ELEC0431 Electromagnetic Energy Conversion
Constant air gap alternator explanations

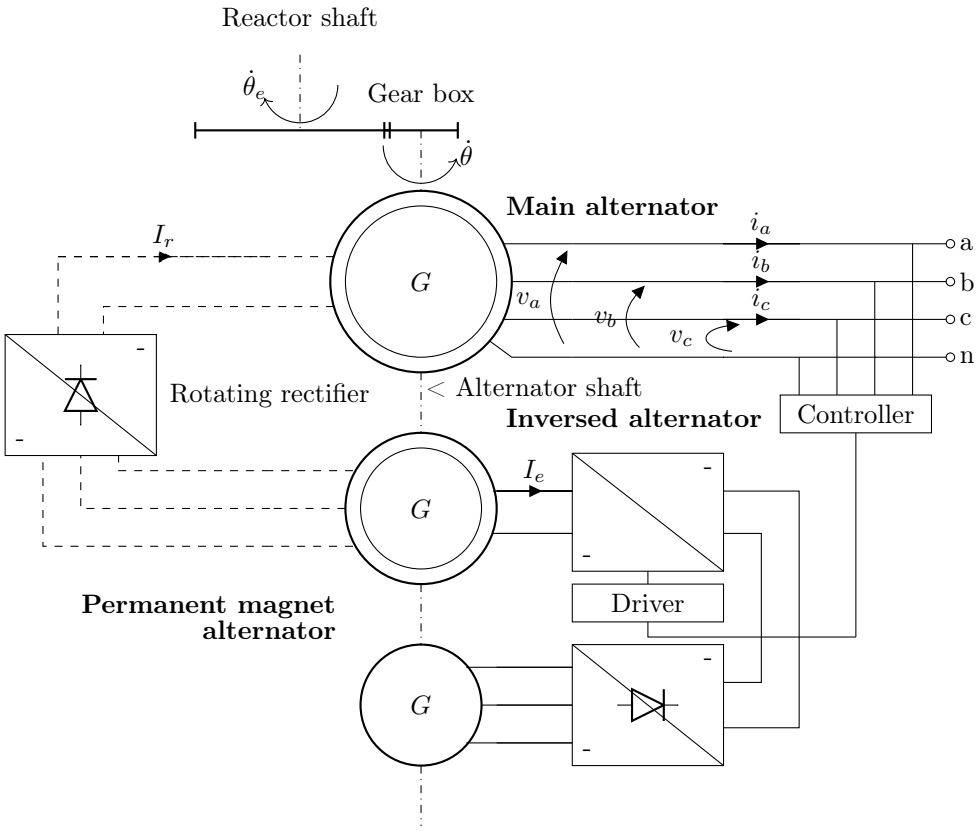

Figure 1: Excitation system of the alternator.

1 Physical explanations

The three synchronous alternators are fixed to the same shaft.

The permanent magnet alternator is the smallest of the three machines (regarding power) and produces some three-phase current alternating current as it rotates.
The current produced is then rectified and used for the excitation of the second machine.

The second machine (here the inversed alternator) is used to increase the power between the small permanent magnet Alternator and the main alternator.

It is called an inversed alternator because the fixed part contains the excitation winding (normally in the rotor for a conventionnal machine) and the moving part contains the three-phase windings

(normally in the stator for a conventionnal machine).

Stator (fixed part) Rotor (rotating part)

The three-phase currents are then rectified and used for the excitation of the main alternator. Remark that the rectifier is also rotating along the inversed alternator.

The main alternator rotor is then excited with the excitation current I_e and the mechanical power applied on the shaft is transfered into three-phase electrical power in the conductors (a,b,c,n).

2 Advantages

The permanent magnet machine allows an autonomous start (no excitation current is required for this machine). Also, this machine is brushless, meaning that no spark are produced when it is rotating. This is an important point for the design of safe aircraft. A brushed DC generator could not be used instead of the permanent magnet alternator because it would create sparks.

The electrical connections of the inversed alternator are simpler and do not require any connecting ring either for the excitation winding or the three-phase windings