DEVELOPMENT OF MECHANICAL & ELECTRICAL FORMS OF THE ROTATING MAGNETIC FIELD

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Abstract

When a balanced poly-phase current flow in a balanced poly-phase windings, a rotating magnetic field is produced.

Thus, all poly phase machines are associated with rotating magnetic fields in their air gaps. Thus, a knowledge of the Rotating field produced by a poly phase winding is essential for understanding ac machines such as synchronous & induction machines.

The purpose of this project is to implement and simulate the theory behind the rotating magnetic field, for educational purposes considering only or 3-phase Machines.

- *In a mechanical form.*
- *In an Electrical form.*

Thus, we could gain a visual understanding of the rotating magnetic field by observing the above two models.

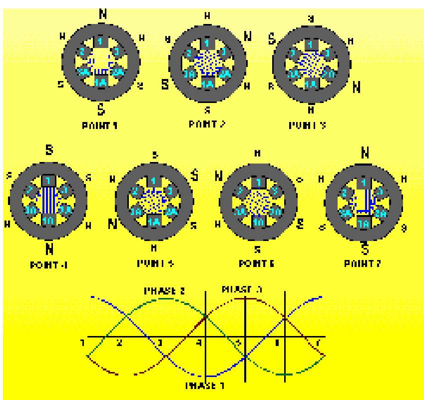
It has been theoretically verified that the rotating magnetic field is distributed sinusoidally in the air gap in most of the cases.

Thus, the mechanical form of the rotating magnetic field should indicate it's sinusoidal variation & rotation in the air-gap.

In modeling the electrical form of the rotating magnetic field, our intention is to simulate a practical situation where our model senses the magnetic field and an output in an electrical form is obtained.

As an example, by illuminating lights we can observe the rotating form of the field in a particular machine.

1. INTRODUCTION



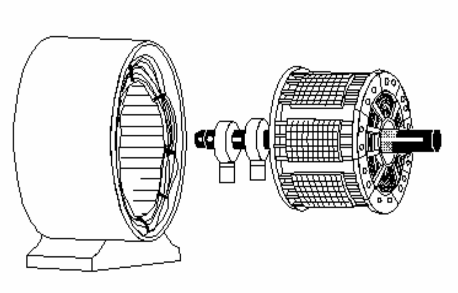
The classic example of an application of the rotating magnetic field is the 3-phase induction motor. They use three phase voltages displaced by 120°.

These voltages when applied to stator winding produce a sinusoidal variation of the flux linkage.

As the above figure shows, when the three phase magnetic field completes one cycle the magnetic field has also completed 360°.

Also, it has been proved that the magnetic field rotates at the synchronous speed, i.e at $2\pi f_o$ electrical radians per second.

The rotating magnetic field generated in the stator, induce a field in the rotor. The two fields interact & cause the rotor to turn.



The above figure shows the rotor & stator winding separately.

Thus, we can clearly see the importance of understanding the rotating magnetic field.

2. MODEL-SIMULATION:

In developing the mechanical model of the rotating magnetic field, a computer simulation was carried out to determine the optimum parameters for the model.

The objective was to determine the parameters of the model to obtain the best visual effect of the model.

To achieve this, the sinusoidal variation of the rotating magnetic field was simulated using a computer program written in Visual Basic.

2.1 The Electrical Form of the Magnetic Field

In this model our objective is to demonstrate the theory of the rotating magnetic field visually, using a sensing circuit & a visual output.

Here, our objective is to demonstrate the form of the rotating magnetic field, by using the field created by a rotating permanent magnet as an input, which would give a visual output using an external circuit.

The implementation of the theory is as follows.

As shown in the diagram below, the rotating magnetic field, is used to attract small sensing units; made using needles & tubes in pens. Due to this attraction, paths of an Electrical circuit of LEDs would be Completed. Thus if the contact is made by a sensor, the corresponding LED would be illuminated.

So, the illumination pattern of LEDs would follow the form of the magnetic field created externally or within a machine.

As, this is only for exhibition purposes,the sensitivity of the sensors may be low.

Other advanced methods of implementation would be to use,

- Hall Sensors.
- Reed Switches.

The above sensors would enhance the sensitivity of the sensing units, but their comparative costs are much high, especially for Hall sensors.

Thus, we've used the simple sensing mechanism designed by us for implementation purposes.

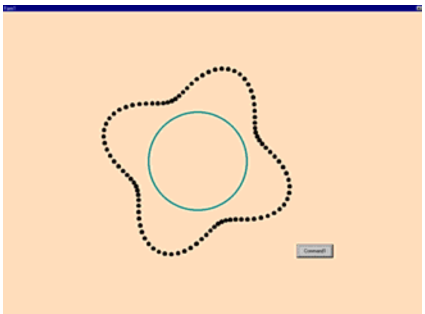
2.2 The Mechanical form of the Rotating Magnetic field

In this model our intention is to implement the rotating magnetic field in a visual form.

Thus, the model would be mechanically created so, that a visualization of the rotating magnetic field in the air gap, could be observed.

A software simulation of the model was created, to decide on the parameters of the model.

The output of the simulation is as given below.



Thus, as shown above the model provides a visualization of the rotating magnetic field in the air gap.

In developing this mechanical model, the concept we're using is; an object traveling along the circumference of a circle, is in effect travelling in a sine wave linearly.

Using the above theory, our intention is to develop the model of the magnetic field variation, using the principle of the cam-shaft operation. Here, CDs are assembled in a shaft in a particular way to get the sinusoidal form during rotation.

This concept can be further explained by observing the figures given below.

4. CONCLUSION

Thus, in conclusion; the concept of the rotating magnetic field is of two forms,i.e

- The Mechanical form.
- The Electrical form.

So, to understand the concept of the rotating magnetic field, it's vital to properly distinguish & understand the above two forms.

Thus, the two simulation models proposed would greatly contribute in understanding the concept of the rotating magnetic field thoroughly.

The models could be implemented by a variety of techniques & the best model has to be decided according to the objective.

5. ACKNOWLEDGEMENT

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6. REFERENCES

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Implementation of The Mechanical Model