STUDY OF DIRECT CURRENT GENERATOR LOSSES AND IMPROVEMENT

A Project and Thesis submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical and Electronic Engineering

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Certification

This is to certify that this project and thesis entitled "**STUDY OF DIRECT CURRENT GENERATOR LOSSES AND IMPROVEMENT**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on 24 January 2021.

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Dedicated to

Our Parents

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List of Abbreviations

DC	Direct current
AC	Alternating Current
EMF	Electromotive Force
KW	Kilo Watt
MW	Mega Watt
kVA	Kilo Volt Ampere
kVAR	Kilo Volt Ampere Reactive
VA	Volt Ampere
HVDC	High Voltage Direct Current

List of Symbols

P	Power
ρ	Resistivity of conductor material
l	Length of the conductor
V	Volt
I	Current
Vm	Maximum voltage
E	E.M.F
F	Frequency

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ABSTRACT

The demand for electricity is increasing day by day.We are always trying to solve that demand.Now we want electricity in every sector.As a developing country,work is being done to solve the demand for electricity.We have not yet been able to ensure uninterrupted power supply in our country.That is why we are using DC generator as a backup source and as a reliable source.In this situation,we need to learn the proper use of the DC generator system to reduce the power deficit.The amount of mechanical energy supplied to the input of the DC generator is not equal to the amount of electrical energy supplied to the output.At the output we get 80% energy or efficiency.There is some loss in the operation of the DC generator so we do not get the 100% efficiency or electrical power at the output.Power and efficiency are related to each other.The demand for high efficiency DC generators is very high.Due to all these losses, a certain portion of energy is being lost every day.

Our goal is to reduce that loss.This thesis discusses how to increase the output efficiency to 80%.I will be able to know about the problems due to low efficiency.I will be able to know about the type,operation,construction,loss of DC generator.We can also get an idea of where the generators are being used and why we are going to use these generators.This thesis is mainly about efficiency improvement.Although it is not possible to increase the efficiency completely,it is possible to improve it a bit. Decreasing the loss of DC generator will increase its efficiency.The main goal of this study is to reduce DC generator losses and increase efficiency.Increasing the power and efficiency of DC generators will play an important role for our future.With the development of technology, losses should be gradually reduced and efficiency should be increased.

CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION

Bangladesh is a developing country.Technology is now a touch in all areas of Bangladesh. Work is underway across the country to keep that technology active and increase the use of technology. The greatest component of that technological work is electricity.Just as we can't think of anything without technology,so we can't think of the development of technology without electricity.Due to such big disasters,our power connection is often disconnected.Then we face many problems in our daily work.So the importance of our backup generator to get reliable power backup is immense.Factory Office-Court Hospital Educational Institution Bank Airport. The need for backup power in such institutions is immense.In the context of Bangladesh,we have not been able to ensure the use of DC generators as a backup power system in all these organizations.We should consider installing backup generators in all these organizations.We too should follow that system.As we get uninterrupted electricity service, our country will be economically developed.The rate of technological advancement will increase.We mostly use natural gas and diesel as fuel for backup generator systems.The generator's backup system for emergencies is the best way to supply power.From this research paper we will learn more about Generator Working Principles,Types of Generators,Construction,Operation.Where gas and diesel generators are used,why we will choose gas or diesel generators.

The DC generator is important because it represents a logical role in the behavior of the DC Generator is a mechanical machine through which mechanical energy is converted into electrical energy.An armature in a magnetic field is required to convert mechanical energy into electrical energy.A wire coil is placed on the surface and the armature is rotated through a magnetic field with the help of DC power.The device by

which the armature is rotated in a magnetic field is called a prime mover.A prime mover diesel engine can be a petrol engine stream or an electric motor.DC generators are often called dynamo.The DC generator generates AC voltage according to Faraday's electromagnetic formula which is converted to DC voltage with the help of a commutator connected to the armature and transmitted to the external circuit.When an armature conductor rotates in a magnetic field, an electrical pressure is created between the conductors and is called e.m.f .

When the DC generator maintains all these rules and generates electricity, then some loss of the generator is seen and that is why the efficiency of the produced voltage is low.From this research we will get an idea about how to increase the efficiency by reducing all those losses.The losses have been divided into three parts.Copper Loss, Iron Loss and Mechanical Loss. Due to these losses the value of voltage efficiency is decreasing. If we want to increase the value of efficiency we have to reduce the level of all these losses. We want to show through this research how we can reduce all these losses.

1.2 Problem Statement

DC generators have low efficiency because there are copper losses,Iron losses and mechanical losses.Any DC generator is designed to get 100% efficiency. But when the operation of the DC generator starts, it cannot give 100% efficiency. Because some loss occurs during the electricity generate. The amount of mechanical energy we are giving at the input is not getting the amount of electrical energy at the output. In this way the amount of our generating electricity at the output is decreasing.That’s why it is not possible to give 100% electricity to the load, so we are facing economic loss.

1.3 Objectives

This research aim is evaluating to improve the technical and financial in DC Generator of Bangladesh.

The specific aims of this research are summarized as follow.

i. Study of the structure,operation and losses DC Generator.

ii. To investigate efficiency performance of DC Generator.

iii. Identify of the DC Generator efficiency improve methods.

iv. Finally evaluate the result of method of optimization.

1.4 Research Methodology

To prepare the thesis, information, data and graph are collected and analyzed from various sources among which the following are notable.

- Main information is collected form reference book.
- Some key information is collected from research papers.
- Other diagram, data, short note and template are also collected from online resources.

1.5 Possible Outcomes

There are different ways to evaluate the performance of a DC generator.This thesis gives an idea of how to increase the generator output voltage efficiency a little. Chapter 5 is how to operate a DC generator with high efficiency.Why we need high efficiency.This is not very fast research.However, it will serve as a progress in the DC generator sector in Bangladesh.

1.6 Thesis outline

This thesis basically consists of six chapters and the main content of the chapter is described below:

Chapter-1: This chapter introduces the DC generator background,problem statement, and possible outcomes of the research methodology.

Chapter-2: This chapter discusses DC Generator Definition,Types of DC Generators, Construction of DC Generators,Operation of DC Generators,DC Generator Losses ,Cause of Loss and Consequence of DC Generators.

Chapter-3: This chapter discusses the total loss of DC generators.Ideas have been given about how the losses are happening.

Chapter-4: This chapter discusses where DC generators are used.The idea of Why choose a used DC generator.

Chapter-5: Discussions have been held on how to increase the efficiency by reducing the total loss of DC generators.

Chapter-6: This chapter discusses results and discussions.

CHAPTER-2

D.C GENERATOR

2.1 Definition of D.C Generator

D.C generator is an electric machine.The main function of a D.C generator is convert to mechanical energy into electrical energy.When,the conductor slashes magnetic flux,an e.m.f is generated based on the electromagnetic induction principle according to Faraday's Laws.This electromagnetic force causes a flow of current when the conductor circuit is closed.

Thus, the required parts of an electric generator are divided into two parts:

(i) Magnetic field.

(ii) Conductor or conductors which can so move as to cut the flux." (B.L.THERAJA, 2017-2018)

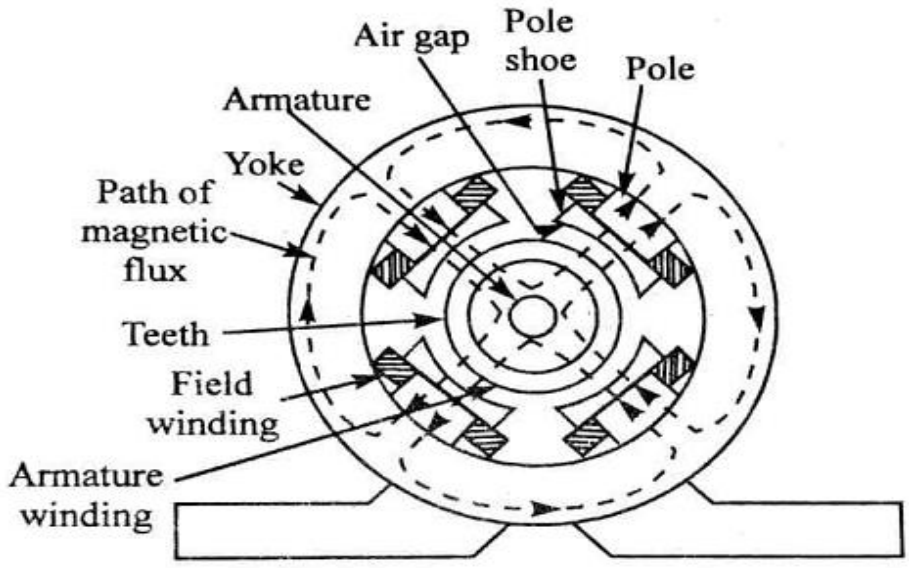
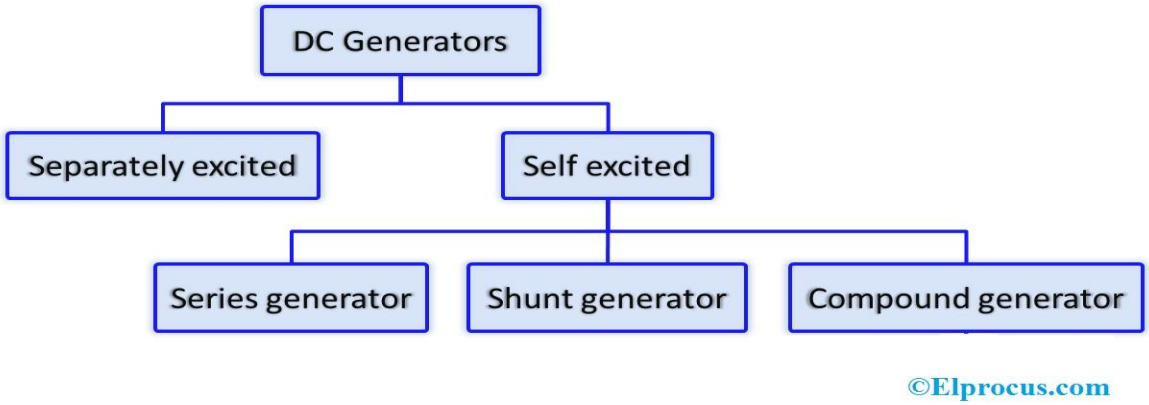


Fig-2.1:D.C GENERATOR

2.2 Type of D.C Generator

The magnetic field in a D.C generator is normally produced by electromagnets rather than permanent magnets.Generators are generally classified according to their methods of field excitation.D.C Generator is mainly two type:

(i) Separately excited d.c generators.
(ii) Self-excited d.c generators.



Separately excited d.c. generators:

A field coil whose excitation is supplied by generating current from a separate generator is called a separately excited generator.

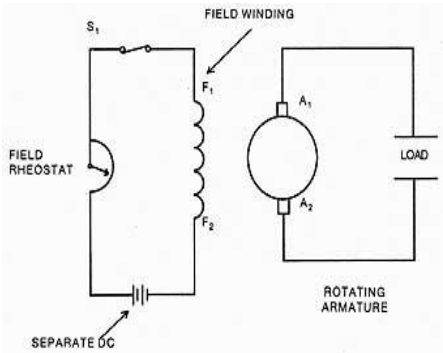


Fig-2.2: Separately excited d.c generators

Self-excited d.c. generators:

A field coil whose current is generated by the current generated by the self-generator is called a self-excited generator. According to the field coil connection with the armature, the self-excited generator is divided into three parts:

(a) series generator

(b) shunt generator

(c) compound generators

a) Series generator: This type of generator field coil is connected in series with the armature.As a result all the load current flows through the field coil.This is why the series has its relatively thick and few spiral.

b) Shunt generator:shunt means parallel connection.The field coils of such generators are connected in parallel to the armature.As a result the full voltage produced by the armature gets this field coil.

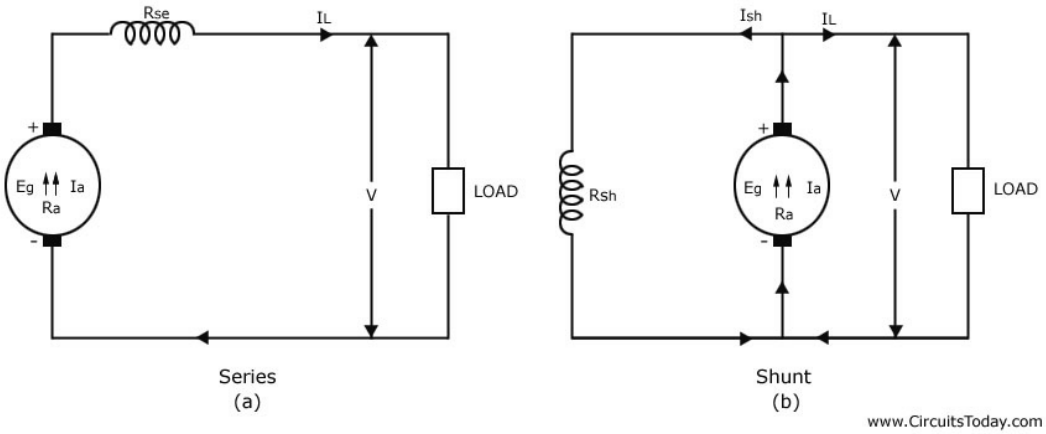


Fig-2.3: a) Series generator, b) Shunt generator

c) Compound generators: This generator consists of a combination of compound generator, series field and shunt field. It can again be divided into two parts. Short shunt and long shunt." (B.L.THERAJA, 2017-2018)

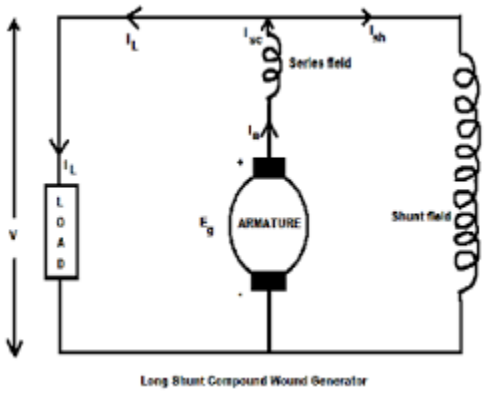


Fig-2.4: Compound generators

2.3 Construction of D.C Generator

1.Magnetic Frame or Yoke

2.Pole cores

3.Pole Coils or Field Coils

4.Armature Core

5.Armature Windings or Conductors

6.Commutator

7.Brushes

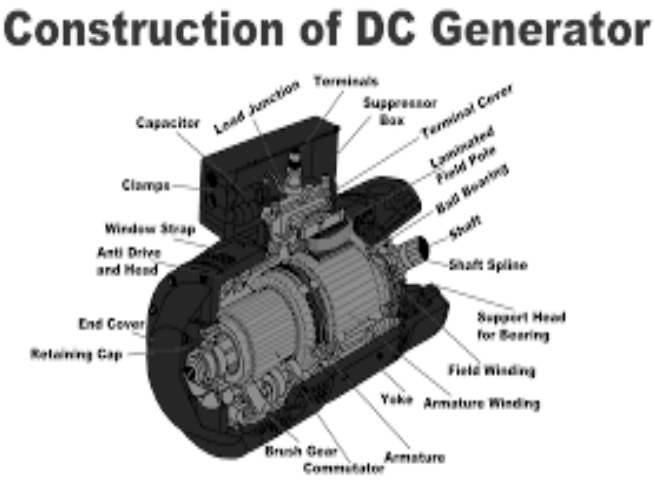


Fig:2.5: Construction of D.C Generator

1.Magnetic Frame or Yoke: The flux generated by the magnetic pole of the DC generator flows through the inside.The yoke of small DC generators is made of cast iron and the yoke of large DC generators is made of this sheets of steel. (B.L.THERAJA, 2017-2018)

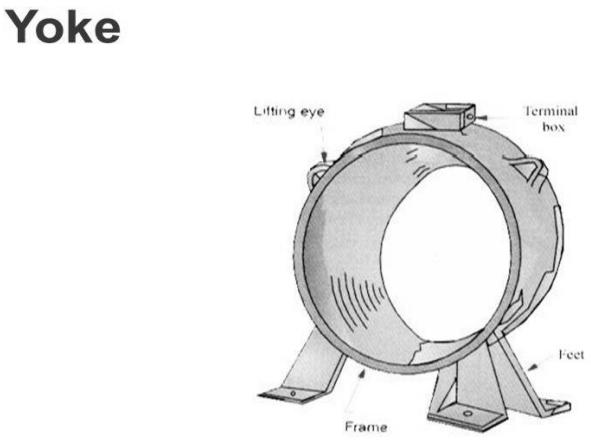


Fig-2.6: Yoke

2.Pole cores: The field coil is basically twisted in the pole core.When DC current flows through it,it's converted into electromagnet and produces unstable flux.Pole cores are made of laminated sheets of cast iron or steel.

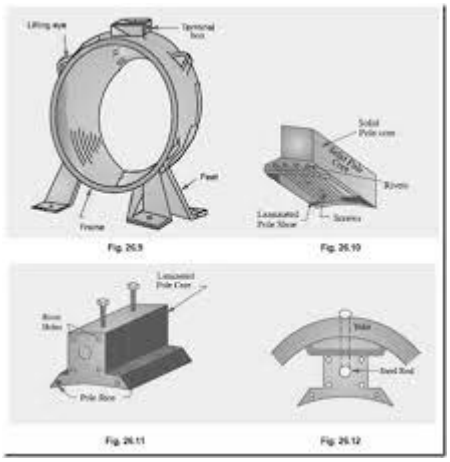


Fig-2.7: Pole cores

3.Pole Coils or Field Coils: The field coil is basically twisted on the pole core.The field coil converts the pole core into an electromagnet when DC current is flowing.This coil is basically made of super enamel copper. (B.L.THERAJA, 2017-2018)

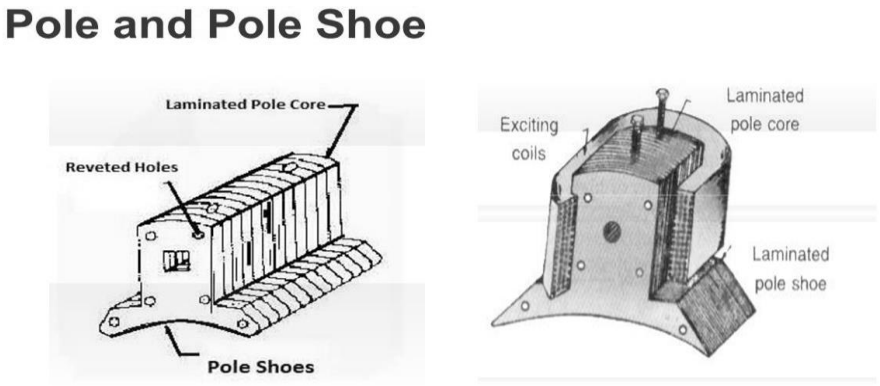


Fig-2.8: Pole Coils or Field Coils

4.Armature Core: Armature core is a cylindrical core made of laminated sheets.This core is basically coiled with super enamel copper wire.This coil are attached to the commutator.When an armature located through a magnetic field is rotated,it produces AC voltage.The armature or pole core laminated sheets of the DC generator is basically made to reduce the eddy current loss.Silicon steel solid core laminated sheets are used to reduce the hysteresis loss of any electric machine.The groove is cut along the length of the surface of the armature core for coil placement. (B.L.THERAJA, 2017-2018)

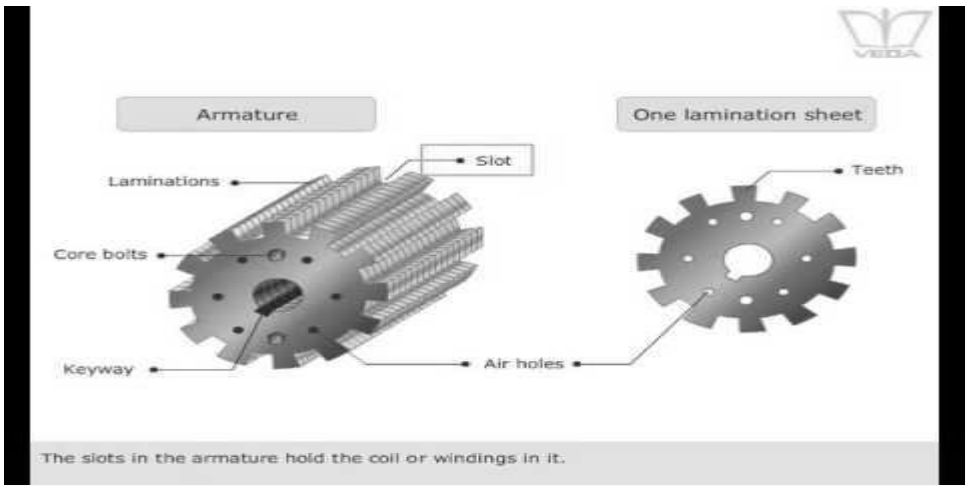


Fig-2.9: Armature Core

5.Armature Windings or Conductors: The method in which the super enamel copper wire coil is placed in the armature slot is called armature winding.Each coil has numerous patches.Each coil is wrapped and varnished with cloth.Later the coil is placed by putting leather wade paper.Based on the armature winding has been divided into two parts:

1.lap winding.

2.wave winding.

6.Commutator: Basically the job of the commutator is to convert the AC voltage generated in the armature to DC.The cylindrical commutator is made by arranging solid copper sheets or bars side by side.

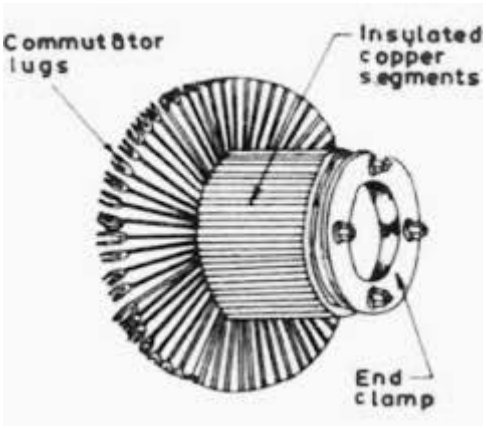


Fig-2.10: Commutator

7.Brushes: Ensuring electrical connection through rotation the purpose of brushes is to create a conductor and a stable outgoing load circuit.All these brushes are made of carbon.The brush pressure is adjusted by means of adjustable springs.If the brush pressure is very large,the friction produces heating of the commutator and the brushes.On the other hand,if it's too weak,the imperfect contact with the commutator may produce sparking.Multipole machines have as many brushes as they have poles." (HUSAIN, 2017-2018)

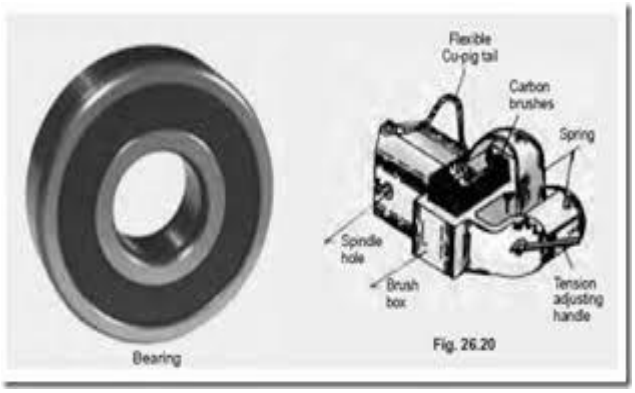


Fig-2.11: Brushes

2.4 Operation of D.C Generator

according to Faraday's laws concerning electromagnetic induction,we know that e.m.f conductors are induced when a current-carrying conductor is placed in different magnetic fields.Then,according to Fleming's right-hand law,the direction of flow changes when the direction of motion of the conductor changes.Rotate an armature clockwise and proceed to the top of a conductor on the left.When the armature completes a half rotation,the direction of motion of the conductor is reversed downwards.Then,the current direction of each armature will be reversed.But With the change of a split ring commutator,the connections of the armature conductors are reversed when a current breakdown occurs.Then we get unidirectional current at the terminals. (B.L.THERAJA, 2017-2018)

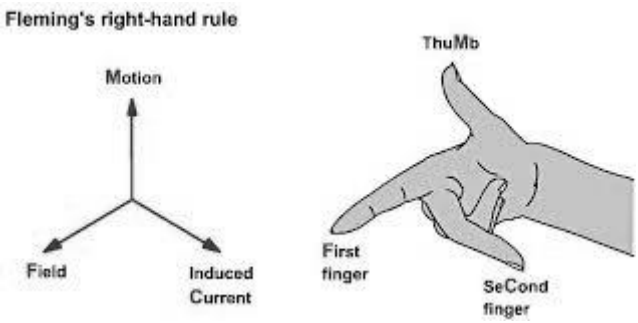


Fig-2.12: Fleming’s right hand rule

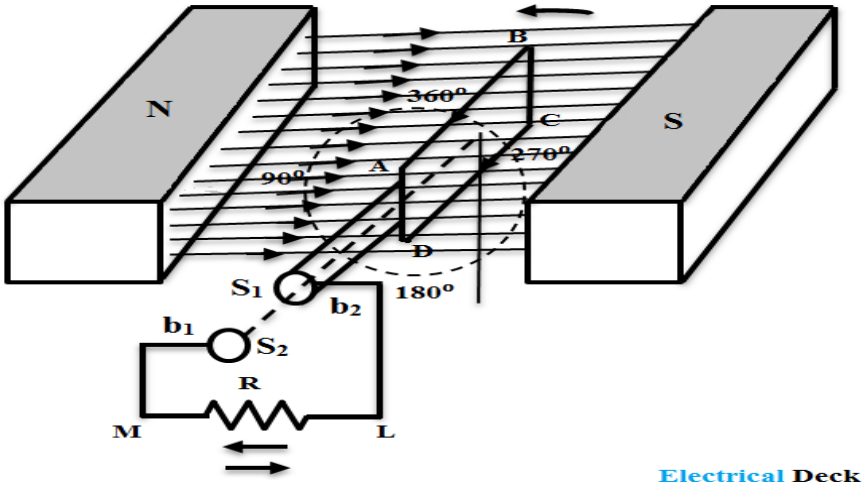


Fig-2.13: Operation of D.C Generator

2.5 D.C Generator losses

Efficiency is a very important specification of an electric machine.When we talk about efficiency,the issue of loss also comes to the front.DC generator efficiency can be calculated if we look at the total loss.DC generators have different types of damage.DC generator losses can be divided into three parts. (HUSAIN, 2017-2018) (B.L.THERAJA, 2017-2018)

1.Copper losses
2.Iron losses
3.Mechanical losses

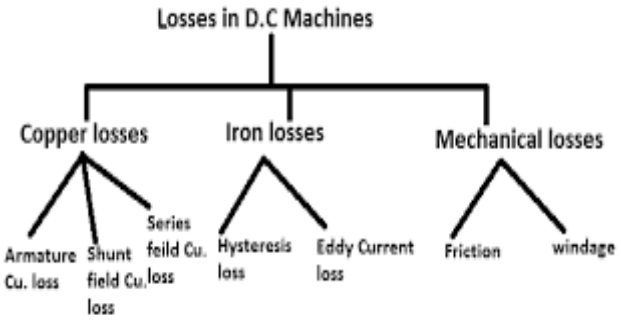


Fig-2.14: D.C Generator losses

2.6 Caused of losses

The causes of generator losses:Generator rotor winding fault,excitation system fault,automatic demagnetization switch trip and circuit fault.Generator loss of excitation fault means that the excitation current provided by the excitation system suddenly disappears completely or partially. (Huang, Fang, & Liu, 2015)

2.7 Consequence of D.C Generator

The importance of a DC generator is immense because it acts as an electrical backup source.The DC generator is capable of producing a large output range.It's design and construction work is very simple.DC generators with a 80% efficiency rating are very reliable.DC generators provide continuous and constant output.DC generators are used to supply variable output power.The DC generator has a high terminal load.We can use it as a reliable backup source.When load shedding occurs due to unwanted reasons,our daily work is interrupted.Then we can solve it by using the DC generator as an electric backup source.The importance of DC generator as a backup source in the bank,hospital,industry in educational institutions is immense.

CHAPTER-3

TOTAL LOSSES IN D.C MACHINE

3.1 Copper losses

When current flows through armature and field conductors,DC generator are copper losses.Some amount of energy is wasted due to the resistive heat of the conductor.Copper losses Consist of Armature Copper loss,field Copper loss and Loss Due to Brush Contact Resistance. (B.L.THERAJA, 2017-2018)

Total Copper Losses=I^2Ra

3.1.1 Armature Cu loss

Armature copper loss = $I_a^2R_a$

where, I_a = Armature current and

R_a= Armature resistance

This loss contribute about 30 to 40% to full load losses. The armature copper loss is variable and depends the amount of loading of the machine. (Daware, 2014)

3.1.2 Field Cu loss

Field copper loss = $I_f^2R_f$

where, I_f = field current and

R_f = field resistance

In the case of shunt wounded field,field copper loss is constant.It contributes 20 to 30% to full load losses. (Daware, 2014)

3.1.3 Loss due to brush contact resistance

Brush contact resistance also contributes to the copper losses.This loss is included into the armature copper loss. (Daware, 2014)

3.2 Iron losses

Since the armature core is made of iron and it rotates in the magnetic field.Eddy Current Loss and Hysteresis Armature Occur in Iron Core.Iron core is also called Core losses or magnetic losses. (HUSAIN, 2017-2018)

3.2.1 Hysteresis loss

Hysteresis loss is mainly caused by the armature of the DC machine.Since part of the armature is subjected to the magnetic field later because it is constantly moving under the pole (Daware, 2014).Armature rotate in two pole machine.Let's consider armature as a small part.When pieces a and b are at the N pole,the magnetic lines move from a to b.After a half-revolution,the same piece of iron then stays at the pole (HUSAIN, 2017-2018).The magnetic lines move from b to a so that the magnetism of the iron is reversed.In contrast,the magnets of a molecular at the core of a continuous armature expend some amount of energy and this is called hysteresis loss.” (Csanyi, 2012)

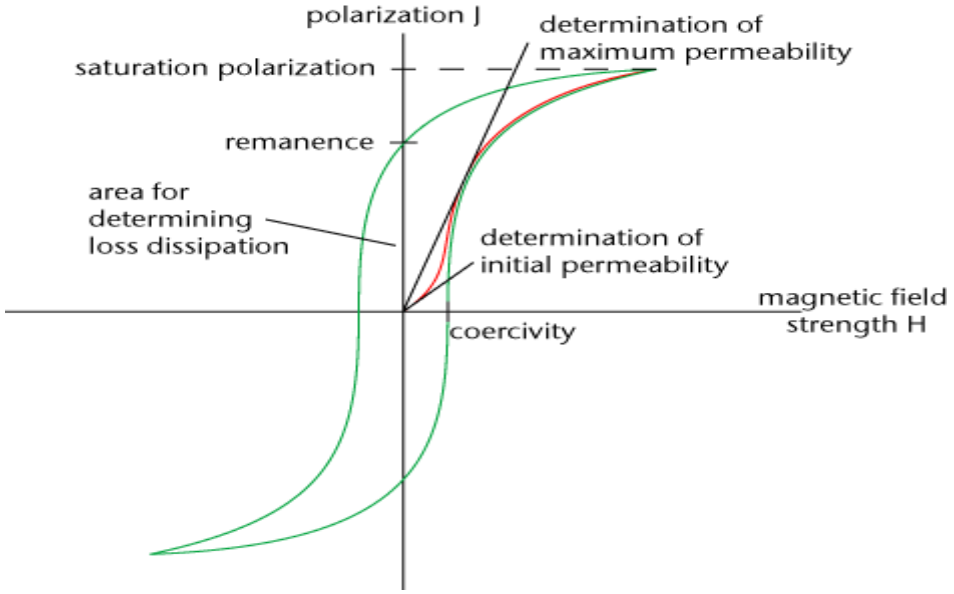


Fig-3.1: Hysteresis loss

3.2.2 Eddy current loss

The armature conductor contains induced voltage as well as induced voltage in the core of the armature,all these voltages create conventional currents in the core of the armature.These are called eddy currents.The energy that flows due to this flow is called eddy current loss.Eddy losses appear as heat Losses appear as heat which raises the temperature of the machine and raises the efficiency of the machine.If a continuous solid iron core is used,the current will be smaller due to the larger cross-sectional area of the core of the current path resistance,resulting in,The magnet of eddy current and hence eddy current loss will be large.The magnitude of eddy current can be reduced by make a core resistance as high practical (Daware, 2014).The core resistance can be increased by constructing the core of thin,round iron sheets called laminations.The laminations are insulated from the each other with coating of varnish.The insulating coating has a high resistance,so very little current flows from one lamination to the other.Also,because each lamination is very thin,the resistance to current flowing through the width of a lamination is also quite large.Thus laminating the core increases.The core resistance which decreases the eddy current and hence the eddy current loss. (B.L.THERAJA, 2017-2018)

3.3 Mechanical losses

Mechanical losses include the loss to bearings and commutator friction.Air friction losses of the rotating armature play a role in these losses.These losses are about 10 to 20 percent of the total load loss.These losses are mainly due to friction and windage.These losses depend on machine speed.They are practically constant for speed. (HUSAIN, 2017-2018)

3.3.1 Friction loss: The losses of the brushes and the commutator are called friction losses. (Daware, 2014)

3.3.2 Windage loss: The launches that take place under Air Friction and Rotating armature are called Windage Loss. (Daware, 2014)

3.4 Power flow diagram:

The power flow diagram is mainly used to determine the efficiency of a generator or motor.From the power flow diagram below we can see that initially the mechanical power is being input and the output is getting electrical power.There are many losses due to friction, windings etc. (Daware, 2014)

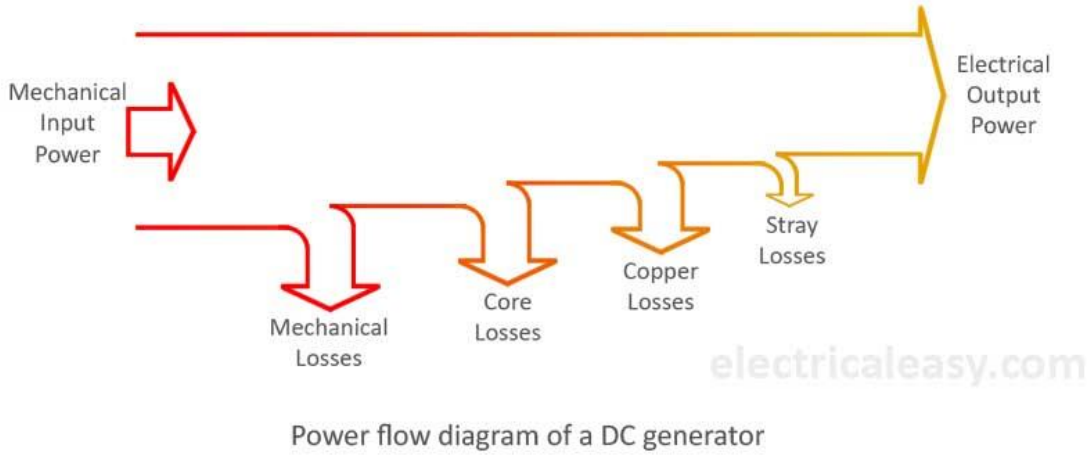


Fig:3.2: Power flow diagram

CHAPTER-4

USING OF D.C GENERATOR

4.1 Where dc Generators Are Used

- DC generators are used for different types of lighting.

- DC generators are used to charge the battery because the D.C generator can give a constant output voltage.Alternators are used to give excitement through DC generators.

- In many cases DC generators are used for small power supply.

- Speed is controlled by DC machine.

- DC generators are mainly used as backup source.They are used as primary power for agricultural work.Where there is no electrical connection,the DC generator is used as the carrying power to work in all those places.Heaters,fish farms,air pumps,irrigation pumps are usually powered by DC generators.

- During road maintenance,workers should work at night to avoid inconvenience to drivers and to do those tasks,electrical supply is required and then DC generator is used as the source of electrical supply.

- DC generators are used because construction sites do not have electrical systems.

- DC generators are used as a backup source in homes and shopping malls.D.C generators are used as a backup source in important devices like accelerator lifts etc.

- Different types of camps are set up at different times and all those camps are supplied with electricity using DC generators.

- DC generators are used for maintenance work when,power grids are shut down for maintained.

- DC generators are the best way to provide uninterrupted power supply.

- DC generators are used in ships.

- DC generators are used as backup source to ensure uninterrupted power supply to important places like hospitals and nursing homes.

- DC generators are also being used as backup source in important places like educational institutions,banks,industries and factories.

4.2 Why choose a used dc generator

- ❖ The DC generator is clearly built and designed.
- ❖ DC generators are very suitable for operating large motors and large electrical devices.
- ❖ The output voltage of the DC generator is very smooth and reduce the fluctuations of the output voltage.
- ❖ The maximum efficiency of a DC generator is 80 to 85%.
- ❖ DC Generator is a reliable backup source.

CHAPTER-5

LOSSES AND EFFICIENCY IMPROVEMENT PROCESS

5.1 Reduce losses and Improve Efficiency of D.C Generator

When the DC generator losses decrease, the efficiency will increase automatically.Power loss and efficiency are important in the case of DC generators.Loss and efficiency should be controlled.Low efficiency is detrimental to electrical systems.

Loss of DC machine can usually be observed from three different sources.It is resistive,magnetic and switching.To reduce the loss of hysteresis,the magnetic core must be covered to prevent eddy current.Preventive losses can be minimized on the basis of careful design because to fill the cross sectional area with the wire,the size of the wire and the insulation thickness are significant.So this is an overview of the various losses of all DC machines,the losses of DC machines are basically copper loss,iron loss and mechanical loss.

5.1.1 Copper loss reduce:

The electrical energy efficiency of a standard DC generator can be improved by reducing the electrical loss through stator winding for example,we can increase the cross sectional area of the conductor,improve the winding technique.Electrical transmission voltage is active thereby reducing electrical loss.

5.1.2 Iron loss reduce:

Eddy loss:

To reduce eddy loss,if we can make armature and field cores from steel sheets,the eddy loss will be reduced because the laminated steel sheets dissipate heat from each other so that current does not flow from one sheet to another.

Hysteresis loss:

To reduce hysteresis loss,most DC armatures are made of heat-treated silicone steel,which easily causes hysteresis loss.After the heat-treated silicon steel is formed to the desired shape,the laminations are heated to a dull red and then allowed to cool.This reduces the loss of hysteresis by a small amount.

5.1.3 Mechanical loss reduce:

By bearing fiction,we mean a rotational or mechanical losses that is present in the commutator as friction or air friction through the brush,so the rotation of the armature causes a variety of problems and frictional losses will occur if there is minimum maintenance. The clean bearings and proper lubrication need to be placed properly to carry the load and reduce friction.Use the right brush. If the quality of the right brush tension is maintained,the losses will be reduced.A smooth and clean conductor brush can help to reduce the mechanical losses by helping to loss reduce.

5.1.4 Other's way to DC Generator losses reduce:

1.The poles of a DC machine do not change their polarity and so there is no reversing loss or short-circuit eddy current loss of hysteresis magnetizing.There is no need to laminate the field poles as there is no eddy current losses.To reduce the losses to the DC machine at the magnetic pole,we can make them permanent magnets,if they are wound.One must choose good copper wire with best conduction paths and good insulation.In order not to get any saturation zone of the magnetic path, the sharp corners should be scattered so that the magnetic lines flowing along the magnetic path

create a horses race-like environment in a circular motion.Which of the magnetic angles should be rounded,off in the magnetic core.The distance of the armature from the pole should be compressed,when the armature is loaded and the armature response does not move too much to the original magnetic lines,when transport sparking will occur.

2.when the armature are subjected to reverse magnetic and therefore has both hysteresis and eddy current losses.Hysteresis loss are reduced by best magnetic material.However,since most magnetic materials is the best conductors in electricity,the rotor must be moved to cut the short circuited effect of a magnetic material like steel.The insulation of the lamination should be dry and the moisture should be dry.The armature slots compromise the magnetic path of the armature circumference.The end of the slots should be a little closed and not just parallel as the magnetic path in the between armature slots could saturate.The winding in the armature could be the bar-type as in DC machine starters and this needs high currents across the commutator segments. Under the carbon brush,there is a short circuit as the current in the armature coils changes their direction. In continuous rated DC machine it's better to reduce the current by using multi-turn windings to magnetize the armature,also the high revolutions armatures should be avoided as a fast armature would reduce the time under the brush for the current to reverse in the coil being " switched" to cater for the fixed pole pieces.Since the armature windings reverse polarity they are constantly " vibrating" in their slots and so they should be tied down securely and impregnated to avoid any vibration which could scratch the enamel insulation on the windings.The "leathered" insulation on the two end faces of the armature should be well rounded and not too sharp cornered as the long term effect on a sharp bend in the winding could have its undesired consequences.The coil ends should not touch the armature laminations and space should be retained for cooling of both armature winding and the armature faces.

3.The sections under the brush will determine in numbers how long it takes for the current to reverse and the resistance of the brush to shrink when the coils are switched.Not enough time.Armature coil shots will limit maximum speed because the armature will decide the current increase and loss of the coil brush gear,brush gear by

is usually resistant and effective to limit a short round coil but it will create a voltage drop in the brush shots.

4.When the armature is loaded,it produced a magnetic reaction that combined with the magnetism of the pole piece,causing the effective magnetic path across the poles through the armature to be slightly distort.If it does not include the inter-pole,then the brush gear should be oriented a little.However,a compromise is needed because the armature reaction depends on the load the DC machine's operation.If the DC machine is required to reverse then the efficiency is bartered with the convenience.

5.Although the magnetic and copper losses should be minimized,there is always some heating to account for so cooling and windage,so plans should be made to keep the cooling ducts.

6.Internal insulation inspection should be done and therefore no leakage current should be allowed to pass through the ball or roller bearing.

7.DC machine that are subjected to impulse loading should use plain journal bearings and not ball or roller bearings.Resilient mounts should be considered where it's convenient to fit them as it would help windings in the DC machine not running loose in their position on the magnetic paths.

8.To reduce the loss of the rotor,we can reduce the resistance of the rotor winding,use a thicker wire with a lower resistivity,or increase the rotor slot cross-sectional area,the material is of course critical,and the conditional production of copper rotors will reduce the loss by 15% Around,the current asynchronous generators are basically aluminum rotors,so the efficiency is not so high.

9.Similarly,there is a same copper loss in the stator, which can increase the slot face of the stator.It can increase the full slot rate of the stator slot,shorten the end length of the stator winding.If a permanent magnet is used to replace the stator winding,there is no need to pass current.Then,of course,skills can be improved.

5.2Improve Efficiency

The efficiency of a DC generator will be maximum when the proportional losses of the load current square are equal to the constant losses of the DC generator.This relationship applies equally to all rotating machines.The internal voltage imbalance of the DC machine needs to be rectified. (Huang, Fang, & Liu, 2015)

5.3 Important of high efficiency D.C Generator

Any DC generator is designed to get 100% efficiency.But when the operation of the DC generator starts,it cannot give 100% efficiency.Because some loss occurs during the generator of electricity 80%.The amount of mechanical energy we give at the input is not getting the amount of electrical energy at the output.This reduces the amount of electricity we are generating at the output.Therefore it is not possible to give 100% electricity to the load.

All of these losses determine the temperature of the machine and can be obtained without rating or power output insulation failure.That is why different types of losses occur in different parts of the DC machine.In this,increasing the temperature inside the machine affects the efficiency of the production of the machine.Through special dehydration.The rating of the machine is directly affected by the loss.For all these losses,the operating cost of the machine increases.Output power loss increases.That is why we are facing losses economically and power losses.

If the level of output efficiency is low,then more mechanical energy has to be applied to the input.This causes a waste of our input power.This increases the cost of our power generation.If the level of efficiency is low then the amount of electrical supply at the load decreases.The importance of maximum efficiency is immense to reduce the power loss of DC generator and increase the generator output energy.

CHAPTER-6

RECOMMENDATION

RESULTS AND DISCUSSIONS

6.1 RECOMMENDATION:

The purpose of this thesis was to find a new result of electric power of DC generator. The use of DC generator is not new in Bangladesh.The use of DC generator has been prevalent in our country for a long time.Natural gas and diesel are used as fuel.DC generators generate electricity through a process called DC generator operation.DC generators are designed in such a way that we get 100% of the output efficiency.

But when the DC generator starts operation for power generation and supplies electrical power to the output at the end of operation,we get 80% of its efficiency. Here we have 20% loss.In this thesis I have worked mainly on those losses.All those losses have been divided into three parts Copper loss,Iron loss and Mechanical.How we can reduce the losses and increase the efficiency.It is not possible to get 100% efficiency in the DC generator output but it is possible to get a little more than 80% efficiency using all these methods.The main goal of this thesis is to increase the efficiency of the DC generator output as much as possible.
This will reduce our power loss,provide more power supply for the load and we will also improve economically.The ways in which we can reduce the losses and increase the efficiency are summarized below:

Copper loss reduce:The electrical energy efficiency of a standard DC generator can be improved by reducing the electrical loss through stator winding for example,we can increase the cross sectional area of the conductor,improve the winding technique.Electrical transmission voltage is active thereby reducing electrical loss.

Eddy loss:To reduce eddy loss,if we can make armature and field cores from steel sheets,the eddy loss will be reduced because the laminated steel sheets dissipate heat from each other so that current does not flow from one sheet to another.

Hysteresis loss:To reduce hysteresis loss,most DC armatures are made of heat-treated silicone steel,which easily causes hysteresis loss.After the heat-treated silicon steel is formed to the desired shape,the laminations are heated to a dull red and then allowed to cool.This reduces the loss of hysteresis by a small amount.

Mechanical loss reduce:By bearing fiction,we mean a rotational or mechanical losses that is present in the commutator as friction or air friction through the brush,so the rotation of the armature causes a variety of problems and frictional losses will occur if there is minimum maintenance. The clean bearings and proper lubrication need to be placed properly to carry the load and reduce friction.Use the right brush. If the quality of the right brush tension is maintained,the losses will be reduced.A smooth and clean conductor brush can help to reduce the mechanical losses by helping to loss reduce.

6.2 RESULTS AND DISCUSSIONS:

Reviewing this thesis,I came up with the idea that it is not possible to get 100% efficiency from a DC generator because there is some internal loss during its operation.No matter how much we use the 100% rowmaterial,the loss will increase again as the machine gradually gets older.Because it is producing electrical power using mechanical power.It is always possible to get a minimum of 80% efficiency.If we can follow the rules discussed in this thesis and by using rowmaterials.Then we get 4 to 5% more efficiency.In that case it is possible to get a little more efficiency than 80% but it is not possible to get a 100% of efficiency.

CONCLUSIONS :

We have already seen how important it is to reduce DC generator losses.All these losses are related to the total power efficiency.Increasing efficiency is very important. High efficiency is more important for any system.Increasing efficiency is very important for us and increasing the efficiency as much as possible will improve our output power and economy.To reduce the generator losses,we have to use raw materials and maintain it every few months through maintenance.Then the losses will be repaid.In addition to improving efficiency,load current will also improve.

REFERANCES

- B.L.THERAJA. (2017-2018). *A TEXT BOOK OF Electrical Technology*. NEW DELHI-110 055: S.CHAND & COMPANY LTD.

- Csanyi, E. (2012, 2 3). *ELECTRICAL ENGINEERING PORTAL*. Retrieved January 11, 2021, from ELECTRICAL ENGINEERING PORTAL WEB SITE: https://electrical-engineering-portal.com/internal-losses-that-reduce-efficiency-of-a-dc-generator

- Daware, K. (2014, 01 01). *ELECTRICAL EASY.COM*. Retrieved JANUARY 5, 2021, from ELECTRICAL EASY.COM WEB SITE:https://www.electricaleasy.com/2014/01/losses-in-dc-machine.html

- HUSAIN, A. (2017-2018). *ELECTRIC MACHINES.* NEW DELHI: DHANPAT RAJ & CO.

- Huang, Z., Fang, J., & Liu, X. (2015). Loss Calculation and Thermal Analysis of Rotors Supported by Active Magnetic Bearings for High-Speed Permanent-Magnet Electrical Machines. *IEEE Transactions on Industrial Electronics , 63* (4), 2027-2035.