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THE NEW PRINCIPLE OF TRANSFORMATION HEAT INTO ELECTRICITY

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ABSTRACT

The general scheme of heat-to-electric power conversion in closed thermally inhomogeneous heterogeneous flow with constantly renewable local imbalance is considered. Conversion system comprises high-speed motor-generator rigidly coupled with propulsor. Propulsor has the form of rotating vessel containing liquid phase of working substance. Nozzles are installed on it to discharge liquid into closed volume filled with gas. The jet of working substance leaving the propulsor under the action of high pressure due to centrifugal forces is directed in the opposite direction of rotation of the generator, but its phase composition and other thermodynamic parameters are not determined. The transition of the working substance from the propulsor to the closed volume goes beyond equilibrium thermodynamics. Motion energy of each element of working substance mass leaving the propulsor is supplied to electric power generation.

Keywords: Energy, Entropy, Laws of thermodynamics.

INTRODUCTION

The role of phase transitions in changing the state of the Earth's atmosphere cannot be overestimated. Condensation of water vapors in clouds rarely occurs under equilibrium conditions. In winter, they pass the liquid phase and condense directly into the snow. But in summer, along with rain, there is hail. Naturally, the question arises of the use of phase transitions in systems for converting heat to other types of energy.

The task of thermodynamics from the very beginning was not so much to find ways to convert heat into work, but to explain the mechanism of action of long-existing thermal machines and improve their characteristics. It put an indelible imprint on it.

The presence of a heater and a cooler is a characteristic feature of such processes. It is the difference in their temperatures that is considered as the "driving force" of the transformation. Chemical or nuclear reactions are commonly used as an energy source, resulting in unavoidable environmental problems.

The working substance of heat converters to operation is most often gases, the thermodynamic characteristics of which vary widely. At the same time, liquid-solid phase transitions are associated with significant energy changes at an almost unchanged temperature. When mercury, amalgam, xenon or other liquefied gases are used as a working substance, the heating can be carried out by a stream of water. The use of this circumstance for the purpose of energy conversion opens up an unlimited source of energy under earth conditions.

THERMODYNAMICS OF FLOWS

The basic concepts of thermodynamics are formulated for fixed equilibrium systems and quasi-static processes. Strictly speaking, the power conversion in such systems is zero. But the time for establishing thermodynamic equilibrium in a small element of the volume of matter decreases as its dimensions decrease. This gives reason to consider the steady-state closed flow of working substance between the heater and cooler, widely used to convert heat into work, locally equilibrium. When moving in the flow, each element of the mass of the working substance cyclically changes its characteristics.

It is believed that the laws of thermodynamics in a known way limit the ability to convert heat into work [1 - 7]. But these laws themselves are valid only in cases of fully integrable Pfaff equations, which determine the course of thermodynamic processes. A characteristic feature of the process of complete heat conversion into operation is the use of heterogeneous thermally inhomogeneous systems [8]. This would seem to exclude the very possibility of using closed flows in it. But such a conclusion would be too hasty. The fact is that the process of converting heat to other types of energy may include a deliberately irreversible step leading to cooling of the working substance.

LOCAL IMBALANCE AND ITS ROLE DURING ENERGY CONVERSION

The basis of the new principle of heat conversion to electricity is the use of a high-speed motor-generator rigidly connected to a propulsor that affects the parameters of the working substance. Rotor, current generator and propulsor are mounted on common shaft and rotate synchronously. Propulsor has the form of axisymmetric vessel expanding upwards, and from below on axis passing into narrow tube immersed in liquid phase of working substance. Nozzles are arranged nearby propulsor cover to discharge fluid jets pressed against propulsor inner surface by centrifugal forces in direction opposite to generator rotation direction. (Fig.)

Let us consider the general features of steady state flow of working substance in the system. The pressure of the liquid on the inner surface of the propulsor is determined by its density and rotation speed of the generator. This pressure sets the flow rate of liquid from the nozzle. The speed of the nozzle is proportional to the speed of rotation of the system, and the speed of outflow is proportional to its square. In the case of sufficiently high rotation speeds of the system, they coincide. At optimal speed of rotation working substance leaves propulsor at zero speed in fixed coordinate system. Behind the nozzle during the rotation of the propulsor there remains an almost stationary "plume" of working substance. When the released element of the working substance stops, the energy of the liquid movement goes to generate current. Without this, it is impossible to exit the propulsor and stop the mass element.

As a result of each one turn at the optimal frequency, the system state returns to the initial one. This opens up the possibility to establish the connection of liquid flow parameters with electric power generation. Although the energy of each mass element during the passage of the propulsor increases as its speed increases, due to the practical incompressibility of the liquid, its temperature remains unchanged like the constant temperature of water in the ocean depending on the depth of immersion. The main energy of the liquid, determined by the high speed of its movement at the outlet of the propulsor, goes to generate current.

Whether, as a result of establishing local thermodynamic equilibrium, the working substance that left the propulsor will be "rain," "hail" or "snow" does not matter. Prior to exiting the propulsor, the high internal pressure in each fluid mass element is balanced by the same high external pressure. The entry of the element of working substance into the surrounding system of a closed volume filled with gas at a significantly lower pressure leads it out of local thermodynamic equilibrium and leads to radical changes in the structure. During the time of establishing the local thermodynamic equilibrium, the element of mass of the working substance released from the propulsor does not have any thermodynamic characteristics other than energy and momentum. As a result of establishing local thermodynamic equilibrium, the element is scattered in pieces with zero pulses of fragments. In steady state, ingress into the surrounding gas will lead to their falling to the surface of the liquid.

As a result of establishing local thermodynamic equilibrium, the local entropy of the mass element that has left the propulsor reaches a maximum, and the local temperature of the fragments will be obviously lower than the temperature of the working substance entering the propulsor, since part of its energy is spent on power generation. At the liquid surface temperature not much higher than the melting temperature, the gas temperature and the working substance entering the propulsor are practically the same. Fragments on the way to the liquid surface are cooled gas. The cooling intensity is proportional to the mass of the liquid passed in one revolution and the heat of its phase transition. Possible cooling below the phase transition temperature can be neglected due to a sharp decrease in heat capacity proportional to the temperature cube. The same value determines the production of electricity in one revolution.

The mismatch of the rotation speed with the optimal at high speeds will lead to the unpredictable development of the process and heating of the gas with fast fragments of a thermodynamically uncertain nature. To achieve stable operation of the system, the possibility of controlling the current in the rotor can be used.

PUTTING THE SYSTEM INTO CONVERSION MODE

In the initial state, the system is stationary at a temperature below the freezing temperature of the liquid. The propulsor tube is above the surface of frozen mercury. To start the system and continue to function, it must be heated and melted. At the same time (unlike water) its density will decrease, and the surface level will grow slightly. Increasing the current in the rotor increases the rotation speed. Under the action of centrifugal forces, gas through the nozzles leaves the volume of the propulsor. Lowering the system causes the propulsor tube to immerse in mercury and fill it with liquid.

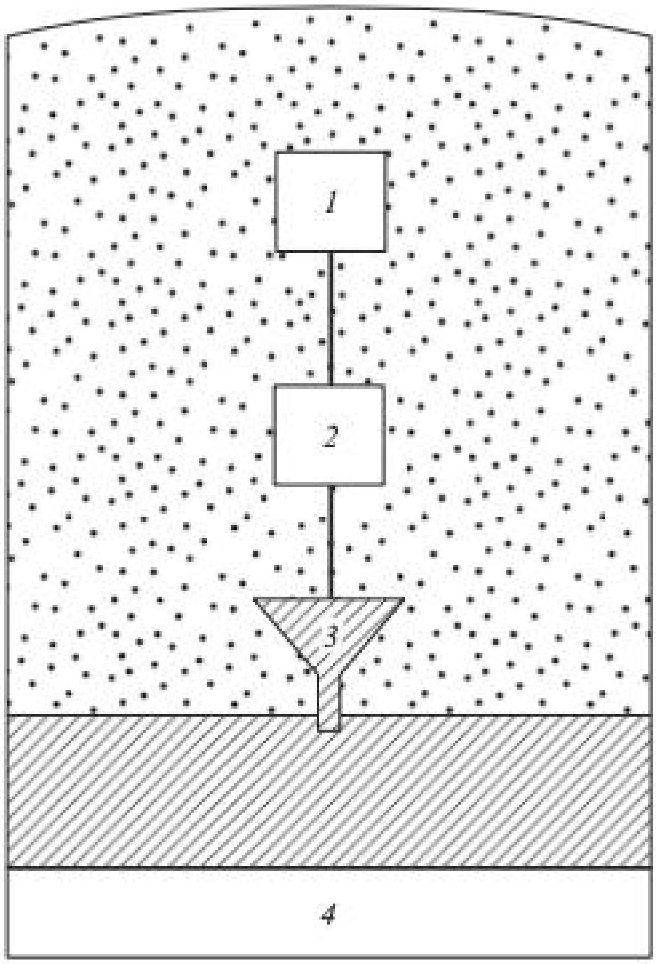
As the volume of the propulsor is filled with liquid, it becomes the second source of energy, which provides, along with the current in the rotor, the rotation of the system. Increasing the rotation speed increasingly increases the role of the propulsor in the process and makes it possible to reduce the growth of current in the rotor. When the optimum frequency is reached, the current growth in the rotor stops. The power of the generator at this moment is equal to the power of the propulsor and is determined by the amount of mercury passing through the propulsor per unit time and the specific heat of the phase transition. At the same time, the current power in the rotor fully compensates for the inevitable losses on friction and ohmic heating of the windings. All heat energy absorbed by the system, minus the energy spent on friction and ohmic heating of the rotor and generator windings, is converted into electricity. Stabilized current energy is not included in the energy balance of the converter, and a small part of the current energy produced by the generator can be used to provide it.

In the case of mercury, with a propulsor size of the order of centimeters, a nozzle outlet diameter of about a tenth of a millimeter and a rotation speed of about several tens of thousands of revolutions per minute, usually used in gyroscopes and centrifuges, the power developed by one nozzle reaches a value of about one kilowatt.

In steady state, the rotation speed is stable, the layer of mercury at the bottom is heated from below by a stream of water and cooled from above by gas and falling fragments. The temperature of mercury entering the propulsor is close to its melting point. Thermal contact of gas and mercury ensures the proximity of their temperatures.

CONCLUSION

Heat is converted into electricity in a narrow temperature range in the low temperature region due to phase transition energy. The rapid transition of the accelerated compressed liquid to the low gas pressure region and its shutdown lead to "self-cooling" of the working substance. Permanent violation of the local thermodynamic equilibrium when compressed liquid enters the gas-filled volume causes a sharp drop in the local temperature of the working substance. The "driving force" of the process is the high pressure created in the liquid by centrifugal forces. The energy source in the process is a small cooling of the water flow. When cooling the flow of water used by humanity by two-three degrees, the electricity produced is an order of magnitude higher than the existing level of energy consumption.



SIGNATURE TO FIGURE

1 - current generator, 2 - motor,

3 - propulsor, 4 - heater.

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