Design And Fabrication of Re-Generative Electromagnetic Braking System

Chandrakanth Nagarakere Shivanna
Department of Mechanical Engineering
Student, Sri Jagadguru Chandrashekaranatha Swamiji Institute of Technology, Bangalore-562101, Karnataka

Abstract- *Energy is always lost as friction in the event of application of a brake. If a part of that energy can be recovered, it helps in improving fuel economy of a vehicle or any machine that consumes petroleum products, ranging from airplanes to drill rigs. This is a concept of regenerative braking. Kinetic Energy Recovery System (K.E.R.S) is one such method used for regenerative braking. It employs the use of motor generator set, coupled to a battery for energy recovery. The motor-generator set acts as a generator in the event of braking and as a motor in the event of acceleration. Thus energy is stored in battery through the generator and the motor runs on this energy generated. Hence energy can be saved during braking and released during acceleration, saving fuel consumption.*

Keywords- Regeneration, Electromagnet, Braking system..

I. INTRODUCTION

Regenerative braking is an energy recovery mechanism which slows a vehicle by converting its kinetic energy into a form which can either be used immediately or stored until needed.

In conventional braking system the motion is retarded or stopped by absorbing kinetic energy by friction, by making the contact of the moving body with frictional rubber pad (called brake liner) which causes the absorption of kinetic energy, and this is wasted in form of heat in surroundings. Each time we brake, the momentum of vehicle is absorbed that it has gained by it and to re-accelerate the vehicle we have to start from the scratch to redevelop that momentum by using the more power from an engine. Thus, it will ultimately result in huge waste of energy.

As the basic law of Physics says ‘energy can neither be created nor be destroyed it can only be converted from one form to another’. It will be good if we could store this energy somehow which is otherwise getting wasted out and reuse it next time we started to accelerate. That's the basic concept of regenerative ("regent") brakes, which provide braking for the system when needed by converting the available energy to some usable form. These are widely used in electric trains and the latest electric cars. 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. Thus, the generated electricity during the braking is fed back into the supply system (in case of electric trains), whereas in battery electric and hybrid electric vehicles, the energy is stored in a battery.

Electromagnetic brakes (also called electro-mechanical brakes or EM brakes) slow or stop motion using electromagnetic force to apply mechanical resistance (friction). The original name was "electro-mechanical brakes" but over the years the name changed to "electromagnetic brakes", referring to their actuation method.

- This project intends to design and implementation electromagnetic brakes with regenerative braking system.
- The design basically consists of very strong magnet and rotating metallic wheel with steel bar.
- The amount of electrical energy capable of dissipation is limited by either the capacity of the supply system to 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.

II. OBJECTIVES

Since the inception of the internal combustion engine, the process of energy conversion from chemical energy to mechanical energy has been optimized to a maximum efficiency of 45%. A majority of the energy lost is in the form of friction and heat. In the second decade of the 21st century, with oil reserves depleting rapidly, a new form of energy is required to drive future societies and electrical energy is the seemingly obvious solution.

With electrical vehicles being developed and deployed to replace conventional IC engines driven vehicles, the electric motors driving them can be as efficient as 98%. The majority of energy lost is now in the form of braking. With this project, we aimed at reducing losses during braking and devising a system that can recapture the energy lost in braking and feed it back to the primary power reserves to extend the overall range of the vehicle

1. Fabrication of working model to demonstrate energy recovery using regenerative braking.
2. To study and understand energy recovery by the incorporation of regenerative braking with electromagnetic brakes.

III. DESIGN ASPECTS

V-Belt Drive System

Diameter of driving pulley, D1= 60mm

Diameter of driven pulley, D2= 47mm

Speed of driven pulley, N2=237rpm

N1xD1=N2xD2

N1=237x47/60

N1=185.65 RPM

Therefore the speed is increased from the supply speed.

The center distance has to be calculated now for open belt drive

L=2C+1.57(D1+D2)+[(D2-D1)2/4C]

L= length of belt

C= center distance between pulley shafts

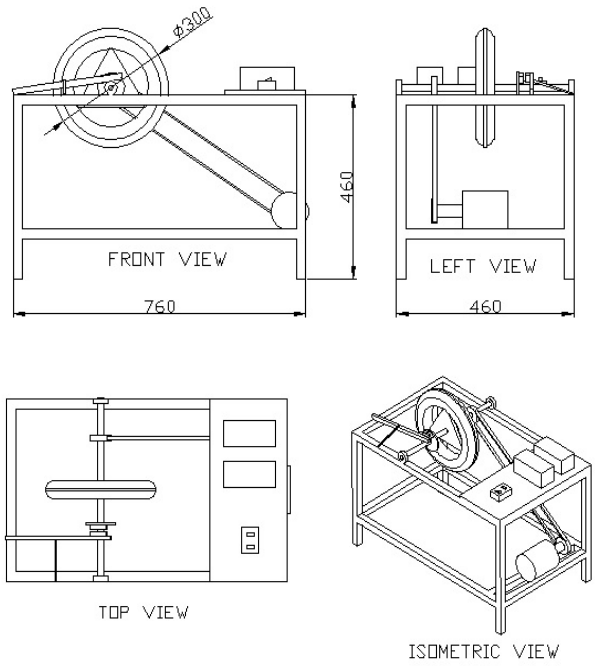
The standard size available is 1306mm made of mix of rubber and leather

1306=2C + 1.57(60+47) + [(60-47)2/4C]

C= 554.32mm

This is the minimum distance between the centers without tension in the belt.

For rubber being highly elastic, we can increase up to 35% of the center distance for the tension in the belt to prevent slipping.



Frictional Power

Under no load or not connected condition
Speed of DC motor= 230rpm
Power consumed by motor under NO LOAD condition

Current (I)= 0.18, Voltage (V)= 24V
Power (P)= VxI= 24x0.18= 4.32W

Power in shaft,

$P= (2\pi NT)/60$

$T= (4.32x60)/2\pi x230$

T=0.179 Nm

IV. RESULT AND DISCUSSION

The test results: All of the test cases that are mentioned above are passed successfully. No defects were encountered.

Sl.No	Working condition	Voltage(V)
1	Motor off	0
2	Motor on	24.3
3	During regenerative braking	4.1(peak)

V. CONCLUSION

Electromagnetic brakes are important supplementary retardation equipment in addition to the regular friction brakes. They have been used in heavy vehicles such as coaches, buses, or trucks. Recent design innovations have led to the applications of electromagnetic brakes to aircraft applications. In this application, a combination of motor/generator is used first as a motor to spin the tires up to speed prior to touchdown, thus reducing wear on the tires, and then as a generator to provide regenerative braking.

REFERENCES

[1] H.D. Wiederick, N. Gauthier, D.A. Campbell, & P. Rochan (1987),Magnetic braking: Simple theory and experiment, Journal of Physics, Vol 55 No.6, June 1987, 500-502

[2] B. P. Chang, H. Md. Akil, and R. Bt. Md. Nasir, “A Review of Regenerative Braking System”, Institute of Transport Studies, University of Leeds, Working paper of 471,” Wear, vol. 297, no. 1–2, pp. 1120–1127, 2013

[3] Z. L. Wang, “Ten years’ venturing in ZnO nanostructures: From discovery to scientific understanding and to technology applications,” Chinese Science Bulletin, vol. 54, no. 22. pp. 4021–4034,2009.reinforced java program composites under dry sliding wear,”

[4] Affatato S Ruggiero A Merola M, “Advanced biomaterials in hip joint arthroplasty. A review on polymer and ceramics composites as alternative bearings.

[5] M. Haslehurst, “Title Manufacturing Technology Higher technician series”, Second edition, English University Press, 1970

[6] Xue X and Cheng K; (2008) "Selection of Electric Motor Drives for Electric Vehi¬cles", Australasian Universities Power Engineering Conference, Vol-1, pp. 1-6