ELECTRICAL WORKSHOP PRACTICE

LAB MANUAL

Subject Code : Pr.1

Class : Diploma VI Semester

Branch : Electrical Engineering

ITT, CHOUDWAR

DEPARTMENT-ELECTRICAL

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INDEX

Experiment 1

Aim of the experiment-:

(i) Identification of single core (SC), twin core (TC), three cores (3c), four cores (4c); copper and aluminum PVC, VIR & Weather proof (WP) wire.

Apparatus Requirements-:

Tools / Instruments		Materials	
• Standard Wire Gauge (SWG 0-36) -	1 No.	• Wires (assorted size) -	as required.
• Electrician's knife -	1 No.	• Cables (underground armoured and unarmoured	
• Manual wire stripper 150 mm -	1 No.	cable) -	as required.
• Combination pliers 150 mm -	1 No	• Wire/ cable specification data book -	1 No

Procedure

1: Identify types of wires and cables

1- Take any one wire from the table, note down its alphabet in Table 1.

2- Identify the type of insulation, type of conductor material and size of wires. Note it down in Table 1.

3 - Take at least five different types of wires and repeat steps 1 and 2 Note down the details in Table 1.

4 - Verify the specifications of the wires by referring with the data book.

5- Take any one cable from the table, note down its alphabet.

6- Identify the type of cable (unarmoured and armoured cable) and note down in Table 1.

7- Identify the type of insulation, core and record in Table 1.

8- Verify the specifications of the cable by referring with the data book.

9- Repeat steps 1 to 8 for various wires and note the data in Table 1

2: Measuring the wire sizes by SWG in gauge number

1 Skin the insulation of the cable

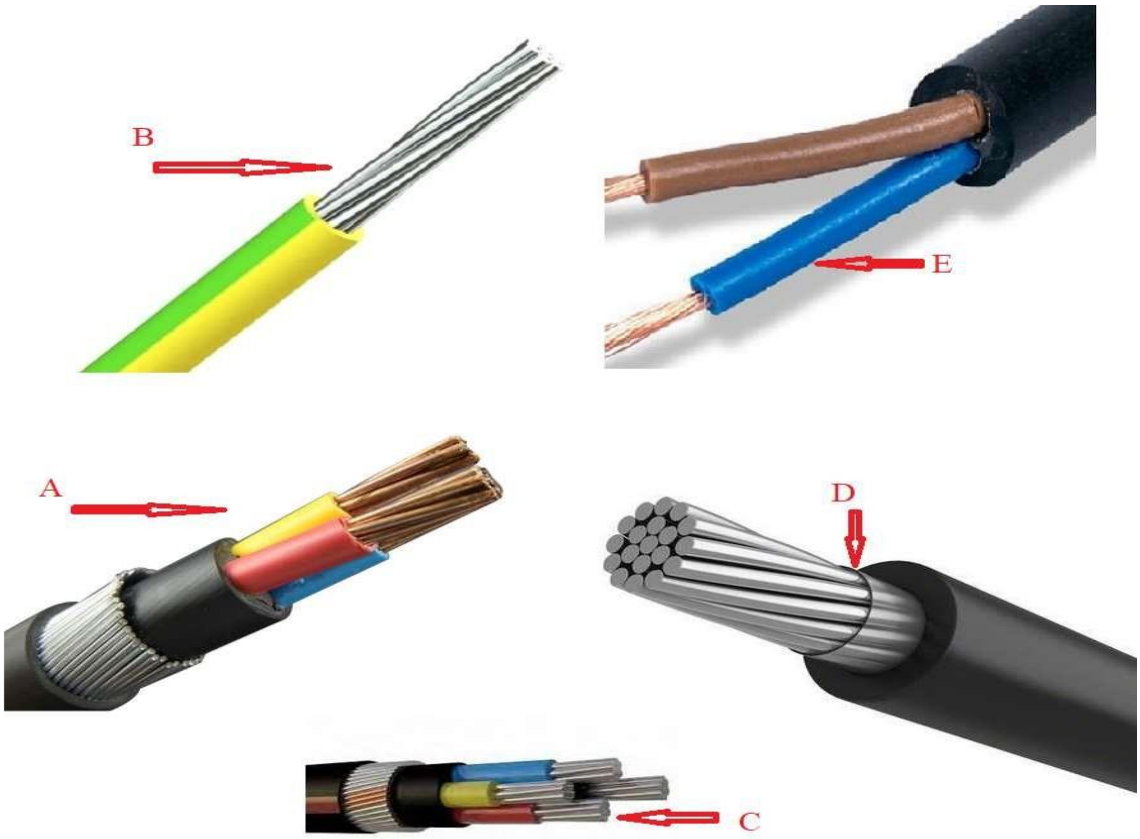
2 Clean the surface of the wire with a cotton cloth. Remove insulation particles and any adhesive coating from the surface of the conductor

3 Straighten the end of the conductor to be measured.

4 Insert the conductor in the slot of the wire gauge and determine its close fit. (Fig 1)

5 Read the marking at the slot, Fig 2. It gives the wire size in SWG. The other side will give you the diameter. of the wire in mm.

6 Record the measured size in Table 1



OBSERVATION TABLE:

sl no	Cable (alph abet)	Type of insulation	Types of conductor materials	Types of cables		Type of core	Core size (diameter) in mm
				Armoured	Unarmoured		
1	A						
2	B						
3	C						
4	D						
5	E						

(TABLE-1)

Conclusion:

From the above experiment we came to know about different types of wires and measured conductor size (diameter).

(ii) To make britannia Tjoint and Married joint of condutor wires.

Apparatus Requirements-:

Tools/Instruments	Materials
• Electrician's knife with two folding steel blades of 75 mm and 100 mm - 1 No.	• PVC insulated copper cable 1/1.12 - 2 m. • PVC insulated aluminium cable 1/1.40 - 2 m.
• stainless steel rule 300 mm, with graduations on either edge cm/mm and inches - 1 No.	• Cotton cloth 30 cm square - 1 No. • Sandpaper `OO' (smooth) - 1 sheet
• Diagonal cutting pliers 150 mm with 660 volts grade insulated handle suitable for cutting hard wires - 1 No	• PVC insulated copper cable 7/0.914/600V - 1 m. • PVC insulated copper cable 3/0.914/250V - 1 m.
• Combination pliers 200 mm with 660 volts grade insulated handles with pipe grip, side cutter and two joint cutters - 1 No	• Bare copper wire 4 mm 30 cm - 2 Nos. • GI wire 4 mm 30 cm - 2 Nos. • Sand Paper 'O' grade - 1 shee

Procedure:-

1: Prepare married joint in 7/0.914 stranded conductors as shown in Fig 1

1 Collect 2 pieces of PVC sheathed copper cable 7/0.914 0.5 metre in leagth.

2 Mark both the the cables at 120 mm from the cable ends.

3 Remove the insulation for 120 mm on both the cables.

Carefully remove the insulation. Do not nick or shave the conductor

4 Open the strands, clean the wires, and re-twist the strands in the original direction up to 50 mm from the cable insulation. (Fig 2)

5 Cut the centre strand of both the cables close to the twist (about 70 mm from the free end).

6 Bind on the twisted part of one cable end as shown in Fig 3.

7 Interlace the strands keeping the centres butt. (Fig 4)

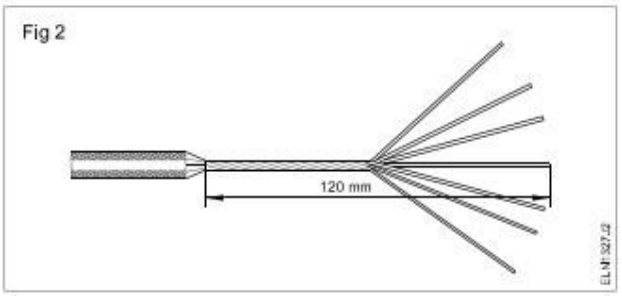
8 Hold the cable end (that is without the binding) in one hand and twist the strands of the other cable end over it, one by one, closely and tightly. Each strand has to be twisted half a turn at a time

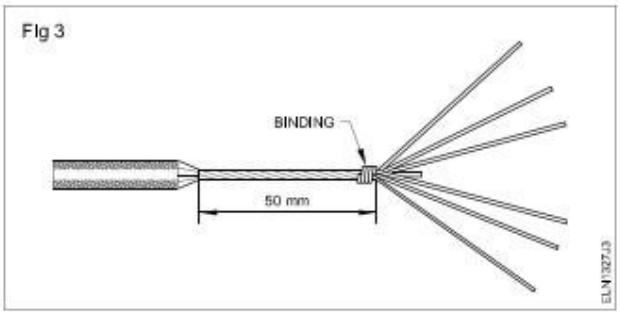
The direction of twist to form the shoulder should be the same as that of the cable twist .

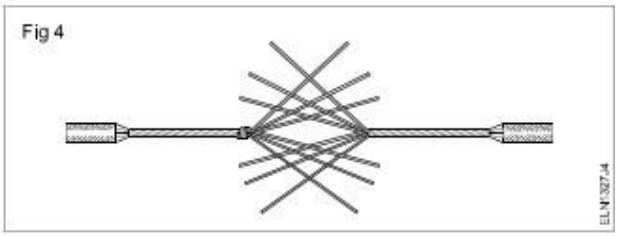
9 Remove the binding made in step 6.

10 Repeat the operation as in step 8 on the other side with the 2nd cable end.

11 Complete the joint as shown in Fig 1 by rounding off the twisted strands with a mallet or pliers, and cut the excess wires.

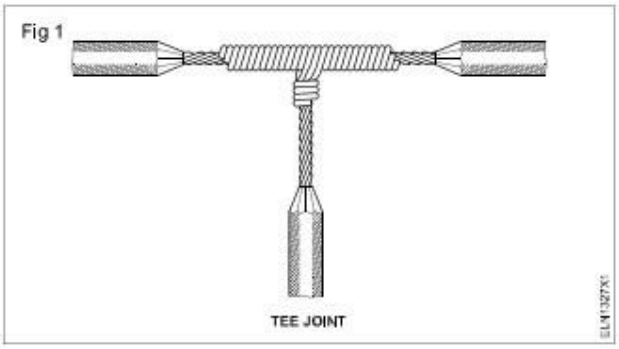






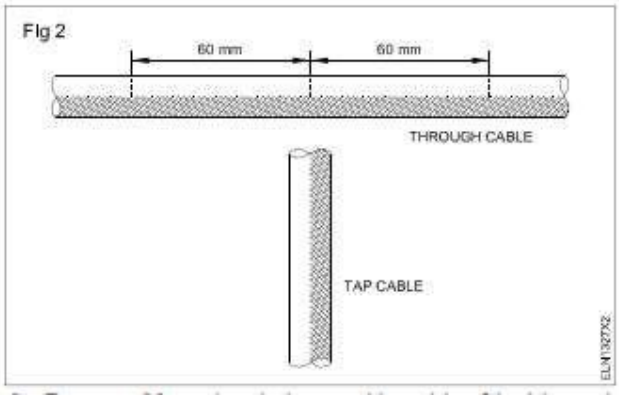
2: Prepare 'T' joint in multi-stranded conductor

Fig 1 shows a completed Tee joint in standard conductors.

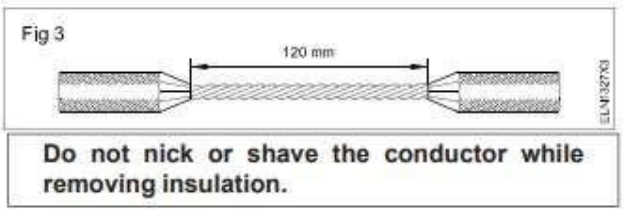


1 Collect two pieces of PVC insulated stranded copper cable 7/0.91. Indicate one piece as `through cable' and the other one as `tap cable'.

2 Mark the point of tap in the `through cable' and mark 60 mm on either side of the tap point for the insulation to be removed as shown in Fig 2



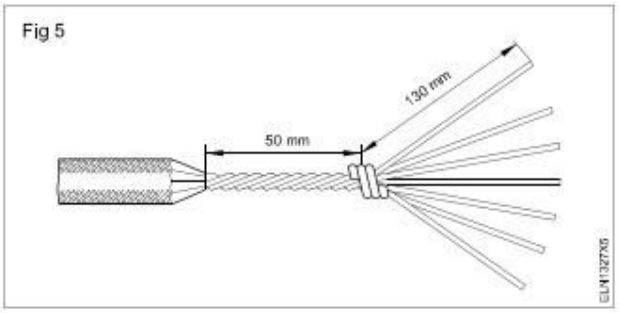
3 Remove 60 mm insulation on either side of the `through cable' from the point of tap. (Fig 3)



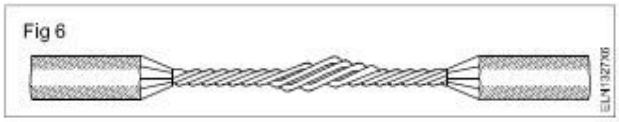
4 Remove the insulation for 180 mm at the end of the `tap cable'. (Fig 4)

5 Open the strands of the `tap cable' and clean it. Use smooth `00' sandpaper, if necessary.

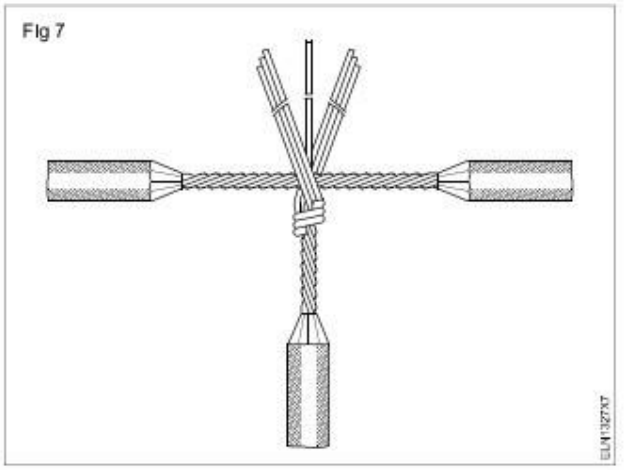
6 Re-twist the strands in the original direction up to 50 mm from insulation, and make a binding on the twisted part of the `tap cable' as shown in Fig 5



7 Untwist the `through cable' to provide opening at the point of tap. (Fig 6)



8 Insert the centre (middle) strand of the `tap cable' in the opening of the 'through cable' as shown in Fig 7



9 Wrap 3 strands of the `tap cable' around the `through cable' on either side of the tap point to form shoulder on `through cable'.

10 Wrap the strands up to 50 mm to leave a 10 mm gap between insulation and shoulders (Fig 1) and trim the excess length of strands.

11 Remove the binding from the `tap cable', wrap the centre strand of the `tap cable' around the `through cable' and wrap it in the place of the binding. (Fig 1).

12 Round the ends with the combination pliers or mallet to avoid sharp edges of the strands.

Note- With 19/1.2, 19/1.63 mm cable, 9 strands of the `tap cable' are to be wrapped on either side of the `through cable'. Insulation that has to be removed is 170 mm on the `through cable' and 250 mm on the `tap cable'.

Precaution:-

1- Carefully remove the insulation. Do not nick or shave the conductor

2- The direction of twist to form the shoulder should be the same as that of the cable twist .

3- With 19/1.2, 19/1.63 mm cable, 9 strands of the `tap cable' are to be wrapped on either side of the `through cable'. Insulation that has to be removed is 170 mm on the `through cable' and 250 mm on the `tap cable'.

Conclusion:-

Frome the above experiment we made britannia Tjoint and Married joint of condutor wires.

DISCUSSION QUESTION:-

1. What is S.W.G?
2. What are the different types of cable ?
3. What are the different type of joints?
4. Why cable joint is necessary ?

Experiment 2

Aim of the experiment-:

Cutting copper and aluminum cable and crimping lug to them from 2.5mm^2 to 6 mm^2 cross section.

Apparatus Requirements-:

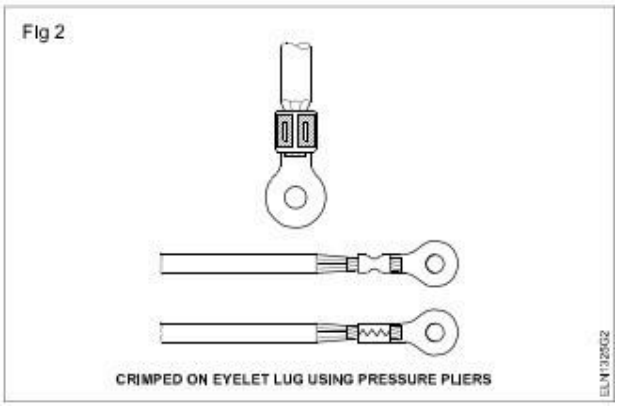
Tools / Instruments		Materials
• Crimping pliers 150/200 mm -	1 No.	• Crimping eyelet, eye hole dia. 2.3 mm - 6 Nos.
• Wire stripper auto-eject 200 mm -	1 No.	• Crimping eyelet, eye hole dia. 3.6 mm - 6 Nos.
• Steel rule 300 mm -	1 No.	• Crimping spade lug 6A - 6 Nos.
• Side cutting pliers 150 mm -	1 No.	

Procedure

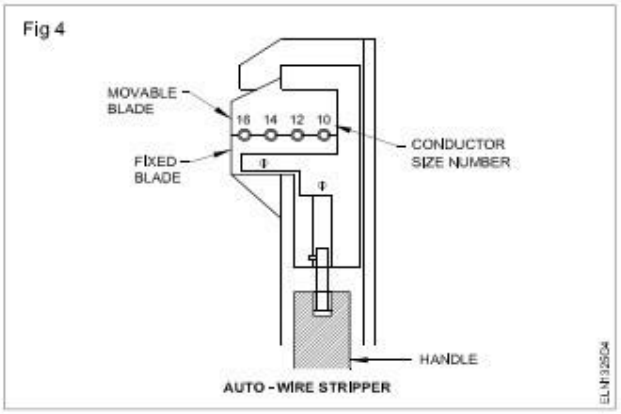
Crimping of lug connector

1 Collect the cable (fine multi-strand copper/Aluminum conductor) and cut a side using side cutting pliers.

2 Collect the spade connector suitable for the wire thickness and terminal size of 2.5mm^2 cross section (Fig 1 &2).

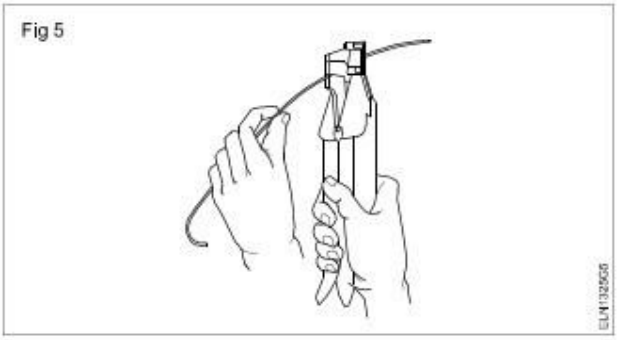


3 Select the wire stripper blade size to match the wires thickness (auto-eject) or adjust the jaws of the stripper. (Fig 4)



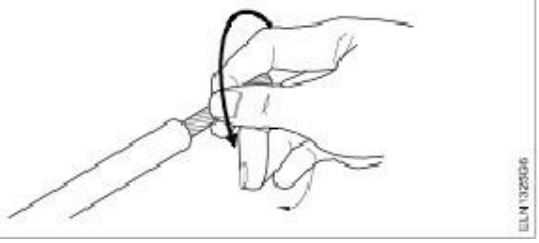
4 Strip a length of insulation that suits the terminal size (spade connector) (Fig 5)

Be sure not to cut or damage the wire core.



5 Twist the strands of the wire lightly in the direction of strands. (Fig 6)

Fig 6

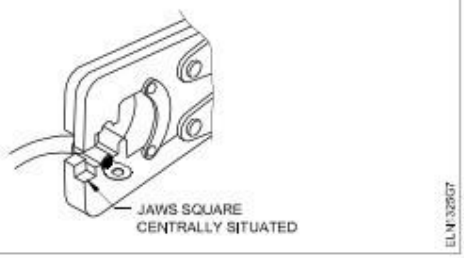


6 Select the crimping pliers that match the terminal size.

7 Clamp the spade connector with the crimping pliers with the matching position of jaws.

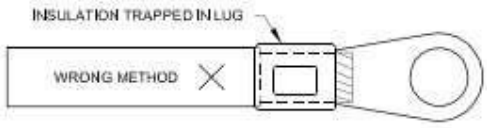
8 Insert the wire far enough in the compression connector. (Fig 7)

Fig 7



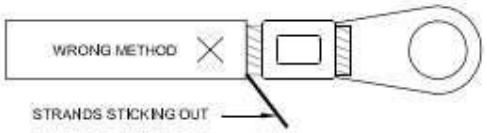
Do not clamp the insulation in the terminal. (Fig 8)

Fig 8



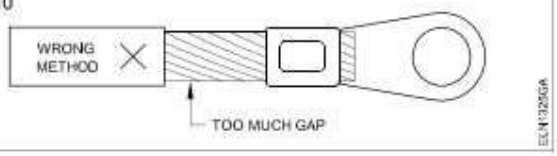
Strands must not stick out of the connector. (Fig 9)

Fig 9



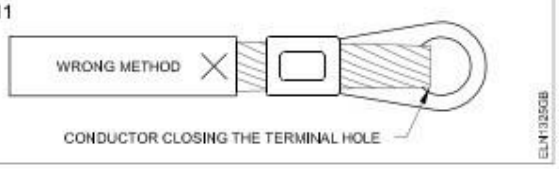
Do not strip too much insulation. (Fig 10)

Fig 10



Adjust the length of the wire so that it does not interfere with the terminal hole. (Fig 11)

Fig 11

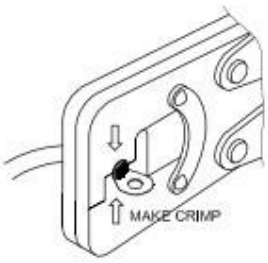


9 Apply light pressure to create a light impression on the compression connector.

10 Check whether the press is located in the middle of the band of compression connector and, if necessary, make final adjustment.

11 Apply sufficient pressure in the handle to press the compression connector fully, as shown in Fig 12.

Fig 12



12 Check whether the prepared compression/crimping joint is firm by pulling the cable and compression connector.

13 Repeat the crimping of compression in the connectors of various sizes of copper and aluminum conductors of different lengths.

PRECAUTION

1-Be sure not to cut or damage the wire core while stripping the insulation of cable.

2-Do not clamp the insulation in the terminal(Fig 8) while clamping the spade connector.

3-Strands must not stick out of the connector (Fig 9).

4-Do not strip too much insulation. (Fig 10)

5- Adjust the length of the wire so that it does not interfere with the terminal hole. (Fig 11)

6-Trim the appropriate length of the skinned cable ends to suit the compression connectors.

Conclusion:

From the above experiment we came to know about crimping tool and how to crimp the lugs at the cable end.

DISCUSSION QUESTION:-

1.What is crimper?

2.What is crimping lug?

3.What is the use of crimping tool?

4.What does crimping wire means?

Experiment 3

Aim of the experiment-:

Connection and testing of fluorescent tube light, high pressure M.V. lamp, sodium vapor lamp, M.H lamp, CFL and latest model lamps – measure inductance, Lux/ lumens (intensity of illumination) in each case-prepare lux table.

Apparatus Requirements-:

Tools / Instruments			**Materials**		
Name of the tool	Specification	quantity	Name of the tool	Specification	quantity
Insulated combination plier	150mm	1 No.	Tube light fitting single	-1200mm	1No
			Tube light Choke	40w,250v	1No
Insulated screwdriver	200 mm x 4mm	1No	Tube light starter	40w,250v	1No
			Tube light holder plain	-	2No
Insulated connector screw driver	100mm	1No	Starter holder	-	2No
			fluorescent tube	40w,250v	1No
Long round nose plier	150mm	1No	HPMV lamp frame fitting	-	1No
			MV lamp ballast choke	150w,250v	1No
D.B. Electrician's knife	100mm	1No	Capacitor	4MFD	1No
			HPMV lamp	150w,250v	1No
Test lamp	100W,250V	1No	Igniter	150w	1No
			HPSV Lamp	150w,250v	1No
LCR Meter	-	1No	HPSV Lamp frame fitting	-	1No
			CFL lamp	27w,230v	1No
Lumen/light Meter	-	1No	MH Lamp	150w	1No
			LED Lamp	9w	1No
			Connecting wires		as per required

1- fluorescent tube

Theory

A **fluorescent lamp** is a low weight mercury vapour lamp that uses fluorescence to deliver visible light. An electric current in the gas energizes mercury vapor which delivers ultraviolet radiation through discharge process and the ultraviolet radiation causes the phosphor coating of the lamp inner wall to radiate visible light.

Working principle-:

- When we switch ON the supply, full voltage comes across the lamp and as well as across the starter through the ballast. But at that instant, no discharge happens, i.e., no lumen output from the lamp.
- At that full voltage first the glow discharge is established in the starter. This is because the electrodes gap in the neon bulb of starter is much lesser than that of the fluorescent lamp.

- Then gas inside the starter gets ionized due to this full voltage and heats the bimetallic strip. That causes to bend the bimetallic strip to connect to the fixed contact. Now, current starts flowing through the starter. Although the ionization potential of the neon is more than that of the argon but still due to small electrode gap, a high voltage gradient appears in the neon bulb and hence glow discharge gets started first in the starter.
- As soon as the current starts flowing through the touched contacts of the neon bulb of the starter, the voltage across the neon bulb gets reduced since the current, causes a voltage drop across the inductor(ballast). At reduced or no voltage across the neon bulb of the starter, there will be no more gas discharge taking place and hence the bimetallic strip gets cool and breaks away from the fixed contact. At the time of breaking of the contacts in the neon bulb of the starter, the current gets interrupted, and hence at that moment, a large voltage surge comes across the inductor(ballast).
- This high valued surge voltage comes across the fluorescent lamp (tube light) electrodes and strikes penning mixture (mixture argon gas and mercury vapor).
- Gas discharge process gets started and continues and hence current again gets a path to flow through the fluorescent lamp tube (tube light) itself. During discharging of penning gas mixture the resistance offered by the gas is lower than the resistance of starter.
- The discharge of mercury atoms produces ultraviolet radiation which in turn excites the phosphor powder coating to radiate visible light.
- Starter gets inactive during glowing of fluorescent lamp (tube light) because no current passes through the starter in that condition.

Procedure

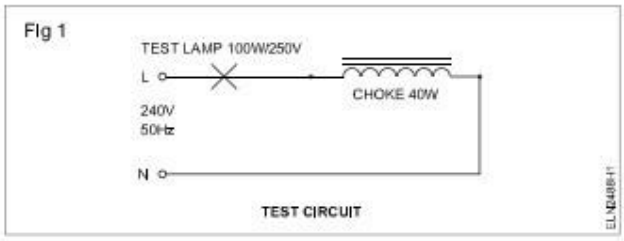
1 Check the choke for its short and open with a test lamp as shown in Fig 1, and record the results

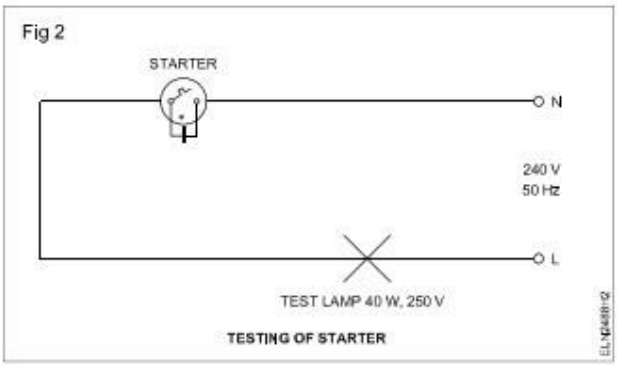
State of lamp glow	Condition of choke
a Normal glow	Internal short circuit
b Dim	Good working condition
c No glow even after checking the leads and connection	Open circuit in the choke

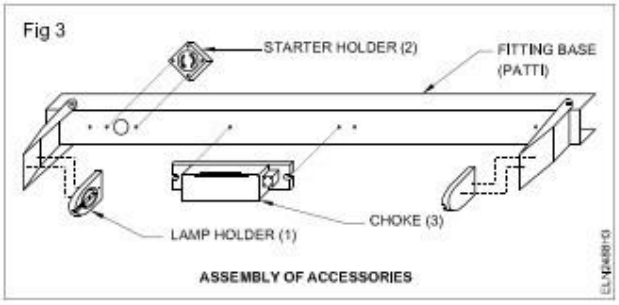
POSSIBLE RESULT
TESTING OF CHOKE

2 Check the starter with a series test lamp as shown in Fig 2. Observe the flickering of the lamp which indicates good condition of the starter.

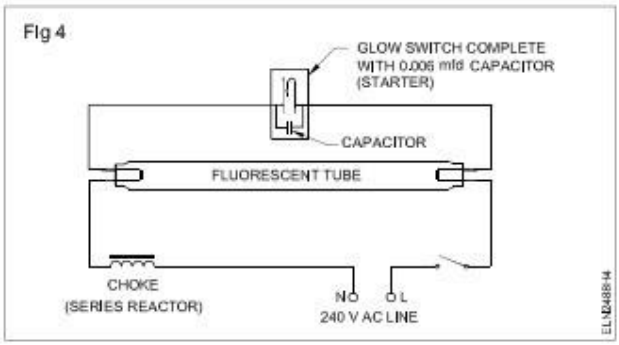
3 Assemble the following fluorescent tube accessories in the fitting base. Refer to the sketch. (Fig 3) 1) Holders for tube 2) Starter-holder 3) choke.



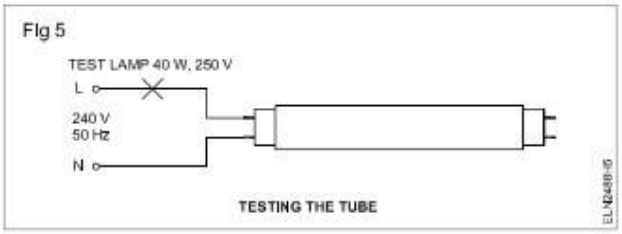




4 Connect the accessories as shown in Fig 4 (for a single tube light). Also install the tested starter.

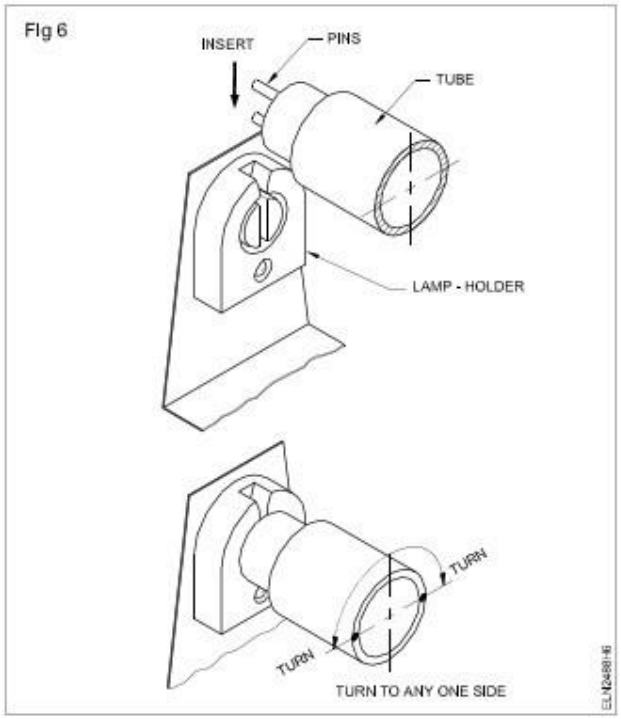


5 Test the filament on both sides of the fluorescent tube for its continuity as shown in Fig 5. Discard the fluorescent tube with open or fused filament in either side.



6 Fix the bulb in the holder.

7 Then insert both the ends (pins) into the holder of the fittings on either side of the tube.(fig. 6)



8 Turn the tube at both ends in any one direction by a quarter turn. Stop when you feel that the pins have `snapped' into position.

9 Measure the inductance of whole circuit using LCR Meter as shown in fig 10 and note it down in table.

10 Test the bulb providing appropriate electric supply and Measure the Intensity of illumination (Lux) using LUX meter and note it down in table.

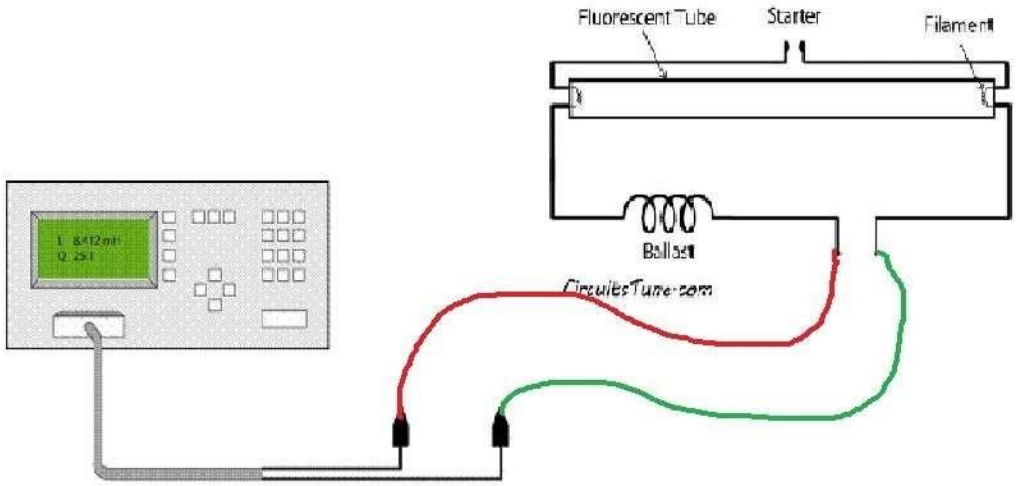
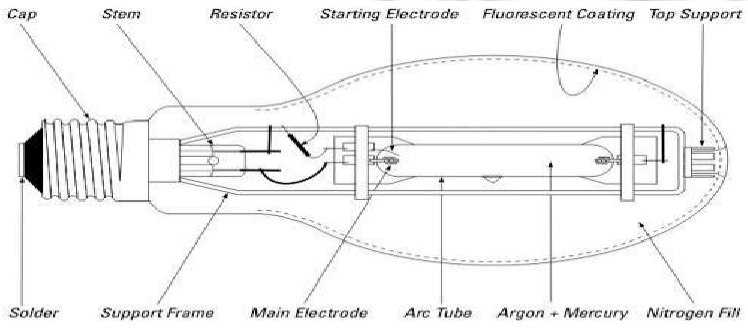


Fig. 10

2- HPMV Lamp

Theory-:

A lamp that consists of vaporized mercury to generate light by using an electric arc is known as a mercury vapor lamp. Basically, this lamp discharges gas when heated or cooled. The mercury which is present inside the tube is in liquid form (at room temperature) which is ionized before generating light.



HIGH PRESSURE MERCURY VAPOUR LAMP

Fig.11

Working principle:

Mercury vapour, at high pressure, is filled inside a glass tube with two electrodes. When current is passed through the tube, mercury vapour is ionized and emits a light in the ultraviolet region. In order to convert the radiation into visible radiation, the tube is coated with fluorescent material.

The light emitted by the mercury vapour lamp has a bluish tinge. The output wavelength of mercury vapour lamps is distributed over the ultra violet, IR, and visible region, with the majority being scattered over the UV and IR regions.

Procedure

1 Connect the H.P.M.V. lamp in series with the 60W 240V bulb and test in 240V AC supply. Check whether the series test lamp glows.

2 Test the choke for its working condition.

3 Assemble the accessories (ballast choke, igniter, holder and capacitor) in the Frame fitting, following the manufacturer's instructions.

4 Connect the accessories as per circuit diagram, Fig 13 (Pictorial diagram Fig 12) using the recommended type of termination.

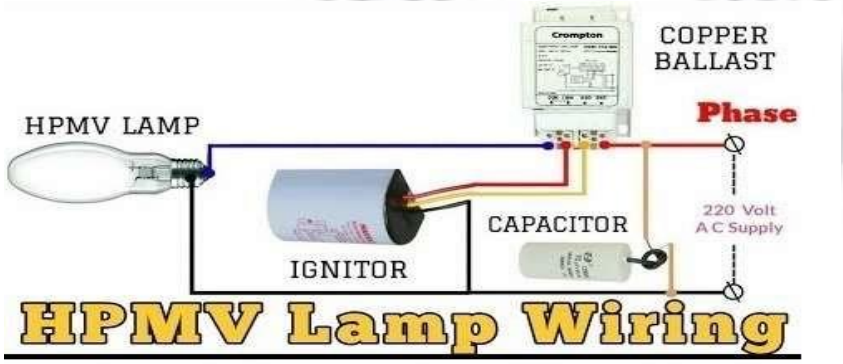


fig.12

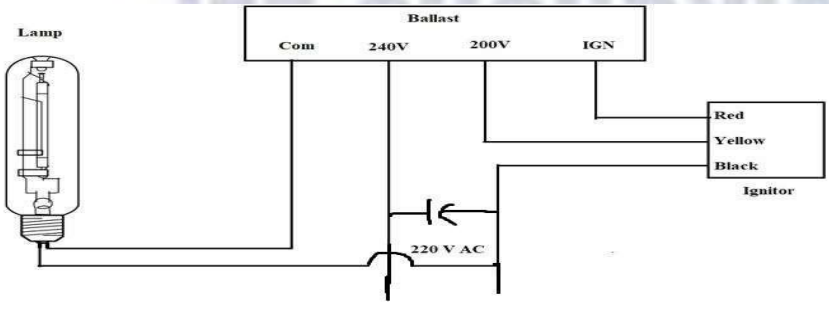


fig.13

5 Fix the bulb in the holder and test the working of the lamp with the supply voltage.

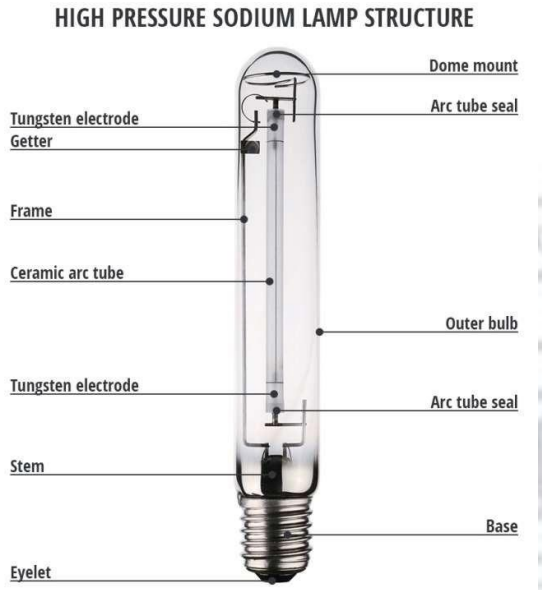
6 Measure the inductance of whole circuit using LCR Meter as shown in fig 10 and note it down in table.

7 Test the bulb providing appropriate electric supply and Measure the Intensity of illumination (Lux) using LUX meter and note it down in table.

3- HPSV LAMP

Theory

HPSV lamp is a gas discharge lamp that uses sodium in an excited state to produce light. A typical HPSV lamp is shown in the figure below.



Working principle

1. Electric power is given to the lamp and it is energized.
2. The electrodes produce an arc and this arc strikes through the conductive gas and the lamp produces a reddish-pink light, characteristic of neon.
3. Current flowing through the inert gas mixture of argon and neon generates heat.
4. This heat vapourises the metallic sodium.
5. With the passage of time, the quantity of sodium in the arc stream increases thus light is produced and this produces the characteristic monochromatic orange color at a wavelength of 489.6 nm.

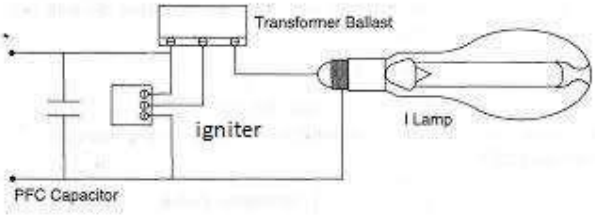
Procedure

1 Connect the H.P.S.V. lamp in series with the 60W 240V bulb and test in 240V AC supply. Check whether the series test lamp glows.

2 Test the choke for its working condition.

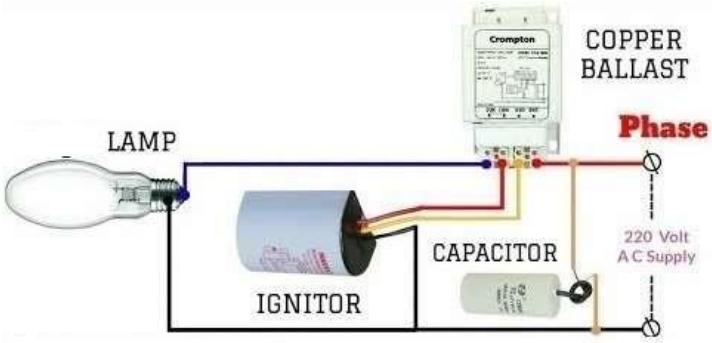
3 Assemble the accessories (ballast choke, igniter, holder and capacitor) in the Frame fitting, following the manufacturer's instructions.

4 Connect the accessories as per circuit diagram, Fig 14 (Pictorial diagram Fig 15) using the recommended type of termination.



High pressure sodium vapour lamp

fig 14



HPSV Lamp wiring diagram

Fig.15

5 Fix the bulb in the holder and test the working of the lamp with the supply voltage.

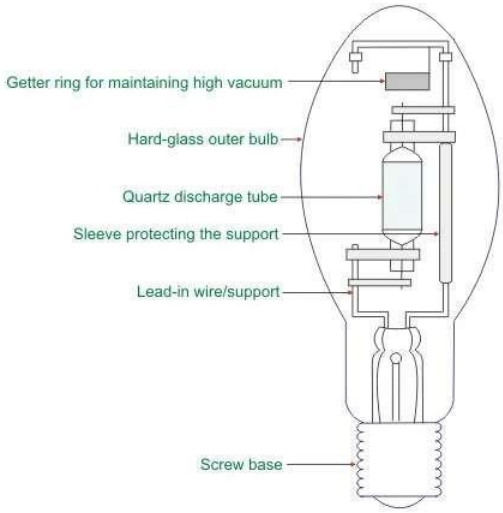
6 Measure the inductance of whole circuit using LCR Meter as shown in fig 10 and note it down in table.

7 Test the bulb providing appropriate electric supply and Measure the Intensity of illumination (Lux) using LUX meter and note it down in table.

4- MH Lamp

Theory

Metal halide lamp is special type of arc discharge lamp that works on the arc stream via some iodide salts along with argon gas and mercury vapor pressure at several millimeters with the arc tube temperature of 1000 K.



Metal halide lamp

Working principle

- When full voltage is applied across the main electrodes, no arc is produced at the time of switching.
- The auxiliary electrode or starter electrode near the main electrodes attached to the glass stem creates initial discharge between them.
- A bimetal switch is there to short the starter electrode to the main electrode just at the time of starting.
- Starter electrode is used to create initial arc between main and auxiliary electrode that heats up the metal halide salts.
- Starter electrode or auxiliary electrode is of high resistance to limit the current at initial arc.
- Again discharge is first in argon and then in mercury.
- Small amount of mercury vapor helps to establish main arc formation between main electrodes through metal halides vapor one by one.
- To reach up to full light output this lamp takes 5 minutes.

PROCEDURE

1 Connect the MH lamp in series with the 60W 240V bulb and test in 240V AC supply. Check whether the series test lamp glows.

2 Test the choke for its working condition.

3 Assemble the accessories (ballast choke, igniter, holder and capacitor) in the Frame fitting, following the manufacturer's instructions.

4 Connect the accessories as per circuit diagram, Fig 16 using the recommended type of termination.

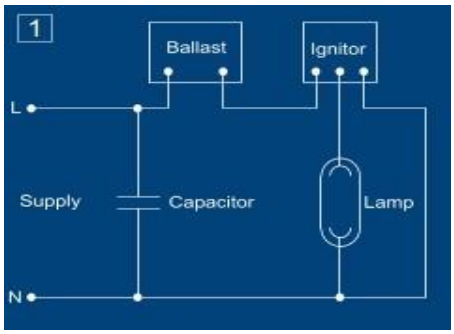


Fig.16

5 Fix the bulb in the holder and test the working of the lamp with the supply voltage.

6 Measure the inductance of whole circuit using LCR Meter as shown in fig 10 and note it down in table.

7 Test the bulb providing appropriate electric supply and Measure the Intensity of illumination (Lux) using LUX meter and note it down in table.

5- LATEST MODEL LAMPS

(i) CFL bulb

Theory

The term 'CFL' stands for Compact Fluorescent Lamp. It is also known as compact fluorescent light, energy-saving light, and compact fluorescent tube. In a **CFL**, an electric current is driven through a **tube** containing argon and a small amount of mercury vapor. This generates invisible ultraviolet **light** that excites a fluorescent coating (called phosphor) on the inside of the **tube**, which then emits visible **light**.

Working principle

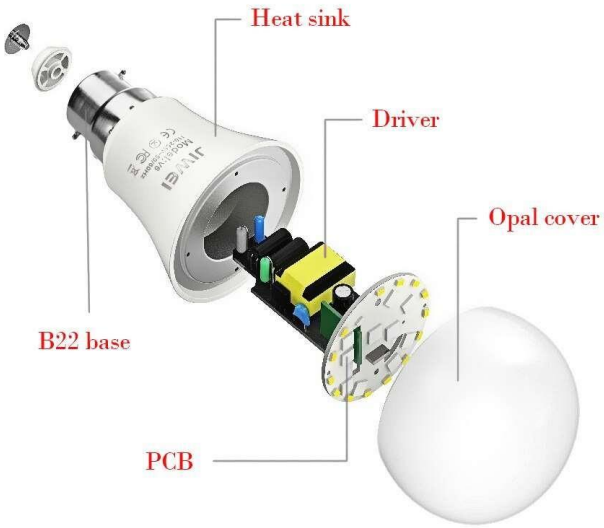
A CFL uses vacuum pipe which is principle wise same to the strip lamps (commonly known as Tube light) . Tube has two electrodes on both ends which is treated with Barium. Cathode is having a temperature of about 900º C and generates a beam of electrons which is further accelerated by potential difference between electrodes.

These accelerated electrons strike Mercury and Argon atoms which in turn results in the arise of a low temperature plasma. This process initiates the radiation of Mercury in Ultra violet form. Tube's inside face contains 'Luminophore' whose function is to convert Ultra violet light into visible light.

This tube is fed with AC power supply which facilitates the changing functionality of Anode and Cathode. The CFL also consists a switched mode converter. It functions on a very high frequency and acts as a replacement of ballast (choke) and starter assembly.

(ii) LED bulb

An **LED bulb** produces **light** by passing the electric current through a semiconducting material—the diode—which then emits photons (**light**) through the **principle** of



electroluminescence.

Working principle

An LED bulb produces light by **passing the electric current through a semiconducting material—the diode—which then emits photons (light) through the principle of electroluminescence.**

It essentially means that a material (in this case, the diode) casts light when power is applied to it. Electrons jump from one side (an electron-full side) to another (an electron-deficient side) across a junction (the "p-n junction"). Think of it this way: When power is applied to the p-n junction, the side lacking in electrons wants to be filled up with the charged electrons

from the other side, and when power is applied the electrons get eager to move. During this process, light is created.

The fact that **LED lights do not rely on heat to produce its light means it runs cooler and is much more energy-efficient than an incandescent light bulb**.

PROCEDURE

1 Fix the bulb **(CFL bulb and LED bulb simultaneously)** in the holder and test the working of the lamp with the supply voltage.

2 Measure the inductance of whole circuit (in each bulb) using LCR Meter as shown in fig 10 and note it down in table.

3 Test the bulb(in each bulb) providing appropriate electric supply and Measure the Intensity of illumination (Lux) using LU meter and note it down in table.

Observation table

Sl. no	Name of lamp/bulb	Inductance of lamp /bulb	Intensity of light in lumens of lamp/b lb
1	Fluorescent lamp	5.4H	3013
2	HPMV lamp	25μH	8150
3	HPSV lamp	22.7μH	12750
4	MH lamp	4.43μH	11750
5	CFL bulb	2.3H	1153
6	LED bulb	5.5mH	820

CONCLUSION

From the above experiment we made the connections for different lamps and m asured the inductance of each lamp/bulb and output illumination in lumens of each lamp.

DISCUSION QUESTION:-

1. What is fluorescent lamp?
2. Why mercury is used in fluorescent lamp?
3. What is mercury light?
4. How does a MV lamp give a pink colour at the start?
5. Why sodium vapour lamp is yellow?
6. How does sodium vapour lamp work?

Experiment 4

Aim of the experiment-:

Study battery charger and make charging of lead acid battery (record charging voltage, current and specific gravity).

Apparatus Requirements-:

Tools / Instruments			Materials		
Name of the tool	**Specification**	**quantity**	**Name of the tool**	**Specification**	**quantity**
Insulated combination plier	150mm	1 No.	Battery	6 volts	1No
Insulated screwdriver	200 mm x 4mm	1No	Battery charger	6 A	1No
Insulated connector screw driver	100mm	1No	Hydrometer	1100-1300	1No
Line tester	500v	1No	Pure water	-	2 litre
D.B. Electrician's knife	100mm	1No	Crocodile clips	-	2 No
			Sulphuric acid	-	500gram
			High rate discharge tester	-	1No

Theory

1) Charge Lead Acid Batteries

It is crucial to understand exactly how charging of high Ampere-Hour lead-acid batteries are accomplished, before you decide to jump into the design information on chargers. Correct knowledge will assist you to figure out at precisely what voltage, at what current the battery must be charged and the time it will need to cut-off from the charger. This will ensure that your battery will likely be recharged optimally and also have significantly less possibility of untimely degradation.

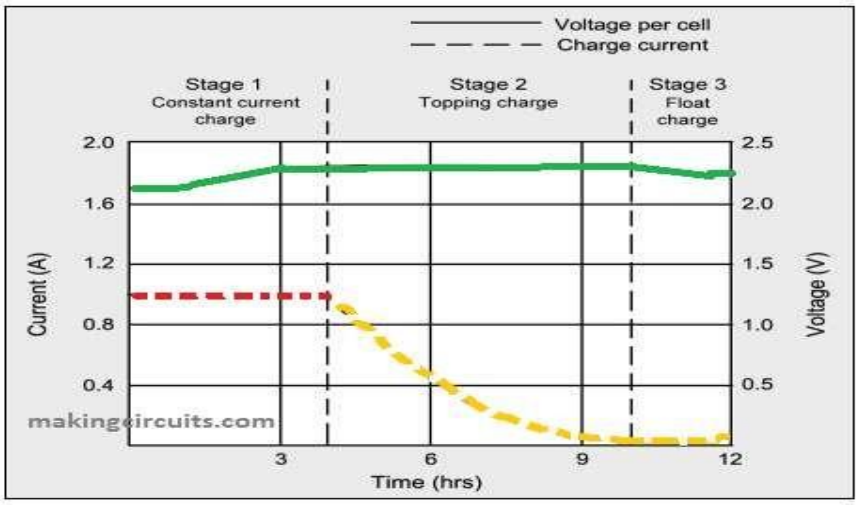
Lead-acid batteries are charged in three stages:

1. **Constant current.**
2. **Constant voltage.**
3. **Trickle charging.**

We need to go through the charging characteristics graph of a lead acid battery:

- Lead Acid battery charging characteristics
    1) **Constant current charging:**

A 12V battery is normally recharged at 14.2 V or 2.40V per cell. Once we attach the charger with the battery, voltage drops from the actual supply 14.2 V level to the discharged level of the battery. As the battery gets charged the terminal voltage begins increasing gradually, until it reaches the set 14.2 V. However, current drawn from the charger will be at the specified rate (For example if the input 10 amp, the consumption will initiate with 10 amp rate.)



Stage 1: Voltage rises at constant current to V-peak.

Stage 2: Current drops; full charge is reached when current levels off

Stage 3: Voltage is lowered to float charge level

In the graph as given in battery university you observe a straight portion of the red line signifies the current this also constant as time passes. This portion of charging procedure is referred to as constant current charging. **70 percent** of the battery will be charged in the course of **constant current** period.

2) Constant voltage charging:

The green-colored line in the graph signifies the voltage of the battery that increases in the course of charging. In the position (14.4V) when the voltage will be constant. Subsequently the current will begin to decrease speedily, this is represented by the orange dotted line. This period is known as constant voltage charging. The rest 30% of the battery will be charged during this phase.

3) Trickle charging:

Trickle charging is performed by making use of current equal to self-discharge rate of battery. It is accomplished with no load connected.

The battery must be totally cut-off from charger or it must be trickle charged at reduced current once the charging current extends to 3% of the battery capacity (Ah).

As an example, a 100Ah battery must be cut-off any time charging current minimized to 3A. A 200Ah battery must be cut-off when charging current gets to 6A. Charging over and above this may harm the battery.

NOTE: By measuring just the voltage is not going to inform us if the battery is completely charged or not. It's the current which reveals the actual condition of charge.

Calculate Charging Current for Lead-Acid battery

Charging current for just about any lead acid battery has to be according to manufacturer's proposition. On the other hand charging the battery lower than particular current is not going to hurt the battery but it is going to take more time to achieve full charge.

Charging current for lead acid batteries is usually from 10% to 25% of the volume. For instance: When you have 100Ah battery it is possible to charge it at 10A. For those who have 200Ah battery it is possible to charge at 20A, and so on.

Let's suppose, the battery is discharged (not over discharged) you can apply this formula:

Hours = Ah / Charging Rate

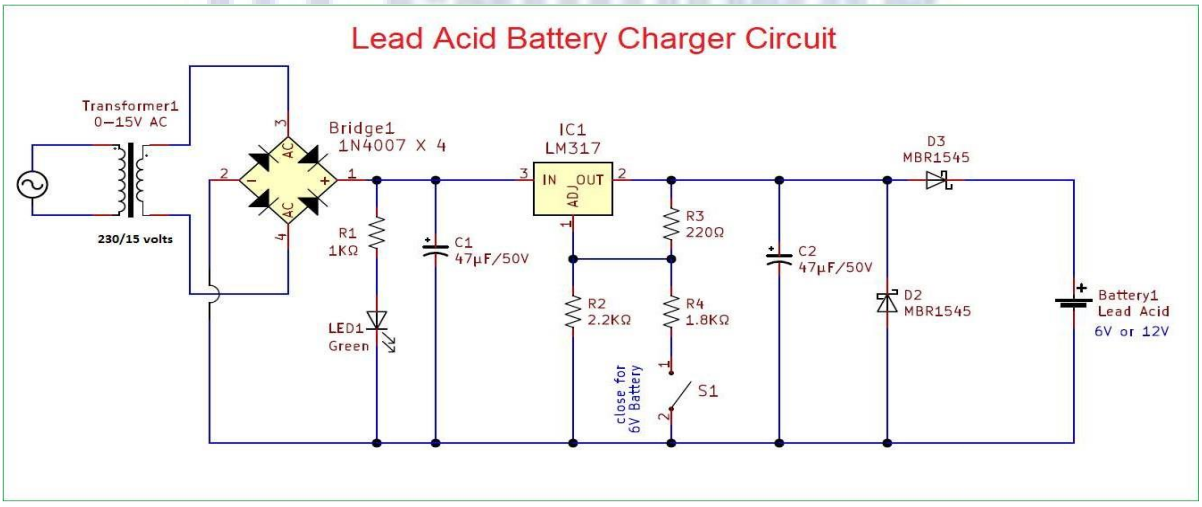
For example:

Hours = 100A / 10Ah = 10 hour.
It is best to measure the current to ascertain if the battery is completely charged or not.

Now you fully understand, at what current and voltage the battery should be charged for an available capacit of lead-acid battery. You understand when should you cut-off the battery from the source voltage and you likewise have obtained a rough idea regarding how much time it requires to charge a battery fully.

2) Battery charger

Circuit diagra of 6v /12v battery charger shown in below fig re.



Components Required

1. Step down Transformer 0-15V AC (as per your requirements)
2. Bridge Rectifier module or 1N4007 X 4
3. Regulator IC LM317
4. Resistors 1KΩ, 2.2KΩ, 220Ω, 1.8KΩ each one
5. Capacitors 47µF/50V = 2
6. LED green
7. SCHOTTKY diode MBR1545 = 2
8. on/off switch

Construction & Working

Lead Acid batteries are having medium lifespan and require proper Recharge and Load circuits. If Lead Acid battery plate active materials are dissolved then battery will no longer sustain recharge cycle that means battery dies. Maintaining Lead Acid battery with proper Recharge circuit can extend the lifespan.

This circuit is designed to charge 6V and 12V battery and Switch S1 decides the output voltage. Here 4 Amps Step down transformer (0-15V AC) is used to reduce the 230V AC supply and then Bridge Rectifier module is used to convert AC supply in to DC supply, LED1 indicates the presence of DC supply and Positive voltage Regulator LM317 Regulates the DC Supply to Required level and by connecting R3, R4 Resistors with Adjust pin this Regulator provides 6V output and disconnecting these Resistors output will rise to 12V.

Two SCHOTTKY Rectifier diodes are connected at the output to protect Battery and circuit from Reverse Current and Reverse polarity connections.

3) Lead acid battery

Working of Lead Acid Battery

The storage battery or secondary battery is such a battery where electrical energy can be stored as chemical energy and this chemical energy is then converted to electrical energy as and when required. The conversion of electrical energy into chemical energy by applying external electrical source is known as charging of battery.

Whereas conversion of chemical energy into electrical energy for supplying the external load is known as discharging of secondary battery.

During charging of battery, current is passed through it which causes some chemical changes inside the battery. This chemical changes absorb energy during their formation. When the battery is connected to the external load, the chemical changes take place in reverse direction, during which the absorbed energy is released as electrical energy and supplied to the load.

Now we will try to understand the principle **working of lead acid battery** and for that we will first discuss about **lead acid battery** which is very commonly used as storage battery or secondary battery.

Materials used for Lead Acid Storage Battery Cells

The main active materials required to construct a lead acid battery are

1) Lead Peroxide (PbO_2)

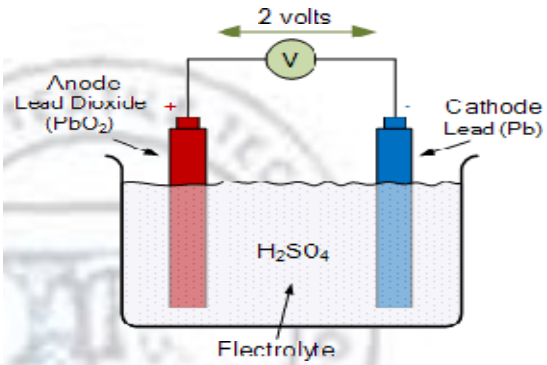
The positive plate is made of lead peroxide. This is dark brown, hard and brittle substance.

2) Sponge Lead (Pb)

The negative plate is made of pure lead in soft sponge condition.

3) Dilute Sulfuric Acid (H_2SO_4)

Dilute sulfuric acid used for lead acid battery has a ratio of water : acid = 3:1.



PROCEDURE

1. Connect the battery charger with supply.
2. Connect the output terminal of the charger with the battery according to its voltage for example a 6 v battery is connected to the 6 volts terminal.
3. Connect the positive (+ve) terminal of the charger with the (+ve) terminal of the battery and the negative (–ve) terminal with the (–ve) terminal of the battery.

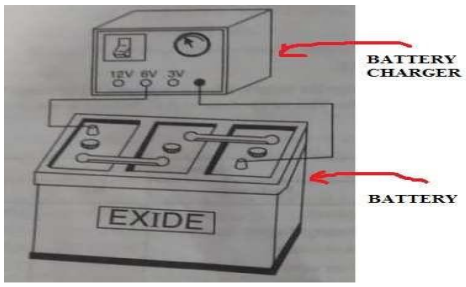


FIG.1

4. Switch ON the supply.
5. Let the battery charge for 24 hours.

6. Switch OFF the supply.

7. Measure the specific gravity of each cell by the hydrometer. Specific gravity f cell should be between 1250 to 1280.

   (I) Take a hydrometer and press the rubber bulb full so that a vaccum is created inside it.
   (II) The rubber nozzle in the electrolyte as shown in the Figure 2.
   (III) Release the rubber bulb slowly.
   (IV) Fill the electrolyte such that it starts floating.
   (V) Note the reading on the glass tube.

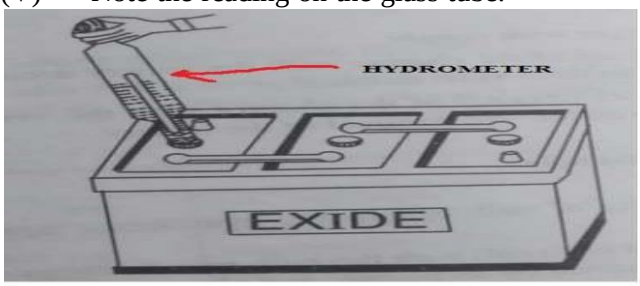


FIG.2

8. Now measure the voltage of each cell with the high rate discharge cell tester. The voltage of each cell is 2V/cell which is indicated by its pointer and also indicates whether it is half charged fully charged or discharged.

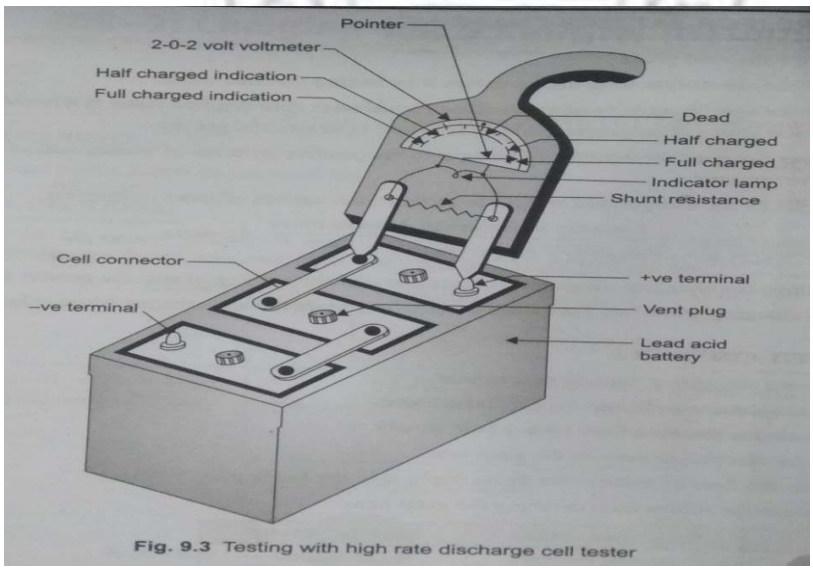


Fig. 9.3 Testing with high rate discharge cell tester

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PRECAUTIONS

1. The output voltage terminal of the charger should be similar to that of voltage terminal of the battery.

2. The +ve terminal of battery should be connected with the +ve terminal of the charger.

3. Use clips for tight connections.

4. Electrolyte should be filled to such an extent that floats starts floating in the hydrometer. 5. If it is felt that electrolyte is less, acid should be poured in water in drops.

6. Cell tester should not be kept on the cell for a long period.

CONCLUSION

From the above experiment we study the working of battery charger. We charged a 6v lithium ion battery using battery charger and measured following data:
Output voltage per cell=2v
Output voltage of battery = 2v
Specific gravity of solution (H_2SO_4) =1254

DISCUSSION QUESTION:-

1.How a lead acid battery charger is made ?

2.What is the life of a lead acid battery ?

3. What is need of lead acid battery ?

4. What is the advantages of lead acid battery?

5.What do lead acid battery die ?

EXPERIMENT NO:05

AIM OF THE EXPT:-

Erection of residential building wiring by CTS and conduit wiring system using main twopoints and test installation by test lamp method and megger

APPARATUS REQUIRED:-

SL NO.	NAME OF EQUIPMENT	SPECIFICATION	QUANTITY
1	Main switch	240V/32A	1no.
2	Single way switch	5A,230V, & 15A	7nos.
3	3 pin socket	5A,230V & 15A	5nos.
4	FAN regulator	60watt	1no.
5	Ceiling rose	5A, 230V	1no.
6	Copper wire	——	As per reqd
7	Earth wire	$1.5mm^2$	As per reqd
8	Wooden screw	1/2”	As per reqd
9	Angle Holder	5A, 230V	1no
10	Batten holder	5A, 230V	1no
11	Switch		
12	Lamp		
13	Wire		
14	Fuse		

TOOLS REQUIRED:-

SL NO.	NAME OF THE TOOLS WITH FULLSPECIFICATION	QUANTITY
1	Insulated combination plier(TAPPARIA)	2no
2	Insulated screw driver(TAPPARIA)	2no
3	Insulated screw driver	1no
4	Hand drill	1no
5	Tester	1no
6	Knife	1no
7	Insulated Cutter	1no

Theory:-

C.T.S. (Cable Type Sheathed) wires: In this type, ordinary insulated conductors are provided with an additional tough rubber sheath .This also provides a protection against moisture, chemical fumes and tear.

Type of Conduit Wiring: Depending upon whether the conduits are laid inside the wall or supported on the walls, there are two types of conduit wiring.

Surface Conduit Wiring: In this method, conduits are fixed on the wall by means of saddles screwed to rawl – plugs or wooden plugs embedded in the wall. In damp situation, these conduits are spaced apart from the wall surface by small wooden blocks fixed below thepipe at regular intervals as illustrated

Concealed Conduit Wiring: This method employs heavy gauge rigid conduits buried under wall plaster. Such wiring is used in case where beauty is the main consideration irrespective of cost.

Application: Surface conduit wiring is mainly used for all indoor and outdoor wiring of permanent nature for light and power e.g. in godowns , workshops and public

buildings. The concealed type is preferably used in public building, offices, shops and housesfor its nice appearance.

The Domestic supply system is u 230v, 1 phase system. The 3 phase, 400v,50c/s ACdistributors. Running through every street caler to the electricity needs of every house hold.

From the service mains, o phase wire & a neutral wire are taken & run the each house, through a cutout or fuse placed in the phase line. These wires are food through a sealed electricity energy

meter (kwit meter) to a main switch from where it is taken to o branch distribution box. From this box the wiring of various house hold circuit are taken. The IE rules no 32 states that an indicotion of permanent natures shall be provided to distinguish neutral conductor from a line conductor. Red color a for line wire (i.e. live wire) & Block for earth neutral. In a 3 Core Coble feeding portable apparatus Red will be for the phase Nine, Black for the earthed neutral & white for the earth Continuity wire.

The wiring may be done in various ways. The wires may be VIR (Vulcanized Indian Rubber)or PVC (Polyviny chloride) or CTS (cob type sheathed) Cable

Conduit wiring is perhaps best from point of view of eventuation of fire hazards of these are totally enclosed.metal sheath wiring is the next best PVC cables are less combustive than VIR wire, From point of view of cheaper cleat .wiring comes first followed casing & capping.CTS wiring sheath & finally conduit wiring.

In house wiring there are certain precautions to be followed.

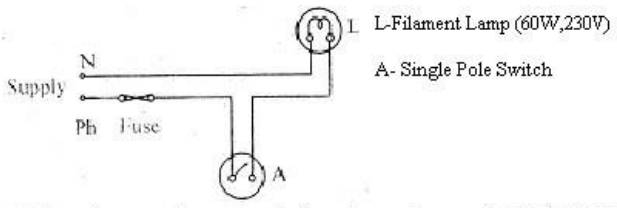
* In a neutral conductor must be replaced by a link. If fuses of the same capacity are providedone on the phase line & the other on the neutral line when a short CKT occurs one of them will blow out first any one of the two. If the fuse on the neutral will blow, the faulty apparatus will continue to be live the phase line fuse will be intact. Hence replace the neutral side fuse holder by a link.

The single pole tumbler switches used frequency must be connected in the phase line only through an witch is equally effective whether it is the neutral line of the phase from the point of view of safety the switch must be on the phase conductor & not on the neutral (IE rule 32)The reason is the switch he in the neutral line, the apparatus us well as part of the wiring will be line even when the switch is open i.e, off the switch position will dissipative may givea false sense of security of however the switch being the phase line & be off the equipment will be dead.

Control of One Lamp :-

Apparatus: Switches, lamps, wires, & fuse.

Wiring diagram: for controlling the lamp L, a single pole switch A is introduced in its circuitsas shown in fig



Wiring diagram for control of one lamp by one single pole switch

The live or phase wire is always connected to the lamp holder through the switch, whereas, neutral is connected directly to it. All the accessories such as a single pole switch, lamp holder etc. are always fitted on the teak wood round block.

Working: When the switch is turned on, a full supply voltage is applied across the lamp terminals and the lamp glows. Thus, the lamp can be independently controlled by the single pole switch.

Application: the circuit is used for single room wiring.

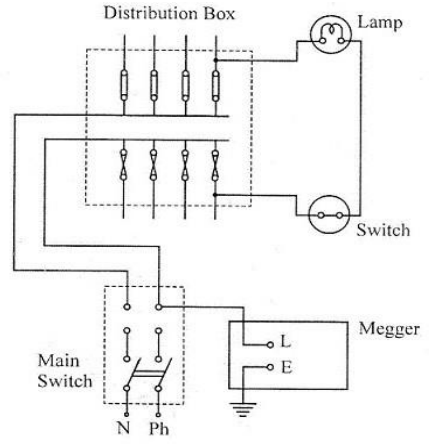
Testing of Wiring Installations Using Megger:-

It is necessary to carry out the following testson a wiring installation before it is put into service.

Insulation Resistance to Earth: Insulation resistance between all the conductors and e rth is measured with the help of a 500 V megger as illustrated in Fig. 1.17. With all fuse links in position, all switches on (exceptmain switch w ich should be off) and alllamps in position, the line terminal of the megger is connected to either of the main leads (phase or neutral) and the earth

terminal is connected to any point on the earth continuity conductor of the system. H ndle of the megger is then rotated and its reading is noted down. This reading directly gives the insulation resistance between all the conductors and earth. This resistance should not be less th n 50 M divided by the number of outlets (every switch, socket and lamp holder counting a an outlet). However, for installations using P. .C. insulated cables, it should not be less than

12.5 MΩ divided by the number of outlets. It is desirable that the insulation resistance shouldbe more than 1 MΩ for the entire i stallation. For motors and large lighting installations,



Measurement of insulation resistance to earth

maximum leakage current allowed is not to exceed 1/5000 part of the full load current. Hence, minimum insulation resistance required may also be calculated from this limiting value of leakage current.

Insulation Resistance between Conductors: Insulation resistance between the two conductors (phase and neutral) of the wiring installation is also measured with the help of a megger. With all fuse links in position, all switches on (except main switch which should be off) and all lamps and appliance out, megger terminals are connected between the two conductors as shown in Fig.1.18. Reading of the megger under this condition gives the insulation resistance between the two conductors under test. The resistance should not be less than that specified inthe previous test.

(c) Continuity Test: Continuity of any wire used for wiring installation or of any circuit in the wiring installation can be checked with the help of a megger. For this, the megger terminals are connected to the two ends of the wire or circuit under test

The handle of the megger is then rotated. If the pointer indicates zero resistance, then the wire or the circuit is continuous (or unbroken). If, however, the pointer shows infinity reading, then the wire or the circuit is faculty (or open-circuited).

FISHING:-

It is the use of a weighted chain to guide a wire or conductor through a hole in the plate of a wall to prevent unnecessary wall damage or removal when remodeling the wiring in existing homes and buildings. A thin nylon rod is sometimes used in a reverse process to push through the openings instead, and some refer to all procedures used to install wiring in existent walls as fishing. A long thin metal tape of study construction called a fish tape is frequently used to pull wires through pre-existing conduits by electricians.

A drawback is that the work is done blindly through enclosed spaces that may contain sharp objects that potentially cause damage to the wires including the possibility of hidden arc- faults.

CONCLUSION:-

From above experiment we study CTS and conduit wiring and measure insulation resistance using megger.

DISCUSSION QUESTION:-

1. What are the different types of wiring?
2. what is fishing?
3. which type of wiring is used temporarily ?
4. Testing of wiring can be done by which methods ?

EXPERIMENT NO-06

AIM OF THE EXPT.

Fault finding and repairing of fan and observation of different parts.

APPARATUS REQUIRED

Sl.no	Name	Specification	Quantity
1	Ceiling Fan	1ø230v,50Hz,60W	1no
2	Insulated Plier	15cm insulated	2no
3	Screw Driver	15cm	2no

THEORY:-

1. What do you do if your fan stops working?

The faults which are occured inside a ceiling fan, they are-

i. Damage of winding insulation due to over heating or short circuit fault.
ii. Slow speed of fan due to weak capacitor.
iii. Some unwanted noise due to bearing faults, cracking of shaft, cracking of blade etc.
iv. Reverse rotation due to wrong connection of capacitor and the terminal of fan.

Repair-

i. At first check continuity of winding by series lamp method. If it is not working then we should rewinding the fan.
ii. If the capacitor is weak then it is replaced.
iii. If any fault occurred inside the bearing then either it is replaced or greased it (put some lubricants).
iv. If any fault is occured in shaft or blade then it is replaced.
v. Reverse rotation can be removed by accurate connection between terminals of fan capacitor.

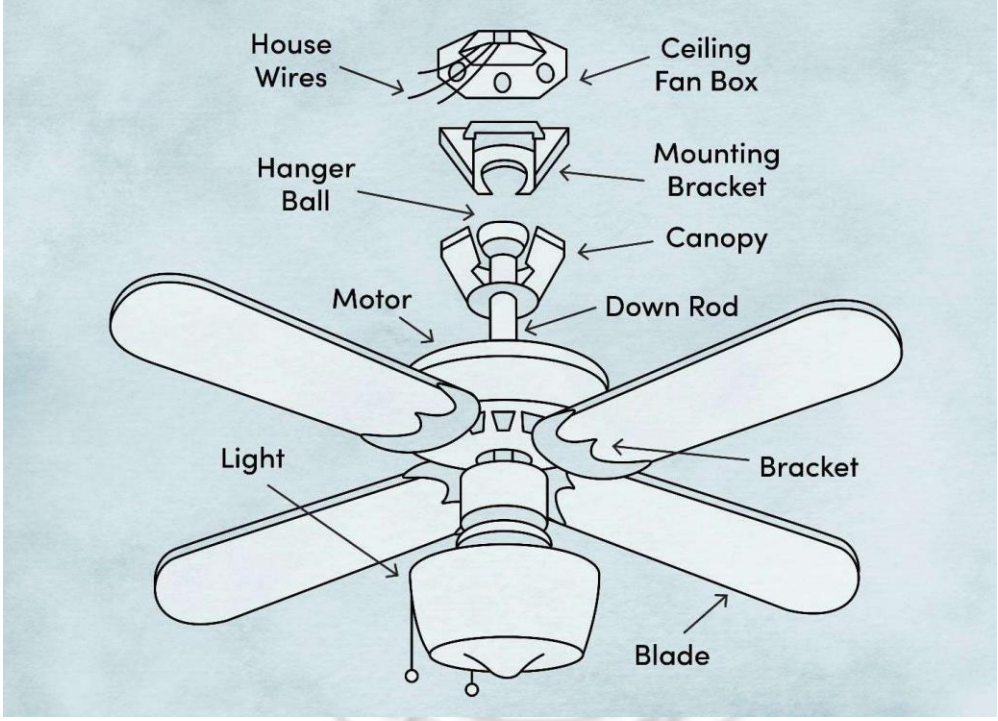
2. How to fix fan blades that won't turn?

i. Turn your fan on and listen for the engine of the fan.
ii. Make sure the fan is unplugged.
iii. Look at where the fan blade unity connects to the bearing and motor.
iv. Remove the center café from the fan blade unity.
v. Press the strand that come with your metal lubricant spray in to the nozzle of the fan.
vi. Look at where the fan blade unity connects to the bearing and motor.
vii. Remove the center café from the fan blade unity.
viii. Press the strand that come with your metal lubricant spray in to the nozzle of the fan.
ix. Look at where the fan blade unity connects to the bearing and motor.
x. Remove the center café from the fan blade unity.
xi. Press the strand that come with your metal lubricant spray in to the nozzle of the fan.

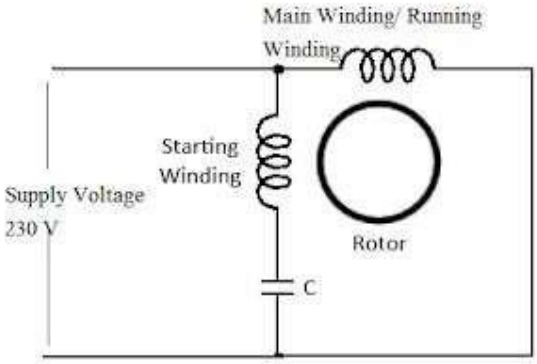
DIAGRAM

ROTOR OF CEILING FAN-:

DIFFERENT PARTS OF CEILING FAN-:



CIRCUIT DIAGRAM-



CONCLUSION-:

From the above experiment we study different parts of ceiling fan and find the fault.

DISCUSSION QUESTION

I. What is S.W.G? Draw a neat diagram.
II. What is Auxillary Winding?
III. What is Main Winding?
IV. What is Ferrari's Principle?
V. Why 1phase I.M are not self starting?

EXPERIMENT NO:-07

AIM OF THE EXPERIMENT:-

Find out fault of DC generator, repair and test it to run.

EQUIPMENT REQUIRED:-

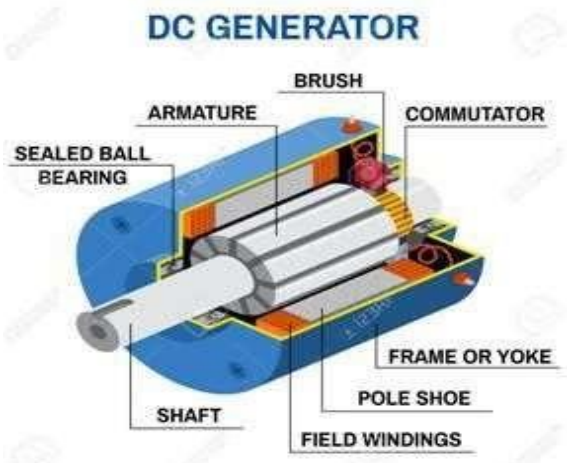
Sl.no	Name	Specification	Quantity
1	DC shunt generator	7 kw 220v dc , 15A	1no
2	Insulated Plier	15cm insulated	2no
3	Screw Driver	15cm	2no

THEORY:-

An electrical machine is a mechanical device which converts mechanical energy in to electrical energy. The energy conversion based on the principle of production of dynamically induced emf .A production machine consists of the following essential parts.

PARTS OF A DC MACHINE:-

1. Pole core or pole shoe.
2. Magnetic frame or yoke.
3. Pole coils or field coils.
4. Armature core3.
5. Armature winding or conductor.
6. Commutator.
7. Brushes



FAULT FINDING OF DC GENERATOR:-

A. Generator fails to build up voltage:

SL.NO	Reason	Remedies
1.	Direction of rotation reverse.	Change the direction of rotation(D.O.R)
2.	No residual magnetism	Recharge the poles by the help of battery or DC source.
3.	Open circuit in armature.	Check the armature winding circuit.
4.	Open circuit in field winding.	Check the field winding circuit.
5.	Short circuit in field winding .	Check the field winding circuit.
6.	Brushes contact not proper withcommutator.	Keep the brushes at M.N.A. and contact shouldbe proper.

B. Generator having heavy sparking at commutator:

SL NO	Reason	Remedies

1.	Brushes are not a M.N.A. position.	Set the brushes at M.N.A. position as per generator direction of rotation.
2.	Not proper spring tension on brushes.	Check and set the spring tension.
3.	Carbon or dust on the surface of commutator.	Clean the commutator with fine sand paper.
4.	Commutator surface is not proper.	Check and get it proper on the lathe machine .
5.	Cross in armature winding.	Check the armature winding and remove the fault.
6.	Wrong connection of inter poles	Check the direction of inter poles .It should be the same in the case of generator and opposite in case of motor with respect to main poles.
7.	Mica is not properly placed .	Check the mica surface between two segments and sets its surface properly.
8.	Brushes are not of proper size and grade.	Check the size and grade of brushes .

C. Generator produces more heat and sound

SL N O	**Reason**	**Remedies**

1.	Defective bearings.	Check and lubricate the bearings or replace the bearing.
2.	More load on armature.	Reduce the load.
3.	Improper fitting on the end	Fit the bearings in covers properly and tight the screws.
4.	covers.More sparking .	Check the reason explained in the above table.
5.	Not properly fixed .	Check the foundation nut bolts.

Finally, to minimize failures, regular preventative maintenance inspections and takes should be carried out. Power supply circuitry should include overload protection to remove transient voltage spikes.

CONCLUSION:-

From the above experiment we study different faults associated to dc generator .and how to minimize the failures

DISCUSION QUESTION:-

1. What is DC generator?
2. What are the effects of armature reaction?
3. Write down main parts of DC generator?
4. Why the armature is laminated?
5. What are types of dc generator?

EXPERIMENT NO.8

AIM OF THE EXPERIMENT-:

Find out fault of d.c. motor starter and a.c. motor starter –prepare an inventory list of parts used in different starter.

APPARATUS REQUIRED.

Sl.no	Name	Specification	Quantity
1	DC 3 point starter	220 V AC , 15A	1
2	DOL Starter	230 V AC, 15A	1
3	Series lamp	-	1no
4	Insulated Plier	15cm insulated	2no
5	Tester	-	1no
6	multimeter	-	1 no

THEORY:-

FAULT FINDIND AND SOLUTION OF AC MOTOR WITH ASTARTER-

PROBLEM	POSSIBLE CASUE	TESTS	SOLUTION
Motor will not start.	**1.** Fault with supply. **2.** Motor or load locked up. **3.** Wrong connections in control circuit.	**1.** Check for correct voltage at motor terminal. **2.** Make sure motor and load are free to turn. **3.** Check to ensure contactors operate.	**1.** Fit news fuse, reset circuit breakers, etc. **2.** Remove clamps, locks, etc. **3.** Sort out control circuit.

Supply or started tripsout at start.	**1.** Wrong or loose connections. **2.** Motor overload. **3.** Intertie of load to high. **4.** Low voltage due to volt drop in cable. **5.** Overload or circuit breaker incorrectly set or sized.3	**1.** Check all lugs are properly crimped or soldered, and connections are tight. **2.** Check load performance data. **3.** Measure voltage at motor terminals while motor starting. **4.** Check setting of overload and circuit breaker and allow for starting current.	**1.** Fix up connections. **2.** Change motor for correct size. **3.** Change cable for correct size. **4.** Correct setting of overload or breaker or change.

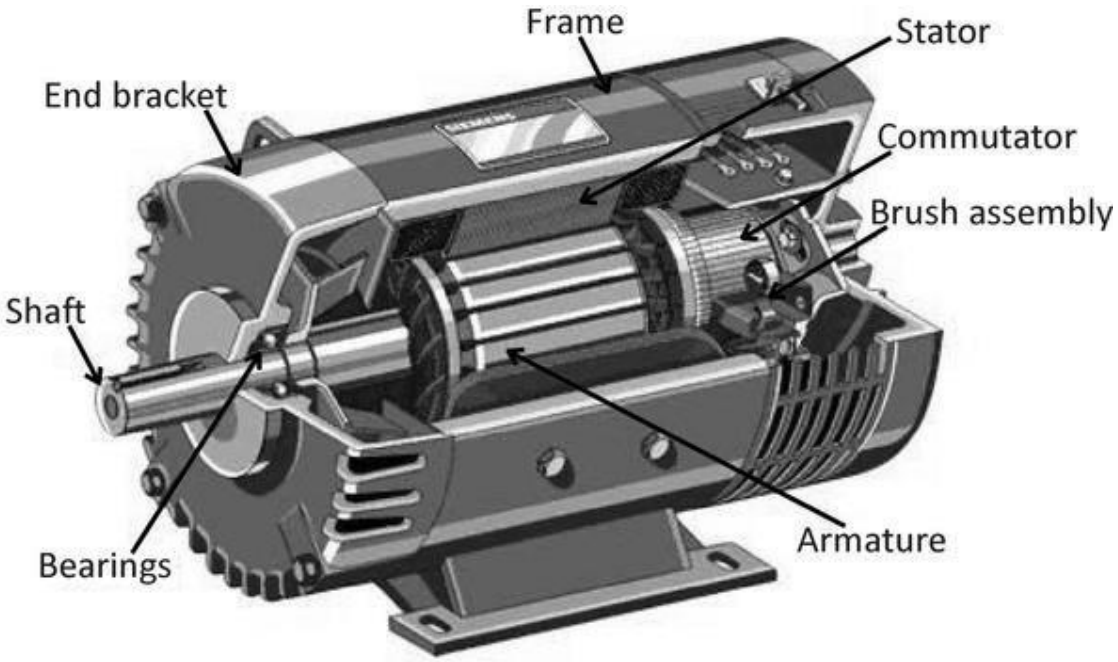
Motor starts but has no torque. Motor does not reach full speed or takes a long time to accelerate.	**1.** Incorrect connection. **2.** Delta wound motor connect in star. **3.** Star/delta starter staying in star. **4.** Intertie of load to high. **5.** Motor overloaded. **6.** Low voltage due to volt drop in cables.	**1.** Check connection diagram and nameplate data. **2.** Check load. **3.** Measure voltage at motor terminals while motor starting.	**1.** Sort out and correct connections. **2.** Check timer and starter control circuit. **3.** Change motor for correct size. **4.** Change cables for correct size.
Motor overheating.	**1.** Motor overloaded. **2.** Ineffective cooling. **3.** Excessive ambient. **4.** Wrong connection. **5.** Delta wound motor in star. **6.** Wrong "single phasing". **7.** Wrong voltage or frequency. **8.** Supply voltage unbalanced.	**1.** Check load performance data. **2.** Check fan and air flow and temperature of air. Look for build-up of dirt. **3.** Check connection diagram nameplate data. **4.** Check volt and amps in all three phase. **5.** Check nameplate.	**1.** Fix problem load or fit large motor. **2.** Clean motor. Sort out cooling of air temp. and flow. **3.** Sort out connections. **4.** Restore supply to all phase. **5.** Correct voltage frequency. Balance supply or accept unbalance.

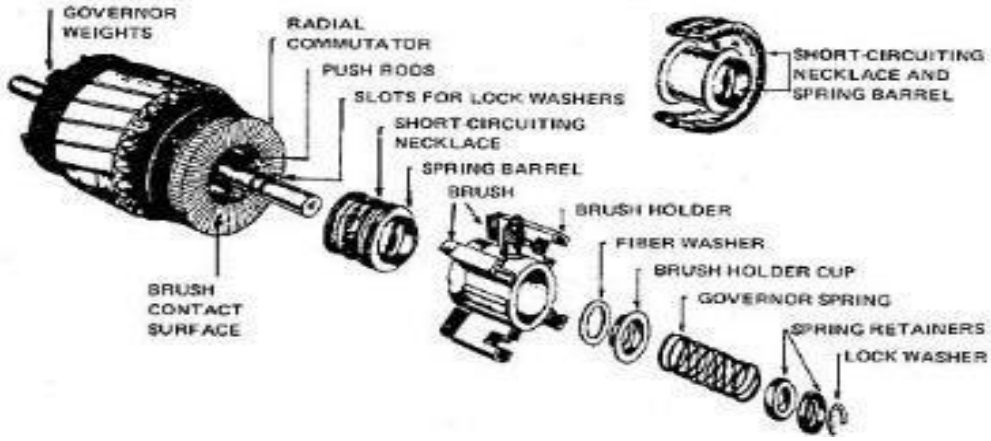
No load amps in excess of full load amps.	**1.** Incorrect connection **2.** Star wound motor connection delta **3.** voltage in excess of nameplate. **4.** Motor supplied for different voltage or frequency.	**1 & 2** . check connection diagram and nameplate data. **3.** measure voltage at motor terminals. **4.** compare supply voltage and frequency to nameplate.	**1 & 2.** Sort out and correct connections at motor terminals. **3.** correct supply voltage. **4.** change motor for correct voltage and frequency.
Mechanical noise or vibration. Noisy bearings. Bearings overheating.	**1.** Trust from load or misalignment. **2.** Damaged bearings too much grease, no grease, or foreign matter in grease. **3.** Rotor pulling or foreign matter in air gap. **4.** Out of balance load, coupling or pulley. **5.** Excessive belt pull.	**1.** Check gap between coupling halves and alignment. **2&3** .turn shaft slowly by hand feel for roughness or stiffness. Check for bent shaft or fan rubbing. **4.** run motor disconnected from load and then with pulley or coupling removed removed. **5.** run motor without belts. **6.** check design and constructions foundations.	**1.** Re-align couplings **2&3**. Clean bearing housing, change bearings and repack with fresh grease. **4.** fix up out of balance items. **5.** loosen belt tension. **6.** increase strength of foundations.
	6. Motor foundations not rigid.		

Motor amps in excess of nameplate full load amps on load.	**1.** Motor overload. **2.** Low supply voltage. **3.** Wrong voltage or frequency. **4.** Wrong connection. **5.** Motor " single phasing". **6.** Supply voltage unbalanced. **7.** Motor speed not match to load.	**1.** Check load and performance data. **2.** Measure voltage at motor terminals. **3.** Check nameplate. **4.** Check nameplate 5&6. Check volts and amps in all three phase. **7.** measure motor speed and check load speed requirements.	**1.** Fix problem with load or fit larger motor. **2.** Fix problem, maybe with larger cables. **3.** Correct voltage or frequency. **4.** Sort out and correct. **5&6**. Restore balanced supply to all three phase. **7.** change motor for correct motor speed.
Excessive electric noise.	**1.** Wrong connection **2.** Wrong voltage. **3.** Motor "single phase".	**1.** Check connections. **2.** Check voltage with nameplate. **3.** Check volts with amps in all three accurately.	**1.** Fix up connections. **2.** Correct voltage. **3.** Restore supply to all three phase.
Unbalanced amps in different phase when motor loaded.	**1.** Unbalanced supplying voltage.	**1.** Measure phase to phase voltage accurately	**1.** Balance supply or accept unbalanced.

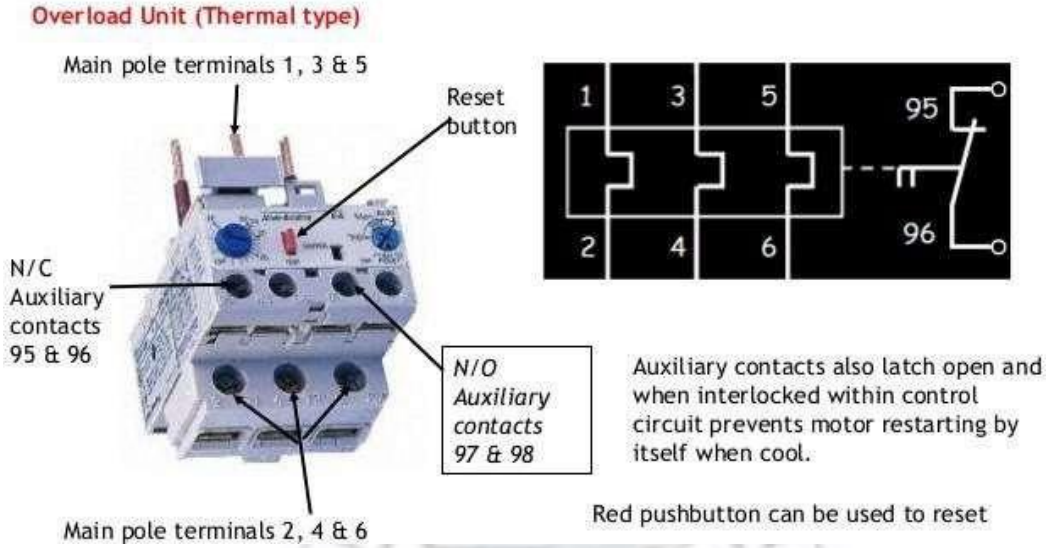
Motor runs in wrong direction.	**1.** Wrong connections.	**1.** Watch shaft rotation.	**1.** Swop two phase of supply.

DIFFERENT PARTS AND AC MOTOR AND STARTER-


Frame
Stator
End bracket
Commutator
Brush assembly
Shaft
Armature
Bearings


GOVERNOR WEIGHTS
RADIAL COMMUTATOR
PUSH RODS
SLOTS FOR LOCK WASHERS
SHORT-CIRCUITING NECKLACE
SPRING BARREL
BRUSH
BRUSH HOLDER
FIBER WASHER
BRUSH HOLDER CUP
GOVERNOR SPRING
SPRING RETAINERS
LOCK WASHER
BRUSH CONTACT SURFACE
SHORT-CIRCUITING NECKLACE AND SPRING BARREL

COMPONENTS OF D.O.L. STARTER :

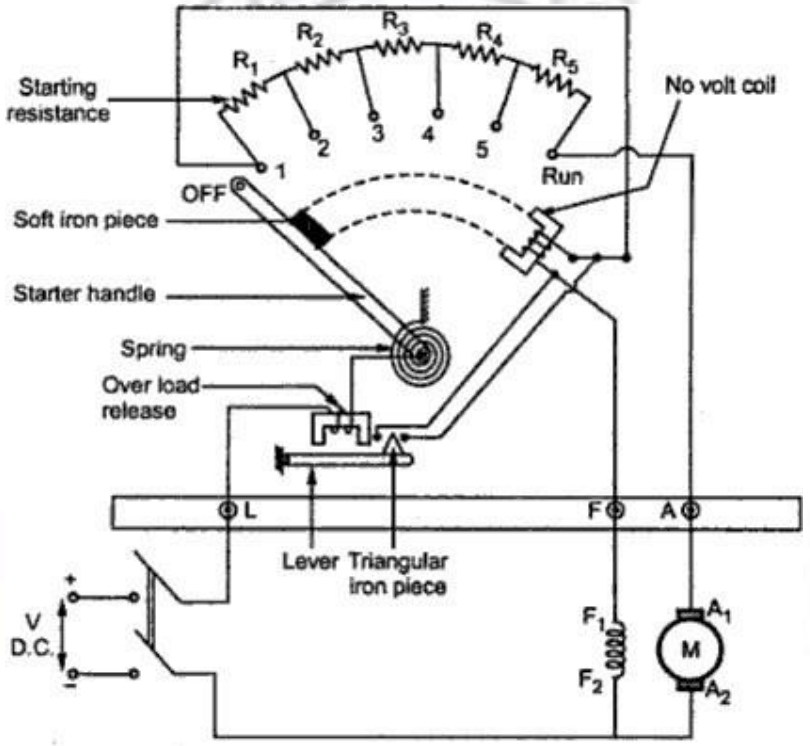


FAULT FINDIND AND SOLUTION OF DC MOTOR WITH ASTARTER.

PROBLEM	CAUSES	REMEDIES
Motor fails to start.	1. Main supply off. 2. The brushes are not making good contact with the commutator. 3. Open circuit in armature or in field winding. 4. There may be break in wiring or cable. 5. There may be break in starter resistance.	1.Test supply or fuse with test lamp. 2.Clean the commutator with sand-paper and set the brushes to exert pressure and make good contact. 3. Test the armature and field windings with a test lamp. 4. Test the continuity of the ending from main switch to motor. 5. Test the starter.

Motor gives shock	1. Armature of field coils or brush holder may be earthed. 2. The body of the motor is not properly earthed.	1. Test the insulation of rocker arm. Tight the earth wire 2. Test the earth wire if it is loose, tight it.
Motor blows fuse at start	1. The capacity of the fuse is small as compared to load. 2. Over load. 3. Body of the machine may be earthed. 4. Short circuit in the starter resistance. 5. Wrong starting and moving the handle very quickly.	1. Replace fuse with proper size. 2. Reduce the load. 3. Trace the earth by megger or test lamp and insulate it. 4. Check the starter resistance and remove the defect. 5. Start the motor properly by slowly moving the handle.
Motor runs at avery highspeed	1. No load (in case series motor) 2. Motor may be different compound. 3. Open circuit is in no coil. 4. Supply voltage is too high. 5. The field regulator of shunt field may be completely in "ON" position.	1. Put the load on motor before starting. 2. Check and reverse the direct of current in series field. 3. Test the continuity with test lamp or megger. 4. Check supply voltage, if it is possible reduce the voltage. 5. Adjust the regulator to the OFF position at the time of starting.
Low speed than rated speed	1. Low voltage. 2. Bearing may be loose. 3. Excessive load on the motor. 4. Short circuit or earth in the armature.	1. Check the supply voltage and start the motor according to its rated voltage. 2. Replace the bearing. 3. Reduce the load. 4. Rest polarity of main poles with a
		compass needle and connect them alternating "N" and "S".
Sparking on the brushes	1. Commutator surface is not round and smooth. 2. Commutator is dirty. 3. Mica level above the commutator segment. 4. Loose contact of brushes with the commutator. 5. Brushes holder are loose. 6. Brushes are not in the neutral axis. 7.Over load on the motor.	1. trun commutator on lathe and also clean with sand-paper. 2. Clean the commutator with sand-paper Or petrol. 3. Cut down the mica 1/10" below the commutator with a fine saw. 4. Adjust the spring tension. 5. Tighten the brushes properly. 6. Adjust brushes position. 7. Reduce load.

Sound in the motor	1. Loose fitting of foundation. 2. Loose field poles to the yoke. 3. Sound from brushes. 4. Loose bolts of side covers. 5. Defective bearing.	1. Tight the nut bolt of the foundation. 2. Tight the field poles. 3. Check the armature shaft on lathe machine and get the fault rectified. 4. Apply a little gasoline on the brushes. 5. Tight the nut bolts. 6. Check and replace if necessary.
Overheating	1. Short circuit in the windings. 2. Faulty or dirty bearings. 3. Overload on motor. 4. Due to sparking at the commutator.	1. Test the winding and remove the fault. 2. Wash it properly. 3. Reduce the load. 4. Remove the cause and reduce the sparking.



3 point Starter

Conclusion-

From above experiment we study different parts of dc and ac starter and different faults associated with starter.

DISCUSSON QUESTION.

1. What is crawling ?
2. What is cogging ?
3. What I plugging ?
4. What is NVR ?
5. What is OLR ?

EXPERIMENT NO.09

AIM OF THE EXPERIMENT

Dismantle, over haul and assemble a single phase induction motor, Test and run it prepare an inventory list

APPARATUS REQUIREMENT

SL NO.	NAME OF EQUIPMENT	SPECIFICATION	QUANTITY
1	1 Phase induction motor	400v,20hp,50hz	1no.
2	Series lamp	100Watt	1nos.
3	Multimeter	Digital	1nos.
4	Neon Tester	0-500v	1no.
5	c-plier	Insulated-15cm	1no.
6	Screw Driver	Insulated-15cm	1no.
7	Spanner	TAPARIA	1no.
8	E Knife	Insulated-15cm	1no.
9	Insulation Tape	PVC type	1no.
10	Connecting Wire	2.5 mm copper	As per required

THEORY: -

Some physical task, this induction motor requires only one power phase for their proper operation. they are commonly used in low power application, in domestic and industrial use, simple construction, cheap cost, better reliability, eases to repair and better maintenance are some of its Markable advantage

Construction of single phase induction motor:

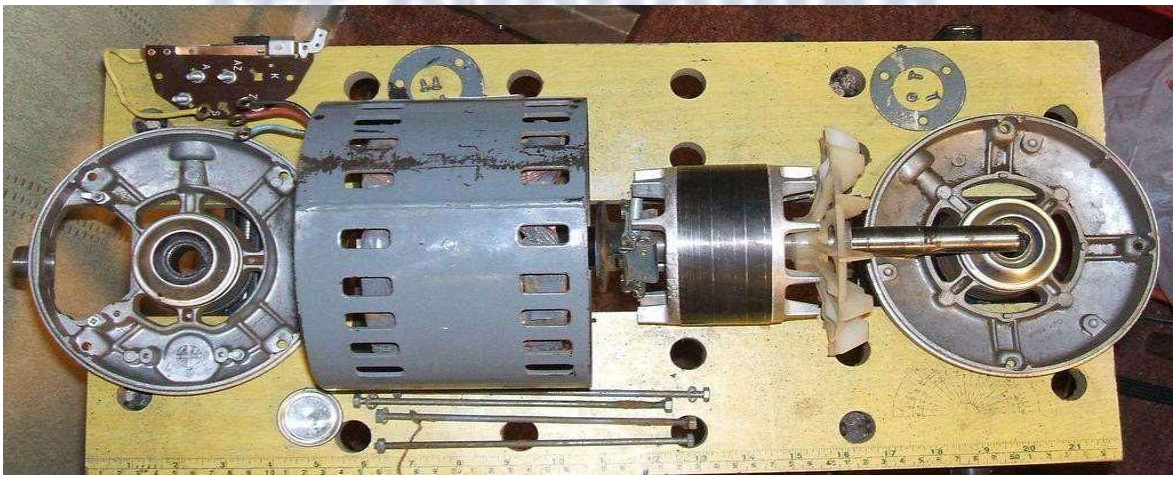
The main components of the Single Phase induction motor are stator and rotor. Stator is known to be

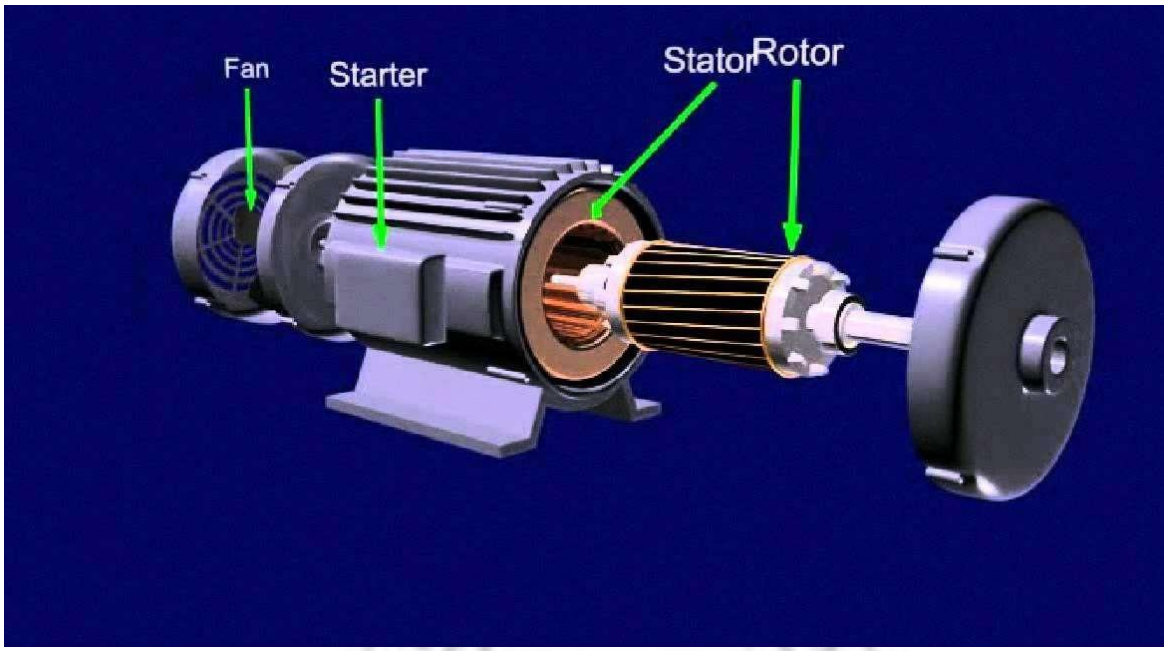
the stationary Single phase induction motor is an AC motor were electrical energy is converted to mechanical energy to perform part. Usually, the single phase alternating supply is given to the stator winding. Rotor is the rotating part of the motor. Rotor is connected to the mechanical load with the help of a shaft. A squirrel cage rotor is used here.

It has a laminated iron core with many slots. Rotor slots are closed or semi-closed type. The rotor windings are symmetrical and at the same type it is short circuited. An air gap is there between the rotor and the stator. The most practical applications of this motor are in refrigerators, clocks, drills, pumps, washing machines etc. The stator winding in the 1Ø induction motor has two parts: Main Winding and Auxiliary Winding. Usually, the Auxiliary winding is perpendicular to the main winding. In 1Ø induction motor the winding with more turns is known as main winding. While the other wire is called as auxiliary winding.

Principle of operation of 1 phase induction motor:

A Single Phase Induction Motor consists of a single phase winding which is mounted on the stator of the motor and a cage winding placed on the rotor. A pulsating magnetic field is produced, when the stator winding of the single-phase induction motor shown below is energized by a single phase supply The Word Pulsating means that the field builds up in one direction falls to zero and then builds up in the opposite direction. Under these conditions, the rotor of an induction motor does not rotate. Hence, a single phase induction motor is not self- starting. It requires some special starting means. If the 1 phase stator winding is excited and the rotor of the motor is rotated by an auxiliary means and the starting device is then removed, the motor continues to rotate in the direction in which it is started. The performance of the single phase induction motor is analyzed by the two theories. One is known as the Double Revolving Field Theory, and the other is Cross Field Theory. Both the theories are similar and explain the reason for the production of torque when the rotor is rotating.





Dismantle of 1phase induction motor

STEPS OF DISMANTLING OF 1 PHASE I.M:-

*First of all remove the pulley of motor on the shaft, also remove the colling fan of the motor then open the screwed on the shaft of the motor.

*The shaft or pully of the motor is always in front of your eyes and then you mark a line on the cover and yoke, the advantage of the line is that when you closing the motor easily meet the mark point & easily cover the motor

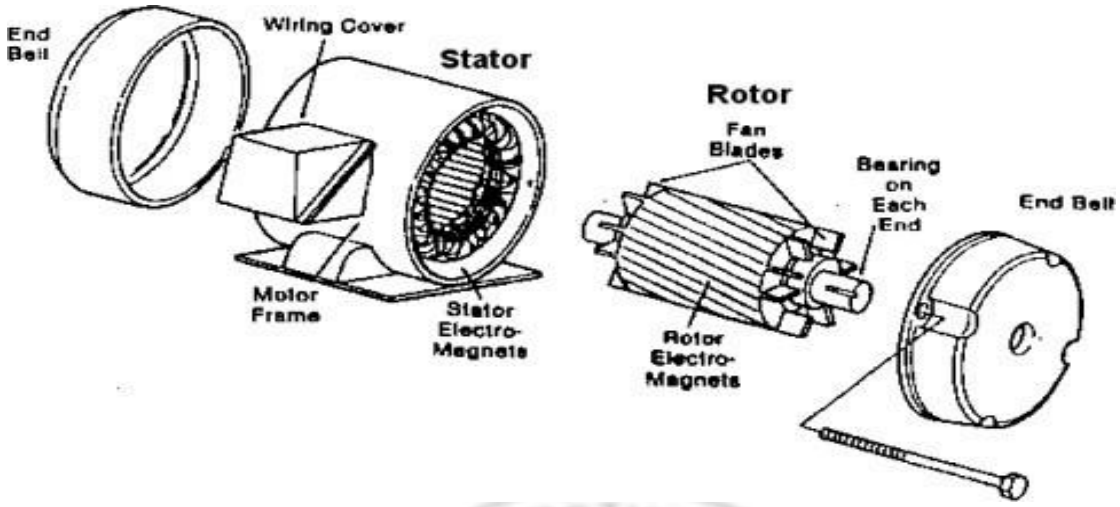
*open the nut-bolt, screw of the end cover of the motor by using spanner or screw driver.

*Two screw driver are inserted in motor cover and apply a little pressure internally as a result, the cover of the motor is easily opened

*After that the rotor of the motor easily come out

*The bearing of the motor is dip in to kerosene, oil and then apply grease into the bearing.

*clean the stator of the motor carefully



STEPS OF ASSEMBLING OF 1 PHASE I.M:-

*First of all, the end cover of the motor is screw with the yoke

*Enter the rotor of the motor in stator

*Fit the rotor in exact position in stator and then screwed the front cover of the motor

*The cooling fan of the motor is screw on the shaft

*in last tight the cover of the cooling fan with the yoke of the motor

STEPS OVER HAULING OF 1 PHASE I.M:-

The 1 phase induction motor can over hauling following manner-

***INSULATION TEST-**

Checking the insulation of the stator winding is very important before and after the overhaul procedure. Multimeter is used for this purpose, with its one probe connected to the winding and other to the earth with switch selected in the resistance knob.

***DISMANTLING-**

Note: Before dismantling any part of the motor or motor connection, marking of both motor housing and connection wires is very important. This will ensure that the boxing back procedure is smooth and there is no mismatch of parts. Also check the direction of the motor rotation before stopping the motor for overhauling.

Before overhauling the motor, pre-planning of removing and fixing back the motor safely in place must be discussed and implemented (depends on place where it's fixed and also on the

size of the motor) otherwise the load side (for e.g. Pump connected to motor) will be damaged by the

motor shaft. The motor can be connected to the load as vertically coupled load and horizontally coupled load.Horizontally coupled having two types:

1. Hinge mounted (Must be done very carefully)

2. Base mounted

Above the processes are completed, perform the following procedure:

1. Removal of Bearing Housing Cover:-

While removing the bearing housing cover, note that some motors will be having inner bearing cover tightened with nut bolts. Remove it carefully.In other constructions the bearing housing cover is locked with bearing by a circle clip. Whenever removing the housing cover on both sides (Driving End & Non Driving End) make sure proper care is taken while handling.

2. Removal of bearing and coupling:-

Use a suitable puller (depends on the size of the bearing or coupling); mostly use the 3 arm puller as it has a good pulling strength.

First use the puller by barely applying any pressure and try to take out the bearing or coupling,

*If it's not coming out even after enough load, use a pipe and extend the tightening spanner and try to remove the bearing

*If the bearing is still stuck at the original position, heat the bearing or coupling up to 100 deg. C while it's locked with the puller and apply little pressure

*If the bearing or coupling is not coming out with the above tricks, the last method is to apply the load on puller through hydraulic jack along with heating

*After opening the stator cover, thoroughly inspect the inside condition of the stator. If there is little damage in rotor, repair it

*If the insulation of the motor is less, clean the windings by an evaporative type cleaner and give some time to let it dry. Apply insulation coating and heat the winding around 40 deg. C to 50 deg. C by means of powerful halogen lamps

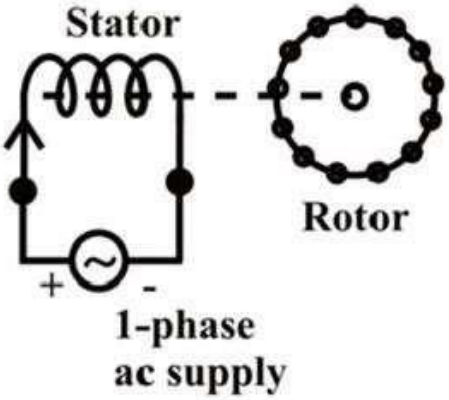
*Clean both side bearing housing covers, cooling fan, body of the motor and protection cover of the motor with electro clean or suitable chemical

3. **Clean the shaft on both ends** and heat the new bearing up to 70 deg. C to avoid tight insertion of the bearing in the shaft. Do this for both sides. Wait for 20 minutes, let the bearing cool down, and after that insert the bearing housing cover from one side.

4. Box back the motor:-

Before boxing up the motor, do the insulation test again to compare with previous values. If the values are on higher side, start boxing back, otherwise heat up the winding for some more time with Halogen

light. Box up to be done as per the markings Take up the rotor with one side cover (If bearing locking nut were there in one of the sides, prefer that to be the first to assemble) and push it inside the stator Lock with one side nut bolts, slowly insert the other side cover, do the hammering slowly by wooden hammer, insert and lock with nut and bolts, and the rotor will now apply load on the bearing Gently tighten the bolts using opposite tightening method. Insert the cooling fan and protection cover, and once again verify the tightness of the bolts Fix in place the motor as per the marking and give the connections accordingly. Try out and check the Amperage. Compare with rated amperage and before overhaul amperage. *Note: Check the direction of rotation after overhauling. If it indicates opposite direction, it means the connection done is wrong.



SAFETY&PRECAUTION: -

*All the connection should correct & tight.

*Before working on machine follow safety rule.

CONCLUSION: -

In the above experiment we perform Dismantle, over haul and assemble a single phase induction motor.

DISCUSSION QUESTION: -

1. State difference between induction motor & squirrel cage motor?
2. Application of induction motor?
3. Write Application of phase wound motor.
4. What type of test perform when the motor is in damaged state?

EXPERIMENT NO :10

Aim of the experiment :

Dismantle over haul and assemble a 3 phase squirrel cage and phase wound motor. Test andrun them.

Equipment Required:

SL no.	Name of the equipment	Specification	Quantity
1.	3phase squirrel cage motor	,20Hp,400v,50Hz	1
2.	Phase wound motor	,400v,50Hz	1
3.	Series lamp		1
4.	Multimeter	Digital	1
5.	Tester	0-500v	1
6.	C-plier	Insulated ,15cm	1
7.	Screw driver	Insulated,15cm	1
8.	E knife	Insulated ,15cm	1
9.	Connecting wire	2.5 mm cu.	As per required

Theory:

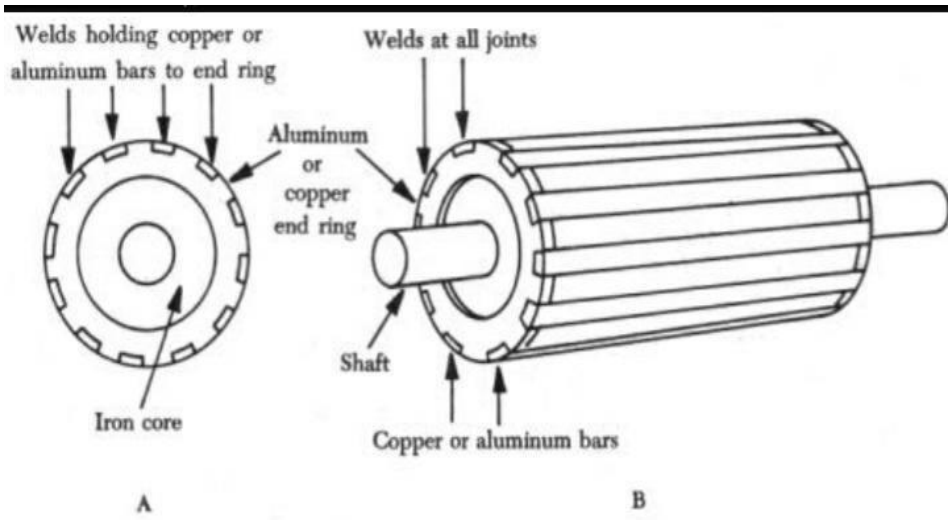
A 3 phase squirrel cage induction motor is a type of 3 phase induction motor which functions based on the principle of electromagnetism. It is called a squirrel cage motor because the rotor inside it looks like a squirrel cage . This type of induction motor are widely used in industrial applications due to cheaper in cost , rugged in construction and low maintenance .

A phase wound induction motor is also known as slip ring rotor motor,iris a type of induction motor where the rotor windings are connected through slip rings to external resistance . Adjusting the resistance allows control of the speed /torque characteristic of the

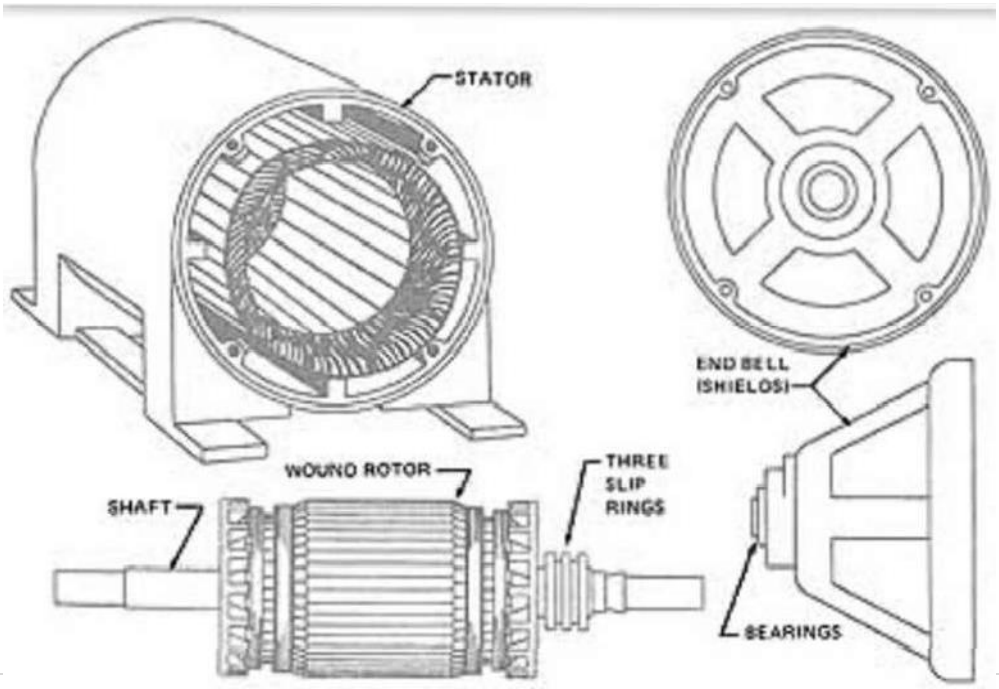
motor . This type of motor is used in applications which require smooth start and adjustable speed . Some of the applications of this motor include cranes ,mills and conveyors. The phase wound motor is used I fans , blowers and mixer etc .

Circuit diagram:

3phase squirrel cage motor :-



Phase wound motor:-



Safety precautions :

- All the connections should be perfect and tight .

Conclusions:

Discussion Questions:

1. what is the difference between squirrel cage and phase wound motor?

2. write the application of phase wound motor.

3. write the application of squirrel cage motor .

EXPERIMENT NO-11

AIM OF THE EXPERIMENT:-

Overhaul of single phase / 3 phase variac.

APPARATUS REQUIRED:-

SL.NO	NAME OF EQUIPMENTS	SPECIFICATION	QUANTITY
1	Single phase variac	1 phase,10A,2.7KVA,230V,50Hz	1no
2	3 phase variac	3 phase,15A,12.8KVA,415V,50Hz	1 no

THEORY

CONSTRUCTION

An autotransformer is an electrical transformer with only one winding. The "auto" (Greek for "self") prefix refers to the single coil acting alone, not to any kind of automatic mechanism. In an autotransformer, portions of the same winding act as both the primary winding and secondary winding sides of the transformer. In contrast, an ordinary transformer has separate primary and secondary windings which are not connected to each other.

The autotransformer winding has at least three taps where electrical connections are made. Since part of the winding does "double duty", autotransformers have the advantages of often being smaller, lighter, and cheaper than typical dual-winding transformers, but the disadvantage of not providing electrical isolation between primary and secondary circuits. Other advantages of autotransformers include lower leakage reactance, lower losses, lower excitation current, and increased VA rating for a given size and mass.

PRINCIPLE:-

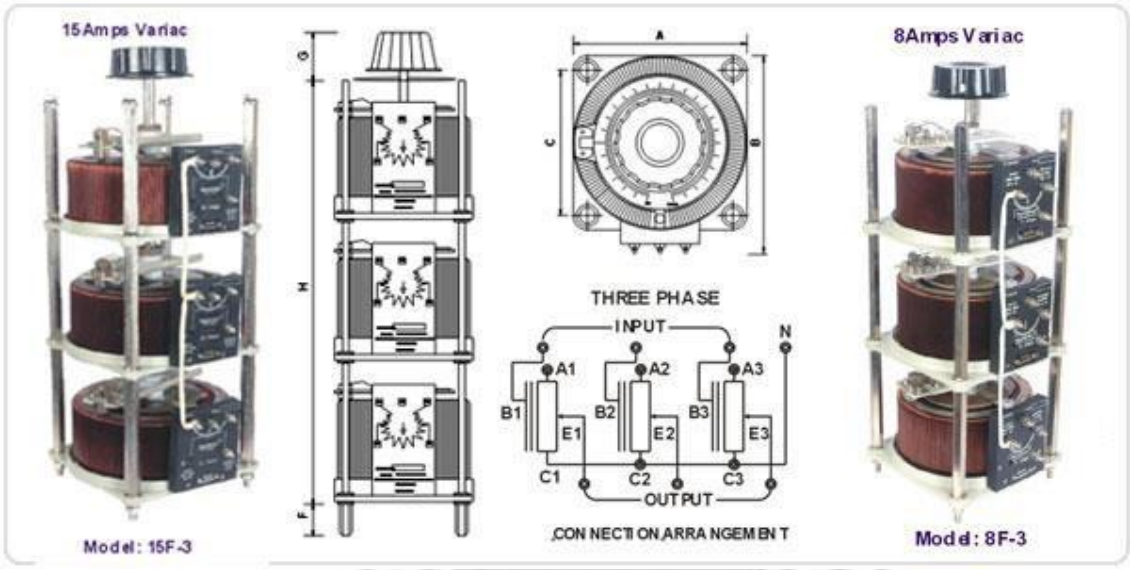
An autotransformer has a single winding with two end terminals and one or more terminals at intermediate tap points. It is a transformer in which the primary and secondary coils have part of their turns in common. The primary voltage is applied across two of the terminals, and the secondary voltage taken from two

terminals, almost always having one terminal in common with the primary voltage. Since the volts-per-turn is the same in both windings, each develops a voltage in proportion to its number of turns. In an autotransformer, part of the current flows directly from the input to the output, and only part is transferred inductively, allowing a smaller, lighter, cheaper core to be used as well as requiring only a single winding.[3] However the voltage and current ratio of autotransformers can be formulated the same as other two-winding transformers.

One end of the winding is usually connected in common to both the voltage source and the electrical load. The other end of the source and load are connected to taps along the winding. Different taps on the winding correspond to different voltages, measured from the common end. In a step-down transformer the source is usually connected across the entire winding while the load is connected by a tap across only a portion of the winding. In a step-up transformer, conversely, the load is attached across the full winding while the source is connected to a tap across a portion of the winding.

DIAGRAM OF SINGLE PHASE VARRIAC:-

DIAGRAM OF 3 PHASE VARIAC:-



CONCLUSION:-

In the above experiment we overhaul the single phase and 3 phase variac andwe conclude that the efficiency of variac is down due to dost and louse contacts.

DISSCUSSION QUESTION:-

1. What is variac ?
2. What is the working principle of variac ?
3. Difference between 1 phase and 3 phase variac ?
4. Why we need to overhaul a variac ?