LESSON 8

Motor appliances

15PBG

LEARNING OBJECTIVES

The objective of this lesson is to know about the electric motor, components, types, operation, winding, its type and appliances such as fan, washing machine, and water pump. Also to know about the advantages, disadvantages, faults, reasons and its remedial measures.

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8.1 MOTOR - INTRODUCTION

A motor is an electro-mechanical device (Fig 8.1). It converts electrical energy into mechanical energy. Motors are designed to produce rotary or linear motion when their electric current and magnetic field interact with each other which is commonly known as electromagnetic interaction. The cross-section of the motor is shown in fig 8.2.

Electrical energy → Motor → Mechanical energy

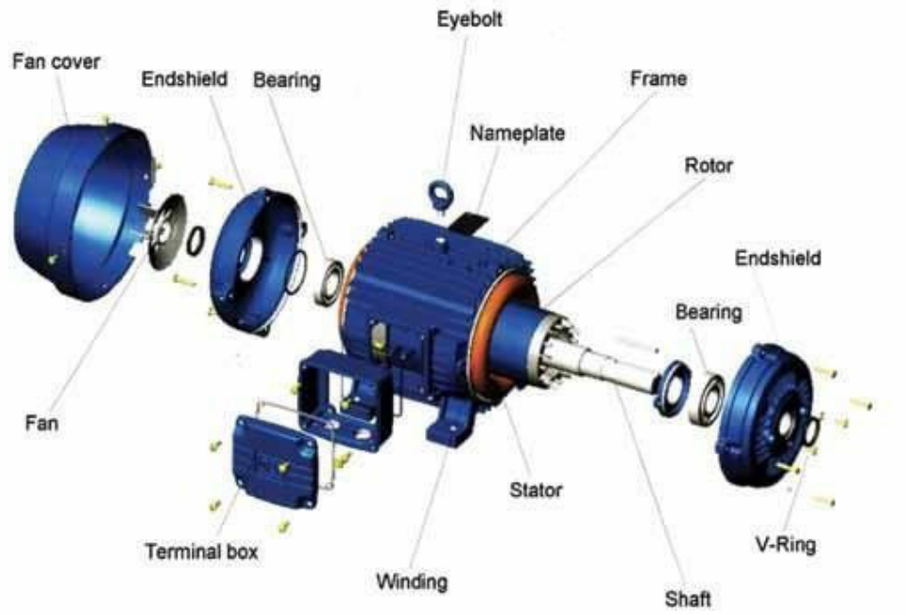


Fig 8.1 *Internal construction of a motor*

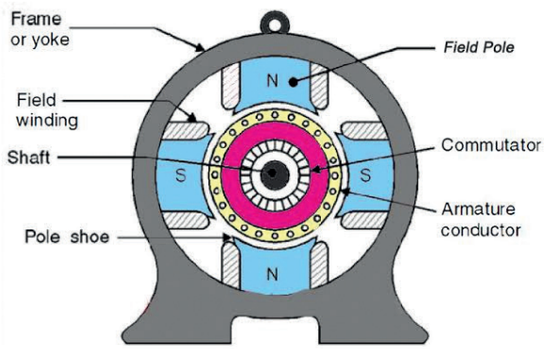


Fig 8.2 *Cross section of a motor*

8.2 PARTS OF MOTOR

The important parts of moter are

1. Field and field winding
2. Armature and Armature winding
3. Yoke
4. Teeth
5. Slot insulation
6. Brushes
7. Shaft

1. Field and field winding

A Field coil is an electromagnet used to generate the required magnetic field. It is fixed in the stator.

2. Armature and Armature winding

Armature is the rotating part of the motor. In the armature, the conductors are housed within the armature slots. The windings are arranged in the armature slots to produced electric field.

3. Yoke

The Yoke of the motor is made up of cast iron or steel. It is an integral part of the stator or the static part of the motor. Its main function is to form a protective covering which covers the inner parts of the motor and provide support to the armature.

4. Magnetic poles

The north-seeking pole of a magnet is called a north magnetic pole. The south-seeking pole is called a south magnetic pole.

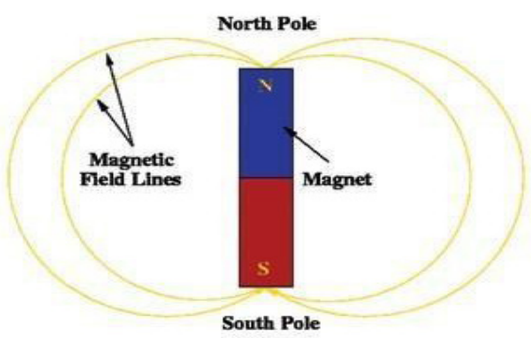


Fig 8.3 *Magnetic poles*

5. Slot insulation

The conductors are housed in the slots provided in the motor.

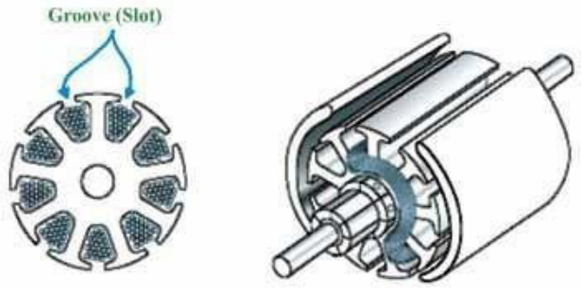


Fig 8.4 *Slot insulation*

6. Brushes

A carbon brush is a device above the commutator placed in a shaft that carrying current between wires and moving parts. Typical applications include alternators, dc motors, and generators.

Fig 8.5 *Carbon brushes*

7. Shaft

A shaft is a rotating part of the machine, usually circular in shape, which is used to transmit mechanical power from one part to another.

Fig 8.6 *Shaft*

8.3 TYPES OF MOTOR

Generally, there are two types of motors. They are

- AC motors
- DC motors
- Special elecric motors

AC Motors

AC motors run in AC supply. Alternating current motors can be further classified into two types. They are

1. Synchronous AC motors
2. Asynchronous AC motors – It can be subdivided into single phase and three phase

DC motors:

DC motors run in DC supply.

Special elecric motors:

The motor runs for specific applications are called as special electric motors

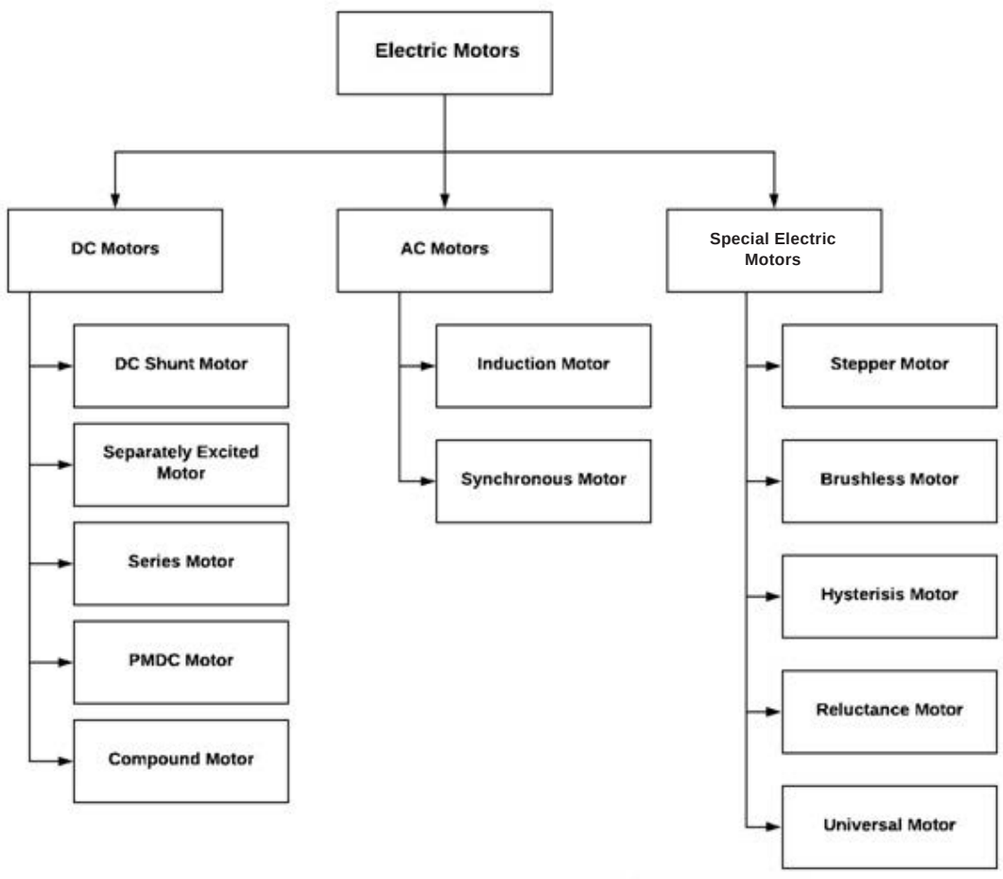


Fig 8.7 *Types of motor*

8.4 WORKING PRINCIPLE OF MOTOR

An electric motor is an electrical machine that converts electrical energy into mechanical energy. The basic working principle of a motor is "whenever a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force". A current-carrying conductor is placed perpendicular to the magnetic field so that it experiences a force.

The direction of this force is given by Flemings left-hand rule and its magnitude is given by,

$$F = BIl \text{ (Newton)}$$

Here,

F- Force, B - Magnetic flux density, I - Current, l - Length of the conductor

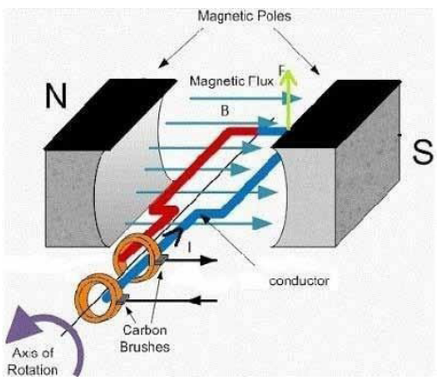


Fig 8.8 *Motor*

Advantages of motor

- Low power demand on start.
- Controlled acceleration.
- Adjustable operational speed.
- Controlled starting current.

Disadvantages of motor

Humming noise is also a very big problem.

Applications of motor

- Drilling machine
- Water pumps
- Grain
- Hoist
- Washing machine

8.5 RPM OF MOTOR

RPM is a measurement used to describe a motor's speed. It stands for revolutions per minute and describes the rate at which the rotor is revolving, which is the number of times the rotor shaft completes a full rotation each minute.

The device used to measure revolution per minute of motor

1. Analog tachometer
2. Digital tachometer

1. Analog tachometer

Analog tachometer is electronic instrument to know the revolution for a time period – revolution per minute (RPM).

Fig 8.9 *Analog tachometer*

2. Digital tachometer

Digital tachometers are relatively straightforward meters that measure the rotational speed of motors and machinery in a digital display.

Fig 8.10 *Digital tachometer*

8.6 WINDING

A conducting material wounded or coiled about an object in order to produce electro magnetic flux is called winding.

Types of winding

1. Lap winding
2. Wave winding

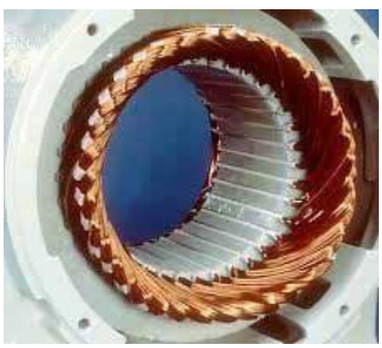


Fig 8.11 *Winding*

1. Lap winding

In lap winding, the conductors are joined in a way that their parallel paths and poles are equal in number. The end of each armature coil (coil 1 and coil 2) is connected to the adjacent segment on the commutator as shown in fig 8.12

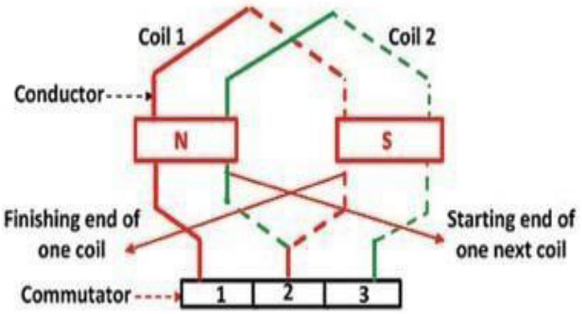


Fig 8.12 *Lap winding*

The lap winding is mainly used in low-voltage, high-current machine applications.

2. Wave winding

In wave winding, only two parallel paths are provided between the positive and negative brushes. An armature winding in which two coils are connected in series and follow each other on the surface of the armature like a wave shape is assumed as shown in the fig 8.13

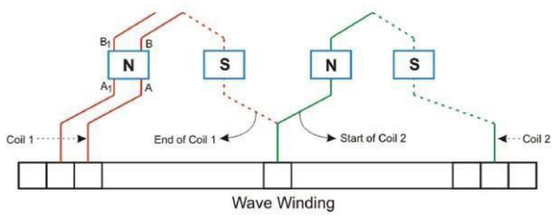


Fig 8.13 *Wave winding*

In this winding, the conductors are connected to two parallel paths irrespective of the number of poles of the machine.

The wave winding is mainly used in high voltage, low current machines.

8.7 ELECTRIC FAN

For domestic and industry applications, electric motors based fans are used. The normal electric fan are classified according to the usage as follows:

1. Ceiling fan
2. Table fan and
3. Exhaust fan

1. Ceiling fan

This type of electric fan is fixed in the ceiling of the roof as shown in fig. 8.14, and operates in AC supply. The energy conversion is from electrical to mechanical energy and gives cool air inside the room.

Fig. 8.14 *Ceiling fan*

The parts of the ceiling fan are

i) Stator
ii) Rotor
iii) Blades
iv) Bearings
v) Down rod

i) Stator

The stator is provided with insulated silicon steel plate as shown in fig. 8.15 Both the starting and running coils are wounded with 90^0 electric degrees.

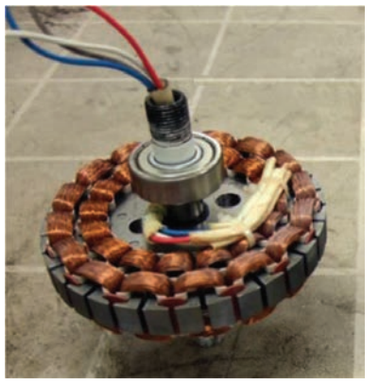


Fig. 8.15 *Stator*

ii) Rotor

Fig. 8.16 *Rotor*

The rotating part of the squirrel cage rotor type is as shown in fig. 8.16 Only in ceiling fan stator is kept inside and rotor is in outside of the fan.

iii) Blade

The blades are made of a steel plate or aluminum plate, as shown in fig. 8.17, and are usually fixed with three or four blades. The blades cover the stator and rotor of the end plates.

Fig. 8.17 *Blade*

iv) Bearing

The bearings are placed on the top and bottom of the fan, used to reduce friction in rotating parts and also to reduce the noise while in motion.

Fig. 8.18 *Bearing*

v) Down rod

The down rod is made up of hard steel, according to the length required. One side of rod is fitted in ceiling hook, and the other side is fitted to the fan.

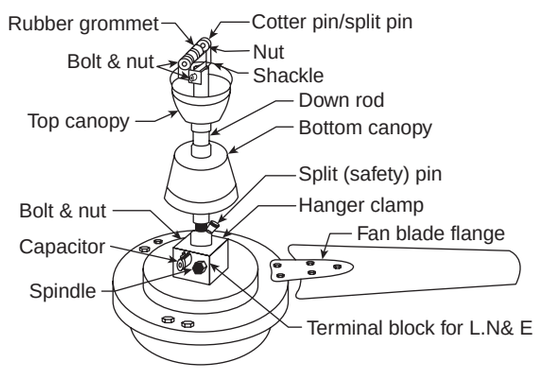


Fig. 8.19 *Structure of the fan*

Working principle of Celling fan

Fig 8.19 shows the structure of an electric fan. When an electric supply is given to the fan, the current passes to main and auxiliary winding and produce rotating magnetic field. The 2.5 micro farad capacitor is connected in series with the auxiliary winding. Due to the production of rotating magnetic field, the blades connected with the rotor rotate and air flow will be circulated to the area where required. Usually the blades are available in various sizes like 900 mm, 1050 mm, 1200 mm, and 1400 mm respectively.

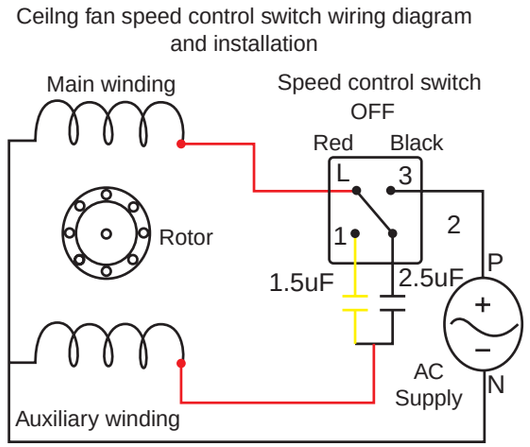


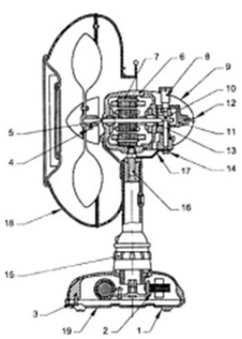
Fig. 8.20 *Circuit diagram*

Fan regulator

Fan regulator is used to control the speed of the fan. Its structure is shown in fig. 8.21. It is connected in series connection with an electric supply. It is connected between supply and fan.

Fig. 8.21 *Fan regulator*

2. Table fan



1. Rubber Feet
2. Regulator Choke
3. Capacitor
4. Blade Bush Fixing Screw
5. Spindle
6. Front Cover
7. Stator
8. Oscillator Knob
9. Back Cover
10. Vertical Spindle
11. Gear Box
12. Back Cover Fixing Screw
13. Bush Bearing
14. Link Fixing Screw
15. Switch
16. Pivot Pin
17. Crank Lever
18. Wire Guard
19. Bottom Cover

Fig. 8.22 *Table fan*

This type of fan is portable and can be used at any place where we required. In this, single phase permanent capacitor motor is used. Table fan is available in various colours as shown in fig. 8.22. Table fans are also available in various types like pedestal type, wall fitting type etc.,

The parts of the table fan are

i) Stator
ii) Rotor
iii) Blades
iv) Bearings
v) Oscillating mechanism

Note: The above parts descriptions are similar to ceiling fan and exhaust fan. (Except oscillating mechanism)

Working principle

When an electric supply is given to the fan, the current passes to the main winding and secondary winding and produces rotating magnetic field. Due to the production of rotating magnetic field, the blades connected with the rotor rotate and air flow will be circulated. Usually the blades are available in various sizes from 100 mm to 400 mm.

3. Exhaust fan

Fig. 8.23 *Exhaust fan*

The exhaust fan is as shown in figure 8.23, is used to exhaust the unwanted air present inside rooms, cinema theatres, marriage halls, factories, homes, industries, kitchens and toilets.

Working principle

Its structure is similar to that of table fan. Capacitor is not used in this type. This fan exhausts heats produced during the summer season, creating low pressure inside of the room and causes cool air to enter in. The sweep of the fans are available from 230 mm to 380 mm.

8.8 ELECTRIC WASHING MACHINE

Electric washing machines are used in houses in large number. We use washing machine for washing and drying of clothes.

Types

i) Semi-automatic washing machine
ii) Automatic washing machine
   a. Top load washing machine
   b. Front load washing machine

8.8.1 Semi automatic washing machine

a) Construction

Semi-automatic type of washing machine is for washing the clothes and is shown in fig. 8.24. This appliance is controlled by timer which control and regulate the time of washing according to the type of cloths and also dries the cloth after washing.

Fig. 8.24 *Semi automatic washing machine*

Capacitor start induction motor is used in this type of washing machine. The speed of the washing cylindrical container is proportional to the rotating speed of the mounting vessel. The clothes were washed in the method of wave up mode.

b) Working principle

After putting the dirty clothes inside the washing machine, soap powder is put into it, proportionate to the clothes to be washed, and water inlet tape is allowed to flow the water inside the container. The agitator rotates right and left and the dirts in the clothes are removed. Then the dirty water is removed through the outlet spout pipe. After the dirty water fully went out, the fresh water re enters and rinses the washed clothes to make clean. The drier then squeezes the water in the

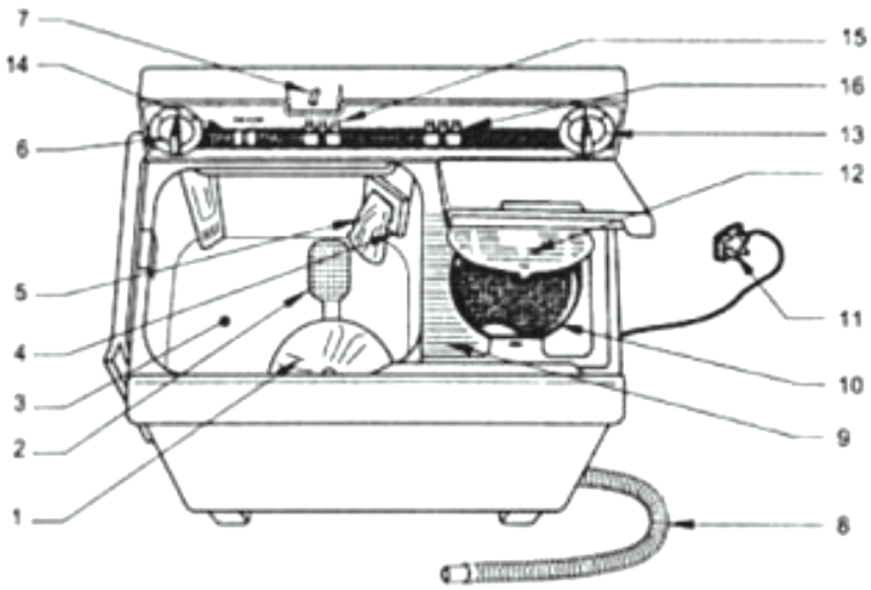


Fig. 8.25 *Internal contruction*

1. Agitator
2. Water filter
3. Washing cylinder
4. Water level selector
5. Cotton filter
6. Washing time control
7. Water inlet pipe
8. Vent pipe
9. Purifier
10. Rotating cylinder
11. Three pin plug
12. Squeezing cylinder lid
13. Squeezing time control
14. Agitator terminal junction
15. Water control tap
16. Water controling knob

washed clothes and make dry. This type of appliance is said to be as semi-automatic washing machine as shown in fig. 8.25. In this, the motor rotates and rinses the clothes with water and makes clean.

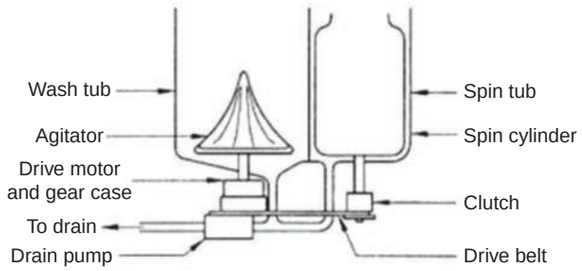


Fig. 8.26 *Construction diagram*

8.8.2 Automatic washing machine

The automatic washing machine is of two types.

1. Top load (open) washing machine.
2. Front load (open) washing machine.

1) Top load washing machine

a) *Construction*

In this type, washing machine, contains a single drum which is used for both washing and drying the clothes. A capacitor start induction motor is used in this washing machine. Water inlet and outlet pipes are connected for the water flow to go in and out.

Fig. 8.27 *Top load washing machine*

b) Water inlet tube time control

In this type of washing machine, a controlling device is mounted. The machine is automatically operated with the washing machine and the water is inserted into the inlet tube.

c) Water outlet tube time control

It works in two ways.

1. Drip out the washed dirty water
2. It is also used to squeeze and remove water from the cloth.

d) Water tank

This washing machine has two tanks.

1. Inner tank
2. Outer tank

Water tanks are made up of steel sheet coated with zinc to prevent corrosion inside the tank. Put the clothes in the inner tub and washing machine perform the tasks like washing, rinsing and squeezing. The inner tank contains small holes in this pot which is used for removal of dirty water. The outer tank is made up of steel and painted to protect from corrosion. In between inner and outer tank, Glass wool is provided in order to protect the hotness from the inner tank, and protect from chillness not to affect the inner tank.

e) Agitator

The agitator is a roller shaped hard plastic and is placed in the middle of the inner tank. The knife edge part of agitator makes the cloths to rotate it, in front and back with soap mixed water. This removes the dirty in the clothes.

f) Electric motor

The fractional horse power motor is used in washing machine. When the supply is given, the agitator rotates along with motor with the setting position according to the quantity of the cloth. Single phase 230-volt, 50 Hz supply is given to this motor.

g) Circuit board

The circuit board combines various electronic components. The mechanism of the machine will be set in advance according to the size and type of fabric used in the washing machine. This circuit determines the duration of washing the clothes, quantity of water, detergent quantity and time duration.

Working principle

The motor is operated by a time control device and it automatically divides all the works. This technique is called neuro muscular technology and works in the micro operating system. This method of functioning depends upon the type of clothes used and its dirty.

In this, clothes to be washed along with soap powder are put in the inner container of the washing machine. Dirty clothes are rotated up and down with soap powder by water. This process takes place for a fixed time duration.

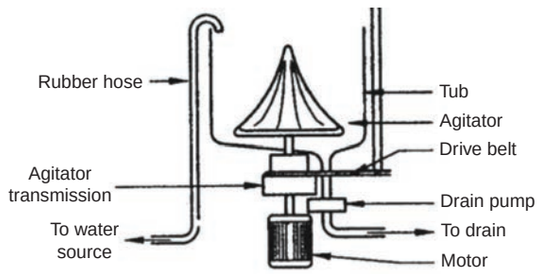


Fig. 8.28 *Agitator*

The inner tub of the washing machine has many holes. Water is sucked out to the outer tub from the inner container by centrifugal force. Water is drained out from the outer tub through a drain vent pipe. When the dirty water is drained out, fresh water is filled into the inner tub again. Agitator rinses the clothes. In this process the chemicals present in the soap are removed. After this process is completed, water in the machine is again drained out through the outer pipe.

After water is drained, the clothes kept in the container are rotated at a high speed and the water in the clothes is removed by the centrifugal force. After this cycle takes place for a certain period of time, the excess water in the clothes are squeezed out with the help of a time controlling device. Now the clothes are washed and are ready to be dried.

2) Front loading washing machine

Fig. 8.29 *Front load washing machine*

The structure and functioning of front loading washing machine are similar to that of top loading washing machine.

A cylindrical type of vessel is used in the front loading washing machine instead of the agitator in the upper loading washing machine. With the help of a roller-shaped container, the cylinder spins. As this event

continues, the clothes are well washed in soapy water.

The impeller is fixed in the cylindrical vessel inside a front loading washing machine. This cylinder vessel is in horizontal position. The impeller fixed to this rotating vessel mixes detergent with water and rubs the clothes together to remove the dirt.

In some types of front loading washing machine, a heating element is placed on the bottom of the pipe to get warm water. Washing the clothes with warm water cleans the clothes quickly.

8.9 ELECTRIC PUMP

Electric pump is used to suck water from underground to tank. When the motor is turned on, due to the vacuum created by the centrifugal force, water is sucked out to a required place. A single phase motor is sufficient for domestic level, since 2000 to 5000 litres of water per day is required.

Based on the structure, the various types of pumps are given below:

1. Centrifugal pump
2. Jet pump
3. Submersible water pump
4. Air compressor

8.9.1 Centrifugal pump

The centrifugal pump is a simple electric motor appliance as in fig. 8.30. Normally, 0.5 to 3 horse power single phase capacitor start induction motor is used in centrifugal pump. By using centrifugal force, water is sucked and delivered. This is called a centrifugal pump.

Parts of a centrifugal pump

i) Basement plate
ii) Water pump box
iii) Impeller
iv) Shaft
v) Rope and box
vi) Bearings

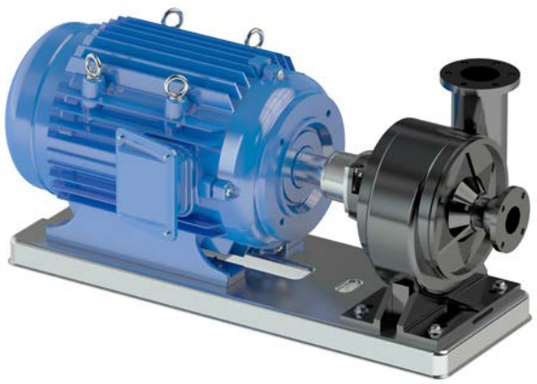


Fig. 8.30 *Centrifugal pump*

i) Basement plate

The basement plate is made up of cast iron or hard steel metal. It is fitted over the base plate with bolts and nuts.

ii) Water pump box

This is usually made up of close-grained cast iron. The vertical plane at the centre of the casing is split into two halves with flanges tightened together by bolts and nuts with gasket for leak proof.

iii) Impeller

Impeller is a rotating part of mechanism made up of cast iron or steel

metal in centrifugal pump as shown in fig. 8.31. By centrifugal force the water is delivered with uniform pressure without any vibration.

Fig. 8.31 *Impeller*

Types

1. Open type impeller.
2. Closed type impeller.

iv) Shaft

It is made of stainless steel, to avoid rusts in the shaft while using salty water. The portion of the shaft which works inside the casing is usually fitted with gun-metal sleeve and hence no chance of depreciation will occur. The gun metal sleeve can be replaced when it gets worn out, and it increases the life span of the shaft.

v) Rope and box

The main purpose of the rope and box is,

i) to prevent leakage of air on the suction side.
ii) to prevent leakage of water on the delivery side due to pressure.

The packing material consists of rings of soft cotton, woven yarn, impregnated with graphite and tallow. The gland bolts should only be tightened lightly, to prevent leakage.

Modern pumps are fitted with mechanical leak-proof seals. Basically it is made up of softer materials like rubber, leather or plastic with nice finishing. It keeps cool with the water inside the pump. Otherwise it causes friction in the shaft and gets heated. This makes the pump function to get stop. It is very important that a centrifugal pump should not be allowed to run without water.

Fig. 8.32 *Internal system*

vi) Bearing

Ball, roller and bush bearings are often used. Usually ball and roller bearings are lubricated with oil and grease.

a) Working principle of centrifugal pump

The impeller starts rotating after the pump is filled with water and is run by a generator or a steam engine as shown in fig. 8.33. When the impeller rotates, due to the centrifugal force, low pressure will be produced. Due to the low pressure, water is sucked in.

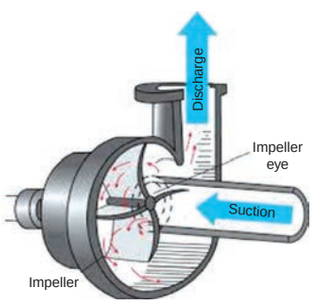


Fig. 8.33 *Internal section view*

The impeller converts the mechanical power into rotating force. Due to conversion of rotating force into pressure force, the water is delivered with the help of water pump box. The amount of energy on the surface of the water is directly proportional to the velocity of the impeller.

If the speed and size of the impeller is high, the force produced in the water will be high. When the water delivers from impeller, primarily it creates friction in the pump box. Secondly, the speed of water is converted into pressure force due to the friction produced in the delivery side. Hence, the pressure of the water is equivalent to the speed of rotation by the impeller.

a) Friction power

When the water passes through the pipe, it creates friction inside the pipe. The friction produced inside the pipe will be according to the speed of the water. Due to this, more power is required to pump the water up. Because of friction produced inside the water pipe, power loss is occurred. The power used to compensate this is called as friction force. It will be good, if the length of the suction pipe is less. The flow of water in higher diameter produces less friction.

b) Suction power

Suction conditions are some of the factors which affect the centrifugal pump operation. A pump cannot pull or "suck" water up into suction pipe, because water does not have tensile strength. When a pump creates suction, it is simply reducing local pressure by creating a partial vacuum (Sucks out the air above the water). External pressure acting on the surface of the liquid pushes the liquid up the suction pipe into the pump.

i) Static suction head

The static suction head refers to the vertical height of the water absorbed in well or the horizontal center at the water pump from the water level of the underground tank. Suction head does not depend upon the length of the pipe. It is from the water level to the pump centre and not from the foot valve or the bottom of the well.

ii) Static delivery head

The static delivery head indicates the vertical height from the horizontal line of the water to the water delivered to the water tank. This does not indicate the length of the delivery pipe.

iii) Priming

When the suction pipe and pump is filled with water, the air inside the pipe should be removed. This method is said to be priming. Before starting the pump, ensure that the pipe and pump is filled with water. The centrifugal pump should not run without water.

Friction occurs when the shaft is rotated. The water is used as a cooling agent to reduce the heat.

If the pump runs without water, the excess heat will be produced and the rotor will burn and cause damage. Therefore, the pump does not run without water in the suction pipe.

8.9.2 Jet Pump

Jet pumps are used to draw water from a well through a suction pipe in order to provide potable water or domestic water

pressure. It is mounted above ground and are non-submersible and more popular in warmer climates or areas with high water tables.

Fig. 8.34 *Jet pump*

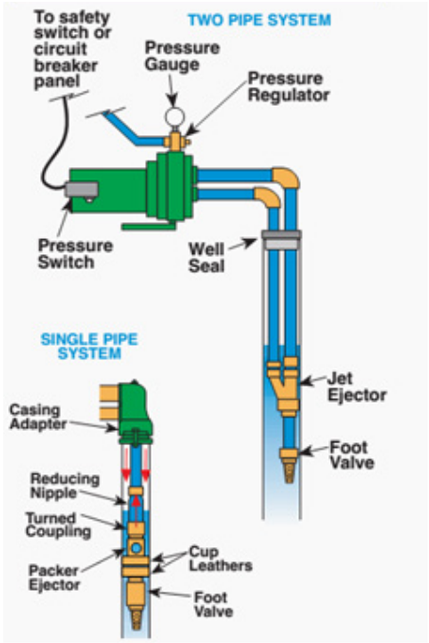


Fig. 8.35 *Fitting of Jet pump*

Other common applications include light commercial or residential irrigation and supplying water for sprinkler systems.

Jet pumps come in two variations: deep well and shallow well. The type of jet pump most suitable for your application will be dependent on the depth of your well. Shallow well jet pumps are used to transport water from wells as deep as 25 feet. Deep well jet pumps are generally used for depths up to about 200 feet. Deep well jet pumps can move larger volumes of water more quickly and over longer distances than shallow well pumps. Please note that altitude can affect the specific depth to which a pump can draw water from

8.9.3 Submersible pump

Fig. 8.36 *Submersible pump*

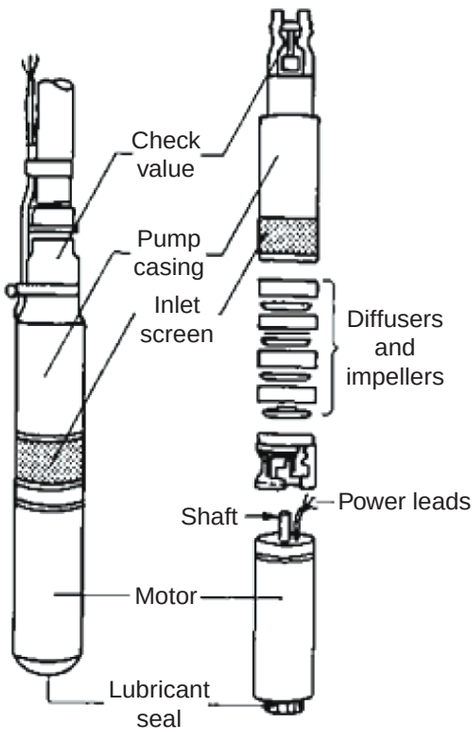


Fig. 8.37 *Inner system*

Fig. 8.36 and 8.37 shows the picture of the modern electric water pump. It consumes

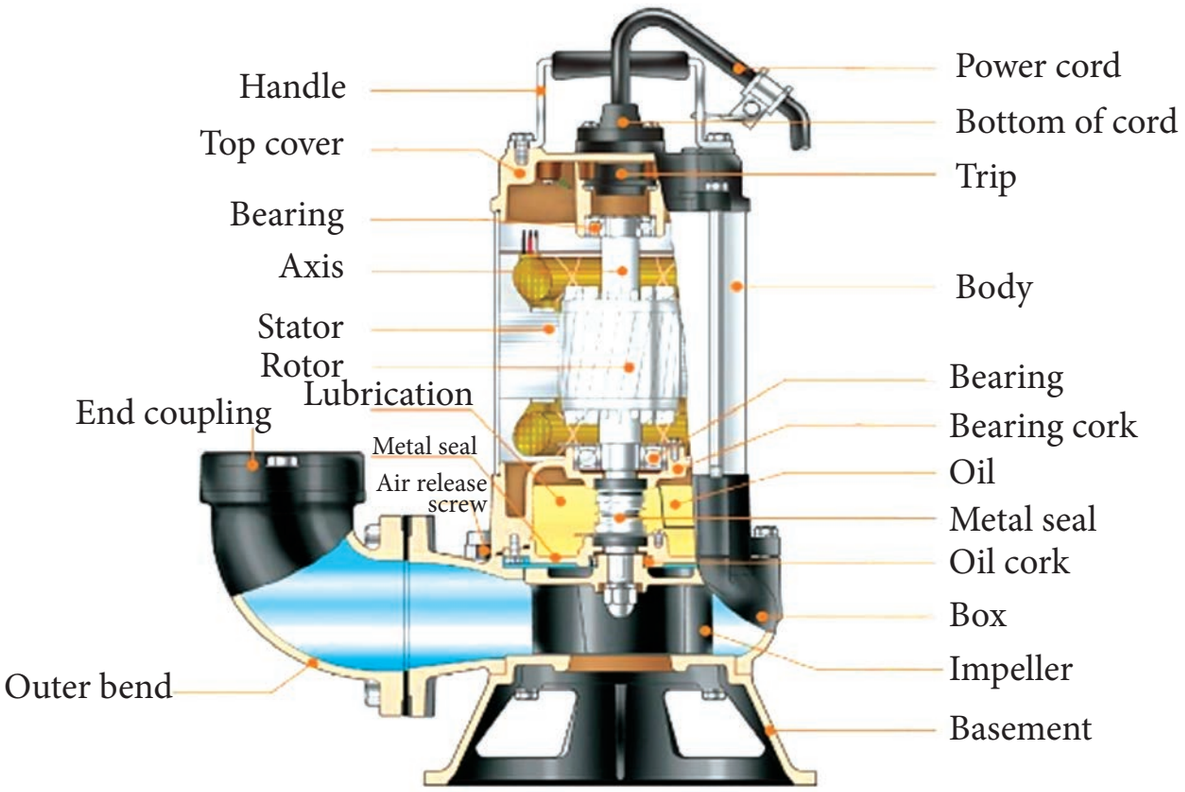


Fig. 8.39 *Internal structure of submersible pump*

less power and run smoothly without noise. This type of pump works to a level of water below 1000 feet. These types of pumps are commonly used in all places.

8.9.4 Air compressor

Fig. 8.38 *Air compressor*

The air compressor shown in fig. 8.38 is a water pump used in the bore well. It creates water bubbles when going into the foot valve with air pressure. It has slightly special features than jet pump. It is used to pump water up to 300 feet with a capacity of 2 HP. The 1.5 HP pumps can deliver water up to a level of 275 feet.

When the compressor pump is running, the noise will be slightly higher. When depreciation occurs in either shaft or bearing in the compressor, oil ring will get damaged and possibility of water gets mixed with oil. Hence, proper maintenance is essential.

8.9.5 Defects, causes and remedies of electric pump

Sl. No.	Defects	Causes	Remedies
1.	No movement in the pump.	1. Packing of the rope in the pump is tight. 2. The bearings are damaged. 3. No power supply.	1. Loose the tightened packing. 2. Check the bearing and lubrication or change the bearing. 3. Check whether the supply is live.
2	Pump is working. But water is not delivered.	1. No water in the suction pipe. 2. Delivery pipe valve is closed. 3. Water level is below foot valve.	1. The suction pipe must be filled with water. 2. Open the valve in the delivery pipe. 3. Increase the length of the suction pipe or increase the blow-up efficiency and set it below the water level.
3	Pump works on short time and deliver small quantity of water and then stopped.	1. Water leakage. Water level decreased in the suction pipe. 2. There is a defect in the electric motor and the starter.	1. Leakage in the water pipe is rectified. The pipe length in the suction area should be increased. 2. Test the circuit of the electric motor and starter with the help of test lamp.
4.	Excessive vibration and noise in the pump	1. Alignment is changed. 2. Loose fitting in connecting screws. 3. No lubrication in the bearing. 4. Shaft is slightly bent. 5. Block in the impeller and friction is in the box.	1. Check alignment. 2. Tight the screws. 3. Apply the grease on the bearing or change the bearing. 4. Change the shaft. 5. Clean the rusts in the impeller and check before to fit.
5	Cracks in the impeller	1. Cracks due to soil or hard objects. 2. Holes on the top of the impeller	1. Clean it and then fix it. 2. The holes should be closed with the washer.

GLOSSARY

Sweep	-	வீச்சு
Oscillation mechanism	-	அலைய வைக்கும் அமைப்பு
Exhaust fan		காற்றை வெளித்தள்ளும் மின்விசிறி
Semi – automatic type		குறைத் தானியங்கி வகை
Rinsing		அலசுதல்
Centrifugal pump		மையவிலக்கு நீரேற்றி

Shaft	-	சுழற்தண்டு
Impeller	-	துருத்தி
Priming	-	கிட்டித்தல்
Submersible motor	-	நீர் மூழ்கி மின்னோடி
Pump	-	நீரேற்றி

Q A

PART A

EBCM3

Mark 1

Choose the correct answer

1. Rotating diameter of the fan is called
   a) Fan connection
   b) Length of the fan
   c) Fan sweep
   d) Fan size

2. Which type of motor is used in the electric fan
   a) Permanent capacitor induction motor
   b) Capacitor start and capacitor run induction motor
   c) Shaded pole motor
   d) Universal motor

3. Which type of fan is used to release smokes and dust?
   a) Ceiling fan
   b) Table fan
   c) Pedestal fan
   d) Exhaust fan

4. Name the washing machine which contains agitator technique.
   a) Semi-automatic
   b) Automatic
   c) Top loading washing machine
   d) Front loading washing machine

5. In which function the soap powder is removed in the clothes?
   a) Washing function
   b) Rinsing function
   c) Dryer function
   d) Exhaust function

6. How many drums are in semi-automatic washing machine
   a) 1
   b) 2
   c) 1 or 2
   d) 3

7. Which part is used to produce centrifugal force?
   a) Scroll cover
   b) Blocking box
   c) Shaft
   d) Impeller

8. Impeller is made up of
   a) Galvanized steel.
   b) Brass.
   c) Cast iron or gun metal.
   d) Copper metal alloy.

9. Velocity imparted by the impeller to the water is converted to pressure by the
   a) Casing or volute
   b) Stuffing box
   c) Spindle
   d) Gland box

10. To ensure that the pump remains always primed it is necessary to have
   a) valve on delivery side should be open
   b) suction side should not be kept open
   c) foot valve is not leaking
   d) gland packing should not be leaking.

11. Pressure developed by the centrifugal pump is always specified in
   a) feet b) feet/min
   c) litres d) kg/cm^2

12. Static suction head and static delivery head is always represented by
   a) feet
   b) Kg/cm^2
   c) vertical height
   d) distance measured along the pipes

Q A PART B

Mark 3

Answer the questions in brief

1. Name the type of motor used in the ceiling fan and table fan.
2. List out the parts of a ceiling fan.
3. Define - sweep.
4. What are the types of fan?
5. What is the use of a regulator in an electric fan?
6. How the speed of the table fan can be changed.
7. What is the use of a capacitor in ceiling fan?
8. Name the two types of automatic washing machine.
9. What type of technology is used in semi-automatic washing machine?
10. Define - Agitator.
11. What type of force makes fluid's rotation in the centrifugal pump?
12. What is priming in centrifugal pump?
13. What happens when the pump is rotated in the opposite direction?
14. What is called the suction head?
15. What is called the delivery head?

Q A PART C

Mark 5

Answer the questions in one page

1. Explain briefly the construction of an electric motor used in electric fan.
2. Explain the oscillating mechanism of a table fan.
3. Explain the working principle of the exhaust fan and state its use.
4. What is the working principle of the rope in pump?
5. What is an impeller and write its type?
6. What is the functions of a impeller?
7. Briefly explain about friction power.

Q A PART D

Mark 10

Answer the questions in two page

1. Write short notes for the following in a ceiling fan.
   a) Bearing
   b) Down rod
   c) Regulator
2. Tabulate the common defects, causes and its remedies in the table fan.
3. Explain the construction and working principle of top loading washing machine.
4. With a neat sketch explain the construction and working principle of the semi-automatic washing machine.
5. Explain the construction and working principle of the centrifugal pump with neat diagram.

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