# Gearing Of An Electric Vehicle

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***Abstract*—The article deals with a transmission device based on the comparison of the Ampere force generated during the operation of the electro-induction clutch and the generator supplying it, with the forces of resistance to the movement of the vehicle, in an asymmetric planetary differential, which has the ability to rotate around the motor axis. This method of constructing a transmission is described in [1]. The device allows for multiple increasing of the torque and gear ratio on the driven shaft automatically, as well as for easy and simple control of the power on the drive wheel of the vehicle in a stepless mode. The device can be used in the automotive industry, railway transport and mechanical engineering.**

***Keywords—** Asymmetric planetary differential, Ampere force, Electro-induction clutch, Torque.*

## I. Introduction

There may be some problems of using an electric motor as a traction one in vehicles. First of all, that is because in almost any electric motor, deviation from its optimal rotor speed leads to a decrease in its basic parameters, torque and efficiency. The wheel speed shall be varied over a wide range, while the motor speed shall remain constant and optimal. The second contradiction is that in energy efficient electric motors the starting torque is relatively short and, to ensure its sufficient value, it is necessary to increase the power of the electric motor, which leads to the complexity of its placement and an increase in the weight and cost of the vehicle. Electric vehicle powertrain devices that solve these problems are usually simpler than those of an internal combustion motor car, but still complex and expensive.

## II. Operation of the Device

One can solve these problems by using a device, the diagram of which is shown in the figure 1.

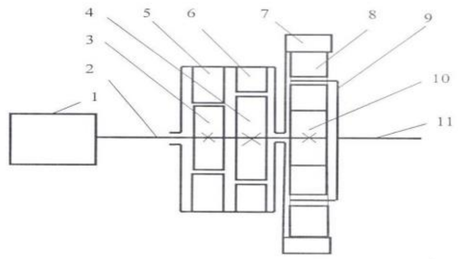


**Figure 1**

1.Electric motor. 2. Motor shaft. 3. Generator rotor. 4 Armature of the Electro-induction clutch. 5. Stator of the generator. 6. Inductor of the electro-induction clutch.. 7. Crown of the planetary gear. 8. Satellites. 9 .Carrier of the differential. 10. Central gear. 11. Driven shaft.

This device consists of an asymmetric planetary differential mounted on a shaft and is able to rotate around it, the input of which is connected to the drive shaft. In its turn, the shaft is connected to the electro-induction clutch and generator. Motor shaft 2 is connected to the input of the planetary differential, the central gear 10. One output, the carrier of the differential 9, is connected through the shaft 11 to the wheel of the vehicle, and its second output with ring gear 7, which is connected to the inductor of the electro-induction clutch 6 and the generator stator 5 that rotate freely on the shaft. The armature of the electro-induction clutch 4 and the rotor of the generator 3 are mounted on the motor shaft and connected to it. When the shaft of the electric motor rotates, the generator produces electric current for the operation of the clutch, while the Ampere force arising between the rotor and the stator of the generator drags the stator by an the rotor. The armature, which is rotated by an electric motor, is also drags the inductor of the electro-induction clutch. These two forces add up and accelerate the rotation of the driven shaft. The gear ratio from the motor to the shaft consists of the rotation of the differential transmitted through the gears and the rotation of the differential around the axle. With an increase in the load on the driven shaft, it slows down, slip in the electro-induction clutch and generator increases, rotation from the motor to the driven shaft is transmitted to a greater extent through the gears of the differential . The gear ratio from the motor shaft to the driven shaft is increased. The torque on the driven shaft also increases. As the vehicle accelerates, the gear ratio from the motor to the driven shaft decreases. Rotation is transmitted to a greater extent through the rotation of the differential around the axis. At the start, the torque is maximum and, in multiples of the planetary gear ratio, exceeds the motor torque. And the gear ratio on the driven shaft varies widely because the inductor of the clutch with the stator of the generator connected to the second output of the differential is able to rotate in the opposite direction, which depends on the ratio of forces

If the rotor excitation is necessary for the operation of the traction electric motor, for example, as it happens in the case of a synchronous electric motor, the generator can provide this as well, as shown in [2]. In this case, a reverse circuit of the electrical electro-induction clutch and generator is used. The rotor of the generator, which will generate current, shall be installed on the shaft of the electric motor, while the stator of the generator operates on permanent magnets. The clutch inductor is also mounted on the shaft. In this case, there are no sliding contacts in the motor-transmission system. The current from the generator to the clutch and the rotor of the traction motor is transmitted through the internal circuit of the closed system "generator rotor - traction motor rotor - inductor of the electro-induction clutch". Control of the clutch, generator and electric motor excitation is preferably remote, for example based on the Hall effect. In this case, the executive unit is also mounted on the motor shaft and rotates with it.

## III. Conclusion

As a result, a significant simplification of the transmission, an increase in reliability and a reduction in the cost of construction have been achieved. Electric control allows simple and reliable use of modern robotic systems. One can use the most economical electric motor and it will work at its optimum during the entire cycle of movement. A detailed description of the operation of such a transmission can be found in [3].

## References

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