Chapter

4

Motor appliances

EGWV9

Do not be afraid of defeat.

Swami Vivekananda

Learning Objectives

Electric power supply is the most essential in our day to day life. In this lesson, we learn about the electric motor appliances such as fan, washing machine, and water pump. The main objectives of this lesson is to study about its construction, working principle, types, advantages, disadvantages, faults, reasons and its remedial measures.

Table of Content

4.1 Introduction

The electric fan, electric washing machine and pumps are essential in domestic for everyday life. In these appliances, electrical energy is converted into mechanical energy. Let us see the appliances in detail.

4.2 Electric fan

According to its utility, the electric fan is classified as,

i. Ceiling fan
ii. Table fan and
iii. Exhaust fan

4.2.1 Ceiling fan

This type of electric fan is fixed in the ceiling of the roof as shown in figure 4.1. In this, the energy conversion is from electrical to mechanical energy and gives cool air inside the room.

Fig. 4.1 **Ceiling fan**

The most important parts of the ceiling fan are

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

Construction

i. Stator

The stator is provided with insulated silicon steel plate as shown in figure 4.2. Both the starting and running coils are wounded with 90^0 electric degrees.

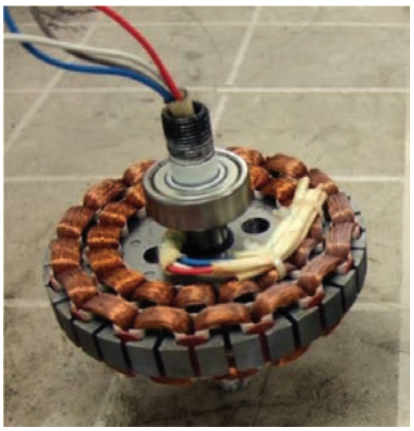


Fig. 4.2 **Stator**

ii. Rotor

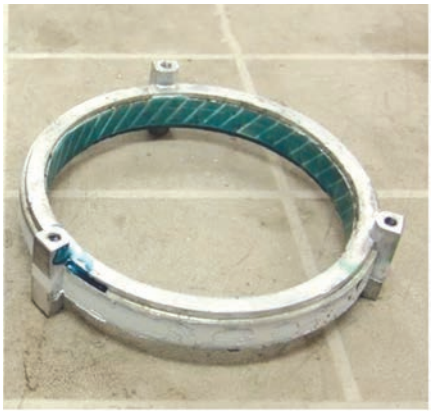


Fig. 4.3 **Rotor**

The rotating part of the squirrel cage rotor type is as shown in figure 4.3. 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 figure 4.4, and are usually fixed with three or four

blades. The blades cover the stator and rotor of the end plates.

Fig. 4.4 **Blade**

iv. Bearings

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. 4.5 **Bearing**

v. Down rod

The down rod is made up of hard steel, according to the length required.

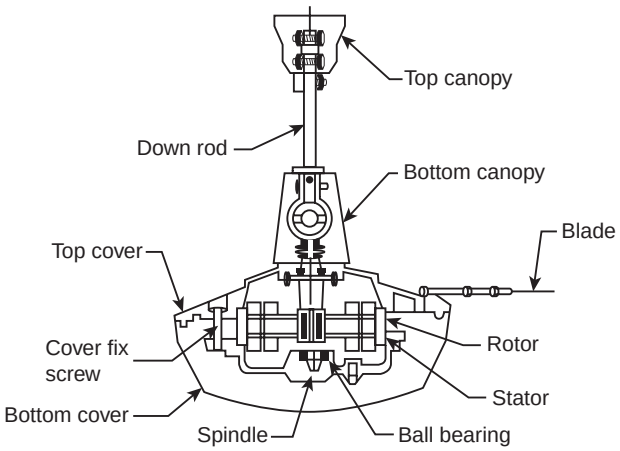


Fig. 4.6 **Internal structure of the fan**

One side of rod is fitted in ceiling hook, and the other side is fitted to the fan.

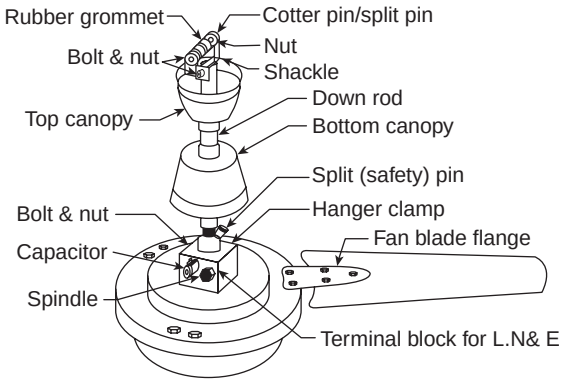


Fig. 4.7 **External structure of the fan**

a) Working principle

Figure 4.8 shows the internal structure of an electric fan. When an electric supply is given to the fan, the current passes to the main winding and auxiliary winding and produces 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.

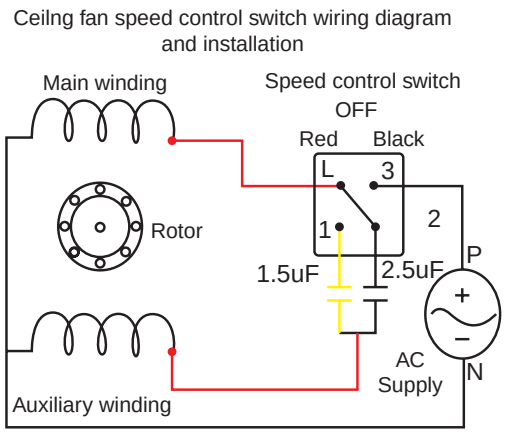


Fig. 4.8 **Circuit diagram**

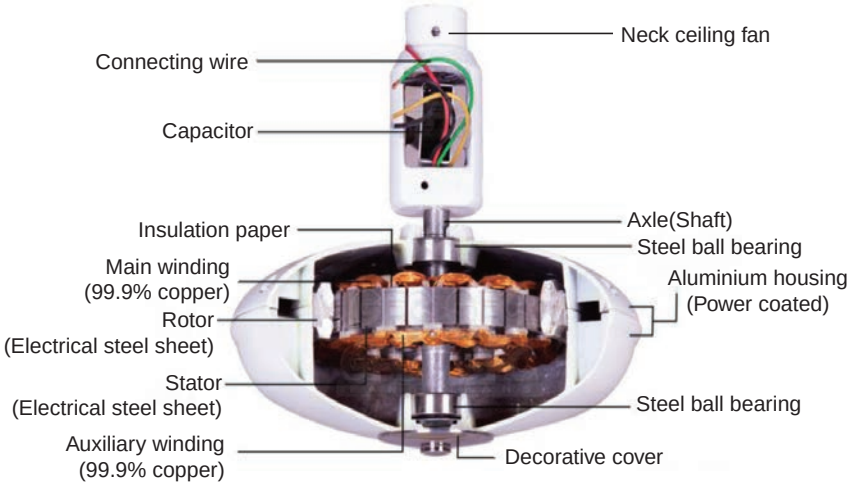


Fig. 4.9 Internal cross section of the fan

b) Ceiling fan regulator

Ceiling fan regulator is used to control the speed of the fan to a required position. Its structure is shown in figure 4.10. It is connected in series connection with an electric supply. Now a days electronic type regulator is used in advanced level.

Fig. 4.10 Ceiling fan regulator

4.2.2 Table fan

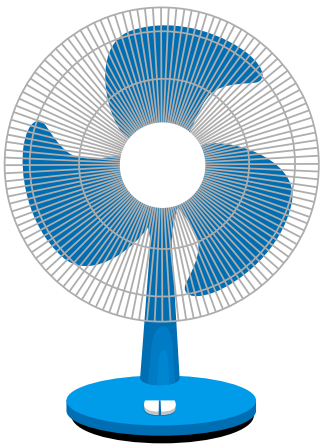


Fig. 4.11 Table fan

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 4.11. Table fans are also available in various types like pedestal type, wall fitting type etc.,

The most important parts of the table fan are

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

i. Stator

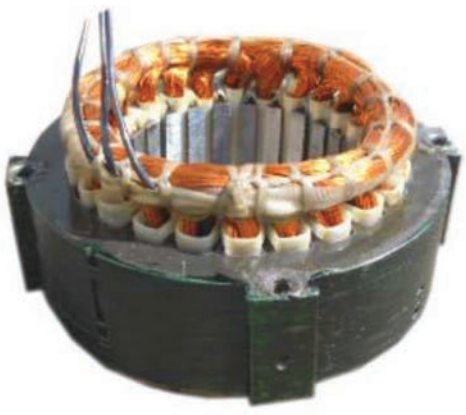


Fig. 4.12 Stator

The stator is made by the insulated silicon steel plate shown in figure 4.12. Both the primary and the secondary winding are fixed with a 90^0 electric angle.

ii. Rotor

Fig. 4.13 **Rotor**

The structure of a squirrel cage rotor is as shown in figure 4.13. This type of rotor is fixed inside the stator.

iii. Blades

Fig. 4.14 **blades**

The blades are made up of steel or aluminum sheet, as shown in figure 4.14. Usually three or four blades are fitted in this type of fan. The blades are fixed on the shaft with the help of screws.

iv. Sleeve bearing

Sleeve bearings are mounted on shaft of the fan. These bearings (as in figure 4.15) are used to reduce friction in rotating parts and reduce the sound while in rotation.

Fig. 4.15 **Sleeve bearing**

v. Oscillating mechanism

The oscillating mechanism is connected to the back of the electric motor shaft. The wrenching system is used to turn the left and right back into the side of the waist to a certain angle.

b) Speed regulator

The speed regulator used is of resistant type which is connected in series with the fan and required flow of air can be utilised.

c) Base of the fan

The bottom of the fan is made of steel iron. When an electric motor rotates, the base is fixed and stay in the same place, even the fan is in tilting movement.

d) 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. The 2.5 micro farad capacitor is connected in series with the secondary winding as in figure 4.16. Due to the production of rotating magnetic field, the blades connected with the rotor rotate and air flow will be circulated to the area and direction where it is fixed. Usually the

blades are available in various sizes from 100 mm to 400 mm. The revolution of the blade will be around 1000 RPM and are covered with plastic or metallic grill.

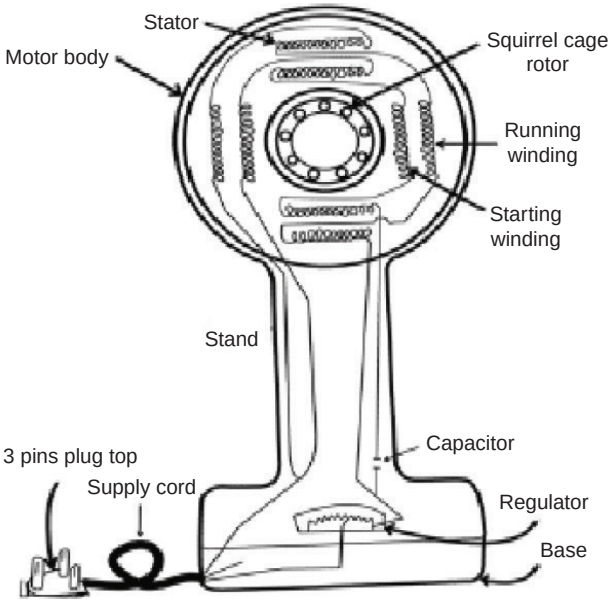


Fig. 4.16 **Table fan**

4.2.3 Exhaust fan

Fig. 4.17 **Exhaust fan**

The exhaust fan is as shown in figure 4.17, is used to exhaust the unwanted air present inside rooms, cinema theatres, marriage halls, factories, homes, industries, kitchens and toilets.

a) Construction

i. Stator

The stator is made up of a silicon steel plate and is small. Both the primary and secondary coils are located with 90^0 electric angles.

ii. Rotor

Squirrel cage type rotor is used in this exhaust type of fan.

iii. Blades

The blades are made up of a steel or aluminum sheet. It contains three or four blades. The blades are fixed on the shaft and fitted with screws.

b) 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.

Trouble shoot chart of an electric fan

Sl. No.	Reasons	Defects	Remedies
1.	The fan is not rotating	The connection may be loose or in open circuit.	Connections are tested with test lamp and open circuit in it is rectified.
		Open circuit or short circuit may be in the coils.	Check the coils with test lamp and change the coil, if necessary.
		Fault in capacitor	Change the capacitor.

2	Fan rotates in low speed.	Low voltage	Check the voltage.
		Fault in capacitor.	Change the new capacitor.
		Bearing is tight	Check the bearing and apply lubricants.
3	The fan is not rotating. If we rotate it, then only it runs.	Problems in starting coil	Replace or rewind the starting coil.
		Low voltage	Check the voltage, and then switch 'on'
		Due to the weakness of the capacitor.	Change the capacitor
4	More noise while rotating.	Worn out bearings.	Change and put new bearing
		The spacing gap of the bearing.	Spacing should be made right in bearing.
		Blade ia not fitted properly	Connect the blades properly.

4.3 Electric washing machine

Nowadays, electric washing machines are used by middle class family in large number. We use washing machine for washing and drying of clothes.

FUOA3

Do you Know?

Who invented electric motor first?

In 1831 Joseph Henry, a physicist, creates machine movement of the first motor by using electricity.

Types

i. Semi-automatic washing machine
ii. Automatic washing machine
   A. Top loading washing machine
   B. Front loading washing machine

4.3.1 Semi automatic washing machine

Fig. 4.18 **Semi automatic washing machine**

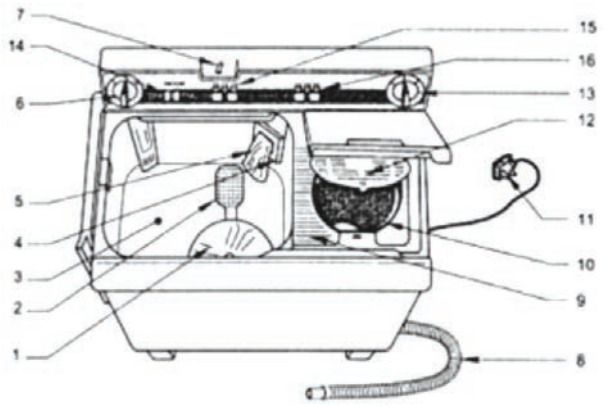
a) Construction

Semi-automatic type of washing machine is for washing the clothes and is shown in figure 4.18. 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.

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



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

Fig. 4.19 Internal contruction

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 washed clothes and make dry. This type of appliance is said to be as semi-automatic washing machine as shown in figure 4.19. In this, the motor rotates and rinses the clothes with water and makes clean.

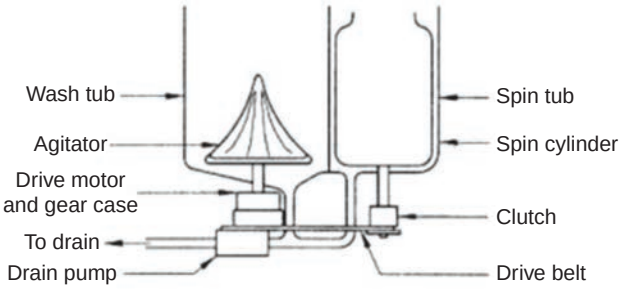


Fig. 4.20 Construciton diagram

4.3.2 Automatic washing machine

The automatic washing machine is of two types.

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

a) Top load washing machine

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.

Working principle

The machine itself supplies the required quantity of soap powder according to the quantity of clothes put inside the drum. Since this washing machine is automatic type, after the supply is 'on', the water incoming and outgoing from the tap is done automatically by washing machine including the timings required for washing and drying with the help of timer switch. 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.

Fig. 4.21 **Top loading 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

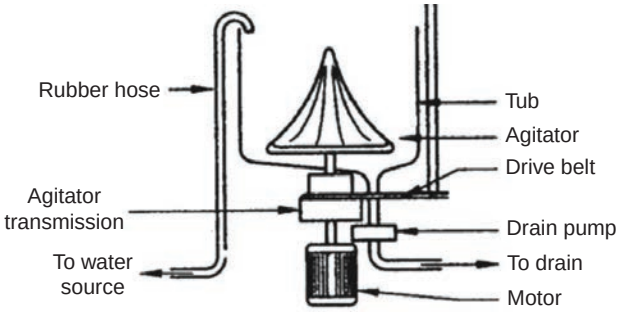


Fig. 4.22

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.

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. 4.22 **Front loading washing machine**

a) Construction

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.

Comparison with top load and front load washing machine

Sl. No.	Top load washing machine	Front load washing machine
1.	Low efficiency.	High efficiency.
2.	The washing drum is a simple type.	The washing drum is complicated type of cylinder
3.	Normal soap powder is used.	Special soap powder is used
4.	Only certain machines have a heating element inside.	All machines have a heating element inside.
5.	Cost is low	Cost is high

4.4 Electric pump

Water 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 are given below:

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

4.4.1 Centrifugal pump

The centrifugal pump is a simple electric motor appliance as in figure 4.24. 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. Base plate
ii. Water pump box
iii. Impeller
iv. Shaft
v. Rope and box
vi. Bearings

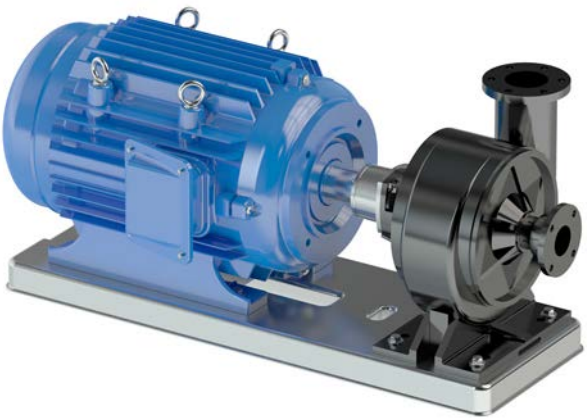


Fig. 4.24 **Centrifugal pump**

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 figure 4.25. By centrifugal force the water is delivered with uniform pressure without any vibration.

Fig. 4.25 **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 as shown in figure 4.26. 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. 4.26 **Internal system**

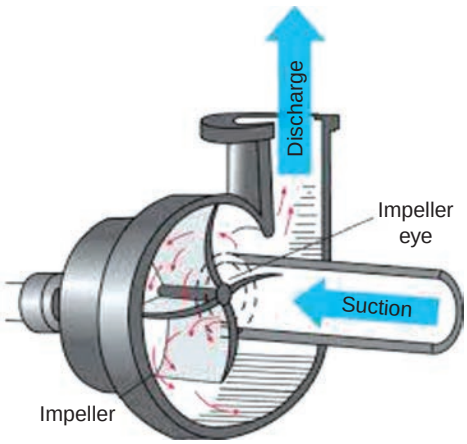


Fig. 4.27 **Internal cutting look**

vi. Bearing

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

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 figure 4.27. When the impeller rotates, due to the centrifugal force, low pressure will be produced. Due to the low pressure, water is sucked in.

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.

4.4.2 Submersible pump

Fig. 4.28 **Submersible pump**

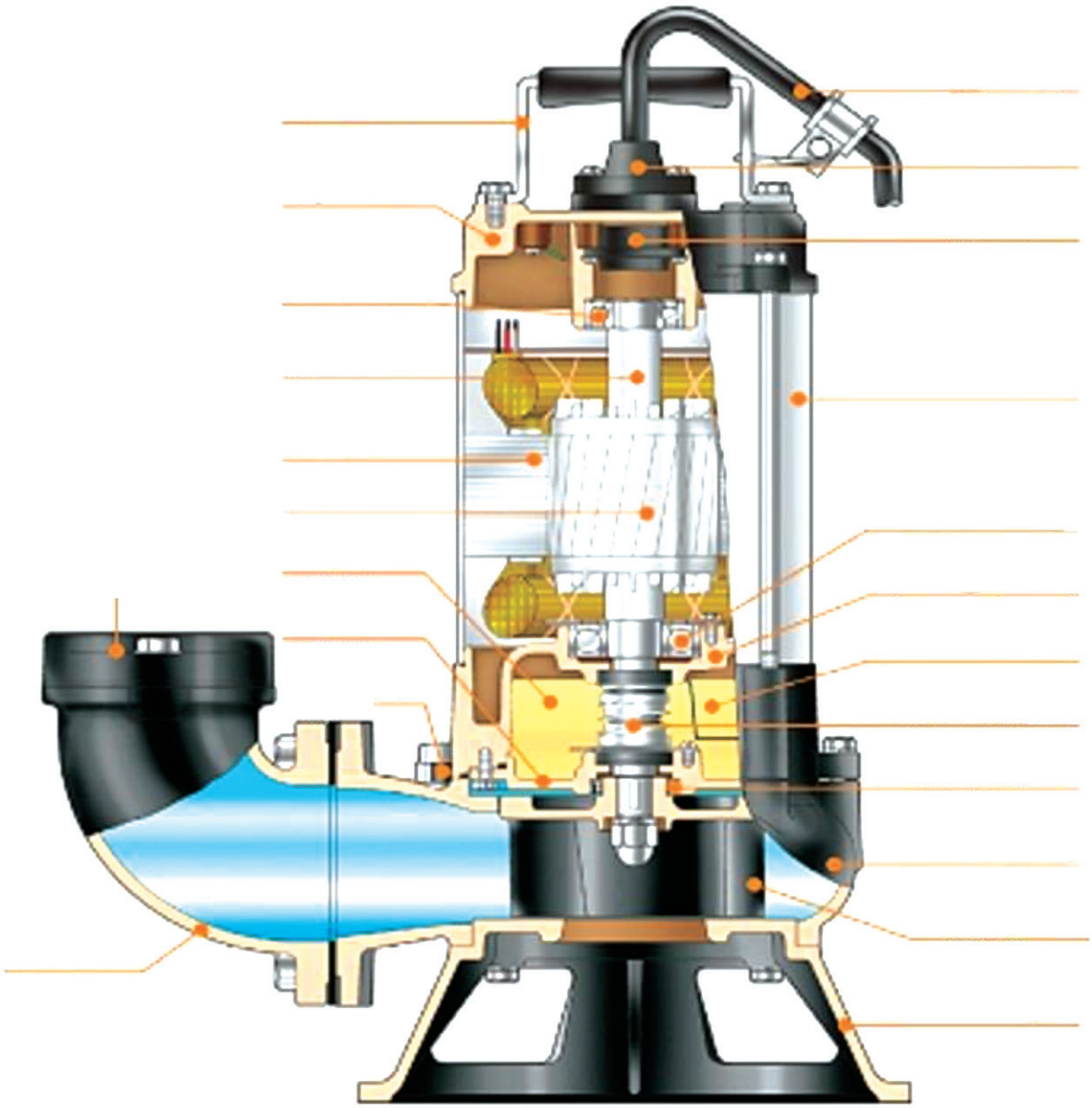


Fig. 4.29 **Internal structure of submersible pump**

Figure 4.29 and 4.30 shows the picture of the modern electric water pump. It consumes 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.

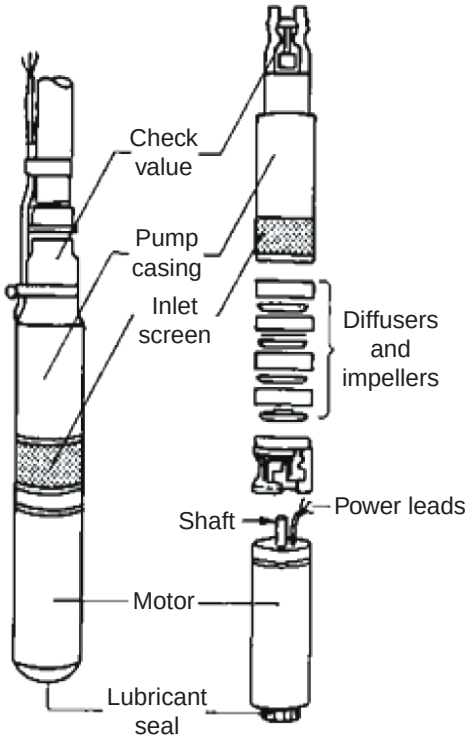


Fig. 4.30 Inner system

i. Selecting methods

Jet pumps are used to suck water to a depth of 500 feet in deep wells. According to the quantity of water required, the motor should be selected. Proper selection of the motor consumes less electric power and time.

In the present modern technology, 1 HP motor is commonly used. This will function up to 200 feet, and 100 liters of water can be obtained per minute. If we use 1.5 HP motor, it can deliver water to a level up to 500 feet in bore wells. If the motor is placed below 350 feet, only 45 liters of water will be delivered. But the cost of the electric motor is double.

ii. Installation of water pump

The good quality of motor and PVC pipes has to be selected and fit it in required depth. The air valve should be placed correctly. Otherwise, the electric motor is rotated in reverse. It will damage the bearing and more maintenance is required for the motor.

iii. Use of water pump

This type of pump is used in places where the water level is below 1000 feet.

4.4.3 Air compressor

Fig. 4.31 Air compressor

The air compressor shown in figure 4.31 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.

4.4.4 Faults, causes and remedies of electric pump

Sl. No.	Faults	Causes	Remedies
1.	No movement in the pump.	1. Packing of the rope in the pump is tight.	1. Loose the tightened packing.
		2. The bearings are damaged.	2. Check the bearing and lubrication or change the bearing.
		3. No power supply.	3. Check whether the supply is live.
2	Pump is working. But water is not delivered.	1. No water in the suction pipe.	1. The suction pipe must be filled with water.
		2. Delivery pipe valve is closed.	2. Open the valve in the delivery pipe.
		3. Water level is below foot valve.	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.	1. Leakage in the water pipe is rectified. The pipe length in the suction area should be increased.
		2. There is a defect in the electric motor and the starter.	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.	1. Check alignment.
		2. Loose fitting in connecting screws.	2. Tight the screws.
		3. No lubrication in the bearing.	3. Apply the grease on the bearing or change the bearing.
		4. Shaft is slightly bent.	4. Change the shaft.
		5. Block in the impeller and friction is in the box.	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.	1. Clean it and then fix it.
		2. Holes on the top of the impeller	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

Evaluation

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PART-A

Choose the correct answer **(1 Marks)**

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) Capacitor start 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. The purpose of the gland packing rope is to
   a) Prevent impeller from coming out
   b) Prevent leakage of water from the casing near the spindle
   c) Provide lubrication to the spindle
   d) Prevent air leakage from the casing.

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

10. 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

11. Maximum suction lift that is possible for water is
   a) 24 feet
   b) 28 feet
   c) 34 feet
   d) 38 feet

12. 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.

13. When using automatic operation of the pump, it should be ensured that
   a) water level is always above the foot valve
   b) delivery valve is closed at the time of starting
   c) suction side is not less than 20 feet.
   d) water level is always below the foot value.

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

15. 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

PART-B

Answer the questions in brief **(3 Marks)**

1. What is the function of the fan?
2. Name the type of motor used in the ceiling fan and table fan?
3. What will happen if the condenser of the fan is in short circuit or in open circuit?
4. What are the parts of a ceiling fan?
5. Define - sweep.
6. What are the types of fan?
7. What is the use of regulator in an electric fan?
8. Write two sweeps of the ceiling fan?
9. How the speed of the table fan can be changed?
10. What is the use of a capacitor in ceiling fan?
11. What are the two types of automatic washing machine?
12 What type of technology is used in semi-automatic washing machine?
13. What is called agitator in the washing machine?
14. List out the maintenances of the washing machine.
15. Why hot water is used in the washing machine?
16. Which material the rope is made upof?
17. What are the types of bearings used in pump?
18. What type of force makes fluid's rotation in the centrifugal pump?
19. What is priming in centrifugal pump?
20. What happens when the pump is rotated in the opposite direction?
21. What is called the suction head and delivery head of the water pump?

PART-C

Answer the questions in one page

(5 Marks)

1. Explain briefly the construction of an electric motor used in the fan?
2. Explain the oscillating mechanism of a table fan.
3. What are the differences between the table fan and the exhaust fan?
4. Explain the working principle of the exhaust fan and state its use.
5. What are the differences between the ceiling fan and the exhaust fan?
6. What is the working principle of the rope in pump?
7. What is impeller? What are its types?
8. What are the functions of the impeller?
9. Briefly explain about friction power.
10. What is the suction head?
11. What is the delivery head?
12. What is foot-valve?

PART-D

Answer the questions in two page

(10 Marks)

1. Write short notes for the following
   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?

Reference Book

1. A text book of 'Electrical Technology' Volume-III B.L.Theraja and A.K.Theraja, S.Chand & Company Ltd.

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1. http://www.wikipedia.org
2. https://www.electrical4u.com