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DIAGNOSTYKA DRGAŃ W MASZYNACH ELEKTRYCZNYCH Z MAGNESAMI TRWAŁYMI WYKORZYSTUJĄCA SYGNAŁY WŁASNE

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Abstract

Vibration diagnostics is mainly based on measurements which use a complicated and expensive apparatus dedicated for this purpose. In case of vibrations exceeding the values permissible by European standards and operating instructions, the registered vibration signal should be divided into components ~~in order~~ to identify the reason of the generated vibrations. By measuring the vibrations, a special attention must be paid to the correct mounting of the sensor to the machine, because it really often creates problems. It happens, because the machine is rarely adapted for this purpose at the factory. The mounting method of the measuring sensor affects the band of the transmitted frequency. In addition, a special attention should be paid to the separation of the measuring circuit from any kind of interference that may cause incorrect indication of the measuring apparatus. Drives consisting of machines with permanent magnets are often mounted in places, which are difficult to access for the diagnostician (wind farms, small hydropower plants, electric vehicle engines) and direct measurement of vibrations by electromechanical sensors is often impossible. Therefore, there is a need to use another method of vibration assessment of these machines without the need to use the electromechanical sensors.

The dissertation's main aim was to develop a new method of vibration diagnostics of drives with permanent magnets machines. The assumption of this method is use own signals (current, voltage) as a diagnostic signal and elimination of the vibration sensor and vibration apparatus in industrial and laboratory applications.

Basing on the analysis of the subject, similarity of the permanent magnets (PM) machine's construction ~~with~~ to the construction of electrodynamic sensor, used to measure vibrations, was found. On the basis of tests using the vibrating table, the author proved that it is possible to use a permanent magnet machine as a vibration sensor to analyze problems that can be encountered in the normal operation of electric drives. The dissertation contains an analysis of several cases of disturbances in the PM machines work encountered during their normal operation:

- PM generator load asymmetry,
- PM motor power supply asymmetry,
- PM motor and generator air gap asymmetry,
- PM motor and generator unbalance.

Computer simulations were performed using the Ansys Maxwell program on 2D field-perimeter models using the Finite Element Method (FEM). Their results coincide with the results of laboratory tests carried out on a purpose built for this purpose. The results of calculations and tests were presented for 5 different machines with permanent magnets.

The obtained results allowed to develop an author's method of detecting an increased level of vibration in machines with permanent magnets, which is based on the frequency analysis of the machine's own signals. Frequency markers were also developed for particular considered disturbance states in machines with permanent magnets.