European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ)

International Conference on Renewable Energies and Power Quality (ICREPQ'10)
Granada (Spain), 23th to 25th March, 2010

Optimal reactive power compensation using synchronous generators

Constantin GHIȚĂ[1], Aurelian CRĂCIUNESCU[2], Valentin NĂVRĂPESCU[3], Ioan Dragoş DEACONU[4], Aurel – Ionuț CHIRILĂ[5], Ion – Daniel ILINA[6]

[1,2,3,4,5,6] Electrical Machines and Drives Department
Electrical Engineering Faculty, Universitatea Politehnica Bucuresti
Splaiul Independenței 313 (Romania)
e-mail: ghita.constantin@gmail.com

The paper presents a study on synchronous machine that can operate as a generator and a compensator simultaneously. Modifying the field current, the reactive power injected into the supplying network is changed. An automated system is described which injects the maximum reactive power for a given amount of electrical active power, under the following conditions: the stator current is limited to the rated value, the field current is maximum admissible, the grid voltage is limited to a maximum reference and over-excited state of the machine is assured.

The synchronous machine is more and more used for wind electrical generation systems. For increased powers the electrically excited type is employed. For medium and low power the permanent magnet synchronous machine is used or hybrid excited type, i.e. both permanent magnet and electrically field generation systems are used in correlation. In cases of electrically excited generators, when the machine is over-excited it generates reactive power into the grid. For long lasting industrial applications, for safety reasons, the thermal requirements should be met. Whatever the situation the stator currents must not exceed the rated value and the field current should not overcome their maximum admissible values.

The synchronous generators inject active power into the grid, but can also inject reactive power in case they are over-compensated. The injected reactive power is controlled through the field current. The paper describes an automated system, attached to a synchronous generator, that has as objective to inject the maximum possible reactive power for any injected active power lower than the rated value, under the following conditions: the stator current is limited to the rated value, the field current is maximum admissible, the grid voltage is limited to a maximum set value and the over-excited synchronous generator operation is assured.

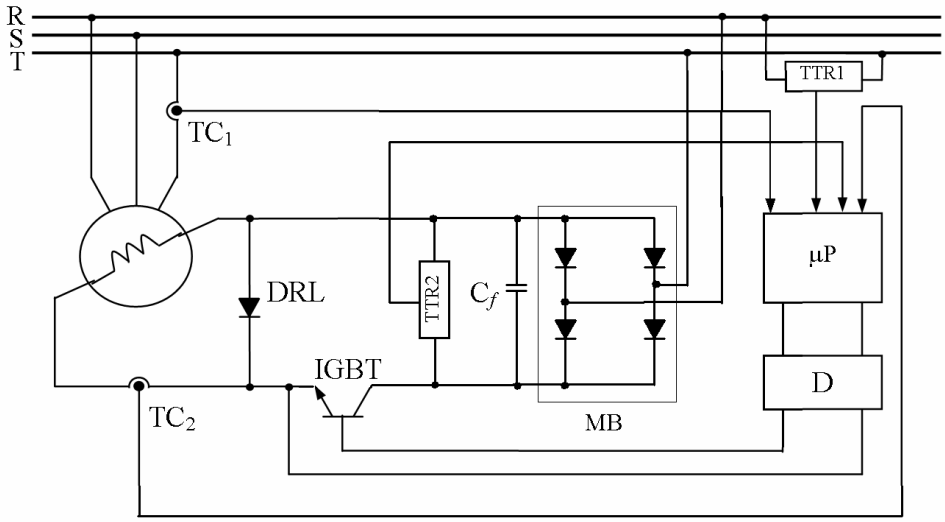

Fig. 1. Automated system diagram.

Fig. 1 presents the diagram of the automated system. It's main components are: current transducers (TC1, TC2), grid voltage transducer (TTR1), field's voltage transducer (TTR2), freewheel diode (DRL), switch transistor (IGBT), processing unit (μP), single-phase bridge (MB), filtering capacitor (C_f), and driver (D).

The presented regulation system has a simple configuration and it is easy to be manufactured due to its cheap and safe components. It performs the following tasks: the stator current is limited to the rated value, the field current is maximum allowed, the grid voltage is limited to a set value and the over-excited state of the machine is assured regardless the active power load.