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Research on Regenerative Braking System (RBS)

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Abstract: Presently what the world needs is a method or a technology that saves energy from getting wasted. Energy conservation is the hour of need. In case of automobiles, energy conservation can be done by using regenerative braking systems (RBS). The use of regenerative braking system in automobiles provides us the means to balance the kinetic energy of the vehicle to some extent which is lost during the process of braking. . A simulation analysis of regenerative braking system performance has been completed in different velocity, braking severity and soc of batteries and three driving cycles. Flywheel is used for converting the kinetic energy to mechanical energy. The simulation results indicate that the vehicle can achieve a better rate of energy recovery and a longer driving range with ensuring braking stability.
Keywords: Regenerative braking, control strategy, energy recovery, simulation, flywheel, batteries.

I. INTRODUCTION

When a conventional vehicle applies its brakes, kinetic energy is converted to heat as friction between the brake pads and wheels. This heat is carries away in the airstream and the energy is effectively wasted The total amount of energy lost in this way depends on how often, how hard and for how long the brakes are applied. Ratio of braking energy and total driving energy is 48.3% in the case of FUDS (Federal Urban Driving Schedule) driving cycle, while the ratio is 53% in the case of 10-15 driving cycle [1].

In Regenerative braking system instead of wasting the kinetic energy of vehicle in the form of heat it is converted into electrical energy to be stored in batteries and capacitors or as mechanical energy of a flywheel having large moment of inertia. In this way a large proportion of energy of vehicle is saved only to be used later for either accelerating the vehicle or for different electrical purpose. So another major factor to reduce energy consumption and improve driving mileage, the research of brake energy recovery technology has become popular and braking energy can be up to 50% of the total energy to drive according to related literature. The driving mileage will be increased if the part of waste energy can be reused [2-4].

II. METHODS & WORKING

Every time we step on our car's brakes, we are actually wasting energy. As we know that energy can neither be created nor be destroyed. It can be just converted from one form to another. So when our car slows down, the kinetic energy that was propelling it in the forward direction has to go somewhere. Most of it simply gets released in the form of heat and becomes useless. The motor becomes generator when electric vehicle braking, transmits the electric power which is converted by the motor to the battery, recharging the battery. Energy recovery system working schematic diagram is shown in Figure 2 [5].The regenerative braking system consists of a flywheel having a large moment of inertia, so that it requires a large torque for rotational acceleration. There is a provision for engagement and disengagement of flywheel with the drive shaft. When driver needs to slow down or stop the vehicle, the flywheel is engaged with the drive shaft with the help of gears. As flywheel gets engaged power now goes divided between driving shaft and flywheel, flywheel having a large moment of inertia absorbs the power from engine in the form of rotational kinetic energy and brings the vehicle to halt and this rotational kinetic energy of flywheel can be used further to accelerating the vehicle. The main drawback of using flywheels in moving vehicles is their heavy weight.

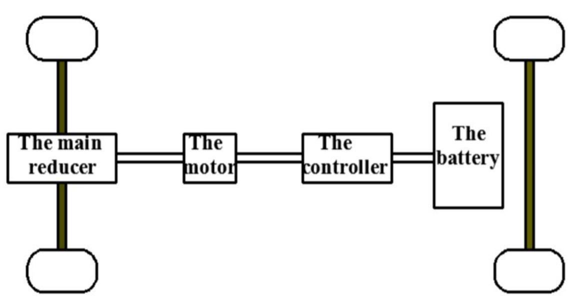

Fig 1. Front Wheel Drive Regenerative Braking System Structure Diagram

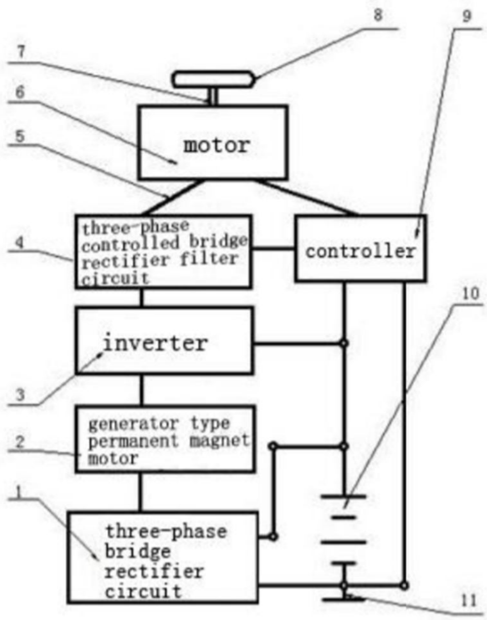

Fig 2. Energy Recovery System Working Schematic Diagram

Here, 1- three-phase bridge rectifier circuit; 2- power type permanent magnet motor; 3- inverter; 4- three-phase controlled bridge rectifier filter circuit; 5- three-phase line; 6-permanet magnet motor; 7-shaft; 8- vehicle driving wheels ; 9- controller; 10-power battery; 11negative grounding end.

A. *Why RBS?*

1) Improved Fuel Economy
2) Reduction In Engine wears
3) Reductions in Brake wear
4) Reducing Cost of Replacement Brake linings
5) Emission Reduction
6) Improved efficiency

III. LIMITATIONS

A. Added weight bulk - extra components can increase weight increasing fuel consumption, offset by engine operating at its best efficiency.

B. Complexity - depends on control necessary for operation of regenerative braking system.

C. Cost - of components, engineering, manufacturing and installation. Mass production would bring costs down to a more reasonable level.

D. Noise - dependent on system.

E. Safety - Primary concern with any energy storage unit of high energy density. There must be very little chance of dangerous failure during normal vehicle operation. Passengers must be protected from risk that may be caused by the failure of the hybrid system.

F. Size and packaging constraints - most important for cars.

G. Added maintenance requirement - dependent on complexity of design.[6].

IV. FUTURE SCOPE OF RBS

Although regenerative braking is more efficient than conventional braking, it is still not popular as electric vehicles and hybrid electric vehicles are still in developing phase. Energy stored in battery can be used to operate air conditioning, lights, mobile charging etc. Besides increasing efficiency of vehicle it increases its weight too that problem can be overcome by using light materials for regenerative circuit components. As our future vehicles will be having electric and hybrid vehicles, regenerative braking system is going to be next revolution in braking system. [7-8].

V. CONCLUSION

In this paper, the design of the electric vehicle energy recovery system converts the braking energy into electric energy which charges for the battery. Regenerative braking can save up to 30% of lost energy as well as can sustain life than conventional braking system. Besides it has a wide scope of development in future that could lead to a huge savings of energy for the world.

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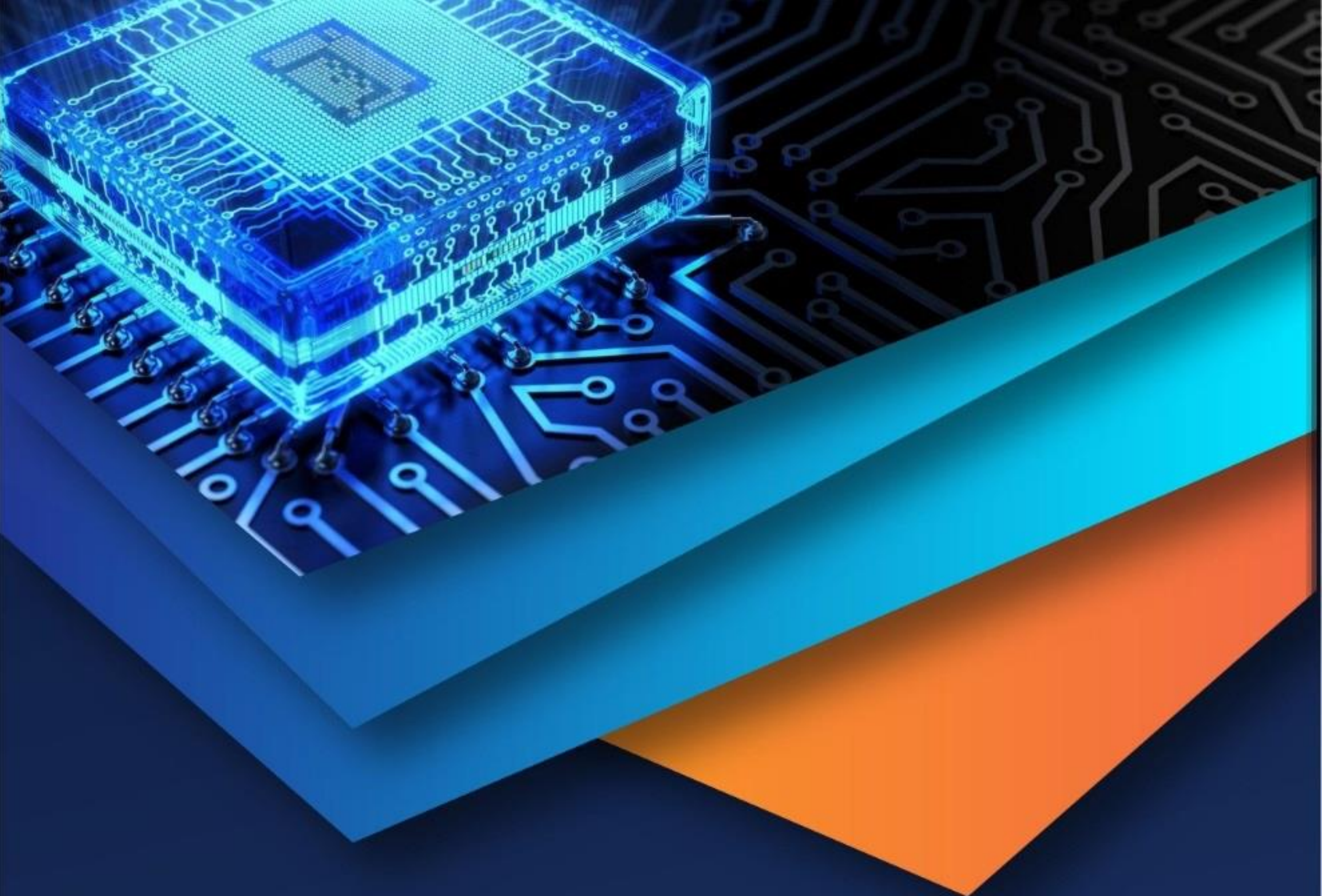

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