

Design and Fabrication of Regenerative Braking System

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ABSTRACT - In today's world, there is an energy crisis and the natural resources are exhausting at higher rate, there is a requirement of such a technology that helps to recover the energy, that is usually wasted. so, here comes the technology called regenerative braking system .the regenerative braking system is energy recovery mechanism that helps automobiles or objects to recover its kinetic energy by slowing the vehicles .the energy that recover from an object it can used directly or further can be used for the future purpose by converts into a particular energy form like storing into a battery or capacitors .energy can also store in the rotating flywheel which is the cost efficient and effective method of storing energy . the electrical automobile used the motor as a generator while operating regenerative braking so the output used to recharge the automobile as well as increase its efficiency.

Keywords: Generator, Regenerative braking, Flywheel Brake pad, Energy recovery

1. Introduction

The demand of reliable alternative energy resources is increase in recent years .today's automotive industry is doing a research on getting higher efficiency and reduce exhaust gas emission .the commercial vehicles that are mostly used as refuse trucks and delivery vehicles lose lot of kinetic energy due to frequent braking , leads to emission of higher greenhouse gases and consumption of fuel .the Diesel particular filter (DPF) and Exhaust gas emission are installed in most modern vehicles are effective ways to reduce the emission but not GHG gases. regenerative braking system is the best feature of electric automobiles. the electric vehicles lose most of its range due to frequent braking and decelerating. the energy recovery system is helping electrified vehicles to reducing the energy consumption. there are two types of regenerative system used in commercial vehicles. the boost recuperation system and regenerative braking system. 50 % to 80% of braking energy loss of commercial vehicles according to current braking.

2. LITERATURE SURVEY

[1]. Sayed Nashit, Sufiyan Adhikari, Shaikh Farhan, Srivastava Avinash and Amruta G

- The project ('Design, Fabrication and Testing of Regenerative Braking Test Rig for BLDC Motor) creates

awareness to engineers towards energy efficiency and energy conservation. The regenerative braking cannot used as primary braking system, it works more efficient at higher speed. The project describes us about the bright and green future of efficient energy due to automobiles as they help to regain the waste part by regenerative braking system

[2]. Tushar L. Patil, Rohit S. Yadav, Abhishek D. r, Mahesh Saggam, Ankul Pratap

- The project (Performance improvement of Regenerative braking system) the techniques to increase the efficiency of the regenerative braking system is mentioned. Due to the use of light weight automobile components increase the overall performance, in regenerative braking system super capacitors can improve the conversion rate.

[3]. C. Jagadeesh Vikram, D. Mohan Kumar, Dr. P. Naveen Chandra

-The project Fabrication should done according to the given measures in automotive transportation to get maximum performance in braking.in regenerative braking system the execution is important.

[4]. Ketan Warake, Dr. S. R. Bhahulikar, Dr. N. V. Satpute

- This system is developed regenerate the wasted battery charge of vehicle. Generally, the friction brakes covert energy into heat which is affected to the surrounding. The mechanical energy of the generator is converted into the useful charge of the battery. As the regenerative braking system cannot bring vehicle to rest that's why it cannot be used as primary braking system. The Project shows 11% of battery charge can be recovered by this system which is either waste in heat due to friction brakes.

3. Working Principle

The regenerative braking is a braking system /mechanism that helps the vehicle to increase its efficiency by using mechanical energy of motor to transform kinetic energy into electrical energy fed back to the battery source. Evidently, good part of kinetic energy transforms by regenerative braking system to power the battery, using the same idea as alternator.

In regenerative braking mode the car is slowing down by using motor when the driver exert compulsion on the brake pedal and the electric motor works in opposite order thus slow down the car. While working in opposite direction the motor works as generator and charge up the batteries as given in fig (1)

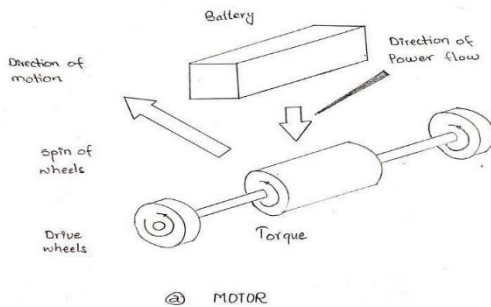


Fig.1.forward driving condition

When the car running in normal condition motor takes Power from the battery to work in forward direction. By the use of regenerative braking, it increases the fuel Efficiency, lowering emissions and reduce the dependence on fuel. Such braking system works efficiently in the urban cities where frequent braking is done.as given in fig (2).

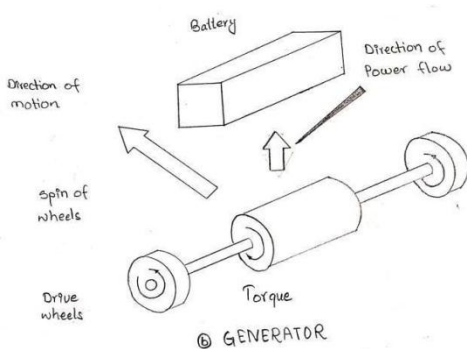


Fig. 2. Regenerative action during braking

4. Types of Regenerative Braking System

In regenerative braking system there are multiple ways of energy transformation along with flywheel, spring, electromagnetic and hydraulic. And hybrid regenerative braking system like electromagnetic -flywheel system come up recently. Every type of regenerative braking system uses a different energy transformation or storage system, giving different efficiency and application for each type. as follows-

a) Electromagnetic

In electromagnetic system, the electric generator is attached to the drivetrain in automobiles, slowing the automobile and generation of electricity takes place. In hybrid and electric vehicles, the generated energy is given

to the batteries, leads to charge up the batteries. In gasoline powered the energy is utilize to power electronics of vehicle or stored to the battery for the future purpose.

b) Flywheel

In flywheel type regenerative braking system, the kinetic energy of the automobile is used to spin flywheel attach to the driveshaft trough transmission. The rotating flywheel gives the torque to the drivetrain, which gives the automobile a power uplift.

5. Fabrication

List of materials used in fabrication.

- Square bar
- Journal Bearing
- Brake Wheel
- Solid Shaft
- Bicycle Wheel
- Brake Spindle
- Sewing Machine Motor
- Pulley
- Pulley Rope
- LEDs
- Electric Wires
- D.C. Motor

6. Equipment

Equipment used in fabrication.

- Drilling Machine
- Metal Cutting
- Hacksaw
- Angle Clip from square bar
- Arc Welding
- Basic Welding Circuit

7. Procedure

- First, the mild steel square bar is cut at an angle of 45 degrees and joined the bar welded together to form a frame.
- To form a table-like structure the square bar is welded at both ends.
- The Plummer block is welded on the square frame provided on the top of flat plate

- scooter wheel, brake wheel and pulley are arranged and fitted to solid shaft in between Plummer block.
- The motor is welded, for operating the frame
- The power of the motor is provided to the scooter wheel by connecting pulley and motor with a belt.
- The geared DC motor set at the brake wheel which is set upon the brake paddle.

8. Design and Calculation

- Motor used = 1 Hp(960rpm)

Motor speed is simply measurement of the revolution per minute, while vibration frequency is expressed in hertz.

Therefore,

vibration frequency (F) = $960/60 = 16\text{hz}$

- Alternator = 20v
- Shaft outer diameter = 25mm
- Plummer block bearing = 25mm
- Driven pulley size = 8inch
- Drive pulley size = 4inch
- Gear ratio = $4/8 = 1:2$
- Frame size = 35*16
- Wheel size = 13inch

9. Precautions Taken while fabrication

- The Apron is must during each process of Fabrication.
- During welding process Face shields and welding gloves should use for facial and hand protection.
- During the Drilling process proper coolant should provide
- During Grinding process, the gloves are used for safety precaution
- In the fabrication process materials were handled very carefully.

A. Design

Creo software used to design this model



Fig.3. Design of Frame

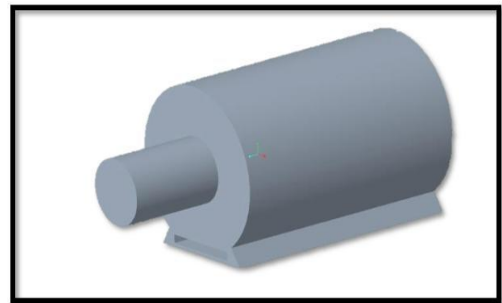


Fig 4. Design of pulley

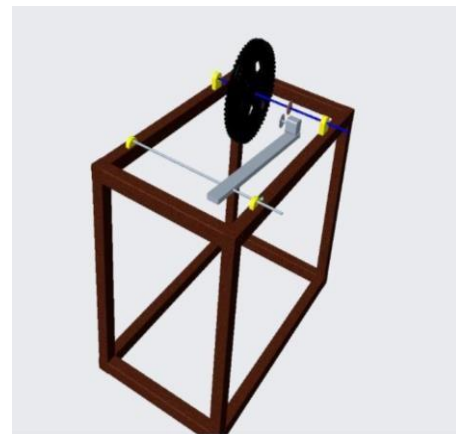


Fig.6.design of motor

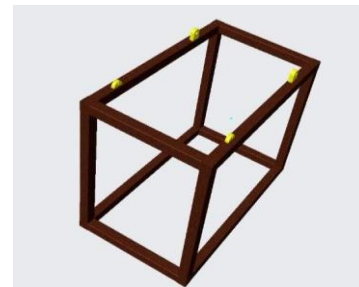


Fig.7.Final assembly with belt drive mechanism

Result

The model is tested and operated successfully and the results obtained in various loading condition are as follows

S. No.	Rpm before brake	Rpm after brake	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

Results obtained in various loading condition

As shown in above tables that the efficiency of the regenerative braking systems using D.C Motors increases as the angular velocity of the motor increases and hence the regenerative braking systems are more productive as higher angular velocities and as the motor speed increases the recoverable energy also increases.

Conclusion

Analytically it is found that the voltage generation is increase while increase in the speed (RPM)of the wheel. During the research the scientist use servo motor as regenerative motor it is replaced with DC motor in this project and motor with gear. Voltage generated by the DC motor is higher than that of two motors.

Thus, 11% of battery power can be recovered if it is placed in actual vehicle using the regenerative braking system which is as always wasted to heat in friction brakes.



Final Fabrication

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