Hydrogen production patents

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Preliminary calculations suggest that 530 million tons of hydrogen can be obtained from the utilization of heat from blast-furnace and converter processes in the global steel production, which is approximately 8 times higher than the current annual production of hydrogen (75 million tons). Mankind, already now, by introducing everywhere the technology of utilizing the heat of cooling steel for the pyrolysis of methane, can achieve an 8-fold excess of world hydrogen production.

To date, the use of heat from metallurgical processes (steel) for methane pyrolysis using all available possibilities for the maximum high-quality and relatively cheap separation of methane into soot and hydrogen is an important tactical task. In the process of globally organized petrochemical production of hydrogen by cracking methane in the steelmaking process, it is possible to arrange the production of high-purity hydrogen and high-purity carbon for further synthesis of tubulenes, graphene-like and fullerene-like materials. However, the following tasks stand in the way of this problem: 1) careful study of the behavior of saturated hydrocarbons, including methane at near-critical parameters and supercritical parameters, 2) organization of the optimal process for removing soot (carbon) from a catalytic cracking processor, 3) profiling the optimal design of catalytic cracking – processor.

Modern patents are described below:

US2024286893 (A1)

The technology relates to a process and system for producing a gas comprising nitrogen (N2) and hydrogen (H2) in a reaction chamber of length L of a reactor. The process comprises injecting air and injecting hydrogen into the reactor and the combustion of a portion of the injected hydrogen with the oxygen from the air in the reaction chamber, in the presence of an overstoichiometric molar excess of hydrogen relative to the oxygen from the air. The combustion is supported by a flame produced by an air flow having a velocity v1 resulting from the injection of air, surrounded by a hydrogen flow having a velocity v2 resulting from the injection of hydrogen, with the velocity v2 being greater than v1.

WO2024172018 (A1)

Provided is a technology which controls the film quality of a precoat. Provided is a plasma treatment method. This method comprises: (a) a step for forming a precoat including a carbon-contained film on a constituent member in a chamber; (b) a step for providing a first substrate on a substrate supporting part in the chamber; and (c) a step for plasma-treating the first substrate. (a) includes: (a1) a step for providing, into the chamber, a first treatment gas including a first gas including carbon and hydrogen; (a2) a step for providing a source RF signal and generating plasma from the first treatment gas; and (a3) a step for providing a bias signal of 90 eV or higher to the constituent member in the chamber.

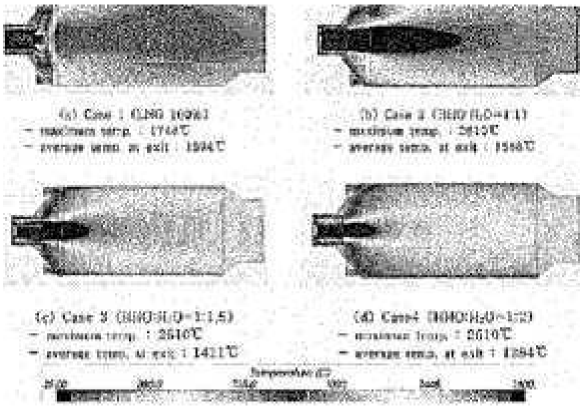
WO2024164453 (A1)

The present invention relates to a method for constructing a risk monitoring and early warning tool of a fuel cell vehicle-mounted hydrogen system. The method comprises the following steps: constructing a device database of a fuel cell vehicle-mounted hydrogen system and a hydrogen leakage database; processing the device database by using a minimum cutset algorithm, so as to obtain a first risk evaluation result, and performing physical analysis on the hydrogen leakage database to obtain a second risk evaluation result; and comprehensively processing the first risk evaluation result and the second risk evaluation result and and performing display. The present invention can implement monitoring and early warning on a risk of a vehicle-mounted hydrogen system, provides guidance for safety management of a hydrogen fuel cell vehicle, and can promote the development and widespread application of hydrogen fuel cell technology.

US2024271825 (A1)

Disclosed is a control method for a hydrogen-fueled domestic gas water heater. A staged combustion technology and a fully premixed combustion technology are combined in the method, a controller judges a combustion mode according to inlet water flow and set hot water input temperature, staged combustion of the hydrogen on a combustor is achieved due to the arrangement of two electromagnetic valves and the staged combustor, and meanwhile the stable combustion of the hydrogen can be achieved by adjusting a rotating speed of a fan and magnitude of currents of a gas proportional valve; and an oxygen sensor is arranged on a exhaust pipe, and the controller judges whether actual hydrogen combustion reaches an optimal state by monitoring outlet water temperature and oxygen concentration in flue gas and performs adjustment.

WO2024158227 (A1)

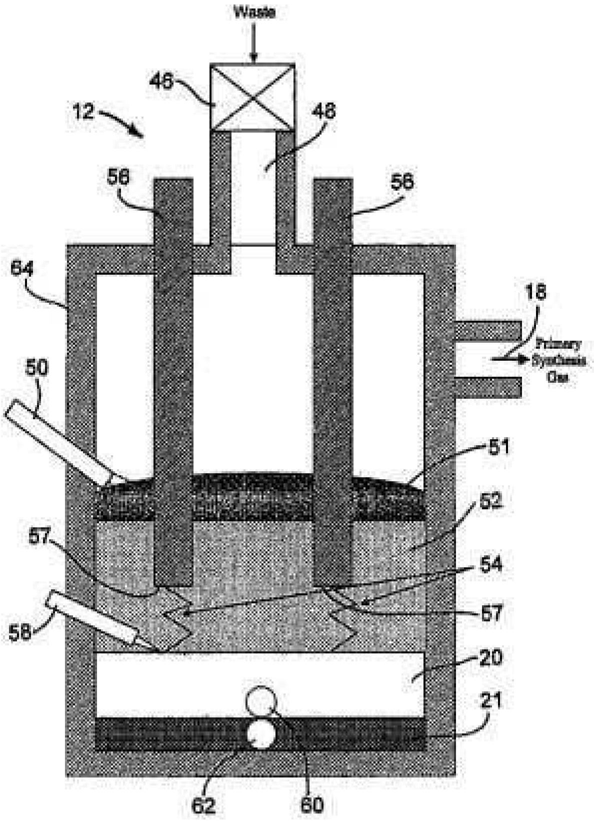


Disclosed is a mixed composition fuel produced after the combustion of hydrogen and oxygen. The mixed composition fuel produced after the combustion of hydrogen and oxygen is prepared by a process in which secondary combustion gas pyrolyzed in a steam injection-heat storage unit is mixed with a fuel in which water vapor is mixed with a water electrolysis gas. In particular, this process includes: a first step for preparing the mixed composition fuel in which the secondary combustion gas pyrolyzed in the steam injection-heat storage unit is mixed with the fuel in which water electrolysis gas and water vapor are mixed; and a second step for using combustion equipment to combust the mixed composition fuel in which the secondary combustion gas pyrolyzed in the steam injection-heat storage unit is mixed with the fuel in which water electrolysis gas and water vapor are mixed. Therefore, the present invention can solve the problem inherent in technology for improving combustion efficiency and reducing pollutants wherein the amount of water electrolysis gas that can be mixed and combusted is significantly limited because flame temperature increases when water vapor is not mixed.

WO2024150736 (A1)

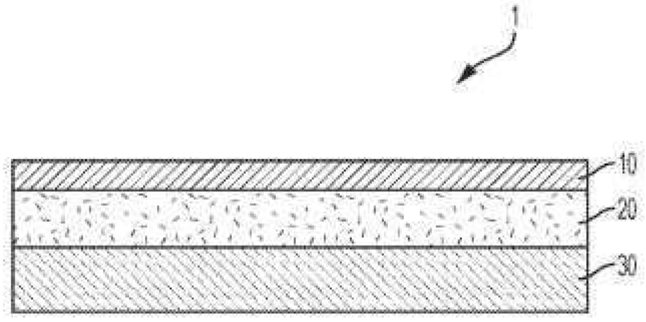
[Problem] To provide a technology capable of realizing intermittent or continuous production of hydrogen by bringing a metal such as magnesium hydride or magnesium metal into contact with water vapor and controlling the reaction to generate hydrogen gas, metal oxide, and heat as products. [Solution] A hydrogen gas production method that triggers a reaction that reacts a metal with water vapor to generate a metal oxide and hydrogen by introducing water vapor into a reactor housing a metal and recovers a gas that contains hydrogen from the reactor, wherein an inert gas is introduced into the reactor to stop the reaction, or the oxygen concentration of the gas recovered from the reactor is kept lower than the explosive limit oxygen concentration of hydrogen. Furthermore, the oxygen concentration can be kept low by reducing the oxygen content of the water vapor, and the temperature of the gas recovered from the reactor can be kept at a predetermined temperature if the inside of the reactor is cooled.

US2024240093 (A1)



A two-step gasification process and apparatus for the conversion of solid or liquid organic waste into clean fuel, suitable for use in a gas engine or a gas burner, is described. The waste is fed initially into a primary gasifier, which is a graphite arc furnace. Within the primary gasifier, the organic components of the waste are mixed with a predetermined amount of air, oxygen or steam, and converted into volatiles and soot. The volatiles consist mainly of carbon monoxide and hydrogen, and may include a variety of other hydrocarbons and some fly ash. The gas exiting the primary gasifier first passes through a hot cyclone, where some of the soot and most of the fly ash is collected and returned to the primary gasifier. The remaining soot along with the volatile organic compounds is further treated in a secondary gasifier where the soot and the volatile compounds mix with a high temperature plasma jet and a metered amount of air, oxygen or steam, and are converted into a synthesis gas consisting primarily of carbon monoxide and hydrogen. The synthesis gas is then quenched and cleaned to form a clean fuel gas suitable for use in a gas engine or a gas burner. This offers higher thermal efficiency than conventional technology and produces a cleaner fuel than other known alternatives.

SA521421328 (B1)



Polymer membranes include a polymer material that is selectively permeable to acidic gases over methane in a gas stream, such as natural gas. The polymer material may be a polymer membrane comprising a fluorinated polytriazole polymer. The fluorinated polytriazole polymer may further comprise a substituted phenyl or a substituted benzenaminyl. The substituted phenyl or substituted benzenaminyl may be substituted with hydrogen, bromo, fluoro, chloro, iodo, hydroxy, methyl, trifluoromethyl, dimethylamino, tert-butyl, or difluoromethoxy groups. The polymer material may have a degree of polymerization of from 100 to 175. The polymer membranes may be incorporated into systems or methods for removing separable gases, such as acidic gases, from gas streams, such as natural gas.

WO2024138147 (A1)

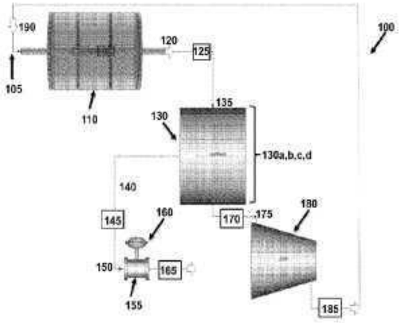
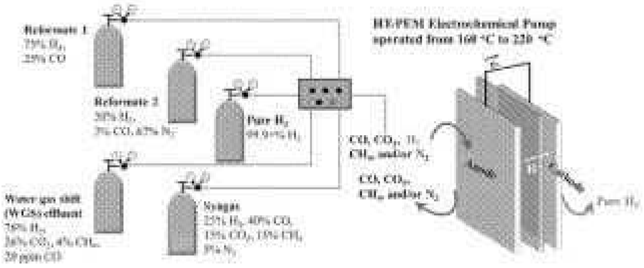


FIG. 1

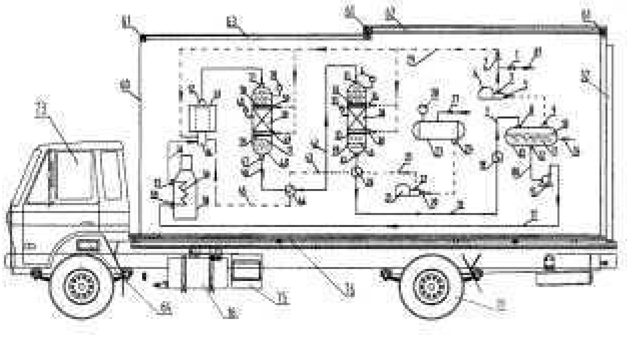
Provided herein are systems and processes for hydrogen production and storage. The systems have three main components that are a plasma-based reformer, a membrane and separation component and a gas compressor(s) that form a continuous fluid loop. The systems also may have a storage system for hydrogen energy storage. In the process natural gas is reformed in the plasma-based reformer into a mix of hydrogen and low-molecular weight hydrocarbons, flowed into the membrane and separation component where the hydrogen is separated out of the mix and stored and the hydrocarbons are recirculated via the gas compressors to the plasma-based reformer.

US2024209523 (A1)


HT-PEM Electrochemical Pump
operated from 160 °C to 220 °C
Reformate 1
75% H_2
25% CO
Reformate 2
30% H_2
3% CO, 67% N_2
Pure H_2
99.9+% H_2
Water gas shift
(WGS) effluent
70% H_2
26% CO_2, 4% CH_4
20 ppm CO
Syngas
25% H_2, 40% CO
15% CO_2, 15% CH_4
5% N_2
CO, CO_2, H_2
CH_4 and/or N_2
CO, CO_2,
CH_4 and/or N_2
Anode
Cathode
Pure H_2

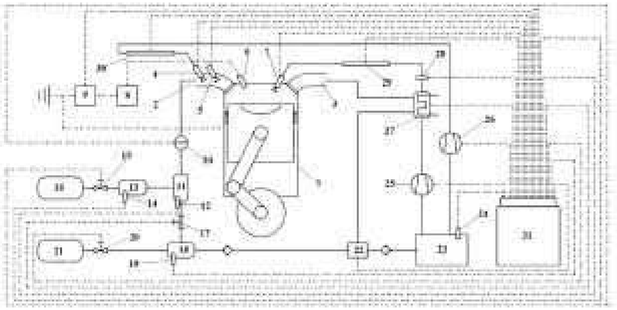
The present disclosure provides for electrochemical hydrogen pumps and methods of producing hydrogen. Embodiments provide for efficient and high yielding electrochemical hydrogen pumps that can operate at high temperatures here other pumps cannot operate effectively and an electrochemical hydrogen pump that can purify hydrogen from gas mixtures with large carbon monoxide compositions as other electrochemical hydrogen pumps technology cannot operate effectively with carbon monoxide in the gas mixture.

CN118224516 (A)



The invention relates to a special vehicle and method for hydrogen storage, hydrogen transportation and dehydrogenation, the special vehicle is mainly composed of a container and a transportation vehicle, the container is provided with hydrogen storage, hydrogen transportation and dehydrogenation equipment, the container is fixed on a chassis of the transportation vehicle to form a whole, and the special vehicle for hydrogen storage, hydrogen transportation and dehydrogenation is formed; by adopting a liquid organic matter hydrogen storage/dehydrogenation technology (LOHC for short), a DL-1 type solid catalyst (Raney-Ni-W-Co/Al2O3) disclosed by the invention can improve the hydrogenation/dehydrogenation catalytic reaction activity of unsaturated liquid organic matters and the efficiency of an industrial fixed bed reactor, and the special vehicle disclosed by the invention can implement a coordinated service of hydrogen storage, hydrogen transportation, dehydrogenation and hydrogen supply. The problems of tedious flow, multiple links, low efficiency and high cost in hydrogen storage, transportation and use are solved; the system has the advantages of high hydrogen storage capacity of a transport vehicle, short operation process, low investment, low operation cost, safety, reliability and comprehensive scientific operation and management, and has good industrial practicability.

CN118208342 (A)



The invention provides a hydrogen-oxygen-argon premixed combustion system based on ionic current, an air inlet channel and in-cylinder composite water spraying and a control method of the hydrogen-oxygen-argon premixed combustion system. According to the hydrogen-oxygen-argon premixed combustion system, the ionic current detection technology and the air inlet channel and in-cylinder composite water spraying technology are combined, the abnormal combustion condition in a cylinder is monitored in real time through ionic current, and the combustion process of an engine is optimized and controlled in cooperation with the air inlet channel and in-cylinder water spraying technology; therefore, efficient and stable closed-loop control of the hydrogen-oxygen-argon premixed combustion system is finally realized. Monitoring and efficient closed-loop control of abnormal combustion of the engine can be achieved, stable pressurization of mixed gas of an argon closed circulation loop is achieved, the heat efficiency and load of the engine are further improved, a foundation is laid for industrial application of the hydrogen fuel argon circulation engine, and great research significance and application value are achieved.

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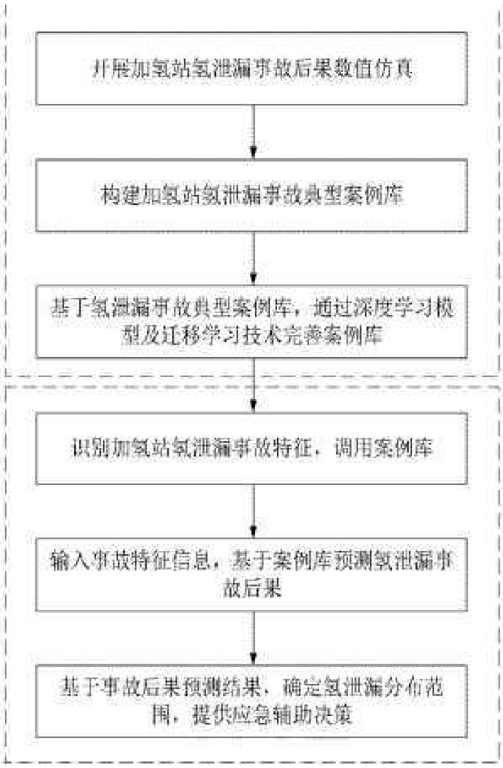
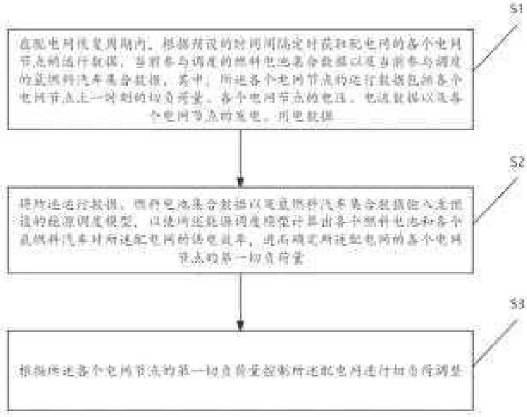

开展加氢站氢泄漏事故后果数值仿真
构建加氢站氢泄漏事故典型案例库
基于氢泄漏事故典型案例库，通过深度学习模型及迁移学习技术完善案例库
识别加氢站氢泄漏事故特征，调用案例库
输入事故特征信息，基于案例库预测氢泄漏事故后果
基于事故后果预测结果，确定氢泄漏分布范围，提供应急辅助决策

The invention discloses a method for intelligently and quickly predicting a hydrogen refueling station leakage accident consequence based on a case library, which belongs to the technical field of hydrogen refueling station accident consequence prediction, and comprises the following steps: carrying out hydrogen refueling station hydrogen leakage accident consequence numerical simulation; constructing a hydrogen refueling station hydrogen leakage accident typical case library based on a hydrogen refueling station numerical simulation result; a typical case library of hydrogen leakage accidents of the hydrogen refueling station is perfected through a deep learning model and a transfer learning technology; identifying leakage accident characteristics of the hydrogen refueling station and calling a hydrogen leakage accident typical case library to obtain scene label information; inputting scene label information and predicting a leakage accident consequence based on a hydrogen leakage accident typical case library; and determining a leaked hydrogen distribution range based on a prediction result and providing an emergency aid decision. According to the intelligent and rapid prediction method for the leakage accident consequence of the hydrogen refueling station based on the case library, rapid and accurate consequence prediction can be provided for the hydrogen leakage accident of the hydrogen refueling station, and then auxiliary decision making is provided for accident emergency disposal.

CN221134065 (U)

The utility model relates to the field of hydrogen decrepitation furnaces, in particular to a hydrogen injection structure of a hydrogen decrepitation furnace, the hydrogen injection structure can fully mix hydrogen and nitrogen, and a quick disassembly and assembly structure is arranged between the hydrogen injection structure and the hydrogen decrepitation furnace, so that the problems proposed in the background technology are effectively solved. Comprising a hydrogen storage tank and a nitrogen storage tank, the hydrogen storage tank and the nitrogen storage tank are connected with a mixing tank through conveying pipes respectively, the mixing tank is connected with a transfer tank through a connecting pipe, a gas inlet pipe is arranged on the right side of the transfer tank, and the right end of the gas inlet pipe is connected with a hydrogen crushing furnace through a quick disassembly and assembly structure; a one-way valve, a conveying pump, a regulating valve and a flow meter are arranged on the conveying pipe; an auxiliary mixing structure is arranged on the transfer tank. The device is easy to operate, convenient to use and suitable for various types of hydrogen decrepitation furnaces.

CN118199083 (A)


S1
在配电网恢复周期内，根据预设的时间间隔定时获取配电网的各个电网节点的运行数据、当前参与调度的燃料电池集合数据以及当前参与调度的氢燃料汽车集合数据，其中，所述各个电网节点的运行数据包括各个电网节点上一时刻的切负荷量、各个电网节点的电压、电流数据以及各个电网节点的发电、用电数据
S2
将所述运行数据、燃料电池集合数据以及氢燃料汽车集合数据输入至预设的能源调度模型，以使所述能源调度模型计算出各个燃料电池和各个氢燃料汽车对所述配电网的供电效率，进而确定所述配电网的各个电网节点的第一切负荷量
S3
根据所述各个电网节点的第一切负荷量控制所述配电网进行切负荷调整

The invention provides a load shedding adjustment method and system based on hydrogen energy storage and a hydrogen fuel automobile. According to a preset time interval, regularly obtaining operation data of each power grid node of the power distribution network, set data of fuel cells currently participating in scheduling and set data of hydrogen fuel vehicles currently participating in scheduling; inputting the operation data, the fuel cell set data and the hydrogen fuel vehicle set data into a preset energy scheduling model, so that the energy scheduling model calculates the power supply efficiency of each fuel cell and each hydrogen fuel vehicle to the power distribution network, and further determines a first cut load capacity of each power grid node of the power distribution network; and controlling the power distribution network to perform load shedding adjustment according to the first load shedding amount of each power grid node. According to the invention, the hydrogen energy technology is integrated into the electric power infrastructure, so that the power supply elasticity and recovery efficiency of the power distribution network in an extreme environment are effectively improved.

Clean energy technology experts at S&P Global Commodity Insights has identified and summarized the top ten cleantech trends expected this year. This complimentary interactive report offers an exploration of our data, analysis, and insights across the cleantech spectrum to help market players understand what lies ahead in clean energy technology sector. Cleantech investment is critical to delivering emissions reductions. S&P Global Commodity Insights help identify and execute on strategies involving the mainstream and emerging clean energy technologies that can accelerate decarbonization.