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Regenrative Braking System

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***Abstract*- This paper explains about how kinetic energy is recovered and converted into electric energy in Regenerative Braking System while braking. Regenerative Braking is an energy recovery mechanism. In conventional braking system the motion is retarded or stopped by absorbing kinetic energy by friction. This project is about regenerating the kinetic energy which lost during braking. Regenerative braking technology funnels the energy created by the braking process back into the system further use. The energy generated will be used in various ways or can be stored in battery for later use. The design and fabrication of Regenerative braking system working model has been described and a new concept was also introduced for further research.**

***Keywords:* Regenerative Braking, Kinetic energy, Friction and Heat**

I.INTRODUCTION

The term „Braking" in a moving vehicle means the application of 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 conventional braking system on 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 is required to replace the energy that was lost by braking.

Every time we step on our car 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. Regenerative brake is an energy recovery mechanism which slows a vehicle by converting its kinetic energy into another form, which can be either used immediately or stored until needed.

II. DESIGN AND FABRICATION

The working model of the Regenerative braking system is made to understand the braking efficiency and power generated in detail. The components used to fabricate the working model are Wheel Drum, Electric motor, Bearing, linkages, a LED to indicate the power generated while braking and a multimeter to check the amount of power generated. The wheel drum is mounted on the cardboard with the help of bearing, so the drum will rotate in similar to the wheel in automobiles. The linkage is introduced for applying braking. During braking the links will slide over the slot and bring electric motor to be in contact with drum. An LED is connected to the electric motor to check the power generation while braking. The components and working model of regenerative braking system is shown below.

WORKING

When brakes are applied in the vehicle, the kinetic energy gets converted into heat energy at the brake pads and dissipates into the surrounding. The dissipated energy can be put into some useful work. This is the basic principle of regenerative braking. This is a kind of braking system that can recapture much of vehicles kinetic energy and convert it into electricity, so that it can be used. This system is called regenerative braking system.

One of the properties of an electric motor is that, when it is run in one direction, it converts electrical energy into mechanical energy that can used to perform work. But when the motor is run in the opposite direction, a properly designed motor becomes a generator. The electrical energy can be fed into a c charging system for the vehicles batteries.

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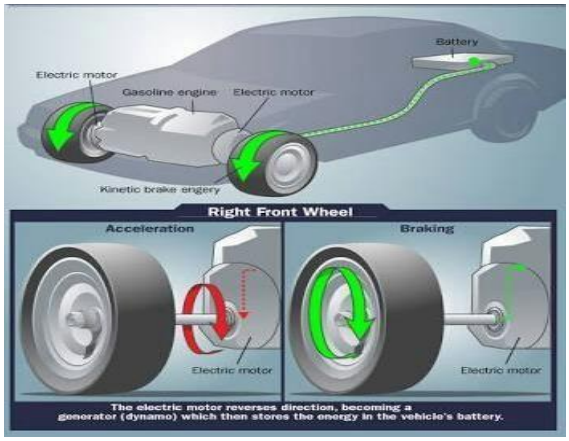

When the driver steps on the brake pedal of a vehicle, these types of brakes put the vehicle‟s electric motor in reverse mode, causing it to run backwards, thus slowing the vehicle‟s wheel. While running backwards, the motor acts as generator thus producing electricity. In this working model during braking the electric motor will be in contact with the drum, which in turn produces electricity. The produced power will be fed into batteries for later use or used immediately.

COMPARISON OF DYNAMIC AND REGENERATIVE BRAKING

Dynamic brakes unlike regenerative brakes, dissipate the electric energy as heat by passing the current through large banks of variable resistors. Vehicles that use dynamic brakes include fork lifts, Diesel- electric locomotives and street cars. If designed appropriately, this heat can be used to warm the vehicle interior. If dissipated externally, large radiator-like cowls are employed to house the resistor banks. The main disadvantage of regenerative brakes when compared with dynamic brakes is the need to closely match the generated current with the supply characteristics. With DC supplies, this requires that the voltage be closely controlled. Only with the development of power electronics has this been possible with AC supplies, where the supply frequency must also be matched. A small number of mountain railways have used 3- phase power supplies and 3- phase induction motors. This results in a near constant speed for all trains as the motors rotate with the supply frequency both when motoring and braking.

REGENERATIVE BRAKING EFFICIENCY

The energy efficiency of a conventional car is only about 20% with the remaining

80% of its energy being converted to heat through friction. The miraculous thing about regenerative braking is that it may be able to capture as much as half of that wasted energy and put in back to work. This could deduce fuel consumption by 10

– 20 %. Hydraulic regenerative braking systems could provide even more impressive gains, potentially reducing fuel use by 25-45 %. In a century that may see the end of the vast fossil fuel reserves that have provided us with energy for automotive and other technologies for

many years, and in which fears about carbon emission are coming to a peak, this added efficiency is being increasingly important.

- In this model of Regenerative braking system the drum rotates at

180 rotation per minute.

- When the drum rotates at 180rpm it generates 2V and 0.3Amps

Power generated is, P = VI

P = 2 * 0.3

P = 0.6w

- This model will generate 0.6w power when the drum rotates at

180rpm.On considering this, the power generation on vehicle is assumed as follows. Here power is directly propositional to RPM. The average RPM of vehicle is assumed to be 3600rpm then the power generated will be 6w

III.APPLICATION

- For recovering kinetic energy of vehicle lost during braking process.
- Regenerative braking is used in some elevator and crane hoist motors.
- One theoretical application of regenerative braking would be in a manufacturing plant that moves

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from one workstation to another on a conveyor system that stops at each point.

- Regenerative braking system are also used in electric railway vehicle (London Underground & Virgin Trains).

IV. ADVANTAGES

- Improved performance
- Improved fuel efficiency
- Reduction in brake wear

V. LIMITATIONS

- Regenerative braking is necessarily limited when the batteries are fully charged. Because the additional charge from regenerative braking would cause the voltage of a fully battery to rise above a safe level, our motor controller will limit regenerative braking torque in this case.
- Increases the total weight of vehicle by around 25-30 Kilograms

VI. FUTURE SCOPE

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.

Future technologies in regenerative braking will include new types of motors which will be more efficient as generators, new drive train designs which will be built with regenerative braking in mind, and electric systems which will be less prone to energy losses. Of course, problems are expected as any new technology is perfected, but few future technologies have more potential for improving vehicle efficiency than does regenerative braking.

VII. CONCLUSION

The regenerative braking system used in the vehicles satisfies the purpose of saving a part of the energy lost during braking. Also it can be operated at high temperature range and are efficient as compared to conventional braking system. The results from some of the test conducted show that around 30% of the energy delivered can be recovered by the system. Regenerative braking system has a wide scope for further development and the energy savings. Thus the use of more efficient systems could lead to huge savings in the economy of any country.

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