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September 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.

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Key Insights this month

- Hyroad's acquisition of Nikola's hydrogen truck fleet and IP, fast-tracks its entry into the zero-emission freight market, providing immediate access to proven technology and infrastructure. Its pay-per-mile, truck-as-a-service model lowers adoption barriers, positioning the company to capitalize on California's zero-emission mandates and offer a scalable model for hydrogen trucking nationwide.

- Advent's partnership with Stralis advances hydrogen-electric propulsion in commercial aviation, using lightweight, efficient fuel cell tech to cut emissions and operating costs. This positions Advent to lead scalable hydrogen aviation, tapping regulatory demand and enabling wider applications across energy, defense, and mobility.

- Dongguan's launch of non-subsidized hydrogen two-wheelers proves that small-format hydrogen mobility is commercially viable today, especially for last-mile delivery. It sets a precedent for urban decarbonization in dense cities, leveraging fast-swap, low-pressure hydrogen systems that eliminate the need for on-site refueling.

- India's hydrogen train offers a scalable, zero-emission alternative for non-electrified routes, meeting clean transport demand and supporting national decarbonization goals. It opens new opportunities for train manufacturers, fuel cell suppliers, and infrastructure developers.

- Many inventions that were published last month had major themes as below:
  - Recently published patents on electrolyzer safety introduce active pressure control and gravity-driven emergency cooling, enhancing system stability and fault response. These innovations enable more efficient and reliable hydrogen production under variable conditions.
  - Recent innovations in hydrogen storage such as solid-state hydride tanks and on-board metal-steam hydrogen generation, improve energy density, safety, and efficiency. Paired with smart fuel controls and vapor recovery, these advances enhance fuel delivery and overall performance in fuel cell vehicles.

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Industry News

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Industry News

Fleet Acquisition

Hyroad Energy acquires Hydrogen Fuel Cell trucks to accelerate deployment of zero-emission commercial fleets

Hyroad Energy, a leader in hydrogen-powered transportation, has acquired 113 hydrogen fuel cell trucks, along with spare parts, software platforms, and IP assets from Nikola Corporation's bankruptcy auction. This strategic acquisition boosts Hyroad's fleet and accelerates its mission to deliver turnkey, zero-emission hydrogen trucking solutions. The company plans to deploy the trucks mainly in California, supported by ongoing development of hydrogen refueling infrastructure and new maintenance facilities. Hyroad will also provide continued support for existing Nikola trucks in operation, reinforcing its commitment to growing the hydrogen truck market in the U.S. Through its innovative truck-as-a-service, pay-per-mile model, Hyroad simplifies adoption of zero-emission Class-8 vehicles and advances its vision of a cleaner, sustainable transportation future.

Source: Hyroad Energy

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Industry News

Hydrogen Aviation

Advent Technologies and Stralis announce pioneering relationship to advance hydrogen electric flight

Advent Technologies, a U.S.-based leader in fuel cell and hydrogen technology, is supplying its proprietary high-temperature proton exchange membrane (HT-PEM) electrode assembly to Australia's Stralis Aircraft for a hydrogen-electric Beechcraft Bonanza. The partnership aims to develop a lightweight, efficient propulsion system offering longer range and lower costs than battery-electric or fossil-fuel aircraft. Advent's HT-PEM tech enables efficient cooling with smaller radiators, reducing weight and drag. Hydrogen-electric systems also promise 40–60% lower maintenance due to fewer moving parts and lower operating temperatures. Advent, with around 150 fuel cell patents, sees this aviation collaboration as part of its broader strategy to deliver clean energy solutions across sectors including marine, automotive, defense, and power generation.

Source: Advent Technologies

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Industry News

Mountain Mobility

Hyundai Motor Group pioneers' hydrogen mobility in NEOM to drive sustainable transport

Hyundai Motor Group, in partnership with NEOM and its energy subsidiary Enowa, successfully completed a groundbreaking hydrogen mobility trial in Trojena, the mountainous region of NEOM in Saudi Arabia. The trial marked the world's first deployment of a hydrogen fuel cell electric coach bus, the UNIVERSE, in high-altitude terrain, reaching 2,080 meters and gradients of 24%. This initiative, supported by a 2024 MoU with NEOM, showcased the feasibility of hydrogen-powered transport in challenging environments and aligns with Saudi Vision 2030. Enabled by Enowa's newly installed hydrogen refueling station, the trial reinforces Hyundai's leadership in hydrogen mobility and its commitment to decarbonization through its HTWO platform, advancing sustainable, zero-emission mobility on a global scale.

Source: Hyundai

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Industry News

Last-Mile Revolution

First commercial fleet of 200 hydrogen two-wheelers launched

Dongguan has launched its first fully commercial, non-subsidized hydrogen mobility project by deploying 50 hydrogen-powered two-wheelers for food delivery in Zhongtang Town, with plans to expand to 200 units by end-2025. These next-generation vehicles, powered by solid metal hydride hydrogen storage and water-cooled fuel cells, offer up to 80 km of zero-emission range per refill, operating around the Zhongtang Methanol-to-Hydrogen Integrated Station. The Zhongtang station enables quick and safe hydrogen tank swaps through low-pressure storage, removing the need for on-site refueling. Dongguan's broader hydrogen strategy includes power generation, transport, and storage, supported by innovations like the country's first rare-earth solid-state hydrogen storage project and the operation of the world's first 500-MW hydrogen-cooled generator.

Source: Full Cell Works

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Industry News

India's Hydrogen Train

India’s hydrogen train passes all tests, set to debut on Jind–Sonepat route

India is set to launch its first hydrogen-powered train, a ₹136 crore ($16.4 million) project under the “Hydrogen for Heritage” initiative, following successful load testing at the Integral Coach Factory (ICF) in Chennai. The 10-coach DEMU train, aimed at cutting emissions on heritage and hill routes, will initially run on the Jind–Sonepat route in Haryana, covering 356 km daily and serving over 2,600 passengers. Powered by hydrogen fuel cell systems replacing traditional diesel engines, the train emits only water vapor and features 220 kg hydrogen storage per power car, with refueling supported by a new 3,000 kg capacity station in Jind. Developed in partnership with ICF Chennai and Medha Servo Drives, and validated by TÜV SÜD, the project advances India’s capabilities in hydrogen rail transport, delivering a scalable, eco-friendly option for future mobility

Source: Fuel Cell Works

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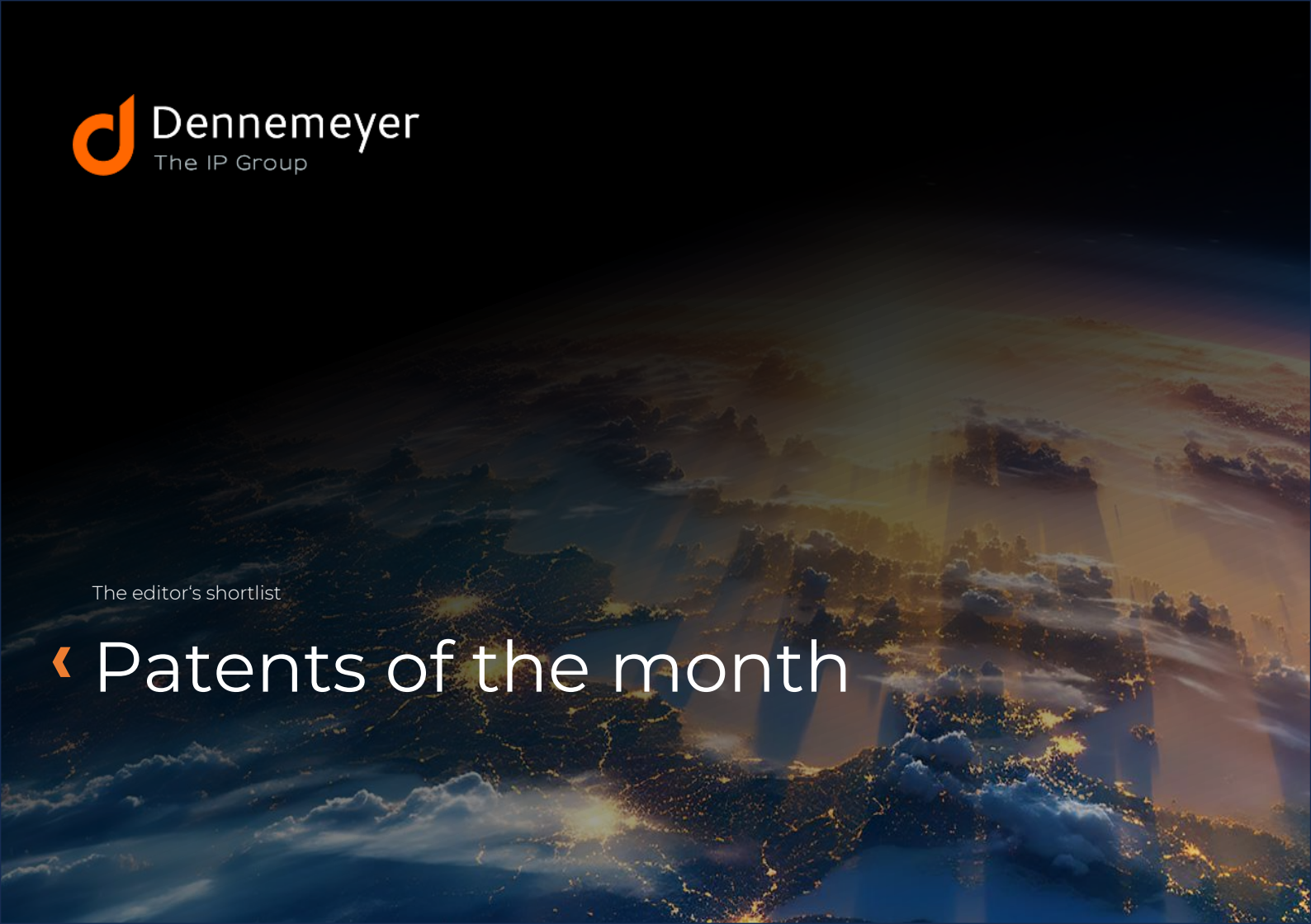

The editor's shortlist

Patents of the month

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

Patents of the month

Published in Aug 2025

Shortlisted and summarized by our analyst

- US12388099B2 - Apparatus for sensing voltage information of fuel cell Green
  Assignee: Hyundai Mobis Co Ltd (Korea)
- US2025273714A1 - Fuel cell system hydrogen tank leak detection Green
  Assignee: Ford Global Tech LLC (USA)
- US2025271106A1 - Intermediate gas store, electrolysis system, and method for proton exchange electrolysis
  Assignee: Siemens Energy Global GMBH & Co Kg (Germany)
- US2025262986A1 - Hydrogen fuel cell electric vehicle energy management
  Assignee: FCA US LLC (USA)
- US2025251088A1 – Installation and method for storing and distributing cryogenic fluid
  Assignee: Air Liquide SA (France)
- EP4605580A2 - Electrolyzer system with vaporizer cooling system Green
  Assignee: Fuelcell Energy INC (USA)
- EP4594248A1 - Oxidization reactor for hydrogen fuel cell vehicle Green
  Assignee: GM Global Technology Operations LLC (USA)
- EP4366002B1 - Solid Oxide Fuel Cell Stack for an aircraft engine Assignee: Airbus Operations GMBH (Germany)
- IN202521070824A - Integrated storage and application tank utilizing metal hydrides for hydrogen management
  Assignee: Individual Inventor (India)
- FR3158835A1 - Diagnosis of the possibility of using vehicle dihydrogen tanks
  Assignee: Stellantis Auto SAS (France)

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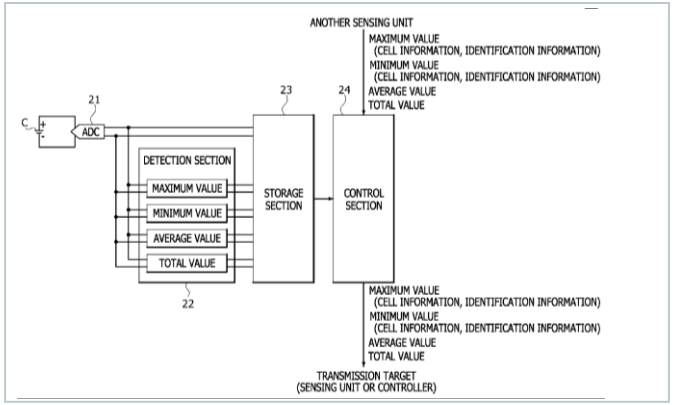
Latest patents

US12388099B2 Green

Apparatus for sensing voltage information of fuel cell



Company name	Hyundai Mobis Co Ltd (Korea)
Inventors	Yeo Yeong Geun, Oh Jung Hwan, Yang Su Hun, Kim Seulkirom
Priority date	22-Nov-2019
Publication date	12-Aug-2025

Summarized by Dennemeyer

The invention talks about sensing voltage information in fuel cells, addressing key issues in traditional systems like slow data acquisition, high communication power consumption, and delayed diagnostics. The disclosed invention introduces a time-division sensing architecture, allowing it to measure voltages of individual and all cells selectively and transmit only necessary, pre-processed data (e.g., max, min, average, and total voltages) directly to the upper controller. This enables faster, more efficient real-time diagnostics and power management, reducing latency and communication load. Multiple sensing units can be configured to share and process data together, ensuring quick identification of faulty cells, preventing damage, and improving system responsiveness.

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Latest patents

US2025273714A1 Green

Fuel cell system hydrogen tank leak detection

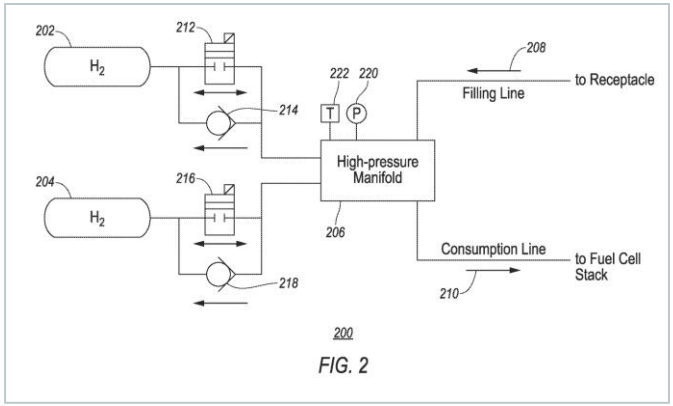

FIG. 2

Company name	Ford Global Tech LLC(USA)
Inventors	Van Nieuwstadt Michiel J, Pursifull Ross Dykstra
Priority date	22-Feb-2024
Publication date	28-Aug-2025

The patent describes a method for detecting and isolating faulty hydrogen fuel tanks in a fuel cell vehicle. The vehicle has multiple pressurized fuel tanks connected via valves to a common manifold. While parked, it sequentially connects each tank to the manifold and monitors changes in a thermodynamic property (such as pressure or density). If an unexpected increase or no change in this property is detected, indicating a possible fault such as a leaking or overfilled tank, the controller disables that tank from supplying fuel during vehicle operation. This enhances safety, prevents potential fuel system failures, and ensures reliable fuel delivery in hydrogen-powered vehicles.

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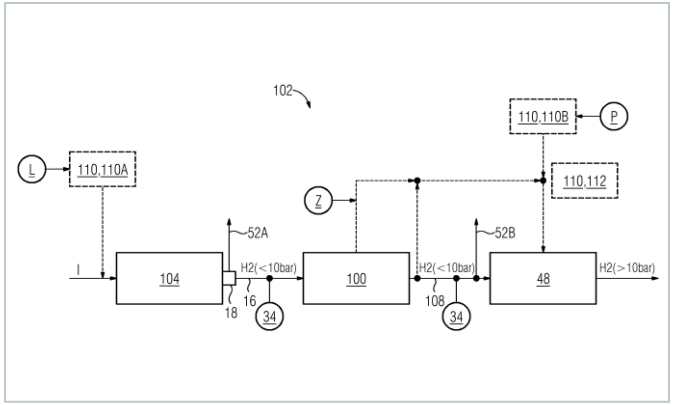
Latest patents

US2025271106A1

Intermediate gas store, electrolysis system, and method for proton exchange electrolysis



Company name	Siemens Energy Global GMBH & Co Kg (Germany)
Inventors	Hannemann Frank, Volkmann Andreas, Braun Stefan
Priority date	17-Mar-2022
Publication date	28-Aug-2025

This invention introduces a smart gas storage system for low-pressure PEM electrolysis that keeps the pressure steady using a flexible membrane and a mechanical controller (actuator). Unlike older systems that only absorbed pressure changes without reacting, this new design actively adjusts the gas volume when the pressure changes. This helps maintain a constant pressure. It can quickly respond to even small pressure changes, making the operation between the electrolyzer and other parts like compressors smooth and stable. Unlike earlier systems that passively absorbed pressure fluctuations, this design offers active control, improving safety, efficiency, and reliability during variable operating conditions.

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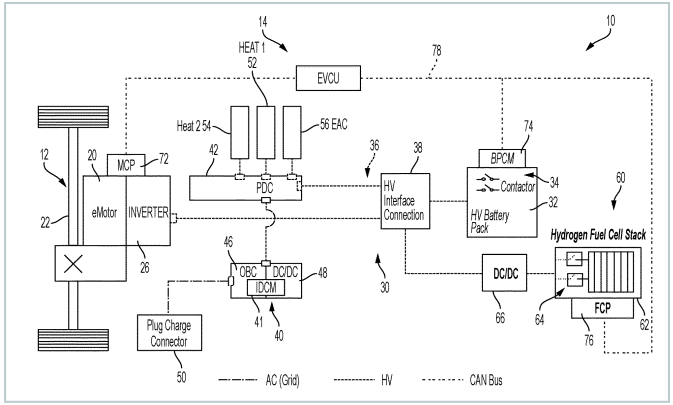
Latest patents

US2025262986A1

Hydrogen fuel cell electric vehicle energy management



This invention is for a control system in hydrogen fuel cell electric vehicles that helps manage the flow of energy and prevent the battery from being overcharged. The vehicle can get energy from two sources: the fuel cell and regenerative braking. If too much energy goes into the battery, it can cause the system to shut down or reduce performance. To avoid this, the control system constantly checks the voltage levels of both the battery and the high-voltage system. It uses the highest of these readings to decide whether to reduce power. First, it lowers the power coming from the fuel cell. If the voltage is still too high, it then reduces the power from braking. This two-step control keeps the battery safe and ensures the vehicle continues to run properly.

Company name	FCA US LLC (USA)
Inventors	Xie Zhentao, Kharpuri Rudolf
Priority date	16-Feb-2024
Publication date	21-Aug-2025

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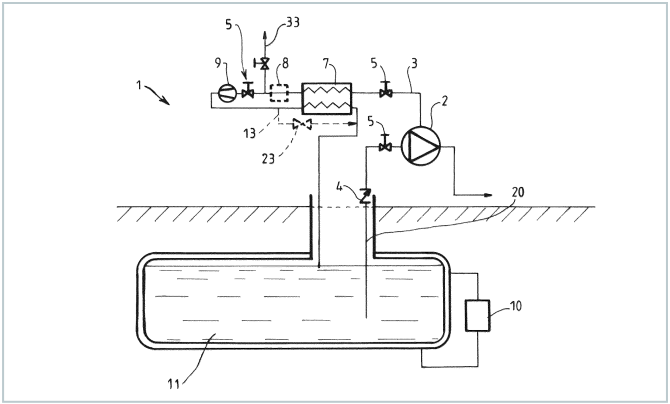
Latest patents

US2025251088A1

Installation and method for storing and distributing cryogenic fluid



Company name	Air Liquide SA (France)
Inventors	Ouakrim Wassim, Benistand Hector Cyril, Try Rasmey
Priority date	01-Feb-2024
Publication date	07-Aug-2025

This patent talks about efficiently storing and distributing cryogenic fluids, such as liquid hydrogen, particularly when the storage tank is buried underground. Traditional systems rely on gravity to supply cryogenic pumps with liquid from above-ground tanks, but this setup doesn't work when the tank is below the pump. The invention solves this by including a vapor recovery system that captures and controls the pressure of gas that evaporates (boil-off gas) during pump operation. This recovered gas is compressed and returned to the underground tank, maintaining a slightly higher pressure inside the tank than at the pump inlet to ensure proper liquid flow. This setup enhances pump performance, reduces fluid loss, and ensures safer, reliable fuel distribution from underground storage.

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Latest patents

EP4605580A2 Green

Electrolyzer system with vaporizer cooling system

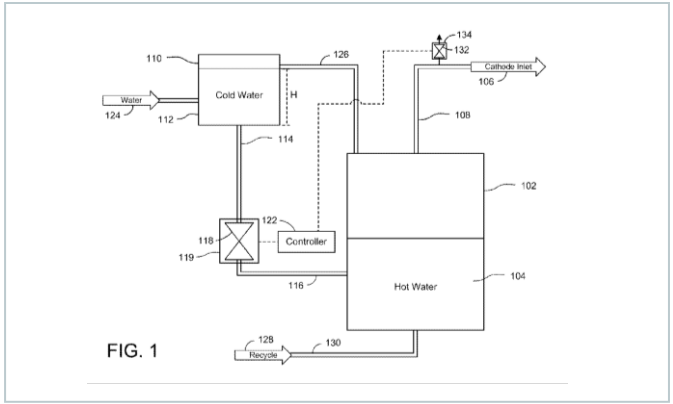

FIG. 1

Company name	Fuelcell Energy INC (USA)
Inventors	Malwitz Jonathan
Priority date	21-Oct-2022
Publication date	27-Aug-2025

The invention relates to an electrolyzer system equipped with a safety mechanism to rapidly cool a vaporizer during system malfunctions. It uses a cold-water tank positioned above the vaporizer, allowing gravity-fed cold water to flow into the vaporizer when triggered by detected faults such as sudden changes in temperature, voltage, current, gas flow, or blower failure. A controller reduces vaporizer pressure and opens a fail-safe valve designed to open automatically during power loss releasing cold water that lowers the vaporizer's temperature below 100°C. The novel aspect lies in this passive, gravity-driven emergency cooling system, enhancing safety and reliability in electrolyzer operations.

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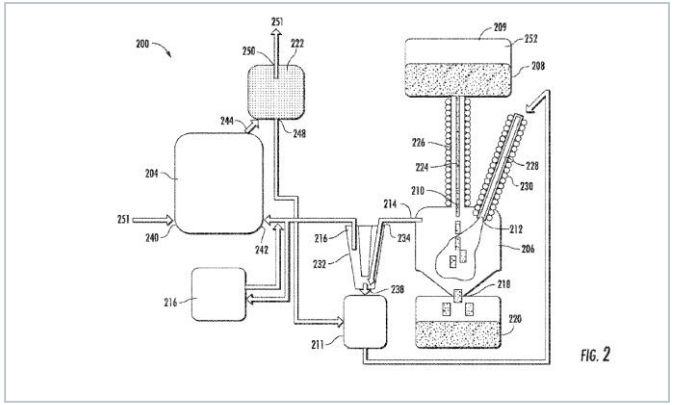
Latest patents

EP4594248A1 Green

Oxidization reactor for hydrogen fuel cell vehicle



Company name	Volvo Truck Corp (Sweden)
Inventors	Lundgren Staffan
Priority date	28-Sep-2022
Publication date	06-Aug-2025

The invention addresses the problem of low energy density in traditional hydrogen storage systems for fuel cell electric vehicles (FCEV) by introducing a more efficient on-board hydrogen generation method. Instead of storing hydrogen as a gas or liquid, it uses metals like aluminum or iron. These metals react with steam, produced from the vehicle's fuel cell exhaust water, to generate hydrogen gas and metal oxide as a byproduct. The setup includes a reactor, heating elements, and separate, replaceable containers for adding metal and collecting oxide. This allows for higher energy density, better use of space, and easier maintenance. By using waste heat to produce steam, it also improves overall energy efficiency.

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Latest patents

EP4366002B1

Solid Oxide Fuel Cell Stack for an aircraft engine

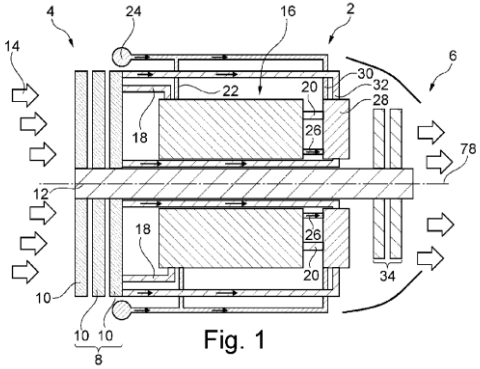

Fig. 1

Company name	Airbus Operations GMBH (Germany)
Inventors	Geisler Helge Ingolf, Nehter Pedro, Vignesh Ahilan
Priority date	04-Nov-2022
Publication date	13-Aug-2025

This invention introduces a solid oxide fuel cell (SOFC) stack for aircraft engines, using ring-shaped tubular SOFCs arranged around a central shaft to improve power density and thermal management. The stack features different types of SOFCs arranged radially to handle a wide temperature range (550°C–850°C) without complex cooling. It includes manifolds for hydrogen flow and air-cooled housing with baffles for better oxygen distribution. The fuel cell stack is built into an engine that includes a combustion chamber, turbine, and compressor. It helps generate both thrust and electricity, while reducing NOx emissions by burning the leftover hydrogen.

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Latest patents

IN202521070824A

Integrated storage and application tank utilizing metal hydrides for hydrogen management

Company name	Individual Inventor (India)
Inventors	Vaishnavi C Jadhav
Priority date	25-Jul-2025
Publication date	15-Aug-2025

Summarized by Dennemeyer

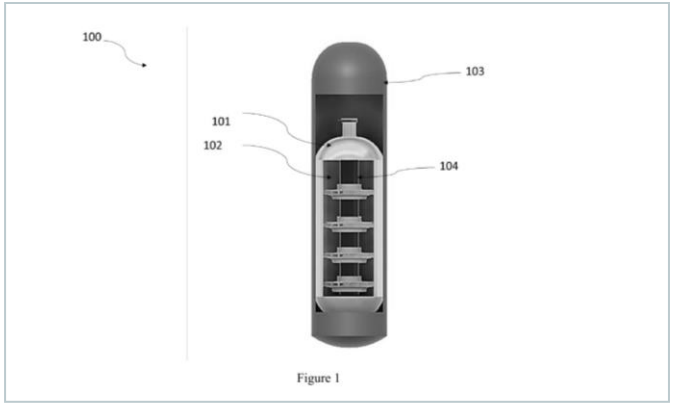

Figure 1

This invention presents a safe, compact, and efficient hydrogen storage tank that uses metal hydrides to store hydrogen in solid form at low pressure. It is well-suited for fuel cells, vehicles, drones, and portable energy devices. Unlike traditional storage methods that use high-pressure gas or cryogenic liquids, this tank has a modular internal design inspired by an impeller. It includes removable disc-flange units filled with hydride material, making maintenance easier and allowing the tank to be scaled as needed. The tank is built with a strong stainless-steel outer shell and a lightweight, carbon-fiber-reinforced aluminum liner inside to improve heat flow. An external heat jacket controls the release of hydrogen when needed, while a central manifold supplies hydrogen gas to other connected systems.

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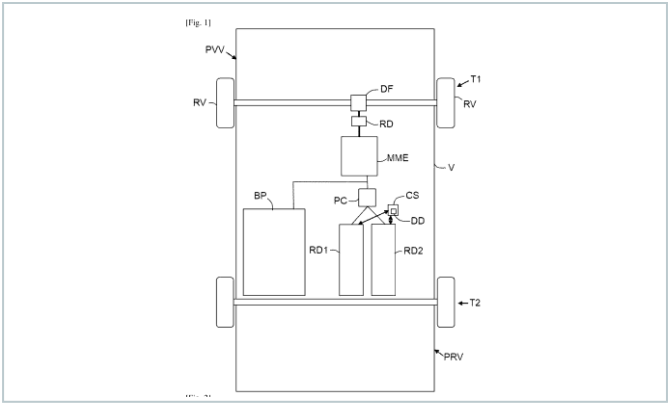
Latest patents

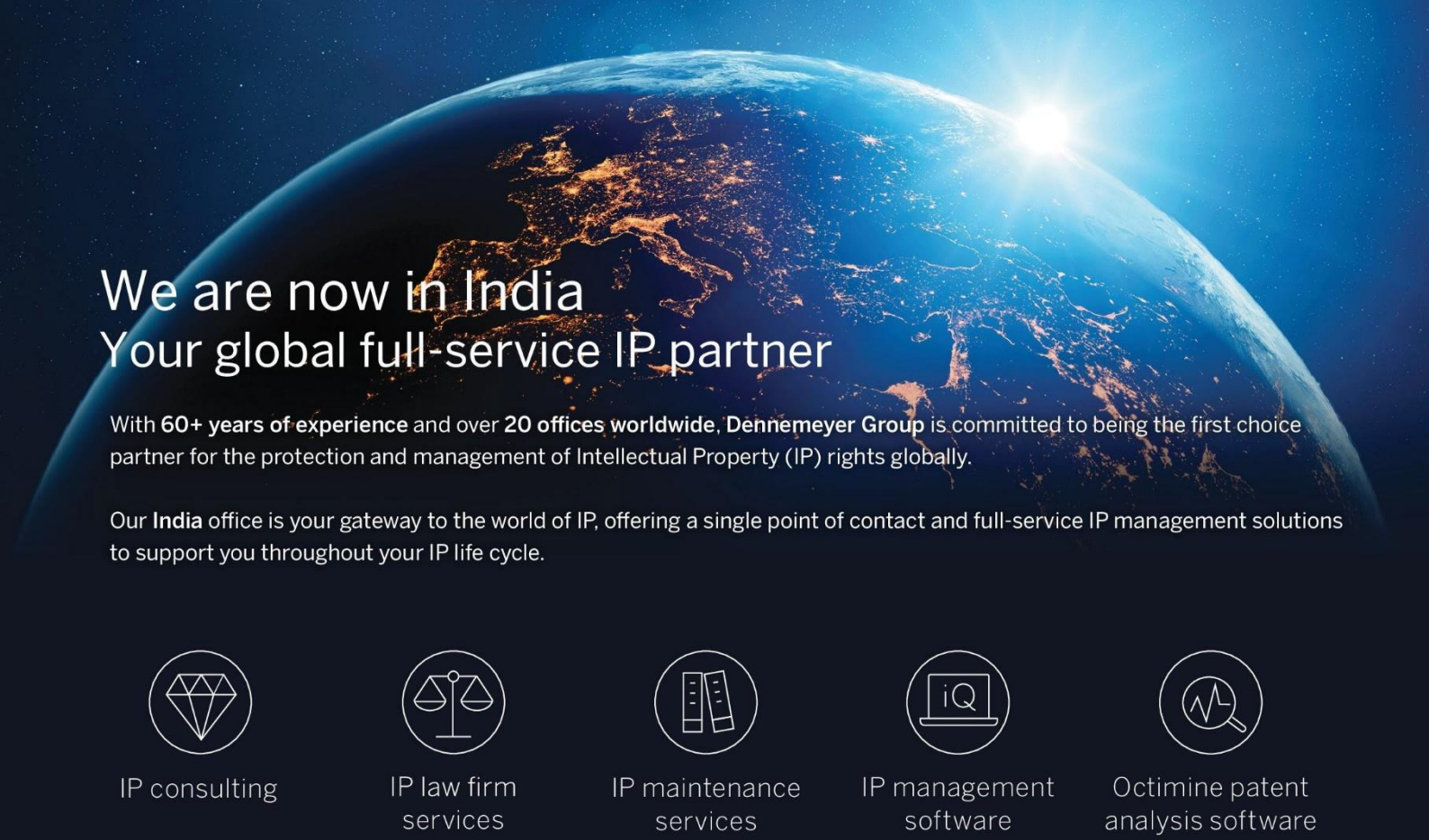
FR3158835A1

Diagnosis of the possibility of using vehicle dihydrogen tanks



Company name	Stellantis Auto SAS (France)
Inventors	Guillaume Pierre Emmanuel
Priority date	25-Jan-2024
Publication date	01-Aug-2025

This invention presents a diagnostic system for hydrogen-powered vehicles with two or more hydrogen tanks supplying a fuel cell. Traditional sensor checks rely on comparing temperatures between tanks, which can fail when only two are present, potentially disabling both and stopping the vehicle. The proposed method avoids that risk by independently diagnosing each tank using internal data. It estimates the actual hydrogen temperature from pressure and density values via a lookup table and compares it to the sensor reading. If the difference exceeds a set threshold (e.g., 3–10°C), the tank is flagged as faulty and disabled. This approach ensures accurate fault detection for any number of tanks (N ≥ 2), improving safety and reliability without unnecessary shutdowns.



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