Efficient Pole-Arc Coefficients for Maximum Flux Linkage in Axial Flux Permanent Magnet DC Machines Double Gap

M. Bendib, B. Abdelhadi and K. Belhouchet

Abstract— today, the magnet machines are important in industrial applications where low power is desired compactness, hardiness and good yield (robotics, appliances, etc ....) Medium power (machine tools, electric vehicles, aerospace, etc ....) for variable speed drives as well as the great powers in particular in rail traction, marine propulsion and the production of electrical energy (wind turbines).

Also there are several special features of axial flux machines. First, it can be designed to have a power to weight ratio higher with substantial savings of materials used. Second, the axial flux machine usually has a greater length-diameter ratio. Third, the topology of the magnetic circuit of the machine axial flux can be easily changed in such a way that various types of axial flux machines can be designed according to the number of wishing floor. In addition to this topology is favored because the magnetic circuit is without notches.

Keywords- Axial Flux Machine, Double Gap, Permanent Magnets, Multi Discs, Radial Flux, Optimization, Genetic Algorithm.

I. INTRODUCTION

Since the early 1980s, the price of permanent magnets (particularly Neodymium Iron Boron) decreased resulting in the development of electrical machines. Today, the radial flux machines with permanent magnets [4] and the axial flux machines with permanent magnets [6] are becoming more frequent. After conducting an exhaustive literature search, two magnet machines have caught our attention: the machine to double air gap radial flux machine and axial flux double gap. To compare the performance of these machines a simple analytical model and optimization, using the software Cades, based on the value of the electromagnetic torque developed.

II. CHARACTERIZATION OF MACHINES

A. *structures*

For several decades now, the designers of electrical machines are working on new structures.

These innovations are possible from the exploitation of low-cost permanent magnet NdFeB (Neodymium Iron Boron) mainly. Synchronous radial flux [8], synchronous axial flux [11] or synchronous transverse flux [7] took advantage of these developments. During the literature search, a database on machines with permanent magnets has been created. This inventory reference flux direction, the coil, the number of gaps and implementation of the magnets of each structure. The choice is motivated by the compactness of these machines, the presence of two gaps to double engine torque. The presence of permanent magnets buried in the rotor eliminates the problem of separation at high speed and use them in flux concentration.

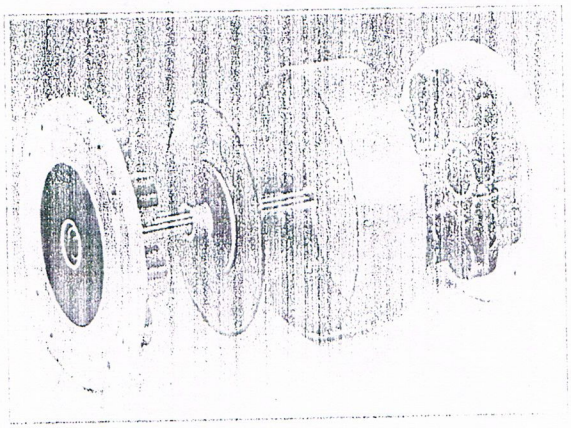

Fig. 1. Double axial flux machine air gap

B. *Descriptive*

The diagram in Fig. 2. represents the path of the flux of axial flux machine with permanent magnets double gap. These flux lines are on the average diameter of the machine. This type of axial machine can be considered a NS Toms machine. It consists of a rotor and two stators. With this configuration, the permanent magnets are used in feed concentration and flux only through the rotor winding, iron losses and eddy current losses are zero [4 5 and 6].

M. Bendib is with the Department of Electrical Engineering University El Hadj Lakhdar Batna, Alegria (e-mail: bendjbamohamed2@yahoo.fr).

B. Abdelhadi is with the Department of Electrical Engineering University El Hadj Lakhdar Batna, Alegria (e-mail: abdelhadi3b@yahoo.com).

K. Belhouchet is with the Department of Electrical Engineering University Farhat Abass Setif, Alegria (e-mail: belhouchat_khaled@yahoo.fr).