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Developing a Comfortable and Easily Control R&E Ravon Hybrid Vehicle

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ANNOTATION. An economical car - R & E RAVON, driven by an "electric motor - internal combustion engine" system, powered by both fuel and an electric battery charge. The electric motor and gasoline engine in hybrid cars can reduce CO₂ emissions by up to 75 g / km, which is incredibly low for a family car. In electric vehicle (EV) mode, it accelerates from 0 to 50 km / h without CO₂ emissions at all.

The main advantage of the hybrid car - R & E RAVON - is the reduction in fuel consumption and harmful emissions. The new R & E RAVON hybrid car based on the Ravon Nexia R3 is equipped with a power plant consisting of a 0.5-liter gasoline engine and two electric motors. According to our calculations, the total power of the units is 120 hp.

KEYWORDS: economy, hybrid car, electric motor, internal combustion engine, recuperation,

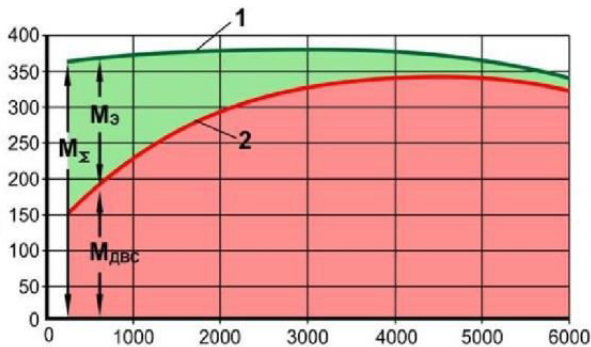


The acceleration time of this model from zero to first hundred is only 7.4 seconds.

Pic. 1. Dimensions of R & E RAVON:
length - 4350 mm; width - 1690 mm; height - 1505 mm;
wheelbase size - 2480 mm.
Trunk volume - 300 l. Curb vehicle weight: 1100 - 1200 kg.

Gross weight: 1300 - 1350 kg.

Traveling around town increases fuel costs in most vehicles. But hybrids are an exception. In their energy is used repeatedly and has two engines - petrol and electric - an ideal combination that allows to spend only 3.7 liters of gasoline per 100 kilometers. Nice economy that's even better in Eco mode. But you cannot spend all fuel: switch to electric mode EV (Pic 1). Save fuel, reduce emissions, generate your own energy - when the advanced technology used in a hybrid vehicle delivers so many benefits that our hybrid vehicles are as easy to drive as possible. A hybrid car is a highly efficient vehicle driven by an electric motor-combustion engine system, powered by both fuel and an electric battery. The main advantage of a hybrid car is the reduction in fuel consumption and harmful emissions (Pic. 2). This is achieved by fully automatic control of the operating mode of the engine system using the on-board computer, starting from the timely shutdown of the engine during a stop in the traffic stream, with the ability to continue driving without starting it, solely on battery energy, and ending with a more complex recuperation mechanism - using an electric motor as an electric current generator to replenish the battery charge.



Pic. 2. Characteristic of the torque when the internal combustion engine and the electric motor work together
1 - curve of the total moment,
2 - ICE torque curve.

Used three-phase AC motors with squirrel-cage rotor, controlled by the controller by changing frequency. They are virtually maintenance free. The efficiency of such electric motors strongly depends on the speed and can vary from 82 to 97%. [1]

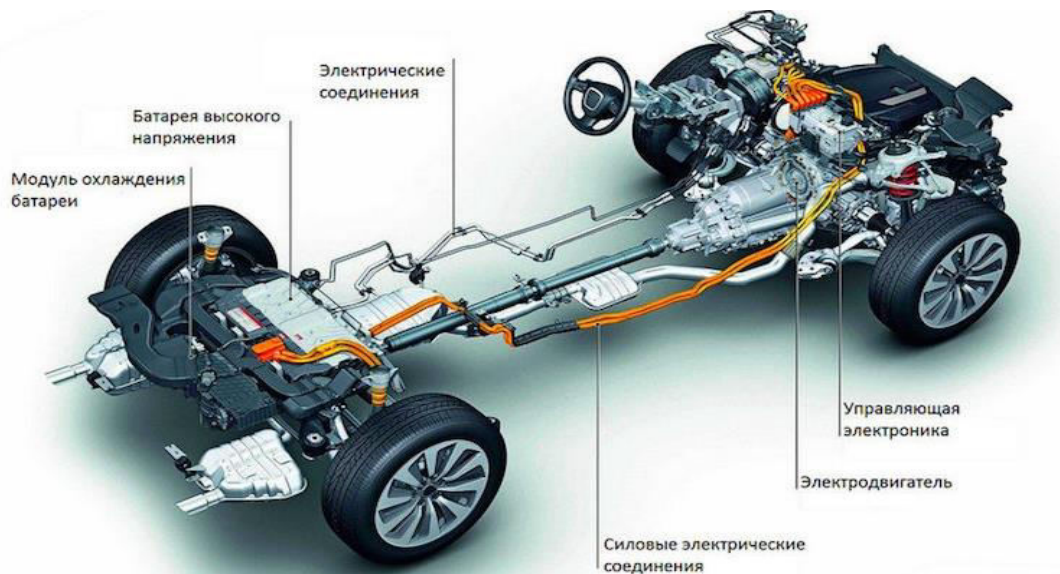
The advantages include the ability to switch from "star" to "delta". When star-connected, the motor has a higher shaft torque and can be used for start-up or heavy duty applications. Switching to the "triangle" scheme increases the speed of rotation of the electric motor shaft, which can be applied when accelerating or driving on the highway. DC motors have been used for a long time.

The speed of such a motor depends on the supply voltage, which simplifies the way it is controlled. Electric motors with series excitation have good traction and speed characteristics. But their efficiency is slightly lower than that of AC motors, the design is more complicated, they need periodic maintenance, they are more sensitive to overloads, the maximum speed is slightly lower.

Electric vehicles with DC motors typically use multi-speed gearboxes. In series excitation motors, the stator and rotor windings are connected in series. DC motors are often used with mixed inclusion of field windings. Such motors have two field windings - serial and parallel.

The efficiency of DC motors is increased by replacing the stator field winding with permanent magnets. Permanent magnets are located on the rotor. The stator is supplied with several winding sections. This is usually three or four windings. An electronic switch connects power to one of the windings, resulting in a traveling electric field. The rotor is equipped with position sensors to determine its position and, accordingly, the timely switching of the stator windings. Such an electric motor is simpler, but the complication of the controller makes it generally more expensive than conventional collector motors. Most often it is used for placement in a wheel. In this case, the magnets are located on the rim, the windings on the fixed hub.

Recently, such motors have been given the name valve. These include synchronous AC motors with electromagnetic excitation from a valve current source with control of the rotor position by special sensors. They are most often used for high-speed transport, sports electric vehicles, rotation of the traction rotor of aircraft and snowmobiles. The efficiency reaches 90% or more. While collector motors can have an efficiency of less than 80%, and serial induction motors have a maximum of 87.5%. Thus, the valve electric motors have two modifications: supplied with alternating current and direct current.



Pic 3. Diagram of the power plant on a hybrid car R & E RAVON

To calculate the power of the electric motor, let us set the initial data of the R & E RAVON electric vehicle: total weight - 1300 kg, rolling friction coefficient on asphalt - 0.018, body streamlining coefficient - 0.32, drag area - 1.8 sq.m., maximum speed 60 km / h. Required power of the car's electric motor:

$$N = G \times F_{TP} \times M \times V + C_x \times S \times V^2 + G \times M \times \sin \alpha ,$$

Applying the above formula, we have:

$$N = 9,8 * 0,018 * 1000 * 16,6 + 0,32 * 1,8 * (16,6)^2 + 9,8 * 1000 * \sin 15 =$$

$$2928,24 + 158,72 + 2548 = 5634,96 \text{ Вт}$$

The sequential kinematic diagram of the power plant excludes the mechanical connection of the wheels with the primary energy source. The internal combustion engine is the source of energy for the electric generator, which, in turn, powers the wheel drive electric motors. An energy storage battery is located between the generator and the drive engine. The accumulator accumulates excess electricity generated by the generator, receives recuperation energy during braking, and provides peak loads on the wheels. The scheme allows to stabilize the mode of operation of the prime mover in terms of maximum fuel efficiency and minimum emissions, to exclude structural elements of a mechanical transmission: gearboxes, shafts, etc. While maintaining the drive torque, a smaller motor can be used (Pic.3)

The hybrid vehicle achieves a unique level of efficiency, environmental friendliness, and at the same time provides increased comfort and handling. The use of a hybrid power plant allows:

- to reduce by 10 times the levels of emissions of harmful substances (CO, CO₂, NO_x, HC, etc.);
- when driving in the urban cycle, fuel economy by 25 ÷ 50%
- to ensure the launch of the internal combustion engine, the generation and recovery of electricity with the accumulation and subsequent use of it;
- use ICEs of lower power (power reduction up to 30% in comparison with the traditional scheme) while maintaining the torque on the wheels;
- to organize the operation of the internal combustion engine in the optimal mode in terms of fuel efficiency and emissions;
- to carry out an autonomous run on electric traction, using only the energy of the drive;
- The well-coordinated operation of the electric motor and the gasoline engine in hybrid cars allows to reduce CO₂ emissions by up to 75 g / km, which is incredibly low for a family car. In electric vehicle (EV) mode, our hybrids accelerate from 0 to 50 km / h without CO₂ emissions at all.



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