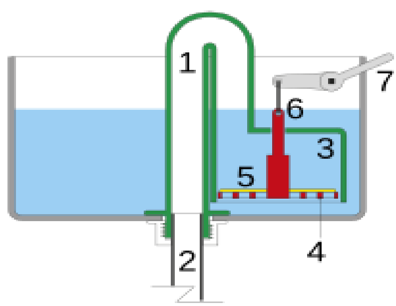


Figure 9.8 Siphonic WC cistern

The siphon is formed of a vertical pipe (1) that links the flush pipe (2) to a domed chamber (3). A perforated disc (4) covered by a flexible plate or flap (5) is joined by the siphon rod (6) to the flush lever (7).

This system, invented by Albert Giblin and common in the UK, uses a storage tank similar to that used in the flapper-flush-valve system above. This flush valve system is sometimes referred to as a *valve-less* system, since no valve as such is required.

The siphon is formed of a vertical pipe that links the flush pipe to a domed chamber inside the cistern. A perforated disc, covered by a flexible plate or flap, is fitted inside this chamber and is joined by a rod to the flush lever.

Pressing the lever raises the disc, forces water over the top of the siphon into the vertical pipe, and starts the siphonic flow. Water flows through the perforated disc past the flap until the cistern is empty, at which point air enters the siphon and the flush stops. The advantage of a siphon over the flush valve is that it has no sealing washers that can wear out and cause leaks, so it is favoured in places where there is a need to conserve water.

In some countries like UK, the use of siphon-type cisterns was mandatory to avoid the potential waste of water by millions of leaking toilets with flapper valves. These valves can sometimes be more difficult to operate than a "flapper"-based flush valve because the lever requires more torque than a flapper-flush-valve system. This additional torque is required at the tank lever because a certain amount of water must be moved up into the siphon passageway in order to initiate the siphon action in the tank. Splitting or jamming of the flexible flap covering the perforated disc can cause the cistern to go out of order.

Dual-flush versions of the siphon cistern provide a shorter flush option by allowing air into the siphon to stop the siphon action before the tank is empty.

The siphon system can also be combined with an air box to allow multiple siphons to be installed in a single trough cistern.

9.2 Sink

Figure 9.9 A sink/basin in a bathroom

A **sink**, also known by other names including **sinker**, **washbowl**, **hand basin** and **wash basin**, is a bowl-shaped plumbing fixture used for washing hands, dishwashing, and other purposes. Sinks have taps (faucets) that supply hot and cold water and may include a spray feature to be used for faster rinsing. They also include a drain to remove used water; this drain may itself include a strainer and/or shut-off device and an overflow-prevention device. Sinks may also have an integrated soap dispenser. Many sinks, especially in kitchens, are installed adjacent to or inside a counter.

When a sink becomes clogged, a person will often resort to use a chemical drain cleaner or a plunger, though most professional plumbers will remove the clog with a *drain auger* (often called a "plumber's snake").

9.2.1 Materials Used in Making Sink

Sinks are made of many different materials. These include:

- Ceramic
- Concrete
- Copper
- Enamel over steel or cast iron
- Glass
- Granite
- Marble
- Nickel

- Plastic
- Polyester
- Porcelain
- Resin washbasin
- Soapstone
- Stainless steel
- Stone
- Terrazzo
- Wood

9.2.1.1 Stainless steel sink

This commonly used in kitchens and commercial applications because it represents a good trade-off between cost, usability, durability, and ease of cleaning. Most stainless steel sinks are made by drawing a sheet of stainless steel over a die. Some very deep sinks are fabricated by welding. Stainless steel sinks will not be damaged by hot or cold objects and resist damage from impacts. One disadvantage of stainless steel is that, being made of thin metal, they tend to be noisier than most other sink materials, although better sinks apply a heavy coating of vibration-damping material to the underside of the sink.

Enamel over cast iron is a popular material for kitchen and bathroom sinks. Heavy and durable, these sinks can also be manufactured in a very wide range of shapes and colors. Like stainless steel, they are very resistant to hot or cold objects, but they can be damaged by sharp impacts and once the glass surface is breached, the underlying cast iron will often corrode, spalling off more of the glass. Aggressive cleaning will dull the surface, leading to more dirt accumulation. Enamel over steel is a similar-appearing but far less rugged and less cost-effective alternative.

Figure 9.10 Double sink with a marble countertop

Solid ceramic sinks have many of the same characteristics as enamel over cast iron, but without the risk of surface damage leading to corrosion.

9.2.1.2 Plastic sink

Plastic sinks come in several basic forms:

- Inexpensive sinks are simply made using injection-molded thermoplastics. These are often deep, free-standing sinks used in laundry rooms. Subject to damage by hot or sharp objects, the principal virtue of these sinks is their low cost.

- High-end acrylic drop-in (lowered into the countertop) and undermount (attached from the bottom) sinks are becoming more popular, although they tend to be easily damaged by hard objects - like scouring a cast iron frying pan in the sink.
- Plastic sinks may also be made from the same materials used to form "solid surface" countertops. These sinks are durable, attractive, and can often be molded with an integrated countertop or joined to a separate countertop in a seamless fashion, leading to no sink-to-countertop joint or a very smooth sink-to-countertop joint that cannot trap dirt or germs. These sinks are subject to damage by hot objects but damaged areas can sometimes be sanded down to expose undamaged material.

Soapstone sinks were once common, but today tend to be used only in very-high-end applications or applications that must resist caustic chemicals that would damage more-conventional sinks.

Wood sinks are from the early days of sinks and baths were made from natural teak with no additional finishing. Teak is chosen because of its natural waterproofing properties – it has been used for hundreds of years in the marine industry for this reason. Teak also has natural antiseptic properties, which is a bonus for its use in baths and sinks.

9.2.1.3 Glass sink

A current trend in bathroom design is the handmade glass sink (often referred to as a vessel sink) which has become fashionable for wealthy homeowners.

Stone sinks have been used for ages. Some of the more popular stones used are: marble, travertine, onyx, granite, and soap stone on high end sinks.

Glass, concrete, and terrazzo sinks are usually designed for their aesthetic appeal and can be obtained in a wide variety of unusual shapes and colors such as floral shapes. Concrete and terrazzo are occasionally also used in very-heavy-duty applications such as janitorial sinks.

Figure 9.11 Bathroom stainless steel vessel sink standing on a wood surface

Figure 9.12 Sinks are available in many colors

9.2.1.4 Top-mount sinks

Self-rimming (*top-mount*) sinks sit in appropriately shaped holes roughly cut in the countertop (or substrate material) using a jigsaw or other cutter appropriate to the material at hand and are suspended by their rim. The rim then inherently forms a fairly close seal with the top surface of the countertop, especially when the sink is clamped into the hole from below.

Figure 9.13 A bottom mount sink

Bottom-mount or *under-mount* sinks are installed below the countertop surface. The edge of the countertop material is exposed at the hole created for the sink (and so must be a carefully finished edge rather than a rough cut). The sink is then clamped to the bottom of the material from below. Especially for bottom-mount sinks, silicone-based sealants are usually used to assure a waterproof joint between the sink and the countertop material. Advantages of an undermount sink include superior ergonomics and a contemporary look; disadvantages include extra cost in both the sink and the counter top. Also, no matter how carefully the cut out is made, the result is either a small ledge or overhang at the interface with the sink. This can create an environment for catching dirt and allowing germs to grow.

Solid-surface plastic materials allow sinks to be made of the same plastic material as the countertop. These sinks can then easily be glued to the underside of the countertop material and the joint sanded flat, creating the usual invisible joint and completely eliminating any dirt-catching seam between the sink and the countertop. In a similar fashion, for stainless steel, a sink may be welded into the countertop; the joint is then ground to create a finished, concealed appearance.

9.2.1.5 Butler's sink

A *butler's sink* is a rectangular ceramic sink with a rounded rim which is set into a work surface. There are generally two kinds of butler's sinks: The London sink and the Belfast sink. In 2006, both types of sinks usually were 61 centimetres (24 in) across and 46 centimetres (18 in) front-to-back, with a depth of 22.5 centimetres (8.9 in). London sinks were originally shallower than Belfast sinks. (One plumbing guide in 1921 suggested that the Belfast sink was 38 centimetres (15 in) deep.) Some believe this was because London had less access to fresh water (and thus a greater need to conserve water), but this theory is now contested. It is more likely the two sinks had different roles within the household. But that difference usually does not exist in the modern era, and both sinks are now shallow. The primary difference both in the past and today between a Belfast and London sink is that the Belfast sink is fitted with an overflow weir which prevented water from spilling over the sink's edge by draining it away and down into the waste Wastewater plumbing water plumbing.

9.2.1.6 Farmer's sink

A *farmer's sink* is a deep sink that has a finished front. Set onto a countertop, the finished front of the sink remains exposed. This style of sink requires very little "reach-over" to access the sink.

9.2.1.7 Vessel sink

A *vessel sink* is a free-standing sink, generally finished and decorated on all sides, that sits directly on the surface of the furniture on which it is mounted. These sinks have become increasingly popular with bathroom designers because of the large range of materials, styles and finishes which they can show to good advantage.

9.3 Exercise

1. Draw & explain the voltage-water pressure analogous circuit
2. Draw & explain Pump-Battery analogous circuit
3. Draw & explain Resistance flow circuit of voltage-pressure circuit
4. Draw & explain Reservoir-Ground circuit
5. Explain the working principle of flush toilet

6. Explain the manual and mechanical flush toilet from a cistern

7. Write short note of the following with regards to the flushing toilet

(i) SIPHON FUNCTION

(ii) INSIDE THE TANK

(iii) WHEN YOU FLUSH

(iv) WHAT HAPPENS IN THE BOWL

8. (a) What is a Sink

(b) List materials used in making sink

(c) Explain flushing system

9. List and explain different types of sink you know

10

WATER SUPPLY-DISTRIBUTION AND NAILS DRIVING TECHNIQUES

10.0 Introduction

In the urban area, the physical infrastructure plays an important role. In water distribution system, the water supplied from the reservoir to the consumer end. The pattern of the pipeline will follow the road network of the area. Due to rapid urbanization in an urban area, the water demand is rapidly increasing. Therefore, the pressure on the existing network is growing. This may result in the gap between supply and consumer chain in different manner. Leak detection plays a significant role in the efficient management of Water Distribution System (WDS), as it will help in reducing water wastage. By applying modern tools in the system, the existing problems will be minimized and give one step ahead for the making of the smart city.

Water is one of the most important natural resource and water scarcity is the most challenging issue at a global level. The water is most crucial for sustaining life and is required for almost all the activities of humankind, i.e., industrial use, domestic use, for irrigation; to meet the growing food and fiber needs, power generation, navigation, recreation, and also required for animal consumption. Due to population growth, climate change at. al. there developed a huge gap between the supply and demand of water. In developing countries like India, the gap in supply and demand of water is increasing and predominant. The existing system of water supply is facing problems like a higher rate of leakage, poor maintenance, poor customer service, and poor quality of water.

A water distribution system is a hydraulic infrastructure that consists of different elements like pipes, valves, pumps, tanks and reservoirs. This infrastructure helps to convey water from the source to the consumers. Designing and operation a water distribution system is the most important consideration for a lifetime of expected loading conditions. Furthermore, a water distribution system must be able to assist the abnormal conditions such as pipe breakage, mechanical failure of pipes, valves, and control systems, power outages and inaccurate demand projections.

10.1 Working of Water Distribution System in Urban Area

The purpose of water distribution system is to deliver water to consumer with appropriate quality, quantity and pressure. Water distribution system is used to describe collectively the facilities used to supply water from its source to the point of usage.

The distribution pipelines are generally laid below the road pavements, and their layouts generally follow the layouts of roads. There are four different types of pipe networks. They are:

- Dead End System
- Grid Iron System
- Ring System
- Radial System

Distribution reservoirs, also called as service reservoirs, are the storage reservoirs, which store the treated water for supplying water during emergencies (such as during fires, repairs, etc.) and also to help in absorbing the hourly fluctuations in the normal water demand. Types of Reservoirs:

- Underground reservoirs
- Small ground level reservoirs
- Large ground level reservoirs
- Overhead tanks

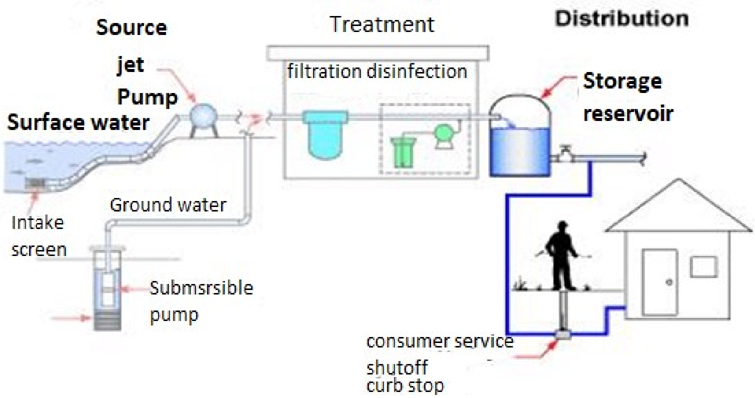


Figure 10.1 The flow of the water from source to consumer

10.2 Water Supply

Precipitation is the main source of water for drinking purposes. A percentage of rainfall evaporates soon after it falls, a percentage runs off the ground to join streams and rivers and a percentage seep through the ground to join underground supplies.

10.3 Sources of Water Supply Consist of Surface Water and Underground Water

Surface water: This includes water collected from roofs and paved areas as well as streams, rivers, lakes and reservoirs. This water is liable to contamination by vegetation and farm pollutants. Sewage and industrial waste are sometimes fed into rivers without any purification treatment. These same rivers are usually expected to supply fresh water to towns and villages.

Rivers have the ability to purify themselves especially if they are fast flowing and shallow. Despite this ability water taken from a river for public use should be treated before consumption.

Underground water: Rain that seeps through the ground may even eventually reach an impervious layer, where it may hold as in a reservoir or it may flow like an underground stream on top of the impervious layer. Layer of water are called aquifers.

Springs: There are two types of springs. Main spring is usually deep and connects to the aquifers layer and a shallow or simple spring which connects to underground surface water. The latter is likely to be intermittent. Spring water is usually pure resulting from the natural purification that occurs as the latter permeates through the ground.

Wells: Wells are different to springs as the ground has to be bore to reach the water. Springs occur naturally. The upper part of a well must be lined to exclude surface water entering it as it may be polluted.

10.4 Water Treatment

Water to be used in a public water supply is required to be fit for drinking. This implies that it poses no danger to health, and it should be colourless, clear. odourless, sparkling, and pleasant to taste. There are four main techniques used for the treatment of water. They are

1. Storage
2. Filtration
3. Sterilization
4. Softening

Storage: Water is stored in reservoirs where contaminants impurities settle to the bottom (sedimentation). Pathogenic bacteria (disease producing) find it difficult to survive in storage due to the lack of food, low temperatures and the effect of sunlight. If water is stored for algae can be controlled using chemicals such as copper sulphate.

Filtration: Water is passed through sand or as fine wire mesh to remove particles. Rapid sand filters act as a physical filter, leaving the water in need of chemical treatment. Slow sand filters provide physical and chemical action. In a slow sand filter water slowly per collates down through the sand. Fine parties, micro-organism and microscopic plant life is retained with sand bed. The bed must be emptied for cleaning after a number of weeks. The slow sand filter produces high quality water which needs little further processing.

Sterilization: Water must be sterilized before it can consume by human. chlorine is added to the water for public supply, but this is not always feasible for small installations. Chlorine kills bacteria making the water safe to drink. After sterilization ammonia is sometimes added to the water to reduce the offensive taste left by the chlorine. For smaller installations water is passed through a very fine filter capable or removing the bacteria.

Main water supply: Most dwelling and building those in rural areas are applied with water from public water supply otherwise known as the supply. The design of a mains water supply needs to consider present demand and anticipated future demand, the size of the water mains and the pressure of the water in this main (this is known as the head) the height to which the water would rise in a vertical pipe. The standard size for water mains is 75mm diameter if it supplied from both ends and 100mm if it is supplied from one end only. 30m is the minimum head of water recommended for firefighting purposes, while a head of 70m is recommended to minimize waste and reduce noise in pipes. The head is achieved by locating reservoirs at appropriate height above the building being served. Full pressure (head) from the reservoir is seldom available as flow is the mains will be taking place at most times. Pressure is further reduced by friction due to flows.

The water mains are usually sited along the edge of a runaway. Permission must be obtained to connect to the mains and to the road if this is necessary. A domestic connection consists of a 12mm diameter pipe with a minimum cover of 750mm below ground as protection from frost.

10.5 Cold Water Storage and Distribution

The connection to the mains water supply is usually taken to the boundary of the site and finished with a stop valve or Storage, housed in a suitable box or purpose chamber. This chamber may be fitted on the service pipe where it enters the building. Where possible this should be at the kitchen sink, although the location is not critical. Inside the house a drain cock should be fitted above the stop valve to allow the cold-water system to be drained down. There are two main types of cold-water supply system within the house. These are known as direct and indirect.

10.5.1 Direct Cold-Water Supply System

In this system, water from the cold-water service pipe feeds the entire cold-water outlet including the sanitary appliances.

This system may be found in old houses, but otherwise it is not recommended for the following reasons:

a. In the event of main failure, there is no reserve
b. Main supply exerts increased pressure on fittings
c. During peak demand the pressure may be reduced

Advantages of this system

1. Economical on pipe work

2. Only a small cold-water storage cistern required to feed the hot water tank
3. Drinking water available from the cold-water outlets.

10.5.2 Cold Water Storage and Distribution

Indirect cold-water supply system: In this system all cold water outlet with the exception of one drinking water outlet are supplied indirectly from cold water storage, cistern, usually located in the roof space. Indirect means the water is not coming directly from the main to the outlets; it is piped to and stored in the cistern in the attic.

Advantages of this system

1. A reserve supply in case of main failure
2. Less pressure on the taps and valve resulting in less wear

Disadvantages

1. More pipe work required
2. Provision and installation of a storage cistern in the attic.

10.6 Techniques of Driving of Nail into the Wall to Avoid Damaging the Wall

To understand the above techniques very well, let consider a case where a picture is to be hang on a Lath-and plaster (a narrow thin strip of wood used as backing for plaster) walls.

Hammering nails into a plaster wall can be a nerve- g experience. After all, the plaster might crack, crumble or even chip off, damaging your wall. Don't be afraid it is possible to hang artwork on plaster walls without causing damage, here are a few options to consider.

1. Heat a nail hot enough so that you have to handle it with pliers, you will find that it can be driven into a plaster wall with much less danger of cracking the plaster. If you have difficult time holding that small nail while trying to hammer it into the wall, poke it through an index card and keep hold on the index card. It is a sure bet that you won't hit your fingers with the hammer.
2. To install small picture hooks all you need is a hammer. Gently tap the nail provided with the hook diagonally into the wall using the hook itself as a guide. With small hooks there is little danger of cracking the plaster.

Larger hooks may require pre-drilling a hole. A cordless drill equipped with a drill bit slightly smaller than the nail is the tools for the job. Drilling a pilot hole removes some of the plaster and greatly reduces the possibility of cracking the plaster make sure to drill the hole on an angle that approximate the angle of the path of the nail. Be cautious about trying to drive a nail into a piece of wood lath. I a nail strikes a piece of lath under the plaster there is a good chance it will vibrate break plaster keys and loosen the plaster from the lath. A “Key is the term used to describe wet plaster that oozed between the lath. These ‘Key’ forms a bound between the dried plaster wall and the lath. You will be able to tell if the nail strikes a piece of lath. It will bounce back when you tap it with your hammer. If that happens, drill a pilot hole no matter which size nail you use.

For heavy pictures we recommend using a wood screw as hanger if the screw can be installed in a stud or a wall anchor if it does not hit a stud. If you have any doubt, pre-drill the ole to avoid cracked plaster.

10.7 Exercise

1. Write short note on water supply and distribution in an urban area
2. (a) List the 4 types of pipe network

   (b) List and explain different types of reservoirs
3. Using a suitable diagram explain flow of the water from source to consumer
4. List and explain different sources of water and which one is the purest water.

5. (a) Write short note on cold water storage and distribution.

(b) why is direct cold-water supply system not recommended for use at home what is the advantage?

6. How is water treatment done in an urban? Explain each technique used in water treatment

7. Explain the technique use in driving nail to the wall to avoid damage to the wall.

MULTIPLE CHOICE QUESTION

REG NUMBER: - ……………………………….

DATE: - …………….

1. Energy is defined as the ability to do…………. (a) Work (b) something (c) power (d) walk

2. The unit of energy is ………….... (a) Joules (b) Jules (c) Joles (d) Joles per seconds

3. An example of energy is…….... (a) A palm-wine tapper (b) A palm-wine tapper standing (c) A palm-wine tapper climbing tree (d) None of these

4. A person pushing a car along a road is doing work on the car. Then the person is said to possess... (a) Power (b) Work (c) Energy (d) Heat

5. The following are said to possess energy except (a) A football player (b) A farm labourer (c) A mango fruit falling from the tree (d) A person standing with a peg of rice on his head

6. The following are forms of energy except (a) Chemist energy (b) Light energy (c) Atomic energy (d) Solar energy

7. An example of mechanical energy is (a) Mechanical energy (b) Potential energy (c) Electrical Energy (d) Thermal energy

8. …… is the time rate of doing work (a) Energy (b) Work (b) Power (c) Kinetic Energy

9. If two boys of the same weight climb flight of steps of the same height, the boy that gets to the top first is (a) Weight (b) Power (c) Energy (d) Potentials

10. The unit Joules per seconds is the unit use for (a) Energy (b) Work done (c) power (d) Kinetic Energy

11. Energy can neither be created nor destroyed but can be change from one form to another is known as (a) principle of conservation of Power (b) Principles of consavation of energy (c) Principles of conservation of energy (d) Principals of conservations of energy

12. Among famous scientist who helped to clear the meaning of energy are the following except (a) Kelvin (b) Newton (c) Joule (d) Helmholtz

13. Energy was fully defined in ……. Century (a) 14th (b) 16th (c) 18th (d) 19th

14………Energy causes a microphone plate to vibrate as ……. energy is the in our food which makes us grow and gives us muscular. (a) Chemical & Light (b) Chemical & Sound (c) Electrical & Chemical (d) Sound & Chemicals

15. Energy conversion from chemical to mechanical is through a process known as (a) Dynamo (b) Thermopile (c) Explosive (d) Steam

16. Energy conversion from Light to Electrical is a process known as (a) Plant life (b) Potocell (c) loudspeaker (d) combustion

17. The bimetallic strip of an electric thermostat is used to ……... (a) Control the heat flow rate (b) control the water level (c) control the temperature (d) Control the electric current

18. The function of make and break in electric iron is to regulate the (a) Power supply (b) Heat energy (c) Temperature (d) Thermal energy

19. When electric power is converted into heat, the greater the value of current, the greater the ……... (a) Temperature (b) Heat generated (c) power generated (d) Energy of the iron

20. The heat generated is proportional to………...(a) Sequare root of the current (b) Square of time (c) Square of the current (d) Current

21. Find the heat produce in an electric coil of resistance 15ohms when a current of 5A flows through it for 30minutes (a) 6.75J (b) 65700J (c) 67500J (d) 675000J

22. The working principle of the refrigerator utilizes the cooling effect of……. (a) Latent heat of Vaporization (b) Evaporation (c) Volatile liquid (d) Refrigerator

23. The volatile liquid used for cooling in refrigerator is called (a) Refrigerant (b) Refrigerance (c) Volatile liquid (d) Refrigerator

24. An example of liquefied gas use for cooling effect is (a) Freon (b) Fraon (c) Feaon (d) Ammonia acid

25. The process in which a substance changes from the liquid to the gaseous state is called ……. (a) Vaporization (b) Evaporation (c) Vaporization (d) Ventilation

26. The function of the pump in a refrigerator is to remove……………… (a) Heat (b) vapor (c) gas (d) Pressure

27. A blender consist of the following except…………... (a) Housing (b) Motor (c) Blades (d) gear switch's

28. Usually a small rubber washer provides a seal around the output shaft to prevent liquid from entering the …………(a) shaft (b) motor (c) Blades (d) gear switch's

29. The blender uses an electric motor which is an electric machine that convert ………… to ………. energy (a) electrical, potential (b) electrical, mechanical (c) electrical, sound (d) mechanical, sound

30. The electric motor operate through the interaction between an electric motor's ………… to………(a) magnetic field, vibration (b) magnetic field, winding current (c) winding coil, magnetic field (d) None of these

31. The electric motors in the blenders are used to produce …………... (a) vibration force (b) Torque (c) Translational force (d) viberation force

32. Loudspeaker converts………...to………… but do not generate usable mechanical power (a) Electrical,

kinetic (b) electricity, motion (c) Motion, vibration (d) mechanical, sound

33. A washing machine is highly popular because of its……. (a) Greater work done (b) Greater energy applications (c) Greater Utility (d) Labour

34. The elementary component of a washing machine are the following except (a) Agitator (b) Inner tube (c) switches (d) DC motor

35. ………...enables the passage of hot and cold water to the washing machine (a) Pump (b) Valves (c) Agitator (d) wash tub

36. The speed of spinning, the special settings for different fabrics and the passage of hot and cold water are the functions monitored by the (a) Switches (b) Agitator (c) Wash tub (d) Timers

37. The process of washing in the washing machine usually start in the ……… (a) Outer wash tub (b) Drain tube (c) Inner wash tub (d) washing machine

38. The detergent contains many ……that work on cloths to clean them (a) chemical reactions (b) Drugs (c) Monitoring agents (d) Catalist

39. ……. are protease, lipase, catalase and amylase (a) Detergent (b) Enzymes (c) chemicals (d) Drugs

40. ………. enhance the action of catalase on clothes (a) Protease (b) Amylase (c) Agitator (d) Enzymes

41. The…………ensures thorough cleaning of the clothing (a) Enzymes (b) Agitator (c) Detergent (d) Drugs

42. The………. force pulls out water from the clothes and makes it move through the holes to the outer tub (a) Centrifugal (b) Centrifigure (c) centripetals (d) Center

43. The water gets drained out through the………. (a) Inner tub (b) Drain tub (c) Outer tub (d) Pumps

44. It is the …………which accelerate the process of washing (a) Motor (b) Inner tub (c) Outer tub (d) Drain

45. Water gets pumped out of the washing machine from……… (a) Drain (b) Outer tub (c) Inner wash tub (d) switches

46. The………force spins out water from fabric and expels it through the drain tub (a) Centrifugal (b) Centripetal (c) center (d) Drain

47. Current flow rate in electrical circuit is analogous to …………… in water circuit (a) Volume rate (b) High pressure (c) Volume flow rate (d) Pump system

48. The dc battery system for electrical circuit is analogous to …………in water circuit (a) Volume rate (b) Pump system (c) High pressure (d) Reservoir

49. The toilet………is a curved tube that is actually molded into the bowl. (a) sifon (b) Siphone (c) Siphon (d) Freon

50. A force over area produced by a pressure different is known as……………. (a) Toilet fush (b) Suction (c) Valves (d) Cupfuls

51. When you depress the handle of a toilet flush system, it raises the chain to lift the ……… (a) Lever (b) Tank handle (c) Flapper (d) Valves

52. Larder hooks may require…………holes for picture hanging. (a) Drilling a (b) Pre-drilling a (c) Hammering a (d) Chiseling a

53. A……...is the term used to describe wet plaster that oozed between the lath when applied and dried partially encasing the lath. (a) Drilling (b) Flapper (c) Key (d) Drain

54. ………...is the main source of water for drinking purposes (a) cold water supply (b) Precipitation (c) Main water supply (d) Sea water

55. The following are surface water except …………... (a) Streams (b) Rivers (c) Lakes (d) Underground streams

56. ……………water occurs naturally (a) Well (b) Springs (c) surface water (d) Underground streams

57. A well-treated water should have the following except …………… (a) Colourless (b) Clear (c) Pleasant to taste (d) Odour

58. If water is stored for long periods……………. tends to grow (a) algae (b) algea (c) agea (d) agae

59. The chemical that is added to water during sterilization to kill bacterial is………………. (a) Ammonia (b) Chlorine (c) Freon (d) iron fins

60. Indirect means that the water is not coming directly from main to the outlets, it is piped to and stored in the ……in the attic (a) Well (b) GP-tank (c) Cistern (d) Cisterm

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96. The following are surface water except …………... (a) Streams (b) Rivers (c) Lakes (d) Underground streams

97. ……………water occurs naturally (a) Well (b) Springs (c) surface water (d) Underground streams

98. A well-treated water should have the following except …………… (a) Colourless (b) Clear (c) Pleasant to taste (d) Odour

99. If water is stored for long periods……………. tends to grow (a) algae (b) algea (c) agea (d) agae

100. The chemical that is added to water during sterilization to kill bacterial is……………… (a) Ammonia (b) Chlorine (c) Freon (d) iron fins

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