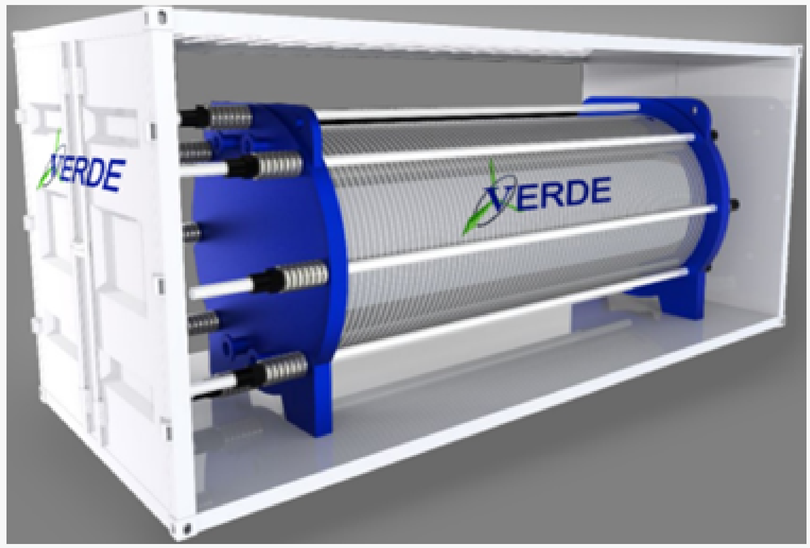
Breakthrough Electrolyzer Design for Variable Renewable



BOSTON, MA, USA, October 13, 2022 /EINPresswire.com/ -- Green hydrogen can help to achieve net-zero carbon dioxide (CO_2) emission, producing green hydrogen by electrolysis from renewable sources such as Wind/Solar actually face the variable electricity source.

As a pioneer in the field of hydrogen energy, VERDE HYDROGEN has been working on Hydrogen Electrolyzer for decades and developed different size of Electrolyzer, including 1200Nm3/H single stack Electrolyzer. The company's patent (U.S. Pat. No. 8,936,704) could bring a milestone design of electrolyzer to renewable energy without transformer and rectifier.

Abstract

Systems and methods for generating hydrogen by electrolysis of water from a volatile power source may facilitate adjusting the operating capacity of an electrolysis stack based on measurements of the electricity output of the power source. In various embodiments, capacity adjustment is achieved by incorporating fewer or more cells of the electrolysis stack into a closed electrical circuit including the incorporated cells in series with the power source.

Background Introduction

Hydrogen has long been regarded as a clean alternative fuel source to fossil fuel energy sources. Hydrogen is non-polluting, transportable, storable, more efficient than petrol, and can be converted directly to heat and electricity for both stationary and mobile applications.

Hydrogen can be generated in a number of ways, for example by electrolysis. Electrolysis provides a particular clean hydrogen-generation method, especially, if the electricity is generated from a green energy source such as solar or wind power. Hydrogen generation by water electrolysis with wind or solar power has high growth potential due to the fact that these are renewable sources of energy. However, wind energy and solar energy have inherent disadvantages that prevent them from being effectively and fully utilized in conventional electrolysis systems. Because these power sources are intermittent and non-dispatchable, there can be many periods of inefficiency with either over- or underproduction of energy available for electrolysis. For example, when winds are strong and the power output is higher than the power demands of a traditional electrolysis system, a large portion of the generated power is wasted. Because of this low conversion efficiency, producing hydrogen from water with renewable energy sources is of high cost, currently preventing the widespread use of hydrogen as a fuel source.

Many attempts have been made to improve the efficiency and reduce the cost of hydrogen production by electrolysis. Previous approaches that address the volatility of input power sources generally fall into two categories:

1. One category involves splitting an electrolysis system into a number of sub-stacks, cells, or plates ("units"), and managing each unit with a control device individually; for example, U.S. Patent Application Publication No. 2011/0155583 describes a hydrogen generation system that includes a number of electrolysis stacks, where the number of operating stacks is constantly controlled by a controlling mechanism. Each stack is turned on/off by a corresponding switch. This inevitably increases the number of controlling devices and the complexity of manufacturing multiple electrolysis units, which in turn increases total cost.
2. The other category involves regulating the input electricity with current or voltage regulation devices, such as a transformer. For example, U.S. Pat. No. 7,892,407 describes a system in which the efficiency of solar-powered electrolysis of water is increased by matching the voltage generated by photovoltaic modules to the operating voltage of the electrolyzer using a DC-DC converter. This approach does not only require extra cost for the electric regulation devices, but also suffers from the efficiency loss of the electric regulation process. Some prior-art systems use both approaches in combination (see, e.g., U.S. Pat. No. 7,906,007).

Both approaches often lead to increased cost and complexity of the hydrogen-generating system, efficiency losses, and/or maintenance issues in the long term.

Patent Implementation Path Description

The present application discloses a new approach to controlling a hydrogen generation system powered by the non-stable stream of electricity produced from wind, solar or other volatile sources for hydrogen production. In various embodiments, the hydrogen generation system includes an automatically controlled electrolysis stack with a controlling function that determines what the operating capacity of the electrolysis stack should be at a given moment in order to efficiently use the momentary input power. The hydrogen generation system may include, in addition to the electrolysis stack, a conductive track, a movable electrical contact bridge and an associated driver, a measuring device, and a controller. The electrolysis stack may include a plurality of electrolysis cells electrically connected in series to form an electrically conductive path therethrough. The operating capacity of the stack can be changed by adjusting the number of electrolysis cells within the path that are connected to the power source. More specifically, the controller may, based on input of the measurement of current electricity and/or other operating parameters of the system (e.g., in conjunction with the preset operating electricity requirement of an electrolysis stack), determine the desired capacity of the operating electrolysis stack (i.e., the desired number of electrolysis cells), and send a corresponding control signal to the driver. The driver may then, based on the signal from the controller, control the position of the movable contact bridge on the conductive track. The contact bridge, by stopping at different positions in accordance with the commands received from the controller, can limit the electricity loop of the electrolysis stack to the desired operating capacity.

Thus, various embodiments disclosed herein provide an efficient method for increasing and decreasing the capacity of an electrolysis stack, allowing a hydrogen generation system to be operated at the desired efficiency with fluctuating electricity in different format.

Furthermore, compared with prior-art systems, the approach disclosed herein reduces the number of sensors, controllers, and/or switches used to control a plurality of electrolysis units, and thereby reduces the technical complexity of the hydrogen generation system. Advantageously, this may, in turn, reduce the cost of hydrogen production and improve the popularity of hydrogen in replacing fossil fuels as a fuel energy source.

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