

Chapter 3

Armature Reaction

ABSTRACT

In Direct Current machines, we have two types of windings. The first one is field winding and the second one is armature winding. Armature field, and armature reaction is about armature winding. In this chapter, we discuss the issue of armature field, Geometrical and magnetic neutral axis (G.NA & M.N.A), resultant field at load. Then we discuss shift of neutral plane in generator vs motor. After that we discuss the calculation of cross-magnetising ampere – turns per pole, compensating windings. Finally, this chapter ends with commutating or inter poles.

3.1 INTRODUCTION

As described earlier there are two windings in a d.c. machine i.e.

- Field winding
- Armature winding

When d.c. voltage is applied to field winding a current flows and thus a magnetic flux is set up. The path of this flux is shown in Figure 4 in Chapter 2. This is called main magnetic flux and the field thus and setup is called main magnetic field. When armature rotates in this field to voltage is induced in the armature winding and a current flows and thus an armature flux flows and armature field is constituted.

The armature reaction is the effect of armature field on main magnetic field.

3.1.1 Armature Field

Let us consider a 2-pole machine as shown in Figure 1 (a).

The direction of current in each conductor is indicated in the Figure 1 (a) and the direction of flux setup due to armature current is shown in Figure 1 (b). the flux lines in the armature are (due to all conductors) following vertically down. Due to this the armature field is also called orthogonal field.

DOI: 10.4018/978-1-4666-8441-6.ch003

Figure 1.

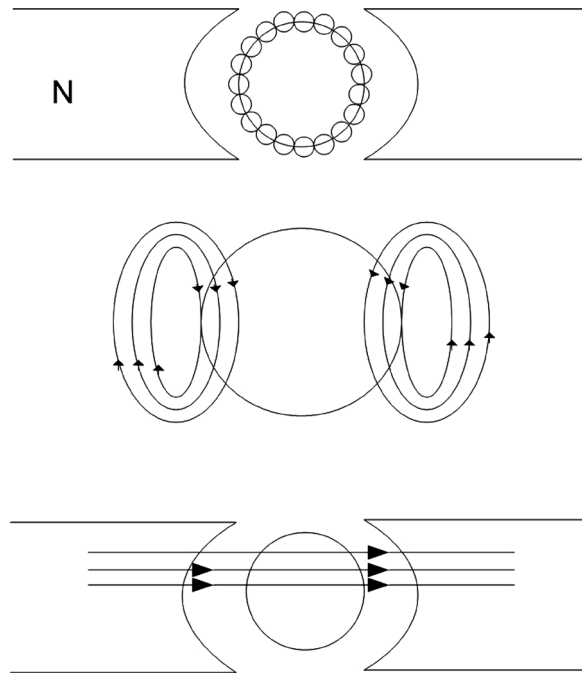


Figure 1 (c) shows the main magnetic field due to field magnets. This field is obviously horizontal. So, we see both armature and the main fields (individually) are at right angle to each other. The armature field is also called as cross field.

3.1.2 Geometrical and Magnetic Neutral Axis (G.N.A & M.N.A)

Referring to Figure 1 in Chapter 2 the voltage induced in the conductor ($e = B l v \sin \theta$) at position 1 and 3 is zero. So a line/plane passing through points 1 and 3 is called magnetic neutral axes. If the effect of armature field is neglected physically this would also be the Geometrical neutral axis. A Geometrical neutral axis is a plane which physically divided the machine into two equal parts. At no-load both these axes will coincide.

3.1.3 Resultant Field at Load

The Figure 2 shows the resultant field.

Note that M.N.A is always perpendicular to the existing magnetic field. It is obvious from the resultant field that pole tips marked 1'1' have been saturated and the field has been distorted.

The armature field now produced due to resultant field is ϕ_a' shifted from ϕ_a by an angle θ . (Note that armature field is always along M.N.A). ϕ_a' can now be resolved into two components.

- $\phi_a' \cos \theta$ at right angle to main field and is therefore, called cross-magnetizing component and is responsible for distortion of main field.

25 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/armature-reaction/131304

Related Content

Designing Solar Power Plant Due to Consumer Load Schedule, Solar Energy Potential, and Electricity Prime Cost

Yuliia Daus, Valeriy Kharchenko, Igor Viktorovich Yudaev, Vera Dyachenko and Shavkat Klychev (2019). *Renewable Energy and Power Supply Challenges for Rural Regions* (pp. 168-196).

www.irma-international.org/chapter/designing-solar-power-plant-due-to-consumer-load-schedule-solar-energy-potential-and-electricity-prime-cost/223852

Treeing Property In Polypropylene Under Various Temperature and Electrical Field

(2020). *Electrical Insulation Breakdown and Its Theory, Process, and Prevention: Emerging Research and Opportunities* (pp. 181-218).

www.irma-international.org/chapter/treeing-property-in-polypropylene-under-various-temperature-and-electrical-field/243862

NPP-Smart Grid Mutual Safety and Cyber Security Assurance

Eugene Brezhniev and Oleg Ivanchenko (2022). *Research Anthology on Smart Grid and Microgrid Development* (pp. 1047-1077).

www.irma-international.org/chapter/npp-smart-grid-mutual-safety-and-cyber-security-assurance/289920

Comparative Study of Stereo Correspondence Techniques for Underwater Images

Prabhakar C. J. (2020). *Applications of Artificial Intelligence in Electrical Engineering* (pp. 230-261).

www.irma-international.org/chapter/comparative-study-of-stereo-correspondence-techniques-for-underwater-images/252605

Design of Grounding System

(2018). *Design Parameters of Electrical Network Grounding Systems* (pp. 38-83).

www.irma-international.org/chapter/design-of-grounding-system/191883