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Synchronous Motor for the Vehicle

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Abstract

This article is a description of the device which is included in the transmission, connecting the synchronous electromotor with the wheel. This device consists of asymmetrical differential included in the transmission between the electromotor and the generator of the electromotor, which provides the electric current for its excitation winding. This design allows automatic change of the parameters in a wide range. Torque, depending on needs, can be repeatedly increased or decreased. Shaft speed also varies automatically multiply. Operation of the device is similar to the automatic gearbox. Parameters vary smoothly and optimally. At the same time, the electromotor rotational speed is constant and optimal.

Keywords

Synchronous Motor, Asymmetrical Differential, Torque

1. Introduction

The most economical and compact synchronous motor has not been yet used on vehicles for several reasons 1) It does not have the starting torque. To commence work, it must first be started and enter into synchronism. 2) It has a strictly constant rotation speed. 3) If you exceed the load on its shaft in excess of the permissible quantities, it will stop. But except for disadvantages, it also has the advantages: i) The main advantage is that synchronous electric motor is the most economical among all systems. ii) Its overload capacity is much higher than overload capacity of the induction motor. iii) It sets network parameters of reactive component and compensates reactive power. iv) It depends less on the voltage drop in the network.

The purpose of development is to remedy these shortcomings, and at the same time to give the synchronous motor very valuable properties, such as a multiple increase in torque at the output shaft and a multiple change of output shaft speed. At that, the rotor of the synchronous electric motor rotates with its optimal and constant speed. Moreover, such changes of parameters are made automatically, depending on their needs at the moment.

In one of its constructional schemes, the synchronous motor has the generator of the current, intended to supply the excitation winding of the rotor motor. It is located on a common axis with the rotor. This generator consumes 6 - 7 percent of motor power. This energy is expended to overcome induction force between the stator and the rotor excitation generator when generating power. Previously, it was discussed similar the inclusion of the asymmetric differential inside the motor [1]. There is a patent application PCT/RU 2016/000524.

2. Connection and Operation of the Device

If the input and two of the outputs of the asymmetrical differential are connected to the motor shaft, as shown in **Figure 1**, then both outputs should rotate in the different direction. When one of them brakes, the speed of the second rotation in the different direction is increased. Any differential can be used. The scheme shows the planetary gear, a so-called mechanism of David.

Such a device provides a sufficiently large gear ratio at the output shaft. Gear ratios can be selected so that more torque is transmitted to one output, at a lower speed of rotation and in the second output with torque which is 10 - 15 times less. The differential is asymmetrical. Its input is connected to the motor shaft and to the rotor of the excitation generator. The output of the differential, to which more torque is applied, is connected to the output shaft. The stator of the excitation generator, which can also rotate around the axis of the shaft, is connected to the output of the differential, to which less torque is applied. The output shaft rotates in the same direction as the motor but the stator of the generator will tend to rotate in the opposite direction. Power of rotor of the excitation generator will enthrall its stator and will lead to partial blocking of the differential and its rotation around the axis of the engine, on which it is located. It reduces the transmission ratio and, as a consequence, accelerates the output shaft. Turnovers of the output shaft depend on the cohesive forces between the stator and the rotor of excitation generator, but they are also dependent on the load on the shaft, which may vary within wide limits. When the load on the output shaft

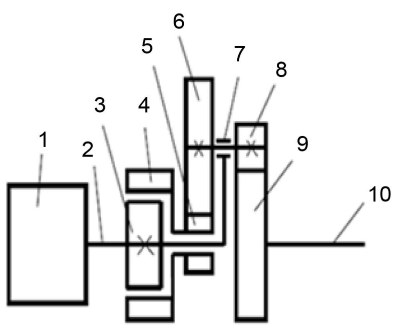

Figure 1. The scheme of the mechanism connection. (1. Synchronous motor. 2. Motor shaft. 3. Rotor of the excitation generator. 4. Stator of the excitation generator. 5. Central wheel. 6. Satellite. 7. Planet carrier of the differential. 8. Satellite. 9. The second central wheel. 10. Output shaft.)

is increased, the output is inhibited. More loads are transmitted through differential components to the generator of excitation and slipping increases between rotor and stator. When stator is inhibited, the differential slows down the rotation around its axis, and the rotation to a greater extent is transmitted over gears. The gear ratio will be increased. This will result in the increase of the torque of the output shaft. The torque will increase in proportion to the gear ratio of the differential. Gear ratio from the motor to the output shaft also grows and reduces its speed. In addition, due to the increased slipping in the generator of the excitation, the excitation current increased. This is necessary for efficient operation of the synchronous motor.

3. Conclusion

A similar mechanism was described earlier [2]. It is simple and therefore reliable. They allow changes at wide range automatically, depending on the load, the gear ratio and torque on the output shaft. At the same time, the speed of the rotor of the engine may remain constant. Model of such a mechanism has been constructed and is included in the transmission with a gasoline engine in order to replace the electric motor. The results of this study confirm the required parameters. Description of the mechanism was described in [3]. Model of the mechanism with electric motor also confirmed the required parameters. The mechanism was described in [4].

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