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POWER GENERATION FROM REGENERATIVE BRAKING

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ABSTRACT

Every time you step on your car's brake, you're wasting energy. Physics tells usthat energy cannot be destroyed. When your car slows down, the kinetic energy that was propelling it forward has to go somewhere. A regenerative brake is a mechanism that reduces vehicle speed by converting some of its kinetic energy into useful form of energy. This captured energy is then stored for future use or fed back into power system for use of other vehicles.

Keywords: *Regenerative brakes, Capacitor, Resistance, Transformer, Diode*

I INTRODUCTION

In the effort to produce greener cars numerous processes have been examined that effect fuel consumption. One process is braking - traditional braking wastes energy because it kills the momentum that the engine has built up. However, with the process of regenerative braking, this energy effectively finds a new home. Instead of being lost as heat in the brakes, the energy is used to drive an alternator which allows the energy to be partially recovered and stored in a batter. In conventional vehicles this stored energy is then used to power electrical components including headlights, stereos and air conditioning. In hybrid cars, regenerative braking is used to charge the battery that propels the electric motor. This is particularly advantageous in town driving situations when cars traditionally travel at low speeds. With regenerative braking a hybrid can rely solely on the electric motor in these situations, therefore producing zero emissions.

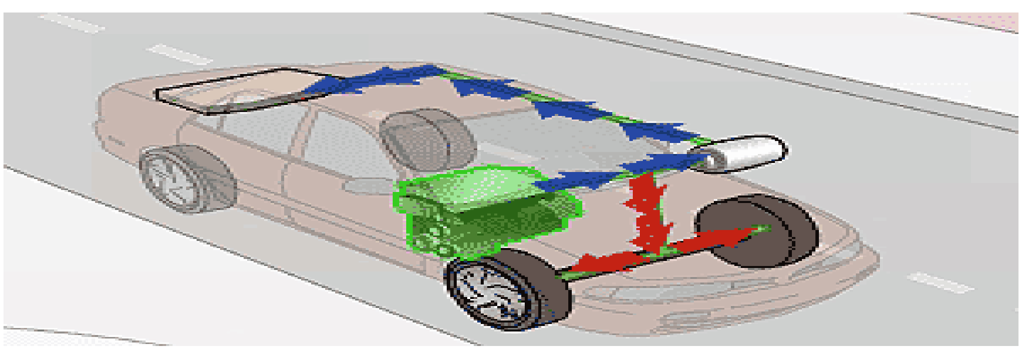

Fig.1. Mechanism of regenerative braking

Regenerative braking is sometimes confused with dynamic braking but the processes are very different. By contrast, dynamic braking dissipates the energy as heat and does not recapture it.

II BRAKING

A brake is a mechanical device which inhibits motion. Its opposite component is a clutch. The rest of this article is dedicated to various types of vehicular brakes.

Most commonly brakes use friction to convert kinetic energy into, though other methods of energy conversion may be employed. For example regenerative braking converts much of the energy to electrical energy, which may be stored for later use. Other methods convert kinetic energy into potential energy in such stored forms as pressurized air or pressurized oil. Eddy current brakes use magnetic fields to convert kinetic energy into electric current in the brake disc, fin, or rail, which is converted into heat. Still other braking methods even transform kinetic energy into different forms, for example by transferring the energy to a rotating flywheel.

Since kinetic energy increases quadratic ally with velocity (energy as one of the same mass moving at 1 m/s, and consequently the theoretical braking distance, when braking at the traction limit, is 100 times as long. In practice, fast vehicles usually have significant air drag, and energy lost to air drag rises quickly with speed.

Friction brake on automobiles store braking heat in the drum brake or disc brake while braking then conduct it to the air gradually. When travelling downhill some vehicles can use their engines to brake.

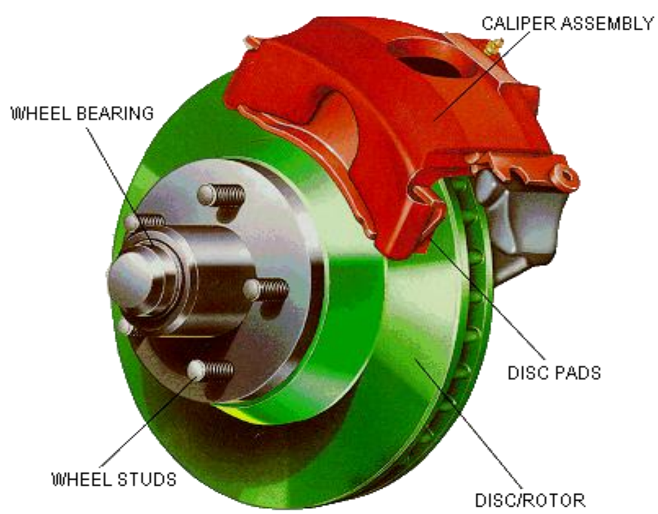

Fig.2 Brakes

When the brake pedal of a modern vehicle with hydraulic brakes is pushed, ultimately a piston pushes the brake pad against the brake disc which slows the wheel down. On the brake drum it is similar as the cylinder pushes the brake shoes against the drum which also slows the wheel down.

III TYPE OF BRAKING

3.1 Electric Braking

Electrical braking is needed in many applications and used instead of mechanical braking. The advantage of electrical braking is virtually no wear and tear is experienced. Electrical braking may be seen in modern cars, traction motor control, train services, alternators and in automotive industries.

The main theory of electrical braking is to use a DC (direct current) injection to provide magneto motive resistance to the running rotor. If a DC flux is provided to the rotor and rotor cuts through it, it eventually slows down because DC injection effectively produces a electrical (or more accurately, magnetic) resistance as described below. During braking it is obvious that we will remove AC supply from the stator. Rotor will be rotating due to its inertia. The larger the angular momentum, the larger time it takes to stop rotation. Now, after removing the AC supply from the stator, if we apply a DC voltage to the stator, a large DC current will be induced in the rotor. This induction happens because the rotor still rotates in a DC field. This large DC current will heat up the rotor coil(resistance of rotor coil, truly) and energy is dissipated in form of heat. So, we see, applying a DC voltage to the stator makes a good method of braking. This method is used in dynamic braking. In regenerative braking, rotors kinetic energy is converted to electrical energy and fed back to main supply or other loads.

3.2 Regenerative Braking:-

A regenerative brake is a mechanism that reduces vehicle vehicle speed by converting some of its kinetic energy kinetic energy into another useful form of energy. This captured energy is then stored for future use or fed back into a power system for use by other vehicles.

For example, electrical regenerative brakes in electric railway railway vehicles feed the generated electricity back into the supply system supply system. In battery electric battery electric and hybrid electric vehicles, the energy is stored in a battery or bank of capacitors for later use. Other forms of energy storage which may be used include compressed air and flywheels.

Regenerative braking should not be confused with dynamic braking, which dissipates the electrical energy as heat and thus is less energy efficient.

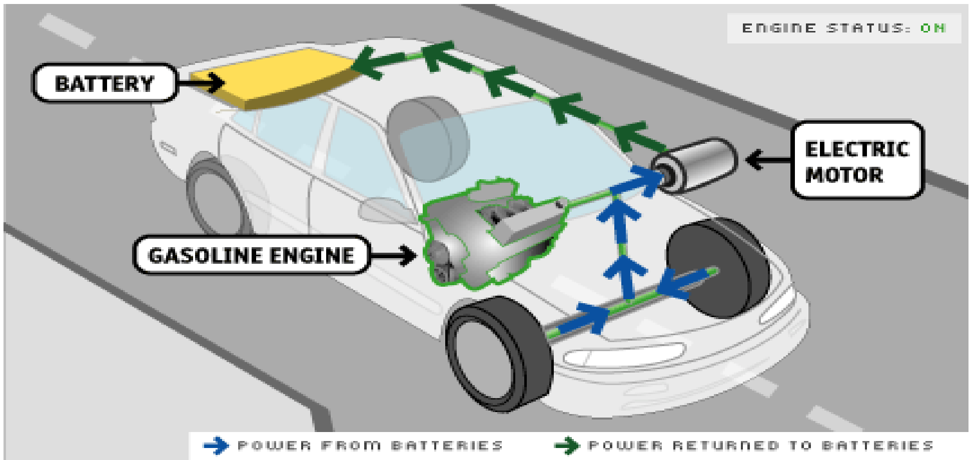

Fig.3. Regenerative braking

Traditional friction-based braking is still used with electrical regenerative braking for the following reasons:

1. The regenerative braking effect rapidly reduces at lower speeds, therefore the friction brake is still required in order to bring the vehicle to a complete halt.
2. The friction brake is a necessary back-up in the event of failure of the regenerative brake.
3. The amount of electrical energy capable of dissipation is limited by either the capacity of the supply system to absorb this energy or on the state of charge of the battery or capacitors.
4. Under emergency braking it is desirable that the braking force exerted be the maximum allowed by the friction between the wheels and the surface without slipping, over the entire speed range from the vehicle's maximum speed down to zero.

For these reasons there is typically the need to control the regenerative braking and match the friction and regenerative braking to produce the desired total braking output.

3.3 Dyanamic braking:

Dynamic braking is the use of the electric traction motors of a railroad vehicle as generators when slowing the locomotive. It is termed rheostat if the generated electrical power is dissipated as heat in brake grid resistors, and regenerative if the power is returned to the supply line. Dynamic braking lowers the wear of friction-based braking components, and additionally regeneration can also lower energy consumption.

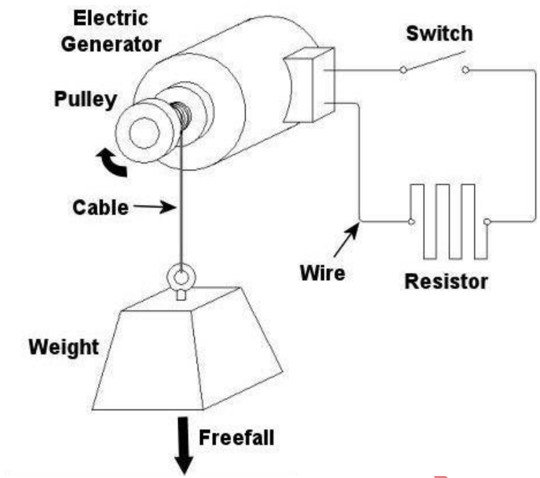

Fig. 3. Dyanamic braking

During dynamic breaking the traction motors which are now acting as generators are connected to the braking grids (Large resistors) which put a large load on the electrical circuit. When a generator circuit is loaded down with resistance it causes the generators to slow their rotation. By varying the amount of excitation in the traction motor fields and the amount of resistance imposed on the circuit by the resistor grids, the traction motors can be slowed down to a virtual stop (approximately 3-5 MPH).

For permanent magnet motors, dynamic braking is easily achieved by shorting the motor terminals, thus bringing the motor to a fast abrupt stop. This method, however, dissipates all the energy as heat in the motor itself, and so cannot be used in anything other than low-power intermittent applications due to cooling limitations. It is not suitable for traction applications.

IV WORKING OF MODEL OF REGENERATIVE BRAKING

Single phase AC supply is given to transformer output of which is stepped down AC voltage. Output of transformer is given to full wave rectifier. Rectifier converts AC supply into DC supply .This DC supply energizes the DC motor. Hence motor starts rotating the wheel attached with it.

When we apply brake mechanically, the friction wheel attached with dynamo touches the main wheel resulting in deceleration of the speed .Due to friction dynamo itself starts rotating with the wheel hence generating electricity.

Fir. 4. Model For regenerative braking

4.1 RATING OF USE COMPONENT

Table no. 1

S.No.	Components	Ratings
1.	Resistance	1KΩ
2.	Transformer	230/6V,2A,46KVA
3.	Diode	IN4007, 6V, 250µA
4.	Capacitor	1000µF,50V,105ºC, paper type
5,	DC Motor	6V,120 RPM, PM
6.	Dyanamo	6V, 1.5A
7.	Battery	6V, 4.5 Ah
8.	Inverter CKT	6V, 9W
9.	LED	6V, 60mA
10.	Capacitor	6V,100µF

V REGENERATIVE BRAKING... THE STOP N' GO MONEY SAVER:-

For decades we have always heard that stop n' go traffic was not only bad for our pocketbooks, but as you'll see on Mean Green Machines, it's also hard on the environment due to the extended driving, excess idling, and wasted engine output. Did you know that about 30 percent of engine output is lost through braking in heavy traffic, and the deeper in the city you travel, chances are the worse.

Not to mention the higher the road rage in your area... the more people are probably stomping on the gas pedal, racing up to your bumper, and then hard braking to a stop.

What if we told you that you could actually save money and a little bit of wear and tear on the environment through such stop n' go travelling? Even those road rage drivers may do the environment a bit of a favor. Well you can, and it is through the nifty little technology called regenerative braking.

This means that every time you apply the brakes to stop that forward movement, you are wasting energy. However, in the case of the hybrid/electric, you would be creating energy. How it works is very similar to an generator. Every time an electric car moves forward it is using its stored energy. This is its torque phase and it generally causes your vehicle to lose stored energy in order to create the energy necessary to move you forward.

A conversion will cost upwards of $5,000, but at $4.00 a gallon for gasoline, you could make that up and then some over the course of the several years you own that vehicle

Regenerative braking is a system in which the electric motor that normally drives a hybrid or pure electric vehicle is essentially operated in reverse (electrically) during braking or coasting. Instead of consuming energy to propel a vehicle, the motor acts as a generator that charges the onboard batteries with electrical energy that would normally be lost as heat through traditional mechanical friction brakes. As the motor "acts in reverse," it generates electricity. The accompanying friction (electrical resistance) assists the normal brake pads in overcoming inertia and helps slow thevehicle. There are adjustable acceleration and deceleration ramps which vary the maximum acceleration and deceleration rate. An Automatic braking system With Regenerative Braking, is a safety system on motor vehicles which prevents the wheels from locking while braking.

VI. ADVANTAGES OF REGENERATIVE BRAKING

The advantages of regenerative braking are clear-cut as effectively drivers can enjoy 'something for nothing'. They will notice no difference to regular braking and yet enjoy better fuel economy, reduced CO_2 emissions and know that they are saving energy.

Effectively the electric motor works in reverse during the process of regenerative braking. The motor acts as the generator to recharge batteries with the energy that would normally be lost. This reduces the reliance on fuel, boosting economy and lowering emissions

VII. APPLICATION

7.1 Use In Motor Sport

F1 teams began testing Kinetic Energy Recovery Systems, or KERS, in January 2009. Teams have said they must respond in a responsible way to the world's environmental challenges.

The FIA allowed the use of 60 kW KERS in the regulations for the 2009 Formula One season. Energy can either be stored as mechanical energy (as in a flywheel) or can be stored as electrical energy (as in a battery or supercapacitor).

7.2 Motorcycles

KTM racing boss Harald Bartol has revealed that the factory raced with a secret Kinetic Energy Recovery System (KERS) fitted to Tommy Koyama's motorcycle during the season-ending 125cc Valencian Grand Prix.

7.3 Carmakers

BMW and Honda are testing it. At the 2008 1000 km of Silverstone, Peugeot Sport unveiled the Peugeot 908 HY, a hybrid electric variant of the diesel 908, with a KERS system. Peugeot plans to campaign the car in the 2009 Le Mans Series season, although it will not be capable of scoring championship points.

Toyota has used a super capacitor for regeneration on Supra HV-R hybrid race car that won the 24 Hours of Tokachi race in July 2007.

VIII. CONCLUSION

The energy efficiency of a conventional brake is only about 20 percent, with the remaining 80 percent 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 it back to work. This reduces fuel consumption by 10 to 25 percent. Hence regenerative braking plays an important role in fuel consumption and also in the field of speed.

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