

# MODIFICATION & ANALYSIS OF REGENERATIVE BRAKING SYSTEM IN 2- WHEELER (PETROL)

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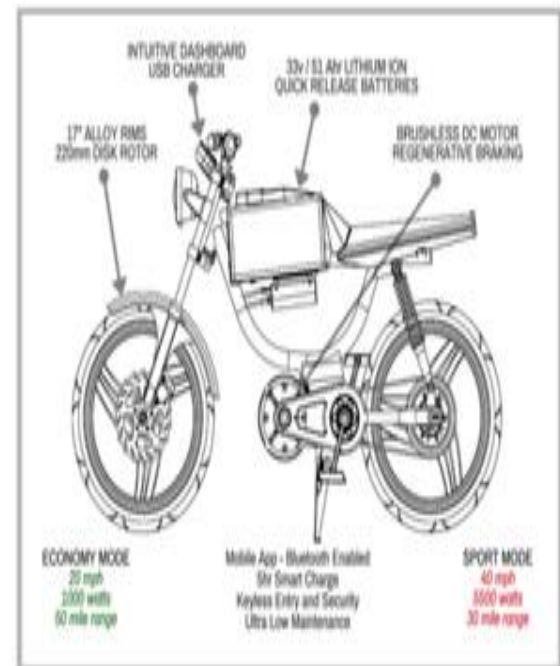
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**Abstract-** Regenerative Braking System is a system which harvests energy from the braking power and converts it into the form of stored energy, which can be used when needed. These days pollution is being increasing day by day and it has serious health problems. In this situation the saying, "Every drop make a mighty ocean" has to be taken into account and efforts are need to be made to make every vehicle less pollutant. This system is used in four wheelers as well as Electric Vehicles (EVs), but it is not used in two wheeler petrol/diesel as it comprises of bulky battery, generator, an inverter and a motor. Components other than the generator can be mounted anywhere on the vehicle body irrespective to its place, but as the generator needs to harvest the power direct from the driving shaft, it is not possible to mount it in the wheel hub directly. So, a special mechanism is to be made to accommodate the generator.

**Keywords-** Regenerative Braking, Electric Vehicles, Two wheelers, Battery, Generator, Motor

## I. INTRODUCTION

Millions of vehicles run on roads everyday. Excepting electric Vehicles (EVs), all vehicles do make pollution at small or large extent. Older vehicles cause more pollution than newer vehicles. Still the newer vehicles emit Carbon Dioxide (CO<sub>2</sub> is the leading pollutant in the context of Greenhouse Effect) by certain amount that is not to be negligible. Considering the prevailing climatic conditions, we should count every single pollutant in and try to reduce the pollution caused by it. There are many methods which are used to reduce the pollution or to increase the efficiency/Mileage of the engine. Fuel blending, Engine Gas Recirculation (EGR), Bio fuels, Different fuel input methods, Variable Valve Timing (VVT)...these are the methods to reduce pollution by modifying the engine assembly or blending fuels in different proportions. Regenerative Braking System (RBS) is such a method by which the mileage can be extended by some extent.



Regenerative Braking System (RBS) is a method which harvests power from braking. Formerly if the brakes were applied, the all power would go in vain. It is the law of conservation of energy in Thermodynamics which states that, "Energy can neither be created, nor be destroyed it can only be transferred from one form to another", under this law the braking energy is converted into heat. The air cools down the local raised temperature and the heat is thus lost. For years we had been doing this taking no energy from braking.

The Regenerative Braking System (RBS) can be applied by several methods like, Mechanical flywheel RBS, Elastomeric flywheel RBS, Hydraulic RBS, Electrical RBS, Kinetic energy storing RBS. These systems can be applied solely or combined use can be made. Out of these all, electrical regenerative braking system is the most effective as it converts the rotating energy into electrical energy and stores the energy making available when needed. Other methods store them as tensioned coil, compressed fluid etc, which have less tendency to store a big amount of energy. Hence electrical Regenerative Braking System is found to be the most efficient amongst all.

## II. WORKING OF RBS OF A TYPICAL 2-WHEELER EV

A typical regenerative Braking system is made by summation of different parts. The main components are Battery, Generator, Driving motor and an Inverter. Here is given a diagram that will help to understand, how it works.

A typical Electric Vehicle runs over electric power only, having no engine. As the vehicle has no engine, it has more space to place the big battery and in addition, the weight of the engine gets subtracted here, make the vehicle lighter. The driving chain which propels the rear vehicle is directly connected to the driving motor. A Brush Less Direct Current (BLDC) motor is used to achieve Regenerative Braking. These days the EVs are fitted along by an ABS system to accompany RBS. ABS helps to reduce the driver fatigue caused by improper braking, and gives smooth braking experience. The vehicle is given with two driving modes, i) Economic ii) sports

When brake is applied, the Brush Less DC motor retards the vehicle and in turn, generates electrical energy. The braking is not done alone with the BLDC but it has conventional brakes too, that helps in emergency. The Electrical energy generated through BLDC is then store in battery via an Inverter. The inverter processes the current and makes it compatible to charge the battery. The inverter alters the frequency and phase to meet this need. Thus the battery gets charged. The charge from the battery is then taken out to propel the vehicle. As soon as the acceleration is given, the battery supplies current to the driving motor and it moves the vehicle ahead.

A fully advanced RBS consists of a driving motor, a generator, a DC-DC converter or other type of fast charging mechanism, Controller to control the motor speed, battery capable of driving the motor (Generally 48v 20Ah).

Amongst all RBS, though we can find pure EVs the most efficient, we still have frequent discharges in EVs. So, to overcome this charging problem, we can use a hybrid electric vehicle instead.

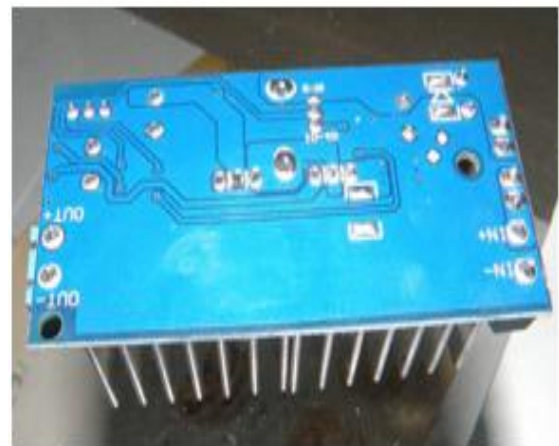
In Hybrid vehicle the propulsion is mainly done by the engine, and electric propulsion sits at secondary propulsion mechanism. For plug in hybrids we have to charge the batteries from electric ports, moreover we can get the energy lost while braking simply with the Regenerative Braking System. As the fully advanced RBS costs more and has moderate charging capacity, it would be better to make some modifications in existing RBS. Some modification regarding improvement in RBS are done here.

Use of an alternator(13.7 v 21A) is made to harvest electrical energy offering braking force simultaneously.



The alternator is placed on chassis by means of welding. The alternator is assisted with a solenoid actuator which pulls the sprocket when actuated. This splined actuator, when actuated, connects the moving chain. As soon as the actuator couples the alternator with the chain, the alternator starts rotating. The rotation in the permanent magnet field cuts the armature winding field flux and induces emf. The alternator gives constant output of 13.7 v by means of a voltage regulator.

The output of this alternator is then fed to a 12-48v DC-DC converter as shown below.



The DC-Dc converter steps up the voltage of 12v to 48v. Use of this particular converter is made to meet the initial experimental setup. The input of this controller connects to the alternator, and the output connects to the battery. The initial setup has a 48v 250w BLDC. To feed the 48v 250w BLDC we need to have a battery of 48v 20Ah 20c. In that note to make it more economic, four small capacity(12v) batteries are taken to make it 48v by a series connection. As the alternator gives 13.7v we will use the DC-DC converter 12-48v making it capable to charge series connected 48 batteries. The series connection of the batteries is shown below.



Now coming to the controller that controls the speed of the driving motor, a controller having ratings related the BLDC is fitted here.



The controller aided by the throttle/accelerator will control the motorspeed for maneuvering the vehicle. The front hub motor wheel (48v 250w) was not fitting the front wheel because of smaller axle rod. Moreover the diameter of the wheel was also smaller 1” than the bike tyre diameter. so the front wheel is still not fitted up. Once a proper wheel is arranged, the mechanism will be ready to take the readings.

After these all there will be two readings first to check the minimum power and second to perform Regenerative Braking. The minimum power readings will be taken with a 48v 250w BLDC and the final will be done with a 60v 1200w BLDC

### III. CONCLUSION

After conducting all the above experiments, it is clearly concluded that, a Regenerative Braking System can be also implemented in a 2-Wheeler (Petrol) making certain design modifications. It was not used in a non-Electric 2-Wheeler just because of less accommodation space and conventional design. If a proper design of components is made and the components included in the Regenerative Braking System, are placed properly on the body of the vehicle, then it is definite that we will step ahead towards the betterment of tomorrow and reduce the pollution, no matter if it is only a tiny drop of a mighty ocean(As it can increase the mileage only by 8-35%).

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