International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

REGENERATIVE BRAKING SYSTEM BY USING HYDRAULIC CYLINDERS

K Ashok Vamsi[1], S V S Charan V[2], Surendra K[3], Ravi babu M[4], Uday Shankar[5]

[1]B. Tech students, Dept of Mechanical, Lingayas Institute of Management & Technology, Madalavarigudem, Nunna, Vijayawada, Andhra Pradesh, India.

Abstract - As in today's world, where there are energy crises and therefore the resources are depleting at a better rate, there's a requirement of specific technology that recovers the energy, which gets usuallywasted. So, just in case of automobiles one among these useful technologies is that the regenerative braking system. Regenerative braking is an energy recovery mechanism that slows avehicle or object by converting its Kinetic Energy (K.E) into a form which will be either used immediately or stored until needed. Using regenerative braking system in automobiles enables usto recover the K.E. of the vehicle to some extent that's lost during the braking process. The converted K.E. is stored for future use or is fed back to the facility system of the vehicle. This energy is often stored during a battery or bank of capacitors for later use. Energy also can be stored with the assistance of a rotating flywheel which is one among the foremost inexpensive and effective method of storing and regenerating power. The present invention provides energy-storingregenerative braking system by transmitting the flywheel force as a torque tending to oppose the forward rotation of a wheel on applying the brakes.

A brake-pad assembly, mounted concentrically with the hub of a ground-engaging wheel, is actuated upon braking to supply frictional engagement between the hub and clutch mechanism, while applying a decelerating torque to the wheel. The special braking mechanism is selectively held in position by a rider-controlled clutch mechanism, to accumulate energy over several brakingevents. Vehicles driven by electric motors use the motor as a generator when using regenerative braking and its output is supplied to an electrical load. The transfer of energy to the load providesthe braking effect and regenerate's power.

Key Words: Regenerative Braking, Generator, Brake pad, Energy Recovery, Flywheel.

1.INTRODUCTION

In recent years, there is the lack of reliable alternative energy sources, increasing efficiency and reducing exhaust gas emissions has become the focus of the modern automotive research.Commercial vehicles such as refuse trucks and delivery vehicles lose a tremendous amount of kinetic energy during frequent braking and constant drive at low speeds on designated city routes, which results in higher fuel consumption and Green House Emission Gas (GHG) emission than other on-road vehicles. Numerous attempts have been made to improve type of vehicles. The technological combination of Exhaust Gas Recirculation (EGR) and Diesel Particulate Filter (DPF) after treatment is one of the effective ways to solve the vehicle emission,especially for NOx and soot. However, this method is not able to reduce the GHG emission sincethe low temperature combustion of this technology results in increasing the fuel penalty. Sacrificing engine efficiency in exchange for reduced pollutants cannot fundamentally solve the energy crisis. In order to achieve overall GHG reduction targets, a strong reduction is needed particularly for commercial vehicles.

Regenerative energy technology is one of the key features of electrified vehicles. It allows the vehicle to capture a tremendous amount of the kinetic energy lost during braking or decelerating for reuse. That is saying, energy recovery technology can significantly bring down the energy consumption of electrified vehicle, particularly in urban operated route. Generally, there are two regenerative energy approaches which have been applied to commercial vehicles: Regenerative Braking System and Boost Recuperation System. The former is usually applied in series hybrid

1.1 Working Principle

Regenerative braking is a braking method that utilizes the mechanical energy from the motor by converting kinetic energy into electrical energy and fed back into the battery source. Theoretically, the regenerative braking system can convert a good fraction of its kinetic energy to charge up the battery, using the same principle is an alternator.

In regenerative braking mode, it uses the motor to slow down the car when the driver applies force to the brake pedal then the electric motor works in reverse direction thus slowing the car. While running backwards, the motor acts as the generator and recharge the batteries

the car in normal running condition whereas the motor turning forward and taken energy from the battery. By using regenerative braking, it vastly reduces the reliance on fuel, boosting fuel economy and lowering emissions. These types of brakes work effectively in driving environment such as stop-and-go driving situations especially in urban city.

2.LITERATURE REVIEW

The first of these systems to be revealed was the Flybrid. This system weighs 24 kg and has an energy capacity of 400 kJ after allowing for internal losses. A maximum power boost of 60 kW

(81.6 PS, 80.4 HP) for 6.67 seconds is available. The 240 mm diameter flywheel weighs 5.0 kg andrevolves at up to 64,500 rpm. Maximum torque is 18 Nm (13.3 ft lbs.). The system occupies a volume of 13 liter.

Formula One have stated that they support responsible solutions to the world's environmental challenges, and the FIA allowed the use of 81 hp (60 kW; 82 PS) KERS in the regulations for the 2009 Formula One season. Teams began testing systems in 2008: energy can either be stored as mechanical energy (as in a flywheel) or as electrical energy (as in a battery or super capacitor).

Two minor incidents were reported during testing of KERS systems in 2008. The first occurred when the Red Bull Racing team tested their KERS battery for the first time in July: it malfunctioned and caused a fire scare that led to the team's factory being evacuated. The secondwas less than a week later when a BMW Sauber mechanic was given an electric shock when he touched Christian Klien's KERS-equipped car during a test at the Jerez circuit. With the introduction of KERS in the 2009 season, four teams used it at some point in the season.

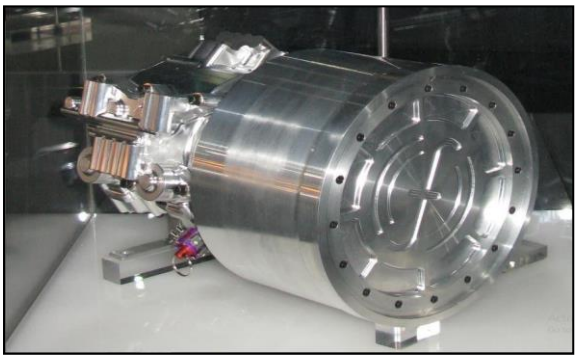


Fig-1 A Flybrid Systems kinetic energy recovery system

3. METHODOLOGY

3.1 Design Considerations

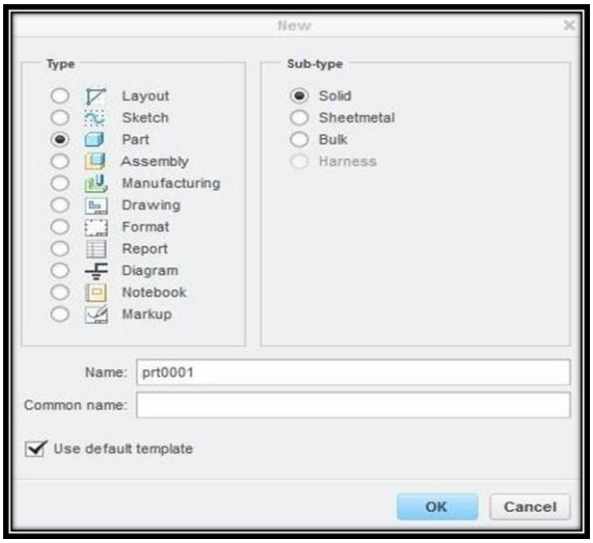
Regenerative braking system may not suffice the basic requirement of braking system alone. This is because of limitation of energy dissipation at very high power. The storage and generation systems may notbe capable to operate at those levels due to design limitations. Due to critical level of safety involved with the system, reliability becomes debatable and it necessitates a frictional braking system to co-exist with electrical regenerative braking system. This forms a hybrid braking system, which means:

1. Just like hybrid propulsion systems, there can be many design configurations and control strategies.
2. Design and control of system should be such that they ensure vehicle's desired braking performancewhile at the same time capturing as much energy as possible.

During developing strategies, a careful consideration of braking behavior and its characteristics with respectto speed, braking power, deceleration rate etc. must be made.

3.1 Design Procedure

The design is done by using Creo software.



1. Open the Creo software version 6.0.
2. Go to the file select new, click on part-design, remove using default templates, then click ok.

Fig-2 Initialization of project

3.2 Design of Frame

Go to the sketch, select the front plane, sketch view.

1. Select Rectangle command and draw the rectangle of 1000mm and breadth 800mm, click ok.
2. Go to extrude command, select the object, give the thickness of plates 15mm, and click OK.

3. Go to Framework and then make the joint as per the required.

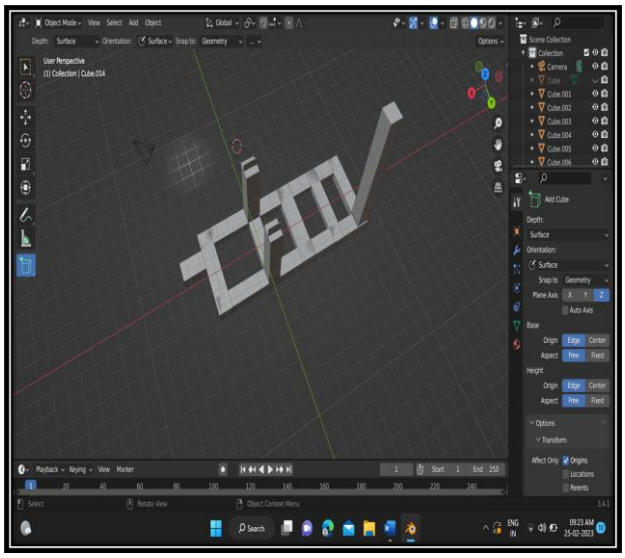


Fig-3 Design of Frame

3.3 Design of Pulley

1. Go to the sketch, select the front plane, draw an axis line, select line command and draw the 2D profile of pulley at one side of the plane with required dimensions, then click ok.
2. Go to the revolve command, select the object then click ok

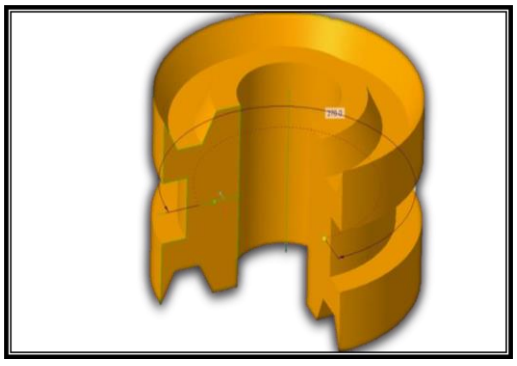


Fig-4 Design of pulley

3.4 Design of Rope

1. Go to the sketch, select the front plane, draw an axis line, select line command and draw the 2Dprofile of rope`
2. at one side of the plane with required dimensions, then click ok.
3. Go to the revolve command, select the object then click ok.

Fig-5 Design of Rope

3.5 Assembly of Parts

1. Go to the file, select new, select Assembly-part, remove use default templates, select mmns-ass-design then click ok.
2. Select the plane, click on assembly, and select the designed part from the files-open, click ok.
3. Select another object, go to assembly, select another part drawing, give the required assembly reference and click on ok.

4.FABRICATION

The assembly reference can be

- Coincident
- Normal
- Tangent
- Distance
- Automatic
- Angle Offset
- Default
- Parallel
- Co-Planar
- Parallel

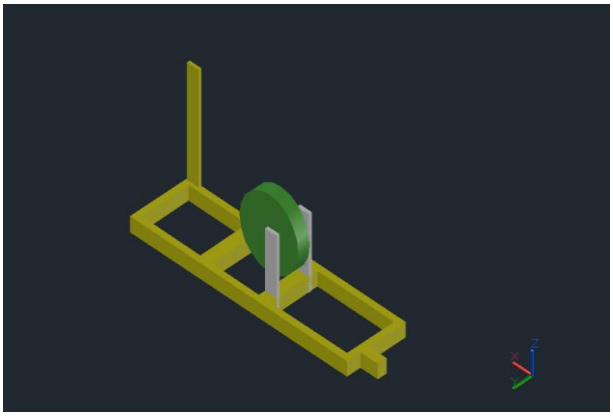


Fig-6 Assembly of the Component

S. No	Name of Parts Used	Description
1	Rectangular bar	20*40 Hollow Bar (M.S)
2	Bearing	Internal Dia.12mm
3	Brake Wheel	Outer Dia.8cm
4	Solid Shaft	Outer Dia.10mm
5	Bike Wheel	Inner Dia. 10 mm
6	Brake Spindle	40*40 Hollow Bar (M.S)
7	Sewing Machine Motor	9500 rpm
8	Pulley	Internal Dia.12mm
9	Rope	Cycle chain
10	LEDs	12v
11	Electric Wires	Copper wire
12	D.C Motor	Brushed D.C 12v
13	Injection syringe's	10 ml quantity
14	Saline pipe	1m
15	C clamps	½ inch

4.1 List of materials used

Table -1: List of Materials

5.PROCEDURE

1. First the rectangular bar is cut into an angle so that they are welded together in order to form arequired frame.
2. The rectangular bar is welded at each corner to form a desired like structure.
3. The wooden material is cut into a disk shape and on this the syringes are placed accordingly in the four corners of the disk
4. The bearings are fitted into the wheel for frictionless moment in the wheel these are placed at the both sides of the wheel such that the moment is free from the friction.
5. Solid threaded shaft is inserted in the wheel into the bearings upon which the bike wheel and brake wheel and the sprockets are fitted.

6. On the Frame the motor is welded.
7. The power of the motor is transmitted to the Bike wheel by the joining the sprocket and motor with a chain drive mechanism.
8. The D.C motor is placed on the tip of the syringe such that the this acts as the brake spindle
9. The L.E.D s are fixed on the frame.
10. The output of the brake wheel D.C motor is connected to L.E. Ds through copper wire.
11. The small wheels are placed on the legs to give movements to the Assembly.
12. The Entire Assembly is coloured with Red and black Paint to protect form Rust.

5.1 PRECAUTIONS

1. The Apron is worn at every process during Fabrication.
2. Face shield and welding gloves are used during the welding process and person should have a mask such that the gas which is coming from it should inheld by the any person.
3. Proper coolant is supplied during the Drilling process and for drilling process it is requested had gloves.

6.RESULTS AND DUSCUSSIONS

After the successful testing, the model is operated and the results obtained in various loadingcondition are noted and tabulated below. It can be seen from the result 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 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 mechanicallosses like friction losses and air drag.

With the markets for hybrid, electric and highly efficient, low emission conventionally- powered vehicles set to grow rapidly, the pace of development of regenerative braking systems looks similarly set to increase. The two key barriers to the market for battery- electric vehicles (BEVs) are currently their high cost (particularly of the battery packs) and limited range. For system developers, future challenges will include reducing costs, increasing vehicle range and meeting stricter safety and emissions standards. The braking regulation will need to be applied to advanced systems that not only stop the vehicle but recover lost braking energy.

S. NO	RPM before brake pedal pressed	RPM after brake pedal pressed	Voltage output
1	500	470	9.3
2	900	860	10.8
3	1300	1250	11.8
4	1700	1640	12.91
5	2100	2030	13.4
6	2300	2260	13.8
7	2500	2450	14.4

Table -2: Output Voltage

7.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 producedby those two motors.

REFERENCES

[1] Sayed Nashit, Sufiyan Adhikari, Shaikh Farhan, Srivastava Avinash and Amruta Gambhire, 'Design, Fabrication and Testing of Regenerative Braking Test Rig for BLDC Motor', 2016.

[2] Tushar L. Patil, Rohit S. Yadav, Abhishek D. Mandhare, Mahesh Saggam, Ankul Pratap, Performance Improvement of Regenerative braking system', International

[3] 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).

[4] Ketan Warake, Dr. S. R. Bhahulikar, Dr. N. V. Satpute, 'Design & Development of Regenerative Braking System at Rear Axle', International Journal of Advanced Mechanical Engineering. Volume 8, Number 2 (2018).

[5] Siddharth K Sheladia, Karan K Patel, Vraj D Savalia, Rutvik G Savaliya, 'A Review on Regenerative Braking Methodology in Electric Vehicle', International Journal of Creative Research Thoughts, Volume 6, Issue 1 (2018).

[6] Ehsani Mehrdad, Gao Yimin, Emadi Ali, Modern Electric, Hybrid Electric and Fuel CellVehicles, CRC Press, 2010.

[7] Gao, Dr. Yimin, "Regenerative Braking," Encyclopedia of Sustainability Science and Technology, 2012.

[8] 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-4 Issue-3 (2018).

BIOGRAPHIES

K. Ashok Vamsi
Assistant Professor
Dept of Mechanical
Lingayas Institute of Management & Technology

V. S. V. Srinivas Charan
UG Student
Dept of Mechanical
Lingayas Institute of Management & Technology

K. Surendra
UG Student
Dept of Mechanical
Lingayas Institute of Management & Technology

M. Ravi Babu
UG Student
Dept of Mechanical
Lingayas Institute of Management & Technology

D. Uday Shankar
UG Student
Dept of Mechanical
Lingayas Institute of Management &Technology