Relativistic Effects and EMF Localization in a Unipolar Generator

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In theoretical physics the thesis of the rotation of a uniform magnetic field is currently not considered. In theoretical physics fields neither rotate nor move, but transform [1]. Therefore, it is considered, for example, that in a Faraday DC rotary unipolar generator, which is a magnetized rotating disk with its center and periphery connected by a conductor, the EMF is induced in the disk because the points of the disk move in their own non-rotating ('stationary') magnetic field of the rotating disk.

In violation of the rules of theoretical physics in electrical engineering, particularly referring to the theory of electric machines, it is often the case that the concept of the rotating magnetic field is resorted to. In a similar - electrotechnical - examination of a unipolar generator one often expresses an opinion that a disk-associated magnetic field rotates together with the disk as well. Herewith it is assumed that there is no effect on conductive electrons of the rotating disk of the unipolar generator, and the EMF is induced in the conductor it being crossed by the lines of force (field lines) of the magnetic field rotating together with the magnet.

The reason for the existence of essentially contradicting explanations of the mechanism of unipolar generation lies in the fact that in a unipolar generator the law according to which the circulation of the electric field strength vector (EMF) $\oint \bar{E} d\bar{l}$ in a closed loop is equal to the velocity $-\partial\Phi/\partial t$ of the flow Φ change of magnetic induction through the loop becomes irrelevant.

At first sight the question of the location of EMF induction in a loop can be solved experimentally. However, in practice the EMF localization by measuring the voltage of the generator using, for example, a voltmeter is difficult enough. The reason for this is the fact that if EMF is induced in the conductor, it is induced in any auxiliary conductor connected in parallel to the conductor.

The paper deals with the issue of induced EMF localization in a Faraday's unipolar generator which is a revolving magnetic disk with its center and periphery connected by a conductor. Attention has also been given to the linear DC generator consisting of a long magnet and a conductor. Functioning as a closed loop, this conductor moves within the magnetic field of the magnet, the ends sliding on its surfaces. It is shown that in a linear unipolar generator the EMF is induced in a conductor irrespective of a reference frame chosen. Reasons are given in favor of the fact that when a magnetic disk is revolving, the EMF is induced in a stationary conductor of a unipolar generator.

References

[1] Ugarov, V.A. (1969) Special Theory of Relativity. Publisher “Nauka”, Moscow. [In Russian], p. 154.