Escalated Energy Generation for Regenerative Braking System

V. Uday Krishnam Raju, U. Rajendra Prasad Varma, M. Hari Krishnam Raju

Abstract

Every time you step on your car's brakes, you're wasting energy. Physics tells us that energy cannot be destroyed. So when your car slows down, the kinetic energy that was propelling it forward has to go somewhere. Most of it simply dissipates as heat and becomes useless. That energy, which could have been used to do work, is essentially wasted. This is designed by using a motor driving a wheel which in turn drives a wheel and a free wheel which is then followed by a flywheel which is connected to the shaft of the DC dynamo. When the dynamo rotates the battery gets charged through Boost Converter.

Keywords: Battery, wheel, Dynamo, Fly wheel, Boost Converter.

1. Introduction

A brake is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion, most often accomplished by means of friction. The term 'Braking' in a moving vehicle means the application of the brakes to reduce its speed or stop its movement, usually by depressing a pedal. The braking distance is the distance between the time the brakes are applied and the time the vehicle comes to a complete stop. In braking systems on conventional vehicles, friction is used to counteract the forward momentum of a moving vehicle. As the brake pads rub against the wheels or a disc that is connected to the axles, excessive heat energy is created. This heat energy dissipates into the air, wasting as much as 30 percent of the vehicle's generated power. Over time, this cycle of friction and wasted heat energy reduces the vehicle's fuel efficiency. More energy from the engine is required to replace the energy that was lost by braking. Most of it simply gets released in the form of heat and becomes useless. That energy, which could have been used to do work, is essentially wasted. The solution for this kind of this problem is Regenerative Braking System. This is a new type of braking system that can recollect much of the car & kinetic energy and convert it into electrical energy or mechanical energy. The energy so produced can then be stored as mechanical energy in flywheels, or as, electrical energy in the automobile battery, which can be used again. There are 7 multiple methods of energy conversion in RBSs including spring, flywheel, electromagnetic and hydraulic. More recently, an electromagnetic-flywheel hybrid RBS has emerged as well. Each type of RBS utilizes a different energy conversion or storage method, giving varying efficiency and applications for each type.

The effect of regenerative brakes is less at lower speeds as compared to that at higher speeds of vehicle. So the friction brakes are needed in a situation of regenerative brake failure, to stop the vehicle completely.

2. LITERATURE SURVEY

Yimin Gao and Mehrdad Ehsani, in this methodology for designing a RBS has been described. Three RBS's were built and tested, first using a HIL test bed and then installed on an operation hybrid electric city bus. For the serial RBS, a key problem of how to adjust the friction braking force has been solved. Some factors have been taken into account for increasing the energy regeneration efficiency. How the RBS reacts with the ABS has been analyzed to ensure the vehicle's longitudinal stability. The results indicate that the serial RBS has high energy regeneration efficiency while retaining acceptable vehicle drivability and stability needed to ensure passenger safety [1].

Two versions of regenerative braking[2] are currently available. The first type is serial regenerative braking that is based on a combination of a friction-based adjustable braking system with a regenerative braking system that transfers energy to the electric motors and batteries under an integrated control strategy.

The second type is a parallel braking system [3,4] in which the friction- based braking system and the regenerative braking system are operated in tandem, without integrated control which means that neither the friction braking force nor the regenerative braking force can be adjusted easily.

The optimum slip ratio is important to ensure that the tire can develop asufficient high braking force to stop the vehicle [5].

Cai et al have designed two anti-skid controllers; a rule-based controller and a fuzzy logic controller to control the motor torque [6].

In that study, the slip level can be estimated bycalculating the ratio of wheel acceleration to motor torque. S. Sakai et al have compared the electricmotor with hydraulic brake system as an actuator of ABS [7].

3. Implementation:

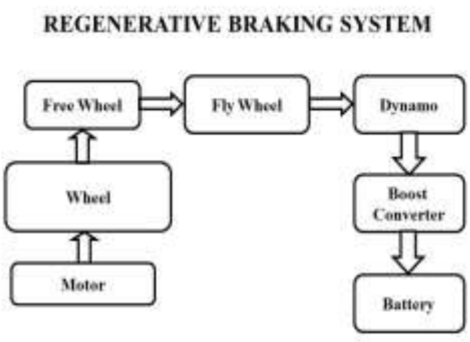

Fig1: Block diagram

This is designed by using a motor driving a wheel which in turn drives a wheel and a free wheel which is then followed by a flywheel which is connected to the shaft of the DC dynamo. When the dynamo rotates the battery gets charged through Boost Converter.

The working of the regenerative braking system depends upon the working principle of an electric motor, which is the important component of the system. Electric motor gets activated when some electric current is passed through it. But, when some external force is applied to activate the motor (during the braking), then it behaves as a generator and generates electricity. This means that whenever motor runs in one direction, the electric energy gets converted into mechanical energy, which is then used to accelerate the vehicle and whenever the motor runs in opposite direction, it performs functions of a generator, which then converts mechanical energy into electrical energy, which makes it possible to utilize the rotational force of the driving axle to turn the electric motors, which results in regenerating electric energy for storage in the battery and simultaneously reducing the speed of the car with the regenerative resistance of the electric motors. This electricity is then used for recharging the battery.

A flywheel is component which is used to store mechanical energy and then release the stored energy when needed for acceleration. Flywheel is a heavy, high-speed rotating disc that builds up kinetic energy as it spins. The amount of energy stored depends upon how heavier it is and how fast it rotates. The method of transmission of energy directly to the vehicle(dynamo) is more efficient rather than first storing it in the battery, as it does not consists of the conversion of energies. As, during the recharging of battery, mechanical energy is converted into electrical energy and during discharging vice-versa . So, due to these conversions transmission loses occur and the efficiency reduces. As, in the other case, there are no transmission loses since mechanical energy stored in the flywheel is directly transferred to the vehicle in its original form.

4. Related Work:

The brief introduction of different modules used in this project is discussed below:

4.1. RECHARGEABLE BATTERY:

Fig2: Rechargeable Battery

A rechargeable battery, storage battery, or accumulator is a type of electrical battery. It comprises one or more electrochemical cells, and is a type of energy accumulator. Rechargeable batteries come in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Rechargeable batteries are known as secondary cell because its electrochemical reactions are reversible.

Rechargeable batteries have lower total cost of use and environmental impact than disposable batteries. Some rechargeable battery types are available in the same sizes as disposable types. Rechargeable batteries have higher initial cost but can be recharged very cheaply and used many times.

4.2. Fly Wheel:

Fig3: Fly wheel

A **flywheel** is a rotating mechanical device that is used to store rotational energy. Flywheels have a significant moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by applying torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing its rotational speed.

4.3. Regenerative Braking System:

Regenerative braking is used in vehicles that make use of electric motors, primarily fully electric vehicles and hybrid electric vehicles. One of the more interesting properties of an electric motor is that, when it's run in one direction, it converts electrical energy into mechanical energy that can be used to perform work (such as turning the wheels of a car), but when the motor is run in the opposite direction, a properly designed motor becomes an electric generator, converting mechanical energy into electrical energy. This electrical energy can then be fed into a charging system for the car's batteries.

4.4. DC dynamo:

Fig4: DC dynamo

A **motor-generator** (an **M-G set** or a **dynamotor** for dynamo-motor) is a device for converting electrical power to another form. Motor-generator sets are used to convert frequency, voltage, or phase of power. They may also be used to isolate electrical loads from the electrical power supply line. Large motor-generators were widely used to convert industrial amounts of power while smaller motor-generators (such as the one shown in the picture) were used to convert battery power to higher DC voltages.

4.5. Boost converter:

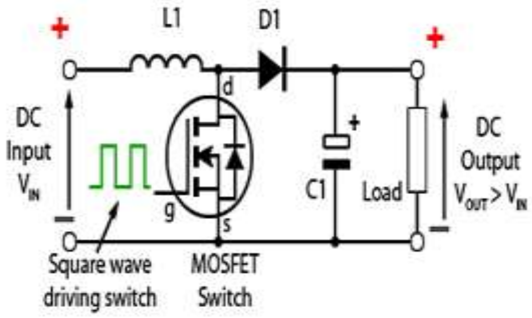

Fig5: Boost Converter

The circuit action during the initial high period of the high frequency square wave applied to the MOSFET gate at start up. During this time MOSFET conducts, placing a short circuit from the right hand side of L1 to the negative input supply terminal. Therefore a current flows between the positive and negative supply terminals through L1, which stores energy in its magnetic field. There is virtually no current flowing in the remainder of the circuit as the combination of D1, C1 and the load represent a much higher impedance than the path directly through the heavily conducting MOSFET.

4.6 DC motor:

Fig6: DC motor

A DC motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors.

The DC motor has two basic parts: the rotating part that is called the armature and the stationary part that includes coils of wire called the field coils. The stationary part is also called the stator.

The current carrying conductor is placed in a magnetic field perpendicularly, and then the conductor experiences a force in the direction mutually perpendicular to both the direction of field and the current carrying conductor. Fleming's left-hand rule says that if we extend the index finger, middle finger and thumb of our left hand perpendicular to each other, in such a way that the middle finger is along the direction of current in the conductor, and index finger is along the direction of magnetic field i.e. north to south pole, then thumb indicates the direction of created mechanical force.

5. Results:

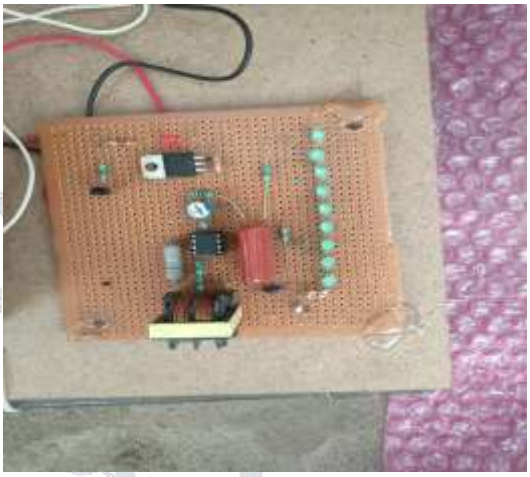

Fig 7 :Boost converter circuit

Fig 8: out put voltage of Regenerative Braking System up to 11.7v

Fig 9: Fly wheel setup with dynamo, boost converter with battery

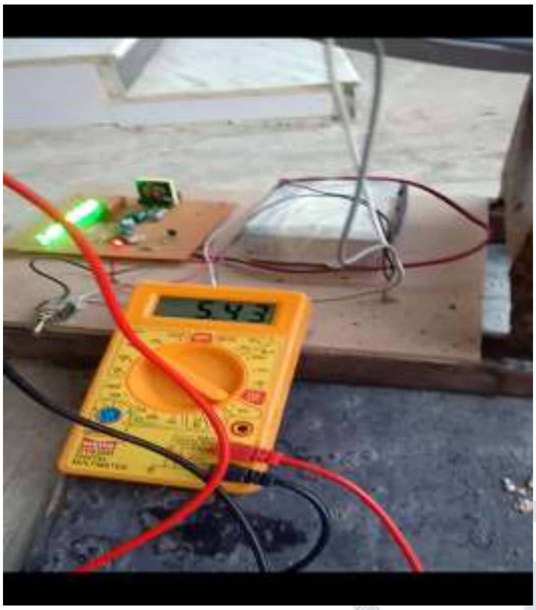

Fig 10: To know the voltage of battery using multi meter

when the battery is turned off the voltage will get reduced slowly from 11.7v to 0v and this output is used as regeneration of current in the batteries.

6. ACKNOWLEDGEMENT

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7. CONCLUSION:

Regenerative braking systems require further research to develop a better system that captures more energy and stops faster. As the time passes, designers and engineers will perfect regenerative braking systems, so these systems will become more and more common. All vehicles in motion can benefit from these systems by recapturing energy that would have been lost during braking process and thereby reducing fuel consumption and increased efficiency. Future technologies in regenerative brakes will include new types of motors which will be more efficient as generators, more powerful battery which can bear more frequent charging and discharging, new drive train designs which will be built with regenerative braking in mind, and electric systems which will be less prone to energy losses.

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