Electric motor with electronic control unit for changing the polarity of the winding to improve reliability and energy efficiency

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Abstract. A technical solution is proposed that increases the motor life, reliability and energy efficiency of the DC motor by replacing the plate collector with ring ones and introducing an electronic control unit for changing the polarity of the winding.

1. Introduction

The proposed technical solution relates to the field of electrical engineering in particular DC motors. An electric motor [1-3], consisting of a frame with poles and excitation windings and an anchor with a winding and a plate collector, brush connection and a power source is known. However, such an electric motor has a significant disadvantage, which is the presence of a plate collector, which reduces the service life and reliability, due to the deposition of conductive dust between the plates of the collector, which also limits the power and speed.

2. Problem Statement

The purpose of the technical solution is to increase the reliability and service life of the electric motor by eliminating the plate collector at anchor.

3. Technical Solution

The proposed DC motor consists of a frame with the main poles and with excitation windings on them and an anchor with windings on the shaft. There are two ring collectors with a brush system, through which the anchor winding is connected to a DC source. To change the polarity of the main poles of the excitation windings, an additional unit of the analog-pulse system of electronic switching of the current direction in the excitation windings is introduced. To control the moment of switching the direction and magnitude of the current in the field windings, additional induction or magnetic sensors on the frame between a pair of different-polar main poles are provided. These sensors monitor the position of the armature winding. The number of additional sections of the main poles, additional induction or magnetic sensors, respectively, can be increased [4,5].
Figure 1. The schematic diagram of the electric motor. 1 – anchor, 2 – contact rings of the anchor collector, 3 – brush-pin assembly, 4 – excitation winding, 5 – main pole of the frame, 6 – frame, 7 – analog-pulse unit of electronic switching of the current direction (ESU) in the excitation winding, 8 – additional induction or magnetic sensors, 9 – DC source 10 – armature winding.

4. The Principle of Operation of the Presented Electric Motor
The schematic diagram of the electric motor is presented in Fig.1. The polarity of the poles of the armature (1) is unchanged. It is determined by the direction of the current flowing from the source (9) through the brush-pin assembly (3) from one ring (2) through the winding to the other ring (2) through the brush-pin assembly (3) back to the current source. On the corresponding excitation winding (4) of the main pole (5) of the frame (6), the current passes the direction determined by the block (7). The armature winding (10) will be affected by the electromagnetic force of the desired direction.

At a certain point in time, the direction of the current in the field windings is switched. This switching is performed in addition provided by the electronic switching unit (ESU) in order to switch in a timely manner in the appropriate spatial position of the armature winding relative to the induction or magnetic sensors (8). The sensors are mounted on the frame between the main poles of the excitation windings. EMF is induced on these sensors from passing the corresponding winding with the current of the armature. Induced EMF is a command pulse to change the direction of current in the windings of the main poles of excitation. By switching the direction of the current in the excitation winding of the main poles, the corresponding polarity will be maintained, which determines the direction of the electromagnetic force on the armature winding, due to which the armature rotates in one direction. If it is necessary to change the direction, it is required to change the direction of polarity on the anchor rings, by changing the polarity of the supplied voltage from the current source [6,7].

It is possible to increase the efficiency of the motor by increasing the number of sections of the main poles, sections of the armature windings, respectively, as well as the number of induction or magnetic sensors [8,9].

5. Conclusions
Analog-to-pulse switching of the direction and magnitude of the current is a remote to start and stop the motor. The analog-pulse unit facilitates the start and stop of the rotating rotor, and when starting, the possibility of changing the polarity of the main and additional poles to change the direction of the current in their windings, from which the direction of rotation changes. At the same time, with the achievement of nominal speed, the additional poles act as sensors of the anchor winding position, and from this the ESU unit switches the polarity of the main poles in accordance with the position of the anchor winding under the main pole.

The proposed technical solution is protected by a utility model patent [10] and can be implemented in the industry.
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