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"Power Utilization Through Braking System"

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Abstract **- Brake is a device for slowing or stopping the motion of a machine or vehicle and to keep it from starting to move again. The kinetic energy lost by the moving parts is usually translated to heat by friction. Alternatively, in regenerative braking, much of energy is recovered and stored in a flywheel capacitor or turned into alternating current by an alternator, then rectified and stored in a battery for later use.**

Power Utilization through braking system should not be confused with dynamic braking which dissipates the recaptured electrical energy as heat. In that respect dynamic braking is not capable of completely stopping a vehicle and therefore is not a substitute for friction brakes .

Keywords: - Brake, Regenerative braking system, Kinetic energy, Friction, Heat dissipation, etc

I. INTRODUCTION

It is also called as regenerative braking arrangement. Regenerative braking is used on hybrid gas/electronic automobiles to reimburse some of the energy lost during stopping. This energy is saved in a storage battery and used later to power the motor whenever the car is in electric mode.

In conventional braking system friction is used to contact the forward momentum of a moving car. As the brake pads rub against the wheels, excessive heat energy is also generated. This heat energy dissipates into the air hence reduces the vehicle's fuel efficiency. More energy from the engine is required to replace the energy lost by braking.

REGENERATIVE BRAKING SYSTEM

A Regenerative braking system is an assembly which allows a vehicle to recapture a part of the kinetic energy that would otherwise be lost in the form of heat when braking and make use of that power system for other vehicles to use.

Regenerative braking should not be confused with dynamic braking which dissipates the recaptured electrical energy as heat; in that respect dynamic braking behaves much like an electromagnetic brake, which employs eddy current losses to produce the braking effect. None of these methods of braking are capable of completely stopping a vehicle and therefore are not a substitute for friction brakes.

II. WORKING PRINCIPLE

A typical electromagnetic brake is composed of a metal disc (rotor) attached to a rotating axis and electromagnet or permanent magnets positioned to generate a magnetic field intersecting the disc. The electromagnet allows control of the braking action by varying the strength of the electromagnets as metal disc rotates inside it. That current then generates a magnetic field in opposition to the original field thus creating a force which acts to decelerate the rotating disc.

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Heat is generated in the disc as a direct result of the electrical resistance of the disc material and the current induced in it; this heat represents the kinetic energy being dissipated and is analogous to the heat generated by a conventional friction brake.

Because the induced current is proportional to the speed of the disc; the braking torque decreases as the disc decelerates resulting in a smooth stop. Electromagnetic brakes of this fashion are therefore unable to completely stop moving part or to keep it still a small friction brake might be coupled for that purpose, exception is used to slow an engine, as once below a certain speed (engine speed) the engine will stall .

Regenerative braking is not used with brakes of this since the induced current is dissipated as heat and is not practical to recover a similar type of braking is used in modern roller coasters, which differs only in that permanent magnets are used instead of electromagnets.

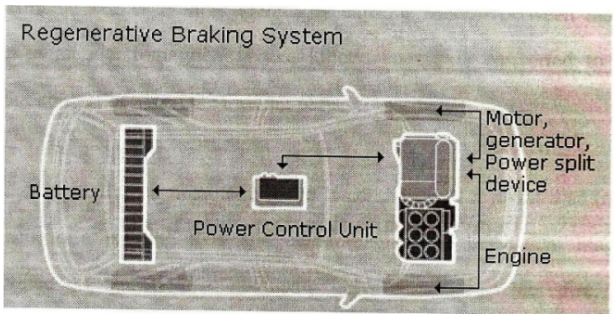

Figure 2.1 – Regenerative Braking System (Top-view)

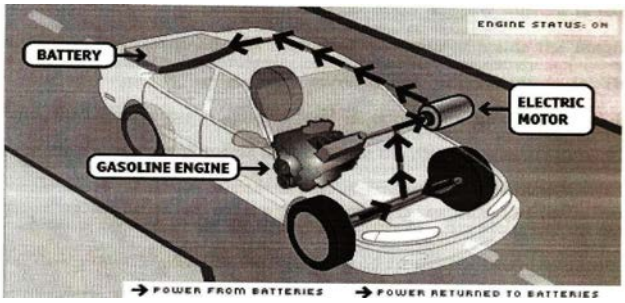

Figure 2.2 – Regenerative Braking System Assembly

Figure Shows:- How we made power through braking system

III. CALCULATION

If the speed of the vehicle is brought down form "u" km/hr to "v'' km/hr in a different of small then retardation

$$f = \frac{\left[\left(\frac{u}{3.6}\right)-\left(\frac{v}{3.6}\right)\right]}{2s} \text{ m/s}^2$$

Braking force F= $\frac{w}{g}$ f

(When the vehicle moves on a level road)

$$F = \frac{w}{g}f + w\sin\theta$$

(when it moves down a gradient)

Work done in braking =
braking force × distance moved
= FS N-m

Heat equivalent to this work i.e. amount of heat generated during braking operation.
= FS N-m or J

Heat generated at each wheel = $\frac{fs}{4}$ J

Where "u" and "v can be calculated as :-

1st Reading

N_1 = 20 rpm
N_2 =10 rpm

$$\omega 1 = \frac{2\pi N1}{60} = (2\times 3.14\times 20)/60 = 2.09$$

$$\omega 2 = \frac{2\pi N2}{60} = (2\times 3.14\times 10)/60 = 1.046$$

u = r $\omega 1$= 2.09 × 24= 50.16 m/s

v = $r\ \omega 2$= 1.046 × 24 =25.104 m/s

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f =[(50.16/3.6)^2 –(25.104/3.6)^2]/2×5

= (194.13-48.62)/10

= 14.551 m/s

F= (5×14.551)/9.8 = 7.4 N-m

Heat generated at each wheel
= (7.4×5)/4 = 9.25 J

2nd Reading

N_1 = 25 rpm
N_2 =15 rpm

$\omega 1 = \frac{2\pi N1}{60}$=(2×3.14×25)/60 = 2.62

$\omega 2 = \frac{2\pi N2}{60}$=(2×3.14×15)/60 =1.57

u = r $\omega 1$= 2.62 × 24= 62.88 m/s

v = $r\ \omega 2$= 1.57 × 24 =37.68 m/s

f =[(62.88/3.6)^2 –(37.68/3.6)^2]/2×5
= (305.08-109.6)/10
= 19.548 m/s

F= (5×19.548)/9.8
= 9.97 N-m

Heat generated at each wheel =(9.97×5)/4 = 12.46 J

3rd Reading

N_1 = 28 rpm
N_2 =23 rpm

$\omega 1 = \frac{2\pi N1}{60}$=(2×3.14×28)/60 = 2.93

$\omega 2 = \frac{2\pi N2}{60}$=(2×3.14×23)/60 =2.407

u = r $\omega 1$= 2.93 × 24= 70.32 m/s

v = $r\ \omega 2$= 2.407 × 24 =57.77 m/s

f =[(70.32 /3.6)^2 –(57.77 /3.6)^2]/2×4.5
= (381.56-257.51)/9

= 13.78 m/s

F= (5×13.78)/9.8
= 7.03 N-m

Heat generated at each wheel
= (7.03×5)/4 = 8.79 J

IV. CONCLUSION

It is estimated that power recovered by braking system in vehicles currently has 31.3% electric generation efficiency with most of the remaining energy being released as heat, the actual efficiency depends on numerous factors such as the state of charge of the battery, how many wheels are equipped to use the regenerative braking system and whether the topology used in parallel or serial in nature

In our system there have low power generation by braking system because our experimental setup is based on light and single wheel.

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