Electric motor

In electric vehicles, the electric motor replaces the combustion engine used in conventionally powered vehicles. In hybrid vehicles, a combustion engine is combined with one or more electric motors. In an electric motor, electrical energy is converted into mechanical work and used for propulsion.

Different types of electric motors

In an electric motor, electrical energy is converted into mechanical work and used for propulsion. A basic distinction is made between the following types of motors:

- Direct-current motors
- Three-phase motors
    - Asynchronous motors
    - Synchronous motors

Today, three-phase motors are used almost exclusively in modern electric and hybrid vehicles.

How electric motors work

In both DC motors and three-phase motors, torque is generated by the attracting force of two magnetic fields. One of these magnetic fields is generated electromagnetically. One magnet is fixed in place and is called the “stator.” The other is mounted on a rotating shaft and is called the “rotor.” Both magnets can also be generated electromagnetically. For example, the rotor can be magnetized by a so-called excitation winding (special coils/wire windings that generate a magnetic field when an electric current flows through them).

Advantages of electric motors

Because electric motors cover a wide range of speeds and torques, they are particularly suitable as vehicle motors because they do not require a multi-speed or manual transmission. They also have a high efficiency rating. Efficiency describes the ratio of energy supplied to energy available for propulsion. Electric motors achieve an efficiency of around 80 to 90 percent, petrol engines around 33 percent, and diesel engines around 45 percent. In addition, electric motors deliver their maximum torque even when stationary and operate extremely quietly. Further advantages include their compact, simple design, low weight, and low maintenance requirements, as well as the possibility of using the motor as a generator during the deceleration phase.

Operation of three-phase motors in electric cars

To fully exploit the potential of three-phase motors, they are operated with high-voltage three-phase current at around 400 volts. The frequency and power of the three-phase current must be variably controlled in order to meet the driver's various requirements in terms of speed and torque. This is the responsibility of power electronics, whose inverters or converters also have the task of converting the direct current supplied by the battery into alternating current. Electric motors are preferably located in the immediate vicinity of the axles they are intended to drive. The electric motors can be mechanically coupled to the wheels in various ways, usually via reduction gears and drive shafts or integrated into the wheel as a so-called wheel hub motor.

Environmental protection

Since electric motors produce no emissions, at least locally, they are considered more environmentally friendly than combustion engines. However, the production of electricity can also generate pollutants. Therefore, the best ecological balance is achieved when 100% renewable energy is used to generate the required electricity.

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