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DESIGN AND FABRICATION OF TWO-WHEELER SERIES HYBRID VEHICLE

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Abstract: The concern over the environmental as well as economical issues provide a compelling impetus to develop clean, efficient and sustainable vehicles for transportation. The dependence on oil as the sole source of energy for passenger vehicles has economical and political implications and the crisis will inevitably become acute as the oil reserves of the world diminish. One of the greatest innovations is Hybrid Electric Vehicle(HEV). The hybrid electric vehicle consists of two or more energy sources for total propulsion of the vehicle. In this paper, the main propulsion is through an electric motor, the range of the vehicle is increased with a combined effort of generator and electric motor. The generator will act as a range extender of the vehicle and electric motor act as propulsion system of the vehicle. The test area is chosen is New Delhi

Keywords: Hybrid Electric Vehicle, Two-Wheeler Series hybrid vehicle, Series Hybrid Electric Scooter.

1. Introduction

Series hybrids have also been referred to an Extended-Range Electric Vehicle (EREV) or range-extended electric vehicles (REEV). Electric transmission has been available as an alternative to conventional mechanical transmissions since 1903. Typically, mechanical transmissions impose many penalties, including weight, bulk, noise, cost, complexity and a drain on engine power with every gear-change, whether accomplished manually or automatically. Unlike combustion engines, with electric motors appropriate to any given vehicle performing any given role a multiple-speed transmission is not essential. In effect, the entire mechanical transmission between the internal combustion engine and the wheels is removed and replaced by an electric generator, some cable and controls, and electric traction motors, with the benefit the internal combustion engine is no longer directly connected from the demand.

A series hybrid is one in which only one energy converter can provide propulsion power. The IC engine acts as a prime mover to drive an electric generator that delivers power to the battery or energy storage link and the propulsion motor. In short, the benefits of a series-hybrid are simplicity. The vehicle is driven only by electric traction motors with an engine/generator set providing the electric power when needed. An electric battery acts as an energy buffer that evens out demand with the stored energy used as the prime source to propel the vehicle. However, when required the engine/generator can be used as a backup, to assist in acceleration, or when pulling heavy loads. O'Keefe and Markel [1] have presented a comparison of the costs (vehicle purchase costs and energy costs) and benefits (reduced petroleum consumption) of PHEVs relative to hybrid electric and conventional vehicles. A detailed simulation model is used to predict petroleum reductions and costs of PHEV designs compared to a baseline midsize sedan. Markel and Simpson [2] discussed the battery power and energy requirements for grid-charged parallel hybrid electric vehicles with different operating strategies. First, they considered the traditional all-electric range based operating concept and shown that this strategy can require a larger, more expensive battery due to the simultaneous requirement for high energy and power. They then proposed an alternative electric-assist operating concept for grid-charged HEVs to enable the use of a smaller, less costly battery. However, this strategy was expected to reduce the vehicle efficiency during both charge depleting and charge-sustaining operation. Markel and Simpson [3] proposed that, plug-in hybrid electric vehicle technology holds much promise for reducing the demand for petroleum in the transportation sector. They discussed on the design options including power, energy and operating strategy as they relate to the energy storage system. T. Wang et al. [4] (2005) studied the advanced batteries for HEV and PHEV applications and investigated the lifecycle costs of different types of 28 vehicles quantitatively. General equations were developed to describe the performance requirements and cost of all subsystems in vehicles. Their conclusions suggest that lead-acid batteries can be manufactured to meet the vehicle life cycle requirements of HEVs and PHEVs. The life cycle cost of HEVs was the lowest among CVs, PHEVs, HEVs. Su-Hau et.al. [5] focused on the highly efficient energy usage of the battery energy and proposed an integrated management system for electric motor. This integrated management system includes the power-saving controller, energy management subsystem and some hardware protection strategies. Wenguang et. al. [6] presented an approach to control powertrain of series hybrid electric vehicles. The sliding mode method was applied to excitation winding control in synchronous generator to achieve the desired current distribution in powertrain. Yimin and Mehrdad [7] introduced a speed and torque coupling hybrid drivetrain. In this drivetrain, a planetary gear unit and a generator/motor decouple the engine speed from the vehicle wheel speed. Also, another shaft-fixed gear unit and traction motor decouple the engine torque from the vehicle wheel torque. Thus, the engine can operate within its optimal speed and torque region, and at the same time, can directly deliver its torque to the driven wheels.

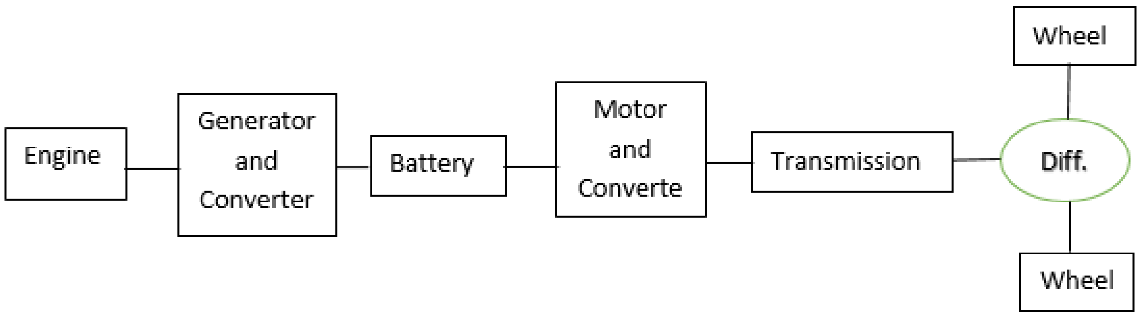

Fig 1 Series HEV Power Train

2.1 Design and Development

The electric motor is connected to the rear wheel it acts as the main propel source for the vehicle and it includes a single cylinder, air cooled internal combustion engine coupled to a gen-set which is connected to the charging circuit and charging circuit is connected to the battery and battery connects the main electric motor, i.e. this circuit acts as a range extender to the vehicle. A 200 watt 24v 11.5-amp electric motor is used to power the vehicle and it is connected to the rear wheel. The controller is designed to control speed of the electric motor and control is torque.

2.2 Virtual Model

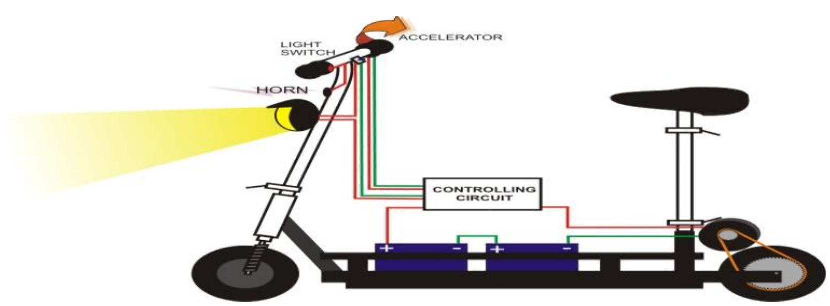

Fig No.2.2(a) Virtual model of the vehicle

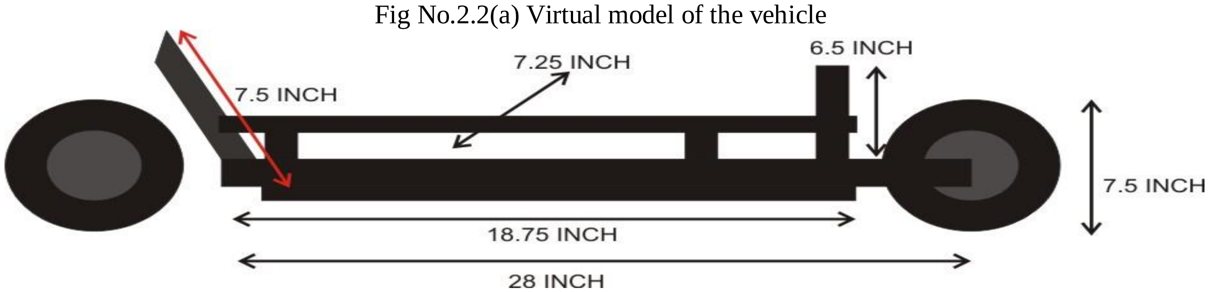

Fig no:- 2.2(b) Frame of the vehicle

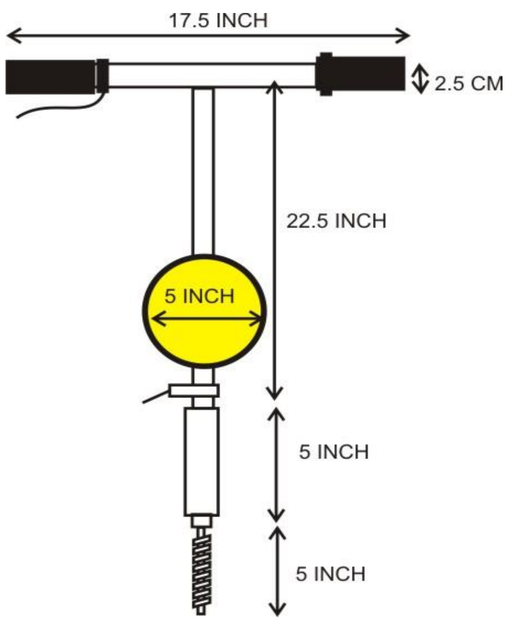

Fig.no 2.2(c) Handle dimension

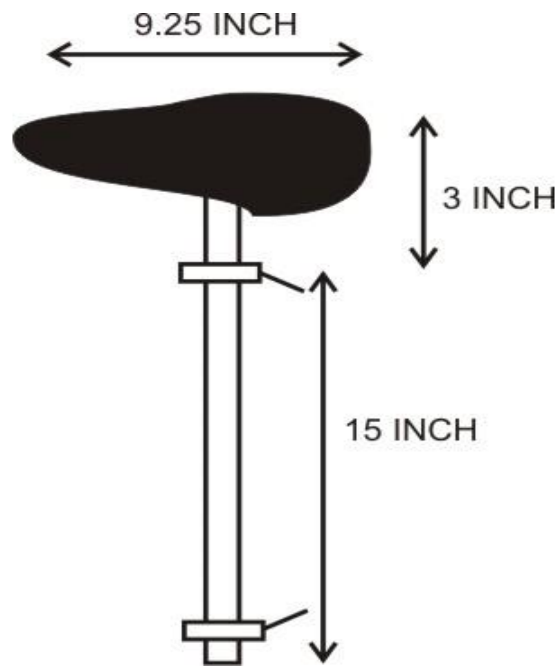

Fig.no 2.2(d) Seats dimension and seat subframe dimension

The prototype for this circuit was constructed on a regular IC proto board with parts and wires stuck into the proto board holes. One version of the finished circuit was used to make a variable speed DC fan, the fan was mounted on top of a small metal box and the PWM circuit was contained inside of the box. I built a simple circuit board using a free circuit board CAD program, PCB (1) that runs on the Linux operating system. The circuit board image was printed on a PostScript laser printer onto a mask transfer product called Techniks Press-n-Peel blue film (2). The printed-on film is then ironed on to a cleaned piece of single sided copper clad board. The board is etched with Ferric Chloride solution.

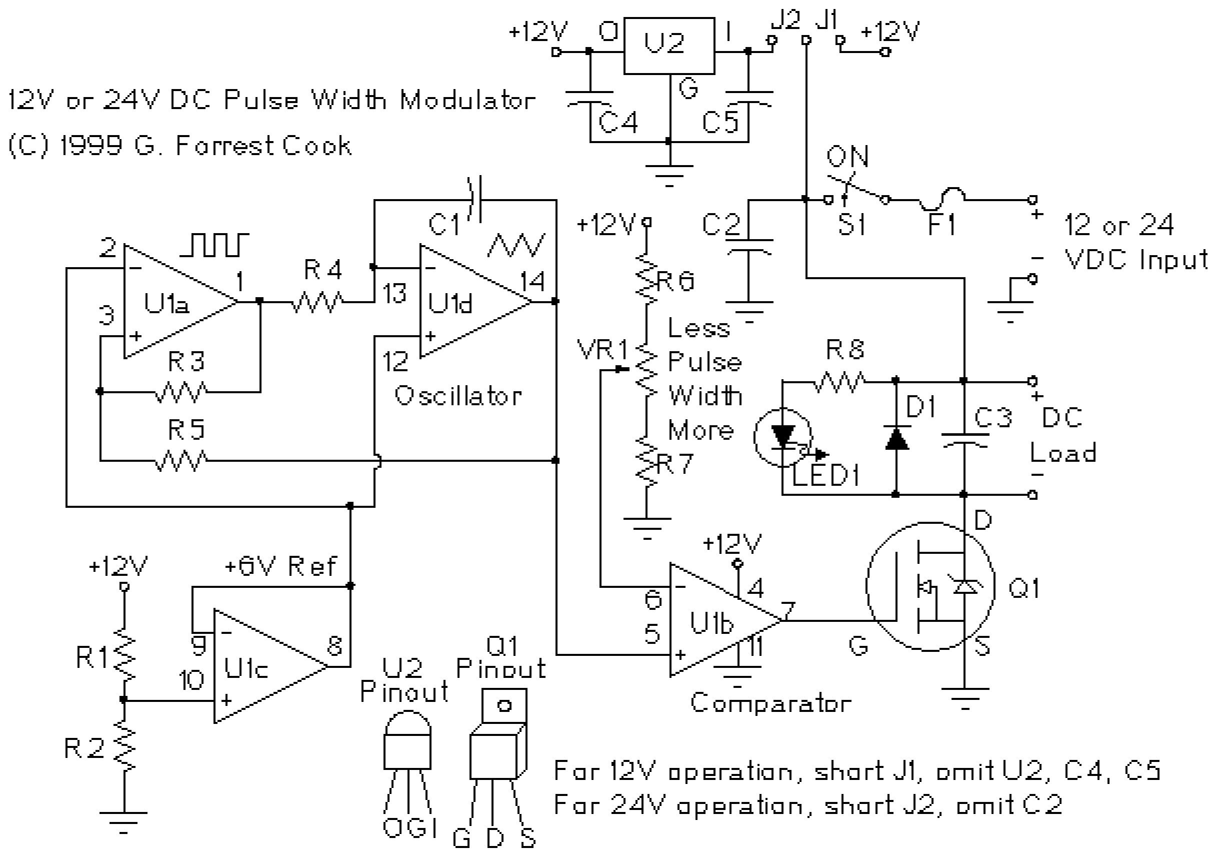

Fig No.2.2(e) Circuit dig. of motor driver

2.3 Main Frame Material Selection

A general market survey was done and the frame is manufactured using cast iron because Cast iron is a group of iron-carbon alloys with a carbon content greater than 2%. Its usefulness derives from its relatively low melting temperature. The alloy constituents affect its colour when fractured, white cast iron has carbide impurities which allow cracks to pass straight through, grey cast iron has graphite flakes which deflect a passing crack and initiate countless new cracks as the material breaks, ductile cast iron which stops the crack from further progressing due to their spherical graphite "nodules".

Fig No. 2.3(f) Assembling of front wheels into the frame along with shock absorber

Fig. No 2.4(g) Final assembly of Two-Wheeler Series Hybrid Vehicle

2.4 Test Run Results

Weight of the vehicle=35kg with generator

Total weight of the weight including test weight=75+35=110kg

Maximum test speed:-25 km/hr

Maximum run time on batteries:-1 hour

Maximum distance travelled using only electric mode: - 20km

Generator maximum power:-600watt

Theoretically we can use a 600watt motor which can increase the vehicle speed up to 55kmph

With 600watt motor

Maximum runtime of the vehicle with 600watt motor 30 minutes

Maximum speed 55kmph

Generator run time on fuel:-3-4hour/litre of gasoline

Fuel economy of the vehicle:-150km/litre

2.5 Performance Evaluation

On the basis of performed tests and confirmation run of the vehicle

Fuel efficiency on current system (300watt motor) =70km/l

Maximum run time of generator=5 hour, 3hour/litre of fuel

Maximum rated power of the motor=300watt

Motor that can be used=600watt

Performance is evaluated using the run tests and input parameters the vehicle has a rated power of 300 watt and can carry a 75kg person

3. Conclusions

A hybrid vehicle uses two or more distinct types of power, such as internal combustion engine+electric motor e.g. in diesel-electric trains using diesel engines and electricity from overhead lines, and submarines that use diesels when surfaced and batteries when submerged. Other means to store energy include pressurized fluid, in hydraulic hybrids. n a series hybrid, the electric motor is the only means of providing power to the wheels. The motor receives electric power from either the battery pack or from a generator run by a gasoline engine. In two-wheeler series hybrid. Gasoline engine in series hybrid tends to be smaller and more efficient since they do not directly power the vehicle and are not subjected to highly variable power demands of stop and go driving. As this hybrid vehicle emits 50% less emission than normal vehicle it plays an important role for reducing pollution to certain extent without compromising with efficiency.

4. Scope of Future Work

Around 93% of today's automobiles run on petroleum based product, which are estimated to be depleted by 2050. Moreover, current automobiles utilize only 25% of the energy released from petroleum and rest is wasted into the atmosphere. Series-hybrids can also be fitted with a super capacitor or a flywheel to store regenerative braking energy, which can improve efficiency by clawing back energy that otherwise would be lost being dissipated via heat through the braking system. Because a series-hybrid omits a mechanical link between the combustion engine and the wheels, the engine can be run at a constant and efficient rate even as the vehicle changes speed, the engine can thus maintain an efficiency closer to the theoretical limit.

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