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OVERVIEW OF REGENERATIVE BRAKING PARAMETERS ELECTRIC VEHICLE SYSTEMS

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Abstract– The number of electric vehicles in the cities of Uzbekistan increases every year. Uzbekistan is one of the promising destinations in the field of transport, with a developing infrastructure necessary for the comfortable use of vehicles of this type. The development of this industry requires solving a number of problems, including the development of regulatory documents, the formation of solution methods and the development of infrastructure. This article is aimed at analyzing and justifying the operation of regenerative and braking systems of electric vehicles.

Key words– Electric car, development prospects, regenerative system, braking system, ecology, transport.

I INTRODUCTION

The hydraulic drive of the brake system of electric vehicles uses brake fluid as a working fluid, which, under pressure, enters the brake cylinders, activating the brake mechanisms. In addition, a regenerative braking system is used to recover some of the energy for reuse in the same process. Braking energy recovery, also known as energy regeneration, significantly improves the driving range of any electric vehicle. In modern electric vehicles this is aimed at ensuring maximum energy efficiency [1;2].

II THE MAIN PART

When you press the brake pedal, the regenerative system is first activated, where instead of using a friction brake mechanism that creates artificial resistance to wheel rotation, an electric generator comes into action. The effective maximum braking torque of a traction motor operating in generator mode depends not only on the strength of the excitation current, but also on the armature speed, which, in turn, depends on the speed of the vehicle. Therefore, braking efficiency varies depending on the driving speed. In case of insufficient braking efficiency by the traction electric motor, the difference between the level of efficiency set by the driver and that created by the electric motor is compensated by the friction braking mechanism. The higher the charging current of the high-voltage battery produced by the electric motor in generator mode, the greater the braking force. Regenerative braking control is achieved through the joint use of the braking system and transmission. With this control, the regenerative braking system and the hydraulic braking system collectively provide the required braking force, taking into account fluctuations in the parameters of the regenerative system caused by the state of charge of the battery or the speed of the vehicle. As a result, the loss of kinetic energy is minimized (Fig. 1) [3].

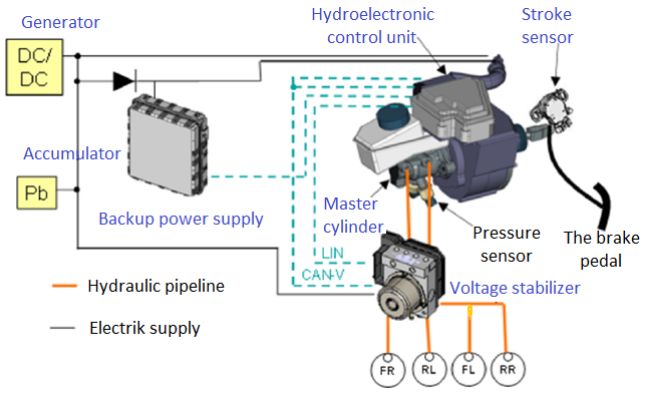

Fig. 1: Electric Brake Control [3]

It can often be difficult to understand what happens when the driver of an electric vehicle releases the accelerator pedal. In this case, the traction motor must switch to generator mode to convert kinetic energy into electrical energy. Energy recovery during braking of electric vehicles is an effective method for reducing the energy consumption of an electric traction system. Modern technological capabilities also provide smooth control of braking force until the vehicle comes to a complete stop. The implementation of this con-

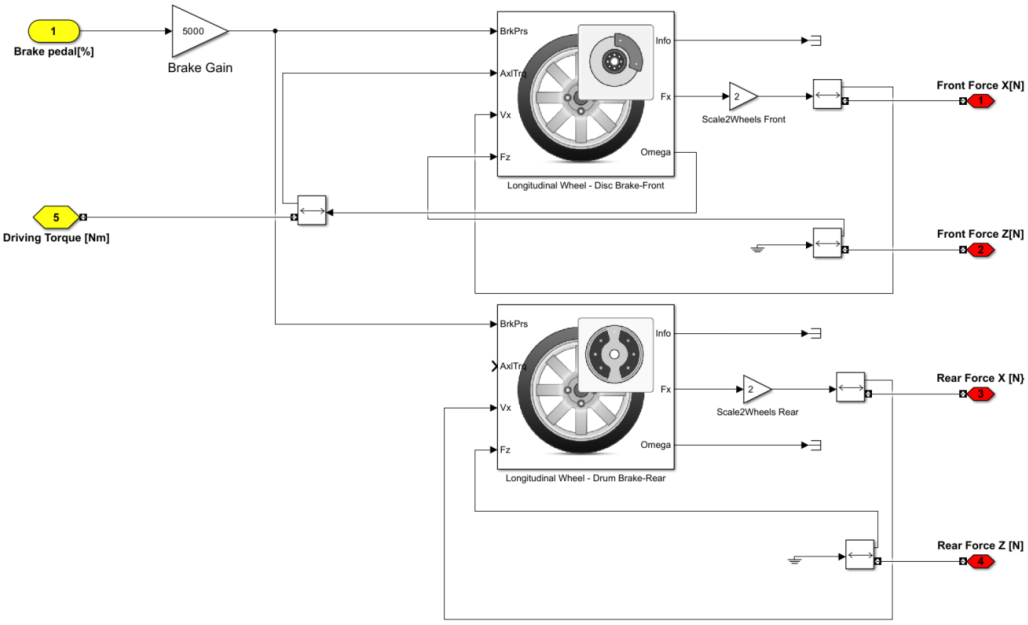

Fig. 2: Model of a brake system with wheels for a modern electric vehicle

cept helps to reduce environmental emissions associated with wear of mechanical brake elements, as well as increase driving comfort and safety. Vehicles using electric braking with energy recovery require virtually no additional braking system. However, modern electric vehicles are equipped with a hydraulic braking system, including friction brake mechanisms [4]. Figure 2 shows a model of a brake system with wheels for a modern electric vehicle.

The operation of regenerative systems varies depending on the manufacturer and model of electric vehicle. In some situations, electric vehicles constantly recuperate energy, while in other electric vehicles, coasting is given priority because any energy conversion inevitably involves losses. This especially applies to mode D - transmission movement, which is the main one and is automatically activated every time the electric vehicle is turned on. [4;5].

Coasting is activated when the driver releases the accelerator pedal, providing comfortable driving and predictable driving. If increased deceleration is necessary, the driver uses the brake pedal, activating braking energy regeneration [6]. The electric motor decelerates with force, which is sufficient for most everyday situations. The wheel brakes are only applied when more intensive braking is required, and this happens almost unnoticed by the driver. This is achieved through precise and high-speed braking and drive control systems. In addition, these systems maintain optimal traction of the rear wheels, where braking energy is recuperated, with the road surface. Efficiency is ensured by the presence of predictive systems in many modern electric vehicles. This system analyzes data from the vehicle's navigation system and sensors, providing the driver with the tools to operate the electric vehicle efficiently and easily. When the electric vehicle approaches areas that require low speed driving (such as residential areas, intersections or curves), Eco Assistance informs the driver to release the accelerator pedal. From this point on, the system automatically optimizes coasting and energy recovery without requiring driver intervention. For example, the car reacts effectively when approaching another vehicle ahead at low speed [6].

The choice between coasting and recuperation driving modes is given to the driver at any time using the driving mode switch. In regenerative driving mode, the drive system of electric vehicles almost always recuperates energy, but not until the electric vehicle comes to a complete stop [7]. The braking force limit for many electric vehicles for energy recovery is set at 0.13 g. In this case, the deceleration is noticeable, but without a pronounced feeling of strong braking. This is done on many modern electric vehicles because ease of operation and intuitive feel are key advantages of electric vehicles. [10].

III CONCLUSION

As a result of the research, the following conclusions can be drawn: Many modern electric vehicle models provide an additional tool for adjusting the relationship between coasting and energy recovery. These modes provide energy recovery during braking, as in the coasting mode, although not

to the same extent as in the enhanced recuperation mode. In some situations, the charge level of the battery is important: if it is fully charged, additional electricity cannot be accepted.

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