SYNCHRONOUS MACHINE FOR ELECTRIC VEHICLES EQUIPPED WITH FIELD WINDING SUPPLIED BY ROTARY TRANSFORMER

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Extended abstract. One of the major concerns of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) manufacturers is to identify solutions to reduce the manufacturing and maintenance costs of electric motors. In this regard, efforts are being made to develop "maintenance free" technologies that applied to electric motors favored the use of Induction Motors (IM) and Permanent Magnet Synchronous Motors (PMSM).

IMs have high efficiency at high speeds and low torques, and PMSM have optimal characteristics at low speeds and high torques [1], characteristics that can be partially optimized by the electronic management system of EV to obtain optimum traction characteristic of EVs.

The PMSM has characteristics (torque-speed and power-speed) closest to the ideal ones, except that the constant excitation flux does not allow constant power at high speeds. An important impediment to the widespread use of PMSM in EVs and HEVs is also the uncertainties regarding price stability and availability of supply with permanent permanent magnets made from rare earths, as China has a 95% monopoly in this area [2].

These elements fully justify the numerous studies conducted in recent years to develop solutions for reducing or even eliminating permanent magnets from synchronous machine construction [3-5]. One of the natural solutions consists in the return to the classical synchronous motors with electromagnetic excitation (SMEE), these machines being able to easily ensure the ideal characteristics for EV, by weakening the excitation magnetic field at high speeds. In addition, these machines have reduces iron losses and copper losses in the excitation winding at partial loads, have a simpler and more robust adjustment system than the PMSM and allow the possibility of rapid de-excitation in the event of a breakdown, etc. [6-9]. For a successful use of SMEE in EV propulsion, however, it would be necessary to eliminate the rings and brushes that do not ensure maintenance-free operation.

In this paper we analyze a non-contact feeding system of the excitation winding of an SMEE based on a high performance Rotary Transformer (RT), made with standard ferrite components operating at 100 kHz frequency. The analysis presented in the paper uses the Finite Element Method (FEM) and aims at numerically calculating specific RT quantities such as: the spatial distribution of magnetic induction, its self, useful and leakage inductances, the variation of primary and secondary voltages, the efficiency versus air-gap length and so on. This paper has 12 pages, 17 references, 18 figures and 1 table.

References