

Design and Fabrication of Modified Gear Train system – A Semi-automatic Hybrid Engine

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Abstract- The increasing demand for non-polluting vehicles has increased from past few years. The sources used for the automobiles are in the stage of extinction so there must be a system which could combine both exhaustible and inexhaustible resources so that there will be a proper balance between the use of them. This system includes both mechanical as well as electrical components which combines in the proper proportion based on the use for a particular automobile during the initial stage the IC Engine is used to run or move the vehicle so that a good torque is achieved and at higher gears vehicle moves with the help of the electric DC Motor where the requirement of the torque is less and speed is more. Hence efficiency could be increased and also emission could be decreased.

Index Terms- Automobile, Efficiency, Hybrid Vehicles, Non-Polluting Vehicles.

I. INTRODUCTION

IC Engine is internal combustion engine where fuel is feed with air into the combustion chamber .when an IC engine is combined with an electric motor it is termed as hybrid vehicle or technology. Where both IC Engine as well as the motor supports for the vehicle propulsion .this hybrid technology was invented long back but came into existence in the recent 10 years in India. Due to growth in transport sector and increased demand of fuel this type of system came into existence. The need for fuel efficient vehicles is most important in country like India with huge population and to conserve resources and to control emission. Hybrid engine is a combination of both IC engine as well as electric motor. Increase in pollution and depletion of fossil fuels have led to higher demand for hybrid vehicles. A combination of both IC engine as well as electric motor is seen as a solution for a short term [1]. Due to environmental issues and the needs for greener

vehicles and reduction in the consumption of fossil fuels there is a huge need for electric and hybrid electric vehicles [6].The effort in the recent past has been towards creating an improvised propulsion system [4]. Encouraging people to use hybrid vehicles can in turn help in reduction of cost and emissions [8]. Due to the favorable advantages such as fuel efficiency and drivability due to optimal operation while compared to the conventional vehicles hybrid vehicles are described as the future vehicles [10].EV's has also been introduced in the past, It may be self contained with the battery or a generator .in the 21st century due to technological development and strict emission norms electric vehicles saw a comeback. It works with electric motor for which the power is supplied from the battery. The rising oil prices and the need of reducing green house gases emission has popularized the use of electric vehicles, but it could not rule the market as it would not support for the IC engine and original equipment manufacturers. Hybrid will have advantages over this as Hybrid can be used either for diesel or petrol engines. it uses regenerative braking ,start or stop system ,dual power sources to increase efficiency and to reduce emission .

II. OBJECTIVES

The main aim of this type of system is to avoid over utilization of non renewable energy sources. The usage of hybrid vehicles means the utilization of motor with engine which reduces the use of non renewable energy sources which are in the verge of extinction.

The comparison of the performance of the normal IC engine with the modified system is also done. first the performance of a normal engine is tested and the

results is compared with results obtained from the modified system.

Imparting this technology to light duty vehicles, since most of the commercial vehicles run on diesel the fuel consumption and emission is supposedly more with the introduction of this type of system the utilization of fuel as well as emission is comparatively low. This system can be used basically for delivery vans or mail vans for shorter distance.

Improvising the overall fuel efficiency of the vehicle by the introduction of this system since only the first two gears need fuel the rest run by a motor so the fuel efficiency of the vehicle is increased

Minimizing the pollution or hazardous gases like CO₂, CO, As the use of petrol or diesel may involve the production of harmful pollutants like carbon monoxide and carbon dioxide this system not only reduces the pollution but provides the same functions as that of a normal IC engine

III. METHODOLOGY

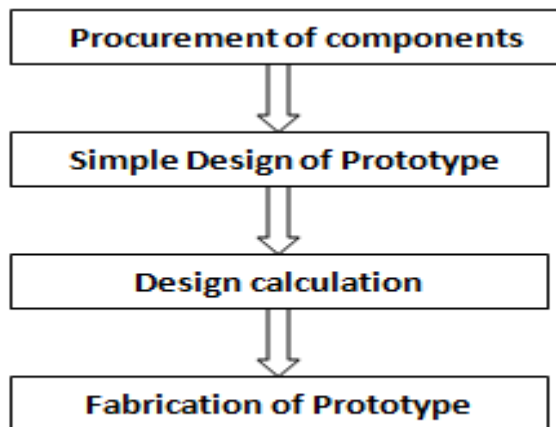


Fig. 1: Methodology

Procurement of IC Engines: A basic internal combustion engine of about 98cc is taken for this prototype. i.e. Of two wheeler vehicle. Where the engine is removed from the vehicle or separated.

Simple Design of Prototype: A simple design sketch made to place the components in correct position.

Design Calculation: Gear ratio for specific gears must be calculated and even timing must be checked to shift the IC engine to motor and vice versa.

Fabrication of the Prototype: First a basement for engine is made. The casing of engine clutch and gearbox is opened from both sides. The multi-plate

clutch is removed. The gear pinion is soldered for when reaching third gear and arrangement for wire to be bought in also made. The wire is placed and is given to negative terminal and the casing is closed. The motor is fixed with a stand above the engine and it is connected to the output shaft with the help of the chain. Throttle for both engine as well as motor is set.

IV. WORKING

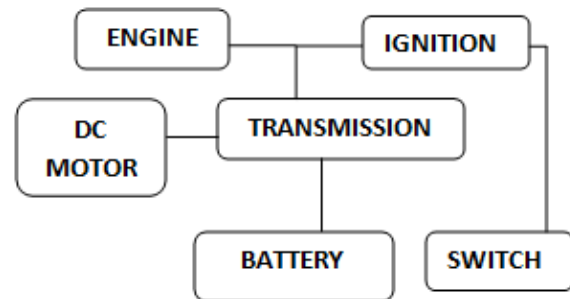


Fig. 2: Working Principle

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There are two stages in this system. The following are the stages involved:

- Working By IC Engine.
- Working By DC Motor.

In this system it is combined work of both IC engine and DC Motor which is arranged for a purpose. In the first gear the IC engine or the vehicle runs with the fuel and even in the second gear there is no change made when the third gear is applied, the ignition is cut off and the motor starts working this is achieved by making a arrangement in the pinion gear where when third gear is applied it closes the circuit for the motor and a switch is fixed to the ignition or the CDI to turn it on and off.

V. DESIGN AND CALCULATION

Calculation of Gear Ratio: Gear Ratio is the ratio of the number of turns the output shaft makes when the input shaft turns once. It is defined as the ratio of driven gear by driver gear. The gear used here is for the transmission of power from DC Motor to output shaft. The Gear is selected based on the no of teeth's required for the transmission of power from motor to wheels.

$$\text{GEAR RATIO} = \frac{\text{DRIVEN}}{\text{DRIVER}}$$

Table 1: Calculated gear ratio

| Gears | Gear Ratio |
|--------|------------|
| Driver | 1 |
| Driven | 1 |

VI. FABRICATION

PMDC Motor: A 500 watt PMDC motor 24V is used in this system. As soon as the third gear is shifted the motor switches on and when the first gear is shifted to again then the motor switches off.



Fig. 3: PMDC Motor

Potentiometer: This device is used to control the speed of the DC Motor. This is three terminal resistors with a sliding or rotating contacts that for an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat. A potentiometer of resistance 4.7K-ohms is used



Fig. 4: Potentiometer

Lead Acid Battery: The battery is used to power the motor or run the motor. A 12V battery is used in this system.

Engine: An Engine with displacement of 100cc which will be able to produce 7.3 PS power which will be able to provide the initial torque for the system.



Fig. 5: Engine

Gear: The gear is used to transfer the power from the dc motor to output shaft. The spur gear used consists of 14 teeth's.

Switch: The switch mechanism is a controller which switches on and off the ignition when the motor is switched on and off.

Fabrication includes the procurement, modification and assembling of components in a proper way according to the planned design. Using trial and error method the motor is fixed in such a way that there is no power loss. The switch is placed between ignition and the motor so that automatic cutoff of ignition takes place when the third gear is applied.



Fig. 6: Fabricated Model

VI. RESULTS AND DISCUSSION

Results: The fuel is not used in third gear since it runs through the DC motor and most of the fuel is saved. Since it is a higher gear we probably shift to higher gear after gaining some speed.

- The DC motor switches on immediately after when the third gear is applied, there is no delay in it. As we can see in the timing check it switches on at 0.99 seconds which is quite a good response and it may also depend on the rider.

- Battery could be simultaneously charged by the alternator or a dynamo if the arrangement is made for it and can also attain maximum range.
- Combustion will not be taking in the third gear or the higher gear there so there will be no emission or pollution, since the ignition will be cut off from the engine in third gear.
- Noise will also be reduced in some amount and also it would be a electric vehicle in higher gears

Discussions: This type of modifications can bring change in modern vehicles and also day today life .since it fully does not use the IC engine it saves fuel and also reduces emission by one side .this type of system can be used in low load carrying vehicles from two-wheeler to four-wheeler depending upon the use. The rising cost of fuel and increased emission standards this type of system can bring a great advantage to automakers as well as the customers. Since roads are getting better both in rural and urban areas the speed which can be achieved to a vehicle as fast as to get in to higher gear also increases .lower gear may give torque which will be sufficient to the vehicle to move forward and later after attaining certain speed torque may not be required as full as much, where speed will be an important factor. Increasing fuel efficiency and lower emissions would be a great factor for achieving this. There are types of hybrid vehicle technology known but they are not efficient and cost effective so need for the good and effective technology to support both manufacturers and customers. EV's don't have a longer range but when this system is used the vehicles will have a longer range for travel and immediate refilling is not required or even refill stations are not required everywhere.

VII. CONCLUSION AND FUTURE SCOPE

The conclusion of the project is that many new technologies and innovations are going on and are also introduced but we have made it to a different arrangement of both engine and the electric motor .The arrangement for torque, speed and efficiency and also emission norm purposes. These types of systems are made but don't find that much efficient when compared. It takes years to adopt for a new technology in country like India but this type of

systems can be a major advantage in adopting because with the available systems used currently we have just modified it. The works are made physically and some type of deletion and addition have been taken place to achieve the aim .additional functions may have included like automatic switches and display for the indication of the shifting of gears and motor.

Increasing demand of fuel day by day tends to end the reserve fuels also, so it would be a better option in the future. When an IC Engine vehicle is compared with this system, These types of system are better in terms of less pollution. In future this type of system may come in to use because we cannot completely eliminate IC engines. R&D on this type of field would be a good field of research, Consumption of fuel for a particular vehicle would be less in this case. This system can be incorporated into LCV but this system can solve the problem of range using a normal electric commercial vehicle since this system includes an IC engine and the required torque can be obtained since it is the most important thing for an LCV. The initial pickup and torque can be obtained from the engine in the first two gears and the rest speed will be managed by the DC motor.

REFERENCES

- [1] Amin Paykani and Mohammad Taghi Shervani-Tabar "A comparative study of hybrid electric vehicle fuel consumption over diverse driving cycles", Theoretical & applied mechanics letters 1, 052005 (2011).
- [2] Mrs. Madhwi Kumari Dr. P. R. Thakura "Design and Estimation of Drive Train Components of Hybrid Electric Vehicle HEV", Research gate (2014).
- [3] Khwaja M. Rahman and Hamid A. Toliyat "Propulsion System Design of Electric and Hybrid Vehicles Due to environmental issues", IEEE transactions on industrial electronics, VOL. 44, NO. 1,(1997).
- [4] Ram teen Sioshansiand Paul Denholm "Emissions Impacts and Benefits of Plug-in Hybrid Electric Vehicles and Vehicle to Grid Plug in hybrid vehicles (PHEV)"
- [5] P. Sivakumar, Rajaseeli Reginald et al "Configuration Study of Hybrid Electric Power

- Pack for Tracked Combat Vehicles” Defence Science Journal, Vol. 67, No. 4, (2017).
- [6] Yoon, s. j. Kim and k.-s. Kim “Conceptual design of economic hybrid vehicle system using clutch less geared smart transmissions”, International Journal of Automotive Technology, Vol. 14, No. 5, pp. 779–784 (2013).
- [7] Trushar soni “Hybrid Electric Vehicle”, IOSR Journal of Mechanical and Civil Engineering volume 12, Issue 2 Ver. VI (2015).
- [8] C Reynolds¹ and M Kandlikar “how hybrid-electric vehicles are different from conventional vehicles”, Environment Research Letter 2 014003(2007).
- [9] Ettore Pennestri. Lorenzo Mariti et al “Efficiency evaluation of gearboxes for parallel hybrid vehicles” Mechanism and Machine Theory 49 157–176(2012)
- [10] Asllan Hajderi, Stavri Paco “Hybrid vehicles and their impact on pollution reduction in urban area” Interdisciplinary Journal of Research and Development Vol (IV), No.2, (2017)