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Retrofitting of an Electric drive train in an I.C. engine Motorbike

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Abstract: **The major disadvantage faced by the present I.C. Engine bikes in the market is that the exhaust coming out from the engine increases the pollution in the atmosphere. The fuel used to run those bikes is non-renewable and also when on run, the bikes give out a lot of noise also. The present electric motorbikes though having a lot of advantage over the conventional I.C. Engine motorbikes suffer when it comes to mileage. The objective of the paper is to build an electric motorbike which is economical and also to overcome the major disadvantage faced by the electric motorbike i.e. mileage (km/charge). The objective of the paper can be achieved by using economic materials and devices which are capable of increasing the mileage of the motorbike by using the energy liberated by the motor.**

I. INTRODUCTION

An electric motor motorbike is a two wheeler unlike a conventional I.C. Engine motorbike which is powered by petroleum; the electric motorbike is powered by electric energy from one or more batteries. The power from the batteries are used for rotating the electric motor which in turn rotates the wheel of the motorbike thus giving the motorbike forward motion. The speed of the motorbike can be controlled by the speed of the motor. The alternator is used to produce the electrical energy using the mechanical energy of the wheel. When the wheel rotates even the alternator starts rotating which in turn produces electrical energy which can be stored and can be used later and in turn can be used to increase the range.

The reason people have started showing interest in electric vehicles is due to the increase of oil prices and also in order to decrease the greenhouse gas affect. As the price of the oil is increasing rapidly, the amount of money which is spent for oil by a country is very immense; hence finding an alternative would be a greater advantage for us as we can save a lot of non-renewable resources and also a lot of money of the country. The products formed by burning the oil increase the amount of greenhouse gas in atmosphere. This leads to global warming increasing the atmospheric temperature and also the depletion of ozone layer which can lead to many harmful radiations reach to the Earth and harm the ecosystem all over the Earth, hence electric vehicles are the best alternative as a fuel for the automobile industries as it is less harmful to the environment and also doesn't harm the environment as much as the other fuels do. Using this fuel instead of the other fuels will help the countries to be independent of the private companies against purchasing liquid fuel energy.

Problem faced by I.C. Engine

There are lots of problems faced by conventional I.C. Engine motorbikes. The conventional I.C. Engine motorbikes which use petroleum as fuel give out lot of exhaust which in turn increases the global warming. The increase in the greenhouse gases in atmosphere will make the living beings difficult to survive. One more major problem with the oil based motorbikes is that the efficiency of the motorbike is low and also all the energy produced in the motorbike is not used completely for running the bike. Lot of energy produced by burning the fuel is dissipated in the atmosphere in the form of heat as it is not used properly.

Problems faced by present Electric motorbikes

Large number of companies is showing interest in electric vehicles but the major problem associated with it still lies untouched. Though Electric motorbike comes out as the solution for most of the problems faced by the conventional I.C. Engine bike but it also comes with its own problems as well. One of the major problems associated with using the electric motorbike is that it lacks mileage. Present Electric motorbikes give a very limited mileage per charge of the battery. Imagine yourself going on a long ride with your loved ones and the battery runs out of charge in a remote area where charging the batteries would not be possible. Another problem faced by some of the countries is that there are no charging facilities developed. These are some of the issues where development is necessary. Another problem associated with using the electric bikes is that the rider has to compromise between the range and speed of the bike. For an electric bike, the range of the bike is indirectly proportional to the speed of the bike. If speed is increased, then the range decreases and vice-versa.

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Solution

Increasing global warming and the recent research in the field of electric batteries has led all the automotive industries to shift their focus towards electric motorbike. All the problems faced when using conventional I.C. Engine motorbike can be overcome by an electric motorbike. Even the electric motorbike has some disadvantages. In order to overcome the disadvantages of the present electric motorbike, an alternator can be used. Two alternators can be placed in the hub of the wheels of the electric motorbike. This electric motorbike can easily remove all the disadvantages of conventional I.C. engine motorbike and also the disadvantages of the present electric motorbikes to some extent.

Role of Electric Motor in Electric Motorbike

A motor is a device which is used to convert electrical energy into mechanical energy. When the power is supplied to the electric motor from the batteries, the electric motor starts rotating. The motor is connected to the rear wheel using Chain Drive just how the engine is connected to the rear wheel in conventional I.C. Engine motorbike. Hence, when the electric motor rotates, through the chain drive the rotational motion is transferred to rear wheel of the bike. Due to this the motorbike starts moving forward.

Figure: Permanent Magnet Electric motor

Figure: Sevcon Gen 4 motor controller

Role of Batteries in Electric Motorbikes

Batteries are the power house of the electric motorbikes. The supply to the motor and other components in the motorbike is supplied from the battery. The speed of the motorbike and range (mileage/charge) depends upon the battery being used in the electric motorbike. Better the battery in the motorbike better will be the performance of the electric motorbike. Researchers have found batteries which are capable of giving a speed of 200kmph and a range of 100-200. In future the battery technology is supposed to be improve which in turn will improve the efficiency of the electric bike in terms of range and mileage.

Figure: Nano-phosphate Li-ion battery

Role of Alternator in Electric Motorbike

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature. When put in the hub of the wheels of the motorbike and the motorbike is in motion, due to the rotational movement of the wheel, alternator also starts rotating. Due to the rotation of the alternator, electrical energy is produced. This electrical energy can be stored in the battery in order to enhance the performance of the motorbike by increasing the mileage of the motorbike.

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The performance of the Motorbike can be increased by just using the charge produced from the alternator.

Figure: Alternator, capable of giving peak charging output of 300Watts

Calculations of Electric Motor

Efficiency of the motor is calculated as mechanical output power divided by electrical input power:

E = Pout / Pin

therefore

Pout = Pin * E

after substitution we get

$\tau * \omega = I * V * E$

$\tau * rpm * 2\pi / 60 = I * V * E$

and the formula for calculating torque will be

$\tau = (I * V * E * 60) / (rpm * 2\pi)$

Where

E= efficiency of the motor,

P= Power output of the motor,

Pin= Power input for motor

τ = Torque,

ω = Angular Velocity,

I= current in Amp,

V= Voltage,

Rpm= speed of the Motor

Calculations for Battery pack

Specification of the battery pack: 60V & 72Ah

Battery type: lithium ion battery (18650 cells)

Specification of each cell:

Nominal Voltage: 3.6V

Capacity: 2.6Ah

Diameter: 18.20mm

Height: 65.50mm

Weight: 48.5g

One battery pack has 4 cells in series and 7 cells in parallel which will have a nominal voltage of 14.4V and 18.2Ah. this can be achieved by utilizing 28 cells.

So, a battery of 5 battery packs in series and 4 battery pack in parallel which will give nominal voltage of 57.6V and capacity of 72Ah. This can be achieved by utilizing 600 cells (considering 40 defect cells also).

Power of battery= Voltage * Capacity

= 72 * 72.8

= 5.242kWh

Charging units required= V*Ah*(1-C) * (1+L)

=72*72.8*0.9*1.2

=5.661kWh

Charging cost= 4*Charging units required

= 4*5.661

= Rs 22.644

Total weight of the battery pack: 21.72Kg

Working Mechanism

The bike has two set of batteries – one is primary and the other one is auxiliary battery. Primary battery is the one which supplies power to the drivetrain for the initial run of the bike. Initially, the power is taken from the primary battery and the motor starts rotating thus rotating the wheel making the bike run. When the bike is running, alternators also start rotating with the same speed as that of the wheel as it is put in the hub of wheel. When the alternators rotate it produces electrical energy which is stored in the auxiliary battery. When the primary battery runs out of charge a smart system in the bike shifts the connection of the drivetrain to the auxiliary battery and puts the primary battery in connection with the alternators. When the auxiliary battery runs out of charge, the smart system connects the primary battery to the drivetrain and the auxiliary battery to the alternators. This process gets repeated till both the batteries are discharged fully. Once the above mentioned state is achieved, external power source is used to charge the primary battery and again the process is continued. This mechanism can give us a mileage 70% (including all the losses) or more than a present electric motorbike.

Figure: Retrofitting of Electric Drive train on an I.C. Engine bike (TVS Flame).

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II. ADVANTAGES AND DISADVANTAGES

The biggest advantage of using an electric motorbike with alternators is that you don't have to worry about the mileage. The only thing to think is the destination without thinking about the distance. Using one such bike will also make us feel proud as it will be a zero emission bike causing no harm to the nature. This will help in slowing down the global warming and also help in building a greener environment so that the next generation can prevail into a greener and cleaner environment. One more advantage using this motorbike is that it doesn't produce sound reducing the sound pollution in the environment. All electric motorbikes can perform better by using alternators. Riding the electric motorbike can feel like riding a bicycle at a speed of 150 km/h without peddling. Also, it is easy to convert a conventional I. C. Engine motorbike into an electric motorbike with alternators. It can be achieved by doing adjustments in the design and transmission of the bike. The possibility of seeing the electric motorbikes on the roads in future is very high. The only disadvantage associated with the electric motorbike is putting the alternators in the hub of the wheel.

III. FUTURE ASPECTS

From the main context of this initiative, to solve the main problem faced by the electric Motorbikes and thus these main problems are cleared by the alternators. Hence a small device can solve a big problem. Let us hope this solution could be useful and possible in the future. This technology will definitely revolutionize the concept of Motorbikes and how we look upon them.

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