Consumer Electronics
Unit-IV
Introduction to different type of domestic/commercial appliances
Part-I

Unit IV

Introduction to different type of domestic/commercial appliances

- **Part I:-**
- **Washing M/c:** different types of machines,
- washing techniques,
- **(Block diagram)** parts of manual, semiautomatic and fully automatic machines,
- basic working principle of manual, semi- automatic and fully automatic machines,
- study the working of motors, different types of timers, power supply circuits.
- **Vacuum cleaner (Block diagram)** working principle,
- main parts of Vacuum cleaner,
- study of different features of the machine,
- study & working of motor used,
- Electronic circuit,
- power supply.

Contents of Unit IV….

- **Various parts & functions of Mixer/Grinder**,
- speed control circuit & auto overload protector.
- Principle of **electric iron**, parts of steam iron, thermostat heat controls.
- **Working principal of RO and UV type of water purifiers**,
- Different components of water purifier,
- consumables required,
- Most frequently occurring faults and their remedial procedures referring to the manual.
- **Principal of Immersion heater**, part of immersion heater, Insulation in Immersion heater.
- Working principle of **Induction cook top**, study of different features of machine. Types of induction tubes,
- Study of different component of induction cooktop,
- Fault identification,
- Heat sinking in induction cooktop.

Washing Machine

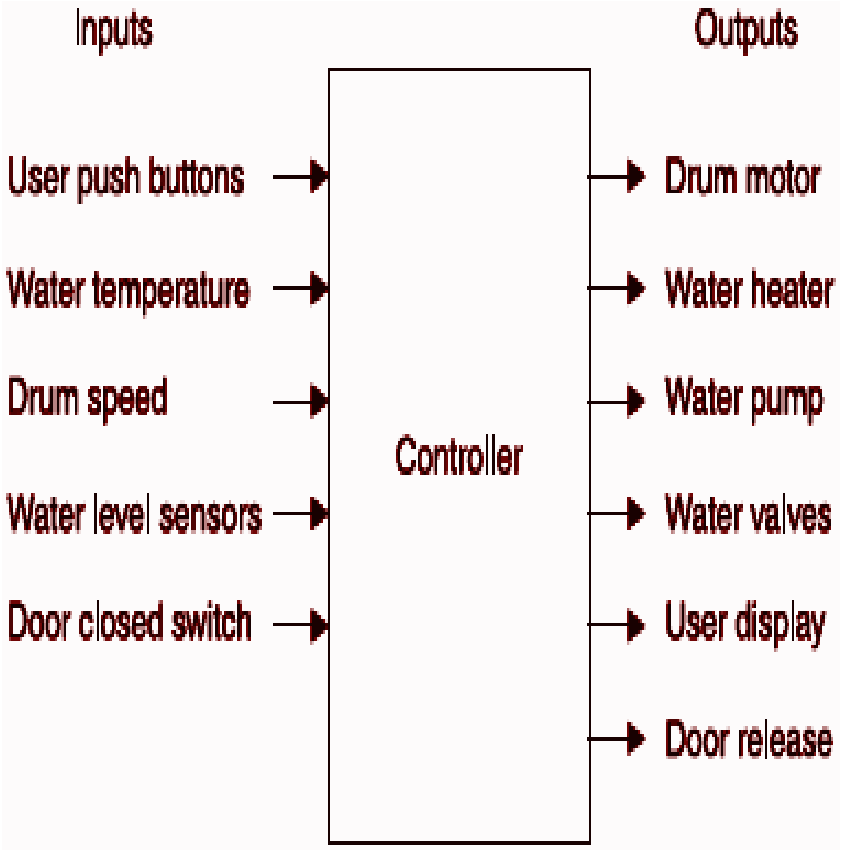
The block diagram shows a possible representation of the Washing machine.

There are many acceptable ways of representing the system.

It would, for example, be possible to consider the display to be internal to the controller and therefore not show it separately.

Similarly clock circuitry used to time the operation of the machine is considered here to be contained within the controller.

It could equally well be considered as an external component.



Inputs and outputs in an electronic washing machine

Washing Machine….

- The block diagram is a good starting point for the generation of the specification since it shows very clearly the structure of the complete system.
- The block diagram makes no assumptions of the form of the controller. It could be implemented using an electromechanical Controllers, or a microcomputer, or a range of other technologies.
- Many modern washing machines now use microcomputer to control their various functions, replacing the electromechanical controllers used in earlier models

Washing Machine….

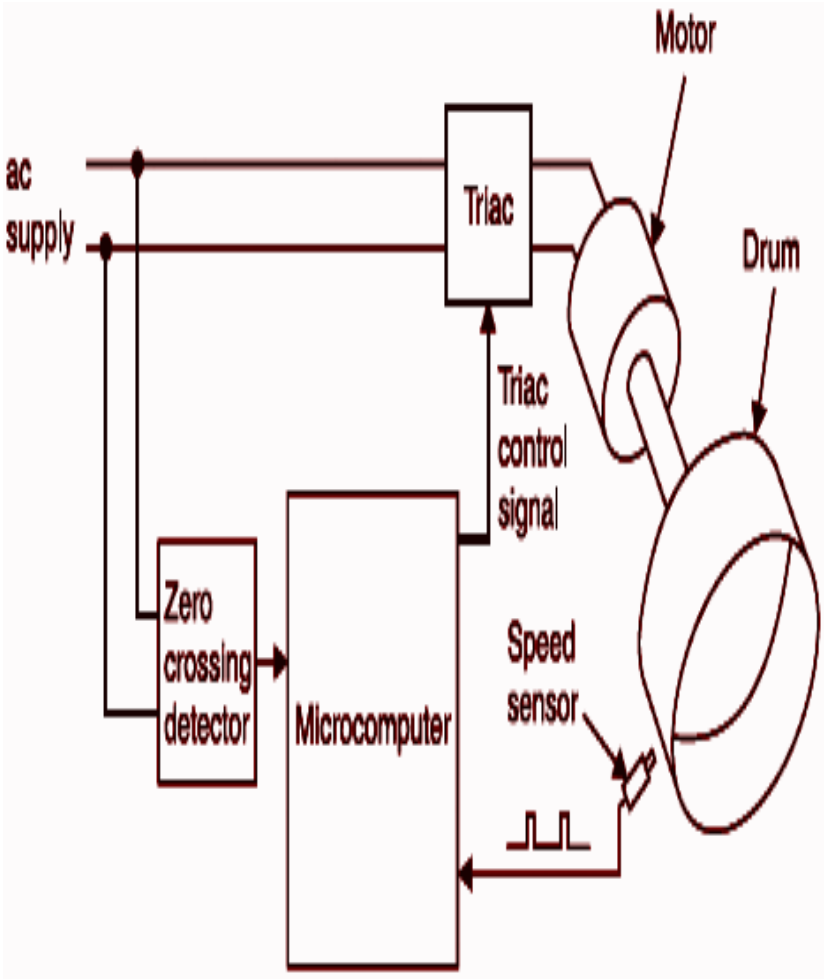
- At various stages of the washing cycle the drum is required to rotate at different speeds.
- These include: a low speed of about 30 revolutions per minute (rpm) while clothes are washed: an intermediate speed of about 90 rpm while the water is pumped out and a high speed of either 500 or 1000 rpm to spin dry the clothes.
- Let's consider how the microcomputer should control the speed of the motor.

BD of Washing Machine….

- The WM system will be open loop or closed loop.
- Since although an open-loop system is theoretically possible using a synchronous motor the cost of such a system for high-power variable-speed applications is prohibitive.
- The system will therefore be closed loop using a motor to drive the drum and some form of sensor to measure its speed.
- One of the simplest methods of speed measurement is to use a counting technique illustrated in Fig. below.
- It uses a fixed inductive sensor to produce a pulse each time it is passed by a magnet which rotates with the drum. This produces one pulse per revolution of the drum which can be used to determine its speed.

BD of Washing Machine….

- The speed of the motor will be controlled by the power dissipated in it. The simplest way of speed control is to use a triac.
- The power could be controlled by some form of electronic circuitry, but the hardware requirement can be reduced if the microcomputer controls the power directly by firing the triac at an appropriate time during its cycle.
- To do this the controller must detect the zero crossing of the ac supply. This will require circuitry to detect the crossing point while protecting the processor from high voltages.
- A block diagram of the system is shown RHS.

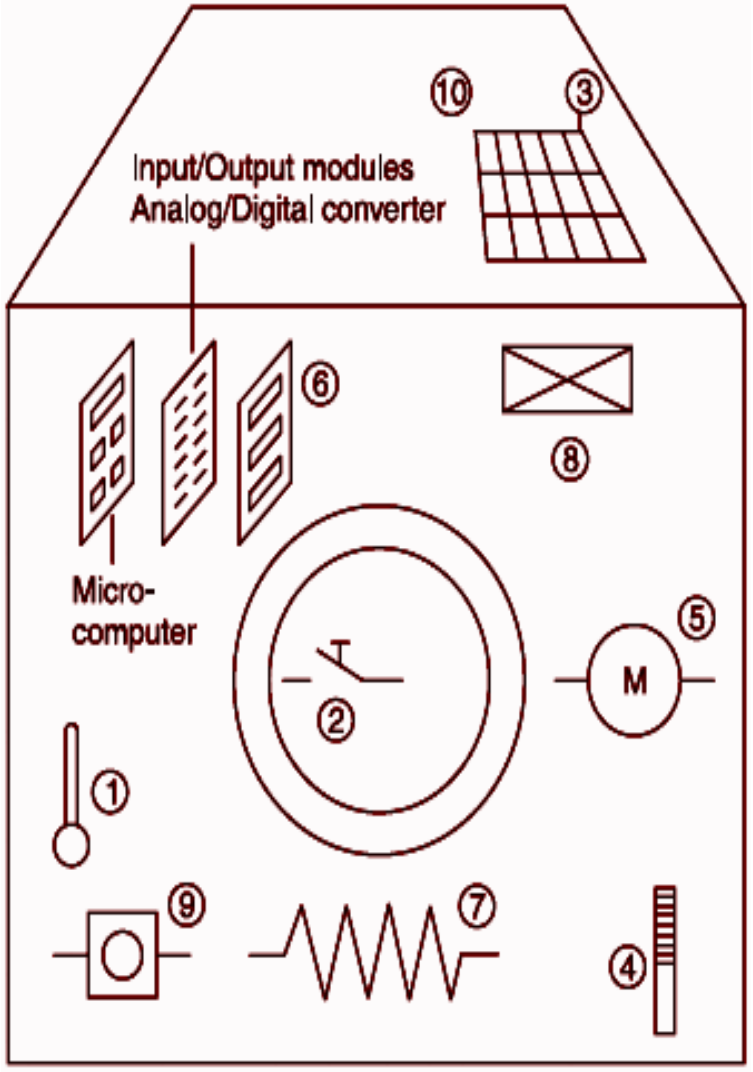


Block Diagram of Washing Machine

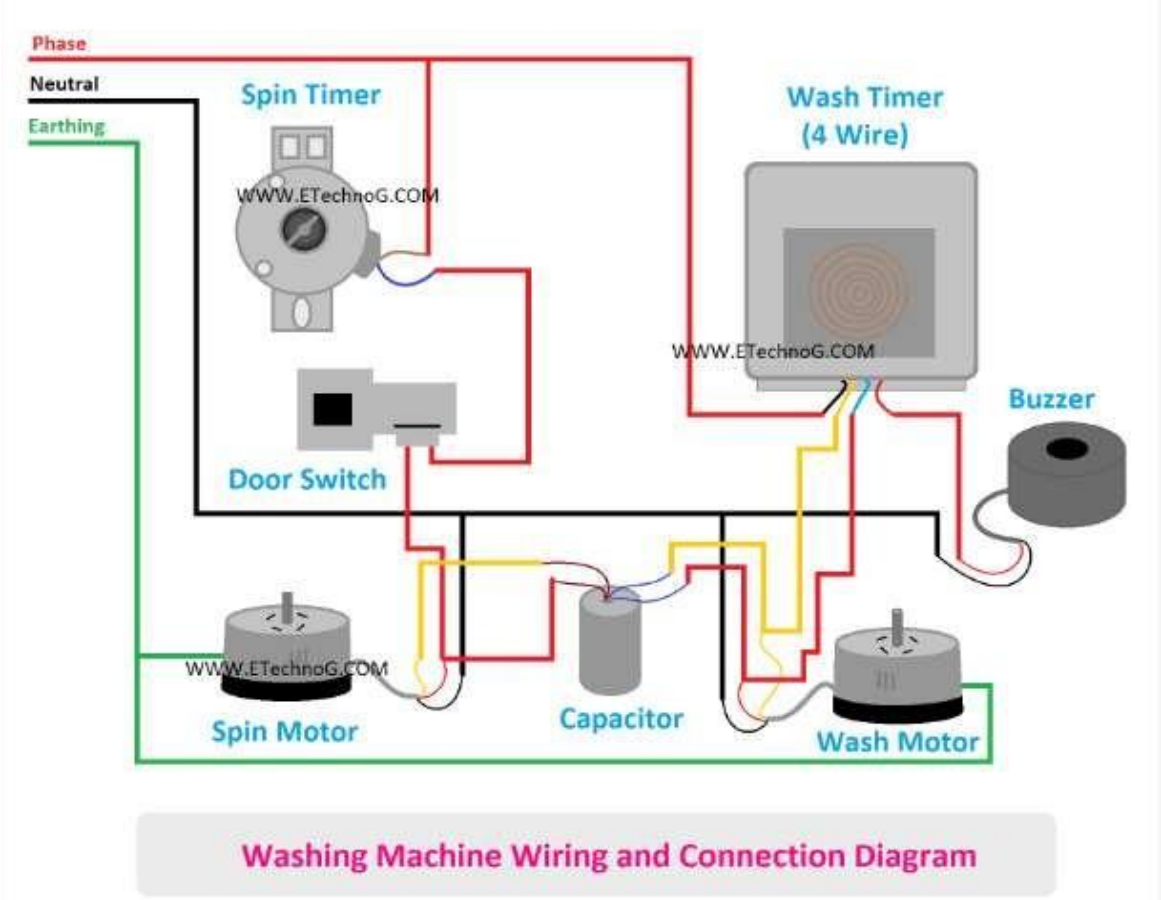
- From a knowledge of the required speed and the actual speed, the controller can determine whether to increase or decrease the power dissipated in the motor.
- The motor power is determined by the timing of the triac firing pulse. If the triac is fired at the beginning of each half of mains cycle it will remain on for the remainder of the half cycle and the motor will operate at full power.
- The longer the processor waits before firing the triac, the less will be the motor power. The processor thus varies the delay time with respect to the zero crossing point of the mains by an appropriate amount to increase or decrease the power in the motor as determined by the difference between the actual and required speeds.
- This method of controlling the motor speed is very processor intensive. It consumes a large amount of processor time and will require a considerable amount of effort in writing and developing the software.
- However, this approach uses very little hardware and is thus very attractive for such a high-volume application.

Washing Machine Hardware:

•A system is an assembly of components united by some form of regulated interaction to form an organised whole.
•The input peripherals of a microcomputer system consist of (Fig. RHS)
•temperature sensor which senses the washing water temperature. (The analog/digital converter changes the analog values to binary numbers).
•safety cut-out switch.
•keyboard for program selection.
•water level gauge.
•motor for washing drum.
•power switches for motor, heater, etc.
•heater for washing water.
•water inlet valve.
•water suction pump.
•control lamps and indicators.



Washing Machine



Washing Machine Wiring and Connection Diagram

washing machine wiring diagram

Washing Machine

- A washing machine is an electrical machine consisting of different types of electric motors, switches, times, buzzers, etc.
- There are different types of washing machines from the different manufacturer are available in the market, **but all the washing machine works almost in the same principle.**

- **Internal Parts of the Washing Machine**

• Spin Motor

- Spin Motor is also known as a dryer motor. It is used to dry the clothes. A spin motor is a single-phase induction motor.
- It has two windings Starting winding and running winding.
- It required a capacitor to start.
- Generally, a capacitor is used with this spin motor. Also, you can see in the above wiring diagram, a capacitor is connected to the spin motor.
- The spin motor is low power rated than the wash motor.

• Wash Motor

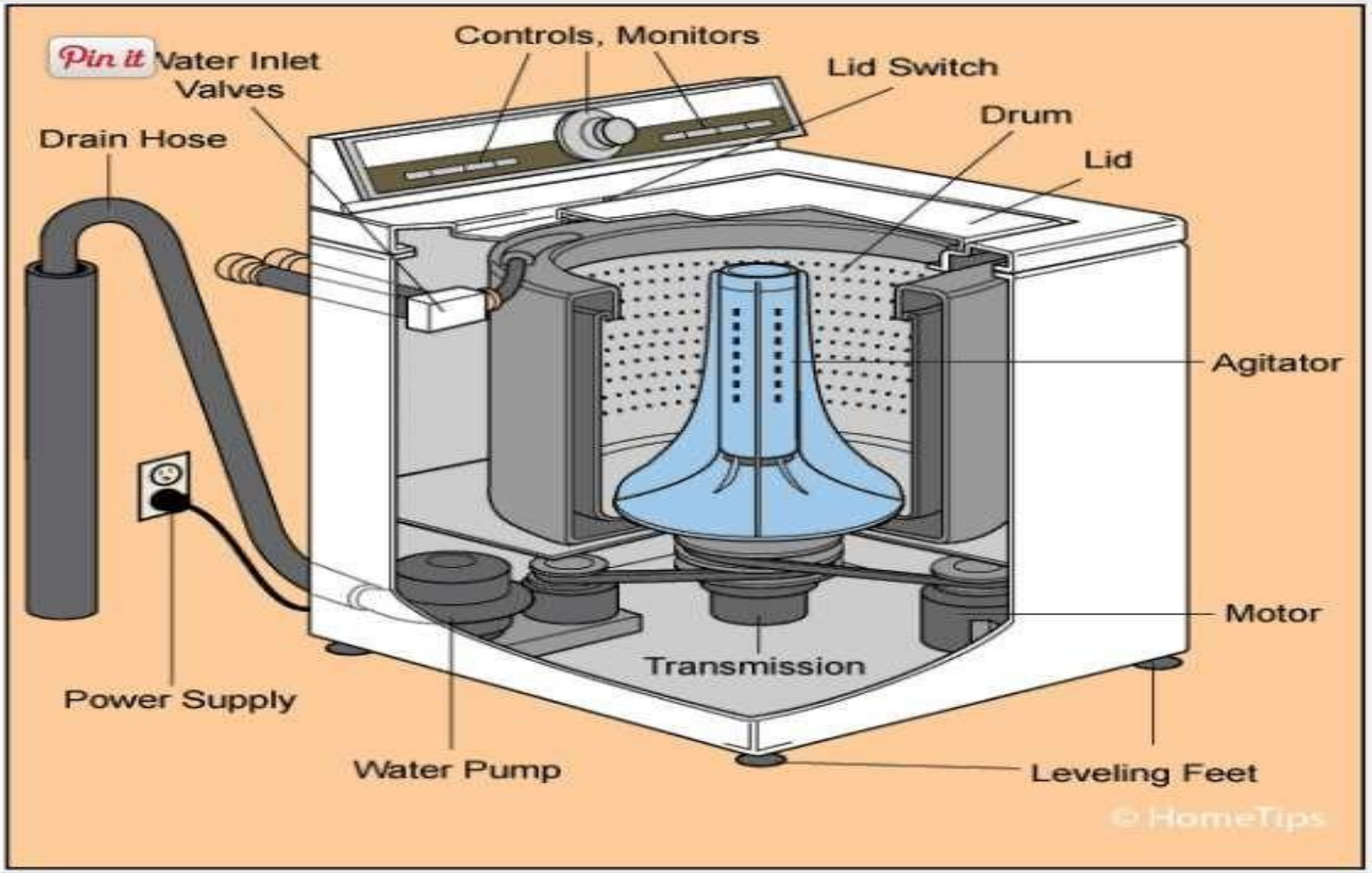
- A Wash motor is used to wash the cloth. It is more powerful than the spin motor because it has to make the movement of wet clothes with water.
- The wash motor is also a single-phase induction motor, it also has two windings - running winding and starting winding. Here also, a capacitor is required for its operation.
- The wash motor is subjected to rotate in both directions and it is done by the wash timer.
- The speed and torque of the Wash motor are more than the spin motor.

Internal Parts of the Washing Machine....

- **Spin Timer**
- Spin Timer is used to operate the Spin motor.
- A spin timer is a two-terminal device, it is to be connected with the spin motor and the power supply.
- Spin motor and Spin timer are used in both semiautomatic and automatic washing machines.
- **Wash Timer**
- The Wash Timer is used to operate the wash motor.
- The function of the wash timer is to rotate the wash motor with a preset time, change the direction of the rotation of the motor, and turn on the buzzer or alarm when washing is completed.
- There are different types of wash timers are available such as three-terminal wash timers, four-terminal wash timers, and six terminal wash timers.

Internal Parts of the Washing Machine

- **Door Switch**
- The door switch provides the function to operate the washing machine when the door is only in closed condition.
- You can see the door switch is connected in series with the spin motor so, until the door is closed, the spin motor will not work.



Clothes Washing Machine Diagram

Types of WM

- Washing machines are mainly of three types, namely Washer, semi-automatic and automatic.
- *Washers Are* single tub machines that only wash.
- Since washers don't have the facilities for drying the clothes, these cost less than semi-automatic and fully automatic machines.
- In *semi-automatic* machine, the controls are not fully automatic and manual intervention is required.
- In *fully automatic* machines, no manual intervention is required during the washing process.

Types of WM….

- For automatic machines, programs have to be selected and set by the user prior to the start of washing cycle.
- Sensors sense the wash load and decide the program ideal for washing the clothes, water level, time required to wash, number of rinses and spins, type of fabric etc.
- Although *washer dryer* (semi-automatic) machines don't operate with the efficiency of *stand alone* washing machines, they offer enormous space saving.
- However, you have to drain all the soap water before drying. Also, you can't wash and dry at the same time and the drying performance is inferior to that of stand alone machines.
- But then washer-dryers cost less and allow you to wash and dry your clothes without having to reset the machines.

Types of WM….

- **Capacity :** The capacity of a washing machine is expressed in terms of the *wash load*, which in turn depends on the type of fabric.
- It is expressed in kg.
- The maximum load for the washer is the amount that will move freely in the wash tub.
- A higher capacity machine offers the convenience of washing more clothes at one go but consumes more power.
- Smaller capacity machines wash fewer clothes and consumes less power, but these machines can easily fit in a limited space.

Types of WM….

- **Wash programs :** High-end washing machines feature different wash programs to suit different types of clothes.
- The program includes *regular* for normal wash, *gentle* for delicate clothes and *tough/hard* for rugged clothes.
- In addition, you are able to select the temperature of wash and the number of runs for better cleaning.
- The number of cycles specifies the number of *preset programs* available on the machine.
- This is important for clothes that require different temperatures.

Types of WM….

- **Spin Speed :** The higher the spin speed, the dryer the clothes at the end of the *washing cycle* and hence the shorter the drying time in the tumbler dryer.
- Thus a high spin speed results in less *washing time.* Some machines spin at more than 1000 rpm, some machines spin as fast as 7000 rpm during *drying cycle.*

Automatic Washing Machine

- Operating Principle
- The washing machines are very commonly used electronic controlled home appliances. Modern washing machines are fully automatic. That is, it washes the clothes according to their type and degree of dirtiness.
- The washing machines also detect the type of clothes and then select the programs for washing. The modern washing machines use microcontrollers or microcomputers with sufficient memory and keyboard/display etc facilities.
- The modern fully automatic washing machines use the advanced control techniques like fuzzy logic to implement washing algorithms.
- Such washing machines decide wash cycle, hot/cold water requirements, agitate/spin/soak/rinse wash modes, wash times etc on their own depending upon the volume of clothes and their dirtiness.

Automatic Washing Machine.....

- Block Diagram

- Fig. next slide shows the block diagram of washing machine.
- It uses the microcontroller or micro computer as the central controller.
- The controller has LCD or LED display and keyboard for program entry.
- The machine can be operated in manual or auto modes.
- The machine has two washing tubs. The inner tub is perforated. This tub contains the clothes to be washed.
- The outer tub is waterscaled. The outer tub has hot/cold water inlets, water outlets, soap inputs etc. The wash tubs are attached to the motor and gear box assembly.

Block Diagram of Automatic WM

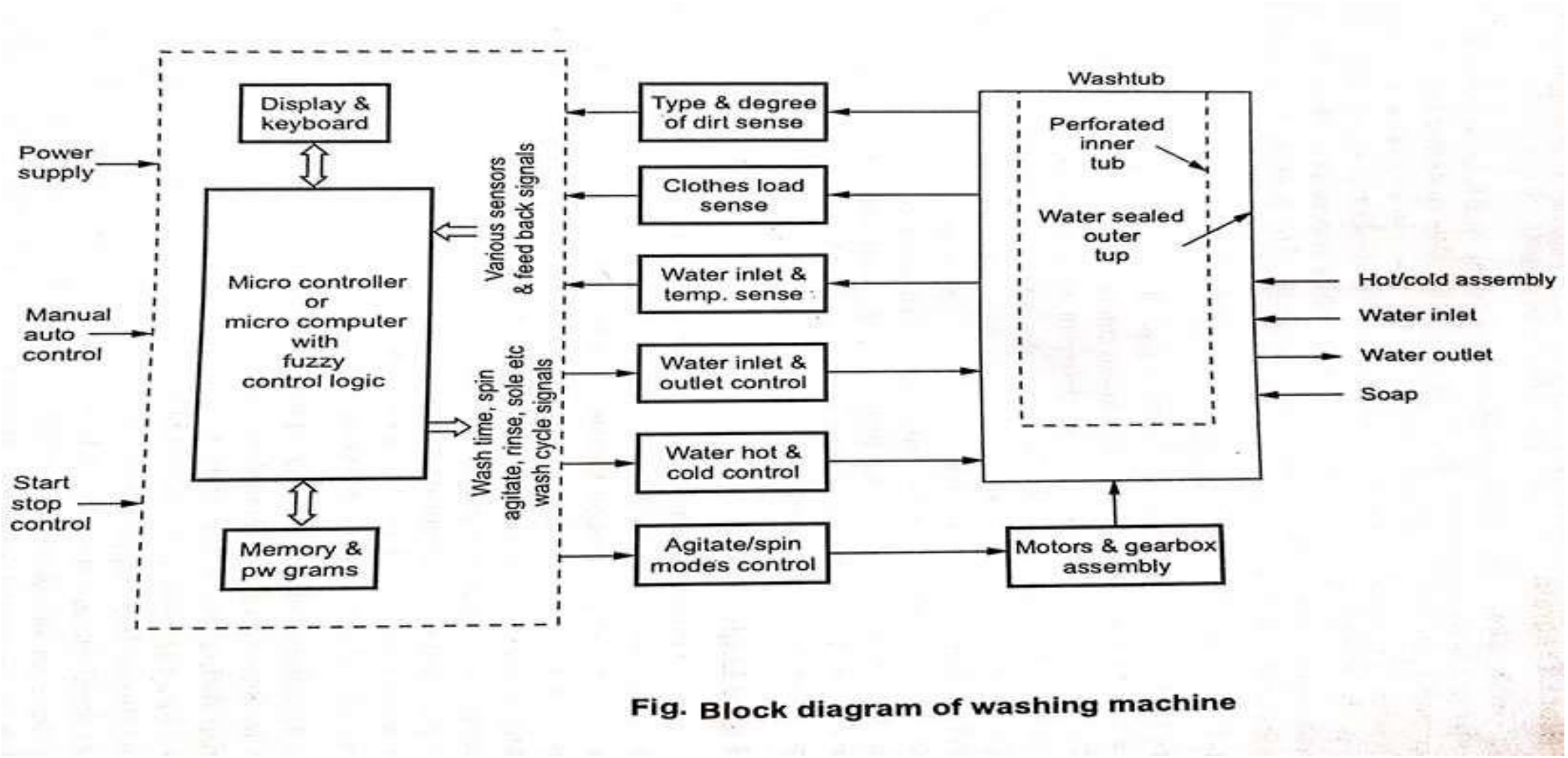


Fig. Block diagram of washing machine

Block Diagram of Automatic WM…

- The controller senses volume of clothes, type of dirt and degree of dirt.
- Depending upon this data, the controller decides various timings of the wash cycle. The controller controls the mixture of hot/cold water, detergent/soap etc.
- After you fill the inner tub upon with clothes, the machine fills the tub with water. The controller then adds the detergent to the water. The controller then agitates the inner tub.
- After the completion of agitation time, the washer drains the water. The solenoid valve of water outlet is opened. The controller spins the inner tub so that water comes out of the holes and goes to the outlet.
- The controller then refills the wash tub, agitates again for some me and spins the inner tub to rinse out the soap.
- This washing cycle continues till the time estimated by the controller.

Fuzzy Logic

- In many applications we often come across the decision making and problem solving tasks, which are too complex to be understood quantitatively.
- Such problems can be solved using imprecise knowledge rather than precise knowledge.
- The fuzzy logic is used to take decisions in such applications. The fuzzy logic resembles human reasoning to make decisions based on approximate information and uncertainty.
- The uncertainty and vagueness of the problem is mathematically represented.
- The fuzzy logic is provided with formalized tools to deal with such imprecision and approximate mathematical representations.
- The knowledge can be expressed in more natural form by fuzzy sets.
- Hence many engineering and decision problems are greatly simplified.

Fuzzy Logic....

- The boundaries of classes or groupings of data are not sharply defined in fuzzy set theory.
- In other words, the boundaries are 'fuzzy' hence the name fuzzy logic is given.
- The crisp definitions of the problem are fuzzified by generalizing the concept of a crisp set to a fuzzy set with blurred boundaries.
- The linguistic variables are also used in some fuzzy logic applications. In such applications, the terms such as large, medium, small etc are used to capture a range of numerical values.
- The fuzzy logic allows these set of values to overlap.
- For example a 85 kg weight of man can be classified as 'large' and 'medium' categories. This classification depends upon varying degrees of belonging or membership to each group.

Fuzzy Logic....

- The fuzzy logic implements soft linguistic variables on a continuous range of values .
- The fuzzy logic handles approximate information in a systematic way. Hence it is ideal for controlling nonlinear systems, or modeling complex systems, or the systems where ambiguity or vagueness is common.
- The fuzzy systems consists of a rule base, membership functions and inference procedure. The fuzzy logic is the broad term which includes fuzzy arithmetic, fuzzy mathematical programming, fuzzy topology, fuzzy graph theory and fuzzy data analysis.
- Today fuzzy logic is used in applications such as chemical process control, manufacturing, washing machines, video cameras, automobiles etc.

Washing Machines with Fuzzy Logic

- When we use the washing machine, we select the length of the wash time based on the amount of clothes, type of dirt and degree of dirt.
- In the automatic machine, sensors can be used to detect these parameters. The wash time then can be determined from these parameters.
- But there is no direct mathematical relationship between volume of clothes, type of dirt, degree of dirt and wash time required.
- Hence the automation of washing machine based on these parameters was difficult. Hence people has to set the wash time manually by trial and error experience.

Washing Machines with Fuzzy Logic….

- The above problem of automation is solved by fuzzy logic. Since the input parameters and output wash time relationship is not clear, the fuzzy logic can be used to take decisions. Here let us consider the operation of the fuzzy controller. The inputs to the fuzzy controller will be type of dirt and degree of dirt.
- The output of the fuzzy controller will be wash time required. This is shown in Fig. next slide .
- For simplicity we have considered only two inputs to the fuzzy controller. In actual washing machine, there are more number of inputs and outputs like water level, spin speed, wash cycles, detergent requirement etc. The dirtiness and type of dirt can be sensed from the single optical sensor. The degree of dirt is determined by the transparency of the wash water.

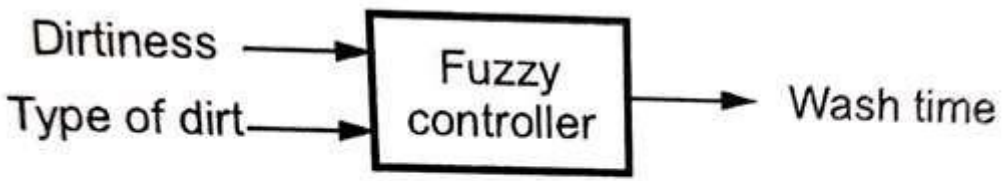
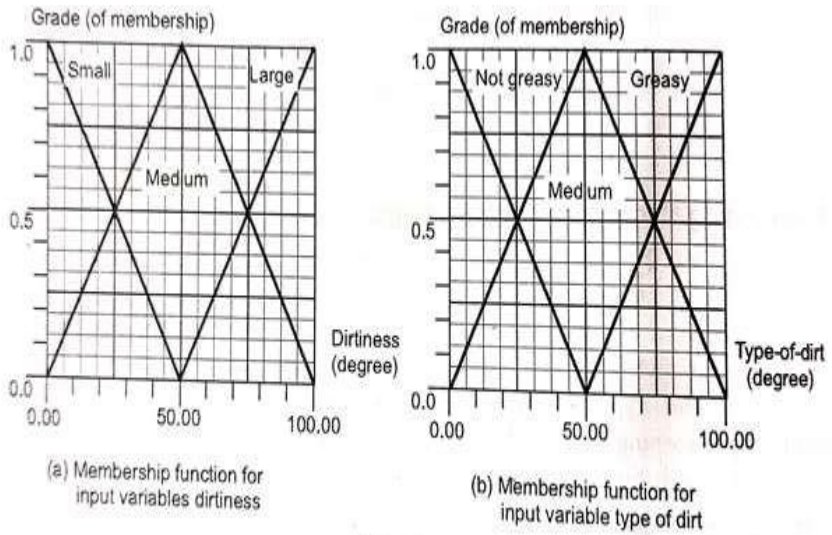


Fig. Block diagram of fuzzy controller

Washing Machines with Fuzzy Logic….

- The transparency of the wash water will reduce if clothes are more dirty. The type of dirt is determined from the saturation time. After a certain time there is no change is transparency of water. This time depends upon type of dirt. For example greasy clothes take longer time for water transparency to reach saturation, since grease is less water soluble. Thus type of dirt can be sensed from saturation time.
- Next is to determine the range of possible values of the input and output variables Fig 6.8.3 (a) next slide shows the grade of membership function versus degree of dirtiness. Observe that the degree of dirtiness is normalized from 0 to 100. The dirtiness is classified as small, medium and large with overlap. Similarly Fig. 6.8.3 (b) shows the membership function versus degree of type of dirt. The degree is normalized from 0 to 100. The type of dirt is classified as not greasy, medium and greasy with overlap. The membership functions are used to translate real world values to fuzzy values and back. Figure 6.8.3 shows such fuzzy values.

Washing Machines with Fuzzy Logic….



(a) Membership function for input variables dirtiness

(b) Membership function for input variable type of dirt

Fig. 6.8.3

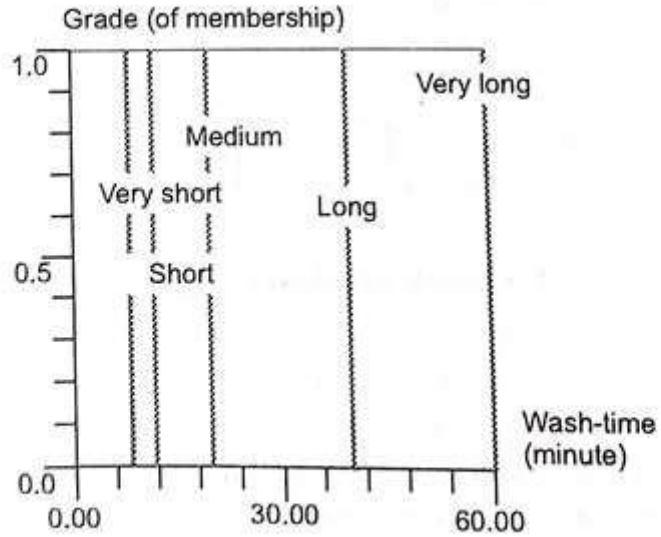


Fig. Grade of membership function for output variable 'wash time'

Washing Machines with Fuzzy Logic….

- The decision making capabilities of the fuzzy controller are coded in a set of rules. These rules are qualitative statements written in English. A typical rule is as follows:
- If saturation time is long and transparency is bad, then wash time should be long. Figure last slide shows the grade of membership functions for output variable 'wash time'

Washing Machines with Fuzzy Logic….

- As shown in the figure last to last slide, the wash time is very short, short, medium, long and very long.
- The membership function is used to translate these fuzzy values to actual time in minutes. Here the wash time is normalized to 60 minutes in above figure.
- The fuzzy controller has fuzzy inference unit (FIU). This unit encodes the controller information. The FIU includes the input/output variable definitions and the rules of application. Figure next slide shows the response surface of the input-output relation as determined by the FIU.

Washing Machines with Fuzzy Logic….

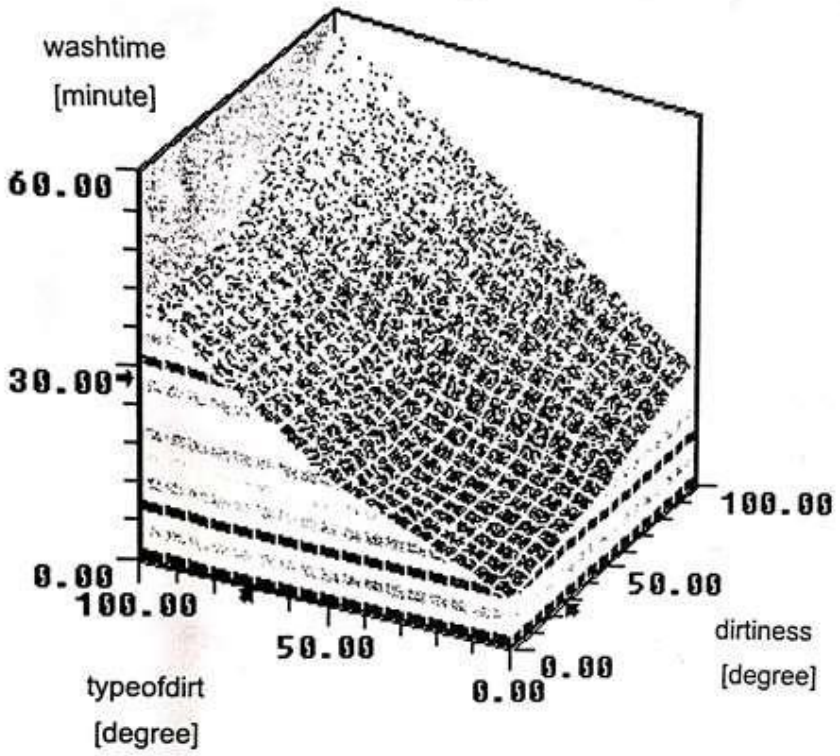


Fig. Input/output response surface as determined by FIU

Washing Machines with Fuzzy Logic….

- As Shown in above figure, the wash time is the function of two dimensions of type of dirt and dirtiness.
- Many other parameters can be controlled by the fuzzy controller. The other variables such as water level, spin speed etc can be controlled. Because of fuzzy Technology, the washing machines have been made fully automatic.

Vacuum Cleaner

- A **vacuum cleaner**, also known simply as a **vacuum** or a **hoover**, is a device that causes suction in order to remove dirt from floors, upholstery, draperies, and other surfaces. It is generally electrically driven.
- The dirt is collected by either a dust bag or a cyclone for later disposal. Vacuum cleaners, which are used in homes as well as in industry, exist in a variety of sizes and models—
- small battery-powered hand-held devices,
- wheeled canister models for home use,
- domestic central vacuum cleaners,
- huge stationary industrial appliances that can handle several hundred litres of dirt before being emptied,
- and self-propelled vacuum trucks for recovery of large spills or removal of contaminated soil.
- Specialized shop vacuums can be used to suck up both solid matter and liquids.

Vacuum Cleaner.....

- Conventional vacuum cleaner is actually made up of only six essential components:
- An **intake port**, which may include a variety of cleaning accessories
- An **exhaust port**
- An **electric motor**
- A **fan**
- A **porous bag**
- A **housing** that contains all the other components

Vacuum Cleaner…..

- Vacuum cleaners work because of **Bernoulli's Principle**, which states that as the speed of air increases, the pressure decreases.
- Air will always flow from a high-pressure area to a low-pressure area, to try to balance out the pressure.
- A vacuum cleaner has an intake port where air enters and an exhaust port where air exits. A fan inside the vacuum forces air toward the exhaust port at a high speed, which lowers the pressure of the air inside, according to Bernoulli’s Principle.

Vacuum Cleaner…..

- This creates ***suction*** **–** the higher pressure air from outside the vacuum rushes in through the intake port to replace the lower-pressure air. The incoming air carries with it dirt and dust from your carpet.
- This dirt is trapped in the filter bag, but the air passes right through the bag and out the exhaust. When the bag is full of dirt, the air slows down, increasing in pressure. This lowers the suction power of your vacuum, which is why it won't work as well when the bag is full.

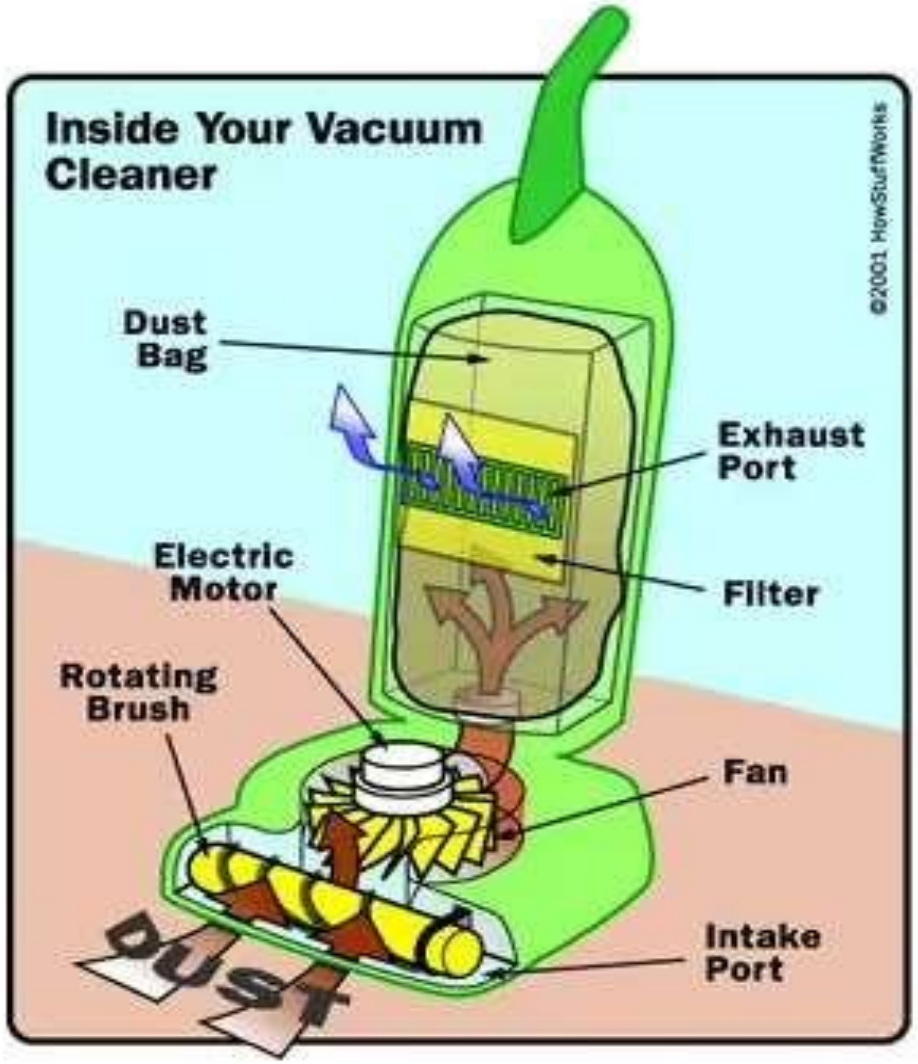
Vacuum Cleaner…..

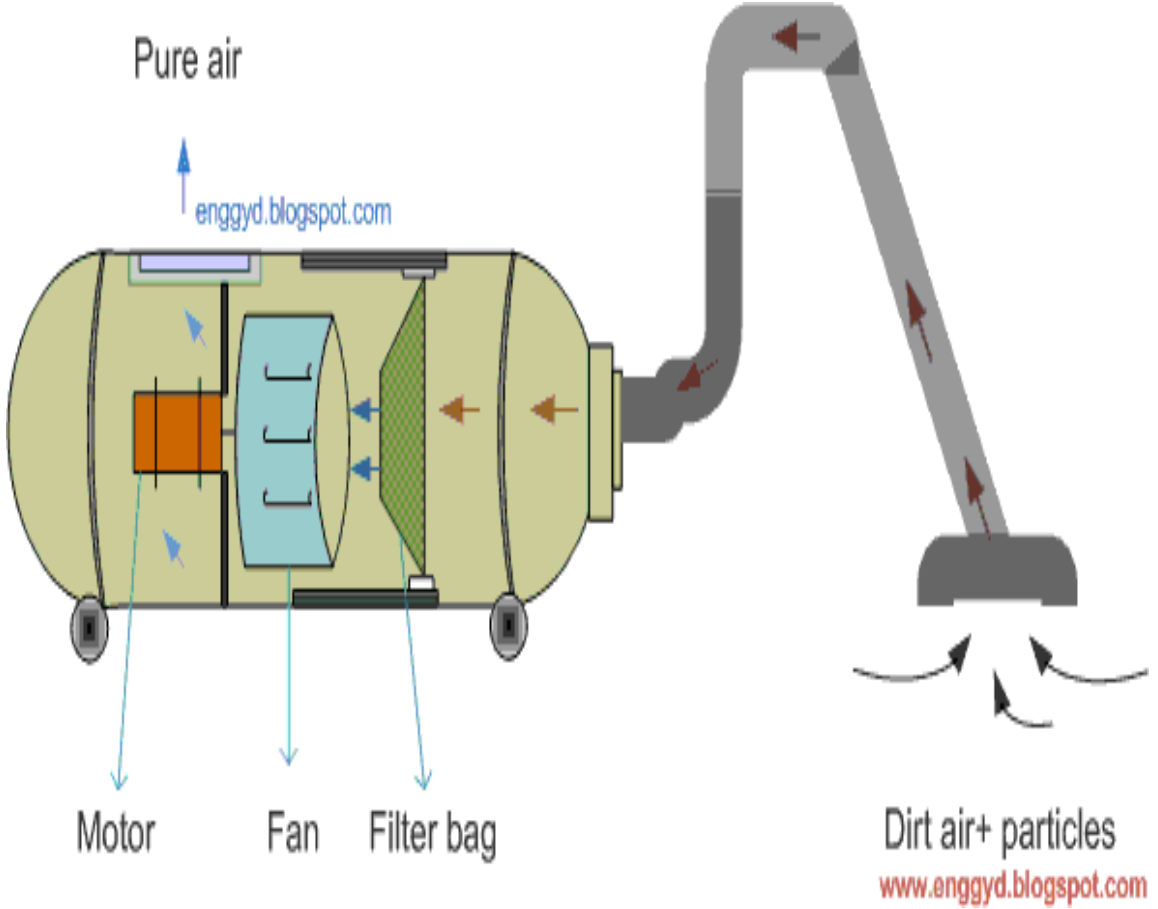
- When you plug the vacuum cleaner in and turn it on, this is what happens:
- The electric current operates the **motor**. The motor is attached to the **fan**, which has angled blades (like an airplane propeller).
- As the **fan blades** turn, they force air forward, toward the **exhaust port**
- When air particles are driven forward, the **density** of particles (and therefore the **air pressure**) increases in front of the fan and decreases behind the fan.

Vacuum Cleaner…..

- This **pressure drop** behind the fan is just like the pressure drop in the straw when you sip from your drink.
- The pressure level in the area behind the fan drops below the pressure level outside the vacuum cleaner (the **ambient air pressure**).
- This creates suction, a **partial vacuum**, inside the vacuum cleaner. The ambient air pushes itself into the vacuum cleaner through the intake port because the air pressure inside the vacuum cleaner is lower than the pressure outside.
- As long as the fan is running and the passageway through the vacuum cleaner remains open, there is a **constant stream of air** moving through the intake port and out the exhaust port.
- But how does a flowing stream of air collect the dirt and debris from your carpet? The key principle is **friction**.

Vacuum Cleaner





Components of Vacuum Cleaner

- Electric motor: A vacuum cleaner has an electric motor that powers the machine. When you turn on the vacuum, the motor spins a fan or impeller that creates suction.
- Suction nozzle: The suction nozzle is the part of the vacuum that comes into contact with the surface you are cleaning. It is usually equipped with brushes or agitators that help to loosen dirt and debris.
- Dustbin: As the air and dirt are sucked in through the suction nozzle, they are pulled into a dustbin or collection bag. The dustbin or collection bag is designed to trap the dirt and debris while allowing air to pass through.
- Filters: A vacuum cleaner also has filters that help to remove dust and other particles from the air. Some vacuums use multiple filters, including a pre-motor filter and a post-motor filter.
- Exhaust port: Once the air and dirt have passed through the filters, the air is released back into the room through an exhaust port.

Components of Vacuum Cleaner..

- Overall, the working principle of a vacuum cleaner involves using a motor to create suction, which pulls in dirt and debris through a suction nozzle and into a dustbin or collection bag. The air is then filtered before being released back into the room through an exhaust port.

Features of the vacuum cleaner

- Suction power: The suction power of a vacuum cleaner is the strength of the airflow generated by the motor. Higher suction power allows the vacuum to clean more deeply.
- Filtration system: Some vacuum cleaners come with advanced filtration systems such as HEPA filters, which can trap microscopic particles like pollen and dust mites.
- Cord length: The cord length determines how far you can move the vacuum cleaner away from the power source.
- Bag or bagless: Some vacuum cleaners use disposable bags to collect dirt and debris, while others are designed to be bagless and use dustbins that can be emptied and reused.
- Brush roll: The brush roll is a rotating brush that helps to dislodge dirt and debris from carpets and upholstery. Some vacuum cleaners come with adjustable brush rolls to accommodate different surfaces.

Features of the vacuum cleaner…

- Attachments: Vacuum cleaners come with a range of attachments such as crevice tools, dusting brushes, and upholstery tools that make it easier to clean hard-to-reach places.
- Noise level: The noise level of a vacuum cleaner can be an important consideration, especially if you live in an apartment or have young children or pets.
- Weight and maneuverability: The weight and maneuverability of a vacuum cleaner can affect how easy it is to use and store.
- Cordless or corded: Cordless vacuum cleaners are powered by rechargeable batteries, making them more convenient and portable than corded models.
- Smart features: Some high-end vacuum cleaners come with smart features such as app control, voice control, and self-emptying dustbins, making cleaning more convenient and efficient.

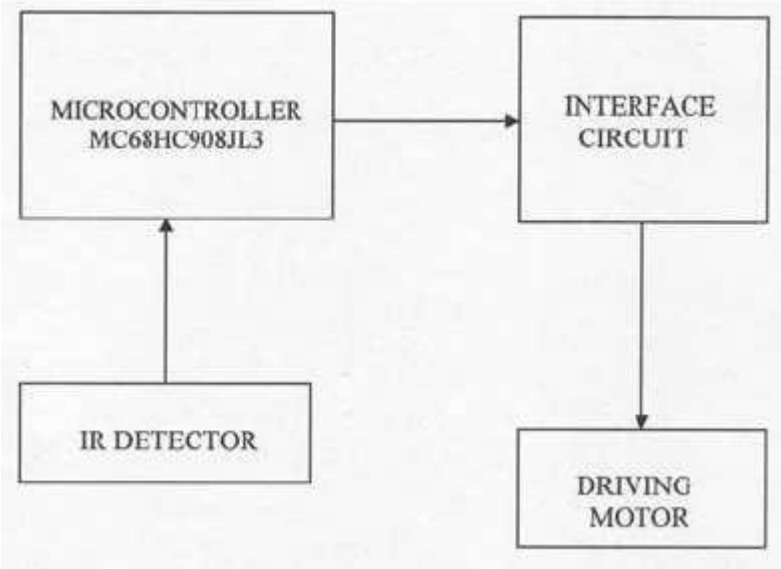
Working of Motors used in Vacuum Cleaner

- Vacuum cleaners use electric motors to generate the suction power required to clean surfaces. The type of motor used in a vacuum cleaner is usually a universal motor, which is a type of electric motor that is capable of running on both AC (alternating current) and DC (direct current) power sources. Here's how the motor works:
- The motor consists of a rotor (rotating part) and a stator (stationary part). The rotor is a cylindrical component that rotates inside the stator.
- The rotor is equipped with a set of carbon brushes that make contact with a commutator, which is a segmented ring on the rotor shaft. The commutator switches the direction of the current flow in the motor windings as the rotor rotates.

Motors used in Vacuum Cleaner

- When a current flows through the motor windings, it creates a magnetic field that interacts with the magnetic field of the stator. This interaction causes the rotor to rotate.
- The rotating rotor is connected to the impeller or fan that generates the suction in the vacuum cleaner.
- The speed of the motor is controlled by adjusting the voltage supplied to the motor. A vacuum cleaner typically has a variable speed control that allows the user to adjust the suction power based on the cleaning requirements.
- Overall, the motor in a vacuum cleaner works by converting electrical energy into mechanical energy, which is then used to power the impeller or fan that generates the suction required for cleaning. The motor is an essential component of the vacuum cleaner, and its performance determines the suction power and overall efficiency of the machine.

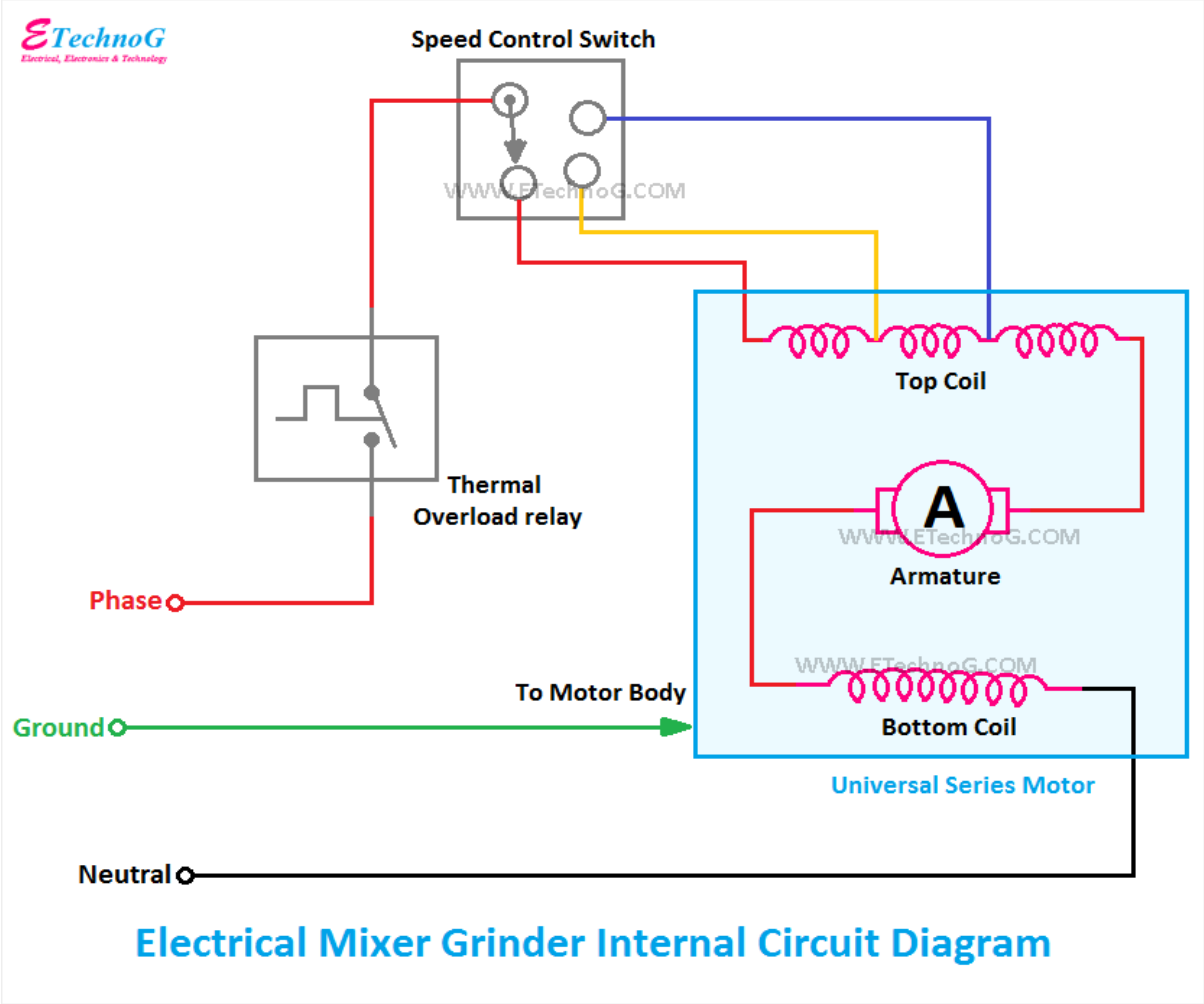
B.D. of Vacuum Cleaner Control System (Electronic Circuit)



Block diagram of the physical arrangement of **vacuum-cleaner control sub-system**

Mixer/Grinder

A mixer and grinder is a popular home appliance used for blending and grinding ingredients. It typically consists of a motorized base with a detachable container or jar, with blades at the bottom for mixing and grinding.



Electrical Mixer Grinder Internal Circuit Diagram

Working of Mixer/Grinder

- **Universal Series Motor**
- Universal series motors are those which are designed to operate with both AC and DC supply.
- Here the word 'series' used because its field windings are connected in series with the armature winding.
- In the above circuit diagram, you can also see there are two series windings. One of these is tapped in three positions. And those tappings are connected to the speed control switch. So this arrangement is for speed control of the motor. So we can obtain three different speeds(low, medium, high) by rotating the switch. Also, you can see the mixer grinder motor connection below.

Working of Mixer/Grinder

- **Thermal Overload Relay or overload switch**
- A thermal Overload Relay or overload switch is used to protect the device from overload or overcurrent fault. If the motor draws overcurrent due to any internal fault, or improper use, the overload relay will automatically disconnect the power supply to the motor. As the mixer grinder is a home appliance, so the thermal overload relay is very helpful to prevent accidents such as burning of motor, fire, and melting due to over current. The overload switch also helps to turn off the motor if you run it for a long time. After fully cool down it will be got automatically turned on. You can see the mixer grinder overload switch connection diagram below.

Working of Mixer/Grinder

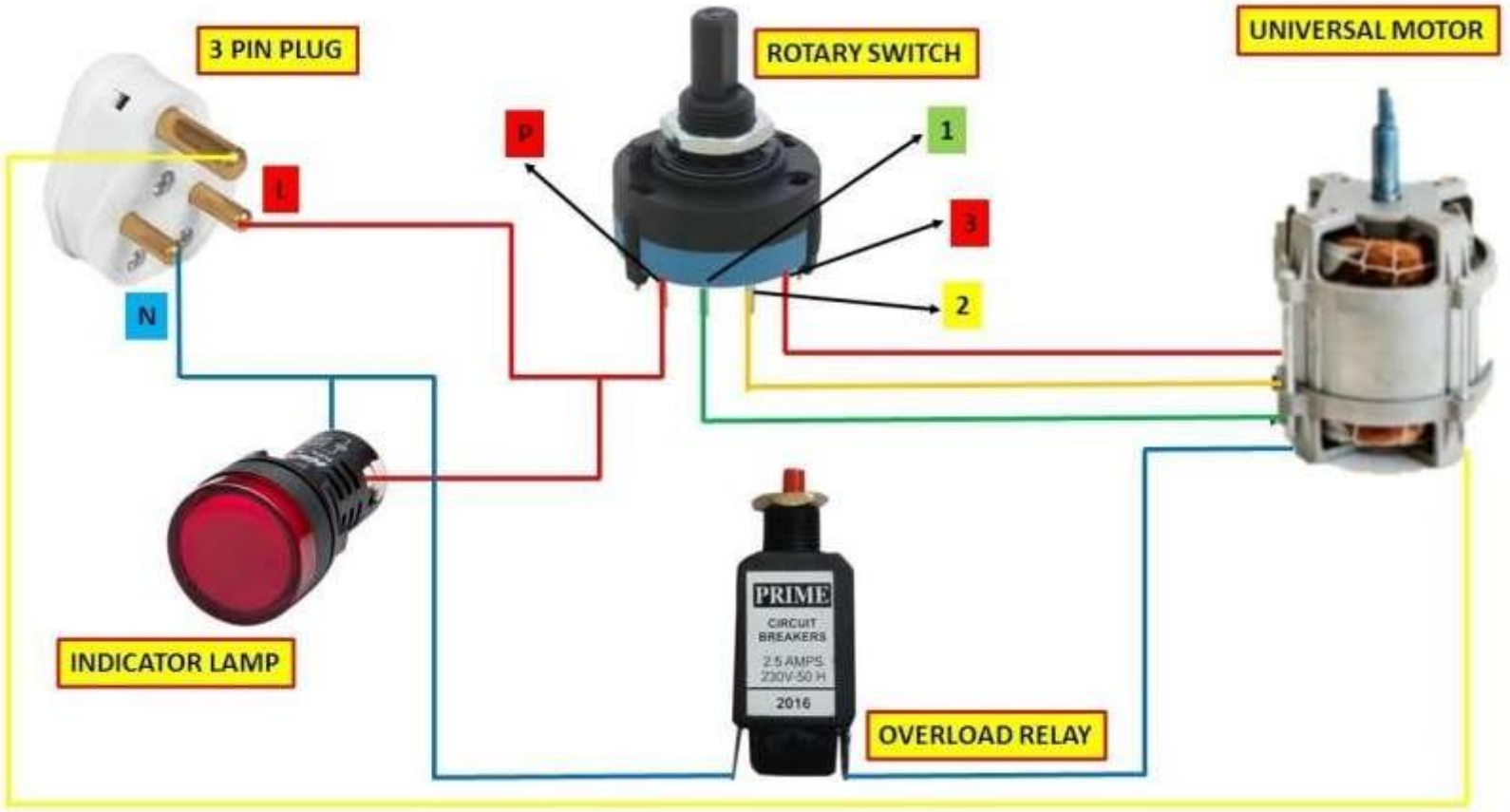
- **Three-Position Rotary Switch**
- It has a total of four terminals. The first one is the input terminal and the other three are output terminals where the terminals of the motor are to be connected. You can see the mixer grinder rotary switch connection diagram below.
- **Power Switch**
- Most of the mixer grinders have the function to switch on and off in their speed control switch but some mixer grinders come with a separate power switch to on and off.

Mixer/Grinder

- A mixer and grinder is a popular home appliance used for blending and grinding ingredients. It typically consists of a motorized base with a detachable container or jar, with blades at the bottom for mixing and grinding.
- Components of Mixer/Grinder?
- Power source: The appliance is powered by electricity from a socket or battery.
- Motor: The motor is usually located at the bottom of the appliance, and it is responsible for powering the blades. The power of the motor determines the strength of the appliance.
- Blades: The blades are usually made of stainless steel and are designed to cut, blend, and grind ingredients. There are different types of blades available depending on the purpose.

How a mixer and grinder works ?

- Jars or Containers: The jars or containers are used to hold the ingredients to be blended or ground. They come in different sizes, and some models have multiple jars for different purposes.
- Controls: The mixer and grinder usually have control knobs or buttons that allow you to adjust the speed and intensity of the motor. The control buttons may also include different functions like pulse, blend, or grind.
- Usage: To use the mixer and grinder, you need to attach the appropriate jar or container to the base of the appliance, add the ingredients, and then adjust the speed and intensity according to the requirement. The blades will then mix and grind the ingredients into the desired consistency.
- Overall, a mixer and grinder is a versatile appliance that can be used to make a variety of recipes, from smoothies to sauces and more.



Wiring circuit of Mixer/Grinder

Working principle of Mixer/grinder

- The working principle of a mixer and grinder is based on the motor's power that drives the blades to mix and grind the ingredients placed in the container or jar.
- When you turn on the mixer or grinder, the motor rotates the blades at a high speed. The blades pull in the ingredients from the top and push them down towards the bottom of the jar. The blades cut and grind the ingredients as they rotate, creating a vortex that mixes everything thoroughly.
- The shape and position of the blades play a crucial role in the mixing and grinding process. Some mixer and grinder models have multiple blades arranged in different angles to ensure that all ingredients are evenly mixed and ground. The blade speed and intensity can be adjusted using the control knob or buttons on the appliance, allowing you to customize the mixing or grinding process based on your requirements.

Working principle of Mixer/grinder

- The container or jar also plays an essential role in the mixing and grinding process. The jar's shape and size determine how well the ingredients are mixed or ground. Some mixer and grinder models come with different-sized jars, which can be used for different purposes, such as blending smoothies, grinding spices, or making dough.
- In summary, the working principle of a mixer and grinder relies on a powerful motor that drives the blades to mix and grind ingredients in the jar or container. The speed and intensity of the motor can be adjusted using the control knob or buttons, allowing you to customize the mixing or grinding process based on your needs.

Motor used in grinder/mixer and how it works?

- The type of motor used in a mixer and grinder is typically an induction motor. An induction motor works on the principle of electromagnetic induction and consists of a stationary stator and a rotating rotor.
- When electricity is supplied to the stator, it creates a rotating magnetic field, which induces an electric current in the rotor. The interaction between the magnetic field and the rotor's current causes the rotor to rotate, which in turn drives the blades of the mixer and grinder.
- Induction motors are commonly used in mixer and grinders because they are reliable, efficient, and require very little maintenance. They are also able to produce a high torque output, which is necessary for blending and grinding tough ingredients.

Motor used in grinder/mixer and how it works?

- Induction motors used in mixer and grinders are typically single-phase or three-phase motors. Single-phase motors are used in smaller appliances, while three-phase motors are used in larger, commercial-grade appliances.
- In summary, an induction motor is used in a mixer and grinder to power the blades that mix and grind the ingredients. The motor works on the principle of electromagnetic induction and consists of a stationary stator and a rotating rotor. The type of motor used depends on the size and capacity of the appliance.

Speed control circuit & auto overload protector circuit in Mixer/grinder

- Most modern mixer and grinder appliances come equipped with speed control circuitry and auto overload protection circuitry.
- The speed control circuit is designed to regulate the speed of the motor, which can be adjusted by the user.
- The circuit typically consists of a potentiometer, which is a variable resistor that can be adjusted to vary the voltage applied to the motor. As the voltage applied to the motor is varied, the speed of the motor changes accordingly. The potentiometer is usually controlled by a knob or a switch on the appliance's control panel.

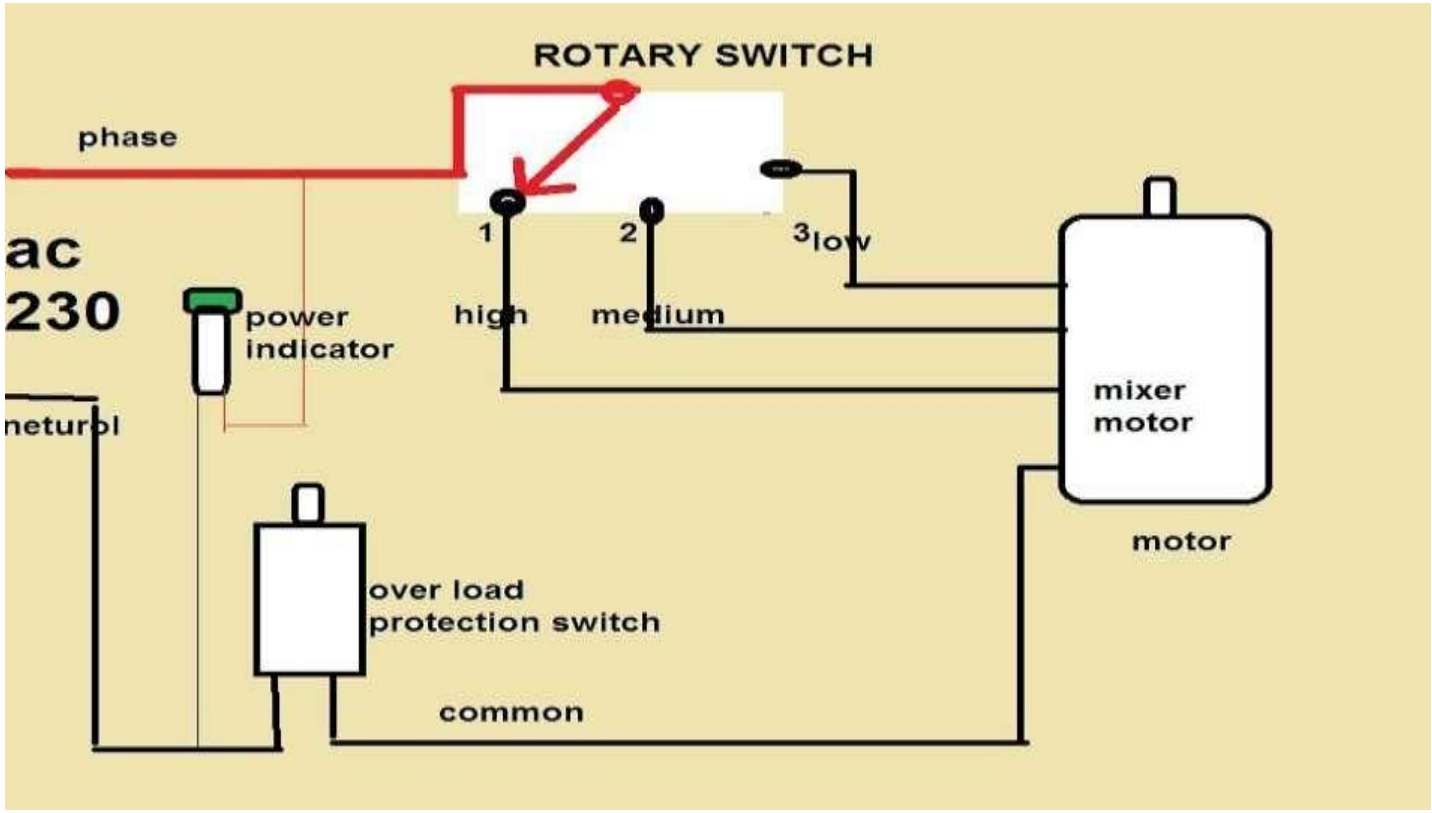
Speed control circuit & auto overload protector circuit in Mixer/grinder

- The auto overload protector circuit is designed to protect the motor from damage due to overload. When the motor is overloaded, it can overheat and cause damage to the appliance. The overload protection circuit is designed to detect when the motor is drawing too much current and automatically shut off the appliance to prevent damage.
- The overload protection circuit typically consists of a current sensor, which is connected in series with the motor. When the current drawn by the motor exceeds a certain threshold, the current sensor detects this and triggers the circuit to shut off the appliance. This protects the motor from overheating and burning out.

Speed control circuit & auto overload protector circuit in Mixer/grinder

- In summary, the speed control circuit and auto overload protector circuit are essential safety features in modern mixer and grinder appliances. The speed control circuit regulates the motor's speed, while the auto overload protector circuit protects the motor from damage due to overload. These features improve the longevity and safety of the appliance, making it a reliable and durable tool in the kitchen.

Speed control circuit & auto overload protector circuit in Mixer/grinder



Overload Protection Circuit of Mixer/Grinder

Principle of electric iron, parts of steam iron, thermostat heat controls.

- Electric irons are household appliances that are used to remove wrinkles from clothing and fabric by pressing the hot soleplate against the fabric.
- The principle of an electric iron is based on the Joule heating effect, which is the phenomenon where the electrical energy is converted into heat energy when a current passes through a conductor.
- An electric iron is based upon the principle of heating effect of current. This principle states that when an electric current is passed through a conductor, it generates heat because of the resistance present in it. The resistance converts electrical energy into heat energy.

The basic parts of an electric iron

- The basic parts of an electric iron include the soleplate, heating element, thermostat, and control knob.
- The soleplate is the flat, smooth surface that comes into contact with the fabric, and is typically made of aluminum or stainless steel.
- The heating element is a coiled wire that is embedded in the soleplate and produces the heat necessary to remove wrinkles from the fabric.
- In a steam iron, in addition to the basic parts mentioned above, there are additional components such as a water tank, spray nozzle, steam vents, and a pump.
- The water tank is used to store water that is sprayed onto the fabric to help remove wrinkles.
- The spray nozzle releases a fine mist of water onto the fabric, while the steam vents release steam onto the fabric.
- The pump draws water from the tank and sends it to the spray nozzle or steam vents.

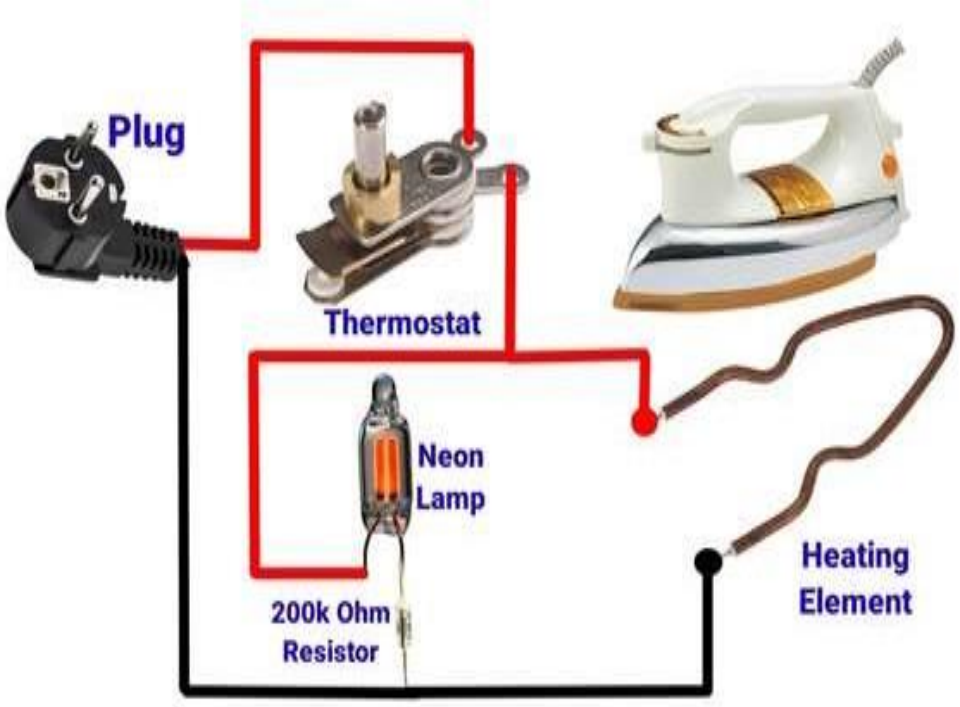
thermostat heat controls

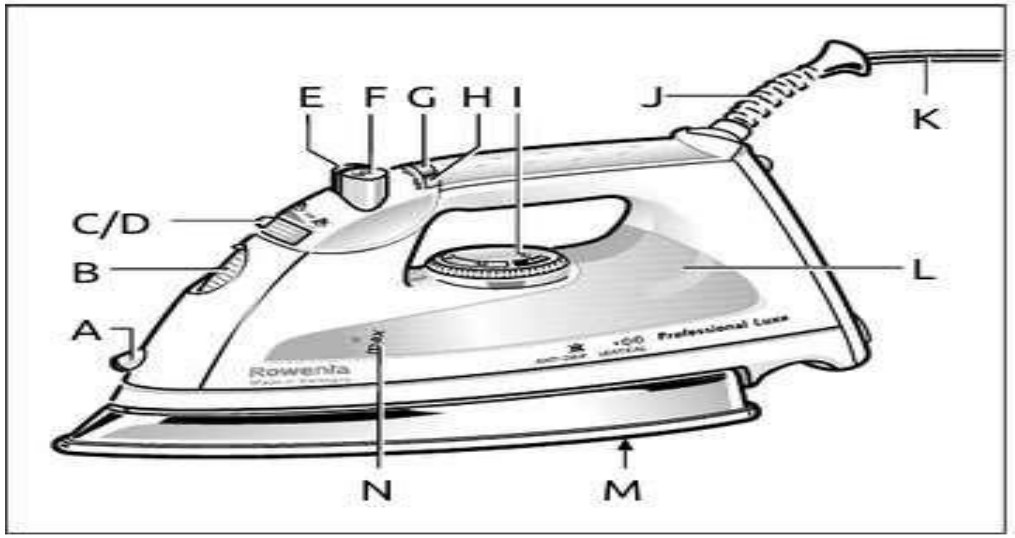
- The thermostat is the part of the iron that controls the temperature of the soleplate.
- The thermostat consists of a bimetallic strip, which is made up of two different metals with different rates of expansion.
- As the temperature of the soleplate increases, the bimetallic strip expands, causing it to bend and activate a switch that turns off the heating element.
- When the temperature of the soleplate decreases, the bimetallic strip contracts, causing it to straighten and activate the switch that turns on the heating element.
- This cycle of expanding and contracting allows the thermostat to regulate the temperature of the soleplate and prevent it from overheating.

thermostat heat controls…

- The control knob is used to adjust the temperature of the iron. It is typically located on the handle of the iron and is connected to the thermostat.
- By turning the control knob, the user can adjust the temperature of the iron, depending on the type of fabric being ironed.

Parts of Iron and Electric wiring diagram



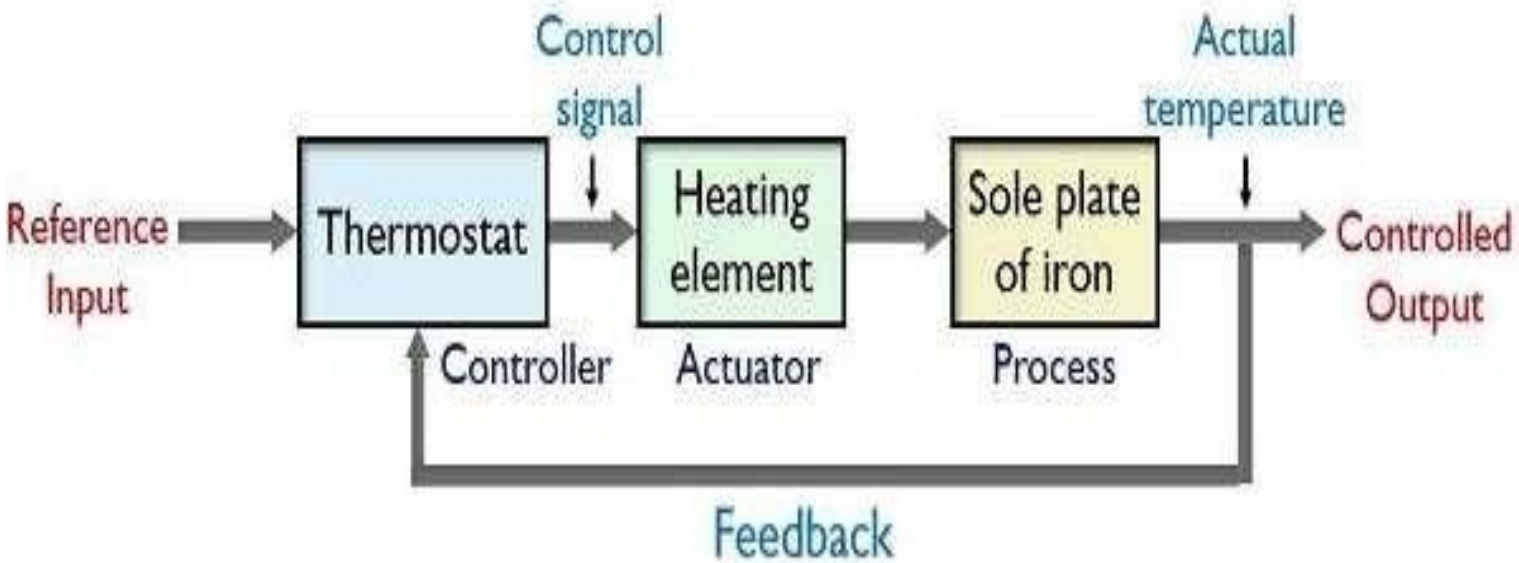


- Description:

A Spray nozzle
B Covered water filling inlet
C Variable steam control
D Self clean system
E Spray button
F Burst of steam button
G Auto-off indicator light (depending on model)
H Pilot light
I Temperature control dial
J Flexible cord protector
K Power cord
L Transparent water tank
M Stainless steel soleplate (depending on model)
N Water level indicator

Automatic Electric Iron

- Consider an example of automatic electric iron which acts as a closed-loop system. The figure below represents the block diagram with major components:



Automatic Electric Iron

Automatic Electric Iron….

- An automatic electric iron consists of a thermostat that acts as a controller of the system, a resistive heating element is present that generates heat.
- The sole-plate of the iron instrument acts as a process of the overall system.
- The basic working performed by an automatic electric iron is such that when the temperature of the sole-plate attains a predefined value then the heating action gets stopped automatically. And when the temperature falls below a certain specified value then again heating starts inside it.

Automatic Electric Iron….

- So, it is clear that in this type of system the controlling depends on the output of the system.
- Initially, in electric iron, the thermostat is provided with a certain specific value which acts as a reference input for the system.
- When the input is provided to the system, then the resistive heating element generates heat inside the system. This leads to rising up the temperature of the iron sole. Through a feedback element, this output temperature is compared with the reference input of the thermostat.

Automatic Electric Iron….

- If the achieved output shows lesser value than the reference input, then the difference temperature actuates the thermostat and this switches on the heating element.
- This resultantly causes an increase in the temperature of the iron sole.
- Once the temperature exceeds the reference value then the heating element automatically turns off. And after a certain point of time, the temperature starts to decrease.
- However, the comparison still goes on and as the temperature falls below the specific value, the heating element again begins to raise the temperature of the sole.
- In this way the continuous process inside an electric iron takes place.

Working principal of RO and UV type of water purifiers

- RO (Reverse Osmosis) and UV (Ultraviolet) are two common types of water purifiers used for domestic and commercial purposes. Both work on different principles and can be used independently or in combination to provide safe and pure drinking water.

Working principle of RO

- RO Water Purifiers: Reverse Osmosis (RO) is a process that uses a semi-permeable membrane to remove impurities and contaminants from water.
- In this process, water is forced through a membrane at high pressure, which blocks impurities and contaminants such as bacteria, viruses, dissolved salts, and heavy metals, while allowing pure water molecules to pass through.
- RO purifiers typically have multiple stages of filtration, including sediment filtration, activated carbon filtration, and RO membrane filtration.
- The pre-filters remove large particles, sediment, and chlorine, while the RO membrane filters out smaller particles and contaminants.
- The final stage usually includes a post-carbon filter to improve the taste and odor of the water.

Working principle of UV

- UV Water Purifiers: Ultraviolet (UV) water purifiers use ultraviolet radiation to kill bacteria, viruses, and other microorganisms present in water. In this process, water is exposed to UV rays (800 THz to 30000THz where 1THz=10^12), which penetrate the cell walls of microorganisms and damage their DNA, rendering them harmless.
- UV purifiers do not remove dissolved impurities, such as salts and heavy metals, or physical impurities, such as sediment and dust.
- As a result, UV purifiers are often used in combination with other filtration technologies, such as RO, to provide comprehensive water purification.

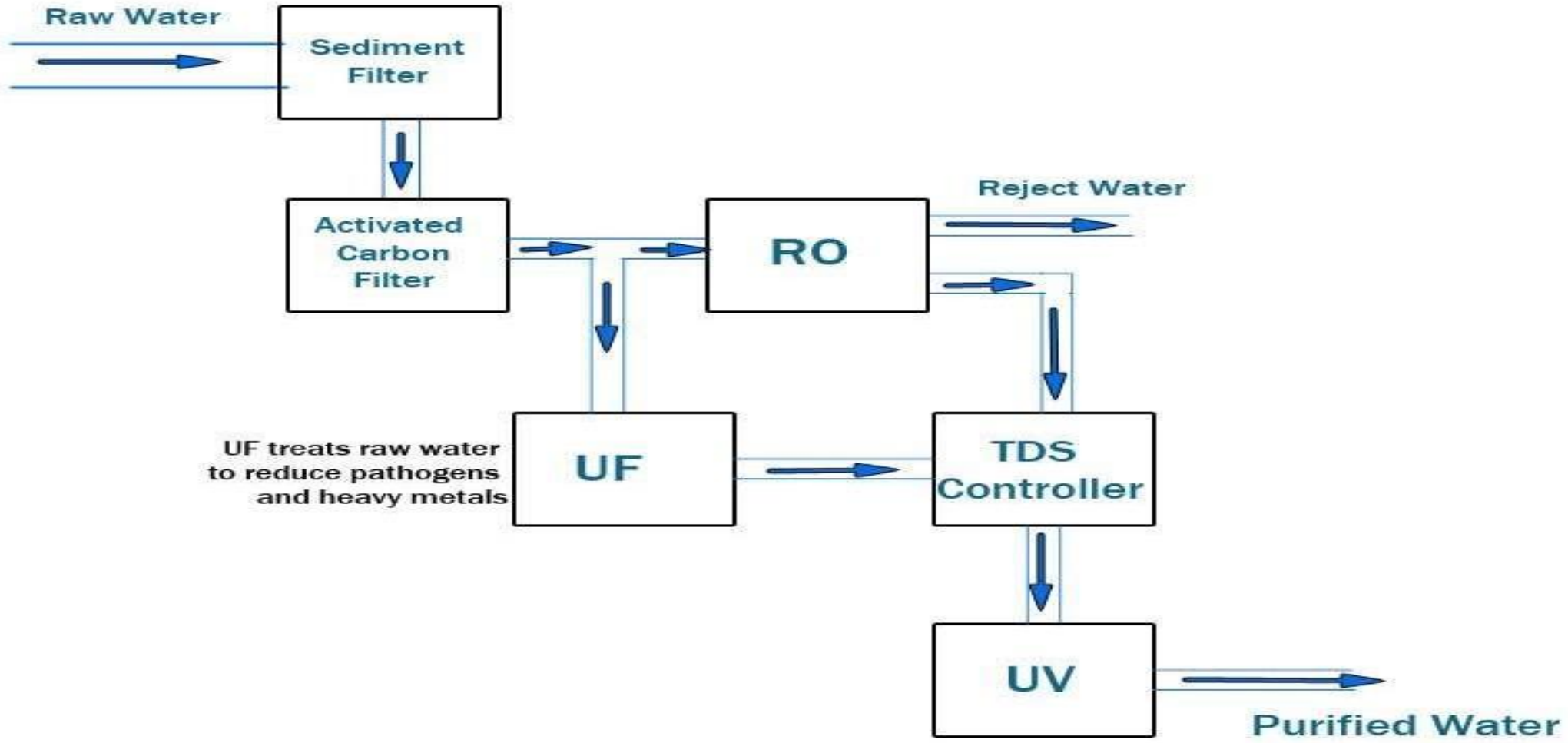
Combination RO and UV Water Purifiers

- Combination RO and UV Water Purifiers: RO and UV technologies can be combined in a single unit to provide comprehensive water purification.
- These purifiers typically have multiple stages of filtration, including sediment filtration, activated carbon filtration, RO membrane filtration, and UV sterilization.
- In these purifiers, water is first passed through pre-filters to remove sediment, chlorine, and other large particles. The water is then forced through an RO membrane to remove dissolved impurities, such as salts and heavy metals. The purified water is then exposed to UV radiation to kill any remaining bacteria, viruses, and other microorganisms.
- Finally, the water is passed through a post-carbon filter to improve its taste and odor.

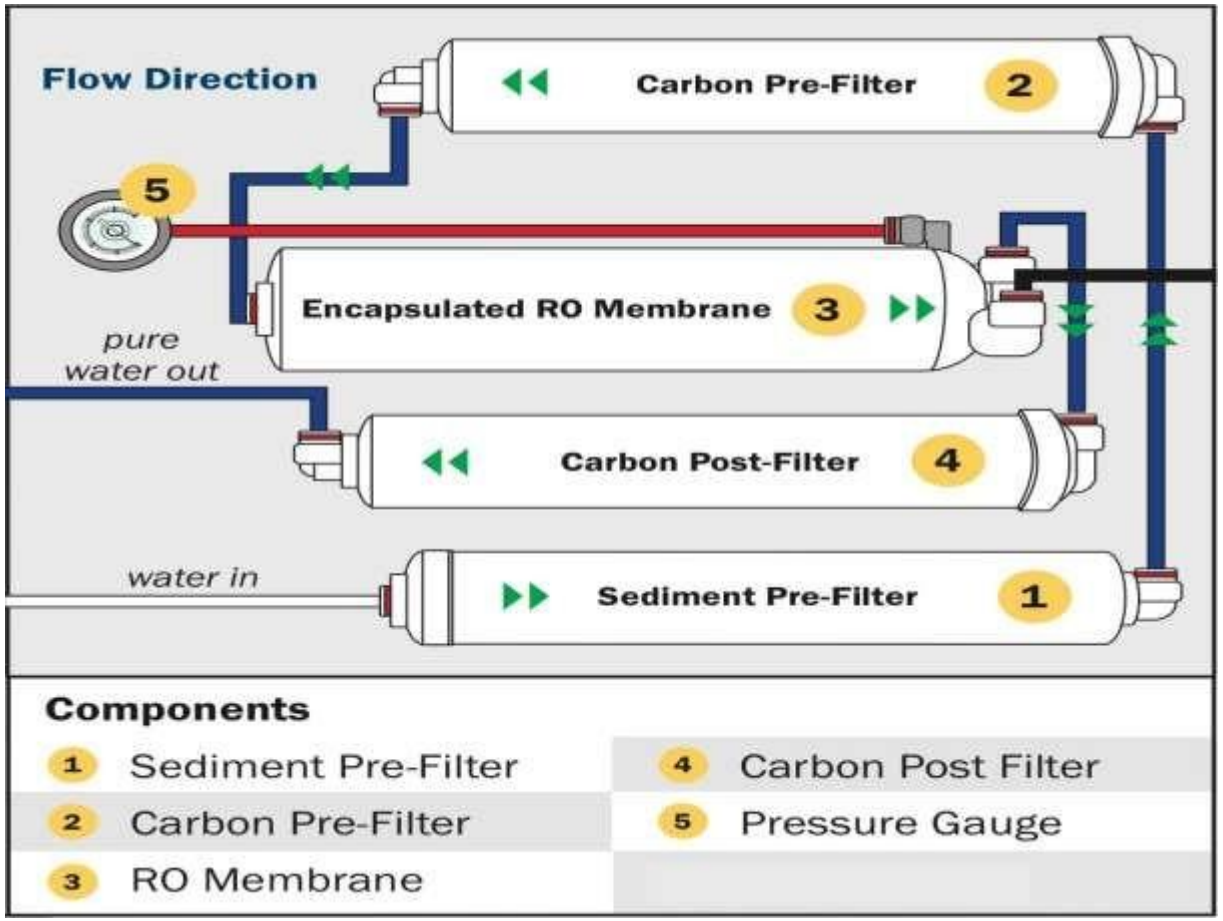
Different components of water purifier and their working

- A water purifier consists of various components that work together to remove impurities and contaminants from water. The following are the different components of a water purifier and their working:
- Sediment filter: The sediment filter is the first stage of filtration in most water purifiers. It is designed to remove large particles such as sand, dust, and rust from the water. The sediment filter works by physically trapping the particles as the water flows through it.
- Activated carbon filter: The activated carbon filter is the second stage of filtration in most water purifiers. It is designed to remove chlorine, volatile organic compounds (VOCs), and other chemicals that affect the taste and odor of the water. Activated carbon works by attracting and adsorbing these impurities onto its surface.

BD of RO & UV filter



BD of RO & UV filter



Different components of water purifier …

- Reverse Osmosis (RO) membrane: The RO membrane is the most important component in an RO water purifier. It is designed to remove dissolved solids, such as salts and minerals, from the water. The RO membrane works by using pressure to force water through a semi-permeable membrane, which blocks the dissolved solids and allows pure water molecules to pass through.
- Ultraviolet (UV) lamp: The UV lamp is an optional component in some water purifiers. It is designed to kill bacteria and viruses that may be present in the water. The UV lamp works by emitting high-energy ultraviolet radiation, which damages the DNA of microorganisms and renders them inactive.
- Post-carbon filter: The post-carbon filter is the final stage of filtration in most water purifiers. It is designed to remove any remaining impurities, improve the taste and odor of the water, and ensure that the water is safe to drink. The post-carbon filter works by adsorbing any remaining impurities onto its surface.

Most frequently occurring faults and their remedial procedures in RO and UV water purifier

- Low water flow: Low water flow is a common problem in RO water purifiers, and it can be caused by clogged filters, low water pressure, or a malfunctioning pump. To fix this problem, you should check the pre-filters and RO membrane for clogs and replace them if necessary. If the problem persists, you may need to increase the water pressure or replace the pump.
- Leaking water: Water leakage can occur in both RO and UV water purifiers and can be caused by loose or damaged fittings, cracked or broken pipes, or a faulty valve. To fix this problem, you should check all the fittings and pipes for damage and tighten or replace them if necessary. If the valve is faulty, it may need to be replaced.
- Bad taste or odor: A bad taste or odor in the water can be caused by a clogged or exhausted carbon filter. To fix this problem, you should replace the carbon filter and flush the system to remove any residual carbon particles.

Most frequently occurring faults…

- No water flow: No water flow is a common problem in UV water purifiers, and it can be caused by a faulty UV lamp, a clogged pre-filter, or a malfunctioning pump. To fix this problem, you should check the UV lamp for damage and replace it if necessary. You should also check the pre-filter and replace it if it is clogged. If the pump is malfunctioning, it may need to be replaced.
- High TDS levels: High TDS (Total Dissolved Solids) levels in the purified water can be caused by a worn-out RO membrane, a clogged pre-filter, or a malfunctioning pump. To fix this problem, you should check the RO membrane for wear and tear and replace it if necessary. You should also check the pre-filter and replace it if it is clogged. If the pump is malfunctioning, it may need to be replaced.

Motor is used in RO and the working of it

- A water purifier, specifically an RO (Reverse Osmosis) water purifier, requires a motor to drive the pump that pushes the water through the RO membrane. The most commonly used motor in an RO water purifier is an electric motor.
- The electric motor used in an RO water purifier typically operates on AC (alternating current) or DC (direct current) power supply, depending on the design of the water purifier. The motor is usually a fractional horsepower (less than one horsepower) and operates at a low speed, usually around 3000 RPM (revolutions per minute).

Motor is used in RO…

- The motor drives a high-pressure pump that creates the necessary pressure to push the water through the RO membrane. The pump also helps maintain a constant flow rate of water through the membrane. The motor and pump work together to ensure that the water is pushed through the RO membrane at a constant rate and at the required pressure.
- **In summary,** an electric motor is typically used in an RO water purifier to drive the high-pressure pump that pushes the water through the RO membrane. The motor operates on AC or DC power supply and is designed to operate at a low speed to ensure a constant flow rate and pressure of water through the membrane.

Principle of Immersion heater

- An immersion heater is an electrical device used to heat liquids by immersing a heating element directly into the fluid. It consists of a heating element, a thermostat, and a protective cover or sheath.
- The principal of an immersion heater is based on Joule heating.
- When an electric current flows through a resistance, it generates heat.
- In an immersion heater, a heating element made of a high-resistance material, such as nichrome wire, is submerged in the liquid to be heated. When an electric current is passed through the heating element, it heats up and transfers the heat to the liquid.

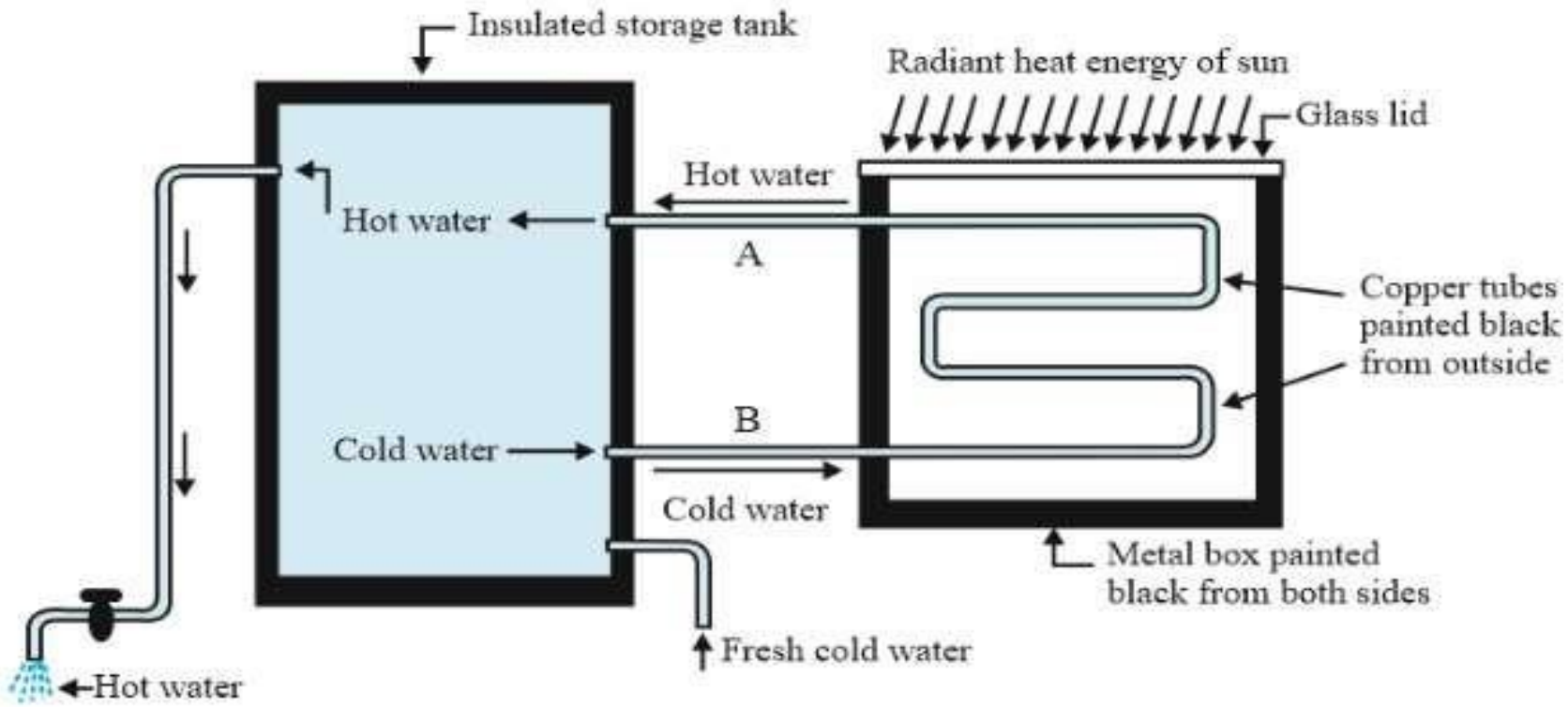
Parts of Immersion heater

- The heating element is the most important part of an immersion heater. It is made of a high-resistance material that can withstand the high temperatures and corrosive environments often found in industrial processes. The most commonly used material for heating elements is nichrome wire, which is an alloy of nickel and chromium.
- Another important part of an immersion heater is the thermostat. It is used to control the temperature of the liquid being heated.
- The thermostat is usually located outside the heating element and is connected to it by a capillary tube. When the temperature of the liquid reaches the desired level, the thermostat switches off the current to the heating element to prevent overheating.

Parts of Immersion heater…..

- Insulation is also an important part of an immersion heater.
- It is used to prevent heat loss from the heating element to the surrounding environment. The insulation material is usually a high-temperature-resistant material, such as ceramic or mica.
- It is wrapped around the heating element to create a barrier that reduces heat loss and ensures efficient heating.

Solar Water Heater



Induction cook top: Working Principle

- Induction cooktops work by using an electromagnetic field to heat up the cookware directly, rather than using a flame or electric coil to transfer heat indirectly. Here's how it works:
- The induction cooktop has a coil of copper wire underneath the cooking surface. When electricity flows through this coil, it creates an electromagnetic field.
- When you place a pot or pan made of a magnetic material (such as cast iron or stainless steel) on the cooking surface, the electromagnetic field induces electrical currents in the cookware.

Working principle of Induction cook top

- These electrical currents generate heat directly in the cookware, causing it to heat up. The cookware then transfers this heat to the food inside it.
- The amount of heat generated can be controlled by adjusting the strength of the electromagnetic field with the cooktop's controls.
- One of the advantages of induction cooking is that it is very energy-efficient, since almost all of the heat generated goes directly into the cookware rather than being lost to the surrounding air.
- It also allows for very precise temperature control, since changes in the electromagnetic field can be made very quickly.

Different features of induction cook top

- Energy efficiency: Induction cooktops are more energy efficient compared to gas or electric cooktops. They transfer almost 90% of the heat generated directly to the cookware, reducing cooking times and energy consumption.
- Precise temperature control: Induction cooktops allow for precise temperature control with digital controls, giving you greater control over cooking temperatures and allowing you to cook food more evenly.

Different features of induction cook top…

- Safety: Induction cooktops are safe to use because they don't use an open flame or exposed heating element, and they automatically shut off when cookware is removed from the cooking surface.
- Easy to clean: Induction cooktops have a smooth, flat surface that is easy to clean and doesn't accumulate grease and grime.
- Rapid heating: Induction cooktops heat up quickly and can boil water faster than gas or electric cooktops.

Types of induction tubes

- There are two main types of induction tubes used in induction cooktops:
- Copper Coil Induction Tube: This type of induction tube is made up of a copper coil that is placed underneath the cooking surface. When electricity flows through the coil, it creates an electromagnetic field that heats up the cookware placed on top of the cooking surface.
- Flat Spiral Induction Tube: This type of induction tube consists of a flat spiral-shaped coil that is placed directly underneath the glass ceramic cooking surface. When electricity flows through the coil, it generates an electromagnetic field that heats up the cookware placed on top of the cooking surface. Flat spiral induction tubes are more efficient than copper coil induction tubes and are commonly used in higher-end induction cooktops.

Different components of induction cooktop?

- Power supply: This component converts the incoming AC power to high-frequency AC power.
- Control board: This component manages the user interface and controls the frequency and power output of the induction cooktop.
- Induction coil: This component generates the magnetic field that heats up the cookware.
- Glass-ceramic cooking surface: This is the flat surface on which the cookware is placed.
- Temperature sensors: These sensors monitor the temperature of the cookware and the cooking surface.
- Fan: This component is responsible for cooling the internal components of the induction cooktop.

Fault identification in induction cooktop:

- Check for power supply issues: The first step in fault identification is to check if the induction cooktop is receiving power. Check the power cord, plug, and outlet for any issues.
- Check the control board: If the cooktop is receiving power, the next step is to check the control board for any issues. Check for any damaged or malfunctioning components, such as capacitors or diodes.
- Check the induction coil: If the control board is working correctly, the next step is to check the induction coil for any issues. Check for any damaged or broken wires, or any other signs of damage.
- Check temperature sensors: If the induction coil is working correctly, the next step is to check the temperature sensors for any issues. Check if they are working correctly and if they are properly connected.

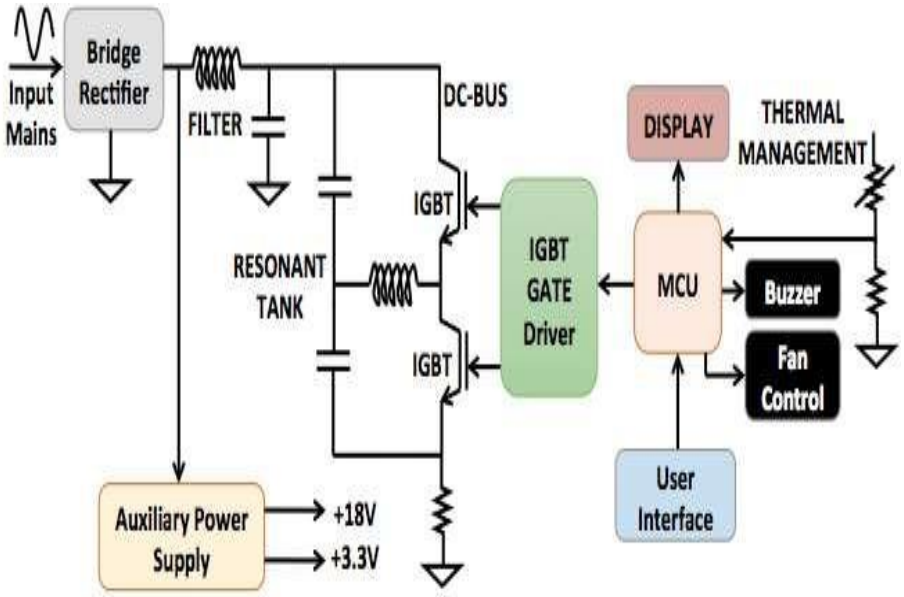
Heat sinking in induction cooktop

- Heat sinking is a process by which heat generated by the components of an induction cooktop is dissipated to prevent overheating.
- The following components need to be heat sinked in an induction cooktop:
- Power supply: The power supply generates heat during operation and needs to be heat sinked to prevent overheating.
- Control board: The control board also generates heat during operation and needs to be heat sinked.
- Induction coil: The induction coil generates heat during operation and needs to be heat sinked to prevent overheating.
- Temperature sensors: The temperature sensors also generate heat during operation and need to be heat sinked.

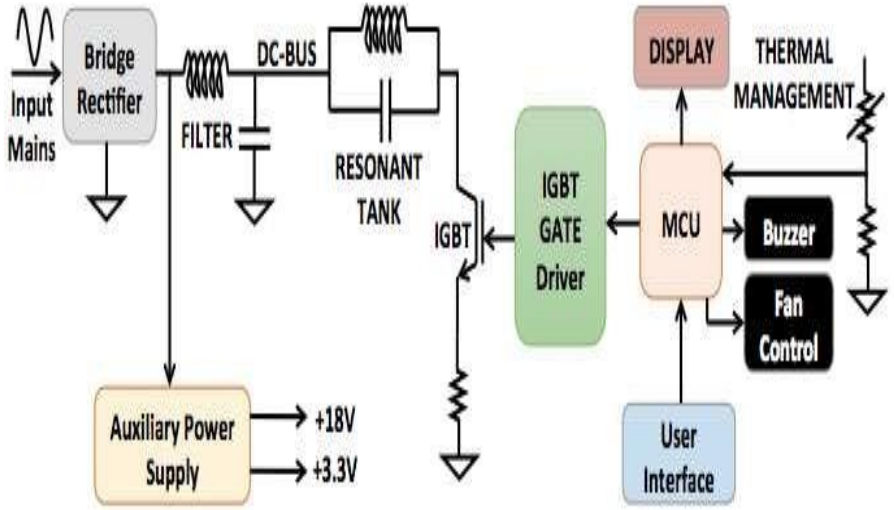
Heat sinking in induction cooktop…

- To dissipate heat from these components, an induction cooktop may use a combination of heat sinks, thermal pads, and fans.
- Heat sinks are typically made of aluminum or copper and are designed to absorb and dissipate heat.
- Thermal pads are used to transfer heat from one component to another,
- while fans are used to circulate air and dissipate heat from the cooktop.

Block Diagrams of Induction Cook Top



Block diagram – quasi resonant induction cooktop



Block diagram – half bridge resonant induction cooktop