OPEN ACCESS

International
Journal
Of Modern Engineering Research (IJMER)

Fabrication of Prototype Model of Infrared Sensor Based Regenerative Braking System Using Electromagnetic Clutch

Abhishek Gaikwad[1], Deepak Singh[2], Mohammad Adnaan Nizami[3], Siddhartha Tripathi[4], Zubair Abrar Khan[5]

[1](*Assistant Professor, Dept. of Mechanical Engineering, SSET, SHIATS-Deemed University, Allahabad, India,*
[2, 3, 4, 5](*Scholars, B. Tech. Production & Industrial Engg, SHIATS-Allahabad, India)*

Abstract: *The objective of this paper is to stored the kinetic energy dissipated in the brakes to accelerate the vehicle. This project is based on prototype model of Regenerative braking system using electromagnetic clutch. Regenerative braking results in an increase in energy output for a given energy input to a vehicle, the efficiency is improved. The amount of work done by the engine of the vehicle is reduced, in turn reducing the amount of prime energy required to propel the vehicle. In order for a regenerative braking system to be cost effective the prime energy saved over a specified lifetime must offset the initial cost, size and weight penalties of the system. The energy storage unit must be compact, durable and capable of handling high power levels efficiently. The energy can be directly provided to dynamo itself to generate current and will be displayed on the Ammeter installed in the set up. This set up also consists of an Infrared Sensor which helps to prevent the frequency of accidents increasing due to inefficient braking system and therefore can be considerably avoided using IR sensors. The vehicle instantly stops as any object appears in front of it where IR Sensors are installed.*

Keyword: *Dynamo, Efficiency, Electromagnetic Clutch, Infrared Sensor, Regenerative Braking.*

I. INTRODUCTION

Most commonly brakes use friction to convert kinetic energy into heat, though other methods of energy conversion may be employed. This work is based on regenerative braking which 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. A regenerative brake 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. This contrasts with conventional braking systems, where the excess kinetic energy is converted to heat by friction in the brake linings and therefore wasted. The most common form of regenerative brake involves using an electric motor as an electric generator. 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. Hydraulic hybrid vehicles use hydraulic motors and store energy in form of compressed air.

Electromagnetic clutches operate electrically, but transmit torque mechanically. This is why they used to be referred to as electro-mechanical clutches. A sensor is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument. An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. It is also capable of measuring heat of an object and detecting motion. Infrared waves are not visible to the human eye.

II. DESCRIPTION

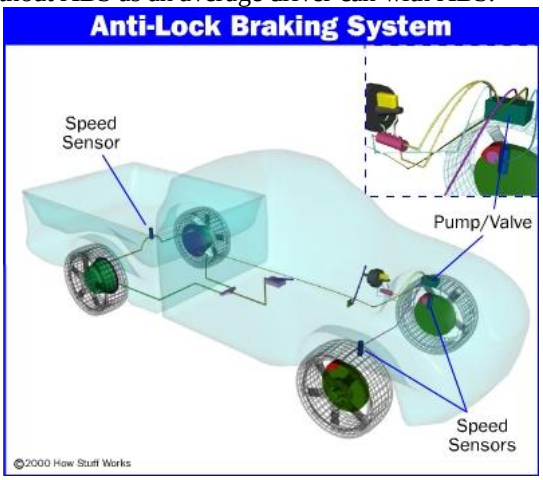
Collision mitigation systems are forward-looking, radar-based systems comprised of collision warning and adaptive cruise control (ACC) with active braking. The collision warning component of collision mitigation systems provides audible and/or visual warnings of vehicles or objects that come within a predefined distance in the front of a vehicle with the system. A radar sensor mounted on the front bumper of the vehicle transmits and receives high frequency radio signals to determine the distance and speed of a target vehicle or object in front of it.

2.1 Techniques Involved

a) Anti-lock braking
b) Regenerative Braking System
c) Infrared sensor based auto braking

2.2 How anti-lock brakes work

Stopping a car in a hurry on a slippery road can be very challenging. Anti-lock braking systems (ABS) take a lot of the challenge out of this sometimes nerve-wracking event. In fact, on slippery surfaces, even professional drivers can't stop as quickly without ABS as an average driver can with ABS.



2.3 The ABS System

Anti-lock brake pump and valves

The theory behind anti-lock brakes is simple. A skidding wheel (where the tire contact patch is sliding relative to the road) has less traction than a non-skidding wheel. If you have been stuck on ice, you know that if your wheels are spinning you have no traction. This is because the contact patch is sliding relative to the ice by keeping the wheels from skidding while you slow down, anti-lock brakes benefit you in two ways: You'll stop faster, and you'll be able to steer while you stop.

There are four main components to an ABS system:

1. Speed Sensors: - The anti-lock braking system needs some way of knowing when a wheel is about to lock up. The speed sensors, which are located at each wheel, or in some cases in the differential, provide this information.
2. Pump: - Since the valve is able to release pressure from the brakes, there has to be some way to put that pressure back. That is what the pump does; when a valve reduces the pressure in a line, the pump is there to get the pressure back up.
3. Valves: - There is a valve in the brake line of each brake controlled by the ABS. On some systems, the valve has three positions:

3.1 In position one, the valve is open; pressure from the master cylinder is passed right through to the brake.

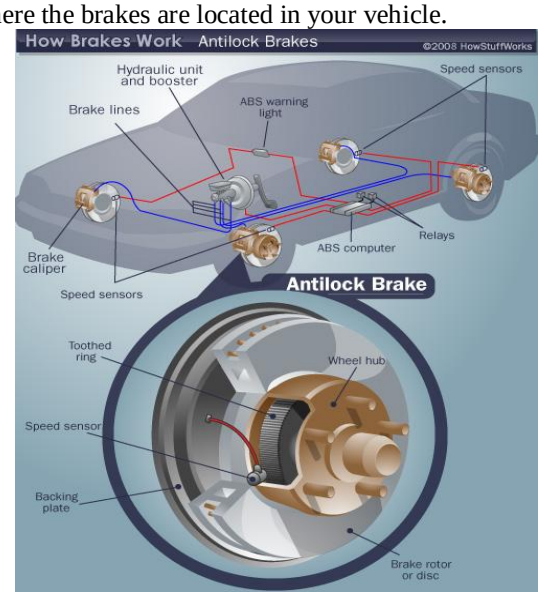
3.2 In position two, the valve blocks the line, isolating that brake from the master cylinder. This prevents the pressure from rising further should the driver push the brake pedal harder.

3.3 In position three, the valve releases some of the pressure from the brake.

4. Controller: - The controller is a computer in the car. It watches the speed sensors and controls the valves.

2.4 Anti-Lock Brake Diagram

Now let's put the parts together to see how anti-lock brakes work as a whole. This diagram provides both a close up view and an example of where the brakes are located in your vehicle.



Anti-lock brake components

III. WHAT IS REGENERATIVE BRAKING?

Regenerative braking means reduce losses and regenerate power by using mechanical structure. Systems use friction to counteract the forward momentum of a moving car. As the brake pads rub against the wheels (or a disc connected to the axle), excessive heat energy is also created. This heat energy dissipates into the air, wasting up to 30% of the car's generated power. Over time, this cycle of friction and wasted heat energy reduces the car's fuel efficiency. More energy from the engine is required to replace the energy lost by braking.

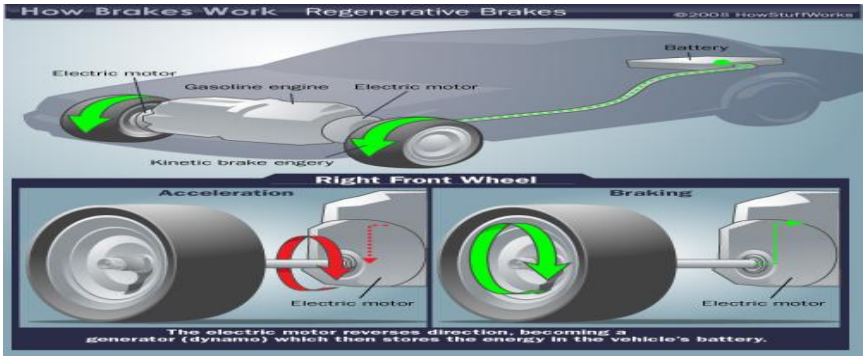
Hybrid gas/electric automobiles now use a completely different method of braking at slower speeds. While hybrid cars still use conventional brake pads at highway speeds, electric motors help the car brake during stop-and-go driving. As the driver applies the brakes through a conventional pedal, the electric motors reverse direction. The torque created by this reversal counteracts the forward momentum and eventually stops the car.

But regenerative braking does more than simply stop the car. Electric motors and electric generators (such as a car's alternator) are essentially two sides of the same technology. Both use magnetic fields and coiled wires, but in different configurations. Regenerative braking systems take advantage of this duality. Whenever the electric motor of a hybrid car begins to reverse direction, it becomes an electric generator or dynamo. This generated electricity is fed into a chemical storage battery and used later to power the car at city speeds.

Regenerative braking takes energy normally wasted during braking and turns it into usable energy. It is not, however, a perpetual motion machine. Energy is still lost through friction with the road surface and other drains on the system. The energy collected during braking does not restore *all* the energy lost during driving. It does improve energy efficiency and assist the main alternator.

3.1 Regenerative Braking Diagram

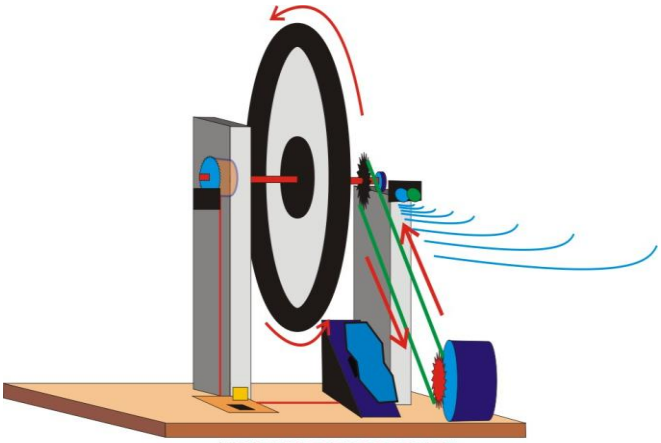
This simple diagram shows how a regenerative braking system is able to recapture some of the vehicle's kinetic energy and convert it into electricity. This electricity is then used to recharge the vehicle's batteries.



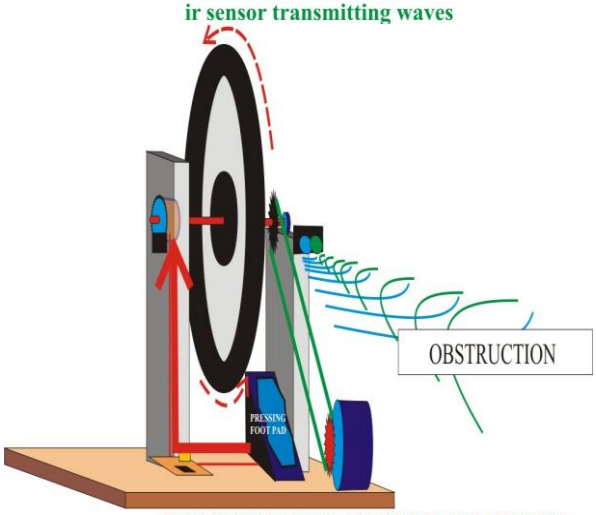
3.2 Construction & Working

We are using three different techniques in our project as mention above. We using electromagnetic clutch in our project as brake shoes and this electromagnetic brake shoe control by small ir based digital circuit. This ir sensor based electronic digital circuit work in auto braking mode at the minimum distance, if driver forget to press brake circuit applied brake in auto mode. Circuit transmit ir waves continuously if some obstruction comes circuit applied automatic braking and this automatic braking system transmit power to dynamo for current generation and braking.

3.2.1 Construction

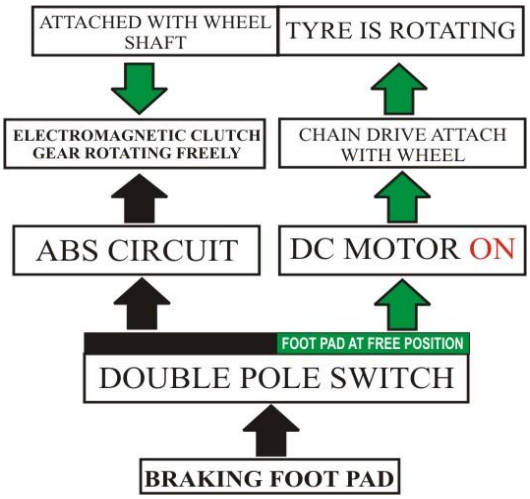


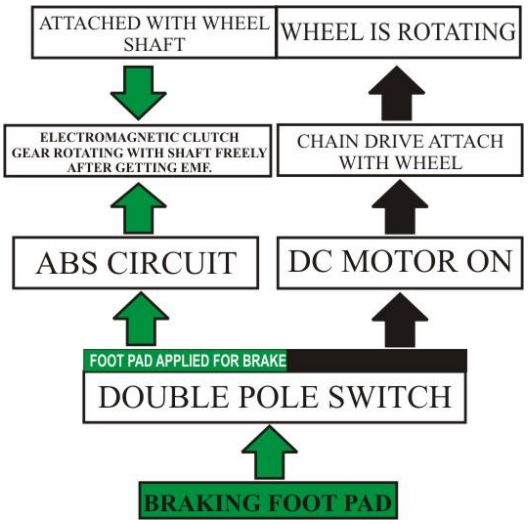
SYSTEM IS WORKING
ir sensor transmitting waves



IF IR SENSOR INTERRUPTER, ABS CIRCUIT CONTROL E.M. CLUTCH FOR GRADUALLY BRAKING

3.2.2 Working block diagram





3.3 HARDWARE DESCRIPTION

3.3.1 MECHANICAL COMPOMENTS

1. Dynamo
2. Transformer
3. Electromagnetic clutch
4. Plastic wheel

3.3.2 Electronic Components

1. Relays
2. Transistor
3. Infrared sensor
4. Integrated circuit
5. Obstacles sensor unit
6. Tone Decoder

3.3 Electrical components

1. Power supply
2. Multimeter

IV. CONCLUSION

We using electromagnetic clutch in our project as brake shoes and this electromagnetic brake shoe control by small ir based digital circuit. This ir sensor based electronic digital circuit work in auto braking mode at the minimum distance, if driver forget to press brake circuit applied brake in auto mode.

Circuit transmit ir waves continuously if some obstruction comes circuit applied automatic braking and this automatic braking system transmit power to dynamo for current generation and braking.

A conclusion section must be included and should indicate clearly the advantages, limitations, and possible applications of the paper. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

Acknowledgements

First of all we want to thank and glorify to our Almighty who is before everything. Quench for knowledge should never finish but one never forgets the teachers who gave us the opportunity of learning. They are very precious and there affords is the only debt that cannot be paid back accepts through gratitude. We praise Almighty for enabling to accomplish the great task of project work by the grace of his glory. Success is the manifestation of diligence, preservance, inspiration and innovation, with an up most degree of sincerity. I express my sincere gratitude to my advisor Er. Abhishek Gaikwad (Assistant Professor, Dept. of Mechanical Engg.) for his valuable guidance, proper advice, painstaking and constant encouragement during my work. I am very thankful to the entire faculty & Staff members of Department of Mechanical Engineering and Applied Mechanics, Shepherd School of Engineering and Technology, SHIATS, Allahabad for their direct and indirect help and cooperation. I am thankful to Er. Mohammad Aman (Project Engineer) in APC Air Systems Pvt. Ltd. New Delhi for his precious time & help.

I am deeply indebted to my parents, sisters, brother, friends and other family members for their constant Prayer support and inspirational encouragements and moral support which enabled me to pursue my studies. Thanking u all.

REFERENCES

[1.] Heaviside, O.W., Electromagnetic Theory, Vol I (London, 1893)
[2.] 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
[3.] Binggang Cao, Zhifeng Bai, Wei Zhang. Research on Control for Regenerative Braking of Electric Vehicle. 0-7803-9435-6, IEEE, 2005: 92-97. (Pubitemid 46049593)
[4.] Sasaki Y, Mtomo A, Kawahata F, et al. Toyota Braking System for Hybrid Vehicle with Regenerative System. Proceedings of the 14th International Electric Vehicle Symposium (EVS-14), Florida, 1997
[5.] Bradley Glenn, Gregory Washington, Giorgio Rizzoni. Operation and control strategies for hybrid electric automobiles. SAE2000-01-1537, 2000.
[6.] Eiji Nakamura, Masayuki Soga, Akira Sakai, AKihiro Otomo, Toshikazu Kobayashi. Development of Electronically Controlled Brake System for Hybrid Vehicle. SAE 2002-01-0300, 2002.
[7.] CHEN Qing-quan, SUN Feng-chun, ZHU Jia-guang. Modern Electric Vehicle Technology. Beijing Institute of Technology Press. 2002: 260-264.
[8.] HE Ren. Study on Methods of Regenerative Braking Energy of Automobile. Journal of Jiangsu University (Natural Science Edition), 2003, (6): 1-3.
[9.] Akshyakumar S.Puttewar Enhancement of Braking System in Automobile Using Electromagnetic Braking 2003
[10.] Sohel Anwar, An Anti-Lock Braking Control System for a Hybrid Electromagnetic/ Electrohydraulic Brake-By-Wire System, Proceeding of the 2004 American Control Conference Boston, Massachusetts June 30 - July 2, 2004
[11.] CHEN Quan-shi, QIU Bin, XIE Qi-cheng. Fuel cell Electric Vehicle. Tsinghua University Press. 2005
[12.] HE Ren, HU Qing-xun. Braking course of city bus with regenerative braking system. Journal of Jiangsu University (Natural Science Edition), 2005, (5): 391-392.
[13.] LUO Yu-gong, LI Peng, JIN Da-feng, etal. A Study on Regenerative Braking Strategy Based on Optimal Control Theory. Automotive Engineering. 2006, (4): 356-360.
[14.] LIANG Peng-fei, WANG Hai-gui, LING Hong. Research on Control Strategy of Regenerative Braking for HEV Diesel Engine, 2007, (3): 46-49.
[15.] Tatsuya Yamasaki, Masaaki Eguchi And Yusuke Makino, Development of an Electromechanical Brake, NTN Technical Review No.75（2007）
[16.] Kumar, K.P., Kadoli, R., Kumar, M.V.A., Mechanical and magnetic analysis of magnetostrictive disc brake system, Industrial and Information Systems (ICIIS), 2010 International Conference ,July 29 2010-Aug. 1 2010
[17.] Bharathram M , Kirubhahar Praveen P , Chandrakala D , Akshay Jalan , Gowtham Ram N, Brake Pad Actuation Using Electromagnetic Coils, Methods Enriching Power & Energy Developments (Meped'13)April 12 , 2013.