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.

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Figure 1.

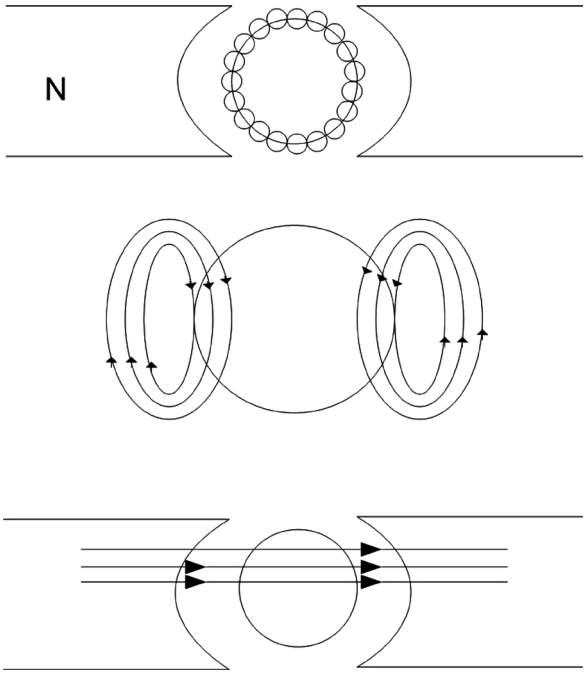

Figure 1 (c) shows the main magnetic field due to field magnets. This field is obviously horizontal. So, we see both armature and the main fields (individually) are at right angel to each other. The armature field is also called as cross field.

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 ($e = B1v \sin \theta$) at position 1 and 3 is zero. So a line/plane passing through points 1 and 3 is called magnetic netural axes. If the effect of armature field is neglected physically this would also be the Geometrical netural axis. A Geometrical netural axis is a plane which physically devided 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 product due to resultant field is $Øa'$ shifted from Øa by an angle θ. (Note that armature field is always along M.N.A). is $Øa'$ can now be resolved into two components.

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