

Development Of Electric Conversion Kit For Motorcycle

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Abstract

Electric vehicles first appeared in mid-19th century. An EV held the vehicular land speed record until around 1900. The high cost, low top speed and short range of battery powered EVs, later compared to IC engine vehicles led to a worldwide decline in their use. In the 21st century owing to environmental problems created by IC engine vehicles resulted in piqued interest in electric vehicles and other alternative fuel vehicles once again. Our paper focuses on making an electric conversion kit for the already existing IC engine motorcycles and keeping the manual transmission intact. The engine-gearbox assembly is replaced by electric motor-gearbox assembly. And a mechanism is designed in order to connect the driving motor to gearbox. Later on, the power is transferred to rear wheel of the vehicle using chain sprocket arrangement. Power which was obtained by burning of fuel (petrol), is replaced by Lithium ion battery. The assembly is done in such a way that the dimensions of modified vehicle should not look different than the original. The final modified motorcycle should give equal performance as the IC engine motorcycle.

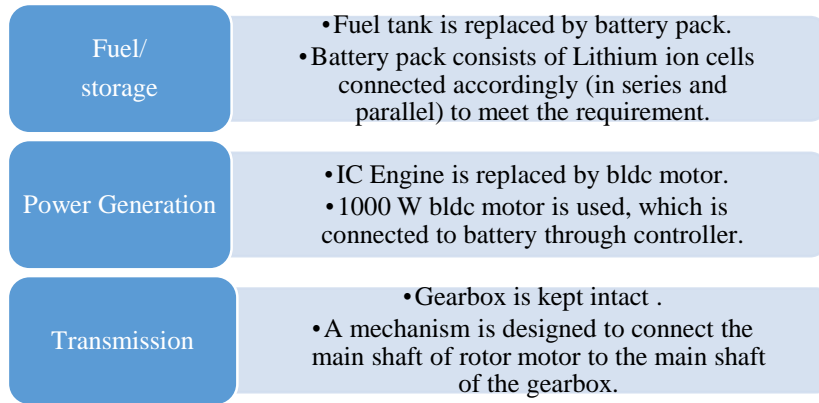
Keywords— *Electric vehicle, Battery powered, Motorcycle, Conversion kit, Manual transmission, Performance*

I. INTRODUCTION

A **motorcycle**, often called a **bike**, **motorbike**, or **cycle**, is a two- or three-wheeled motor vehicle. Motorcycle design varies greatly to suit a range of different purposes: long distance travel, commuting, cruising, sport including racing, riding. When we come to electric motorcycles, they have very high fuel economy equivalents. Electric motorcycles are nearly silent, zero-emission electric motor-driven vehicles and are the need of the hour, due to increasing carbon emission levels. Operating range and top speed are limited by battery technology. Fuel cells and petroleum-electric hybrids are also under development to extend the range and improve performance of the electric drive system. Although many innovators have already worked on the idea of electric motorcycles, none of them have focused on the approach of converting a petrol engine motorcycle into electric motorcycle keeping the maximum possible parts same. So through this project, we are making an electric conversion kit suitable for the current existing petrol engine motorcycles with least effect on the performance.

II. METHODOLOGY

The engine-gearbox assembly is replaced by electric motor-gearbox assembly. Power which was obtained by burning of fuel (petrol), is replaced by Lithium ion battery pack. Step by step modification is stated below:



III. VEHICLE POWER LOAD DESIGN

A. Objective: Design of two wheeler vehicle to find out the required specification of electric motor.

Assumptions:

Maximum load = 180Kg
 Top speed = 50Kmph
 Efficiency of motor = 90%
 Rolling resistance ~ 0.02
 Coefficient of drag (Cd) ~ 0.3
 Area of vehicle (m²) ~ 1 m²
 Density of air ~ 0.6465Kg/m³
 Wheel size (diameter) ~ 23 inch = 0.5689 m
 Radius of wheel = 0.5689/2 m = 0.28445 m

B. Steps of design

- (1) Linear distance traveled by the wheel = πd
 $= 3.14 \times 0.575$
 $= 1.8 \text{ m}$
- (2) Speed/velocity (v) = 50Kmph
 $= 50 \times 1000/3600$
 $= 13.88 \text{ m/s}$
- (3) RPM = Total distance covered per hour/ Linear distance
 $= 50000/1.8 \times 60$
 $= 463 \text{ RPM}$
- (4) Power input (Pin) = { (M in kg) \times g (acceleration) \times v \times rolling resistance } +
 $\{ \text{air density} \times \text{Area (frontal)} \times v^3 \}$ _____ (i)
 $= \{ 180 \times 9.8 \times 14 \times 0.02 \} + \{ 0.6465 \times 1 \times 14^3 \}$
 $\text{Pin} = 2267 \sim \mathbf{2300W}$
 $= \mathbf{2.3kW}$

C. With the use of gearbox:

N th Gear	T _{output} / T _{input}	Gear Ratios (GR)
1	37/11	3.36
2	31/17	1.8235

3	31/26	1.1923
4	27/29	0.931

- For 2kW motor,
Rated torque = 6.37 Nm..... (from user manual)
- For 1kW motor,
Rated torque = 4.5 Nm..... (from user manual)

After using gearbox for 1kW motor:

$$\text{Torque at 1}^{\text{st}} \text{ gear i.e. } T_{\text{max}} = (4.5/1.6) * GR_1 \\ = \mathbf{9.45 \text{ Nm}}$$

**1.6 is pulley ratio

Actual torque while engine was driving source = **8.05 Nm**..... (from user manual)
(Torque required)

Obtained torque after using 1kW motor with gearbox = **9.45 Nm (> 8.05 Nm)**

➤ **Considering intermediate shaft reduction and wheel drive reduction :-**

Sr.No.	Rotation of crank per rotation of wheel
1	38
2	20.5
3	13.5
4	10

➤ **Pulley ratio calculation for efficient speed :-**

Maximum speed :- 50 kmph

Crank rotation for tyre size:- 22.6 inches

Motor rpm:- 3000

Therefore,

$$= 4800/3000$$

$$= 1.6$$

(i.e. If diameter of pulley at motor end is 12.7 cm, the diameter of pulley at crank end will be 7.62 cm.)

IV.SPECIFICATIONS OF COMPONENTS

1] BLDC Motor:-

Motor has been selected according to the required output power as we don't want to affect the power of the modified vehicle. This motor fits in our budget and is selected due to its availability.

Specifications of BLDC Motor (1000w)-

- Type- Permanent Magnet BLDC
- Voltage (volts)- 48
- Rated Speed (RPM)-3000
- Rated Torque(Nm)-4.5
- Rated power (w)-1000
- Max Output Power (w)-1700

2] Heavy Duty BLDC Motor Controller:-

This motor controller is selected as it was available with the motor in combination to it. The set fits our budget.

Specifications of heavy duty BLDC-Motor Controller-

- Rated DC Voltage(Volts)- 48
- Over Voltage cut-off(Volts)-58
- Under Voltage cut-off(Volts)-41
- Rated Power (Watts)-1000
- Rated Current(Ampere)-40
- Number of Mosfets-24
- Type of Mosfets- N-Channel mosfet(HY3408AP)
- Braking type- High level braking / low level braking
- Regenerative feature

3] Lithium-ion Rechargeable battery:-

We are still working on the battery pack as its availability is less and has high cost. Making the battery pack is risky as lithium ion batteries are highly flammable and lot of precautions are to be taken while handling them.

Battery Pack Requirements:-

- Voltage(Volts)- 48
- Capacity- 12Ah

Specification of Lithium-ion Rechargeable battery (3.7V):-

- Voltage - 3.7 V(Working), 4.2 V(Peak), 3 V(Cut-off)
- Capacity- 2.6 Ah
- Dimensions- 18mm * 65mm
- Prewired- Charging / Discharging Terminals

4] Motorcycle to be modified: - BAJAJ CT 100

Specifications:-

- Mileage- 89 – 99 kmpl
- Engine displacement (cc) - 102cc
- Power: - 7.7ps @7500 rpm (1 PS = 0.986 HP)

V. CONCLUSIONS

The modified motorcycle will be assembled by selection of correct components. All required components should be according to the required specifications. The components are selected such that they aid in high performance. All the pros are to be put to maximum use. Final calculations should be done by considering all the other affecting factors. Tests of the final assembled motorcycle are to be

taken manually and all errors are to be rectified. By keeping the gearbox intact the modified motorcycle should work properly and provide the normal function of transmission.

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