

January 2025

Path to Sustainability

Harnessing Hydrogen

Recent developments


Curated and summarized - Industry and Patent news

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Preface



There is a major transformation taking place in the global energy landscape as countries try to reduce carbon emissions and mitigate the impact of climate change. Hydrogen, a clean and versatile energy carrier, is emerging as a promising solution for a sustainable future. Its applications are diverse, ranging from powering vehicles and generating electricity to fueling industrial processes. The hydrogen ecosystem is rapidly evolving, with innovations emerging across the entire value chain.

This monthly report is focused on **“Hydrogen as a fuel”** including applications in transportation, manufacturing industries and energy sector. This report is a free resource for anyone working in this domain including technologists, innovators, Intellectual Property (IP) managers, strategy makers, environmental enthusiasts, etc. The report contains curated insights and summaries of the latest news and key patents published in the last one month, including the latest products, business updates, collaborations, new innovations, and more.



Key Insights this month

- ❑ Recent notable developments in last month are - India's hydrogen-powered train trials, China's launch of a hydrogen-powered container ship, and Hyundai's partnership with Glovis for clean logistics operations.
- ❑ The LONGi Hydrogen and HydrogenPro partnership emphasizes the importance of collaborations between technology providers to scale up green hydrogen production through advancements in electrolyzer technology.
- ❑ Companies are looking for vertical integration in Hydrogen ecosystem for disruptive innovation play. For example, companies like Jio Platform (Reliance Industries) is actively innovating to optimize the hydrogen distribution network.
- ❑ Many inventions that were published last month had major themes as below:
 - Advancements in electrolyzer technology, aiming to enhance efficiency and reduce costs for fuel cell applications. These innovations include material advancements (utilizing ultra-thin, doped silica membranes to significantly reduce energy losses and improve energy efficiency).
 - System optimization (employing multi-stage electrolyzer cells) and Implementing precise cell voltage measurements to identify and mitigate membrane leaks, crucial for safe and reliable operation.
 - Continuous innovation in fuel cell technology, such as optimizing start-up and shutdown procedures and implementing coordinated decompression strategies so that hydrogen doesn't flow back in the wrong direction while releasing pressure from the water electrolyzer and hydrogen compressor.

Hyundai's Green Logistics

Hyundai Motor Group Deploys XCIENT Hydrogen Fuel Cell Trucks for HMGMA Clean Logistics

Hyundai Motor Group Metaplant America (HMGMA) has partnered with Glovis America to deploy 21 XCIENT heavy-duty hydrogen fuel-cell electric trucks for its logistics operations, in USA. This initiative aims to reduce HMGMA's carbon footprint and promote sustainable practices. The zero-emission trucks will transport vehicle parts from suppliers to the Megasite. HTWO Logistics, a joint venture between Hyundai and Glovis America, will install a mobile hydrogen refueling station at the Megasite, with a permanent hydrogen production and refueling station planned for the future. This move demonstrates Hyundai Motor Group's commitment to environmental responsibility and leadership in sustainable transportation.



Honda's Hydrogen Push

Honda to Utilize Existing Powertrain Unit Factory to Establish New Production Plant for Next-generation Fuel Cell System in Japan

Honda announced plans to build a new plant in Japan dedicated to producing its next-generation fuel cell system. Production is slated to begin in FY2028 at the former Powertrain Unit Factory in Tochigi Prefecture. With an annual production capacity of 30,000 units, the plant will utilize state-of-the-art equipment for high-efficiency and high-quality production. Honda aims to leverage this fuel cell system in four core domains: FCEVs, commercial vehicles, stationary power stations, and construction machinery. The company targets a 5% market share for FC-powered trucks by 2030 and an ambitious 30% share by 2040, positioning its hydrogen business as a key growth area.



Sustainable Factory by Panasonic

Panasonic Installs an In-house Hydrogen-based Renewable Energy Power Generation System in Its UK Factory

Panasonic has completed the installation and begun trial operation of a demonstration power generation system at its UK manufacturing facility. This system integrates pure hydrogen fuel cells, photovoltaic generators, and storage batteries to power the microwave oven assembly factory with renewable energy. The system enhances energy resilience by efficiently generating and storing electricity on-site. An energy management system (EMS) will be implemented by March 2025 to optimize energy use based on factory demand and weather conditions, ensuring a stable supply of renewable energy. Furthermore, the system utilizes cogeneration, capturing heat generated from the fuel cells for heating and hot water, achieving 95% energy efficiency for the fuel cells.



Hydrogen Vessel

China launches hydrogen-powered container ship

China has launched its first hydrogen-powered container ship, marking a major step towards green shipping solutions. This eco-friendly vessel boasts a capacity of 64 containers, travels 380 kilometers on a single charge, and produces zero emissions during operation. The ship utilizes two 240 kW hydrogen fuel cell systems and boasts the largest hydrogen storage system ever deployed on a ship (550 kg). This innovative project integrates newly developed hydrogen storage, supply, fuel cell, and control systems. Following equipment installation and testing, the ship is expected to begin operations in 2025 on the Zhapu-Xiasha route, establishing China's first green hydrogen-powered inland container transport line.



Hydrogen Train

Indian railways to launch first hydrogen train trials in December 2024

Indian Railways is set to launch trials for its first hydrogen-powered train. This marks a significant milestone in the railways' journey towards its 2030 net-zero emissions goal. These zero-emission trains, powered by hydrogen fuel cells, offer environmental and economic advantages over diesel locomotives, particularly on non-electrified routes. Following successful trials, Indian Railways plans to introduce 35 hydrogen trains by 2025. India joins Germany, China, and other nations in embracing hydrogen-powered rail transport. This technological embrace by Indian Railways demonstrates its commitment to sustainability and innovation, paving the way for a cleaner, greener future for the nation and potentially setting a global standard.



Strategic partnership

LONGi Hydrogen Enters Partnership with HydrogenPro

LONGi Hydrogen has entered in a strategic partnership with HydrogenPro, to collaborate on scaling up manufacturing, engineering, and service of electrolyzers for the European green hydrogen market. This partnership leverages LONGi Hydrogen's highly efficient alkaline water electrolysis technology, which boasts minimal energy consumption of 4.0 kWh/Nm³. Optimized for efficiency, reliability, and low capital costs, LONGi's electrolyzers make green hydrogen production more cost-effective. They serve diverse sectors like petrochemicals, steel, and transportation. This alliance signifies a significant step forward in advancing green hydrogen technologies, contributing to a more sustainable energy future by reducing carbon emissions and fostering a cleaner energy ecosystem.



The editor's shortlist

Patents of the month




Patents of the month

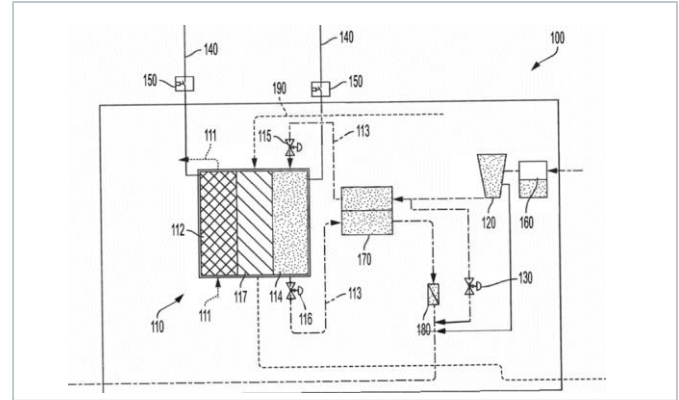
Published in December 2024

Shortlisted and summarized by our analyst

- [US12176587B2](#) - Cell voltage control through oxygen starvation for fuel cell systems
Assignee: Ford Global Technology LLC (USA)
- [US2024417862A1](#) - An Alkaline Electrolyzer Arrangement
Assignee: ABB Schweiz AG (Switzerland)
- [US2024405244A1](#) - H+ conductivity for fuel cell electrolyzers
Assignee: Forge Nano Inc (USA)
- [US2024401219A1](#) - Apparatuses and methods for multi-stage electrolysis
Assignee: Noram Electrolysis Systems Inc (Canada)
- [DE102021129872B4](#) - Method of controlling hydrogen/oxygen producing system and hydrogen/oxygen producing system
Assignee: Honda Motor Co Ltd (Japan)
- [DE102023002544A1](#) - Fuel cell vehicle
Assignee: Mercedes Benz Group AG (Germany)
- [JP2024171791A](#) - Water electrolysis and fuel cell systems
Assignee: Toyota Motor Corp (Japan)
- [EP4288845A4](#) - System and method for optimizing supply chain of hydrogen distribution network
Assignee: Jio Platforms Ltd (India)
- [IN202441095340A](#) - Electric Vehicle Powered by Photovoltaic roof assembly and sustained by Fuel cell
Assignee: CVR College Of Engineering (India)
- [CN112292778B](#) - Method and system for identifying leaks in a membrane of a fuel cell
Assignee: Robert Bosch Ltd (Germany)

◀ **US12176587B2** 

Cell voltage control through oxygen starvation for fuel cell systems



The patent talks about improving the longevity and performance of fuel cells, particularly in vehicles, by dynamically controlling the flow of oxidant (e.g., oxygen). By addressing voltage fluctuations, which can degrade the fuel cell during low or no-load events (e.g., during start-up or idling/stopping), the patent proposes a control mechanism that reduces oxidant supply during these periods. This approach, which actively adapts to varying load demands, enhances fuel cell stability and reliability by providing more precise control over oxidant flow, ultimately leading to improved performance and extended lifespan for vehicle applications.

Company name Ford Global Technology LLC (USA)

Inventors Mejia Mejia Valentina,
Qiu Zeng,
Sanderson Jr William Frederick,
Milacic Milos,
Ben-kalefa Majed

Priority date 11-Feb-2022

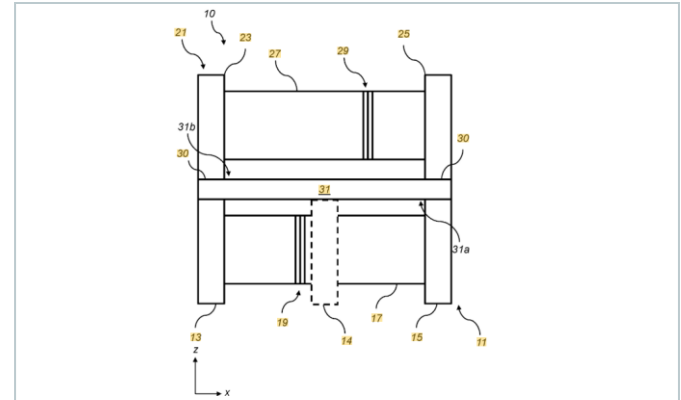
Publication date 24-Dec-2024



US2024417862A1

Green

An Alkaline Electrolyzer Arrangement



The invention describes an improved alkaline electrolyzer arrangement for producing hydrogen. The proposed solution addresses the challenge of maximizing hydrogen production capacity within a limited installation space, a common issue in large-scale hydrogen plants. This design uses two electrolyzer units stacked on top of each other, supported by a load-bearing surface. This vertical stacking maximizes space utilization, increasing hydrogen production capacity per unit area. The design also incorporates safety features like gas sensors and a protective covering to enhance operational reliability. The invention overcomes the limitations of traditional, more spread-out electrolyzer arrangements, leading to a more efficient and cost-effective hydrogen production system.

Company name ABB Schweiz AG (Switzerland)

Inventors Thorburn Stefan,
Leal-ayala Andres,
Biskoping Matthias,
Chartouni Daniel,
Primas Bernhard, Koenig Kai,
Gutermuth Georg

Priority date 16-Dec-2021

Publication date 19-Dec-2024

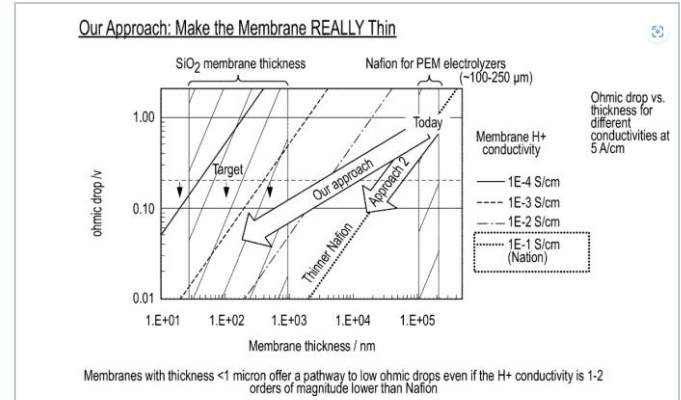




US2024405244A1

Green

H⁺ conductivity for fuel cell electrolyzers



This invention focuses on improving how we make hydrogen using electrolysis. It aims to address the problems with current methods, specifically the limitations of the materials used to separate the electrodes in electrolyzers. By replacing traditional polymer membranes with ultra-thin, doped silica membranes, the invention significantly reduces energy losses and improves energy efficiency. These ultra-thin, precisely controlled silica layers are created using a unique Atomic Layer Deposition (ALD) technique. This offers a promising pathway to cost-competitive green hydrogen production by minimizing energy consumption and maximizing output, thereby accelerating the transition to a more sustainable energy future.

Company name Forge Nano Inc (USA)

Inventors Weimer Matthew,
Harris Sara,
Dameron Arrelaine

Priority date 14-Feb-2023

Publication date 05-Dec-2024

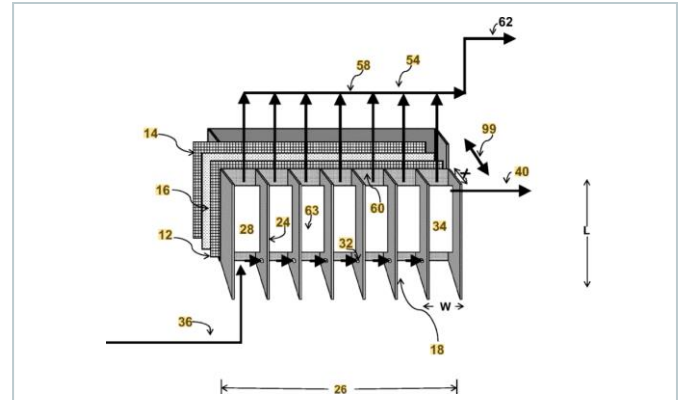




US2024401219A1

Green

Apparatuses and methods for multi-stage electrolysis



This invention describes a multi-stage electrolyzer cell designed to improve the efficiency and reduce the costs associated with electrochemical processes. Unlike conventional single-stage electrolyzer cells, this invention incorporates multiple process stages within each chamber, allowing for a more controlled and efficient reaction. This design allows for sequential processing of electrolyte solutions through these stages, leading to enhanced mass transfer, improved reactant utilization, and reduced recirculation needs. By optimizing the reaction process across multiple stages, it offers a significant advancement in electrolysis technology, promising improved performance and reduced operational costs for various industrial applications.

Company name Noram Electrolysis Systems Inc (Canada)

Inventors Wolfs Warren,
Brereton Clive,
Sylvester Alex,
Mielke Eric,
Magnan Jean-francois,
Mahecha-botero Andrés

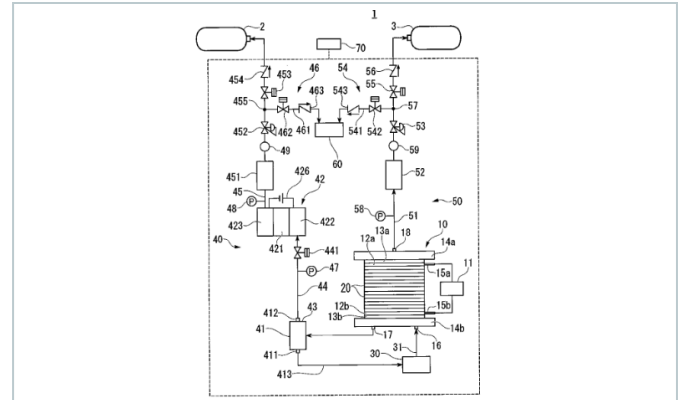
Priority date 29-May-2023

Publication date 05-Dec-2024



DE102021129872B4 Green

Method of controlling hydrogen/oxygen producing system and hydrogen/oxygen producing system



This invention explains how to safely shut down a system that makes hydrogen and oxygen. The system has two main parts: a water electrolyzer to split water into hydrogen and oxygen, and a compressor to increase the pressure of the hydrogen. The invention describes a special way to release the pressure in both parts of the system at the right speed to prevent damage and ensure safety. First, it carefully releases the pressure in the hydrogen compressor to avoid damaging the membrane inside. At the same time, it slowly releases the pressure in the water electrolyzer, making sure that the hydrogen doesn't flow back in the wrong direction and cause problems. This "coordinated decompression" makes sure the system shuts down smoothly and without any problems.

Company name Honda Motor Co Ltd (Japan)

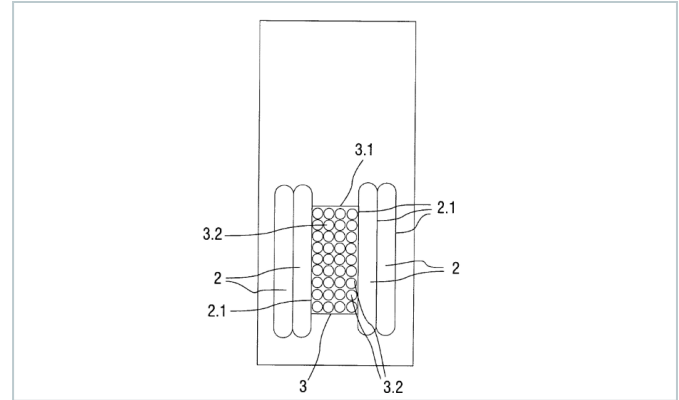
Inventors Mitsuta Naoki

Priority date 24-Nov-2020

Publication date 12-Dec-2024

◀ DE102023002544A1

Fuel cell vehicle



The patent addresses the challenge of optimizing fuel cell vehicle design for safety and efficiency. The solution involves strategically positioning the traction battery between multiple hydrogen tanks. This configuration enhances safety by allowing the hydrogen tanks a significant portion of the collision energy, reducing the impact on the battery. Also, this configuration enables a more compact and lightweight vehicle design by allowing for thinner, more lightweight structural components for the battery housing. This innovative approach prioritizes safety and efficiency by optimizing the arrangement of key components within the fuel cell vehicle.

Company name Mercedes Benz Group AG (Germany)

Inventors Doersam Thomas,
Reymann Kristof

Priority date 23-Jun-2023

Publication date 24-Dec-2024

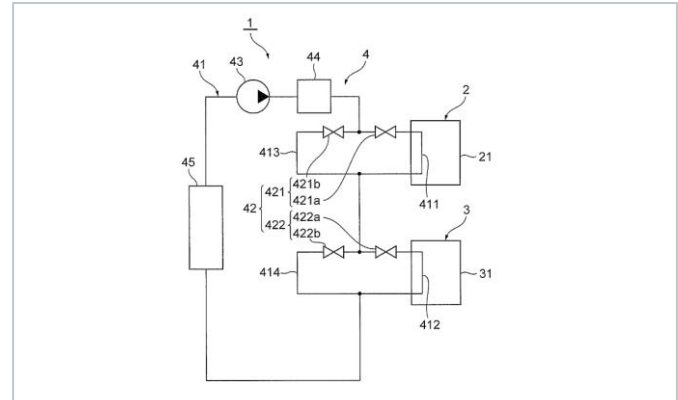




JP2024171791A

Green

Water electrolysis and fuel cell systems



The invention discloses a water electrolysis/fuel cell system that addresses the limitations of existing systems where the heat medium for both modules flows through a single, potentially long path. This can lead to increased pressure drop and the risk of overheating the water electrolysis module. The key idea is that the system has a flexible heat medium flow path. By incorporating bypass valves, the system can selectively route the heat medium around either the water electrolysis module or the fuel cell module depending on their operational status. This dynamic routing minimizes pressure loss and ensures that the water electrolysis module operates within its optimal temperature range, thereby improving overall system efficiency and durability.

Company name Toyota Motor Corp (Japan)

Inventors Yasuhiro Izawa,
Misuke Haga,

Priority date 30-May-2023

Publication date 12-Dec-2024

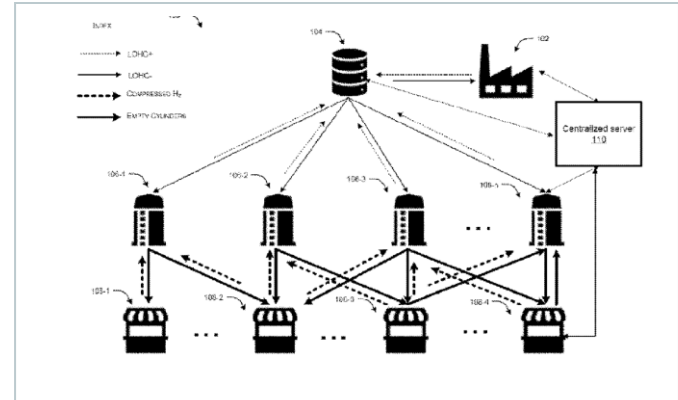




EP4288845A4

Green

System and method for optimizing supply chain of hydrogen distribution network



The patent talks about optimizing the hydrogen distribution network supply chain, by leveraging multiple transportation methods depending on the distance and volume of hydrogen being moved. Hydrogen is initially transported from production facilities to depots as Liquid Organic Hydrogen Carriers (LOHCs) due to their high energy density and ease of transportation. At the depots, LOHCs are dehydrogenated to release hydrogen, which is then compressed and transported to retailers in high-pressure cylinders. Route optimization algorithms are incorporated to minimize transportation distances and maximize vehicle capacity utilization. This integrated approach streamlines the hydrogen distribution process, enhancing efficiency and facilitating wider adoption by optimizing logistics and minimizing costs from production to delivery.

Company name Jio Platforms Ltd (India)

Inventors Kumar Dr Akansha,
Pandey Anurag Vedprakash,
Surendran Athira,
Munagekar Ameya

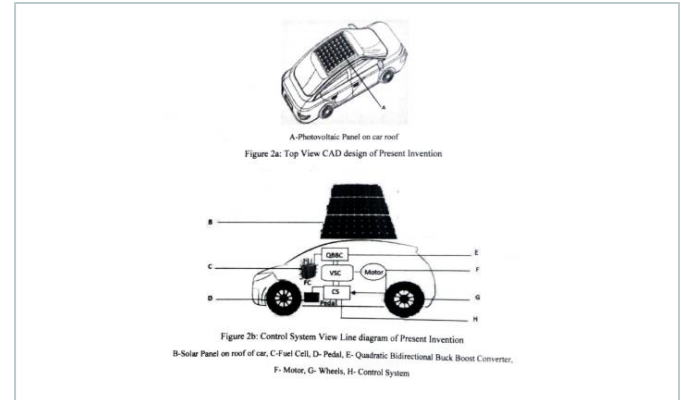
Priority date 30-May-2023

Publication date 12-Dec-2024



IN202441095340A

Electric Vehicle Powered by Photovoltaic roof assembly and sustained by Fuel cell



The invention introduces a novel approach to sustainable transportation by integrating photovoltaic (PV) roof assemblies and fuel cells into electric vehicles (EVs). This hybrid system addresses limitations of current EVs by combining solar power generation with fuel cell technology. PV panels on the vehicle's roof capture solar energy, while the fuel cell provides supplementary power, extending driving range and reducing reliance on external charging infrastructure. By utilizing clean, renewable energy sources, this innovation minimizes environmental impact and promotes energy independence. This integrated approach significantly improves the efficiency and sustainability of electric vehicles, paving the way for a cleaner and more sustainable transportation future.

Company name CVR College Of Engineering (India)

Inventors G Divya,
K S V Phani Kumar,
G Sree Lakshmi

Priority date 04-Dec-2024

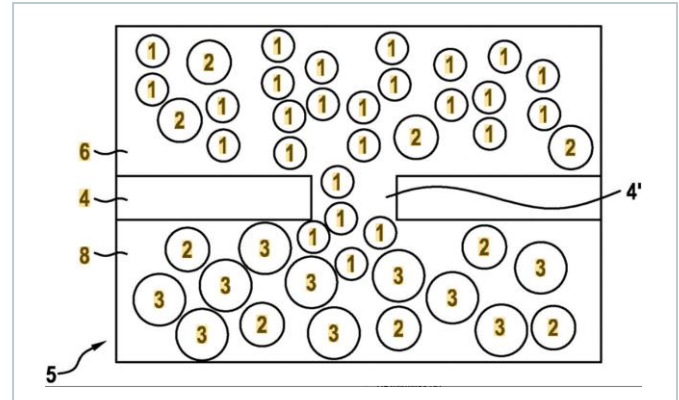
Publication date 13-Dec-2024



CN112292778B

Green

Method and system for identifying leaks in a membrane of a fuel cell



The invention is about detecting leaks in the membrane of a fuel cell, particularly in vehicles. Traditional leak detection methods, relying on cell voltage monitoring, become less reliable under high vehicle loads. This invention overcomes this limitation by temporarily reducing the fuel cell's power output to a minimum level. This allows for precise cell voltage measurements without the interference of normal operating conditions. During this period, an auxiliary energy source, such as a battery, temporarily supplies the vehicle's power needs. By analyzing the cell voltage data during this reduced power period, the system can accurately identify any deviations caused by membrane leaks. This approach enhances safety by enabling early detection and mitigation of leaks and improves efficiency by minimizing disruptions to vehicle operation.



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