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November 2025

Path to Sustainability

Harnessing Hydrogen

Recent developments

Curated and summarized - Industry and Patent news

Published by Dennemeyer India Private Limited

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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

- Hydrogen-powered heavy trucks set a new global standard in fuel efficiency, outperform previous benchmarks, cut fuel costs, and boost competitiveness against diesel. Horizon's VL-IV-240 system delivers 240 kW of constant power, making hydrogen fleets a strong candidate for large-scale adoption and infrastructure investment.

- MB Energy and Gen2 Energy are building a secure, RFNBO-compliant (Renewable Fuels of Non-Biological Origin) liquid hydrogen supply chain to strengthen Europe's green hydrogen ecosystem and reduce logistics and pricing challenges. Their partnership ensures long-term supply from Norway to Germany, creating strategic opportunities for commercial transport and industrial decarbonization.

- Advanced thermal management is critical for hydrogen-electric propulsion, ensuring safe and efficient zero-emission flight. Conflux's additive-manufactured heat exchanger for Airbus' ZEROe project drives aerospace innovation and unlocks high-value opportunities for hydrogen technologies in aviation.

- Off-grid charging solutions close infrastructure gaps and accelerate fleet electrification in remote operations. Nuvera and OneH2's HydroCharge™ merges hydrogen and electrification to enable flexible, zero-emission charging, creating new revenue streams and reinforcing hydrogen's role in clean energy ecosystems.

- Many inventions published last month revolved around two major themes:

  - Enhancing safety during hydrogen refueling and defueling by automating critical processes. This includes verifying secure nozzle-to-tank connections at H_2 stations and replacing slow, error-prone manual defueling with electronic valves, sensors, and real-time flow control for precise, reliable operation.

  - Innovations in electrochemical stack design and membrane technology are driving major performance gains for hydrogen systems. A new catalyst layer with interwoven wires of varied thickness and hardness improves flexibility and conductivity, while a nanostructured proton-exchange membrane with polyelectrolyte coatings reduces gas crossover and enhances durability.

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Industry News

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High-Efficiency Fuel Cell

Horizon unveils latest heavy duty fuel cell system: more power, lower hydrogen consumption

Horizon Fuel Cell launched its latest integrated fuel cell system, the VL-IV-240, at the 9th International Hydrogen and Fuel Cell Expo in Foshan, China. Designed for heavy trucks and stationary power, the system uses Horizon's 400 kW fuel cell stack and delivers up to 240 kW of constant power with significant efficiency improvements. It achieves a record 49% fuel efficiency, surpassing the global benchmark of 44–47%, which helps reduce fuel consumption and lower Total Cost of Ownership (TCO) for fleet operators. This advancement positions fuel cell vehicles closer to diesel competitiveness and supports large-scale adoption. Horizon has validated its VL-Series fuel cells worldwide, powering Hyzon heavy-duty trucks and diverse applications, including AI data centers that need reliable energy as electrical grids struggle to meet soaring demand.

Source: Horizon Fuel Cell

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Industry News

Liquid Hydrogen Alliance

MB Energy and Gen2 Energy sign agreement to collaborate on liquid hydrogen supply chain into Germany

MB Energy and Gen2 Energy signed an MoU at Hydrogen Technology World Expo in Hamburg to collaborate on producing, offtaking, and distributing RFNBO-compliant (Renewable Fuels of Non-Biological Origin) liquid hydrogen from Gen2 Energy's projects in Norway to MB Energy's customers in Germany. The partnership will strengthen production and supply potential from Gen2 Energy's planned Nesbruket site and develop a long-term supply chain for liquid hydrogen, examining logistics, pricing, and safety considerations. MB Energy brings decades of expertise in importing and distributing liquid energy products, while Gen2 Energy contributes its deep knowledge of green hydrogen production. Both companies see liquid hydrogen as a critical enabler for the energy transition, particularly in commercial transport, and aim to accelerate its adoption through this strategic collaboration.

Source: MB Energy

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Industry News

Hydrogen-Powered Transit

Osaka metro gearing up for clean transportation with Panasonic hydrogen energy and solar power technology

Osaka Metro has launched Japan's first railway-integrated hydrogen fuel cell demonstration at its Morinomiya Depot, using Panasonic's pure hydrogen system combined with solar panels to advance decarbonized rail operations. The facility generates over 110,000kWh annually enough to power 17 homes and includes remote monitoring via Panasonic's Soranet platform and energy visualization services. This marks Panasonic's first delivery of a pure hydrogen fuel cell to a railway operator, signaling a major step toward sustainable train operations. Osaka Metro aims to use this system to power trains, reducing carbon emissions and promoting renewable energy adoption. The initiative aligns with Kansai's broader decarbonization efforts, as operators like Hankyu and Hanshin transition to renewable-powered services across the regional rail network.

Source: Panasonic

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Industry News

Hydrogen Heat Exchanger

Conflux Technology collaborates with Airbus on hydrogen aircraft thermal management

Conflux Technology is supporting Airbus' ZEROe project by developing an advanced heat exchanger using additive manufacturing for hydrogen-electric propulsion systems. The component, now undergoing readiness assessment, ensures efficient thermal regulation in megawatt-class fuel cell systems. Built through CFD modeling and validated in lab tests, the lightweight design meets aerospace integration demands. This development marks a major advancement in applying additive manufacturing to sustainable aviation, enabling safe and efficient hydrogen-powered flight. Airbus aims to bring a commercially viable hydrogen-electric aircraft to market, and Conflux's heat exchanger is being evaluated for integration into its broader fuel cell architecture with further system-level testing planned.

Source: Conflux

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Industry News

Hydrogen Mobile Charging

Nuvera and OneH2 showcase hydrogen-powered mobile charger for off-grid EV fleets

Nuvera Fuel Cells and OneH2 have introduced HydroCharge™, a hydrogen-powered mobile fast charger that delivers zero-emission DC fast charging and AC power in areas with limited or no grid access. The system converts hydrogen into on-demand electricity for EV fleets, heavy-duty yard equipment, and remote operations, combining OneH2's mobile refueling assets with Nuvera's fuel-cell technology. This collaboration demonstrates how hydrogen and electrification can complement each other, offering a practical solution for logistics yards, ports, and distribution centers where grid capacity falls short. By enabling flexible, portable charging, HydroCharge supports fleet electrification and advances a broader hydrogen energy ecosystem through interoperability and innovation.

Source: Nuvera

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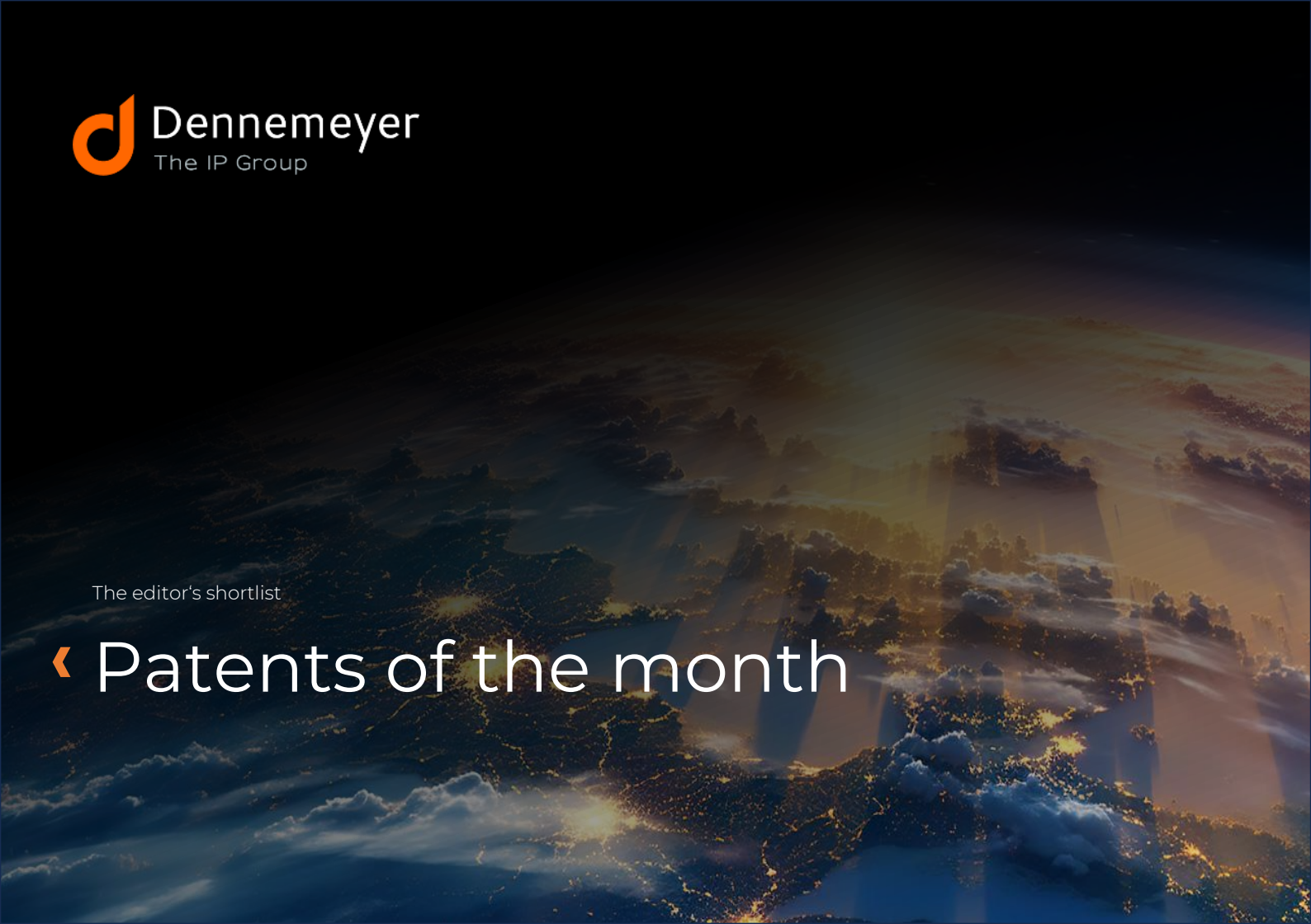

The editor's shortlist

Patents of the month

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

Patents of the month

Published in Oct 2025

Shortlisted and summarized by our analyst

- US20252794411A1 - High-pressure hydrogen distribution system for an aircraft with a tank storing supercritical hydrogen
  Assignee: Airbus Operations SAS, Airbus SAS (France)
- US12405594B2 - Hydrogen defuel system for hydrogen tanks Green
  Assignee: Caterpillar Inc (USA)
- US2025334305A1 - Apparatus and systems for separating phases in liquid hydrogen pumps
  Assignee: General Electric Company (USA)
- US2025323304A1 - Electrochemical cell stacks including multi-diameter mesh contact layer Green
  Assignee: Bloom Energy Corp (USA)
- US2025316736A1 – Polyelectrolyte multilayer coated proton exchange membrane for electrolysis and fuel cell applications Green
  Assignee: UOP LLLC (USA)
- EP3919802B1 - Device for checking a fuelling procedure at a H2 fuel station Green
  Assignee: Westenergie AG (Germany)
- FR3155282B1 - Method for reducing losses by hydrogen evaporation Green
  Assignee: Air Liquide SA (France)
- JP2025150967A - Regenerative fuel cell system and method of operating same Green
  Assignee: Honda Motor Co Ltd (Japan)
- KR20250146546A - Apparatus and method for determining poor charging of hydrogen tank Green
  Assignee: Hyundai Motor Co (Korea)
- CN115711358B - Liquid hydrogen storage tank system Green
  Assignee: Mianyang Keda Jiuchuang Technology Co Ltd (China)

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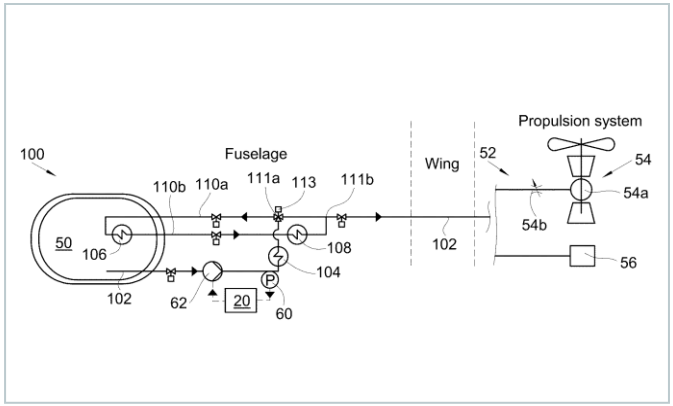
Latest patents

US2025334229A1

High-pressure hydrogen distribution system for an aircraft with a tank storing supercritical hydrogen



Company name	Airbus Operations SAS, Airbus SAS (France)
Inventors	Raveneau Guillaume, Landolt Jonathan
Priority date	26-Apr-2024
Publication date	30-Oct-2025

The invention proposes a hydrogen distribution system for aircraft that supplies hydrogen from a tank to a consumer, such as a fuel cell or combustion engine, at high pressure without relying on complex pumps or compressors. The system stores hydrogen at supercritical pressure and uses a supply pipe equipped with heat exchangers and a tank heater to manage temperature and pressure. Sensors monitor line pressure, tank pressure, and temperature, while a control unit adjusts pump speed, heating, and valve positions for optimal performance. This design reduces risks associated with cryogenic pumps, overpressure, and insulation requirements, offering a simpler, safer, and more efficient solution for hydrogen-powered aviation.

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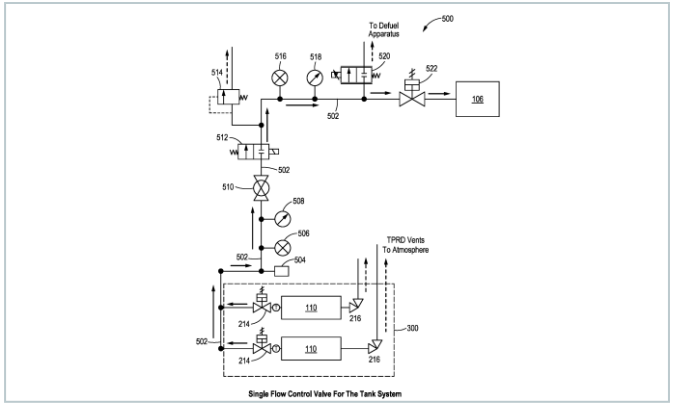
Latest patents

US12405594B2 Green

Hydrogen defuel system for hydrogen tanks



Company name	Caterpillar Inc (USA)
Inventors	Caldwell Curtis John, Ost Seth Michael
Priority date	09-Apr-2024
Publication date	09-Oct-2025

The patent addresses inefficiencies and safety risks in manual hydrogen tank defueling, which is slow, error-prone, and requires constant monitoring of pressure and temperature, especially for multiple tanks. The invention introduces an automated defueling system with electronic valves, pressure and temperature sensors, and a control unit that uses real-time data to modulate valve operations and regulate hydrogen flow safely. It integrates advanced features such as TPRDs, leak detection, emergency shut-off, geofence-triggered automation, and user interfaces displaying operational data and estimated depressurization times. This approach improves safety, reduces manual intervention, and enables precise, efficient defueling across varied conditions.

Summarized by Dennemeyer

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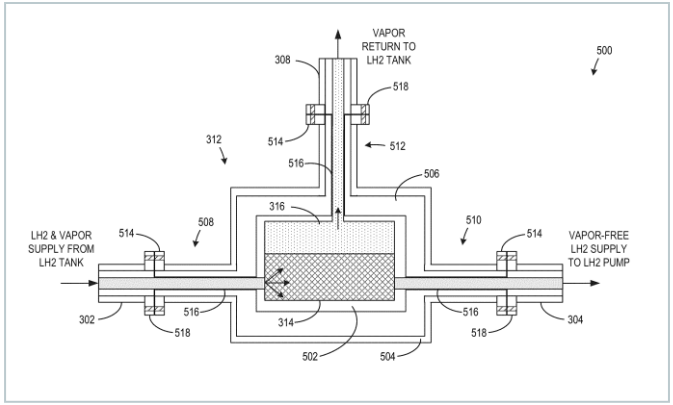
Latest patents

US2025334305A1

Apparatus and systems for separating phases in liquid hydrogen pumps



Company name	General Electric Company (USA)
Inventors	Stautner Ernst Wolfgang, Minas Constantinos
Priority date	31-Aug-2022
Publication date	30-Oct-2025

Liquid hydrogen pumps in hydrogen-powered vehicles often suffer cavitation damage caused by vapor bubbles in the LH2 supply, leading to erosion, reduced flow rates, and costly repairs. The disclosed solution integrates a phase separator with an additively manufactured sintered metal filter between the tank and pump to remove gaseous hydrogen before pumping. Separated vapor is returned to the tank via insulated flowlines with pressure sensors and automated regulator valves, maintaining optimal pressure, reducing boil-off losses, and improving net positive suction head. This invention not only minimizes cavitation risk but also enables dynamic pressure control and reuse of recovered hydrogen for other vehicle systems, enhancing efficiency and reliability.

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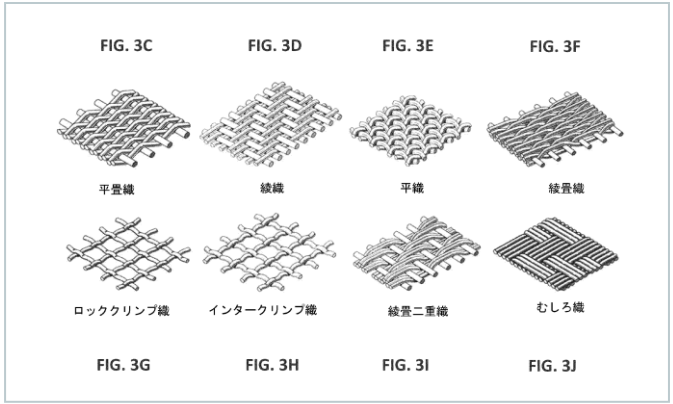
Latest patents

US2025323304A1 Green

Electrochemical cell stacks including multi-diameter mesh contact layer



Company name	Bloom Energy Corp (USA)
Inventors	Gasda Michael, Armstrong Tad, Lu Zigui
Priority date	08-Feb-2024
Publication date	16-Oct-2025

Summarized by Dennemeyer

The disclosure relates to electrochemical cell stacks, such as fuel cells or electrolyzers, and introduces a design improvement for contact layers that ensure electrical connection between interconnects and fuel electrodes. Instead of using uniform wire meshes, the proposed contact layer consists of interwoven wires arranged in two different directions, with variations in wire properties. These include alternating thinner and thicker wires, wires made from materials of different hardness, and differing wire densities along each direction. This configuration enhances mechanical compliance, reduces stress during compression and thermal cycling, and maintains reliable electrical conductivity, offering a more robust and adaptable solution for stack performance.

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Latest patents

US2025316736A1 Green

Polyelectrolyte multilayer coated proton exchange membrane for electrolysis and fuel cell applications

Company name	UOP LLLC (USA)
Inventors	Liu Chunqing, Dong Xueliang, Ba Chaoyi
Priority date	18-Oct-2021
Publication date	09-Oct-2025

Summarized by Dennemeyer

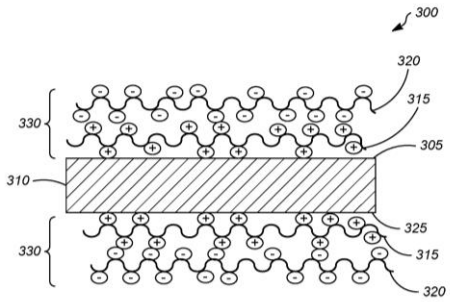

FIG. 3

The invention introduces a new proton-exchange membrane for electrolysis and fuel cells that addresses key limitations of conventional membranes like Nafion®. These membranes suffer from high cost, resistance, gas crossover, and limited proton conductivity. The solution coats a cation exchange membrane with alternating layers of polycation and polyanion polymers using layer-by-layer self-assembly methods such as dip coating, spray deposition, or electrodeposition. These multilayers form through electrostatic and other bonding mechanisms, creating a nanostructured, thermally and chemically stable coating. Layer count, thickness, and properties can be tailored by adjusting parameters like pH, ionic strength, and temperature, resulting in a durable, high-performance membrane for energy applications.

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Latest patents

EP3919802B1 Green

Device for checking a fuelling procedure at a H2 fuel station

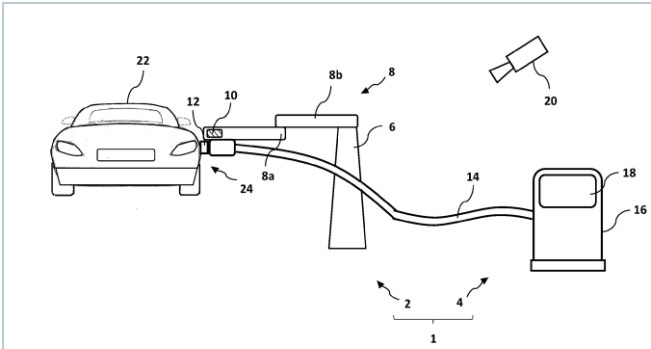

Fig. 2

Company name	Westenergie AG (Germany)
Inventors	Herr Stefan, Kledewski Ingo
Priority date	05-Jun-2020
Publication date	22-Oct-2025

Summarized by Dennemeyer

The patent provides a safety-enhanced, cost-effective solution for hydrogen refueling by introducing a device that verifies proper nozzle-to-tank connections at H_2 filling stations. The device checks if the nozzle at the filling station is properly connected to the vehicle's tank. It uses sensors like pressure, torque, contact, or cameras to detect incorrect connections and prevent leaks. The device can move close to the tank for better inspection and can even work as a robot to help connect or disconnect the nozzle automatically. Extra features like lights for dark areas, external cameras for monitoring, and safety-certified sensors make the system reliable. Overall, it improves safety, reduces the need for trained staff, and allows partial automation of hydrogen refueling.

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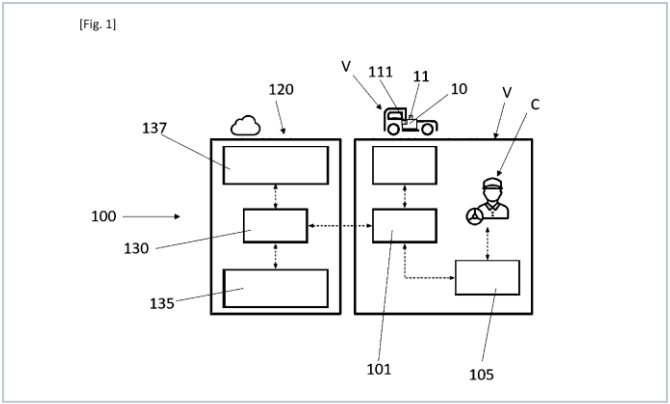
Latest patents

FR3155282B1 Green

Method for reducing losses by hydrogen evaporation



Company name	Air Liquide SA (France)
Inventors	Koh Kai Jun, Petitpas Guillaume, Girard Claire
Priority date	09-Nov-2023
Publication date	03-Oct-2025

The patent introduces a system to reduce hydrogen loss from liquid hydrogen tanks during vehicle parking by optimizing the tank's fill level at refueling. Instead of always filling the tank completely, the method calculates an optimal "parking start filling level" based on planned trips, parking duration, and environmental conditions. Using thermodynamic models, real-time sensor data, historical travel patterns, and user input, the system predicts dormancy time before venting and adjusts refueling strategies accordingly. It can also communicate with remote servers for advanced calculations and provide guidance through driver interfaces or automated fueling controls, minimizing evaporative losses, lowering costs, and improving sustainability.

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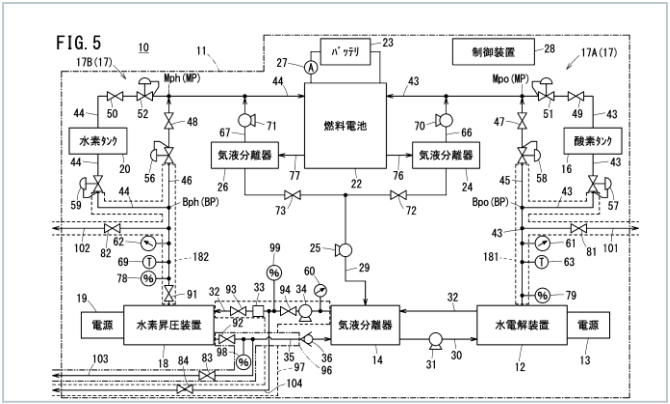
Latest patents

JP2025150967A Green

Regenerative fuel cell system and method of operating same

Company name	Honda Motor Co Ltd (Japan)
Inventors	Satoshi Inoue, Koki Tamura
Priority date	27-Mar-2024
Publication date	09-Oct-2025

Summarized by Dennemeyer



Regenerative fuel cell systems often face moisture buildup in hydrogen and oxygen pipes, which can damage sensors and other parts. Traditional drying methods use heaters or special materials to absorb moisture, but these need extra power and regular maintenance. The new solution uses several external valves that link the gas supply and discharge lines to a vacuum space when the system is turned off. This vacuum helps moisture evaporate without using energy-heavy equipment. The process also collects leftover gases, reduces pressure by generating electricity from them, and then removes moisture under vacuum conditions. This method saves power, removes the need for replacing drying materials, and keeps sensors working reliably even in harsh environments like lunar surfaces.

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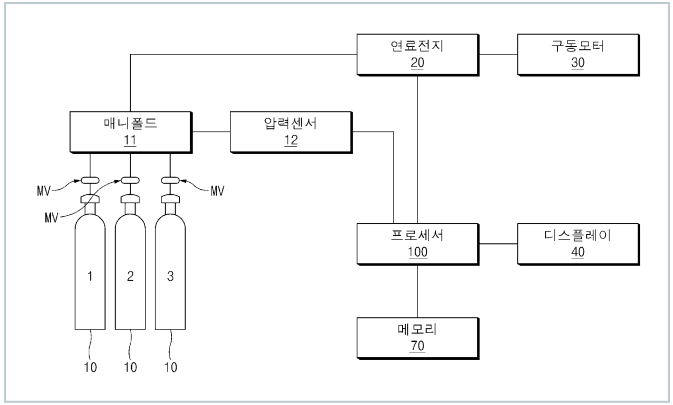
Latest patents

KR20250146546A Green

Apparatus and method for determining poor charging of hydrogen tank



Company name	Hyundai Motor Co (Korea)
Inventors	Quiet wine
Priority date	01-Apr-2024
Publication date	13-Oct-2025

The invention introduces a device and method for detecting poor hydrogen charging in multiple tanks on hydrogen-powered mobility vehicles without adding costly sensors. It stores tank capacity data to estimate the hydrogen amount based on driving distance and remaining range, then compares it to a calculated threshold derived from tank capacity and the charging method (communication or non-communication). The threshold varies depending on the charging method and number of tanks, with communication-based charging having stricter parameters. The system determines charging status after a reference time post-refueling and can display guidance to check manual valve positions if a tank is underfilled. This approach reduces parts cost while ensuring accurate detection of charging failures.

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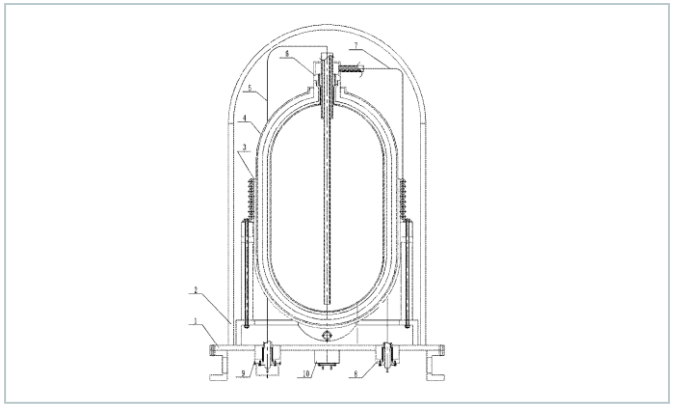
Latest patents

CN115711358B Green

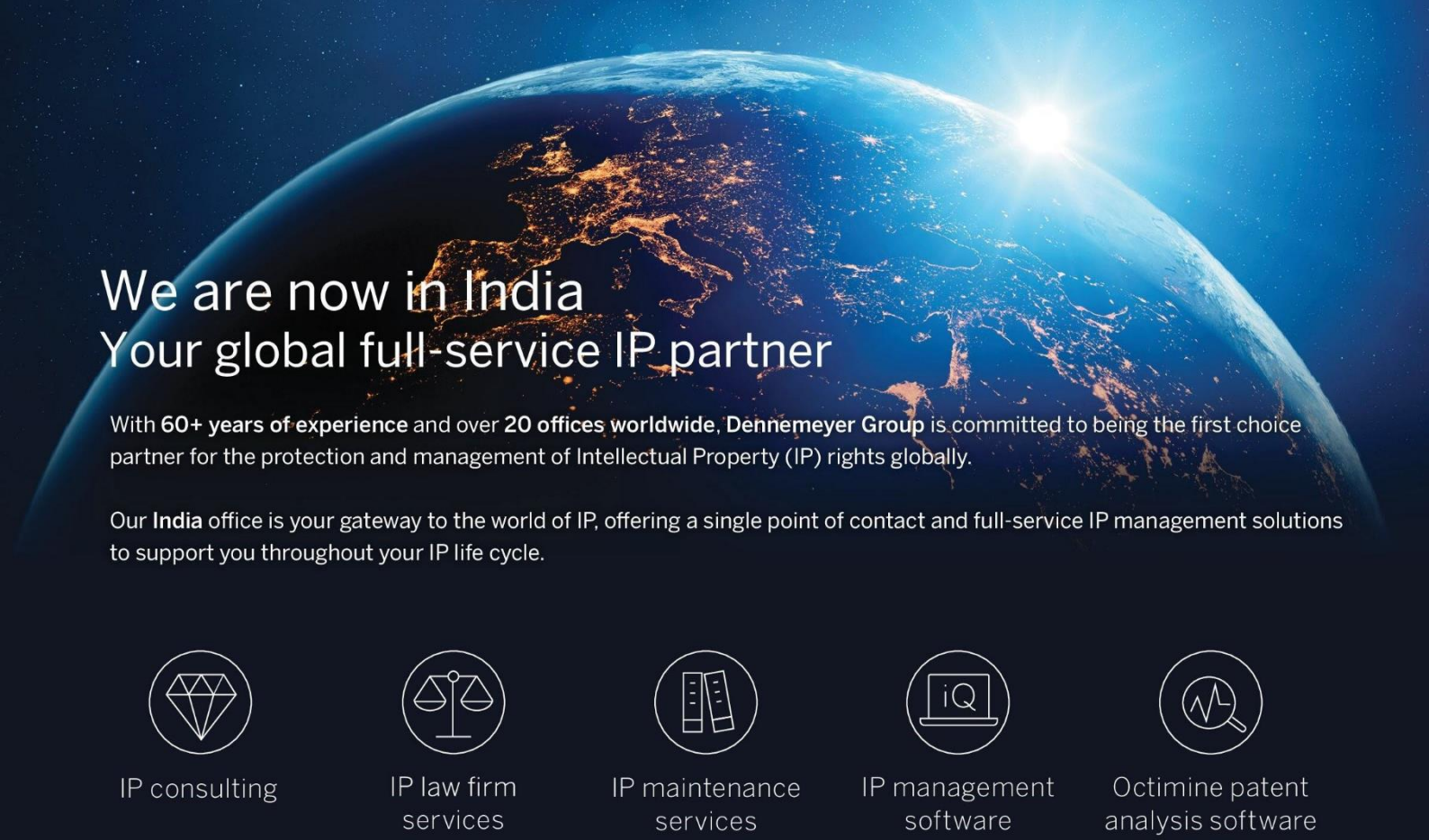
Liquid hydrogen storage tank system



Company name	Mianyang Keda Jiuchuang Technology Co Ltd (China)
Inventors	Gao Feng, Xiong Boru, Lu Qingyi
Priority date	14-Nov-2022
Publication date	14-Oct-2025

Summarized by Dennemeyer

The invention provides a highly secure and efficient liquid hydrogen storage and transportation system that addresses issues like hydrogen embrittlement, heat leakage, vacuum failure, and safety during transit. It features a multilayer capsule structure with an inner high-strength steel vessel lined with aluminum and a composite middle shell of PTFE micro powder and glass microspheres to reduce hydrogen permeability and improve insulation. Dual vacuum containers ensure redundancy in thermal protection, while spiral tube heat exchangers and a fuel cell-driven refrigeration system use cold gaseous hydrogen for active cooling, minimizing evaporation losses. Specialized insulated pipelines and robust mounting assemblies further enhance safety and reliability during large-scale hydrogen storage and transport.



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