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RESEARCH ARTICLE

NEW ENVIRONMENTALLY SAFE REACTOR - SOURCE OF HEAT

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ABSTRACT

The article discusses the operating principle and design of the environmentally safe reactor of the heat source - K&RK generator invented by the authors based on a new initiation method for cold fusion reaction in ordinary water. The paper demonstrates the result of the action of the K&RK generator as a new type of heat source whose yield turns out to be positive for the first time in world history without any additional energy sources connected to the device. It contains a short overview of the physical nature of the initiation method of cold fusion reactions in ordinary water making a revolutionary change in the power industry.

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INTRODUCTION

In 2016 Russian scientists – Corresponding Member of the Russian Academy of Sciences, Dr. Sci. in Physics and Mathematics A. V. Kulakov and Cand. Sci. in Physics and Mathematics V.A. Rantsev-Kartinov invented a new environmentally safe source of heat. The invention belongs to the development of an environmentally safe (ES) source of heat (SH) based on a new initiation method for cold fusion nuclear reactions (CFNR) in ordinary water. The initiation method for CFNR in light water is a know-how of the authors of this application. For this reason, it is not discussed herein; consideration is only given to the proposed device demonstrating the result of its action as a new type of SH whose yield turns out to be positive for the first time in world history without any additional energy sources connected to the device in question and making possible its action. Heavy water electrolysis cells with palladium electrodes were used in early experiments to demonstrate cold fusion (Fleischmann, 1989). In 1990 a paper was published (Kulakov, 1990) which proposed a theory of the machinist of nuclear reactions occurring on a deuterium integrated into the crystal lattice of palladium (Fleischmann, 1989) based on the assumption that the fusion reaction is determined by a substantial decrease of Coulombic potential barrier due to shielding in degenerate crystal plasma and due to the action of quantum exchange forces in condensed media (Kulakov, 1988; Kulakov, 1990). These circumstances give rise to the phenomenon of preferential tunneling of electrons and heavy nuclei carried away by them through the potential barrier, which allows them to merge into new nuclei with release of mass defect energy in the form of energy of the resulting heavier nuclei. The paper (Kulakov, 1990) has calculated the level of release energy in the process of CFNR and explains the extremely llow electron yield in the experiment. Today there is another way of demonstrating energy release, supposedly, also at the expense of CFNR, but without using deuterium. The author of the source of heat patented in the USA is Italian inventor Rossi (Installation and heat generation methods, US patent №US 2014/0326711A1), in scientific literature this device is referred to as the E-Cat, which basically is an alundum tube blinded with alundum plugs with a heat-emitting spiral wound on it. The plugs are sealed with heat-resistant cement which is also used to coat the whole tube from the external side. Hydrogen-saturated nickel powder with $LiAlH_4$ in a proportion of 10:1 is placed inside the tube before the seal.

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The reaction that releases a great amount of heat is activated by heating the tube above 1,000 Cº with current passage through the spiral. The experiments showed that the released energy due to the behavior of a reaction unknown to the inventor were in large excess over the spent energy and by an order of magnitude greater than the calorific capacity of any chemical fuel [Installation and heat generation methods, US patent №US 2014/0326711A1]. In conducting the experiments neither the author nor the experts who checked the smooth operation of the device managed to find any harmful radiation (neutron, X-ray, gamma, alfa) and understand what type of reaction occurred in the device and how energy is released in it. In contrast to Rossi, the authors of this invention have developed conditions and a theory for the processes taking place in the operating chamber of the proposed new environmentally safe reactor -source of heat (NESRSH) of the Kulakov and Rantsev-Kartinov (K&RK) generator based on a new initiation method of CFNR by a suspension prepared of the nano-powder of active metal and hydrogen-saturated light water without any additional energy sources connected to the device and ensuring its action.

suspensions can be described by the paper of V. A. Rantsev-Kartinov (2015), where the water drop potential formula is derived. The development of this type of SH-K&RK generator must in fact lead to the creation of an entirely new power industry. It will allow environmentally safe energy to be produced: without any additional sources and restrictions directly at site; without destroying and deforming the surface cover of the Earth and without polluting is atmosphere and water. In fact, it is true since the NESRSH can have a volume as small as 10 cm^3 with the capacity exceeding ~ 10 kW. The operation of the K&RK generator is not accompanied by any harmful radiation, i.e., it is invasive in relation to all living things. Furthermore, the authors of the invention in fact suggest a new initiation method for cold fusion reactions to generate heat from protium, but not as a result of the chemical reaction of its oxidation or thermonuclear reactions, but owing to the process which includes creating such conditions in the laboratory system that in the whole volume of the reactor of the device filled with water nano-suspension based on hydrogen-saturated palladium nano-powder at a certain

Table 1. Table of changes of temperature of a suspension, the water temperature and the temperature in the Cabinet during operation of the reactor

	Testing time, min.	Pressure in the reactor, kg/cm^2	Suspension temperature, °C	Water temperature, °C	Temperature in the box, °C
No.	1	2	3	4	5
1	0	0	14.1	14.1	14
2	2	5	13.6	14.3	14
3	3	5	13.4	14.3	13.9
4	3.5	5	13.6	14.3	13.9
5	4	5	13.6	14.4	13.8
6	5	5	13.7	14.4	13.7
7	6	5	13.8	14.4	13.6
8	7	5	13.9	14.4	13.6
9	9	5	13.9	14.5	13.5
10	9.3	5	14	14.4	13.5
11	9.6	5	14	14.5	13.5
12	11	10	14	14.4	13.3
13	11.5	10	14.1	14.4	13.3
14	14	10	14.1	14.4	13.2
15	15	15	14.2	14.4	13.2
16	17	15	14.2	14.4	13.1
17	19	20	14.2	14.3	13.1
18	22	25	14.2	14.3	13
19	25	30	14.2	14.2	13
20	27	30	14.4	14.2	12.9
21	29	30	14.1	14.2	12.9
22	29.5	30	14.2	14.2	12.9
23	30	35	14.2	14.2	12.9
24	32	35	14.1	14.2	12.9
25	33	40	14.2	14.2	12.9
26	34	40	14.2	14.1	12.9
27	35	40	14.1	14.1	12.9
28	38	11	13.9	14.2	12.9
29	39	3	13.7	14.3	12.9
30	44	2	13.7	14.2	12.8
31	61	2	13.6	14	12.8

The authors refer to the metal that dissolve hydrogen well (such as palladium, chromium, nickel, vanadium, and tantalum) as AM. The hydrogen saturation level of the water is determined by adding hydrogen fed to the operating chamber of the NESRSH. To activate such a SH it is essential to carry out the following processes: a) selection of an AM which absorbs hydrogen intensively; b) its preparation in the form of NP based on the know-how of the authors and application of the Universal Module (UM) patented by them; [Rantsev and Kulakov, 2015]; c) preparation of a suspension of this NP in light water simulating CFNR; d) ensuring that the operating chamber is sealed at hydrogen pressure ; e) feeding protium through a needle leak valve and a palladium filter. The initial approach to the initiation stage of CFNR process in such

pressure (virtually at room temperature or at a temperature of several hundreds of degrees) under the action of the nano-powder of electric fields in nano-scale there appears a hydrogen plasma of such a density (know-how of the authors) with which superexchange quantum forces act (previously first described and considered by A.V. Kulakov (Kulakov and Rumyantsev, 1988; Kulakov et al., 1990; Kulakov, 2017), (Kulakov, 1988; Kulakov, 1990; Kulakov, 2017) leading to such a degree of its compression where the distance between particles becomes smaller than de Broglie wave length of electrons at a given temperature.The authors think that in the plasma studied herein the same conditions exist as may take place inside the stars where neutrons must be born with the ready mass defect of ~ 1.44 MeV.

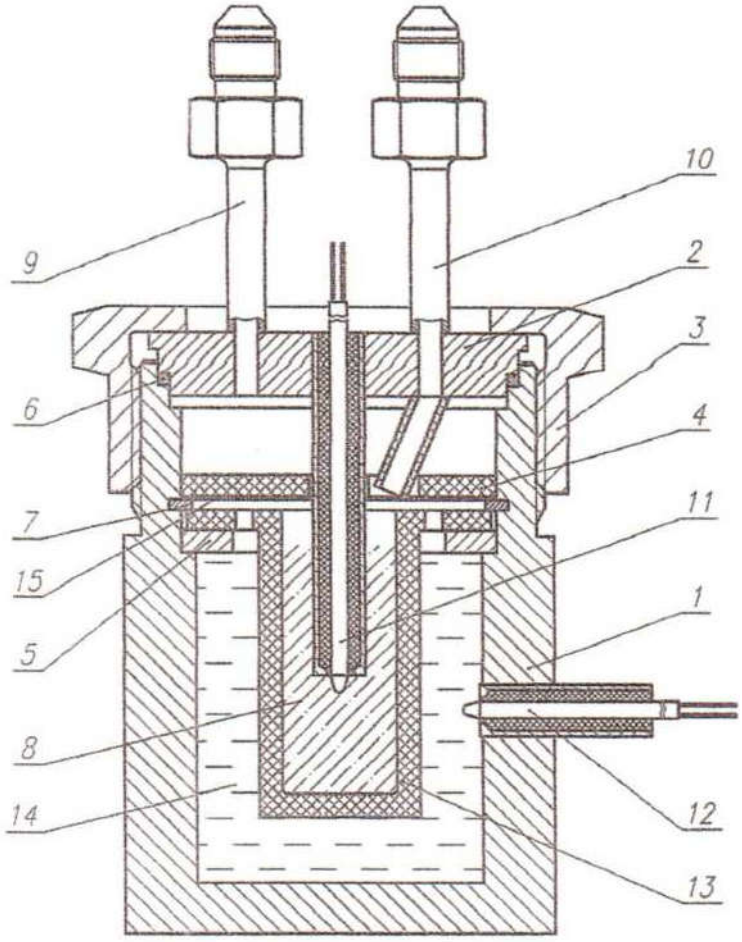

Fig.1. General view of the NESRSH

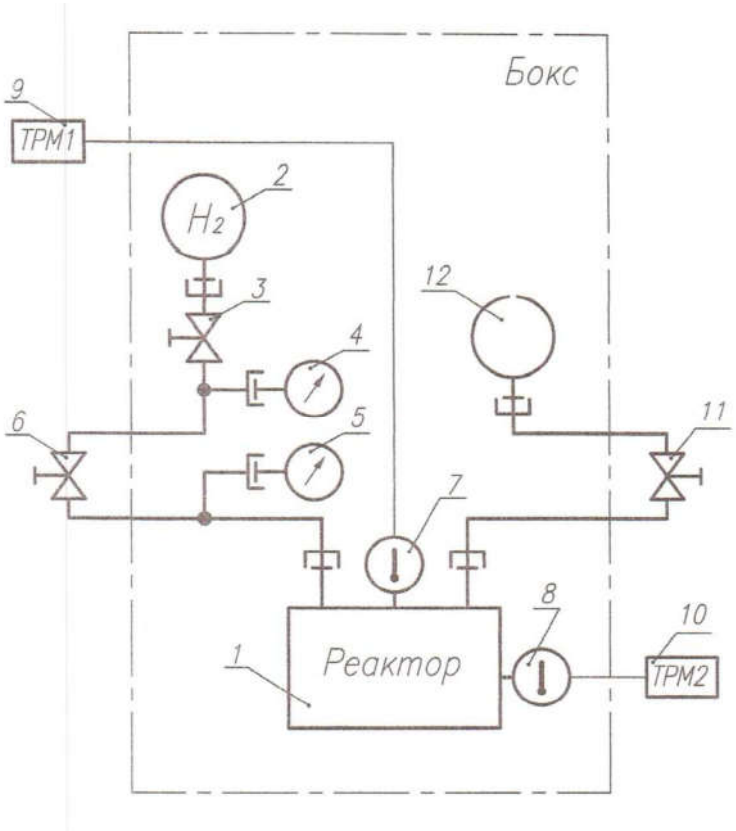

Fig. 2. NESRSH connection to the mountings and equipment

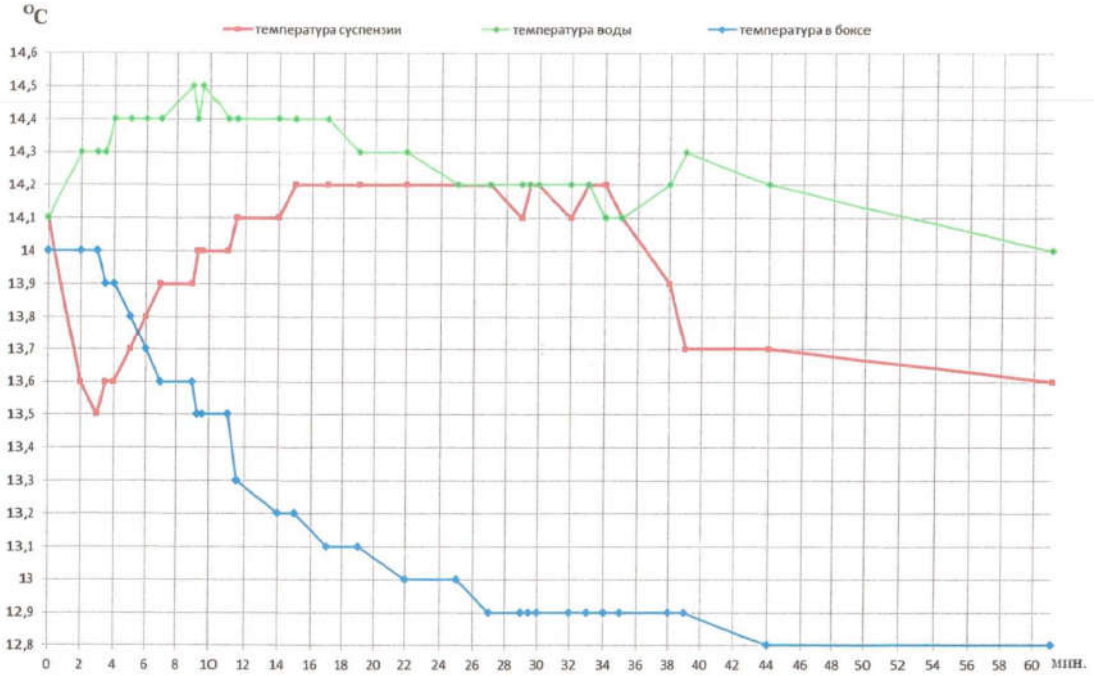

Fig.3. Graphs of temperature changes of a suspension, the water temperature and the temperature in the Cabinet during operation of the reactor, the same figure Russian names replaced by English: the temperature of the suspension, the water temperature, the temperature in the box

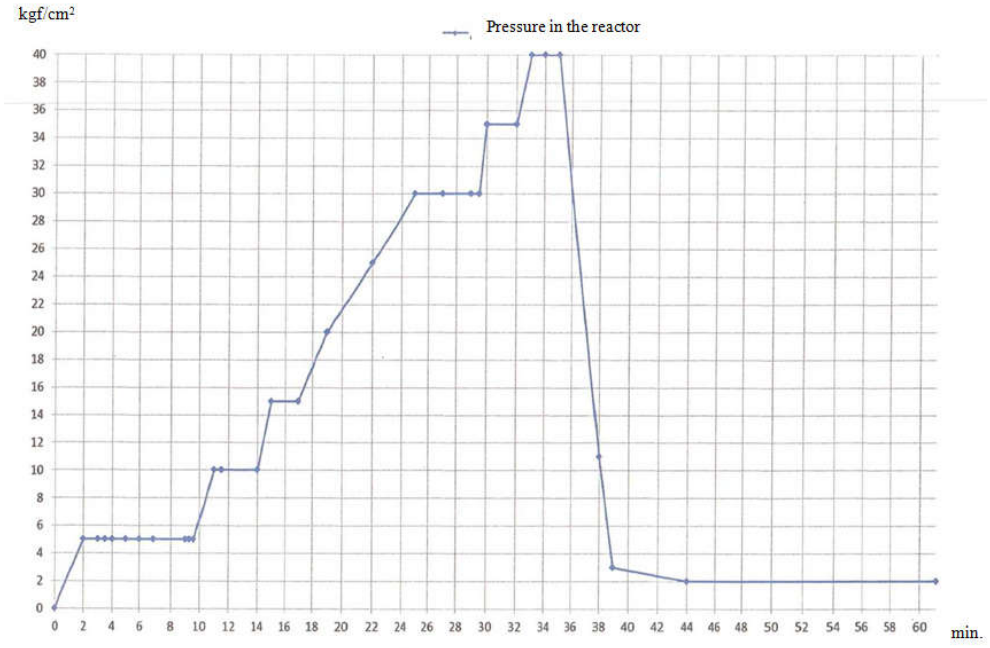

Fig.4 Pressure curve

In fact, such processes take place in star neutronization processes when the whole star matter is transformed into neutrons which ultimately lead to the production of neutron stars. The transformation process of proton to neutron with entrapped plasma electron can be shown by the following formula. Since no energy is by any means supplied to the reactor of the device, the neutron produced in this plasma is a thermal one ($E_n \approx 3 \cdot 10^{-2} eV$) with a very big section of radioactive capture by atomic nuclei of the near nuclei, in this case protons, near the energy of the excited nucleus state *(n, y)*$\approx 10^6$ *barn*, and this reaction takes place as a result of a strong interaction. Our theoretical research showed that deutron formation occurs in the proposed experiment with a special type of plasma near the particles of nano-power in the above nano-suspension when there is a contact between the proton and "ready" neutron (as it happens in stellar interiors) which preliminarily acquired the initial mass defect ensuring deuteron-binding energy. With the setting of this experiment you need not overcome Coulomb repulsion of nuclei and use high temperature to draw them closer since the conditions created in the reactor generate an extremely dense quantum interacting hydrogen plasma near the nano-particles of the hydrogen-saturated water nano-suspension which meets the condition that the distance between the particles is a priori lower than de Broglie wave length of electrons at a given temperature.

The formula of the invention can be written as follows

The invention - "New environmentally safe reactor- source of heat" K&RK is a high pressure device that emits heat at the expense of cold fusion nuclear reactions in it and that includes: body of a heater filled with heat carrier in the form of light water; where a fused quartz operating chamber is partially submersed filled with a suspension of the nano-powder of active metal prepared based on the nano-technology developed by the authors based on using the Universal Module (UM) patented by the same in ordinary water, which in the presence of hydrogen stimulates fusion reactions; lid of the body of the heater with vacuum power points of thermocouples (atmosphere and heat carrier of the heater, suspension of the operating chamber) and a gas tube to feed hydrogen from the bottle through a needle leak valve to the operating chamber to achieve the required pressure recorded by a pressure gauge and distinguished by the following: 1) the device does not have any external energy sources; 2) nano-powder has been selected as active metal; 3) the authors propose cold fusion nuclear reactions as the main source of energy emitted by the device, the behavior of which and theoretical calculations are a know-how of the authors; 4) suspension of the nano-powder of active metal in hydrogen-saturated water is proposed as an activator and a fuel for cold fusion nuclear reactions; 5) the level of hydrogen saturation in water is regulated by its pressure in the operating chamber ; 6) the power of the source is regulated by the concentration of the nano-powder of active metal in the suspension, the overall weight of the nano-powder and hydrogen pressure in the operating chamber of the device. In order to confirm the theoretical results of the discovery, the authors carried out an experiment to obtain heat power on the new environmentally safe source of heat operating on the nano-powder with characteristic particle size within (70÷100) nm. As the processed results showed, the authors obtained a specific power yield equal to $p = 5\ ^{w}/_{g}$ which was in line with the theoretical results of the calculations. Since, as the theory of the authors suggests, the specific power of the energy release process in the reactor under consideration must depend on hydrogen pressure; fineness of nano-powder; temperature; the authors are confident that they will be able to achieve this parameter $p = 500\ ^{w}/_{g}$. The NESRSH-K&RK generator is brought to working condition by the following scenario: the body of the heater is filled with water, except the volume of the operating chamber; the operating chamber is filled with 500mg of the suspension prepared using a special technology developed by the authors. Nano-powder of active metal in water; after that the operating chamber is placed on the annular batter of the internal wall of the heater body in the operating chamber, the heat carrier of the heater and in the gap between the heater lid and the ends of the operating chamber, i.e., into the atmosphere of the heater, the respective thermocouples are inserted, the body of the heater is closed with its lid and sealed; hydrogen under s suitable pressure is fed over the corresponding tube of the gas line from the bottle through a needle leak valve. This moment is considered to be a base point for activating cold fusion nuclear reactions.

Testing the reactor-source of heat NESRSH

The general view of the NESRSH-K&RK generator and its connection to the mountings and equipment is presented in Figure 1 and 2 respectively. The water suspension of nickel nano-powder with a particle size of 70-80nm was placed in the sleeve pos. 13 (Fig.1) In order to displace air from the reactor, the testing was preceded by hydrogen blowdown at a pressure of 2 kgf/cm" for 3 minutes. After which hydrogen was gradually fed to the reactor-source of heat through the nozzle pos. 10 (Fig.1) at a variable pressure from 5 kgf/cm² to 40 kgf/cm² and was retained within the periodof time presented in Table 1. Temperatures of water suspension, distilled water and temperatures in the box were recorded based on the readings of instruments pos. 9, 10 (Fig.2) with a measuring accuracy of 0.1 °C and combined instrument TESTO 622. The test results are presented in Table 1 and in Graphics in Fig. 3,4.

1-body; 2-lid; 3-nut; 4-sleeve cover; 5-bushing; 6-gasket 7-lock ring; 8-suspension (a mixture of nickel nano-powder and distilled water); 9-pressure relief nozzle; 10-pressure supply nozzle; 11- resistance temperature detector for measuring suspension temperature; 12-;resistance temperature detector for measuring distilled water temperature 13-PTFE sleeve; 14-distilled water (V=94 cm); 15-aluminum foil. -reactor; 2-hydrogen bottle; 3-hydrogen bottle valve; 4-pressure gauge (bottle pressure); 5-pressure gauge (reactor pressure); 6-pressure supply valve; 7-resistance temperature detector (suspension temperature); 8-resistance temperature detector (water temperature); 9,10-universal measuring regulator (TPM138); 11-pressure relief valve; 12-bottle with a hole. It is noteworthy that the nano-powder of active metal and suspension out of it in water is prepared based on the nano-technologies developed by the authors with the use of their proprietary Universal Modules. The proposed device allows increasing the heat power yield efficiency in its operating chamber by an order of magnitude per unit of the mass of the matter residing in it, which can be only conditionally be regarded as fuel since the energy emitted in it is determined by cold fusion nuclear reactions occurring in the nuclei of the substances which form part of the suspension of the nano-powder of active metal in ordinary water at hydrogen pressure. The operating chamber of the source consumes mostly nuclei of water and gas hydrogen which are converted to the nuclei of heavier elements by transmutation, whereby each act (without generating any harmful radiation) produces an absolutely environmentally safe heat energy owing to the mass defect. In principle, the proposed scheme of the source of heat energy-K&RK generator can be calculated for any total capacity - from mkW and to hundreds of GW, therefore, it is applicable as a heat activator of physical and chemical processes and can be used for developing new elements andalso as a heat engine in various production sectors.

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