

Regeneration of Energy from Braking System

Lalatendu B.Sahoo¹, Chandan K. Behera¹, Sibuna Behera¹, Swapneswar Mahanta¹, Bikash K. Mahato¹, Khitish K. Dash²

¹UG Scholar, Department of Mechanical Engineering, Gandhi Institute for Technology (GIFT), Bhubaneswar

²Asso. Professor, Department of Mechanical Engineering, Gandhi Institute for Technology (GIFT), Bhubaneswar

Abstract-As in these day's global, wherein there are energy crises and therefore the resources are depleting at a better rate, there may be a requirement of precise era that recovers the energy, which gets generally wasted. So, just in case of vehicles one in all those beneficial technology is that the regenerative braking machine. Regenerative braking is an energy recovery mechanism that slows a vehicle or object via converting its Kinetic Energy (K.E) right into a form a good way to be both used without delay or stored till wished. Using regenerative braking system in automobiles enables us to get better the K.E. Of the automobile to a degree that's misplaced at some stage in the braking technique. The converted K.E. Is saved for future use or is fed returned to the ability machine of the car. This power is often saved at some stage in a battery or bank of capacitors for later use. Energy additionally may be stored with the assistance of a rotating flywheel that is one some of the predominant inexpensive and effective technique of storing and regenerating power. The present invention presents electricity-storing regenerative braking machine by way of transmitting the flywheel pressure as a torque tending to oppose the ahead rotation of a wheel on applying the brakes.

A brake-pad assembly, established concentrically with the hub of a floor-enticing wheel, is actuated upon braking to supply frictional engagement among the hub and snatch mechanism, at the same time as making use of a decelerating torque to the wheel. The unique braking mechanism is selectively held in position by way of a rider-managed clutch mechanism, to build up strength over several braking occasions. Vehicles pushed by electric cars use the motor as a generator when the usage of regenerative braking and its output is supplied to an electrical load. The switch of electricity to the load affords the braking impact and regenerates energy.

Keywords: Regenerative Braking, Generator, Brake pad, Energy Recovery, Flywheel.

1. Introduction

In recent years, there's the lack of dependable opportunity energy sources, increasing efficiency and reducing exhaust gas emissions has emerge as the focal point of the modern automotive studies. Commercial cars which includes refuse trucks and delivery cars lose a exquisite amount of kinetic power for the duration of common braking and steady force at low speeds on unique city routes, which ends up in better fuel intake and Green House Emission Gas (GHG) emission than different on-street cars. Numerous tries have been made to enhance form of vehicles. The technological aggregate of Exhaust Gas Recirculation (EGR) and Diesel Particulate Filter (DPF) after remedy is one of the effective ways to clear up the vehicle emission, mainly for NOx and soot. However, this approach isn't always able to reduce the GHG emission since the low temperature combustion of this era results in increasing the gas penalty. Sacrificing engine performance in exchange for reduced pollutants cannot fundamentally resolve the energy crisis. In order to gain overall GHG reduction objectives, a robust reduction is wanted especially for commercial motors.

Regenerative strength era is one of the key features of electrified vehicles. It lets in the vehicle to seize a exquisite amount of the kinetic energy misplaced in the course of braking or decelerating for reuse. That is pronouncing, power recovery generation can appreciably convey down the energy intake of electrified car, specifically in city operated route. Generally, there are regenerative energy approaches that have been carried out to business vehicles: Regenerative Braking System and Boost Recuperation System. The former is typically implemented in series hybrid architecture; the latter within the parallel structure. The regenerative braking system is prepared in the driven axle to recover the braking power loss. The improve recuperation gadget is parallelly coupled with the mechanical propulsion system to get better kinetic electricity during the deceleration technique. Both technology allow industrial motors to have a great improvement of decreasing fuel intake as well as emissions. However, few researchers have addressed the regenerative strength price of hybrid business vehicles. The extra energy the regenerative braking recuperates; the less fuel is consumed. Typical hybrid industrial motors are typically designed as rear power and the regenerative braking gadget is geared up in rear pushed axle(es) to recover the braking energy loss. Due to the trade of the middle gravity in the vehicle beneath unique load conditions, braking energy loss may also vary in each front and rear axles.

Current braking studies indicates that around 50-eighty% of braking strength lack of industrial vehicles occurs in the front axle and the braking electricity loss varies barely underneath exceptional load states. Therefore, the bulk of the regenerative energy potential is not tape.

2.Literature Review

Sayed Nashit, Sufiyan Adhikari, Shaikh Farhan, Srivastava Avinash and Amruta Gambhire, ‘Design, Fabrication and Testing of Regenerative Braking Test Rig for BLDC Motor’, 2016, 1881-84.In this paper a check bench for testing of regenerative braking capability of a Brushless DC Motor is layout and then fabricated. The undertaking creates recognition to engineers closer to power performance and electricity conservation. It concludes that the regenerative braking structures are more efficient at higher velocity and it can't be used because the best brakes in a automobile. The exact use of this technology described as in the task within the destiny motors can assist us to a positive level to sustainable and vivid future of energy green international as part of energy this is misplaced may be regained through using the regenerative braking device.

Khushboo Rahim, and Mohd. Tanveer, ‘Regenerative Braking System: Review Paper’, International Journal on Recent and Innovation Trends in Computing and Communication, five.Five (2018), 736-39.In this paper been stated. Regenerative braking systems can paintings on the excessive temperature tiers and are highly green whilst in comparison to the conventional brakes. They are extra powerful at better momentum. The extra often a vehicle stops, the greater it can advantage from this braking gadget. Large and heavy automobiles that films at excessive speeds builds up lots of kinetic strength, so that they preserve strength extra correctly. It has wide scope for similarly advancements and the energy conservation.

Tushar L. Patil, Rohit S. Yadav, Abhishek D. Are, Mahesh Saggam, Ankul Pratap, ‘Performance Improvement of Regenerative braking system’, International Journal of Scientific & Engineering Research Volume 9, Issue 5, (2018). 2229-5518 In this paper the techniques to growth the efficiency of the regenerative braking system is cited. The method noted become to lessen the weight of the auto which growth performance, the use of splendid capacitor also improves the conversion rate of energy in regenerative braking machine, making the automobile compact additionally has a tendency to boom the performance of the system.

C. Jagadeesh Vikram, D. Mohan Kumar, Dr. P. Naveen Chandra, ‘Fabrication of Regenerative Braking System’, International Journal of Pure and Applied Mathematics Volume 119, (2018). 9973-9982.In this paper the Fabrication method at the Regenerative Braking System were applied as per the prescribed measures has been taken and the future enhancements must be processed on basis of the need of the observe. The Implementation of the regenerative braking gadget be pretty crucial in car transportation with maximized overall performance in braking.

A. Eswaran, S Ajith, V Karthikeyan, P Kavin, S Loganandh, ‘Design and Fabrication of Regenerative Braking System’, International Journal of Advance Research and Innovative Ideas in Education-Vol-four Issue-three (2018). 2395-4396, In this paper the regenerative braking gadget used in the cars satisfies the reason of saving part of the power lost in the course of braking. Also, it may be operated at high temperature variety and are green as compared to conventional braking system. Regenerative braking structures require in addition studies to develop a higher machine that captures greater power and prevents faster. All motors in movement can benefit from these structures via recapturing energy that might have been misplaced at some stage in braking technique. The use of greater efficient systems should result in large savings within the economic system.

Braking System at Rear Axle’, International Journal of Advanced Mechanical Engineering. Volume eight, Number 2 (2018), 2250-3234.In this paper the regenerative braking gadget used in the vehicles satisfies the purpose of saving a part of the strength lost at some stage in braking. The regenerative braking device is designed to partly get better the battery rate wasted in braking of the vehicle. The power is transformed into warmth with the aid of friction brake which is dissipated to the environment. This Energy is applied to rotate the rotor of generator converting mechanical power of wheels into useful price of battery. The regenerative braking device can not be used as primary braking machine of automobile as it cannot deliver the car to relaxation. Experimentation suggests that minimal eleven% battery energy may be recovered using the regenerative braking gadget which could in any other case be wasted to warmness in friction brakes. Hence the gap travelled between successive charging requirements may be increase to 10 to fifteen % the use of this regenerative braking, while hooked up in real motors.

3. Objectives

- To manipulate the velocity of the automobile in addition to prevent it quick and efficiently without sticking.
- To reduce the reaction time of braking by means of the usage of regenerative braking and generating strength by way of changing kinetic energy into electric power.

4. Methodology

Regenerative braking device may not suffice the simple requirement of braking system by myself. This is due to trouble of power dissipation at very excessive energy. The storage and technology structures might not be capable to operate at the ones ranges due to design obstacles. Due to crucial stage of protection concerned with the device, reliability turns into arguable and it necessitates a frictional braking system to co-exist with electrical regenerative braking gadget. This bureaucracy a hybrid braking system which means:

1. Just like hybrid propulsion structures, there can be many design configurations and manipulate strategies.
2. Design and manipulate of system must be such that they make sure automobile's desired braking overall performance whilst on the equal time taking pictures as a lot strength as viable. During growing strategies, a careful attention of braking behavior and its traits with respect to speed, braking energy, deceleration fee etc. Should be made.

4.1.Component Required

MS square pipe	30 feet approx.
MS flat	As per requirement
Electric motor	01 no.
Drive and driven pulley	01set
Drive shaft	01 nos.
Bearing	02 nos.
'V' belt	01 nos.
Wheel	01 no.
Friction disc	02 no.
Generator	02 no.
Brake & accelerator pedal	01 set

Coil spring	As per requirement
Electrical accessories	As per requirement
fasteners	As per requirement

4.2. Block Diagram

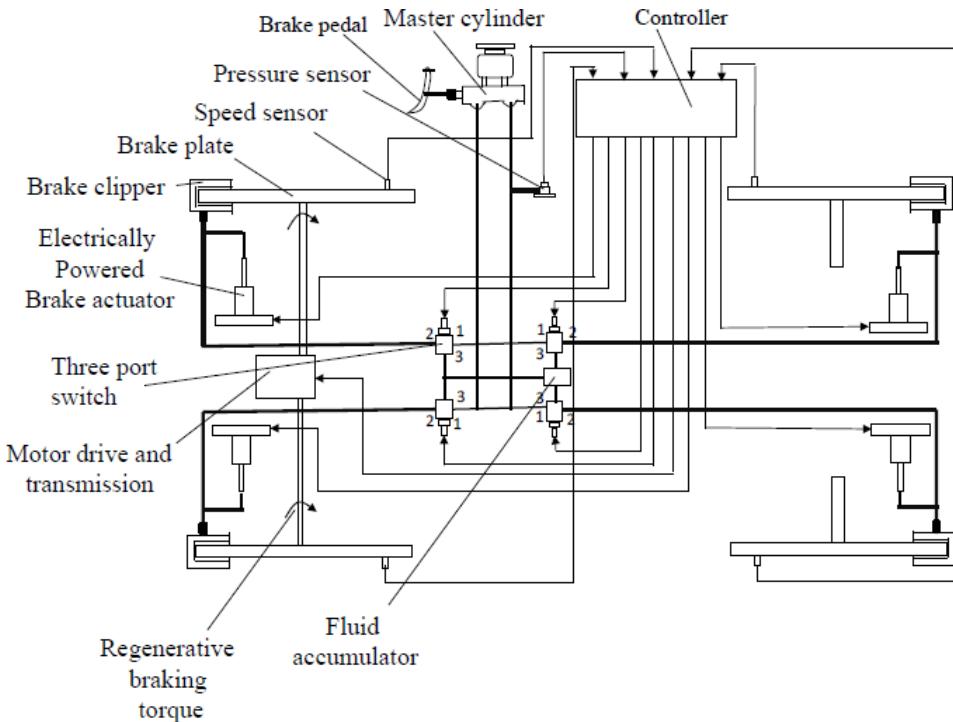


Fig-1.Block Diagram

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. Physical locking of the rotor is also required to prevent vehicles from rolling down hills. The friction brake is a necessary back-up in the event of failure of the regenerative brake. Most road vehicles with regenerative braking only have power on some wheels (as in a two-wheel drive car) and regenerative braking power only applies to such wheels, so in order to provide controlled braking under difficult conditions (such as in wet roads) friction based braking is necessary on the other wheels.

4.3. Experiment Model

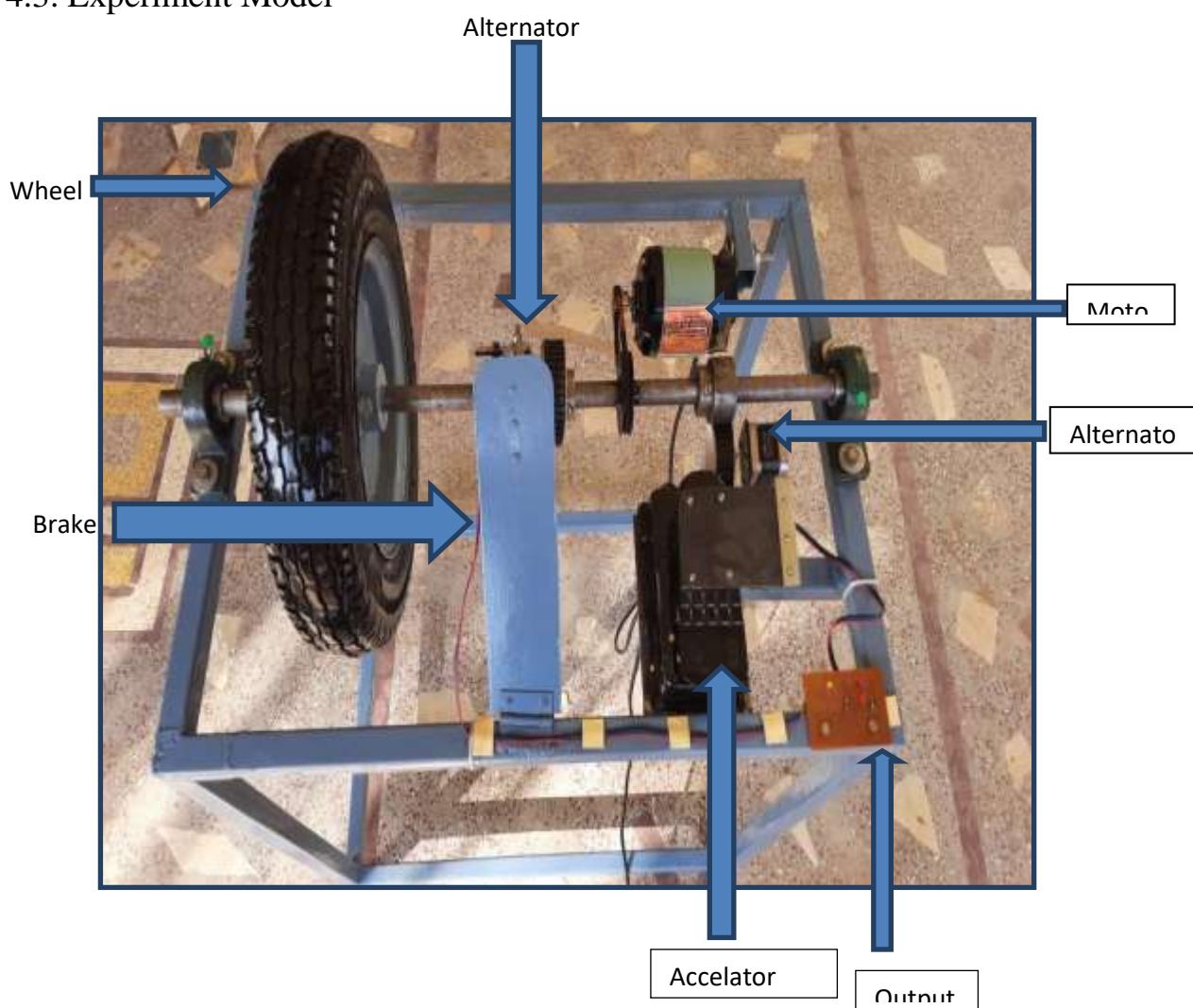


Fig-2.Experimental Set up

5. Results and Discussion

After the successful testing, the model is operated and the results obtained in various loading condition are noted and tabulated below.

Table -1

S.N	RPM before brake pedal pressed	RPM after brake pedal pressed	Voltage output
1	500	480	9.34
2	900	870	10.88
3	1300	1260	11.81

4	1700	1650	12.91
5	2100	2040	13.49
6	2300	2270	13.89
7	2500	2460	14.49

D.C Motors increases as the angular velocity of the motor increases and hence the regenerative braking systems are more efficient as higher angular velocities and the recoverable energy increases with increase in the motor speed. The losses are higher at lower speed because the motors are inefficient at lower speeds, whereas the losses at higher speeds are mainly mechanical losses like friction losses and air drag.

6. Conclusion

The regenerative braking system used in the vehicles satisfies the purpose of saving a part of the energy lost during braking. The regenerative braking system is designed to partially recover the battery charge wasted in braking of the vehicle. The energy is converted into heat by friction brakes which are dissipated to the environment. This Energy is utilized to rotate the rotor of generator converting mechanical energy of wheels into useful charge of battery. The regenerative braking system cannot be used as main braking system of vehicle as it cannot bring the vehicle to rest. Experimentally it is found that, on increasing the speed of the wheel (rpm) the voltage generated will also be increasing and vice-versa. As others researchers had used stepper or servo motors as regenerative motor, so in this project, it is replaced with D.C motor. motor with gear. It has been found that the voltage generated by the D.C motor with gear is higher than that of voltage produced by those two motors.

Hence, if this system is installed in the actual vehicles minimum 11% battery energy can be recovered using the regenerative braking system which would otherwise be wasted to heat in friction brakes. So the distance travelled between two successive charging requirements can be increase to 10 to 15 % using this regenerative braking.

Reference

1. S.J.Clegg, "A Review of Regenerative Braking System", Institute of Transport Studies, University of Leeds, Working paper of 471, 1996.

2. Gao, Y., Chen, L., Ehsani, M., "Investigation of the Effectiveness of Regenerative Braking for EV and HEV", SAE Paper 1999-01-2910, August 1999.
3. Allen E. Fuhs, *Hybrid Vehicles – The future of personal transportation*
4. Mehrdad Ehsani, Yimin Gao and Sebastien E. Gay., *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*
5. Chibulka.J, "Kinetic Energy Recovery System by means of Flywheel Energy Storage", Advanced Engineering, Vol. 3,
6. Ranjan Kumar , Department of Mechanical Engineering, Indian School Of Mines, Dhanbad, "Regenerative Brake: To Harness the Kinetic Energy of Braking" JETIR (ISSN-2349-5162) January 2015, Volume 2, Issue 1
7. http://energyeducation.ca/encyclopedia/Regenerative_braking
8. <https://www.tesla.com/blog/magic-tesla-roadster-regenerative-braking>