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New Transmission For A Hybrid

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***Abstract*—The article deals with transmission for a hybrid vehicle having no any speed gearbox and a coupling mechanism. The motor runs at continuous and optimal fuel consumption modes. The transmission is electrically controlled thus simplifying the use of automatic means.**

Keywords— Planetary differential, generator, electromagnetic inductive clutch, torque, Ampere force

I. Introduction

It is proposed to consider a completely unusual design of the vehicle transmission. Usually, any innovation goes through three stages of consideration: 1. This is some kind of nonsense, the mechanism cannot work correctly. 2. There is something to it. 3. So it should be that there is incomprehensible. The proposed design is now at the first stage. But the mechanism works and there is hope for its promising.

The traditional transmission device is not always convenient to use in a hybrid vehicle scheme. Vehicle transmission is a complex and expensive mechanism. The use of the construction proposed in this article simplifies and makes the transmission cheaper.

II. Method

It contains series-connected mechanisms consisting of a planetary differential connected to a generator, which has a stator that can rotate about the axis, forming together an electric machine of double rotation. One of such mechanisms consisting of a generator connected to an asymmetrical planetary differential is shown on the scheme, Fig. 1.

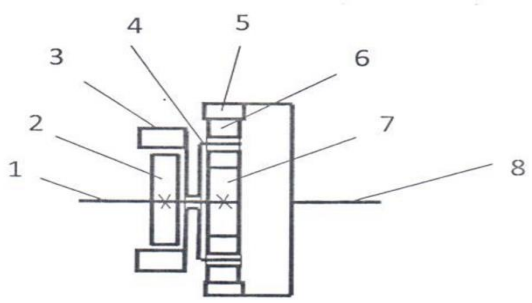

Figure 1 Scheme of the method.
1. Motor shaft. 2. Rotor of the generator. 3. Stator of the generator. 4 and 5. Outputs of the differential. 6.Sateltes 7. Input of the differential. 8. Output shaft.

III. Operation of the Device

The rotor of the generator 2 is connected to the motor shaft 1. The input of the differential 7 is also connected to the motor. One output of the differential 5 transmitting a

large torque is connected to the output shaft 8, and the second output 4- the planetary differential carrier-with

satellites 6 is connected the stator of the generator 3, which is able to rotate about the common driven shaft axis. Rotation from the motor is transmitted to the output shaft, which rotates in the same direction as the driven shaft does, and to the stator, which tends to rotate in the opposite direction. But an electrical load in the generator causes the Ampere force and entrains the stator behind the rotor, partially blocking the differential and increasing the sliding between the stator and the rotor, leads to a reduction in the transmission ratio from the motor to the output shaft, and increases the speed of rotation of the driven shaft. With increasing load on the driven shaft, it is slowed down and the rotation is mostly transmitted through the differential gears. This increases the transmission ratio and the torque on the output shaft. With increasing sliding between the stator and the rotor as well, the Ampere force increases, which further increases the torque. Moreover, the change of electrical load in the generator circuit can control the transmission ratio and the torque on the output shaft. In this case, it is possible to maintain the constant and optimal shaft speed within wide limits. Fig. 2 shows the main part of the transmission scheme. It consists of two generators connected to differentials as shown in Fig. 1. Mechanisms are interconnected via the clutch with a synchronizer, which is necessary for the guaranteed disconnection of the drive and the output shaft. The transmission ratio of differentials can be chosen so as to provide conditions for the operation of both generators, as well as to get a maximal output torque.

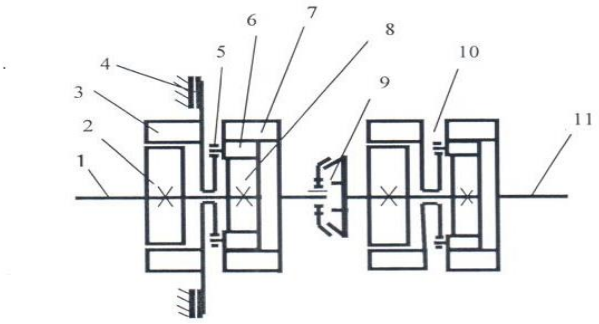

Figure 2 Scheme of the method.

1. Motor shaft. 2. Rotor of the generator.

3. Stator of the generator. 4. Power clutch. 5. Carrier. 6. Satellites. 7. Crown. 8. Central gear. 9. clutch with a synchronizer. 10. Second same mechanism. 11. Output shaft

The motor shaft 1 is connected to the anchor of the generator 2 and the central gear 8. The stator of the generator 3 is connected to the shaft and to the carrier 5. Rotation from the drive through satellites 6 rotates the crown 7 and the stator of the generator. The carrier through

the power clutch of sliding 4 can be connected to the housing and stop the stator. It allows to use this mechanism as an electro-motor, if necessary, as well as to generate an electric current for charging accumulators before driving. The crown is connected to the clutch with a synchronizer 9 and transmits rotation to the second same mechanism 10, from which power is transmitted to the output shaft 11 connected to the wheel.

If the transmission ratio of each differential is equal to two, then the torque from the drive to the output of the differential will increase by a factor of two, and totally by a factor of four. Is it enough to ensure optimal transmission performance? Usually, this value for vehicles is not more than five. But with a rotation speed of the drive shaft that differs from an optimal one used for engine operation in the usual transmission scheme, the torque is much more less. This transmission expects the engine to be operated start of movement and up to the certain limits at an optimal speed. Therefore, an increase of the torque by a factor of four will be surely enough. A driver of the vehicle increases the speed to the optimum value, then the clutch with a synchronizer is on, followed by an electric load of generators. The power is controlled by changing the electrical load in generators unless the required power exceeds the maximum value, which corresponds to optimal speeds.

One of the advantages of such mechanism is the absence of coupling in the transmission. In the absence of an electrical load in generator circuits the torque is not transmitted to the driven shaft. To start the movement, it is necessary to turn the electrical load in the generator circuit on, so the speed controller, in order to ensure its consistency, will respectively increase the motor power.

Electric current produced by the generator is supplied to electric motors not connected to the driven shaft, through the mechanism consisting of a planetary gear and an electromagnetic clutch of the slip. The planetary gear can be located in the motor housing, in its own housing, or inside a wheel. Fig. 3 presents an example of

such mechanism installed inside the wheel.

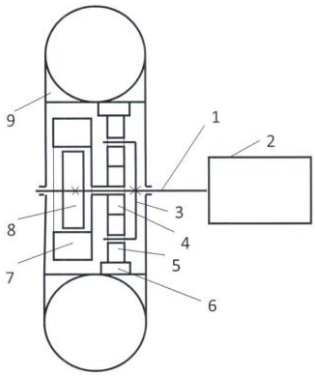

Figure 3 Mechanism of connecting the electro-motor with the wheel

1.Shaft of the electro-motor. 2. Electro-motor. 3. Carrier. 4. Central wheel. 5. Satellites. 6. Crown. 7. Inductor. 8. Anchor. 9. Vehicle wheel.

Shaft 1of the electro-motor 2 connected to the carrier 3 and the anchor of electromagnetic clutch 8. Rotation via

satellites 5 is transmitted to the central wheel 4 and the crown 6 that is connected to the vehicle wheel 9. The central wheel 4 easily rotates on the shaft, but is connected to the inductor 7 of electromagnetic clutch of the slip. In this case, when the motor shaft rotates, the crown connected to the wheel will rotate at a speed reduced in proportion to the transmission ratio of the planetary gear in the same direction as the driven shaft does. The inductor of electromagnetic clutch connected to the central wheel will tend to rotate in the opposite direction. Since the clutch anchor rotates in the same direction as the driven shaft with respect to the electric motor, and is closely connected to it, the anchor pulls the inductor and partially blocks the differential reducing overall transmission ratio from the driven shaft to the wheel. The anchor and the inductor can be installed in different ways: The anchor can be connected to the central wheel, and the inductor does to the driven shaft. Electromagnetic induction force can be controlled by the inductor current allowing controlling the transmission torque and the acceleration rate of a vehicle, but the clutch may not be controlled, for example, with permanent magnets instead of exciting windings on the inductor. Therefore, with increasing load the wheel slows down, the sliding in the clutch increases, the rotation is mostly transmitted through

the gears of the differential, the transmission ratio from the driven shaft to the wheel increases, its speed reduces, the torque accordingly increases, and the turnovers of the electric motor remain relatively constant. The stator can even stop and rotate in the opposite direction, whereas the torque on the wheel is maximal. With decreasing load, the glide in the electromagnetic clutch decreases, the transmission ration becomes less and the wheel accelerates. The transmission ratio and torque of such transmission automatically change depending on the load on the wheel.

Electric motors on the wheels can be standard, asynchronous and having a small accelerating torque. But, if it is a synchronous electric motor, then it can be started without any load, at idle speed, and only after being synchronized, the exciting current of an electromagnetic clutch can be switched on.

IV. Conclusion

The scheme of the proposed transmission is unusual, but it is obvious that it will be useful in the application. Vehicles will be more economical, safer and cheaper. It is also important that the management of such a transmission is simpler, and therefore more reliable. It can be controlled by an electronic unit with a special program necessary to ensure the greatest economy. Such a transmission can be supplemented with elements already used, for example, in case of need to increase the starting torque for a truck or tractor, you can use the clutch mechanism described in [1], which will increase the starting torque by another two times. To simplify the transmission, possibly replace the second generator an electric induction clutch, as well as apply stators and inductors with permanent magnets in the mechanisms. The transmission device contains mechanisms of the same type, the method of which is included in the patent [2], and the mechanism itself is documented in the patent [3].

References

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