

Electromobiles that Extract Heat from the Air and Require No Charging: The Entropy Increase Law Does Not Prohibit This

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Abstract: *Electromobiles protect the biosphere in places of human residence. Globally, they destroy it, as the electrical energy they consumed is extracted using "dirty" energy carriers. This article suggests learning the electromobiles to generate electrical energy in eco-friendly way, extracting heat from the air. Specifically, we suggest to equip the electromobiles with the Orlov and etc. installation, which schematically is a converging tube where the air flow is by itself accelerated and, according to the Bernoulli equation, is cooled; and its narrow end contains the electrical energy generating turbine. The problem is that the Orlov and etc. installation is prohibited by the entropy increase law due to the flow entropy decrease during its operation. However, it is important that actually in this case the Clausius entropy, i.e. thermal entropy, decreases. The thermal and total entropy increase laws are different laws that separately require verification. Planck, Fermi et al. indicated the cases of total conversion of heat into other forms of energy accompanied by thermal entropy decrease. These cases, proving invalidity of the thermal entropy increase law, admit transition to electromobiles with air heat traction. As well as transition of water transport to ship's electric engines with water heat traction.*

Keywords: Bernoulli's equation, thermal entropy increase law, total entropy increase law, cooling of our Metagalaxy, isothermal expansion of gas

1. Introduction: Palliative Nature of the Current Electromobile Revolution

There is the electromobile revolution in the world; the American inventor and entrepreneur Elon Musk and his company Tesla play a major part in it; the USA, Europe and China take the lead. In California, the authorities recently announced their intentions since 2035: to ban selling new cars with internal combustion engines. Multitude of US states, starting from the New-York, where the corresponding draft law has already been sent to the State Senate, is going to follow California. New President of the USA Joseph Biden intends to provide all possible government support to this course. In Europe, a share of electromobiles in auto sales in October 2020 was significantly more than 10%: from 11.8% in France and 17.5% in Germany to 79% (!) in Norway. In the People's Republic of China, according to the forecast of the Society of Automotive Engineers (SAE-China), sales of the "new energy vehicles" (NEV) will grow to 20% of all new vehicles sales by 2025, and to 50% – by 2035, given that 95% of NEV sales in 2035 will be battery electric vehicles (BEV).

Transition to electromobility is carried out as part of the common human drive for the "Green" Energetics aimed at consumption of pure types of energy. The point of replacement of conventional vehicles with electromobiles is to divide an energy consumption process into two stages related to *stationary* and *mobile* installations. Electrical energy is generated at the stationary power plants that, in case of using "dirty" energy carriers, are extremely difficult, if not impossible at all, to make environmentally safe. However, they may be located away from the places of residence of people, which is done, if possible. As for the mobile installations (automobiles), they are designed for use predominantly in the places of residence of people; their transition to electrical

energy makes them almost 100% environmentally safe.

As we can see, transition to electromobiles helps protect the biosphere in the places of residence of people. But globally, transition to electromobiles still destroys the biosphere, as the electric energy they consumed is generated at the stationary power plants using the environmentally "dirty" energy carriers – hydrocarbons and nuclear fuel.

Additionally, the required regular charging of electromobiles substantially complicates lives not only for several drivers, but generally for countries. Let's say, plans of Joseph Biden for transition of the USA to electromobiles provide for building of 500 thousand charging stations in the country at public expense, and also huge investment in renewable energy resources intended for power supply of these stations, as well as construction of new nuclear power plants for these purposes.

2. Suggested drastic solution to the problem

Let's ask ourselves a strange question: may the electromobiles be relieved from the necessity to be charged with the electrical energy at the stationary charging stations? May the electromobiles be reconstructed so that they could extract electrical energy in eco-friendly way from the ambient air, cooling it? Such electromobile, if invented, could extract heat from the ambient air, converting it into the electrical energy, subsequently supplying it to the traction engine.

Consuming energy, we do not eliminate it, which is prohibited by the energy conservation law, but convert it from one form into another one. Finally, almost the entire consumed energy is dissipated as heat, heating the environment. Finally, almost the entire energy consumed by our electromobile will be dissipated as heat. Heat extracted by it from

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the environment will be returned to them on the environment. There is no conflict with the energy conservation law, as the energy consumption will simply become a heat circulation.

Let's see how this idea may be realized.

3. Orlovand etc. installation and its possible use in electromobile

It is known that moving along the converging tube the air flow by itself (for geometric reasons) accelerates so that its kinetic energy grows. According to the energy conservation law, this growth cannot appear from anywhere. Bernoulli's equation

$$\frac{v^2}{2} + c_p T = \text{const} \quad (1)$$

(v is the flow velocity, c_p is the specific heat capacity of the gas at constant pressure, T is an absolute temperature) specifies this proposition: gain in kinetic energy of converging flow, as the Bernoulli equation states, is provided by its cooling, i.e., it occurs due to heat containing in the flow. If we place the electrical energy generating turbine in the narrow end of the converging tube, we will get an energetic installation that consumes heat extracted from the ambient air. This is exactly what Russian authors I. Orlov, M. Yegorov and E. Sobol' suggested to do about twenty years ago [1-3]. To increase power of their installation, the inventors place not just a converging tube in it, but a cascade of three Laval nozzles (such nozzle first narrows and then expands); the turbine is located in a narrow section of the third nozzle. According to calculations of the inventors, the air flow in their installation may be accelerated almost to the speed of sound.

Then everything is simple. We mount the appropriately adapted Orlovand etc. installation onto the electromobile roof with its wide part facing the movement and use the electrical energy it generates for power supply of the traction engine.

We got (on paper) what we wanted – the eco-friendly electromobile consuming heat dissipated in the ambient air, therefore requiring no charging.

4. Cognitive barrier

Orlovand etc. installation has been patented a long enough time ago by its inventors, however, its application is inhibited by the entropy increase law with which it is in contradiction, because the flow entropy decreases during operation of this installation. To be precise, the Clausius entropy decreases. Indeed, according to definition of the Clausius entropy,

$$dS = \frac{dQ}{T} \quad (2)$$

(dQ – a small change in amount of heat in the system; dS – a small change in its thermal entropy), conversion of heat into other forms of energy is accompanied with decrease in thermal entropy (with negative dQ , dS is also negative). This is exactly what we have in case of converging air flow: its

the Clausius entropy decreases while the flow is being cooled during acceleration.

It would seem, the Orlovand etc. installation is indeed impossible due to its conflict with the entropy increase law. However, it's not all that simple: validity of the Bernoulli equation (in the ideal gas approximation) is out of question, the air flow in the converging tube actually accelerates, which may be achieved only by its cooling, that means decrease of the Clausius entropy.

Therefore, this is not about the Bernoulli equation and the Orlovand etc. installation. *Horribile dictum* – there is something wrong about the entropy increase law.

5. Two entropy increase laws

First of all note that the Clausius entropy is a purely *thermal* value, that varies only in case of thermal variations in the system. It did not hinder Rudolf Clausius, when he introduced his thermal (!) entropy in 1865, from declaring the entropy increase law as the general law of nature. However, thermal interactions are only a minor part of the entire spectrum of interactions in real systems. Having recognized this obvious fact, the authors who followed Clausius started generalizing the entropy concept to non-thermal interactions while discussing the entropy increase law.

In respect of the entropy concept that was expanded in such a way, the entropy increase law gradually began to gain a status of the total entropy increase law that covers all natural phenomena. A decisive contribution to new understanding of entropy was made by Ludwig Boltzmann and Max Planck. The Boltzmann principle (1877) that identified entropy with the system macrostate probability logarithm has explicitly generalized the entropy increase law beyond the thermal events. Planck, starting with his doctoral dissertation "On the Second Law of the Mechanical Theory of Heat" (1879), insisted on the fact that an increase in entropy occurs "in all nature processes" [4. P. 96].

This plot was very important for Planck. I think it was that idea that Planck had in the back of his mind when in the 1920 in his Nobel lecture he regretted that new ideas triumph in science not through discussions, but as a result of the natural extinction of the carriers of the old ones. He had no reason to complain about the perception by the scientific community of his quantum idea.

Planck's efforts were not in vain, other authors followed him, although not immediately. For example, L.D. Landau and E.M. Lifshits, in their course of statistical physics, extend the entropy increase law to all irreversible processes that occur with macroscopic bodies [5. P. 49].

Seemingly, it is obvious that generalization of the entropy increase law to irreversible processes of any nature requires a clear understanding of the difference between thermal entropy for thermal phenomena and total entropy for the all totality of phenomena. It is extremely strange, however, that this generalization remains non-reflected in physics. It would be difficult to come across a discussion of the interrelation of thermal and total entropy increase laws neither in Boltzmann

and Planck, nor in modern authors' works. Often one just cannot understand what law they speak in any given situation – the thermal entropy increase law or the total entropy increase law. And it is quite impossible to say which of these two laws they think is correct. It is because of this buzz in brain, the entropy increase law is frequently called the second law of *thermodynamics*. In fact, the thermal entropy increase law and the total entropy increase law are two different laws, each being requiring its own verification.

Hereinafter in this article we will talk only about the thermal entropy increase law.

6. Examples that prove invalidity of the thermal entropy increase law

To refute the general law of nature, among which, as is commonly believed nowadays, it is customary to include the entropy increase law, just a single case of its contravention is enough. In the meantime, in physical literature there are quite a few examples of total conversion of heat in the system into other forms of energy, when – it's not customary to focus on! – its (of system) Clausius entropy decreases. Here, we will briefly discuss two of them.

1) The cooling of our Metagalaxy

At the turn of 1920–1930, after discovery of cosmic expansion (runaway of galaxies from each other), it was clear that the observed world is limited for us by an apparent horizon with a radius of about 13.8 billion light-years. As there is no signal may propagate faster than light, and expansion had begun about 13.8 billion years ago, then information about the events beyond this sphere is not available for us. That means that the cosmology that studies the Universe in general has zero empirical basis (this is its difference from other natural sciences). So, all our statements about the Universe in general are only assumptions or, scientifically speaking, hypotheses. In a strange way, this does not prevent cosmologists from now and then to confidently talk about the expansion of the Universe, the Big Bang of the Universe, the age of the Universe etc.

Mentally reversing the cosmic expansion, the cosmologists have concluded that about 13.8 billion years ago the Universe had undergone the Hot Big Bang. Their logic is clear. As nowadays the Universe is being expanded, then it used to be in a denser state. Taking into account the gigantic masses that are involved in the process, it is hard to avoid the conclusion that this initial state was not only dreadfully dense, but also dreadfully hot, and that lead to the Bang, therefore the expansion of the Universe from this hot state is accompanied by its cooling.

All this is very similar to the truth. However, it's safe to say only about expansion along with cooling of *the observed world* (our Metagalaxy) with a radius of about 13.8 billion light-years. However, that's enough for us in this article: as total amount of heat in our Metagalaxy decreases in its expansion, then – already about 13.8 billion years! – its thermal entropy is being also decreases (see eq. (2)).

2) The isothermal expansion of a perfect gas

Let's again be based on the statement by Max Planck: “If a

perfect gas be allowed to expand, doing external work, and be prevented from cooling by connecting it with a heat-reservoir of higher temperature, the temperature of the gas, and the same time its internal energy, remains unchanged, and it may be said that the amount of heat given out by the reservoir is completely changed into work without an exchange of energy taking place anywhere” [4. P. 74].

As we can see, here Planck states unequivocally about total conversion of heat into work (into other forms of energy). In the same vein this example is also considered by Enrico Fermi in his “Thermodynamics”:

“Consider, for example, the isothermal expansion of an ideal gas that is kept in thermal contact with a source of a heat at the temperature T . Since the energy of the [ideal] gas depend only on the temperature, and the temperature does not change during the process, we must have $\Delta U = 0$. From the first law... [the law of energy conservation], we obtain, then $L = Q$. That is, the work L , performed by the expanding gas is equal to the heat Q which it absorbs from the source. There is thus a complete transformation of heat Q into work L ” [6. P. 30].

Other authors also give this example. As along with decreasing amount of heat in the system its Clausius entropy decreases (see eq. (2)), then here again we get decrease of the thermal entropy.

7. Conclusion-forecast

The thermal entropy increase law, as we may conclude, is quite definitely invalid. Consequently, electromobility with air heat traction that do not require charging are in principle possible. As such electromobility will give not palliative, but rather drastic solution to environmental problems in the sphere of vehicles, then transition to them is extremely desirable. I suppose, the real future lies with them.

It would appear that similar transition is expected in the sphere of the water transport. In other words, we are faced with transition to ship's electric engines with water heat traction. The heat capacity per unit volume of water thousands times exceeds the one per unit volume of air, therefore installations of the Orlov and etc. installation type, that extract heat from water, under otherwise equal conditions, will have significantly more power, than installations that extract heat from the ambient air.

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Author Profile



Sergey Haitun, until May 2016, has been the leading researcher in the Institute of History of Science and Technology of Russian Academy of Sciences. He has over 200 scientific publications, including 16 monographs, among which are: “Scientometrics: State and Prospects” (1983), “Problems of Quantitative Analysis of Science” (1989), “Irreversibility and Mechanics” (1996), “The Phenomenon of Man against the Backdrop of Universal Evolution” (2005), “From the Ergodic Hypothesis to the Fractal Picture of the World” (2007), “The Hypothesis of the Fractal Universe: Background. Foundations. 24 Consequences” (2018), “Invectives against the Entropy Increase Law, Reinforced by the Hypothesis of the Fractal Universe” (2018), “The Entropy Increase Law: Historical and Scientific Roots of the Fake” (2021) (all monographs are in Russian).