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CONVERTION OF EXISTING INTERNAL COMBUSTION ENGINES TO ELECTRICAL ENGINES - A VIEW

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Abstract

The availability of electric energy as motive energy in motor vehicles, the eco-friendliness and the contribution of the economy increases the interest in electric vehicles. There is no harmful gas release due to motor vehicles working with electricity. Therefore, it is possible to convert the vehicles into electric energy and to use them in an environmentally friendly and economical way due to the environmental pollution caused by harmful emissions resulting from high fuel consumption and low combustion efficiency in internal combustion motor vehicles. In addition, if the internal combustion engine vehicle is converted to electricity, noise pollution will not occur. The fact that electric vehicles do not need any maintenance other than mechanically brakes and tires will make the use economical and advantageous. The electric vehicle can be used in people and freight transport, in factories, anywhere where there is a passenger. If the world is thought to be able to reduce the use of gasoline and diesel-powered vehicles in the future, the prospect of converting internal combustion motor vehicles to electric vehicles will be greater.

Keywords: Internal Combustion Vehicles, Electrical Vehicles, Conversation, Battery

Introduction

In the harmful gases that pollute the environment and are thrown into the atmosphere; 65% of vehicle carbon monoxide, 55% of nitrogen oxides and 45% of hydro carbons are caused by exhaust emissions of electrical vehicles. These emissions are serious hazards to human health. Electric vehicles are preferred and recommended for use in electrical vehicles for the end of consumption of fossil fuels that cause these harmful effects for the environment and human beings. The manufacturers have increased the prospects and projects for electrical vehicles. Electric energy can be produced from fuels that generate carbon emissions to the environment, such as coal, natural gas and oil, as well as natural energy sources that do not release carbon emissions to the environment such as wind energy and solar energy. In terms of human and environmental health, it is necessary to convert internal combustion motor vehicles to electric vehicles and it is important that electric vehicles use natural resources as electricity.The main disadvantage of Electric Vehicle is the lack of capability of storing sufficient energy to run the vehicle for a long time. The energy storage capacity of battery used in electric vehicle is very low compare to conventional fuels used in modern automobiles.

The operation, performance and efficiency of motor driven electric vehicles are much better than engine driven vehicles, at the same time electric vehicles are very much environment friendly. Still electric vehicles are falling behind in the automobile industries due to the problem of storage of energy [1].

Electrical Vehicles

Electrical vehicles are hibrit elektrikli araçlar, yakıt hücreli elektrikli araçlar ve tam elektrikli araçlardır. The electric vehicle has been around for over 100 years, and it has an interesting history of development that continues to the present. France and England were the first nations to develop the electric vehicle in the late 1800s. It was not until 1895 that Americans began to devote attention to electric vehicles. Many innovations followed and interest in motor vehicles increased greatly in the late 1890s and early 1900s. In 1897 the first commercial application was established as a fleet of New York City taxis. The early electric vehicles, such as the 1902 Wood's Phaeton (Fig.1), were little more than electrified horse less vehicle riages and surreys.

Fig. 1. 1902 Wood’s Electric Phaeto (1)

Since the invention of electric vehicle, it has been developed till date. Despite this fact, the major challenge which is their short driving range still exists. Fig. 2 shows 1902 Wood’s Electric Phaeto Typical 2011 Model of Electric Vehicle .

Fig. 2 Typical 2011 Model of Electrical Vehicle (1)

Electrical vehicle driving system is made up of three main parts; namely, the motor, the controller and the battery [2].

Electric motor

The motor (Fig. 3) is the most important part of the vehicle; it is the part responsible for the propelling of the vehicle.There are three different types of electric motors; these include, DC wound, Permanent magnet DC and AC motor.

Fig. 3. Electrical Vehicle Motor (2)

Motor life is prolonged when the direct current motor is brushless. The electric motor used in the operation is a brushless direct current (DC) motive. In addition, economical factors have been taken into account when choosing engines. The following formula (1) is used in torque, speed and power calculations used in DC motors [3].

In Eq. (1) ; T shows torque [Nm], P power [kW], and n revolutions [1 / min]. The motor used is 1600 1/min and maximum power is 5 kW. In this case, the torque of the motor is calculated as 29.8 Nm in equation (1). In DC motors, the torque produced by the motor is constant at all revolutions. Figure 4 shows the relationship between engine revolutions and torque. This relationship is also between motor power and torque. The torque is constant even though the engine power varies.

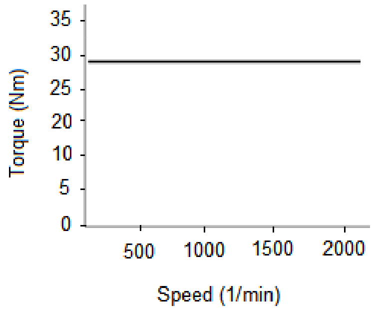

Fig. 4. Engine Speed-torque diagram

The power change according to the value of n of the electric motor is shown in Fig.5. The control of the motor is vehicleried out by controlling the voltage and current of the drive motor. In this study, a DC motor with a voltage of 41 V was selected. The higher the voltage of the motor to be selected, the smaller the size and weight and the lower the cost. The 5 kW engine in the city needs in city for a vehicle weighing a ton.

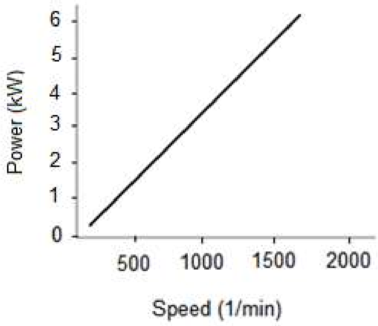

Fig. 5. Engine Speed-power diagram

Battery

The number two major component of electric vehicle parts is the battery (Fig. 6). While some vehicles would use the standard vehicle batteries as a source of energy, the more advanced ones use the Lion batteries as more efficient energy source that gives extra range of operation for the vehicle. They require less time to be charged and provide more energy for the motor attached.

Fig. 6. LiFePO4 Battery Pack (24 V-300 AH) (2)

Batteries today have different characteristics. They are preferred according to various properties such as power, location, life, and cost. Li-ion or NiMH batteries are used if a conversion is required, lead acid batteries are used when an economical battery is to be purchased. Here, 4 batteries are connected in series (12 V 120 Ah) to obtain 48 V 120 Ah electrical energy. In Equation (2), the voltage value required for the motor is calculated.

$$W = I.U \quad (watt) \qquad (2)$$

(2) equation gives W power (watt), I current (amper) and U voltage (voltage). The electric motor is connected in series to obtain the required voltage value for the motor. The more voltage the engine needs, the more the battery number increases proportionally. Generally a serial connection is made in the pouches in 6 V or 12 V packages. It's the current value that flows through these connections in the hour. is the same as the current value given by the system at the time, only the voltage is increasing. For example, in a series connection with a 60 Ah capacitor, the current value is 60 Ah, only the voltage increases. Figure 7 shows 4 batteries with 12V each connected in series [4] .

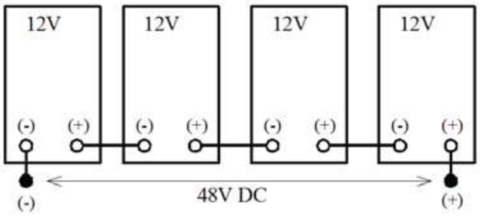

Fig. 7. Serial Connected 48 V 60 Ah batteries (3)

Controller

The third part of the electric vehicle parts is the controller (Fig. 8). This part is responsible for power management; it senses the amount of energy needed by the motor and supplies it directly from the batteries in order to get the vehicle moving. The controller is very important because it synchronizes the operation of both the motor and the battery [5].

Fig. 8. Electrical Vehicle Controller (3)

Electric Vehicle Charging

Batteries are charged with constant current, constant voltage and constant current-constant voltage. When charging with constant current, the voltage is increased over time and the current is kept constant. Such chargers may overheat and overcharge during charging. NiMH batteries are charged by constant current. In this work, a charger with a constant voltage of 48 V 35 A is used to charge the vehicle that is converted to electricity. This charger has separate input and output current fuses. There are two control buttons which can be adjusted coarse and fine current. This charger weighs 20 kg is not installed by hand and is connected to this device when the vehicle is being charged. It is a charger with short circuit protection and current cutoff characteristics when charging is finished. Electrical vehicle chargers are responsible for charging the battery pack in an electric vehicle. These chargers are installed in homes, offices, shopping stores and public places to enable one to charge his/her vehicle. Fully charging an electric vehicle can take 6–8 hours. Electrical vehicle chargers are responsible for charging the battery pack in an electrical vehicle. These chargers are installed in homes, offices, shopping stores and public places to enable one to charge his/her vehicle. Fully charging an electric vehicle can take 6–8 hours [6].

Gas pedal

Unlike conventional gas pedals, there is a set resistance (potentiometer). The electronic driver is a circuit element that provides control of the unit. The driver works from zero to a certain resistance value or vice versa, depending on the nature of the drive [7]. The gas used in operation has a potentiometer in the range of 0-5 kΩ. At 0-5 kΩ the drive cuts off the electric current. From 0 Ω to 5 kΩ, the drive increasingly permits electrical flow. When the resistance rises above 5 kΩ, the drive keeps the voltage of the electrical constant at 48 volts. Some electric vehicles have a switch on and off under the gas pedals. When the accelerator pedal is depressed, the potentiometer opens or closes the circuit. Since the driver circuit used in the operation also fulfills the task of this switch, the use of the switch with gas pedal is not needed. Figure 9 shows the voltage value set by the changing driver with the resistance value of the accelerator pedal.

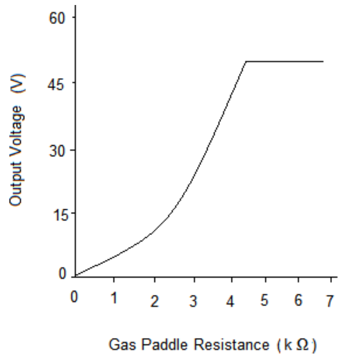

Fig. 9. Changed Driver Voltage Due to Gas Paddle Resistance

Clunker Vehicles

Most of the internal combustion engine vehicles are abandoned without being used for reasons such as excessive fuel consumption, noise pollution, accidental states, etc., and are withdrawn from traffic every year. This situation causes vehicle junkets to be filled with many vehicles. Manufacturers of vehicles give a ten-year warranty against chassis and bonnet rotting. Therefore, many of these vehicles are drawn into clunker vehicle parks before they complete the life of the chassis. In other words, they are left to rot in the vehicle cemeteries. Vehicles that are pulled out of traffic and left to rot cause environmental pollution in areas where they are located. over time, they rust into the soil, damage the environment, and lose their ability to be restored. In other words, every area has a loss. Image pollution occurs in areas where clunker vehicles are located, reducing city dignity, prestige and living standards. Every vehicle left to rot is national wealth. For this reason, it is necessary to reintroduce clunker vehicles into the system. These vehicles, which are separated from the rest, need to be converted to electricity and used again and earned an economy. Thus, the components of electric vehicles are produced and developed in the country [8]. In Fig.10 shows, the work carried out here shows that the Fıat 126 BIS model, purchased from the scrap yard, a- accidently state b- repaired state c- state of taken of electrical motor vehicle .

a) accidently vehicle b) Repaired vehicle c) Taken of electrical motor vehicle

Fig.10. Experimental Vehicle

Conversion

The conversion of internal combustion motor vehicles into electrical vehicles is done in two ways. Conversion without internal combustion engine removal and conversion from internal combustion engine. Here, the transformer was chosen to be a full electric vehicle and the internal combustion engine, clutch and gearbox were removed from the vehicle. The vehicle is rear-wheel-drive and the engine is located under the passenger cabin. If the vehicle is intended to be a hybrid electric vehicle conversion, it will not be necessary to remove the internal combustion engine and motion transmission organs. With the dismantling process, the weight of the vehicle has been significantly reduced thanks to the engine and brooms removed from the vehicle. The conversion process is divided into mechanical conversion and electronic conversion: mechanical conversion; electric motor, coupling, shaft and differential. Only by adding a shaft between the motor and the differential, motion transmission is provided [9]. Figure 11 shows the electric drive motor and other mechatronic elements connection.

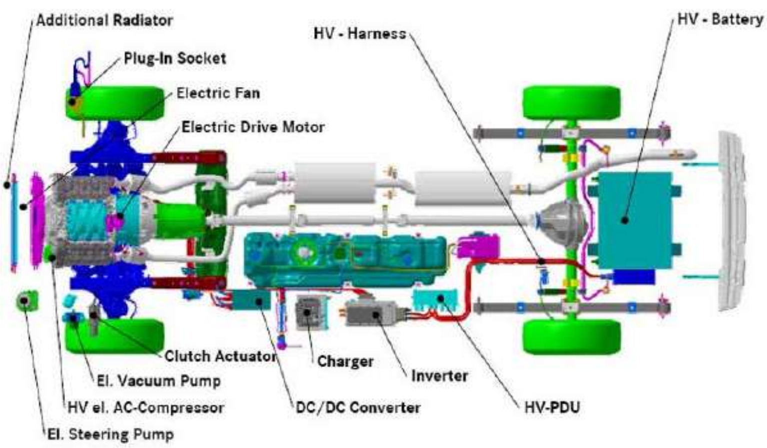

Fig.11. Electric Motor and mechatronic elements (4)

The closer the electric motor is placed to the differential, the smaller the shaft size will be. The maximum revolution of the electric motor is 1600 1 / min. The output torque of the electric motor is calculated as 29.8 Nm. In addition, the tire diameter is 0.45 m. Based on these data, the speed of the vehicle was calculated by equation (3) and found to be 31 km / h. The values obtained with the theoretical speed are overlapped [10].

$$\boldsymbol{V} = \frac{\boldsymbol{n.\pi.R.60}}{\boldsymbol{i.1000}} \quad (km / h) \tag{3}$$

Equation (3) is the speed of vehicle V km / h, speed [1 / min], the rate of differential rotation i and the radius R of tire R [m]. Prior to the conversion, the internal combustion engine had a mass of 1100 kg, while the vehicle's engine, motion transmission and exhaust were removed and a 45 kg electric motor was installed. The total weight of the vehicletridges, each 30 kg, is 120 kg. The weight of the next vehicle converted to electricity was 710 kg. The output torque of the motor is 29.8 Nm and the differential conversion ratio is 5. The load vehiclerying capacity of the vehicle was tested with 800 kg, and no decline in speed and traction was observed. It may be possible to increase the speed of the vehicle by placing a speed reducer between the electric motor and the differential; but the gearbox is not used in order to prevent the torque from decreasing in the aim of the vehicle to be used.

Results and discussion

For the purpose of converting an internal combustion engine vehicle into an electric vehicle, the total capacity of the pylons is calculated as 5.78 kWh and the engine power is 5 kW. The values of the speed, speed, power and torque parameters obtained from the vehicle are shown in Table 1.

Table 1. Obtained Speed, Power and Torque Values of electrical Vehicle

Speed (1/min)	Velocity (km/h)	Power (kW)	Torque (Nm)
900	19,43	2,64	129,1
1000	20,89	2,75	129,1
1100	21,95	2,81	129,1
1200	23,34	3,16	129,1
1300	25,64	3,54	129,1
1400	28,93	3,91	129,1
1500	31,02	4,02	129,1
1600	33,55	4,06	129,1

Assuming that the vehicle travels at a velocity of 20,89 km / h, the power required by the vehicle is 2.75 kW. In this case, the cruising time is 2.5 hours. Assuming that the vehicle travels at a constant speed, the range is calculated as 50 km. If the vehicle is considered to travel at a constant speed of 31.02 km / h, then the power required by the vehicle is 4.02 kW. In this case, the duration of the cruise is 1.51 hours and the range is 48.9 km. In order to fill 5.78 kWh, about 5 kWh of electrical energy is needed together with the losses. It takes about 4 hours to fully charge the empty batteries with a charger of 35 A to 48 V. There is a battery status indicator to monitor the status of the vehicle's battery. This indicator provides information on the charge rate of the batteries over a voltage of the battery.

Conclusion

Here, a clunker vehicle was converted into an electrical vehicle. The electric vehicle reached a speed of 35 km / h and vehiclerieda load of 1100 kg in 45 minutes. There is no harmful gas release in this electrical vehicle. The vehicle can travel 51 km on the test drive thanks to the electric motor. As a result, the conversion of clunker vehicles to electricity due to environmental pollution resulting from harmful emissions in internal combustion motor vehicles will be an environmentally friendly and economic advantage. The damage to the surrounding area due to corrosion of the parts of the automobile parts will be prevented. Noise pollution will not occur due to the silent operation of the engine.

In addition, materials of clunker vehicles will be re-assessed and economy contribution will be provided. The lack of any mechanics other than brakes and tires will make it economical and advantageous to re-use old vehicles. The electrical vehicle, which is converted as an example in the study, can be used for conversion of people and goods, factories, anywhere with roads. Given the fact that countries will be constraining the use of gasoline and diesel-powered vehicles in the coming years, the prospect of converting internal combustion motor vehicles to electrical vehicles will increase even further. The most important issue is to leave the location of bicycle conversion or conversion services on campus areas to electrical bicycles or electrical vehicles.

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