RESEARCH ARTICLE OPEN ACCESS

Modification and Analysis in design of series hybrid vehicle

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ABSTRACT
The main objective of this paper is to some reformation in series hybrid vehicles. Fundamentally, in series hybrid vehicles having 2 or 3 cylinder engine to evaluating energy but this research insert only one cylinder engine and having lower CC that use for generating electricity and having 2 batteries to increase efficiency of the vehicle. When 1st battery is used for supplying power that time 2nd battery is under charging condition by the alternator and when 1st is under dead condition then power is cut-off from 2nd battery and that battery is used for moving motor. This paper is focus on to commute in scale and amount of fuel that using in engine. Also, the charging system is faster compare to available design of hybrid.
Keywords: Engine, Alternator, Super-fast charging system, Motor

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Date of Submission: 31-08-2017 Date of acceptance: 14-08-2017

I. INTRODUCTION

The environment effect is raises day by day and that affects global warming by gasoline engine cars. While the future of the harmonious environment needed for continual existence of humankind is under a tremendous threat, continuous effort is going on to replace all the consumer product and technologies with more environment friendly technologies. Deter that effect will design hybrid vehicle. In hybrid vehicles there are two different types of vehicles:

1. Parallel hybrid vehicles
2. Series hybrid vehicles

In a series hybrid system, the combustion engine drives an electric generator instead of directly driving the wheels. The generator both charges a battery and powers an electric motor that moves the vehicle. When large amount of power are required, the motor draws electricity from both the batteries and generators but in this system the ICE, the generator and electric motor are dimensioned to handle the full power of the vehicle. Therefore, the total weight, cost & size of the power train can excessive. Second problem is that power from the combustion engine has to run through both the generator and electric motors induction from the battery and also generator.

This paper will solve the problems by creating a new delineation. We can use the small 25 CC engine and that giving high rpm output to generate the electricity by alternator or dynamo. That generated electricity is using for only to charge the battery. Battery supplies electricity to the motor and motor will turned and help to moving vehicle.

The difference between series hybrid and according to this paper that actually differ cause in series design power supplied from generator to the direct traction motor and in high speed generator and battery both supplied electricity to the motor but in this paper the engine having only work to turn the alternator and alternator is only for charging the battery, no direct connection to the traction motor.

IMPORTANT FEATURES

The main feature we are used in this experiment is that Atkinson cycle engine - which is 2-stroke engine, permanent magnet motor (BLDC), Micro-converter and Micro-inverter, Alternator and lithium-ion batteries. This is the main organ or feature that create hybrid vehicle more efficient and low costly.

II. CONSTRUCTION & WORKING

According to this experiment, its topology is different compare to series hybrid design. The modification in hybrid vehicle there is engine that fitted for turn alternator. Alternator is connected with inverter to convert the power AC to DC & also alternator current passing through DC to DC converter. We have 2 batteries that attached with cut-out & voltage regulator and other end is connected with micro-controller to manage the power. Micro-controller control whole electric system and that power is transfer to the motor. We are using DC brushless motor, which attached with transmission system of the vehicle.

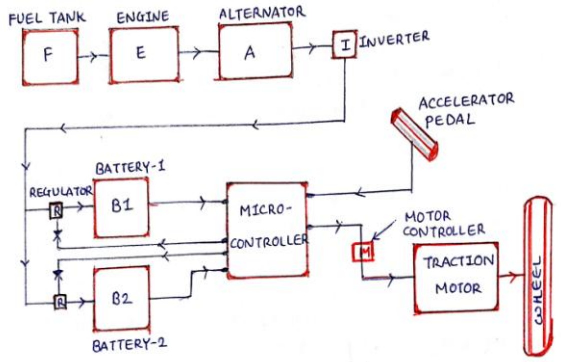

Fig: reformation of hybrid - block diagram

Above figure is indicating the concept and working of this paper. When the engine is started by the using of starter motor at that time the engine rolls over its idle speed and it will rotate 4000 RPM. Engine will transfer 4000 rpm to the alternator by belt-pulley. His gear ratio is kept as alternator moves around 4000 RPM the ratio is about 1:1 to produce high power ampere and for producing constant power and HP. If alternator required more RPM then we should be change in engine gear ratio. Alternator is used for generate electricity, electricity is in alternating current but then converted to direct current by the commutator and brushes. At 4000-5000 RPM alternator producing 100 ampere, if the voltage becomes low than we are using transformer to increasing voltage to give batteries.

The power of the alternator will be given to the battery so that it can be charged. Charging system is differing from other electric car or plug-in hybrid cars. There are two batteries will be fitted. When we need to move vehicle at that time suppose battery-1 is power supplying by micro-controller then battery-2 is under charging by the alternator and when battery-1 is about to discharge that time micro-controller is giving signal to cut-out relay or regulator to cut that power from battery-1, traction motor is running by battey-2 and at that time battery-1 is under charging process. Micro-controller is giving signals for discharge condition and regulator. The traction motor is running according to accelerator pedal. There is accelerator sensor that senses the movement of pedal after sensing signal adjusted by micro-controller and according to condition controller decided how much power required for traction motor.

III. COMPONENT ANALYSIS

3.1 Engine Analysis

In engine analysis, we tested emission test and efficiency analysis is given below:

3.1.1 Emission Analysis

Emission of carbon monoxide (CO), carbon dioxide (CO2) and hydro carbon (HC) are shown in figure 1, 2 & 3.

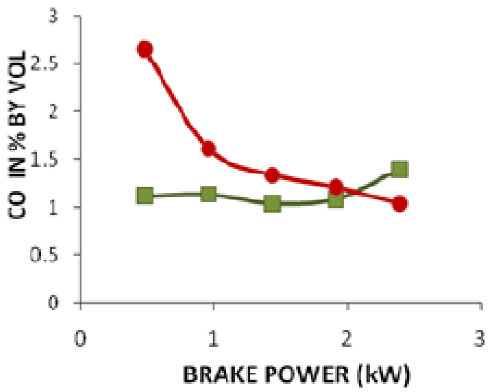

Fig.1 Brake Power Vs CO Emission

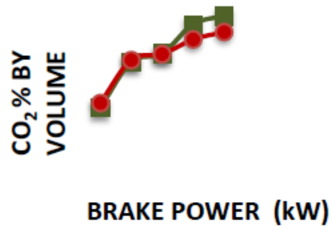

Fig.2 Brake Power Vs CO2 Emission

In a two-stroke engine, HC emissions will depend on how much fuel is short-circuited and also on the extent of combustion of the trapped fuel. Hence, in the case of retarded injection timing (even through a better trapping of the injected fuel can be expected) the HC levels are higher due to poor combustion because of insufficient time available for mixture formation.

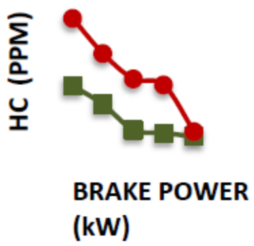

Fig.3 Brake Power Vs HC Emission

The CO level with direct injection is higher than with manifold injection because the trapped air and fuel mixture is richer. With lean mixture where almost all of the trapped fuel can be expected to burn as more fuel is trapped and the trapped mixture becomes richer.

3.1.2 Efficiency Analysis

Specific fuel consumption of Gasoline direct engine is 8.66% reduced, compared with conventional type. The advantage of low specific fuel consumption is, it increase the mileage and the variation is specific fuel consumption is show in figure 4. The variations in the indicated power are shown in figure 5. Mechanical efficiency of GDI engine is 13.5% better compared with the conventional type. The variation is shown in figure 6 and the brake thermal efficiency of GDI engine is 11.6% better. Indicating thermal efficiency of GDI engine is 12.02% Good then conventional type as shown in figure 7.

The gasoline direct injection engine provides improved torque and fulfils future emission requirements. GDI is simple to implement and can be retrofitted in two stroke engines. Fuel consumption was reduces by 15-20% higher torque 5-10% was produced.

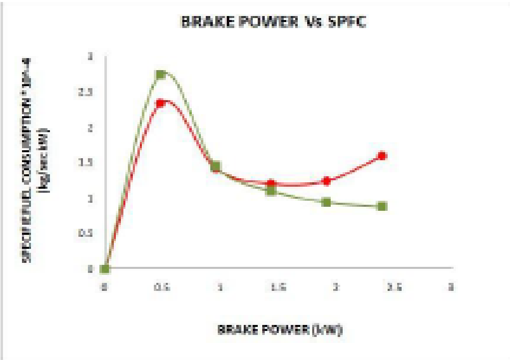

Fig. 4 Brake Power Vs SPFC

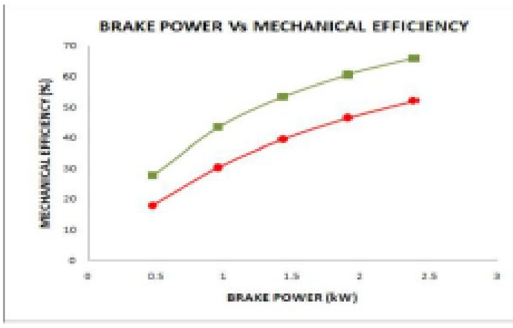

Fig. 5 Brake Power Vs Mechanical Efficiency

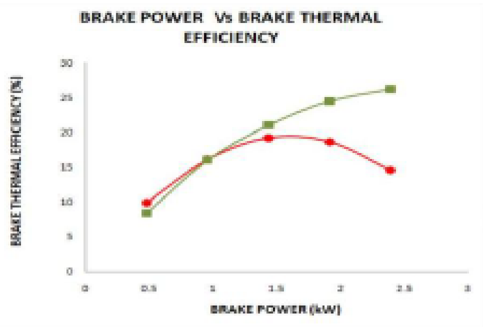

Fig. 6 Brake Power Vs Brake Thermal Efficiency

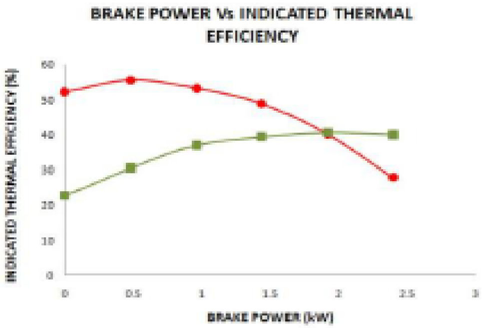

Fig.7 Brake Power Vs Indicated Thermal Efficiency

3.2 ALTERNATOR ANALYSIS

The alternator sizes commercially available for vehicular auxiliary power application have current rating typically in the range of 100-250A for 24V battery system. A 24V/110A model from Mastervolt GmbH was available and was selected for the analysis. The current rating usually has an impact on the size of battery bank to be employed. The rule-of-thumb for the dimensioning of the alternator and battery bank is that the alternator output equals 20-25% of the battery capacity. Foe a 110-Amp alternator considered for this work, a corresponding minimum battery capacity rating of 440-550Ah would be required. If other charging sources are also present e.g. a PV generator, the total charging current (alternator plus PV) is first determined, and then appropriate battery capacity is calculated using the same rule. In this particular case, however, the PV generator current contribution was considered less significant in comparison to the alternator charging current and was therefore not included in the calculation.

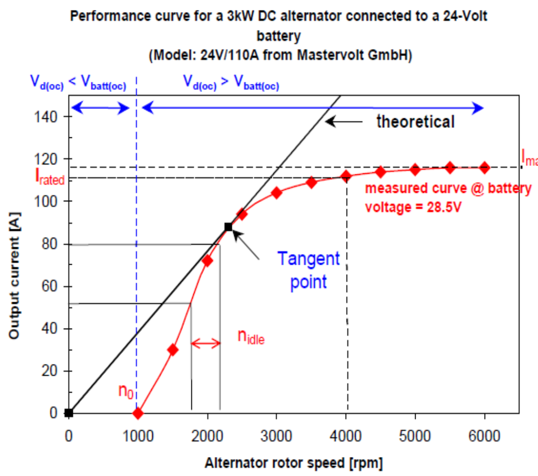

Fig.8 Performance curve for 3kW/28V DC alternator

The voltage generated by the alternator increases along with alternator speed and the excitation current. Theoretically, for a fully excited alternator unconnected to the battery or load, the unregulated voltage would increase linearly with alternator speed, that is, v = k f, for low-to medium speed (typically < 6000 rpm) where, v is the voltage, f is the frequency, and k is a constant, called machine constant as shown in figure. At high speeds, however, a point of saturation is reached whereby the voltage increase is very small for large speed increase due to losses (iron core, copper and frictional losses). The alternator does not produce any current until the open circuit voltage Vd at the terminals of the rectifier is greater than the battery open circuit voltage Vb and this occurs at an alternator rotor speed denoted by η in figure. The output current is low at engine idling speeds ~700 rpm corresponding to alternator rotor speed, η = 1800-2100 rpm when a transmission ration of about 3:1 is assumed. However, it increases tremendously and then levels off to almost maximum charging rate as soon as the vehicle attains cruising speed, which is normally in the range of 1300-2500 rpm for an omnibus or heavy-duty trucks.

3.3 Battery Analysis

DCFC (DC fast charging) equipment requires commercial grade 480-volt AC power service and its power requirement are approximately equal to 15 average size residential central air conditioning units. As a general rule, DCFC recharging will add approximately 80-100 miles of travel with 20-30 minutes of charging. The DCFC EVSE converts AC to DC within the EVSE equipment, bypassing the car's charger to provide high power DC directly to the PEV's traction batteries through the charging inlet on the vehicle. DCFCs are being deployed across the United States, typically in public or commercial settings. While the power supplied to PEVs by all DCFCs is standardized, there is not uniform agreement on the connector.

	Charge Time	Voltage/Amps	Power Equivalent	Installation
Level 1	Up to 20 hrs.	120/15	Toaster	Self
Level 2	Up to 7 hrs.	240/40	Clothes dryer	Professional
DC Fast Charge	Up to 30 min.	480/125	15 Central A.C.	Professional

3.4 Traction Motor Analysis

On the complete characteristic of motor we see that the maximum electric power is 34.77 kW and maximum torque is 340 Nm. Furthermore, we can see traces of braking torque acting on the motor for a given gear, the gearbox and engine speed. By combining full speed characteristics of the map we can determine the efficiency of an electric motor which works best and when it again.

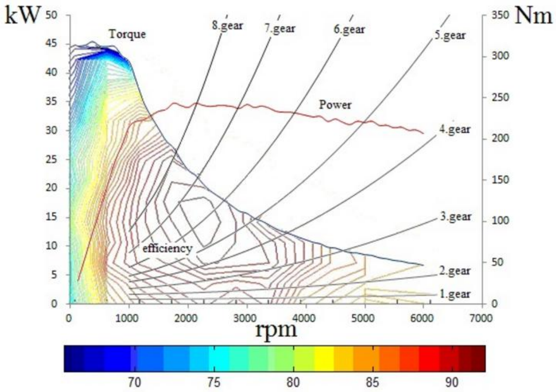

Fig. 9 Complete characteristic of motor with map of efficiency

Appropriate management cooperation combustion engine and electric motor can achieve the lowest fuel consumption, with the highest efficiency of the hybrid system. This means that for example when the internal combustion engine is operating with low load and very high fuel consumption, the control unit, as far as conditions permit, set the motor to the generator, thereby increasing the load on the internal combustion engine and thus the internal combustion engine to operate with less fuel a generator can recharge the battery.

IV. CONCLUSION

The Advantages of this concept is minimum fuel consumption by engine so fuel economy will be increasing and after that vehicle totally depends upon electric power. The weight of vehicle will also decrease and low frictions. Vehicle cabin space will be more. The limitation according to this research, there are no external charging system providing like electric vehicle charging system. If the alternator having a problem then whole charging system is stopped. The disadvantage of this is not a complete electric car even though a lot changes happen in the economy.

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International Journal of Engineering Research and Applications (IJERA) is **UGC approved** Journal with Sl. No. 4525, Journal no. 47088. Indexed in Cross Ref, Index Copernicus (ICV 80.82), NASA, Ads, Researcher Id Thomson Reuters, DOAJ.

Nikunj Anaghan. "Modification and Analysis in design of series hybrid vehicle." International Journal of Engineering Research and Applications (IJERA), vol. 7, no. 8, 2017, pp. 60–64.