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August 2025

Path to Sustainability

Harnessing Hydrogen

Recent developments

Curated and summarized - Industry and Patent news

Published by Dennemeyer India Private Limited

Parag Thakre (pthakre@dennemeyer.com)

Prachi Gupta (pgupta@dennemeyer.com)

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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.

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Key Insights this month

- A new iridium-based catalyst boosts hydrogen release from formic acid by 5x, maximizing efficiency. This makes hydrogen storage systems more scalable and cost-effective. It opens licensing and integration opportunities for mobile and off-grid use, giving companies a strategic edge in next-gen hydrogen solutions.

- Greece's first hydrogen law (5251/2025) streamlines project approvals and aligns with EU standards, creating a clear framework for hydrogen production and certification. This positions Greece as a key hydrogen export hub. Companies entering now can secure first-mover advantages in a compliant and investment-ready landscape.

- Fraunhofer's 3D sensor enables real-time defect detection in bipolar plates, feeding data to digital twins for smarter manufacturing. This cuts production time and costs, helping companies scale faster, accelerate commercialization, and capture early market share in the growing fuel cell sector.

- Many inventions that were published last month had major themes as below:

  - New fuel cell patents boost safety with real-time diagnostics of fuel cell stack and parked-vehicle hydrogen leak detection using thermal imaging. The trend signals a strong push toward smarter, safer fuel cell systems critical for commercialization and regulatory validation.

  - Latest innovations in smart energy management for fuel cell vehicles use predictive route data to balance battery charge during peak demand, while another leverages real-time fleet data to boost fuel efficiency and extend component life, together driving better performance and lower operating costs.

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Industry News

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Industry News

Catalytic Synergy

New catalyst approach combines the best of two worlds

Researchers from Forschungszentrum Jülich and RWTH Aachen University have developed a novel catalyst based on iridium that combines the advantages of homogeneous and heterogeneous catalysis. By embedding iridium atoms in a terpyridine-based polymer, they created a solid molecular catalyst (SMC) that achieves both high catalytic activity five times that of previous systems and long-term stability. This hybrid approach allows for efficient hydrogen release from formic acid, combining the high activity of homogeneous catalysis with the easy separability and recyclability of heterogeneous catalysis. The breakthrough enhances the efficiency of expensive iridium, advancing green hydrogen as a viable, climate-friendly energy storage solution. Future work will focus on scaling up the system and exploring cheaper alternative metals and other hydrogen carrier molecules.

Source: FZ Jülich

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Industry News

Scaling Green Hydrogen

Siemens and Paragon to scale ultra-clean hydrogen production

Siemens and Paragon Resources Ltd. have signed a memorandum of understanding (MoU) to scale up Paragon's novel, ultra-clean hydrogen production process, which operates without fossil fuels, electrolysis, or external electricity. The method uses treated, recycled aluminium and water with a catalyst to generate hydrogen gas, heat, and aluminium hydroxide, an industrially valuable byproduct with zero emissions and minimal environmental impact. Siemens will serve as Paragon's preferred technology partner, integrating its expertise in automation, AI-driven control, digital twins, and cybersecurity through the Siemens Xcelerator platform to accelerate the transition from pilot stage to industrial-scale deployment. This collaboration supports the decarbonisation of hard-to-abate sectors and promotes circular economy principles by recycling aluminium that would otherwise go to landfill.

Source: Siemens

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Industry News

Electrolyser Alliance

Battolyser Systems and VDL Hydrogen Systems merge to develop the first fully flexible industrial electrolyser

Battolyser Systems and VDL Hydrogen Systems will merge in Q4 2025 to create a single company focused on developing a fully flexible, high-capacity, pressurized alkaline electrolyser for industrial use. The merger, equally funded by both companies, combines Battolyser's technology with VDL's manufacturing capabilities to scale stack production after ongoing pilots. Designed for rapid start-up and shut-down, the system is ideal for intermittent renewables like offshore wind. It targets low-cost green hydrogen production for hard-to-abate sectors such as e-fuels, steel, and power grids. The merger also supports Europe's energy independence by building a local value chain for sustainable hydrogen technology.

Source: Battolyser

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Industry News

Greece Hydrogen Law

Greece passes first hydrogen law: Unlocking the national hydrogen economy

On 2 July 2025, Greece passed its first dedicated hydrogen law (Law 5251/2025), creating a comprehensive legal framework for the production, certification, and regulation of renewable (green) hydrogen. The law aligns with key EU directives and regulations, including Directive 2024/1788 and Delegated Regulation 2023/1184, supporting the goals of the European Green Deal, REPowerEU, and Greece's updated National Energy and Climate Plan (NECP 2021–2030). It makes the approval process easier by introducing a Hydrogen Producer Certificate, which can be used right away without needing extra laws. This new law sees hydrogen as an important part of the energy system, helping to use extra renewable electricity, improve energy flexibility, and make Greece a key hub for hydrogen exports in the region.

Source: Greece's Law

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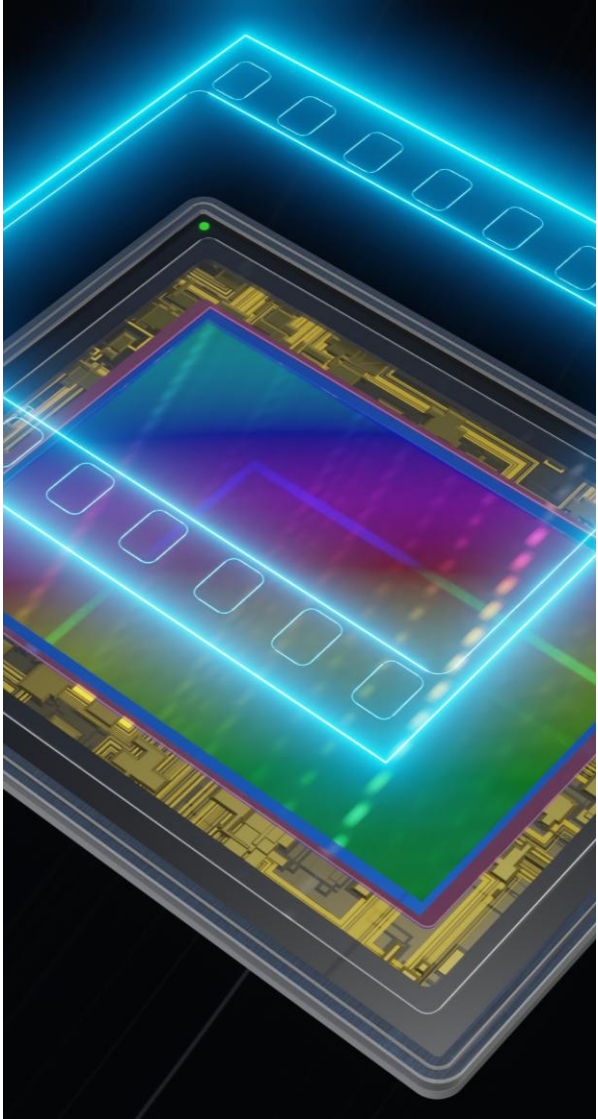
Industry News

Holographic Inspection

Digital-holographic 3D sensor for metal bipolar plates quality assurance

Researchers from Fraunhofer IPM, the University of Stuttgart, and industry partners have developed a digital holographic 3D sensor system that enables full-surface, micrometer-accurate quality control of metal bipolar plates used in fuel cells. These plates, which are critical for electrical conductivity and gas distribution in fuel cells, are prone to defects like tearing or wrinkling during forming. The new sensor captures high-resolution 3D data in under a second without moving parts and can be scaled for different plate sizes. This real-time data not only identifies defective parts but also feeds into a digital twin of the forming process, helping to analyze recurring errors and optimize production. The system is currently being tested in near-series conditions and supports the long-term goal of active process control and improved manufacturing reliability.

Source: Hydrogen Fuel News



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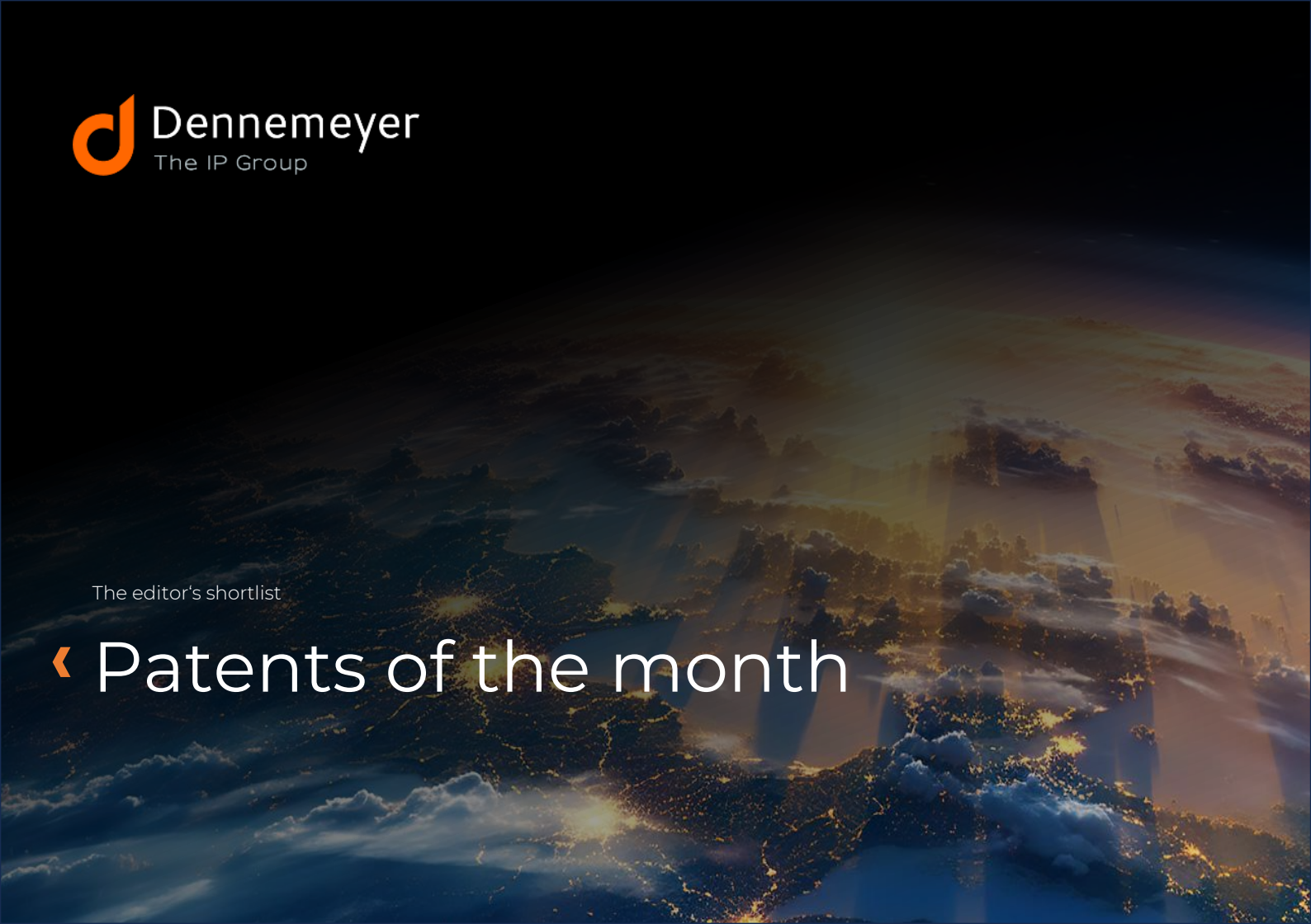

The editor's shortlist

Patents of the month

Green **Green patent indicator** powered by Octimine Dennemeyer IP Group

Patents of the month

Published in July 2025

Shortlisted and summarized by our analyst

- US12368173B2 - Method for diagnosing at least one fuel cell stack of a fuel cell device, computer-readable storage medium, and fuel cell diagnostic system Green
  Assignee: BMW AG (Germany)
- US12365268B2 - System for improving startability of fuel cell vehicle and control method thereof Green
  Assignee: Hyundai Motor Co Ltd, Kia Corp (South Korea)
- US12365237B2 - Fuel cell exhaust system for fuel cell electric vehicle
  Assignee: Nikola Corp (USA) Green
- US12351331B2 - Refueling system for hydrogen fuel cell-powered aircraft Green
  Assignee: Zeroavia Ltd (USA)
- US12358396B2 - Predictive fuel cell and battery power management for high sustained load conditions Green
  Assignee: Ford Global Tech LLC (USA)
- EP4590538A2 - A system for hybrid electric vehicle fleet management
  Assignee: Hydrogen Vehicle Systems Ltd (UK) Green
- EP4585845A1 - Control system and method for preventing hydrogen boil-off losses
  Assignee: Volvo Truck Corp (Sweden)
- IN202521059803A - An ECU controlled onboard hydrogen generation and utilization system in automobiles
  Assignee: Individual Inventor (India)
- KR102835252B1 - Apparatus for diagnosing condition of hydrogen fuel cell vehicle and method thereof Green
  Assignee: Korea Automotive Tech Inst (South Korea)
- CN120341328A - Proton exchange membrane, fuel cell and water electrolyzer comprising proton exchange membrane
  Assignee: Beijing Qingchi Technology Co, Ltd. (China)

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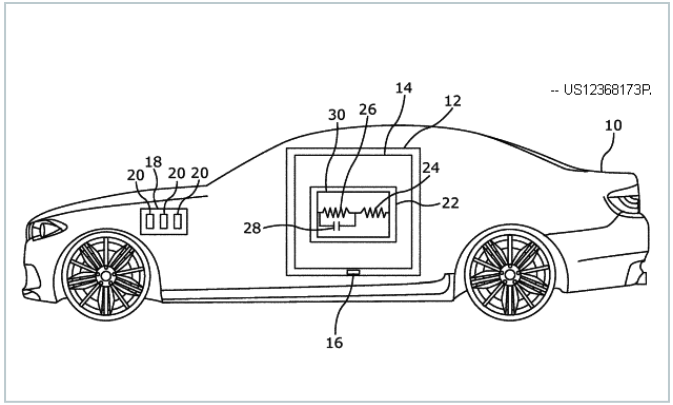
Latest patents

US12368173B2 Green

Method for diagnosing at least one fuel cell stack of a fuel cell device, computer-readable storage medium, and fuel cell diagnostic system



Company name	BMW AG (Germany)
Inventors	Lochner Tim, Perchthaler Markus
Priority date	19-Dec-2019
Publication date	22-Jul-2025

Summarized by Dennemeyer

The invention describes a novel method for real-time diagnosis of fuel cell stacks using a diagnostic system, particularly while it's in use. The core innovation lies in applying two sinusoidal alternating currents at different frequencies to the fuel cell stack. By detecting the resulting voltage responses, a diagnostic system can use a specific analytical algorithm to determine the fuel cell stack's ohmic resistance, electrochemical resistance, and capacitance. These parameters are used to detect faults such as drying out, hydrogen or oxygen undersupply and identify their causes during vehicle operation. The approach enables on-the-fly diagnosis with minimal computing effort. It can be used to make early, automatic adjustments to improve the fuel cell's performance, extend its lifespan, and reduce fuel consumption.

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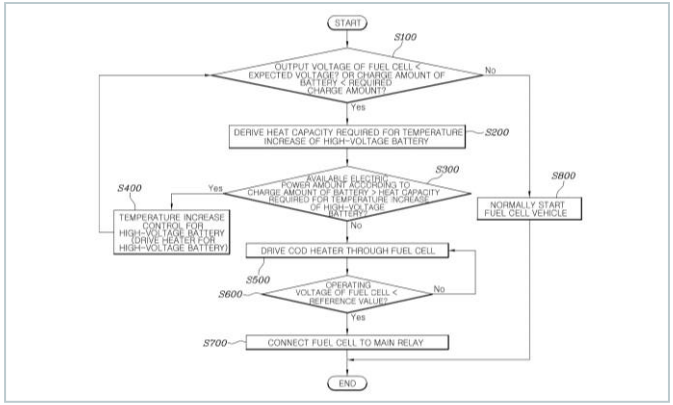
Latest patents

US12365268B2 Green

System for improving startability of fuel cell vehicle and control method thereof



The patent addresses the issue of voltage reversal in fuel cell electric vehicles, a phenomenon where current flows from the fuel cell to the high-voltage battery during startup, especially in cold weather. This problem can degrade the fuel cell over time, and previous solutions such as increasing battery capacity, were often costly and added vehicle weight. The innovative solution is a proactive control system that can predict potential voltage overlap using temperature-dependent data maps and adjusts the operating voltage of either the fuel cell or battery by controlling their temperatures. This is achieved through components like heaters and relays that selectively warm the battery or fuel cell. This ensures safe startup and fuel cell protection without costly or heavy hardware upgrades.

Company name	Hyundai Motor Co Ltd, Kia Corp (Korea)
Inventors	Jung Jae Kwon, Jeong Seong Cheol
Priority date	15-Jun-2022
Publication date	22-Jul-2025

Summarized by Dennemeyer

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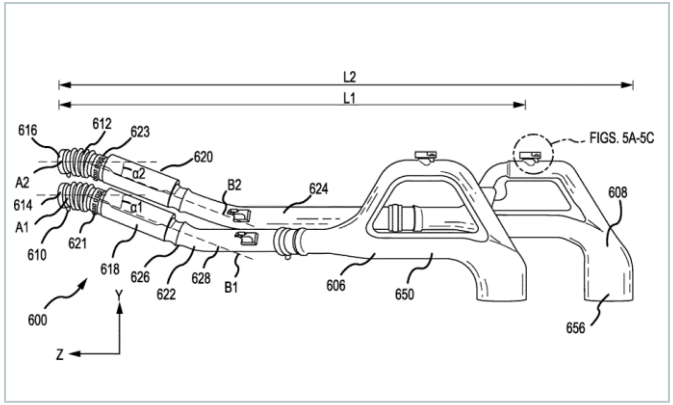
Latest patents

US12365237B2 Green

Fuel cell exhaust system for fuel cell electric vehicle



Company name	Nikola Corp (USA)
Inventors	Madi Abdulhadi, Marley William, Purania Narendra, Widhalm Daniel
Priority date	18-Feb-2022
Publication date	22-Jul-2025

Summarized by Dennemeyer

The patent details an improved exhaust system for fuel cell electric vehicles (FCEVs) designed to accurately measure hydrogen levels. The problem with conventional systems is that water vapor in the exhaust can interfere with hydrogen sensors, leading to inaccurate readings and potential safety risks. The novel solution is a unique exhaust duct design that separates the exhaust into two vertical streams: a lower duct and an upper duct. The upper duct, positioned above the lower duct, contains a hydrogen sensor. This vertical separation leverages the fact that water, being heavier than hydrogen, will collect in the lower duct, while the lighter hydrogen gas will rise into the upper duct. By placing the sensor in the upper, drier stream, it can obtain a more accurate and reliable measurement of hydrogen content.

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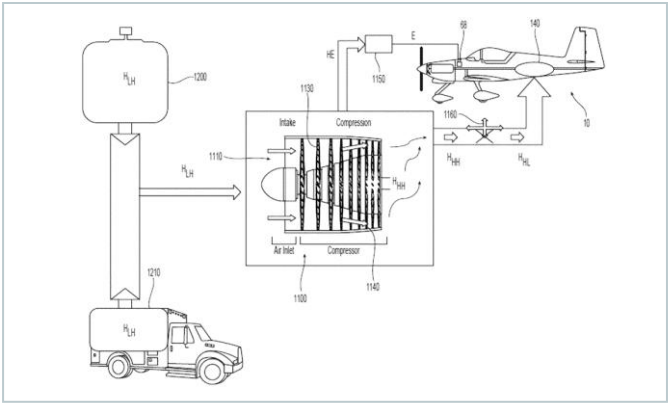
Latest patents

US12351331B2 Green

Refueling system for hydrogen fuel cell-powered aircraft



Company name	Zeroavia Ltd (USA)
Inventors	Miftakhov Valery, Kiselev Sergey
Priority date	31-Mar-2021
Publication date	08-Jul-2025

Summarized by Dennemeyer

The invention addresses the challenges of hydrogen fuel storage and transport in aircraft, such as managing leakage, boil-off, and pressure during refueling. The proposed solution is a specialized refueling system for hydrogen fuel cell-powered aircraft that features a compressor and a compression chamber. This efficiently converts low-temperature, high-pressure hydrogen gas to a higher-temperature, lower-pressure state suitable for onboard storage. A key innovation is the inclusion of a heat exchanger that captures and converts excess heat from the compression process into storable energy, which can then be used to power other aircraft components. This system not only provides efficient pressure management but also introduces a method for energy recovery.

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Latest patents

US12358396B2 Green

Predictive fuel cell and battery power management for high sustained load conditions

Company name	Ford Global Tech LLC (USA)
Inventors	Gogna Naginder, Meyer Jason, Ortmann Walter Joseph, Bower Jr Stanley L, Johri Rajit
Priority date	21-Feb-2022
Publication date	15-Jul-2025

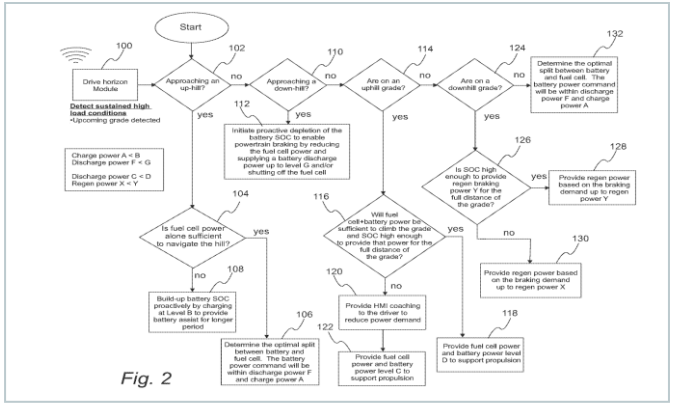

Fig. 2

The patent addresses limitations of fuel cell-only propulsion in vehicles, particularly during high-power demand scenarios like uphill driving, and proposes a fuel cell and battery power management system to improve performance and efficiency. The system manages power flow between a traction battery and fuel cell using predictive route data, such as upcoming grades. When fuel cell power is insufficient, it increases battery charging in advance to ensure enough energy for assist. Conversely, it proactively depletes battery charge before downhill sections to enable regenerative braking and consistent negative torque. It can also coach drivers via HMI to adjust power demands when needed. This ensures smoother vehicle operation, improved energy recovery, and optimized use of both power sources.

Summarized by Dennemeyer

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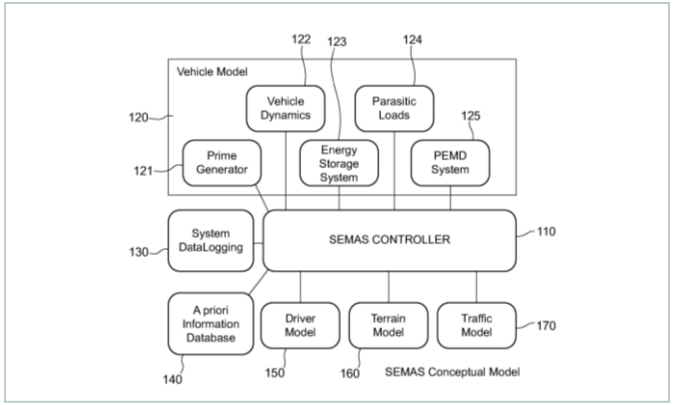
Latest patents

EP4590538A2 Green

A system for hybrid electric vehicle fleet management

Company name	Hydrogen Vehicle Systems Ltd (UK)
Inventors	Telford David
Priority date	20-Mar-2023
Publication date	30-Jul-2025

Summarized by Dennemeyer



The patent provides a solution for optimizing hybrid fuel cell electric vehicles (FCEVs), particularly heavy goods vehicles (HGVs), through a smart fleet and vehicle-level control system. It addresses key challenges in transitioning from diesel to hydrogen-powered transport, including high total cost of ownership (TCO), limited durability of electrochemical components, and complex transient power demands. By integrating real-time data (e.g., route, traffic, load, and component status), the controller uses adaptive simulation and model predictive control to optimize energy use and improve fuel efficiency. It ensures the fuel cell operates steadily at optimal levels while the energy storage system handles peak and transient loads, extending component life and reducing TCO.

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Latest patents

EP4585845A1

Control system and method for preventing hydrogen boil-off losses

Company name	Volvo Truck Corp (Sweden)
Inventors	Desai Parthav
Priority date	11-Jan-2024
Publication date	16-Jul-2025

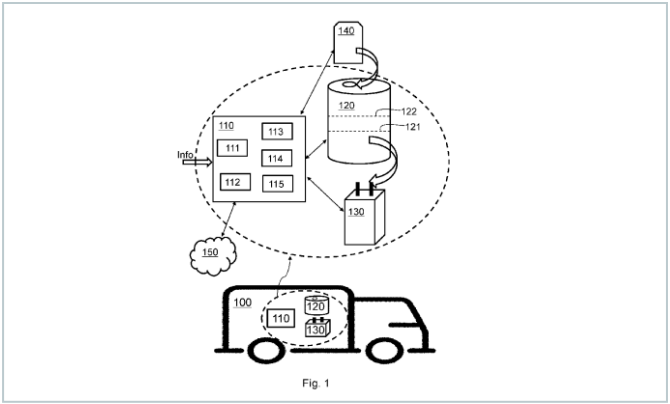

Fig. 1

The invention talks about managing the hydrogen charge level in a vehicle's cryogenic hydrogen storage system to prevent or reduce hydrogen boil-off losses. Boil-off occurs when heat causes liquid hydrogen to evaporate, increasing pressure and necessitating venting, which results in fuel loss. It uses data such as the vehicle's stop duration, location, and hydrogen usage requirements to calculate the maximum allowable hydrogen level upon arrival. Then it controls hydrogen refueling such as by adjusting energy storage charging to ensure this level is not exceeded. Implemented via software without adding hardware or weight, the invention provides a cost-effective solution for improving hydrogen fuel efficiency and reducing environmental impact, especially in fuel cell and hydrogen ICE vehicles.

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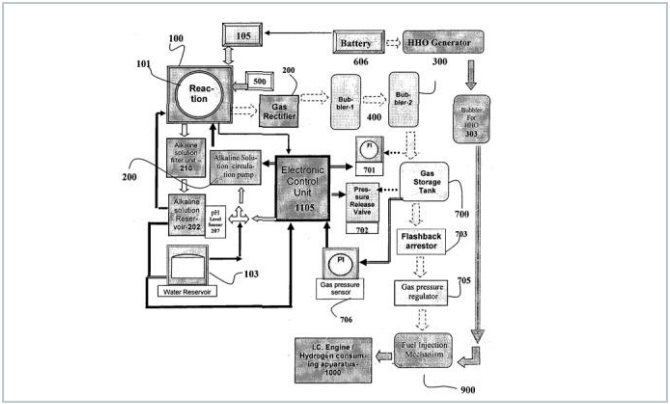
Latest patents

IN202521059803A

An ECU controlled onboard hydrogen generation and utilization system in automobiles

Company name	Individual Inventor (India)
Inventors	Solanki Vijaykumar Hargovandas
Priority date	23-Jun-2025
Publication date	25-Jul-2025

Summarized by Dennemeyer



The invention presents a compact, cost-effective, and efficient onboard hydrogen generation system that powers internal combustion engines and fuel cells using a chemical reaction between aluminum powder, water, and sodium hydroxide, supplemented by electrolysis. Controlled by an ECU, the system generates hydrogen and oxygen on demand, stores gas at regulated pressures, and supports spark and compression ignition engines, including dual-fuel applications for heavy-duty vehicles like locomotives. It features hydrogen storage, diesel vaporization via ultrasonic transducers, and a self-sustaining electrical system powered by a petrol engine. This solution eliminates the need for high-pressure hydrogen infrastructure, reduces fossil fuel dependence, and supports sustainable energy through accessible materials.

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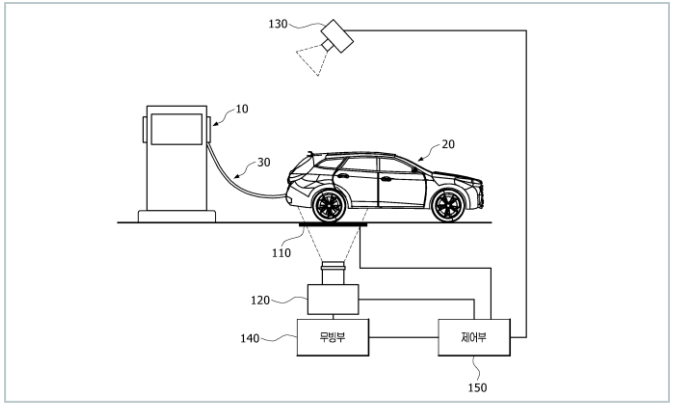
Latest patents

KR102835252B1 Green

Apparatus for diagnosing condition of hydrogen fuel cell vehicle and method thereof



Company name	Korea Automotive Tech Inst (Korea)
Inventors	Kong Im Mo, Jung Gil Sung
Priority date	11-Dec-2020
Publication date	17-Jul-2025

The present invention describes diagnosing the condition of hydrogen fuel cell vehicles, specifically for detecting gas leaks around the charging hose and pressure vessel while the vehicle is parked at a hydrogen charging station. There is a screen unit with a transparent panel, a movable first camera (digital or thermal), and an optional second camera for monitoring the charging hose. The control unit analyzes thermal images to detect abnormal temperature differences indicating potential leaks and can adjust the camera's position for more accurate diagnosis. It also initiates warnings, gas cutoffs, or safety responses when a leak is detected, offering accurate, automated leak detection regardless of vehicle type or parking position.

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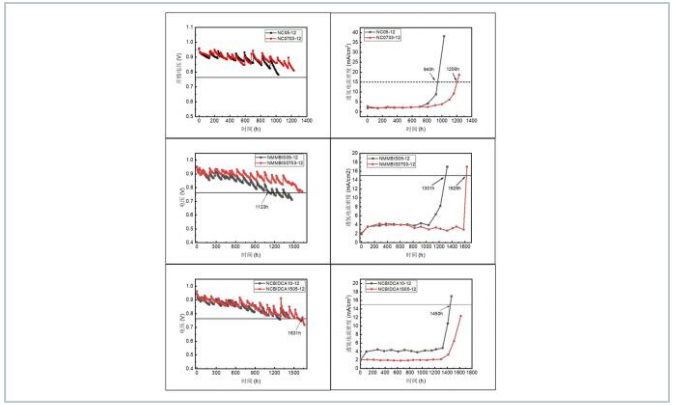
Latest patents

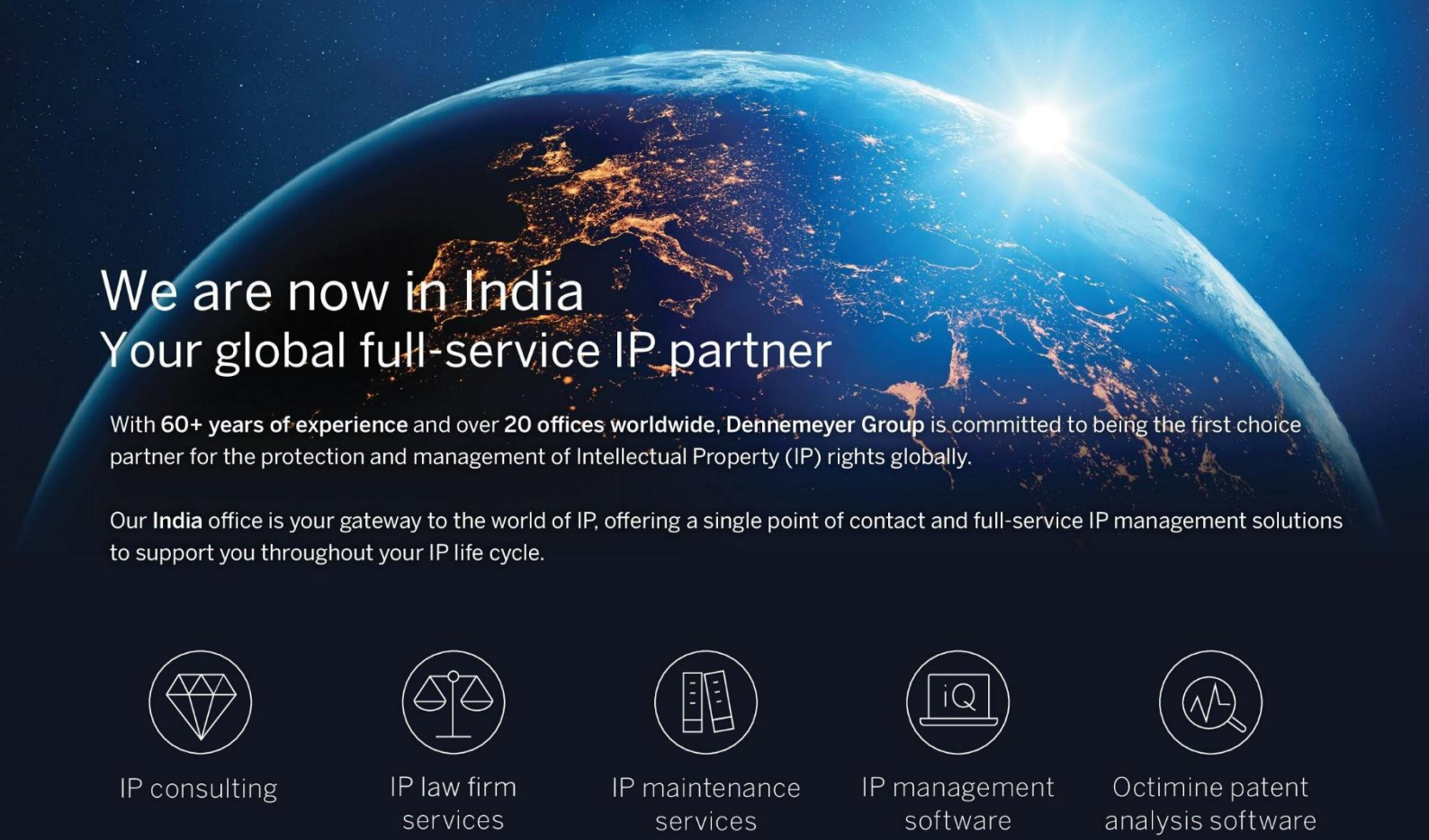
CN120341328A

Proton exchange membrane, fuel cell and water electrolyzer comprising proton exchange membrane



Company name	Beijing Qingchi Technology Co, Ltd. (China)
Inventors	Zheng Ta, Wang Shihua, Gao Ruijing, Zhang Jing
Priority date	17-Jan-2024
Publication date	18-Jul-2025

The patent introduces an improved proton exchange membrane (PEM) design that overcomes the drawbacks of current durability solutions. Existing methods use free radical neutralizers compounds that extend membrane life by preventing oxidative damage, but they either don't last long or reduce proton conductivity when used in larger amounts. This new design uses a dual-layer membrane with different levels of neutralizers on the anode and cathode sides, creating a gradient that boosts chemical durability without harming performance. The result is a longer-lasting, more reliable PEM for fuel cells, water electrolyzers, hydrogen production systems, and flow batteries.



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