International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869 (O) 2454-4698 (P), Volume-4, Issue-3, March 2016

Regenerative Braking Mechanism

Manu Garg

Abstract— **How to conserve energy wasted during braking system. Specifically in case of Locomotives large extent of energy is dissipated in the form of heat. Even heat dissipation process also requires additional energy source. So kinetic energy of locomotive can be converted in another form (instead of heat) which can be stored in the chemical batteries, for future use.**

Index Terms— **Locomotives, conserve energy, kinetic energy.**

I. INTRODUCTION

A regenerative brake is an energy recovery mechanism which slows a vehicle or an object down by converting its kinetic energy into electrical energy, which can be either used immediately or stored until needed.
In traditional braking system, brake pads produce friction with the brake rotors to slow or stop the vehicle. This friction will convert car's kinetic energy into heat, which is dissipated in an environment and hence wasted.

II. LITERATURE

In 1908 "C.J. Paulson" [1]Patented a smart car (Figure no.1) with Regenerative Braking System. C.J.'s automobile had a mechanism for motor vehicles of various kinds such as driven by electric motor, or explosive engine's, and has for its object to provide means in the nature of an auxiliary spring powered device, whereby a surplus of power from the motor and also from the momentum of the car can be stored in the spring to assist in running the car, or if the motor becomes disabled the vehicle can be propelled a short distance.

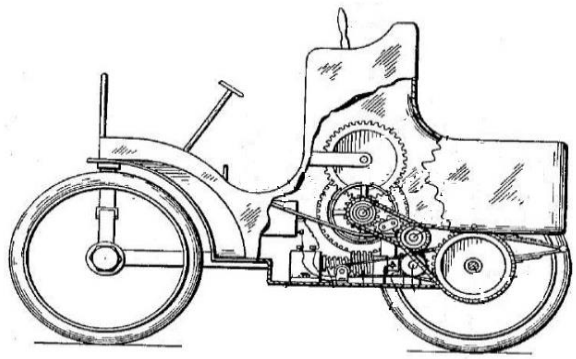

Figure 1

Manu Garg, Master Of Technology (Mechanical Engineering) Universal Group Of Institutions, Lalru (Punjab)

The "Energy Regeneration Brake" system was developed in 1967 [2] by American Motors Corporation (AMC) in co-operation with Gulton Industries.
The Energy Regeneration from braking idea was later commercialized by the Japanese and both Ford & Chevrolet licensed it from Toyota for use in their domestic built hybrid vehicles.
During the late 2000's an electronic control unit used by BMW [3] that engages alternator during braking.
The front wheel drive Life Wheego [4] Electric Vehicle (2012) has 60bhp from the 115volt Lithium Battery Pack and the life features a proportional regenerative braking system to put power back into the battery during braking. The Wheego Whip Life (Figure no. 2) has a top speed of approx. 100 km/ hr.

.

Figure 2

III. THEORY

1. [5] From early stages to nowadays all concepts of Regenerative Brakes are being implemented on vehicles, but there is major scope of this technique in case of Locomotive's (Diesel Engine's used in Railways).
2. Most diesel locomotives are actually diesel/electric units. A diesel engine which is called a prime mover is connected an electric generator. On some it is a/c current and some it is d/c, this depends on the preference of the customer or railroad who is buying the locomotive. The prime mover revs up and down depending on the power needs of the train. Higher the revolutions, more electricity in being made. Forward and reverse motion is achieved by reversing the polarity of the current being fed to the traction motors on each axle.

Dynamic Braking system is used in case of locomotives. This system uses electric traction motor of locomotive as a generator when slowing down it. This system is termed as rheostatic as the generated electrical power is dissipated as a heat in brake grid resistors.

- **In AC current system**

- During braking the motor fields are connected across either the main traction generator (diesel-electric loco) or the supply (electric locomotive)and the motor armatures are connected across the brake grids. The rolling locomotive wheels turn the motor armatures, and if the motor field are now excited, the motors ill act as generator.
- During dynamic braking, the traction motors, which are now acting as generator, are connected to the braking grids (large resistors), which put a large load on the electric circuit. When a generator circuit is loaded down with resistance, it causes the generator to slow their rotation. By varying the amount of excitation in the traction motor field and the amount of resistance imposed on the circuit by the resistor grid (Figure no. 3), the traction motor can be slowed down to a virtual stop.

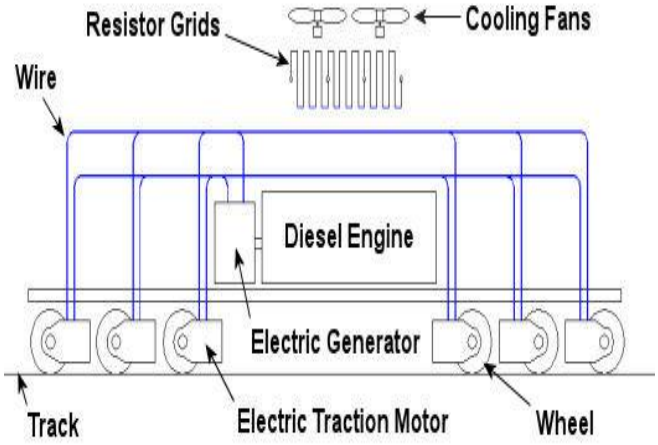

Figure 3

- **In DC current system**

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.

The electrical energy produced by the motors is dissipated as heat by a bank of on-board resistors. Large cooling fans are necessary to protect the resistors from damage. Modern system have thermal monitoring, so, if the temperature of the bank become excessive, it will be switched off, and the braking will revert to friction only.

3. Concept

The traction motors, which act as generator while braking, can be connected to storage batteries. So current produced while braking is fed back into power supply system (Figure no. 4) for used by other traction units, instead of being wasted as heat.

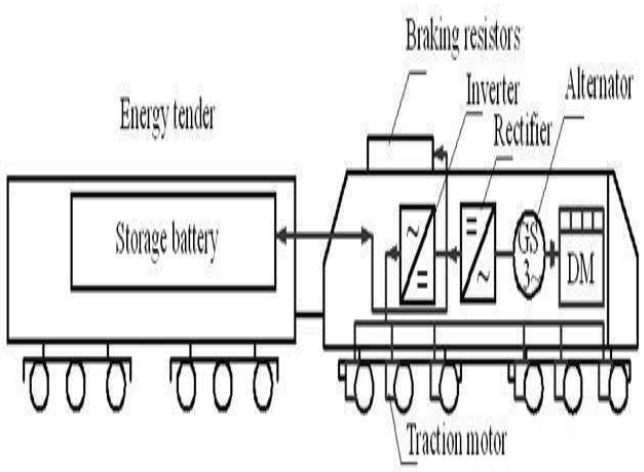

Figure 4

So it is an energy recovery mechanism which slows a vehicle or object down by converting its kinetic energy into another form, which can be either used immediately or stored until needed.In electric railways the generated electricity is fed back into the supply system, whereas in battery electric and hybrid electric vehicles, the energy is stored chemically in a battery, electrically in a bank of capacitors, or mechanically in a rotating flywheel.

IV. Conclusion

- The regenerative braking effect drops off at lower speeds; therefore the friction brake is still required in order to bring the vehicle to a complete halt.
- The friction brake is a necessary back-up in the event of failure of the regenerative brake.

References

[1]http://history-of-inventions.blogspot.in/2012/03/first-smart-car-with-regenerative.html

[2]^a b "AMC Gulton".American Mechanist, Metal Working Manufacturing112: 27.Retrieved4 May2014.

[3] ^Kavanagh, Jason (8 May 2006). "Inside BMW's Latest Powertrain Technologies". Edmunds.com. Archived fromtheoriginalon 28 March 2012. Retrieved4 May 2014.

[4]^Jim Motavalli (2012-03-14). "Can The Tiny Wheego Win The Electric Car Race?".Forbes.Retrieved2012-03-22.

[5]^Professor Satoru Sone, Kogakuin University (2007-07-02). "Wayside and on-board storage can capture more regenerated energy". Railway Gazette International