

Short Research Article

Electromechanical Transmission

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Abstract

The article is to propose an entirely new transmission scheme. At a common practice that transmission parameters in a car change the gear ratio and the torque by five or six times. Taking into account the engine speed change, the actual gear ratio change is by more than twenty times. The torque cannot change within these limits. On the contrary, when the engine rpm speed differs from the optimum one, the torque decreases. Losses at gear ratio alteration, especially at low gears, can reach ten percent of the power. These torque and ratio control parameters can be achieved by applying the transmission scheme described in this article. Her work is also documented in a patent RU2726378 (2020) and application PCT/RU2020/000322. The operation of a transmission of this design is an improved version of the transmission described in Khadeev (2017).

1. Transmission Operation

Transmission consists of two joint major elements, a planetary differential and a generator with an electroinductive clutch combined into a common block, which is a double-rotation machine, mounted on the drive shaft. See the device structure diagram in Figure 1.

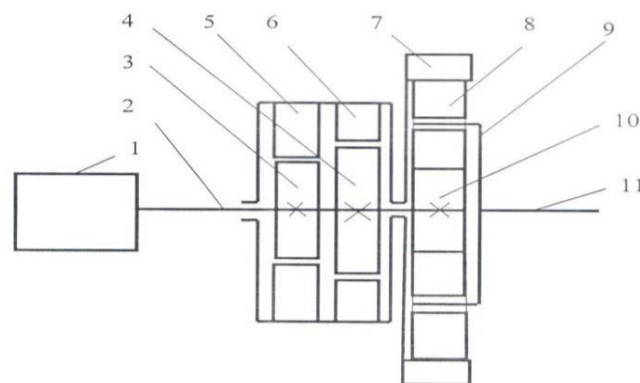


Figure 1. Mechanism Diagram

Note. 1. Drive motor; 2. Drive shaft; 3. Generator rotor; 4. Armature of the electroinductive clutch 5. Generator stator; 6. Inductor of the electroinductive clutch; 7. Planetary differential ring gear; 8. Satellite; 9. Cage; 10. Differential central gear; 11. Driven shaft.

When the drive shaft 2 rotates, the generator rotor 3, the armature of the electroinductive clutch 4 and the planetary differential input, the differential central gear (:) 10, connected to it, rotate as well. One differential output, the cage 9 with satellites 8, is connected to the driven shaft 11. The second output, the planetary differential ring gear 7, is connected to the generator stator 5 and the inductor of the electroinductive clutch 6, which are combined into a common block and connected by electrical circuit. The planetary differential ring gear rotates the generator stator and the inductor of the electroinductive clutch around the drive shaft. The current, produced by the generator, feeds the field winding of the electroinductive clutch. The torque, transmitted by the cage to the driven shaft, can exceed the torque on the motor shaft by six or seven times. The torque on the planetary differential ring gear will be factor of less. The cage and the driven shaft rotate in the same direction as the drive shaft. The ring gear and the generator stator with the inductor of the electroinductive clutch, connected to it, tend to rotate in the opposite direction. Nevertheless, when the drive shaft rotates, the generator produces current, and the Ampere force entrains the generator stator to follow the rotor, which is connected to the drive shaft. The generator provides current to the field winding of the inductor of the electroinductive clutch, which carries the ring gear behind the drive shaft as well as the drive electric motor, accelerating the driven shaft. The gear ratio and the torque are controlled automatically at change of the ratio of power on the drive shaft and the amount of load on the driven shaft. To manage you need changing the electrical connection between the generator and the electroinductive clutch. Remote current control devices can be used for control, probably based on the Hall Effect, or other. The generator and the electroinductive clutch included, in such a way that the inductor and the stator of the generator are installed on the drive shaft. Armature of the electroinductive clutch and the rotor generator connected to the crown of the planetary differential, and rotor generator can be equipped with permanent magnets..

Transmission losses are calculated by slip losses and friction losses in gear pairs. The minimum amount of operating losses occurs at nominal slips of about 0.3-0.35 percent of power, which is significantly less than losses in other types of transmissions. The losses increase at increase of slip. When the slip increases up to the starting position, the loss may be of 3.5%. However, it is necessary to take into account that with such transmission layout, the electroinductive clutch with the generator are part of the arm, which transmits no more than twenty percent of the power and the generator performs the large portion of general work. Therefore, the total share of losses is significantly less.

2. Operation of the Transmission with an Electric Motor

Such transmission can be enabled with any engine. Its enabling with an electric motor should be reviewed separately. The operation of the mechanism with an electric motor is described in Khadeev

(2020). The electric motor is effective at optimal speeds. There are ways to control the speed within a reasonably wide range, but energy losses exist in this case and the torque on the driven shaft does not increase. The synchronous motor is the most effective one. It is adequate in many aspects, for example, it has excellent features at overload and power at voltage loss. But this motor can only work at constant speeds. Using the synchronous motor with such transmission solves the problems of its use perfectly well. In addition, the armature in a synchronous motor is excited by direct current and about seven percent of power is spent on excitation. Generator mounted on the shaft, can supply electric current to both the inductor of the electroinductive clutch and the rotor of the drive synchronous motor for electric excitation, which increases the share of the generator force, entraining the generator rotor and the armature of the electroinductive clutch to follow the generator stator and the inductor of the electroinductive clutch. In this case, the drive motor rotor, the generator stator and the inductor of the electroinductive clutch are located on the shaft and need no sliding contacts for connection.

3. Conclusions

The transmission is simple and reliable with little loss. This is due to the simplicity and reliability of the electroinductive clutch and the generator. The primary advantages of the electroinductive clutch, such as simplicity of design and control, low cost and absence of wear parts determine an increased operational life. Generator designs are technologically tried, and are simple and reliable as well. There are no sliding contacts in the electrical circuits of the transmission, which also increases reliability. The transmission has no gear shifting, the drive is not disconnected from the driven shaft, and there is no power drop. The only planetary gear available in such transmission is present in each gearbox. Transmission parameters control the torque and the gear ratio in a wider range than the known, modern designs. This transmission is simple and more effective, allowing the engine to operate at optimum rpm speeds at all stages of the vehicle travel. It can be of use for all types of transport, especially for electrical means of transportation.

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