



An overview of electric vehicle concepts and its features

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ABSTRACT: The production of electric cars dates back to 1900 AD, at that time, on the one hand, due to the problems that electric motors had. And on the other hand, the discovery of oil and its abundant production were not taken into account in the remarkable development of internal combustion engines for the construction of these cars. But with the emergence of world wars and conflicts over oil, this substance gained more value and attracted more attention to electric cars. And it was that since 1990, the production of electric cars was more seriously considered. Therefore, in this research, the introduction of the electric car, the characteristics of the electric car, the types of electric motors and the car's power transmission equipment were discussed.

KEYWORDS: electric car, electric motors, car power.

1. INTRODUCTION

The electric vehicle (EV) is not a new invention. The early years of production and construction of electric cars go back to 1900 AD, At that time, on the one hand, due to the problems that electric motors had And on the other hand, the new discovery of oil and its abundant production were not taken into account in the remarkable progress of the internal combustion engines of these cars. But with the emergence of world wars and conflicts over oil, this substance gained more value and attracted more attention to electric cars. And it was that since 1990, the production of electric cars was more seriously considered. In electric cars, the power supply system includes an electric motor, controller, batteries and charger. The electric drive system of an electric car has the task of converting the direct current produced by the battery into mechanical energy, which means all the parts that convert the direct current of the batteries into traction force and torque necessary for the wheels to move. One of the most important features of an electric car is the range and power of movement (acceleration, speed, incline, loading and flexibility), charging time and the high price of batteries in most existing electric cars. Due to the increasing development of the automobile industry and the mass production of internal combustion vehicles, which causes various problems such as air pollution Also, due to the limited and expensive fossil fuel reserves, research and design of electric vehicles has become one of the main programs of the automobile industry, especially in advanced European and American countries. In Iran, research has been done in this field in the last few years.

The most important features of electric cars are: range and power of movement (acceleration, speed, incline and loading and flexibility and charging time and high price of batteries, in most existing electric cars, the driving set consists of a controller (regulating member), motor Electric, gearbox with reducing ratio on the axles and distribution box for two or four wheels, other solutions are also used. For example, two engines with or without a gearbox. The stimulus set must satisfy many and varied demands, which are used as criteria for evaluating and comparing different solutions. For example, some of the most important criteria are: easy to use, high efficiency, low cost, high reliability, no need for service and maintenance, low weight, low construction volume. It should be noted that all these criteria cannot be gathered well in one stimulus set, so that generally high efficiency is opposed to low cost.

Review of previous research

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- Taghipour et al.[3], studied The Impact of ICT on Knowledge Sharing Obstacles in Knowledge Management Process (Including Case-Study).
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- Alamdar khoodaki et al.[6], studied Taghipour et al.[8], studied Effect of integrated marketing communication on brand value with the role of agency's reputation (including case study).
- Taghipour et al.[7], studied A Survey of BPL Technology and Feasibility of Its Application in Iran (Gilan Province).
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2. TYPES OF ELECTRIC MOTORS

Direct current electric motors

In this type of motors, the main current passes through the core coils, and causes the core to rotate and create a torque in it. The stator includes magnetic poles, The core includes the main shaft of the motor and several coils, each coil is connected to the next coil, And the current exists in all of them, of course, the type of connection of the coils to each other creates different properties that create different types of DC motors. Series, shunt, combination

(which is a combination of type 1 and 2), with permanent magnets, without brushes, comprehensive Direct current motors generally have a simple and cheap inverter circuit with very high capability and the speed of the motor can be controlled easily, high weight and volume, high price, complexity of construction, high repair and maintenance cost, low efficiency and the presence of a vacuum cleaner are some of the disadvantages of these motors. In engines without high maintenance, low efficiency and the existence of a brush are among the disadvantages of these engines, In the type of brushless motor where there is no brush, speed control is done easily and the motor has a high power density, this type of motor is used at high speeds, the volume of the motor is small and the noise is less compared to other motors. The engine and its high price.

Alternating current electric motors

AC current has good features, such as it can be easily transmitted at high voltages and with the presence of a transformer, the voltage value can be converted easily. The most important and most used AC motor is a rack motor. In this type of motor, the basis of which is like a moving transformer, the presence of current in the stator coil induces current in the core coil, so the forces resulting from the current field in the core cause it to rotate and Torque is produced. The most important features of the rack induction motor are as follows: There is no need for a sweeper or combator, it has the least necessary repairs, it is suitable for the workload in dirty environments, it has high reliability, it has high efficiency, it has high hardness and life, it has low cost, weight, volume and moment of inertia. Below, more explanations are given about the three types of alternating current motors that are considered for use in electric vehicles.

1- Synchronous or permanent magnet motors

In this type of motor, the power density is high, due to the control of the current and the stator field, more torque can be produced, there is no brush, and it can be used at high speeds and a wide range of speeds.

2- Three-phase induction motors

The construction of the motor is simple, this motor is light, resistant, compact, cheap and has high efficiency and does not need a brush.

3- Axial flux motors

Recently, Axial flux motors (Afm) or axial flux motors have also been made, which have two models of using the motor inside the car wheel (whell motor) or motors with two rotors and one stator in such a way that the motor is installed instead of the car differential. They can be. Of course, the last two motors require higher technology to make and use and have a higher price, but their efficiency and performance are better than induction and normal PMSM motors.

Batteries that can be used in electric cars

Capacity and amount of current are two characteristic factors of batteries. Capacity is the amount of energy stored in the battery and they depend on many factors, the most important of which are: The surface or physical size of the plates covered by the electrolyte, the weight and amount of material in the plates, the number of plates and the type of separator between them, the amount of electrolyte and its specific mass, battery age, cell conditions - the amount of sediment at the bottom of the cell, temperature, limit Low voltage, discharge rate. The capacity of the battery is determined in terms of ampere-hours, the current is another characteristic of the battery And it is in amperes, the amount of current determines the rate of energy when charging or discharging For example, for a 100 ampere-hour battery with a current of one ampere, the discharge time is 100 hours, and this battery is characterized by a current of 100/C. Perhaps the only weakness of the electric car is its batteries, due to the low energy density stored in the battery, a large number of batteries must be used, which increases its weight, and extra energy is consumed to carry this weight. And the mileage is less compared to combustion cars, Also, the charger of these batteries will take time, A high cost will also be spent on buying batteries If suitable batteries are made for cars that do not have the current problems, Of course, cars with internal combustion engines are left out., All kinds of chemical batteries are made, including lead-acid, nickel-cadmium, nickel-iron, nickel-manganese, sodium-sulfur and zinc-bromine batteries. Sodium-sulfur batteries have the highest energy density of about 150 Wh/kg. But they are explosive Lead-acid batteries have the lowest energy density of about 35 Wh/kg, But due to the good performance life of about 750 charging cycles, high reliability and reasonable price, they are used the most.

Electric energy storage system

Chemical batteries are usually used in electric cars, which are given below the general parameters and specifications of the batteries used in electric cars.

Full charge time

The charging time for different batteries is not the same and it depends on the type of battery and the way of charging. For lead-acid batteries it is 4-8 hours, li-ion is about 5 hours, Nimh is about 6-8 hours.

Charge type

Charging can be done by two methods, Inductive or Conductive, also the feeding power can be one phase or three isolated phases, the power is about 6 KW, the maximum output voltage is V388, and the output current can be up to A15.

Power consumption per battery charger

This amount can have different values depending on the capacity of the batteries and their number, the range of the vehicle, the loss of the vehicle, etc.

Battery life

Depending on the type of battery used in the car and the specifications provided by the manufacturer, the battery life is different, For example, in the case of coated lead-acid batteries, if they are discharged and re-charged up to half of their allowed capacity, they can be charged and discharged up to 1000 times, and if the entire capacity of the battery is used, they can be charged and discharged up to 500 times.

Battery type

Choosing the type of battery depends on various factors such as the amount of space in the car, the price of the car, the range of the car and the expected life of the car, etc. Iran because the technology of lead-acid batteries is available And their finished price is much lower than other batteries, lead-acid batteries are used, of course, to prevent additional maintenance and repair, gel batteries can be used. Power generation and transmission systems for mass-produced electric vehicles.

Electric vehicle with direct current DC motor

Based on the experiences gained over many years by Chloride Group and Lucas Industries, which was established in England And it was invested with the financial assistance of the Ministry of Experience and Industry of England, The specific goal was to build a series of electric cars with high efficiency and with the cooperation of normal car manufacturers., Both parent companies have followed DC power transmission systems that were separately excited, And both companies have had experiences in brushless power transmission systems. The power transmission systems that were followed by each of these companies used separate excitation DC motors for similar reasons., And it included a better reaction of the separate excitation system in fault conditions, the presence of a more flexible force-speed characteristic, and more efficiency and ability to work under DC current conditions.

Most of the effort was focused on improving the existing system, which led to the production of a two-transistor control system (output 160 volts, 50 kilowatts) and a four-transistor system (output 216 volts, 40 kilowatts). The transmission system must be able to be installed on the vehicle in the production line of the manufacturer's factory. The system must have sufficient reliability, And it must be able to meet the working needs of the car manufacturer, which is built at the desired rate and fully developed before being presented to car manufacturers has shown practical experience, A DC traction motor, if it is properly designed and manufactured, is a highly reliable product, The improvement of the system capability by replacing the brushless motor instead of the DC motor is small And the choice of the engine for the next generation transmission system will be based on the cost of the engine and the cost of connecting the engine and the control system. The complete analysis of the car price will also show the things that can be improved., And we summarize the most specific features of this economic analysis as follows.

- 1- Mechanical integration of electronic equipment, DC/DC converter, state of charge measurement device, battery insulation, pedal magnetic converters and charger**
- 2- Removal of electromagnetic parts such as relays, contactors and contactor testers as active parts in the transmission system.**
- 3- Minimizing electrical connections**
- 4- Minimizing electronic parts**
- 5- Eliminating dependence on 12-volt car power supply**

Power transmission equipment

The transmission equipment includes all the parts that transfer the production power to the wheels and tires they give When we talk about power transmission equipment, this equipment and their performance should be considered separately in an electric vehicle and an internal combustion engine. In this section, we discuss about the main parts including the differences between the electric motor and the internal combustion engine. We discuss the processes of power transfer.

Power transmission systems

We start with the issue of what is the function of the power transmission system in a car with a combustion engine. In practice, the power obtained from the engine must be equal to the work of resistance and friction forces that are calculated for each speed. Using the power of the engine to turn the wheels and tires with the least losses and the most efficiency is the clear task of the power transmission system. And in general, the power transmission system must meet the following requirements. Conversion and change of torque and speed from the engine to the movement of the vehicle - traction, Changing the direction of the output round to ensure the forward and backward movement of the car, Provision of different rotation speeds in the drive wheels and in the screws-differential

3. OVERCOMING THE SLOPE OF THE ROAD**Maximum fuel economy**

A simple view of the power transmission system in internal combustion vehicles can be described as follows:

- The internal combustion engine (or electric engine) is responsible for providing the power and pushing torque of the car.
- Clutch: for the combustion engine, cutting off the power transmission from the engine to the tires: so the transmission gears can be changed. And the car can reach high speed from a standstill.
- Manual gearbox: providing the ratio of gears that the car needs for maximum torque or maximum speed and normal speed for movement or maximum efficiency and economy.
- Drive shaft: connecting the drive wheels to the gearbox is useless in cars with rear-wheel drive and in cars with front-wheel drive.
- Differential: The duty of the differential is to accommodate the problem that the outer wheel travels a greater distance than the inner wheel when turning, and the transfer of the 90 degree power to the rear wheels of the car is done with the help of the differential.
- Driving axles: to transfer power from the differential to the driving wheels
- The difference between electric motor and combustion engine

In the comparison of electric motor and combustion engine with the same production power, the electric motor is preferable. The electric motor produces maximum torque at the moment of starting. While the combustion engine does not provide any torque to reach enough revolutions, a basic difference between these two types of engines is the production power rate. The rated power of an electric motor produces a higher maximum power, while combustion engines have maximum torque and maximum power in a certain range of revolutions. The maximum power output rate of a combustion engine is obtained under laboratory conditions. Electric motors are such that they can be used at less than their maximum, And the consumption of these engines should also be reduced, the production power can be used continuously for an hour or more without causing the engine to heat up. In an electric motor, the output power is much lower than the maximum output power, it is almost two to three times smaller. And therefore, we will have a considerable maximum power.

One of the main differences between these two types of engines is the amount of production torque. An electric engine can generate a lot of torque at zero speed, a combustion engine needs torque to reach the desired speed. The electric motor can be directly connected to the drive wheels without the need for clutches, gearboxes and torque converters that are used in the combustion engine. The speed of the electric motor can be selected and controlled by the consumption current of the controller. In the combustion engine, the maximum torque is provided only in the speed range in order to provide the maximum torque in a wider range of vehicle speed, a gearbox with different gear ratio is needed. With the above explanations, we conclude that most of the electric motor is used on the power transmission system of a combustion engine, less loads are applied to its components, therefore, a special lighter power transmission system should be designed in the mass production of electric vehicles. The clutch is also an intermediary between the engine and other components, including the gearbox, and it makes us unnecessary to build a connection device between the electric motor and the wheels. In the future, the AC motor and controller will be used for the mass production of electric cars. And there is no need for a complete mechanical gearbox. In this case, the electric motor can be directly connected to a simple, light, one-way gearbox with a maximum of two gear ratios. And therefore, there is no need for a clutch. In the mode gearbox, the gear ratio changes automatically. Gear box in an electric car - in an electric car, the presence of a gear box creates diversity in the choice of electric motor, it creates backward movement. And we don't have to use a two-way motor with the corresponding controller, and the work becomes simple. In the future, the presence of AC motor and controllers will ensure backward movement and the gearbox will be very simple. Drive shaft, differential and driving axles - these equipments are always used and must be present in an electric car. Of course, in mass production, if two electric motors installed on the driving wheels are used, these components are removed, but the use of a simple motor will be more

Checking the gears

The gear ratio of the box is combined with the ratio obtained from the differential, And the power of the torque produced by the combustion engine is adjusted, and the maximum torque is provided for moving the slopes and the lowest cost for moving with high efficiency.

Automatic and manual gearbox

The first thing that can be consciously avoided is the automatic gearbox, because high efficiency is required in an electric car, while the automatic gearbox has a low efficiency of around 80%. The better reason is that when converting the car to an electric car, the torque transmission system and the design in the automatic gearbox is such that we cannot have the desired gear ratio. And this gearbox will not be compatible with the characteristics of the electric motor. The best way to convert an electric car is to use a manual gearbox and clutch.

Power transmission systems and light or heavy fluids for lubrication

The need to use high efficiency in an electric vehicle rejects the use of an automatic gearbox, Also, this demand does not impose unnecessary weight on the system in the design of power transmission parts, Because the heaviness of the axle or driver, gearbox, clutch or anything else that adds weight reduces efficiency, even a manual gearbox designed for maximum torque causes losses when working at a lower load. Low electric vehicle results in low efficiency of the system, Therefore, it is better to convert a combustion engine car with a light engine. It is also very important to choose a lubricating fluid. The use of a fluid with low viscosity in the differential makes the parts rotate more easily, although the rules of lubrication do not apply. In an electric car, during normal movement, approximately 10% of the maximum torque of the combustion engine is used, Therefore, it is better to use the power transmission system designed to transmit less maximum torque, as a result, the electric motor covers smaller loads entering the system and uses a maximum of 50% of the designed capacity of the vehicle power transmission system with a combustion engine. Therefore, less pressure on the gears makes it possible to use a lubricant with less viscosity and the final efficiency of the system increases.

4. RESULT

Due to the increasing development of the automobile industry and the mass production of internal combustion vehicles, which causes various problems such as air pollution, Also, because fossil fuel reserves are limited and expensive, research and design of electric vehicles has become one of the main programs of the automobile industry, especially in advanced European and American countries. In this research, the introduction of the electric car, the characteristics of the electric car, the types of electric motors and the car's power transmission equipment were discussed.

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