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(54) Title: DEVICE FOR HYDROGEN GENERATION BY CAVITATION ELECTROLYSIS

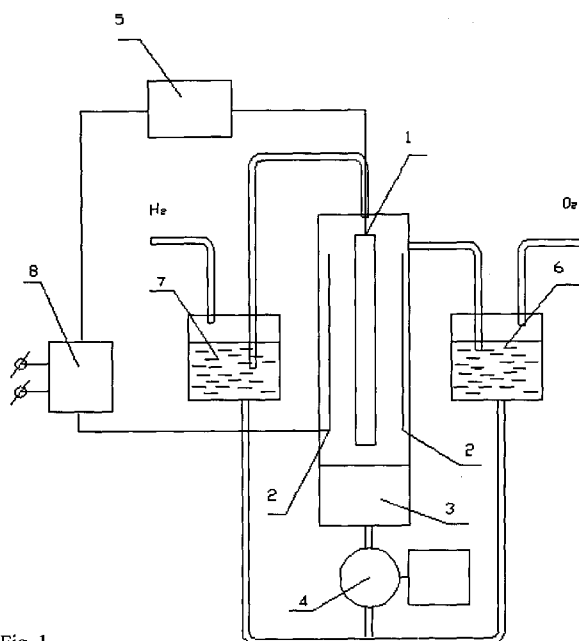


Fig. 1

(57) Abstract: The present invention relates to cavitation-electrolysis hydrogen generator. The cavitation-electrolysis hydrogen generator of the present invention comprises a filled with water cylindrical cavitator, located in it cathode and anode, connected by tube to cavitators bottom circulation water pump, connected to cathode and anode pulsed energy source, voltage modulator, hydrogen and oxygen tanks connected to pump and cavitators upper part, were enriched by hydrogen and oxygen water undergoes degassing and by connected to tank tube hydrogen output is obtained. According to the cavitation-electrolysis hydrogen generator of the present invention, there are advantages in that the efficiency of hydrogen generation can be improved by energy effective combination of cavitation and electrolysis and hydrogen production costs also is remarkably reduced due to device cheap materials construction.

DESCREPTION

Today hydrogen is obtained mainly from natural gas and despite the fact that this technology is energetically very competitive, development of this technology is not considered as a perspective direction. Firstly, natural gas is not renewable source of energy; secondly, this technology is characterized with greenhouse gases emission during the production of hydrogen. Therefore, production of hydrogen from natural gas cannot solve the problem of global warming. Same problems are presented during hydrogen production from coal.

Only completely clean technology of hydrogen production is electrolysis, but today its high energy consumption rate is a barrier for its commercialization. We propose solving exactly this problem in this invention with absolutely new cavitation-electrolysis method, which not only significantly decreases the energy consumption but also reduces cost of device.

The several types of electrolysis are currently known with their strong and weak points. Especial we would like to underline the two types of technologies: high temperature and high pressure electrolysis. Our completely new type cavitation-electrolysis method unites the strong sides of these technologies and doesn't include their weak points. For example, in the cavitation bubble very high temperatures and high pressures are located. Therefore we need not high pressure proof containers because high pressure is located in the cavitation bubble. As a result the cost of technology significantly decreases; the high pressure proof containers are costly technology. In the given technology for reaching high temperatures providing of additional heat is not required. As a result we have also significant increase in energy efficiency.

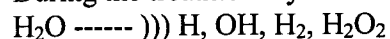
In widely-spread electrolyzers chemically very active catalysts are used, therefore electrodes are required to be covered by rare substances (for example platinum), which also makes this technology more expensive compared to our method which has no such requirements.

Really we have a new method of hydrogen production and a device, which by its main characteristics is cavitation physical-chemical reactor - electrolysis cell.

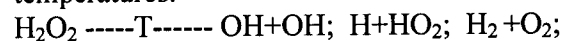
Most close to this invention is a cavitation hydrogen generator, which is represented by US patent (1), which used only hydraulic cavitation. In presented invention also effectively is used nonlinear electrolysis method, as a result efficiency of device increased compare to prototype. What about Meyer's nonlinear etecrolysis device, improved method of which is used in this invention, it without modification has production rate restriction. This problem is overcome in given invention.

Given method differs from existed electrolysis technologies mainly with using of cavitaiion. Cavitation phenomenon is interesting by itself with diversity, contradictive and amazing discoveries.

Cavitation is defined as disruption of fluid by arising of negative pressure. The pressure decrease may be achieved by different methods: by fluid stream flow round the body, by solid body movement with high velocity through the fluid, by pushing fluid by plunger, by fast tearing away the plunger, by fluid turbulence. Also it is known acoustic ultrasonic cavitation. Therefore, mainly there are two types of cavitation in the fluid: acoustic and hydrodynamical. It is worth to mention separately the ultrasonic cavitation: sonoluminiscence and sonochemistry. The chemical effects of ultrasonic cavitation chemistry, sonochemistry are well investigated. During the treatment by ultrasound in water develops next reactions:



Next thermal splitting reactions may develop in cavitaiion bubble as a result of high temperatures:



As we saw, during the ultrasonic cavitation hydrogen is made and this fact is well known for science, but this process is charactered with high recombination rate. Thus, ultrasonic

cavitation is not used for production of industrial hydrogen. In our technology hydrodynamical turbulent cavitator is used, which differs from sonochemistry and allows to treat huge mass of water and can obtain significant amount of hydrogen.

Cavitation bubble collapse produces intense local heating (5000K), high pressures (~1000 atm.), and enormous heating and cooling rates (>100k/sec), providing a unique interaction of energy and matter. These extreme conditions affect hydrogen bonding in water and facilitate destruction of water clusters, reducing energy consumption for the electrolysis.

One of the objectives of invention is development of turbulent cavitation theoretical model by mathematical modeling. Another objective of project is theoretical investigation of hydrogen bonding in water and experimental investigation of its effects on water macro properties. We think that hydrogen bonding and cluster formation in water affects electrolysis efficiency.

Developed during cavitation phenomenon can be considered as plasma. It is also known that plasma chemical methods of hydrogen production are one of the most energy effective. Plasma chemical processes which are obtained by nonuniform plasma high frequency treatment of water are very energy effective.

In our device cavitation and electrolysis in other words plasma-chemical and electrochemical effective combination is used and achieved maximal energy efficiency.

Expected result of invention is development of completely new cheap hydrogen technology by cavitation electrolysis method. It is expected that obtained by this technology electrolyzer will be 10 times cheaper of existed prototypes. The energy efficiency also will increase.

Really we have a new hydrogen production method and device, which by its main characteristics is cavitation physical-chemical reactor - electrolysis cell. We developed absolutely new approach for electrolysis: cavitation electrolysis method. Our approach is based on the investigation of fundamental properties of water, investigation of hydrogen bonding in water and its effects on water properties, investigation of cavitation effects on water fundamental properties and its usage for electrolysis.

The device for production of hydrogen by cavitation electrolysis method is shown on Fig. 1.

Numbers indicate:

1,2 - electrodes, cylindrical cathode and anode;

3 - cavitator;

4 - water pump;

5 - modulator;

6, 7 - oxygen and hydrogen tanks;

8 - energy source.

Electrodes 1, 2 - anode and cathode are made from stainless steel.

Cavitator includes water input and output parts.

Water pump 4 is chosen by hydrogen production rates demand.

Modulator 5 includes resonance circuit elements.

Energy source 8 supplies pulsed voltage.

Cavitation electrolysis device operates on next principle:

By means of water pump (4) water is supplied to cavitator (3), in which it undergoes turbulent hydraulic cavitation. Water continues cavitating and turbulent rotation, goes up and appears between coaxial, made from stainless steel cylindrical electrodes (1, 2) (cathode and anode). Electrodes are supplied by special impulse high frequency water own frequency modulate current. On the first electrode - cathode hydrogen is generated, second electrode (anode) - oxygen is generated. Gas accumulation on electrodes by generation from water by cavitation and electrolysis is more stimulated also by water rotation centrifugal effect. The distance between electrodes should be sufficient that water enriched by oxygen and hydrogen should not be mixed up. Electrodes with supplied water play role of condenser in resonance circuit which is regulated according to water own frequencies. Device size is defined by production rates. Accordingly is made modulator which is switched on in circuit between energy source and cathode. Only main issue which should be taken into account is water own frequency. As a result a device has not upper and lower production limits.

After passing space through electrodes enriched by hydrogen and oxygen water flows by tubes in two different tanks and undergoes degassing. After this water by tubes located at the bottom of tanks through the pump returns to cyclic system. Obtained hydrogen and oxygen lead out by tubes which are located on hydrogen and oxygen tanks.

Device does not need purified water and can work on tap water. Device also can work on sea water, with adjustment for sea water frequency. Also it should be taken into account on this case utilization of additional products obtained during sea water electrolysis.

1. US, 6719817B1, 13.04.2004

CLAIMS

1. Hydrogen generation cavitation electrolysis device comprises filled with water cylindrical cavitator, located in it cathode and anode, which are made from stainless steel and have coaxial cylindrical form, connected by tube to cavitator circulation water pump, connected to cathode and anode pulsed energy source, switched on in the circuit between energy source and cathode modulator, connected to cavitator upper part by tube hydrogen tank, connected to cavitator upper part by tube oxygen tank, connected to these tanks bottom parts by tubes mentioned above water pump, connected to hydrogen and oxygen tanks gas output tubes.

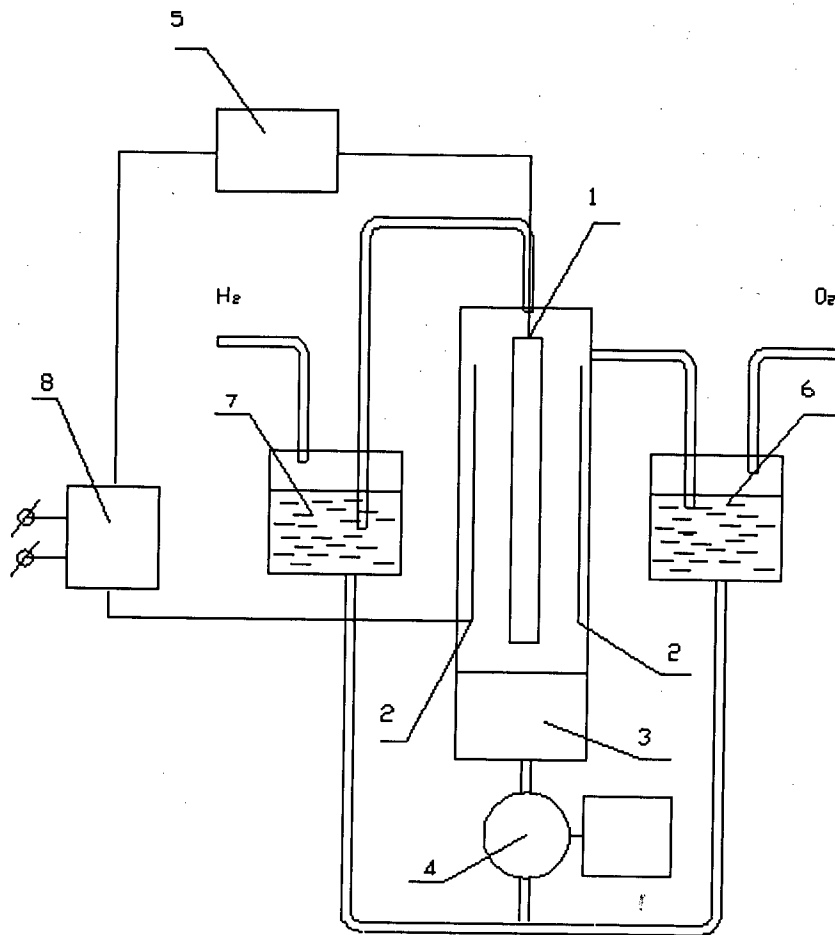


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. C25B1/04 C25B11/02 C25B15/08 C25B9/00
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
C25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

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- "O" document referring to an oral disclosure, use, exhibition or other means
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- "&" document member of the same patent family

Date of the actual completion of the international search 12 February 2014	Date of mailing of the international search report 19/02/2014
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Perednis, Dainius
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INTERNATIONAL SEARCH REPORT

International application No
PCT/GE2013/000009

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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International application No PCT/GE2013/000009

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