

January 2026

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.

Key Insights this month

- ❑ HySynergy's integration of grid balancing with green hydrogen production sets a new benchmark for Power-to-X, creating dual revenue streams and strengthening the business case for large-scale hydrogen projects. This model accelerates renewable integration and positions hydrogen as a cornerstone for energy flexibility and resilience.
- ❑ Successful hydrogen drone trials with India-produced composite cylinders demonstrate hydrogen's superior endurance, 3–5x longer than battery UAVs. This unlocks high-value opportunities in defense, logistics, and surveillance, while positioning India for self-reliance in hydrogen technology.
- ❑ Renewable Fuels of Non-Biological Origin (RFNBO) certification and stricter GHG (Green House Gas) quotas accelerate demand for green hydrogen. H2APEX's compliance advantage strengthens market leadership and drives adoption in mobility and fuel blending, positioning hydrogen as a key enabler of Europe's decarbonization strategy.
- ❑ Tyczka Hydrogen's acquisition of additional refuelling stations signals that hydrogen mobility especially for heavy-duty transport is entering a scale-up phase, where infrastructure expansion and supportive incentives together lower adoption barriers and strengthen the business case for green hydrogen logistics.
- ❑ Many inventions published last month revolved around two major themes:
 - Innovations in hydrogen storage and delivery enable safer, more efficient fueling for heavy-duty and multi-modal transport. A dual-section liquid hydrogen tank with integrated pumps and heat exchanger ensures rapid, high-pressure gas supply for zero-emission vehicles, while a modular multi-pressure vessel assembly reduces installation complexity and footprint, supporting scalable, cost-effective hydrogen infrastructure.
 - Compact hydrogen purification systems with continuous operation and efficient impurity removal enhance fuel quality and reliability. Advanced regeneration and modular design reduce downtime, supporting scalable and energy-efficient hydrogen infrastructure.



◀ Industry News

Hydrogen Grid Integration

Everfuel's HySynergy plant becomes the world's first facility to stabilize the power grid while producing green hydrogen

Everfuel has achieved a global first by using its large-scale HySynergy electrolyser plant in Fredericia to provide automatic frequency restoration reserve (aFRR) balancing services to Denmark's power grid while producing certified green hydrogen as a Renewable Fuel of Non-Biological Origin (RFNBO). This milestone demonstrates that electrolysis can both stabilize the grid and generate renewable hydrogen, supporting a flexible and sustainable energy system. In collaboration with Energinet and Centrica, HySynergy is now integrated as balancing capacity, marking the first Power-to-X facility in Denmark to do so. The plant can adjust hydrogen production up or down within five minutes based on grid needs, helping manage fluctuations from wind and solar energy and paving the way for similar projects across Europe.



Hydrogen Powertrains

Hydrovert Energy aims to transform India's urban mobility with hydrogen powertrains

Hydrovert Energy, founded in 2021, is developing hydrogen fuel cell powertrains and generators at Pune's Venture Center (NCL campus). These systems emit only water and are designed to replace diesel and CNG engines in sectors where electrification struggles. They currently target cargo three-wheelers and will soon expand to light and medium commercial vehicles, along with stationary generators under testing in the Maharashtra Energy Development Agency (MEDA)-backed certification program. Additionally, Hydrovert is working on a hydrogen-powered two-wheeler prototype. The early proof-of-concept achieved a 50 km test run and led to provisional patents for its thermal management system and high-pressure hydrogen cylinder. Plans are underway for a more advanced prototype featuring fivefold power gains, higher payload, two-person capacity, slope-climbing capability, quick refueling, and extended range for last-mile urban mobility.

Source: [FuelCell Works](#)



India's Hydrogen Drone

Time Technoplast successfully completes flight trials of in-house hydrogen drone

Time Technoplast, an Indian industrial materials manufacturer, has successfully completed flight trials of a hydrogen fuel-cell-powered drone using its own Type-III composite hydrogen cylinders, marking India's first integration of domestically produced cylinders with a fuel-cell UAV. The drone met performance, payload, and endurance targets, showcasing hydrogen's advantages over batteries, including three to five times longer flight duration, quick refueling, and stable power under heavy loads ideal for surveillance, logistics, and defense. This milestone expands the company's presence into clean-energy hardware and UAV platforms, supported by prior regulatory approvals and partnerships with Imperial Auto Industries and Germany's Poppe + Potthoff to develop advanced hydrogen system solutions, as it targets a share of the global drone market projected to reach \$70 billion by 2033.



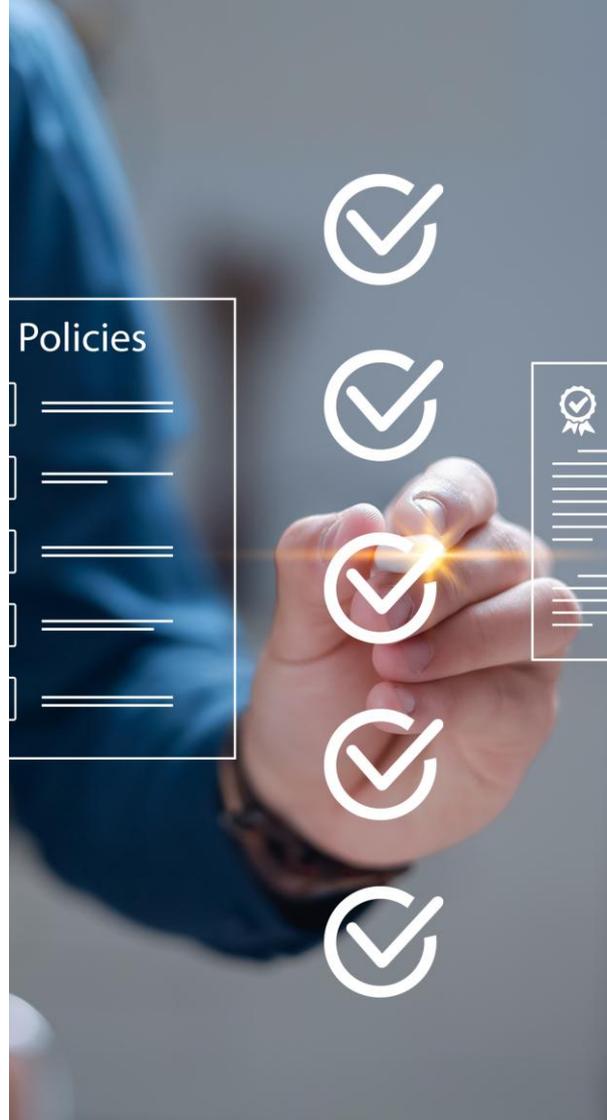
H2APEX Mobility Milestone

RFNBO Certification and draft law on GHG quotas: H2APEX welcomes important steps for the ramp-up of the hydrogen economy

H2APEX Group has obtained RFNBO (Renewable Fuels of Non-Biological Origin) certification for its green hydrogen produced at the Rostock-Laage plant, officially recognizing it as renewable hydrogen under EU standards. This certification allows customers to benefit from greenhouse gas (GHG) reduction quotas, supporting decarbonization goals. The company welcomed Germany's draft law to extend and increase mandatory GHG reductions in fuels to 59% by 2040, which is expected to boost green hydrogen use in mobility. H2APEX already produces significant volumes of green hydrogen, enabling 1.5 million emission-free kilometers for hydrogen buses in Rostock and covering about 25% of Germany's hydrogen mobility market. This achievement strengthens H2APEX's position as a leading player in Europe's clean energy transition.

Policies

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Refuelling Infrastructure

Tyczka hydrogen acquires two hydrogen refuelling stations from morgen mobility

Tyczka Hydrogen is expanding its hydrogen mobility network by acquiring refuelling stations in Giengen an der Brenz and Hallstadt from MorGen Mobility GmbH. The company already operates or plans stations in Augsburg, Schweinfurt, and Ravensburg, strengthening its position as a green hydrogen supplier in southern Germany. Both new stations support 350- and 700-bar refuelling, with upgrades planned for heavy-duty transport. Hydrogen trucks benefit from long ranges, quick refuelling, and higher payloads, making them suitable for intensive logistics. The expansion also aligns with Bavaria's new funding program, which covers up to 80% of the extra cost of hydrogen trucks, helping operators begin fleet decarbonisation. Together, these developments signal growing momentum for hydrogen in heavy-duty mobility.



The editor's shortlist

◀ Patents of the month



Patents of the month

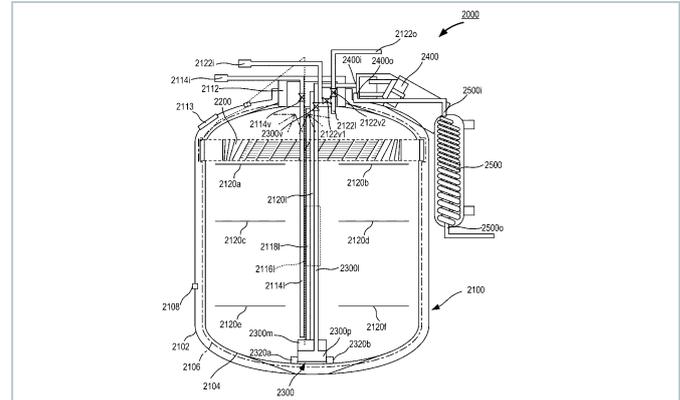
Published in Dec 2025

Shortlisted and summarized by our analyst

- [US2025389389A1](#) - Systems and methods for building pressure when using low pressure liquid hydrogen storage
Assignee: Cummins Inc (USA)
- [US12504126B2](#) - Method and apparatus for delivering hydrogen
Assignee: H2 Clipper Inc (USA)
- [US2025389393A1](#) - Storage assembly for storing pressurised fluid, such as hydrogen
Assignee: Tenaris Connections BV (Netherlands)
- [US2025381499A1](#) - SOE plant and process for performing solid oxide electrolysis
Assignee: Topsoe AS (Denmark)
- [AU2022368854B2](#) - Polyelectrolyte multilayer coated proton exchange membrane for electrolysis and fuel cell applications
Assignee: UOP LLC (USA)
- [EP4511896B1](#) - Fuel cell system
Assignee: Rolls Royce PLC (UK)
- [EP4670820A1](#) - A purification arrangement for purifying hydrogen gas
Assignee: Volvo Truck Corp (Sweden)
- [JP7788603B2](#) - Catalyst layer, electrolyte membrane-electrode assembly, fuel cell, and method for manufacturing catalyst layer
Assignee: Panasonic Intellectual Property Management Co Ltd (Japan)
- [IN202517100400A](#) - Tank system for hydrogen applications, fuel cell arrangement,...and method for measuring an average temperature in a tank system
Assignee: Robert Bosch GMBH (Germany)
- [CN121224528A](#) - Integrated control system and method suitable for hydrogen fuel cell heavy truck
Assignee: Shenzhen Yinghe Automobile Co Ltd (China)

◀ US2025389389A1

Systems and methods for building pressure when using low pressure liquid hydrogen storage



This invention enables efficient storage and delivery of liquid hydrogen for heavy-duty vehicles like mining haul trucks. It uses a tank with two sections: liquid hydrogen at the bottom and gaseous hydrogen at the top. A first pump draws liquid hydrogen at low pressure and transfers it to a second pump that boosts it to high pressure (up to 450 bar). The liquid hydrogen then passes through a heat exchanger to produce hydrogen gas for fuel cells or engines, while excess gas can return to the tank. A thermal device inside the tank maintains pressure by heating gaseous hydrogen, ensuring reliable power for zero-emission operation. The design supports long-duration operation and quick hydrogen delivery, making it suitable for demanding industrial environments. It can also be adapted for multiple transport modes, including aerospace, rail, and maritime.

Company name Cummins Inc (USA)

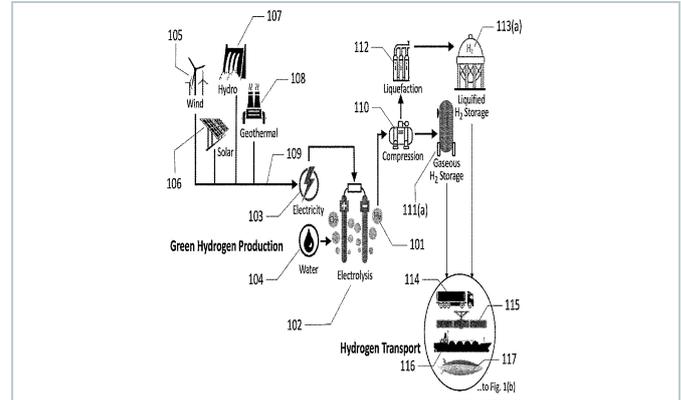
Inventors Higgins Russell Hiatt,
Raymond Jordan,
Wolflick John David

Priority date 18-Jun-2025

Publication date 25-Dec-2025

US12504126B2 Green

Method and apparatus for delivering hydrogen



The invention provides a safe, cost-effective system for transporting, storing, and tracking hydrogen. It uses a dedicated hydrogen delivery line made of suitable materials, optionally enclosed within a safety pipe. An annular space between the pipes carries a sweeper gas or liquid to purge leaked hydrogen, with sensors monitoring for dangerous levels and triggering automatic shutdowns. It measures hydrogen purity at multiple points and records data such as production method, power source, injection pressure, and withdrawal quantities in a secure digital ledger, preferably blockchain-based, ensuring traceability and compliance with ISO14687-2019. Additional features include infrastructure integration, automated valves, and data-driven incentives. This approach enhances safety, reduces cost, and supports sustainability goals.

Company name H2 Clipper Inc (USA)

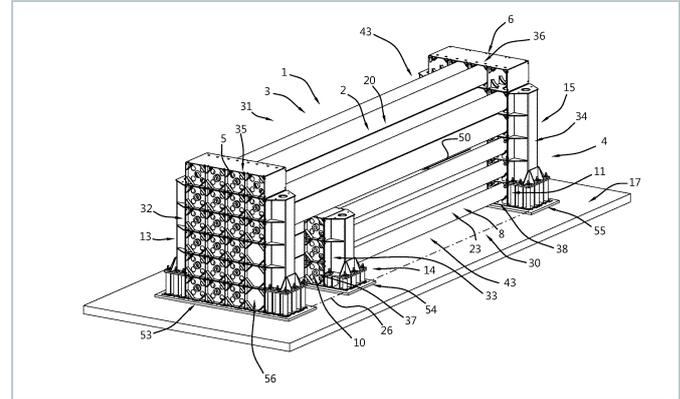
Inventors Brutoco Rinaldo S,
Shelton Robert H

Priority date 04-May-2023

Publication date 23-Dec-2025

◀ US2025389393A1

Storage assembly for storing pressurised fluid, such as hydrogen



The invention relates to a storage assembly for pressurised fluids, such as hydrogen, designed to store fluids at different pressures more efficiently. It comprises at least one primary cylindrical pressure vessel for a first pressure and at least one secondary cylindrical pressure vessel for a higher second pressure, supported by three supports: a primary support, a secondary support, and a shared support for both vessels. This configuration reduces labor and ground area compared to conventional assemblies requiring separate setups. The design accommodates differences in vessel length, mass, and wall thickness to handle varying pressures while simplifying construction and enabling modular assembly. The invention also includes producing the assembly using interconnected support units and optional hoisting members for easier installation.

Company name Tenaris Connections BV (Netherlands)

Inventors Rajesh Booravalli Seetharama Sastry,
Satya Prakash Pandey,
Bipul Kumar,
Gulprit Singh

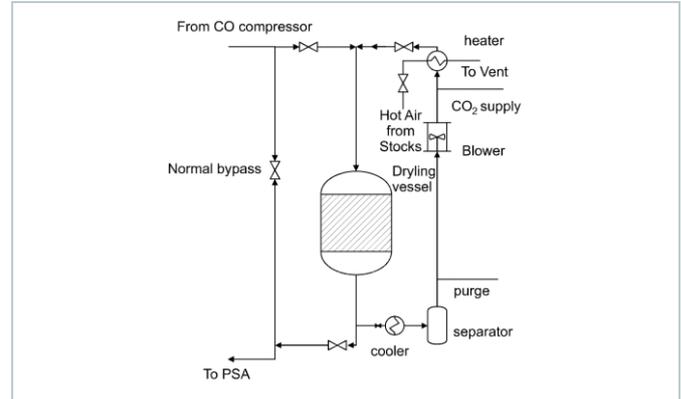
Priority date 06-Jul-2022

Publication date 25-Dec-2025



◀ US2025381499A1 🌱 Green

SOE plant and process for performing solid oxide electrolysis



The invention addresses the challenge of moisture in flush gas reducing the efficiency and lifetime of high-temperature solid oxide electrolysis cells (SOECs). It proposes drying moist flush gas using an adsorbent bed before entering the oxy side of the SOEC and reusing the spent flush gas exiting the SOEC as regeneration gas to desorb moisture from the adsorbent bed. This approach recycles heat, minimizes energy consumption, and maintains near-ambient pressure to reduce compression losses. By effectively removing moisture, it improves SOEC performance and durability while optimizing thermal integration and reducing operational complexity. Additionally, this enables continuous operation by alternating adsorption and desorption cycles between multiple adsorbent beds for uninterrupted drying efficiency.

Company name	Topsoe AS (Denmark)
Inventors	Stummann Troels Dahlggaard, Holstebroer Majken, Speth Christian Henrik, Hansen John B Gild
Priority date	12-Jul-2022
Publication date	18-Dec-2025

◀ **AU2022368854B2** Green

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

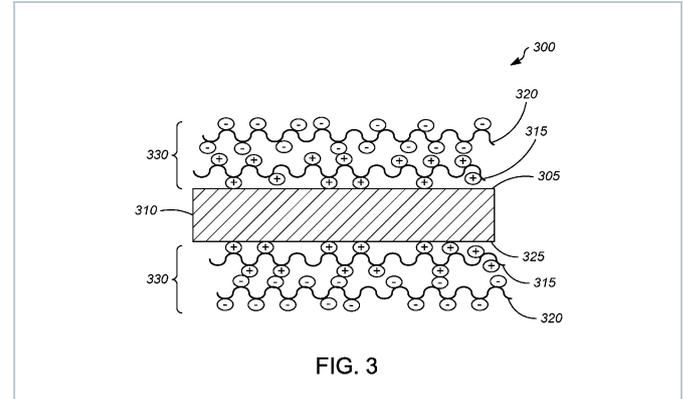


FIG. 3

The patent discloses a polyelectrolyte multilayer coated proton-exchange membrane (PEM) for electrolysis and fuel cells, comprising a cation exchange membrane with one or both surfaces coated by alternating polycation and polyanion polymer layers, where the polycation layer contacts the membrane. The coating is formed via layer-by-layer self-assembly using dip or spray deposition, employing perfluorinated sulfonic acid polymers for the membrane, poly hydrochloride as the polycation, and sulfonated hydrocarbon or polysaccharide-based polyanions such as sulfonated. This design reduces H₂ and O₂ crossover compared to Nafion membranes, enhances proton conductivity with higher in-plane values, and lowers area-specific resistance, resulting in improved electrolysis efficiency, reduced cell voltage, and stable thermal and chemical performance.

Company name UOP LLC (USA)

Inventors Liu Chunqing,
Dong Xueliang,
Ba Chaoyi

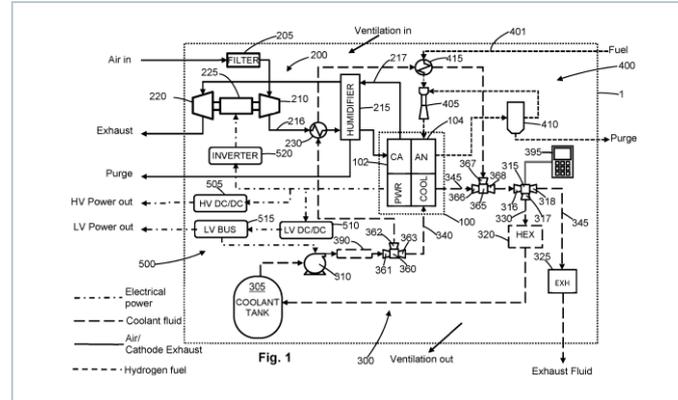
Priority date 18-Oct-2021

Publication date 11-Dec-2025



EP4511896B1 

Fuel cell system



The invention is about a fuel cell system that cools efficiently without needing large, heavy parts. Traditional systems require big heat exchangers and lots of coolant to handle heat during the hottest and most demanding times, like aircraft take-off on hot days. This design solves that by using a smart valve setup that switches between two modes: closed-loop cooling, where coolant is recycled through a heat exchanger, and open-vented cooling, where coolant is released outside when extra heat cannot be handled. There is also a third mode that mixes both, reducing coolant waste. A computer controls these modes based on cooling needs, allowing the heat exchanger to be smaller and lighter, saving weight, space, and cost, making it ideal for aircraft fuel cells.

Company name Rolls Royce PLC (UK)

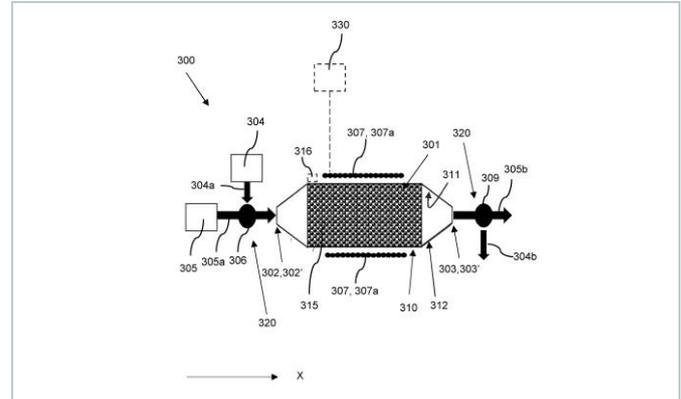
Inventors Tacconi Jacopo

Priority date 21-Apr-2022

Publication date 31-Dec-2025

EP4670820A1 Green

A purification arrangement for purifying hydrogen gas



The invention provides a hydrogen purification arrangement that removes impurities like carbon and sulfur from hydrogen gas using a substrate housed within a compact device. Hydrogen flows through the substrate during purification, while a separate regeneration process uses air or another gas to clean the substrate by desorbing stored impurities. A valve system switches between these two modes, enabling continuous operation without interrupting hydrogen supply. Heating elements raise the temperature during regeneration to oxidize impurities for safer removal. This design integrates dual flow paths for hydrogen and regeneration gases, uses advanced substrates such as zeolite with catalytic coatings, and includes thermal desorption for efficient impurity removal, making the system adaptable and energy-efficient.

Company name Volvo Truck Corp (Sweden)

Inventors Lundgren Staffan

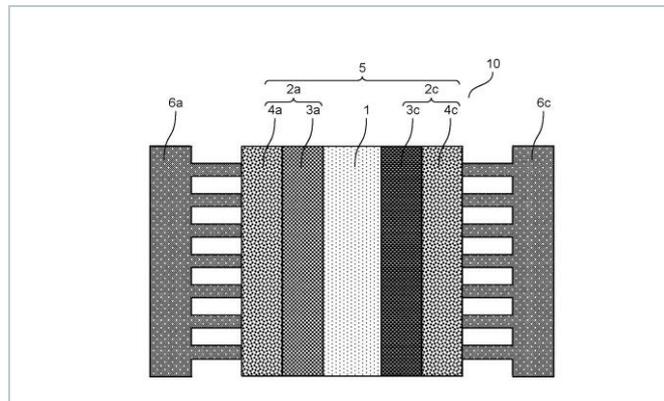
Priority date 28-Jun-2024

Publication date 31-Dec-2025



◀ **JP7788603B2**

Catalyst layer, electrolyte membrane-electrode assembly, fuel cell, and method for manufacturing catalyst layer



The invention presents a fuel cell catalyst layer that boosts proton conductivity and reduces catalyst poisoning from ionomer contact. It uses a conductive mesoporous material with catalysts inside its pores and hydrophobic non-catalyst fibers. An ionomer with a hydrophobic backbone and hydrophilic side chains partially coats both materials, with more coverage on the fibers than on the mesoporous material. This design creates continuous proton paths through coated fibers while limiting ionomer contact with catalytic sites, preventing performance loss. The process first adsorbs ionomer onto hydrophobic fibers in a hydrophilic solvent, then adds catalyst-supported mesoporous material before coating and drying. This structure improves conductivity, prevents catalyst degradation, and enhances fuel cell efficiency.

Company name Panasonic Intellectual Property Management Co Ltd (Japan)

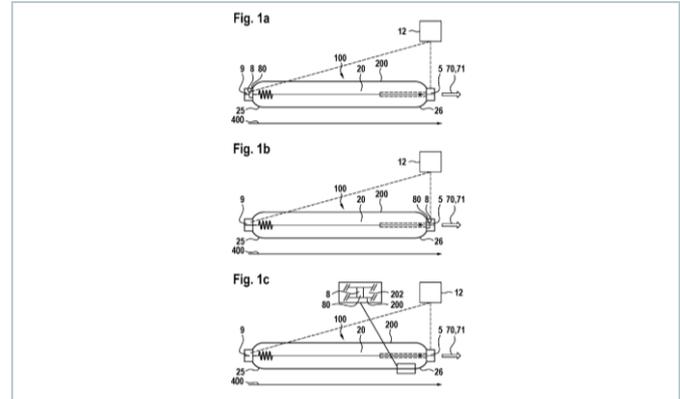
Inventors Gemba Miho,
Akatsuka Takuya,
Endo Noriaki,
Hikichi Takumi

Priority date 14-Mar-2022

Publication date 19-Dec-2025

◀ **IN202517100400A**

Tank system for hydrogen applications, fuel cell arrangement,.....and method for measuring an average temperature in a tank system



The invention relates to a hydrogen tank system that enables precise and rapid temperature measurement during refueling, improving safety and efficiency. Instead of conventional sensors that measure only local temperatures and respond slowly, this system uses a sound-based sensor, preferably ultrasonic, to determine the average temperature inside the tank almost in real time. The sensor emits sound signals and calculates the speed of sound using methods like time-of-flight or resonance frequency measurements, combined with pressure data and reference values, to accurately determine gas temperature. This approach accounts for temperature variations throughout the tank, reduces delays, and integrates easily into the tank structure. The invention ensures safe filling and optimal operation.

Company name Robert Bosch GMBH (Germany)

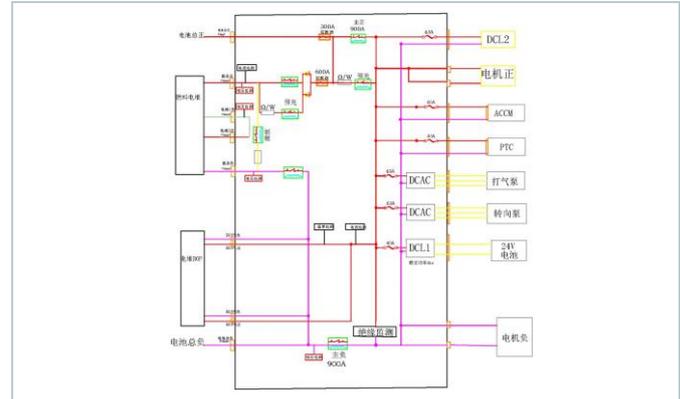
Inventors Bleile Thomas,
Breitbach Thomas

Priority date 17-Apr-2023

Publication date 05-Dec-2025

◀ CN121224528A

Integrated control system and method suitable for hydrogen fuel cell heavy truck



The invention introduces an integrated control system for hydrogen fuel cell heavy trucks that replaces multiple controllers with a single unit. This controller manages power flow and coordinates key modules, including the fuel cell system, motor load, DC-DC and DC-AC converters, insulation monitoring, auxiliary battery, and components like heaters and pumps. It enables real-time monitoring, smart power distribution based on driving conditions, fault detection with protection, and efficient energy management to maintain fuel economy, battery charge, and thermal safety. By combining all functions, the system reduces hardware, lowers cost, simplifies maintenance, improves communication, and enhances reliability and safety for hydrogen fuel cell trucks.

Company name Shenzhen Yinghe Automobile Co Ltd (China)

Inventors Zhou Feikun,
He Juji,
Zhang Minglong,
Wu Jiaming

Priority date 24-Nov-2025

Publication date 30-Dec-2025

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