Design and Analysis of Vehicle Drive Shaft Based Alternator

Jitendra Dnyandeo Shingate[1], Amit Dilip Thorat[2], Akash Hindurao Yadav[3], Prof Vaishali Burungale[4]

[1,2,3]Students, [4]Assistant Professor At SVPM's COE, Malegaon (BK)
Department of Electrical Engineering, Savitribai Phule Pune University.
SVPM's COE, Malegaon (Bk),
Baramati, India

***Abstract*: *The* aim of the paper is to design new system for charging of vehicle with the help of drive shaft based variable speed alternator. The alternator can harvest energy from vehicle momentum and store in battery. The stored energy of battery can be further used to drive the engine with the help of electric motor to improve vehicle performance. The design of vehicle drive shaft based alternator is most suitable for Hybrid vehicles with rear wheel drive system. The free running of vehicle can be utilized in efficient manner in this concept so the performance of Hybrid vehicles can be improved in efficient manner.**

Keywords: Hybrid Vehicle, Shaft Alternator.

I. INTRODUCTION

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current and voltage. But drive shaft based alternator is an automotive alternator built in rectifier circuit consisting of six diodes called Trio. In this project the 3 phase alternator is mounted on a vehicle drive (Shaft) in such a way that when vehicle moves at that time shaft of alternator also moves at same speed of drive shaft. When vehicle is moving at high speed and acceleration becomes zero at that time drive shaft based alternator is in operation and only at that time alternator gives us output power and that output power is further used to charge batteries with the help of charging circuitry. The design is most suitable for hybrid vehicles with rear wheel drive system.

II. DESIGN CONCEPT

A. REQUIREMENT FOR DRIVE SHAFT ALTERNATOR

For designing the drive shaft alternator we use automotive alternator which require speed above 1000rpm to generate electrical power.

B. MODEL OF DRIVE SHAFT ALTERNATOR

Alternator consists of electromagnetic field coil mounted on rotor and three-phase star connected armature winding mounted on stator.
Electrical power is conducted to the rotating field coil through a pair of copper slip rings mounted concentrically on the alternator shaft, connected by stationary brushes. The brushes are held in firm contact with the slip rings by spring tension.
And the regulator circuit also build-in. Which automatically switch battery power on and off to the rotor coil to regulate output voltage.

Fig.1 Shaft Based Alternator Arrangement in Vehicle

III. PRINCIPLE OF OPERATION

In our project, rotor is the rotary part which houses field winding and stator is stationary part which hoses armature winding. The automotive alternator is designed in such a way that the magnetic field strength can be controlled, in order to that output voltage may be controlled independently of rotor speed, because alternator is coupled in vehicle with the help of belt drive and the speed of engine was not constant. So as to make output voltage constant independent of rotor speed such arrangement is made in automotive alternators for battery charging purpose. In our project alternator is placed on vehicle drive shaft so speed is not constant but rotor speed and drive shaft speed was same at every time. And the rotor magnet coil (field winding) is energized by battery power so that it takes a small amount of electrical power input to alternator to get it to generate a lot of output power with the help of rotary motion of drive shaft.

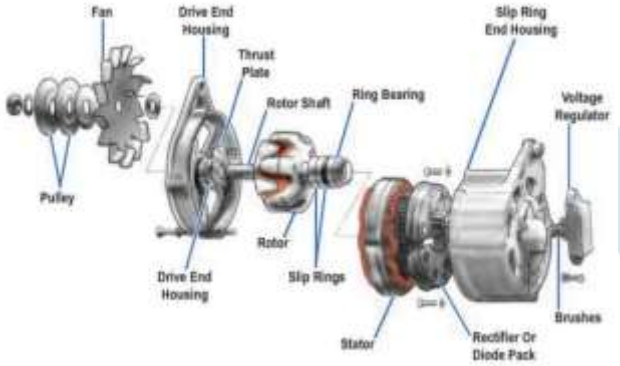

Fig.2 Component of Drive Shaft Alternator.

TABLE I SPECIFICATION OF DRIVE SHAFT ALTERNATOR

ACTUAL DESIGN OF PROJECT

Field Coil	12 V
Output Voltage	12V Constant 14.5V(Max)
Current rating	65 Amp (Max)

VII. CALCULATION

For testing and calculation purpose we test our car alternator first for checking standard output on a test setup. According to test setup results and shaft speed calculations of assumed vehicle the calculation table as follows.

We consider regular average speed of vehicle or car as 40km/hr. And vehicle running at 8 to 25Km/hr. in 2nd gear, 25 to 48Km/hr. in 3rd gear, 48 to 64Km/hr. in 4th gear and so on for next gears. According to this assumption we test shaft speed at various gears on which we are going to setup alternator.

TABLE II. GEAR, AVERAGE VEHICLE SPEED AND DRIVE SHAFT SPEED.

Sr No	Vehicle Gear	Average vehicle Speed (Km/hr.)	Drive shaft speed (rpm)
1	1	8 to 25	500
2	2	25 to 48	978
3	3	48 to 64	2156
4	4	64 Upward	3425

From above various speed conditions, we calculate output of alternator.

TABLE III. RESULT

The outputs of alternator are as shown in table below.

TABLE III. SPEED GENERATED VOLTAGE AND CURRENT

Sr No	Vehicle Gear	Shaft Speed (rpm)	O/p Voltage (Volt)	O/p Current (Amp)
1	1	500	14.2	0
2	2	978	14.2	0
3	3	2156	14.2	30 (Max)
4	4	3425	14.2	65 (Max)

The output voltage of alternator was constant irrespective to speed of alternator because constant voltage regulator is inbuilt in alternator to regulate output voltage constant but output current is not constant. The value of current is depending upon load which is connected to the load side of alternator.
The alternator gives constant output voltage above 1000rpm and the value of current is then totally depends upon load connected to alternator

Fig, Actual Project Assembly

IX. CONCLUSION

In this paper, we discussed about design concept and implementation of vehicle drive shaft based alternator. By using these, we can improve the performance of hybrid vehicles effectively.

REFERENCES

[1] Kamel Bouallaga, Abdel Moumen Darcherif, IEEE member EPMI-ECS [EA 3649] “A System for Charging of Dual Voltage Level Batteries in Automotive Applications,” 1-4244-0743-5/07 2007IEEE.
[2] Bharat Khushalani, Prem Alluri, Venkata Kasani, Jignesh Solanki, “Coordinated Charging Strategies for Plug-in Hybrid Electric Vehicles,” IEEE Conference 2017 North American Power Symposium (NAPS).
[3] Zhang Xiaoqin, Li Zhihong, Wang Baoling, “Performance Test and Data Acquisition of Voltage Regulator for Automotive Alternator,” December 2011 International conference on transportation, Mechanical, and Electrical Engineering (TMEE).
[4] F. B. Reiter, Kaushik Rajashekara, Ronald J. krefta, “ Salient Pole Generator for Belt-Driven Automotive Alternator Applications,” IEEE Industry Applications Conference 2001Vivek Kumar, Dr. Prakash Verma “Design And Fabrication Of Planetary Drive Magnet Pedal Power Hub-Dynamo ” September 2015.
[5] B. Asaei, S. Farhangi, “Intelligent Energy Managaement in aVehicle with Integrated Starter Alternator,” IEEE Conference 2007.
[6] SAM Electronics an L3 Communications Company, “Shaft Alternator System with PWM Frequency Converter for Ship Propulsion System,” www.sam-electronics.de