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Effective Regenerative Braking System for Electric Vehicle

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Abstract - To improve driving ability of electric vehicle. Regenerative braking system (RBS) are an effective method of recovering the energy released and at the same time reducing the exhaust and brake emissions of vehicle . this method is based on the principle of converting the kinetic energy created by mechanical energy of the motor into electrical energy and the converted electrical energy is stored in battery for later use. These system provide economic benefits via fuel saving . This use also contribute to a clean environment and renewable energy source

***Keywords* — Regenerative brake, Energy, Vehicle, Emission ,Fuel Saving ,Clean air, Power saving**

I. INTRODUCTION

The global warming and recent warning of the exhausted fuel source are serious problem in the world Evs are expected to reduce co2, it should increase the

running distance time in one electric charge .The solution for this kind of problem is Regenerative braking system. It is a new type of braking system that can recollect kinetic energy into electrical energy. The energy so produced can be stored in automobile battery , which can be used again .

A general mechanical brake ingenerates the stopping force by over braking brake disk to break pad, the braking energy converted into heat and it is not reused . The running distance by one electric charge is increases by the regenerative brake . However, it is limited the possibility of absorb energy of the regenerative because of the current limit of the battery and the motor capacity . the effect of regenerative brakes is less at lower speeds as compared to that at higher speed of vehicle. So the friction brakes are needed in a situation of regenerative brake failure, to stop the vehicle completely.

II. THE STRUCTURE AND WORKING PRINCIPLE OF REGENERATIVE BRAKING SYSTEM

II. THE STRUCTURE

A front - wheel drive vehicle regenerative braking structure diagram . When electric vehicle speeding up, the motor controls the current output by the battery through the sensor signal, and then its speed is adjusted for providing power. The motor becomes generator when electric vehicle braking, transmits the electric power which is converted by the motor to the battery, recharging the battery. Energy recovery system working schematic diagram.

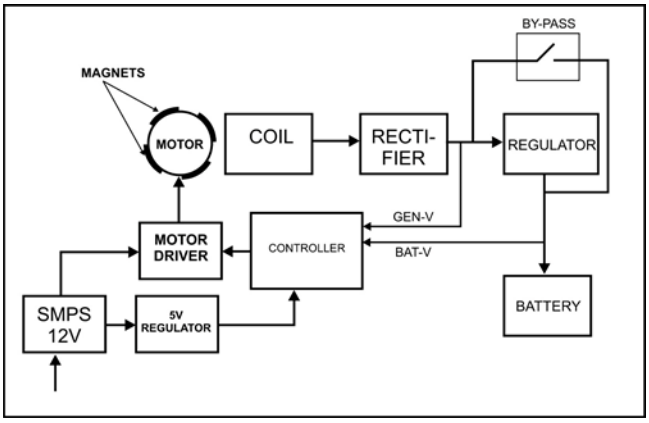

Figure 1 – Block diagram

The hardware structure BLDC motor , PI (micro controller), relay, 3 phase bridge rectifier, and So on..,

When the control signal changes from 1.0v to 3.5 V, the controller controls BLDC motor rotating work driving vehicle,when the value is below 1.0 V,control energy recovery system works and generats electromagnetic braking force and finally realizes the driving wheel braking.

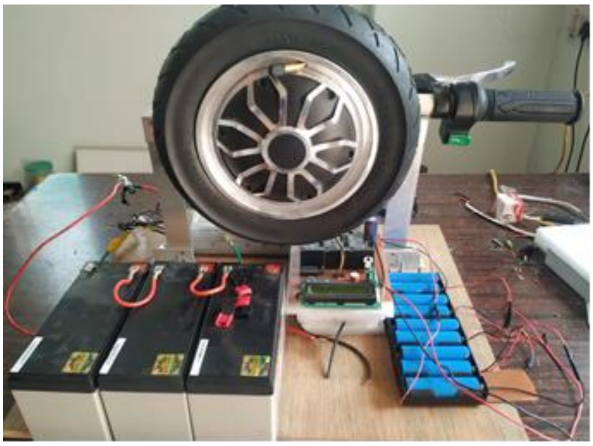

Figure 2- Structure of model

A. *Equipment required:-*

1.. PIC micro controller- 16F - to check Battery voltage and generation output voltage.
2.. RELAY - SPDT 30A Operated at 12V
3.. Relay Driver 16PIN UIN2003.
4.. Regulator IC 7805 to generated 5V require for micro controller
5.. LCD display 16*2
6.. Capacitor input filter 1000 microfarad two capacitor used
7.. Capacitor for storage 5V - 220 F
8.. 3phase bridge Rectifier
9- Resistance
10- battery

B. *Working:-*

- The BLDC motor is of 36v
- IN this Project we are using BLDC Hub motor (36v).
- The controller used for drawing this motor operates on (36 as well is 48 v)
- The PCB requires 12 V supply for its operation.
- We are using three batteries in series of 12 V 7.5A for supplying this connections.
- And a battery pack of li-on consist of 9 batteries of 2.7 amh each are connected in series to store energy .
- The PCB is connected to a single battery
- Initially, the LED screen displays the battery voltage & acceleration percentage.
- The microcontroller is programed such that when the accelartion /throttle is given more than 30 %, its relay pick ups and the motor runs in motoring mode .
- But as the acceleration drops below 30%,,it sends commands to switch off relay &the motor runs in generating mode.
- The LED displays the voltage being used while motor runs in motoring mode & as the throttle drops below 30% it display the voltage being generated by motor in generation mode.

(PDF).

III. MATH

- **The Energy Conversion Analysis of Electric Vehicle under Different Speeds:-**

The paper analyzes the energy conversion at 26km / h□V and 2km / h□V the two moments

The motor speed n is

$$n = (1 + 10\%) \cdot \frac{30 \cdot V}{3.6 \cdot \pi \cdot r}$$

The counter electromotive force E is

$$E = K_E \cdot \omega$$

Among them: KE is the electromotive force constant, its value usually is 0.9. The efficiency of E is

$$\eta_{反} = E / U$$

Among them: U is the lithium battery module voltage, its value is 36 V . From Table 2, we can see values of electric vehicle at 26km / h=V and 2km / h .=V

Table 1. The Main Parameters of Front Wheel Driving Electric Vehicle

The parameter name	The parameter value
Vehicle mass(kg)	150
Wheel radius (m)	0.25
Rolling resistance coefficient	0.016
Wind resistance coefficient	0.34
Mechanical resistance cofficient	0.9
Power generation efficiency	0.9-0.82
Brushless DC hub motor rated power (kw)	0.35
Lead acid battery capacity (Ah)	7
Lead acid battery module voltage(V)	36

Table 2. The Parameter Values of Electric Vehicle Different Speed

The Parameter	V= 26km/h	V= 2km /h
Motor rotation speed	237 r/min.	26 r/min.
Motor angular velocity	25 rad/s	2.7 rad/s
Counter electromotive force	22.4 V	2.4 V
Motor efficiency	21.2%	2.3%
Rolling resistance	49.8 N	44.6 N
Wind resistance	44.25 N	0.6 N
Total resistance	94 N	45.2 N
Output power	2.65 kw	0.33 kw
Driving torque	27.1 N. m	13 N. m

IV. STATIC OF BATTERY

We are using 2 battery .while performing experiment on our module we are considering two different parameters of battery .

1- It is continuously discharge using motoring mode for 30 mints and it is accelerated 100%.

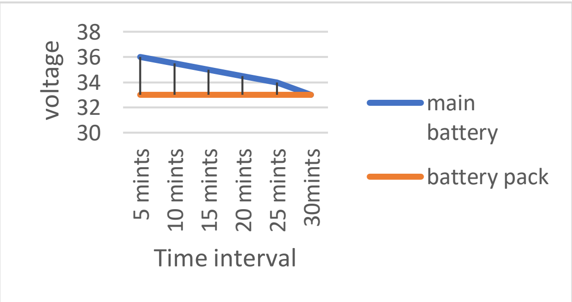

Figure3 – Graphical representation of voltage and time interval of the battery when speed is constant.

2- lowering acceleration by 30 %. In 5 -5 mints interval simultaneously.

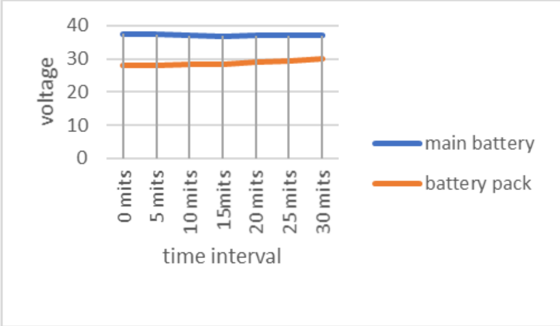

Figure 4 – graphical representation of voltage and time of batteries when the the regenerative breaks are applied

And the reading of voltage variation and discharging of the batteries in different time period.

Table 3. The Voltage variation of batteries in different time interval

time	Main battery voltage	Battery pack voltage
0 mits	37.5	28
5 mits	37.3	27.9
10 mits	37.0	28.3
15 mits	36.9	28.5
20 mits	37.0	28.9
25 mits	37.1	29.5
30 mits	37.5	30

Conclusion

This study presents information about the principles and properties of regenerative braking systems. automation, electromechanical, and constructive studies have been carried out in this field in order to boost recovered Many energy efficiency and reduce operating costs. the most of the economic losses worldwide are caused by mechanical wear, the importance of regenerative braking systems has become better recognized. Safety, comfort, and economic aspects can be increased by developing these brake systems. Regenerative braking systems, currently in limited use in electric vehicles, can also be used in conventional braking or other motion control systems. When they are widely used, economic input can be obtained by the reduction of mechanical losses and energy savings can be achieved as a result of the recovered electrical energy.

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