STRUCTURAL PREDICTION AND INNOVATIVE SYNTHESIS OF NEW VARIETIES OF THREE-PHASE TWO-STATORS INDUCTION MOTORS

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Introduction. In addition to induction motors for general industrial purposes, which form the basis of modern electric drive, in recent years, more and more usage of special purposes induction motors was find. The use of such motors simplifies the electric drive and gives it some specific properties, that are not provided by general purpose motors. Special purposes motors are characterized by unconventional design. Such motors include two-stators asynchronous motors. Two-stators induction motors differ from general industrial ones in that they consist of two stators and can also have a specific design of the secondary element [1]. These motors do not differ from general purpose induction motors by the principle of the action. This type of motors is used in electric drives that require increased torque. It is also possible to obtain an arbitrary speed of rotation of the rotor, by separate control of the stators. Based on the peculiarities of use and the prospects of application, the three-phase two-stators induction motor was chosen as the object of the study of this article.

The aim of the work is to implement structural prediction and directed synthesis of new varieties of three-phase two-stators induction motors by a given objective function with a guaranteed innovative effect.

Materials of research. According to the results of the patent research [1], the prototype structure of a three-phase two-stators induction motor was selected (Fig. 1) and, based on the results of genetic analysis, its genetic code 2TP 0.2y was determined.

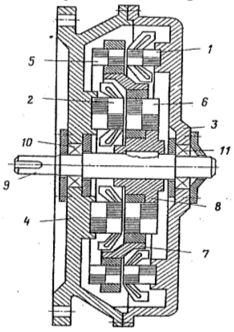


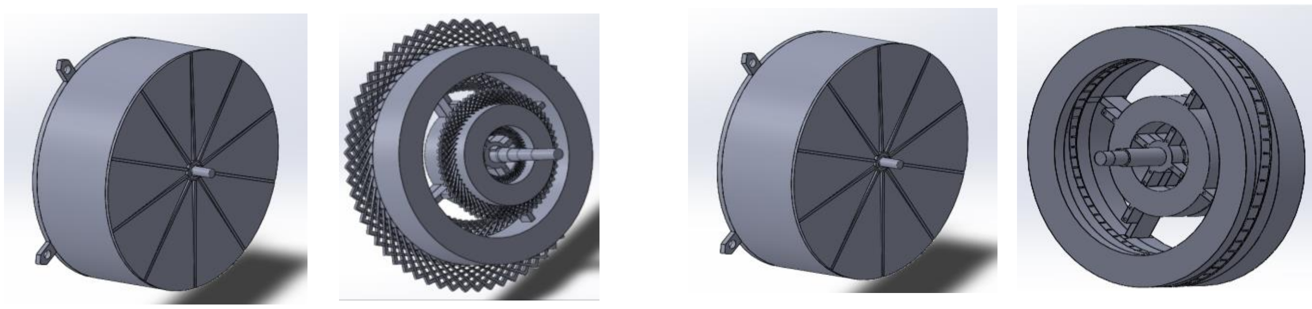
Figure 1 – Prototype structure of the three-phase two-stators induction motor [1]

According to [2] target research function was formulated. The selected prototype has the following essential features: 1) spatial motion-rotational (ω); 2) power supply type – three phase alternating current (m=3); 3) stator winding – three-phase distributed (W_R); 4) rotor winding - cast short-circuited from aluminum (squirrel cage); 5) presence of the replication – motor has 2 stators. Impose the restrictions on the research area: 1) research provided only within the first large period of genetic classification; 2) isotope sources are not considred in the research; 3) complex structures and hybrids are not considered in the research.

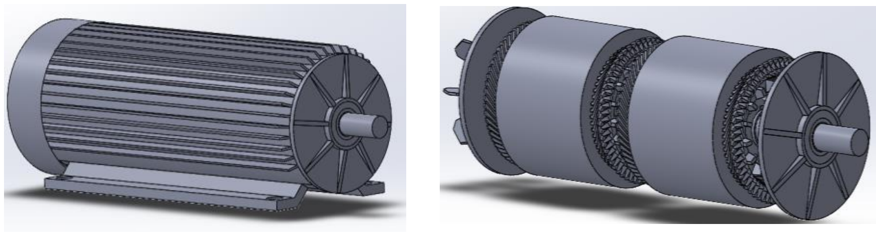
Therefore, the area of the existence [3] of the three-phase two-stators induction motors (prototype structure 2TP 0.2y) will be determined by the following chromosome sets:

$$Q_{АД} = (H_{0.2y}\,;\, H_{2.2y}),$$
$$H_{0.2y} = (\,CL\ 0.2y;\ KN\ 0.2y;\ TP\ 0.2y;\ SF\ 0.2y;\ TC\ 0.2y),$$
$$H_{2.2y} = (\,CL\ 2.2y;\ KN\ 2.2y;\ TP\ 2.2y;\ SF\ 2.2y;\ TC\ 2.2y).$$

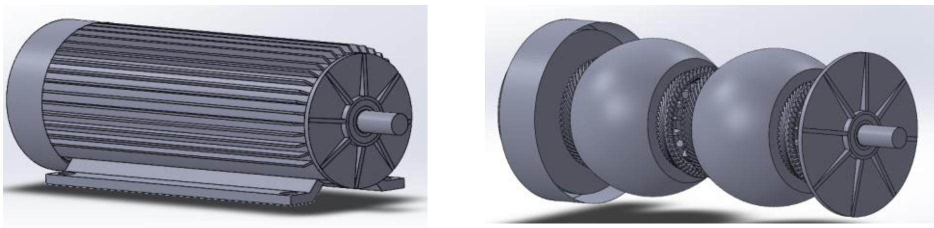
The synthesis of the homologous structures is carried out on the basis of the use of a group of topological transformations of the initial structure, while preserving its genetic topological features within the ideal homologous series of a certain region of Q_{AD} existence [3]. Visualized structures are shown in Fig. 2.



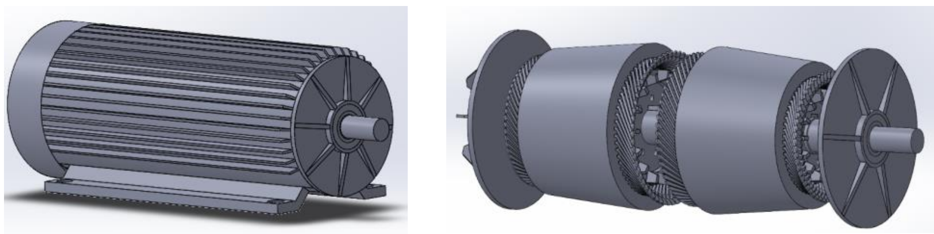
a) *b)*



c)



d)



e)

Figure 2 – Visualized structures of the three-phase two-stators induction motors: a) prototype structure 2TP 0.2y; b) cylindrical toroid structure 2TC 0.2y; c) cylindrical structure 2CL0.2y; d) conical structure 2KN0.2y; e) spherical structure 2SF0.2y.

The main advantages of a modified technical implementation of the toroidal flat structure 2TP0.2y (Fig. 2 a) are the increased torque and achievement of reduction of the radial size of the motor. The main disadvantage is the complexity of manufacturing the stacked magnetic circuit, because it will not be transverse but longitudinal, will be stacked from concentric rings of different diameters. The synthesized cylindrical toroid structure 2TC0.2y (Fig. 2 b) will differ from the prototype only with the spatial form of the active parts. This form of active parts gives an advantage in more rational use of the active surface of the stator and rotor at the same length of the magnetic circuit.

The advantages and features of the technical implementation of the structure 2CL0.2y (Fig. 2 c) are the same as in the structure 2TP0.2y. As we can see, the resulting structure has all the essential features of the prototype, and has a number of technical features: both rotors are located on the same shaft, the shaft is made stepped, because it is known that this design helps to reduce mechanical stresses in it, separate control of stators is possible. The advantage of this motor is the increased torque and disadvantages are increased requirements for mechanical strength of the shaft, as it is longer than the classic single-stator and single-rotor motors, and must withstand the weight of 2 rotors and increased consumption of active materials, as you need to make 2 stators and 2 rotors.

The main disadvantage of the conical structure 2KN0.2y (Fig. 2 d) is the complexity of manufacturing of the stacked magnetic circuit of the rotor and stator, as each subsequent sheet of electrical steel will have different outer and inner diameters. All other advantages and disadvantages are identical to the 2CL0.2y structure.

The main advantage of the spherical structure 2SF0.2y (Fig. 2 e) is a more rational use of the active surface of the stator and rotor at the same length of the magnetic circuit compared to conical and cylindrical machines. All other advantages and disadvantages are identical to the structures 2CL0.2y and 2KN0.2y.

Conclusions. According to the results of the analysis, 5 new structures 2CL0.2y, 2KN0.2y, 2TP0.2y, 2SF0.2y, 2TC0.2y were synthesized and visualized for the first time. The most widely used are 2TP0.2y and 2CL0.2y structures, because of advantages over existing rotating machines and designs which technical implementation is feasible economically. The 2SF0.2y structure would be used in special electric drives, as it has an advantage of a more rational use of the active surfaces of the stator and rotor at the same length of the magnetic circuit. Structures 2KN0.2y and 2TC0.2y would not find the industrial application because the structure 2KN0.2y has no advantages over the structures 2CL0.2y and 2SF0.2y, and the structure 2TC0.2y although offers a more rational use of the active surface compared to the structure 2TP0.2y, but has a very complex design of the active part, which will significantly increase its cost.

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