Chapter

10

Maintenance and repairs of electrical machines

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Life is the most beautiful gift of god

– Mother Theresa

Learning Objectives

Electrical equipments plays major role in domestic work, industries and workshops. Electric motors are mainly used in all these electrical equipments. Hence we must briefly know about the operating methods, maintenance, repairs and testing of electrical machines

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10.1 Introduction

In this lesson, we have to learn about the periodical maintenance procedure for our house holding electrical equipments, motors and electrical machines in industries. Also we have to learn briefly about the reasons for the faults, rectification methods and avoiding methods.

10.2 Electrical machines maintenance

10.2.1 Aim of maintenance

It is essential to maintain the electrical machines and their secondary instruments in our houses, workshops and industries for their proper operation. If we maintain properly there will not be any longer from the equipment's and they will function for the long period with high efficiency.

10.2.2 Maintenance

Maintenance is the process of operation needed for the functioning of the motors and other electrical machines with good efficiency. When the electrical machines work, they deliver mechanical power from it. So, it causes to worn out in their rotating parts. Hence the proper maintenance should be needed for the electrical machines.

10.2.3 Planned maintenance

The structure, operating methods, load level of the electrical machines, can be maintained daily, weekly, monthly and yearly. This process of inspection and proper maintenance work is called as planned maintenance.

10.2.4 Types of maintenance

i. Routine maintenance
ii. Preventive maintenance
iii. Break down maintenance
iv. Capital repairs or corrective maintenance

i. Routine maintenance

Based on the electric machines type, age and workload, the process such as cleaning, greasing, minor repairing works and minor adjustments done are called routine maintenance.

ii. Preventive maintenance

To prevent the sudden failure of the machines and to protect from major repairs, the planning of preventive maintenance should be followed. It will reduce the losses.

If the electric machine undergoes sudden breakdown, then two types of losses will occur.

a. Direct losses

It is defined as the repair charges for electric machines.

b. Indirect losses

It is based on the worth of loss of work, labour salary and unable to supply the production materials in particular time.

iii. Breakdown maintenance

If breakdown occurs suddenly after doing the routine maintenance and preventive maintenance, the machine is to be immediately repaired to a good condition is called breakdown maintenance.

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iv Capital repairs or corrective maintenance

After many years of working, the machine operation should be stopped and dismantling the machines for doing this maintenance for replaced the damaged parts. It should be done in number of days with more cost.

10.2.5 Planned maintenance Project

If the electric machine is working continuously, properly and efficiently, then the following planned maintenance be carried.

i. The new motor should be placed in proper and give proper connection to it.

ii. The hand tools, instruments and part of the motor should be readily kept for immediate maintenance.

iii. If the efficiency of the machine is reduced, then dismantle and overhaul it properly.

iv. Do the emergency repairs immediately.

v. Replaced the old machines with a new one.

vi. The maintenance consists of the layout, connection and construction of the machines, lubrication materials, planned maintenance list, previous maintenance list etc.

vii. Proper training should be given to the workers about new machineries.

viii. The cost for one year maintenance should be planned and submitted.

10.2.6 Importance of maintenance

Proper maintenance, acquires the following advantages.

i. The problems caused in machines are prevented.

ii. Sudden breakdown in the machines are prevented.

iii. Major complaints and expenses are reduced.

iv. Electrical machines with rated efficiency can be achieved.

v. Achieve the target of proper production with materials without any interruption.

10.2.7 General maintenance works made in electrical machines

i. Open the terminal box once in six months and test the terminals whether they are tight.

ii. Remove the grease completely for once in a year and apply the new grease. The process of removing the grease is called as “Degreasing”. After cleaning the bearings, apply new grease on it. This process is called “Greasing”.

iii. If the electrical equipment does not use for six months, then the old grease should be removed and apply new grease before to start it.

iv. Over hauling should be done on electrical machines for a period of once in three years.At that time, dismantle the all parts of the machines and clean the stator, rotor, bearings, grease cups, front and back end covers and assemble it.

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Do you Know?

Feeler Gauge is an instrument which is used to measure the air gap between the stator and the rotor of the motors. The air gap value may be from few mils to 50 mills. 1 ml is equal to 0.025 mm or 1/1000 inch. Generally, the air gap is value of d.c. machines is more than a.c. machines.

10.3 Faults in a power system

Definition

Fault in electrical equipment or apparatus is defined as an imperfection in the electrical circuit due to which current is deflected from the intended path. In other words, the fault is the abnormal condition of the electrical system which damages the electrical equipment and disturbs the normal flow of the electric current.

The most common and dangerous fault that occurs in a power system is the short circuit or shunt fault. During short circuit fault, heavy current flow through the circuit which damages the insulation of current carrying phase conductors corresponding to earth or in the insulation between phases.

Types of electrical fault

Types of electrical fault can be classified into two major type

i. Symmetrical fault
ii. Asymmetrical fault

Symmetrical fault

The faults are of symmetrical in nature and occurs to symmetrical current, i.e., equal fault current in all the three phases with 120° displacement.

Types of fault

a. Ground fault in all three phases
b. Short circuit fault between phases

a. Ground fault in all three phases

It occurs due to a breakdown of insulation between all the phases as well as to the earth. It is the most severe type of the fault and rarely occurs in the power system.

b. Short circuit fault between phases

It mainly occurs due to a breakdown of insulation between all the three phases. It occur is rarely 2% to 3% in the power system.

Asymmetrical fault

This fault are asymmetrical nature and occurs to asymmetrical current, i.e., different currents in the three phases.

Types

i. Single Phase to ground fault
ii. Phase-to-Phase fault
iii. Two phases to ground fault
iv. Phase to phase and third phase to ground fault

1. Single phase to ground fault

i. It is also called a line-to-ground fault.
ii. It mainly occurs due to insulation breakdown between one of the phase and earth.

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iii. Similarly this type of fault is most frequently occurs in the power system.
iv. Their chances of appearance in the power system 70%.

2. Phase-to-Phase fault

i. It is also called line-to-line fault.
ii. It occurs when two conductors are short circuited.
iii. Such type of fault rarely occurred on the power system.
iv. Their chance of appearance is hardly 15% in the power system.

3. Two phases to ground fault

i. It is also called Line-to-line-to-ground fault (L-L-G).
ii. In this type of fault breakdowns of insulation between two phases and earth occur.
iii. It is the most severe type of fault but rarely occurs in the power system.
iv. Their chance of occurrence is hardly 10%.

4. Phase to phase and third Phase to ground fault

i. It is the combination of phase to phase and phase to phase to ground fault.
ii. Such types of fault occur due to the breakdown of insulation between two phases and simultaneous breakdown of insulation between the third phase and earth.
iii. The chance of such type of fault is hardly 2% to 3%.

10.4 General defects in machines

According to the supply, machines are classified into two major types.

1. DC machines
2. AC machines

General defects and its remedy for DC machine are given below.

In DC machine, end connection and poles are very important. In DC machines terminal should be connected correctly (positive terminal to positive terminal and negative terminal to negative terminal), otherwise DC machines does not work.

10.4.1 General defects and its remedies for DC machines

Defects	Reasons	Remedies
1. When an electric supply is given to the DC motors, it is not running	1. Low voltage.	Check each and every phase supply voltage and measure the required voltage value and correct it.
	2. Over load.	Reduce the over load
	3. Fault occurs in winding coils.	Check the winding coils and correct it

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Defects	Reasons	Remedies
	4. Open circuit fault occurs.	Check the winding coils and correct it.
	5. The wrong connection of the coil.	Check the coil connection test and connect it properly.
	6. Check whether the brushes are having contacts with the slip rings.	Check the brush contacts properly
2. When the electric supply is given to the DC motors, the fuse wire is melted.	1. Over load.	Reduce the over load.
	2. Short-circuit in winding coils.	Check the winding coils, test and correct it.
	3. Short-circuit in supply voltage.	Test the supply voltage and correct it.
3. Get the electric shock when we touch the motors	1. Due to low insulation resisting winding coil touches the motor body.	Check the insulation resistance and insulate the motor.
	2. Coil touches the body (or) core.	Check the slot insulation and correct it properly.
4. Sparking at the commutator.	1. Low quality carbon brushes.	Quality brushes can be replaced.
	2. Pressure on the brushes are not proper.	Proper pressure should be applied.
	3. Wear and tear of brushes.	Brushes can be replaced.
5. Vibration in machines.	1. Motor is not fixed properly.	Proper fixation is to be made.
	2. No proper alignment.	Check the alignment.
	3. No proper balancing.	Check the balancing.
	4. Worn out bearings.	Replace the bearings.

10.4.2 General defects and remedies for AC motors

Sl. No.	Defects	Reasons	Remedies
1.	Motor not gets started.	1. Open circuit.	Trace the open circuit and correct it properly.
		2. Low voltage.	Operate with proper (or) rated voltage.
		3. Damaged rotor.	Replace the rotor.
		4. Over load.	Reduce the load.
		5. Bearings are fitted with tight.	Lubricate the bearings and check it.

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2.	Motor is not running at rated speed.	1. Low voltage	Check the wiring
3.	When motor is started, the fuse gets melted.	1. Over load.	Reduce the load.
		2. Short-circuit in motor circuit.	Check the short circuit and rectify it.
4.	Motor stops when started.	1. Major fault in motor	Replace the motor.
		2. Over load	Reduce the load.
5.	Motor is getting heat when runs with load.	1. Dust in air passage	Clean the air passage and check the outgoing hot air.
		2. Grounded wiring	Check and rectify the fault.
		3. Over voltage	Motor should be operated only with rated voltage.
		4. Rotor touches with the stator	Check alignment and correct it.
6.	Vibration of electrical motors	1. Motor is not fixed properly	Fix it properly.
		2. Fault in bearings	Replace the bearings.
		3. No proper alignment of bearings	Adjust the alignment of bearings.
		4. No proper end play	Replace the washers.
7.	Bearings gets heat when motor rotates.	1. Dust in oil ways of bearings	Clean the oil ways and replace it with new oil.
		2. Damaged bearings	Replace the bearings
		3. Low (or) high viscosity of lubricant.	Apply new lubricant.
		4. Lubricantion is not enough.	Enough lubricantion should be applied.
		5. Higher end thrust.	Rectify the fault.
8.	Rotor rotates in opposite directions.	1. Wrong winding connection	Make the proper connection.

10.5 Testing of new machines

It is important to note the following points.

a. In a motor, check whether the terminal connections and wiring are correct or not as in the wiring diagram.
b. Open the terminal box once in six months to test the terminals for tightening
c. Measure the insulation resistance value.
d. Do the continuity test.
e. The protective device which is used to control the motor is fixed at the 'minimum current value' and 'minimum time setting' before the motor is used.
f. If the rotor rotates in the opposite direction, switch off the supply and change any two connections of the wire. Check whether the rotor is rotating in same direction.

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Initially the rotor is rotated in low speed and after some time, the speed is increased step by step. Then check there is any vibration or sound in the motor.

10.6 Precautionary measures to be taken before using electrical machines

10.6.1 Alignment

When the motor shaft and load shaft are connected through the flange, note that the shafts are placed in one line. Plum bob, Try square and Dial guage are used to measure the alignment.

10.6.2 Airgap

The gap between stator and the rotor of a machine is called 'Air gap'. The air gap is increased when the bearing is worn out and depreciation is bearing housing. To measure air gap, feeler gauge is used.

10.6.3 Armature balancing

The rotor or armature of the machine is in roller shape. The weight of armature should be equal in all sides at all parts is called balancing. If weight is not equal then it is called unbalancing. i.e, one side of armature has more weight and the other side has less weight. This is called unbalanced rotor.

10.6.4 Importance of balancing

If the armature or rotor is not in balanced condition, the rotor will hit the stator and bearing gets damaged while rotating. If there is any damage in bearing, the alignment will get change. If the alignment is not proper, the air gap between stator and rotor will become unequal. Hence balancing is very important.

10.6.5 Types of balancing

1. Static balancing
2. Dynamic balancing

1. Static balancing

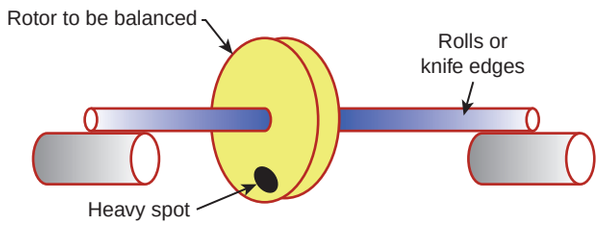

Fig. 10.1 Static balancing

The armature or rotor is placed on the two equal knife edges which are fitted on the flat surface. If the rotor is balanced it should not rotate. If it is unbalanced, it will stand in a slanting position. After one rotation is completed, The part or side which has more weight is placed in bottom side and the side which has light weight is placed on the upper side. Hence some weight should be added to the upper side for balance or reduce some weight from the lower side. Again do the test, if it is unbalance then add or remove the weight till it is balancing.

2. Dynamic balancing

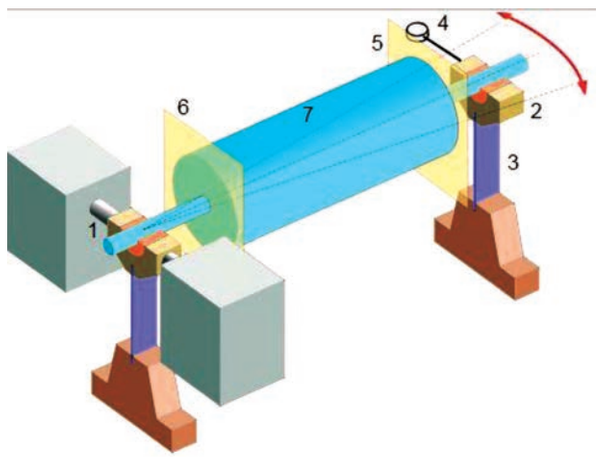

Fig. 10.2 Dynamic balancing

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The dynamic balancing machine is used to find the vibrations of armature or rotor when it rotates fast and it also gives the details of unbalance condition. i.e, which the part has more weight or less weight in the armature.

The accurate balancing of armature is not possible in static balancing method. But in dynamic balancing method, it can be done properly. While testing, the rotor is rotated fast. If it is unbalance, the weight is added to the required to balance the rotor.

In large type machines, the armature balancing is tested by using electronic device, oscilloscope and vibration detectors. If balance is not correct, it will damage the bearings and the laminated core in the armature and the commutator becomes loose. This makes the armature to vibrate fast and produces sound. The motor starts to move from its position. If it is not in proper. bolt it with ground.

The fan kept in the motor is used to reduce the heat. The weight can be added on the fan's wing for balance. For balancing the method of adding weight is better than reducing the weight.

10.6.6 End play

The motor shaft is fixed without moving front and back position in length wise. The end play occurs while the shaft is moving more than $1/64^{th}$ part of inch is called end play.

10.6.7 End thrust

Unwanted force acting on the shaft sides of the motor or towards the one end of the motor is called end thrust.

10.6.8 Bearing

To support and noiseless rotation of shaft, bearing are used. The place where the bearing are installed are known as housing of bearing. Bearing are used in the end cover of the machine and shaft. With bearing puller, we can easily remove the bearing.

10.7 Testing of windings

For a reliable operation of electrical machines, it is important it they must be tested at regular intervals. Over to all, testing is important to know about the type of fault and to desire the cost and time required to rectify the fault.

Generally four types of tests were conducted in windings. They are,

1. Winding resistance test
2. Insulation resistance test
3. Growler test
4. Drop test

1. Winding resistance test

Winding resistance test is used for finding the short circuits within the coil between conductors and also between the coils. Low voltage DC supply should be given to the windings pay connecting ammeter in series and the voltmeter in parallel with the winding and readings are taken and tabulated.

According to ohm's law, we know that,

Winding resistance test

$$R = \frac{voltage\ applied\ to\ winding)}{current}$$

Resistance value must be calculated for each pole winding and phase winding. If the resistance value of pole or phase winding is low in value, then there is a short circuit in the particular pole or phase winding.

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We can also find the winding resistance by using the Kelvin bridge method.

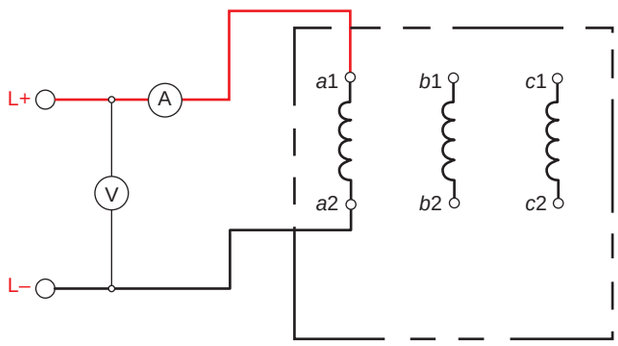

Fig. 10.3 Winding resistance test

2. Insulation resistance test

Megger is an instrument used for measuring high value of resistance and hence it is used to measure insulation resistance of winding. Two leads of megger are connected between winding terminal and the body of the motor. Now rotate the handle of the megger about 160 revolutions per minute (RPM).

Generally 1000v is used to measure the insulation resistance and the value should not be less than 1Mega ohm.

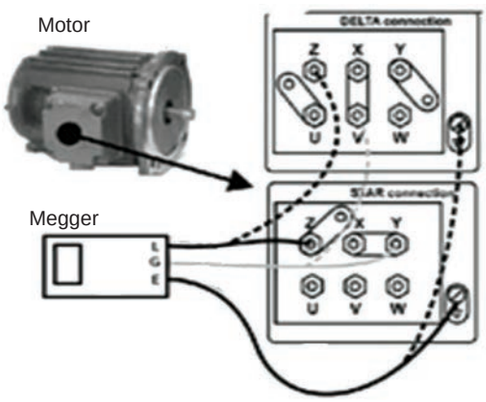

Fig. 10.4 Insulation resistance test

3. Growler test

Growler is an electromagnetic device which is used to find the open circuit, short circuit and ground faults in windings.

There are two types of growlers. They are

1. Internal growler
2. External growler

Internal growler is used to find faults in the stationary parts i.e, stator windings of motor, where as external growler is used to find faults in rotating parts i.e, rotor windings and armature windings of DC machines

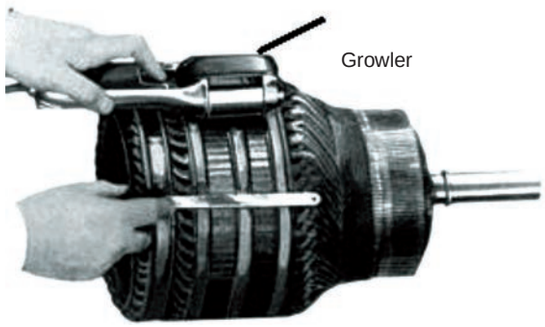

Fig. 10.5 Internal growler

Construction of growler

a. Internal growler

Internal growler consists of a winding over 'V' shaped laminated iron core. The legs were cut out on the top slantingly, to insert the legs into the stator slots easily. Internal growler has two types. They are

1. Internal growler with feeler
2. Internal growler without feeler

This type of growler with feeler is used in small size stators where we cannot insert growler to test the windings. In large type stators, there will be more space to test the winding and hence growler without feeler can be used. Here hacksaw blade is used instead of a feeler

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b. External growler

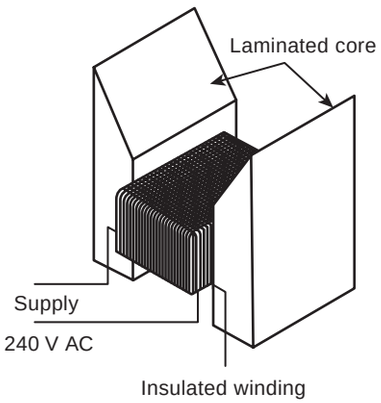

Fig. 10.6 External growler

External growler consists of a winding over 'H' shaped laminated iron core. One side of its leg is cut out on the top in slantingly to place the rotor or armature winding.

c. Working principle

When we give AC, 1ϕ, 230v, supply to the growler winding, it works in transformer principle (Mutual induction). Growler winding acts like a primary of the transformer and the winding to be tested acts like secondary. Due to this, magnetic field voltage is induced.

For testing stator and rotor windings of AC motors, hacksaw blade is used and the fault can be identified by its vibrations.

For testing the armature windings of DC machines AC mili voltmeter is connected with the commutator segment and the fault can be identified by readings.

d. Testing of armature winding by growler

i. Open circuit test

The armature to be tested is placed on the growler as shown in the figure 10.7. AC supply is given to the growler. Now voltage is induced in the armature windings according to the transformer action and it can be measured by AC milli voltmeter. The two leads of the AC milli voltmeter is connected with the adjacent bars as shown in the figure 10.7.

The pointer of the milli voltmeter must deflect to any value when we made test on all commutator segments. If the pointer does not deflect, the coil connected with the particular commutator segment is subjected to open circuit fault. The fault may be inside the coil or in the soldering part of the commutator segment.

This test can be made without the meter. For example, by shorting the top two bars with a piece of wire instead of meter. If there is a spark, it indicates the armature coil is in good condition. Absence of spark indicates that the coil is open.

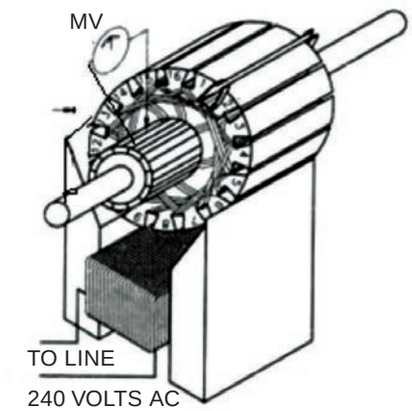

Fig. 10.7 Open circuit test

ii. Short circuit test

The armature to be tested is placed on the growler as shown in the figure and AC supply is given to the growler. Hold a hacksaw blade over the top slots of the armature as shown in the figure 10.8. If the coil in the slot is shorted, the blade will vibrate rapidly and create a growling noise. If the blade remains stationary, it is an indication that no short exist in the coil under test.

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iii. Body short circuit test or Ground fault test

The armature to be tested is placed on the growler as shown in the figure 10.9 and AC supply is given to the growler. Now voltage is induced in the armature winding according to the transformer action. And it can be measured by AC milli voltmeter. The two leads of the milli voltmeter is connected between the commutator segment and the shaft of the armature.

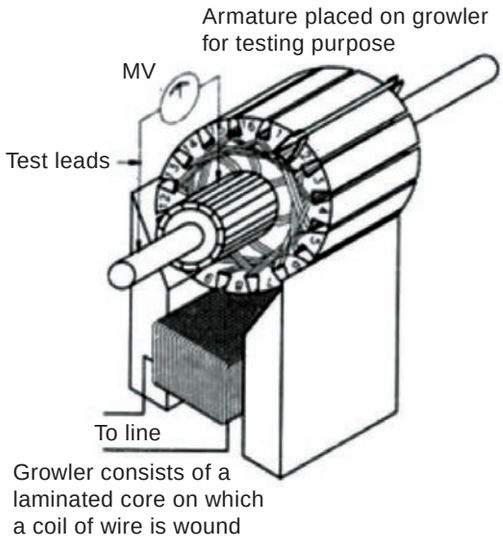

Fig. 10.9 Earth fault test

The pointer of the mili voltmeter must deflect to any value when we made test on all commutator segments. If the pointer does not deflect, the coil connected with the particular segment is subjected to contact with iron parts of the armature.

iv. Drop test

The most accurate method of testing the armature for open circuit, short circuit, ground fault, and reversal of connection can be done by the Drop test. Connect a low voltage DC supply across the commutator segment at distance of pole pitch.

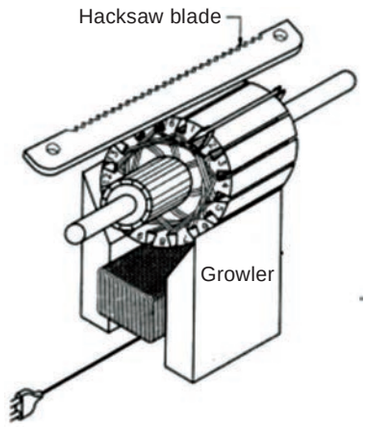

Fig. 10.8 Short circuit test

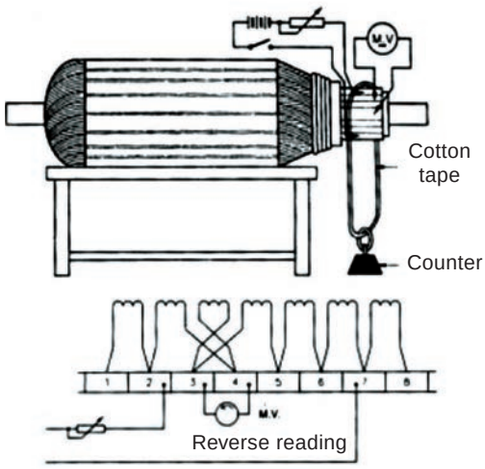

Fig. 10.10 Drop test

Insert a variable resistance in series as shown in the figure. For example, in two pole machines DC supply is given to the opposite brushes, and in four pole machine DC supply is given to the adjacent brushes.

Now place the DC millimeter leads with the adjacent bars and find the readings for all commutator segments. From the meter readings, we can conclude that

1. If all the readings are same, the windings is in good connection
2. If the meter reads zero or low voltage, the coil connected to the particular segment is short.

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3. If the milli voltmeter reads high voltage, the coil connected to the segment is open.
4. If the milli voltmeter deflects in the reverse directions as shown in the figure, the coil connected with the segment is reversed.

Generally armatures are tested for insulation resistance and for shorted coils. Only when a fault in the armature winding is suspected, drop test is conducted. But the results from the drop test are more reliable.

Activities

1. Dismantle and assemble the electric machines.
2. Alignment test for Direct coupled machines.

Glossary

Motor	-	மின்னோடி
Stator	-	நிலையி
Rotor	-	சுழலி
Bearings	-	தாங்கிகள்
Pulley	-	சக்தி மாற்றுச் சக்கரம்
Balancing	-	சமநிலைப் படுத்துதல் அல்லது சம எடைப் பகிர்வு
Alignment	-	ஒத்தமைவு
Commutator	-	திசைமாற்றி
Brush	-	தொடுவி
End play	-	முனை இடிப்பு
End trust	-	முனை அசைவு
Growler	-	உருள் அடை உருமி

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Evaluation

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Part–A

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

1. In motor electrical energy is converted in to _____ energy
   a. Electrical
   b. Mechanical
   c. Heat
   d. Magnetic

2. In electrical motor stator is made up of _____ material
   a. Silicon steel
   b. Cast-iron
   c. Mild steel
   d. Stainless steel

3. Bush bearings are lubricated with _____ material
   a. Lubrication oil
   b. Grease
   c. Vegetable oil
   d. Transformer oil

4. Core is made up of _____ material
   a. Silicon steel
   b. Cast-iron
   c. Mild steel
   d. Stainless steel

5. _____ bearings are used at load side
   a. Ball
   b. Roller
   c. Sleeve
   d. Ball & Sleeve

6. _____is the instruments used to remove the bearing
   a. Bearing puller
   b. feeler gauge
   c. Plum bob
   d. Tri square

7. Major repair is called_____
   a. Minor repair
   b. Preventive maintenance
   c. Routine maintenance
   d. Overhauling

8. To avoid direct and indirect loss which maintenance should be followed?
   a. Routine maintenance
   b. Preventive maintenance
   c. Major repair
   d. Breakdown maintenance

9. Alignment is called_____
   a. Gap between stator and rotor
   b. Motor shaft and load shaft should be in one line
   c. Motor shaft and load shaft should not be in one line
   d. Motor shaft and load shaft should be in opposite direction

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10. Which effect was caused by fault in electrical circuit?
    a. high current
    b. damage of equipments
    c. increasing in efficiency
    d. High voltage

11. The lubrication should be applied to a electrical machine for _____ once.
    a. Six month
    b. one year
    c. Two year
    d. Three months

12. Electrical test is _____
    a. To measure insulation resistance
    b. To measure air gap
    c. Lubricating oil
    d. Alignment testing

13. End play is _____
    a. The motor shaft is fixed without moving front and back position in length wise
    b. Abnormal load operated in motor
    c. Improper alignment
    d. Unbalanced load

14. Which instrument is used to measure the air gap _____
    a. Feeler gauge
    b. Bearing puller
    c. Megger
    d. Voltmeter

15. In symmetrical fault, the value of current in three phase is _____
    a. Less
    b. equal
    c. high
    d. Unequal

16. _____ test gives the accurate result for testing the armature.
    a. Growler
    b. Winding resistance
    c. Drop
    d. Insulation resistance

PART-B

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

1. Write the importance of maintenance in electrical machines?
2. What is meant by preventive maintenance?
3. What is an overhauling?
4. Define short notes on alignment?
5. What is meant by air gap?
6. What is the necessity of balancing?
7. What is end play?
8. What is meant by fault in electrical circuit?
9. Define short notes on bearing?

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PART-C

Answer the questions in one page **(5 Marks)**

1. Explain about planned maintenance procedure.
2. Explain the symmetrical fault in detail.
3. Write the reason for the vibration of electrical machines and its rectification methods.
4. Explain about the dynamic balancing method.
5. Explain about the static balancing method.
6. State aim and importance of maintenance.
7. Explain the various test conducting in electrical machines.
8. Write the construction and working g principle of growler.
9. Describe the method of conducting open circuit test by using growler
10. Explain the drop test with neat sketch.

PART-D

Answer the questions in two page **(10 Marks)**

1. Explain the different types of maintenance
2. Explain the causes for the common defects occurred in DC machines and its rectification methods
3. Explain the causes for the common defects occurred in AC machines and its remedies.

Reference Book

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

Reference Internet Source

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

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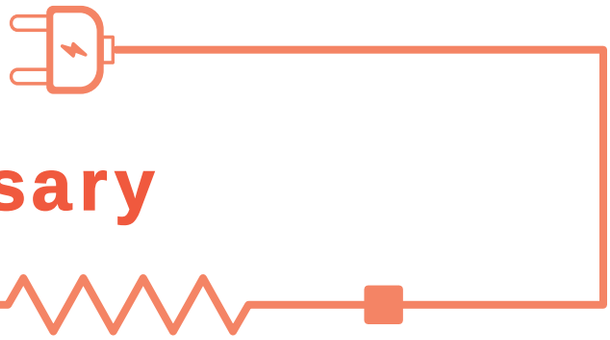

Corona	–	வெளிச்சுடரொளி
Di-electric strength	–	மின்காப்பு வலிமை
Feeder lines	–	ஊட்டளிப்புத் தொடர்
Grid	–	வலையிணைப்பு (அ) மின்கட்டமைப்பு
Insulator	–	மின்காப்பான்
Peak load	–	உச்சக்கட்ட பளு
Regulation	–	ஒழுங்கு முறை
Power factor	–	திறன்காரணி
Receiving station	–	ஏற்பு நிலையம்
Plane angle	-	தளக் கோணம்
Solid angle	-	திண்மக் கோணம்
Luminous flux	-	ஒளிர்வுப் பாயம்
Luminous intensity	-	ஒளி விளக்கச் செறிவு
Luminous efficacy	-	ஒளிர்வுத்திறன் விகிதம்
Lux	-	ஒளித்திறன்
Glare	-	கூசொளி
Depreciation factor	-	தேய்மானக் காரணி
Space height ratio	-	இடைவெளி – உயர விகிதம்
Utilization factor	-	பயன்பாட்டுக் காரணி
Pilot lamp	-	அறிகுறி விளக்கு
Thermostat	-	வெப்பநிலைப்பி
Bi-metallic strip	-	ஈருலோகத் தகடு
Pressure release valve	-	அழுத்தம் அகற்றும் வால்வு
Induction stove	-	தூண்டல் அடுப்பு
Geyser	-	நீர் சூடேற்றும் கலன்
Fusible vent plug	-	உ ருகி வழிவிடும் அடைப்பான்
Sweep	-	வீச்சு

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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
Squirrel cage motor	-	அணில் கூடு மின்னோடி
Synchronous motor	-	ஒத்தியங்கு மின்னோடி
Induction motor	-	தூண்டு மின்னோடி
Stepper motor	-	படிநிலை மின்னோடி
Variable motor	-	மாறு வேக மின்னோடி
Motor shaft	-	மின்னோடி அச்சுத்தண்டு
Deflecting torque	-	விலக்க சுழற்றுமை
Controlling torque	-	கட்டுப்படுத்தும் சுழற்றுமை
Damping torque	-	ஒடுக்கல் சுழற்றுமை
Moving iron	-	இயங்கு இரும்பு
Absolute instruments	-	தனிநிலைக் கருவிகள்
Spring control	-	வில் கட்டுப்பாடு
Gravity control	-	ஈர்ப்பு விசைக் கட்டுப்பாடு
Piston	-	உந்துத் தண்டு
Multiplier	-	பெருக்கி
Shunt	-	இணைத்தடம்
Analog multimeter	-	குறிமுள் பல்நோக்கு அளவுமானி
Digital multimeter	-	எண்ணிலக்க பல்நோக்கு அளவுமானி
Eddy current	-	சுழல் மின்னோட்டம்
Range	-	நெடுக்கம்
Galvano meter	-	மின்னோட்ட அளவி
Piezo resistivity	-	தகவுத்தடை
Potentiometer	-	மின்னழுத்தமானி
Signal	-	சிக்னல்
Strain gauge	-	திரிபளவுமானி

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Thermistor	-	வெப்பத்தடையகம்
Permeability	-	ஊடுருவும் தன்மை
Linear variable differential transformer	-	நேரியல் மாறி மாறுபட்டமின்மாற்றி
Thermocouple	-	வெப்பமின்னிரட்டை
Armature	:	மின்னகம்
Back electro motive force	:	எதிர் மின் இயக்கு விசை
Induction motor	:	தூண்டல் மின்னோடி
Three point starter	:	மூன்று முனை துவக்கி
Symmetrical fault	:	சமச்சீர் பழுதுகள்
Electrical circuit fault	:	மின் சுற்று பழுது
Electrical circuit isolator	:	மின் சுற்று பிரிப்பான்
Electrical circuit breaker	:	மின் சுற்று துண்டிப்பான்
Over load relay	:	மீறிய மின் பளு உணர்த்தி
Time delay relay	:	நேரக் கட்டுப்பாடு உணர்த்தி
Air break type circuit breaker	:	காற்று முறிவு வகை மின்சுற்று துண்டிப்பான்
Gauge number	-	கதவு எண்
Winding coil	-	உல்லைச் சுருள்
Phase	-	நிலை
Stator	-	நிலையி
Rotor	-	சுழலி
Armature	-	மின்னகம்
Motor	-	மின்னோடி
Stator	-	நிலையி
Rotor	-	சுழலி
Bearings	-	தாங்கிகள்
Pulley	-	சக்தி மாற்றுச் சக்கரம்
Balancing	-	சமநிலைப் படுத்துதல் அல்லது சம எடைப் பகிர்வு
Alignment	-	ஒத்தமைவு
Commutator	-	திசைமாற்றி
Brush	-	தொடுவி
End play	-	முனை இடிப்பு
End trust	-	முனை அசைவு
Growler	-	உருள் அடை உருமி

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