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The IP Group

February 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

- Tata Steel's in-house R&D has achieved a major breakthrough with hydrogen-compatible steel pipes, which paves the way for India's hydrogen infrastructure development.

- The strong interest in India's SIGHT (Strategic Interventions for Green Hydrogen Transition Programme) scheme, with numerous companies (L&T Energy, Waaree Energy, Reliance, and AM Green, etc.) bidding for incentives, demonstrates the government's successful efforts to stimulate green hydrogen production.

- Hyundai's hydrogen-powered excavator showcases the versatility of hydrogen fuel cell technology. This application demonstrates the potential for decarbonizing heavy machinery and construction, sectors that are traditionally difficult to electrify.

- The partnership between Mattiq and Heraeus highlights the critical need to reduce the cost of green hydrogen. Their focus on developing low-Iridium electrocatalysts for PEM (proton-exchange membrane) water electrolysis addresses the scarcity and expense of Iridium, a major barrier to wider adoption of green hydrogen.

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

    - Hydrogen storage is advancing with tougher pressure vessel liners, integrated buffer tanks for efficient storage and pressure management, and innovative container designs (with internal projections or rough surfaces) for optimized heat distribution.
    - Optimization of fuel cell systems is progressing through optimized exhaust handling, improved battery utilization in FCEV (fuel cell electric vehicles), and enhanced fuel supply systems for ships.

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Industry News

Hydrogen-Ready Pipes

Tata Steel becomes India’s first steel company to demonstrate end-to-end capabilities to develop steel pipes for transportation of hydrogen

Tata Steel has achieved a significant milestone in India's hydrogen infrastructure development by becoming the first Indian steel company to produce and have its API X65 ERW steel pipes approved for transporting pure gaseous hydrogen at 100 bar pressure. The successful testing demonstrates Tata Steel's end-to-end capabilities in developing hydrogen-compatible steel pipes, a crucial component for the National Hydrogen Mission, which aims to produce at least 5 MMT of green hydrogen annually by 2030. These pipes, manufactured at Tata Steel's Khopoli plant using steel from its Kalinganagar facility, were qualified by RINA-CSM, an Italian certification organization. Tata Steel's in-house R&D team developed the entire process, from hot-rolled steel production to pipe manufacturing.

Source: https://www.tatasteel.com/

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Industry News

Refueling Innovation

Toyota Motor Europe partners with Hydrogen Refueling Solutions and ENGIE for a fast and cost-efficient hydrogen refuelling infrastructure

Toyota Motor Europe has partnered with Hydrogen Refueling Solutions (HRS) and ENGIE to develop and deploy next-generation hydrogen refueling infrastructure. Their collaboration focuses on a new "Twin Mid Flow Technology" that significantly reduces refueling times for both light and heavy-duty vehicles. This innovative dual-nozzle system allows a single dispenser to refuel a 40-tonne truck for 600km in 8 minutes or 900km in 12 minutes, and light vehicles in under 5 minutes, eliminating the need for separate dispensers. This faster refueling, combined with significantly lower installation costs for hydrogen stations, addresses key hydrogen infrastructure challenges.

Source: Toyota Motor Europe

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Industry News

Sustainable Construction

Hyundai Construction Equipment to demonstrate hydrogen fuel cell-powered excavator at Bauma

Hyundai Construction Equipment is showcasing its HW155H hydrogen fuel cell-powered wheeled excavator concept at Bauma 2025, demonstrating its potential for carbon-free construction. This pre-production, 15-tonne excavator uses a combination of 30kW and 50kW fuel cells developed in partnership with Hyundai Motor Company, generating 70–100KW of power. The fuel cell powers an electric motor driving the hydraulic system, enabling eight hours of operation with a 10-20 minute refueling time. Their high-density, solid-state hydrogen storage system doubles the capacity of conventional tanks while using lower filling pressure, optimizing space, and improving on-site safety. The HW155H's versatility suits various construction uses, and the fuel cell technology can also be used in other equipment like forklifts and generators.

Source: https://www.ivtinternational.com/

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Industry News

Bosch‘s Hydrogen Truck

Bosch Spotlights Innovations in Safety, Software, and Low-Emission Mobility

At the Bharat Mobility Global Expo (BMGE) 2025 in New Delhi (India), Bosch Limited showcased its commitment to sustainable mobility, particularly through advancements in hydrogen technology. A key highlight was the Hydrogen Demonstrator Truck, representing Bosch's dedication to zero-emission solutions for long-haul trucking, a promising alternative to diesel in India. With a global investment of approximately $2 billion in hydrogen technology, Bosch is actively driving the development of this clean fuel, aiming to reduce carbon footprints and promote sustainable automotive solutions, especially in markets like India. The BMGE served as a platform for Bosch to demonstrate its innovations and leadership in shaping the future of transportation.

Source: https://www.bosch-press.in/

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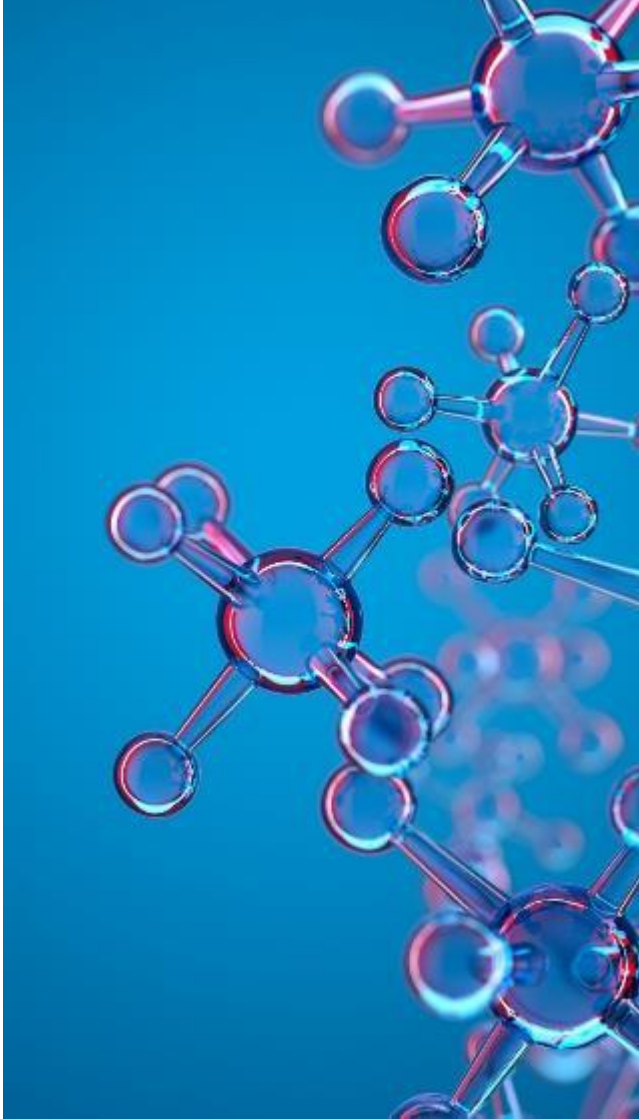
Industry News

Green Hydrogen Catalyst

Mattiq and Heraeus Partner to Advance Electrocatalyst Innovation

Mattiq and Heraeus Precious Metals have partnered to develop and commercialize advanced, low-Iridium electrocatalysts for green hydrogen production via PEM (proton-exchange membrane) water electrolysis. Recognizing Iridium's scarcity and importance in PEM electrolyzers, the collaboration aims to significantly reduce Iridium usage without compromising performance, thereby lowering the cost of green hydrogen production. Mattiq brings its expertise in electrochemical systems design, nanotechnology, and AI-driven catalyst discovery, including a comprehensive study of over one million potential low-Iridium catalysts. Heraeus contributes its leadership in precious metals processing, catalyst manufacturing, and experience in scaling up production.



Source: https://mattiq.com/

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Industry News

India‘s Hydrogen Push

Ten companies including Reliance, L&T and Waaree win government incentives for green hydrogen production

Ten companies, including L&T Energy, Waaree Clean Energy, Reliance Green Hydrogen, and AM Green, have emerged as the lowest bidders for government incentives under the second phase of India's Strategic Interventions for Green Hydrogen Transition (SIGHT) scheme. Oriana Power submitted the lowest bid, requesting a minimal incentive of INR 0.01 per kilogram for 10,000 tonnes of annual green hydrogen production. Fourteen companies bid for more capacity than the government's 450,000-tonne offer. Most winners secured their full requested capacity. The incentives (capped at INR 50/40/30/kg over three years) support India's National Green Hydrogen Mission and aim to boost production via various methods, advancing sustainable energy goals.

Source: https://agriinsite.com/

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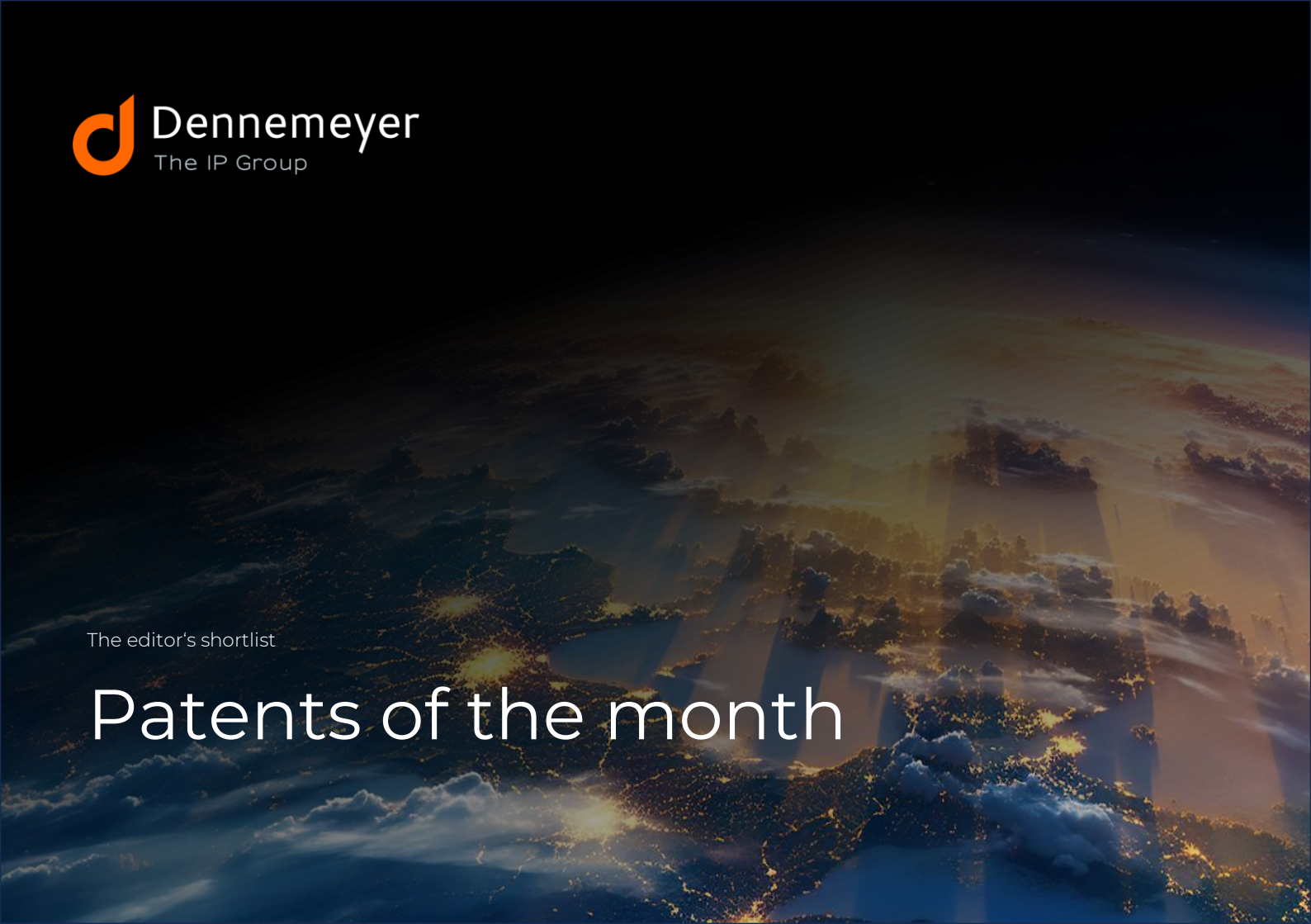

The editor's shortlist

Patents of the month

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

Patents of the month

Published in January 2025

Shortlisted and summarized by our analyst

- US2025012403A1 - Liner and pressure vessel Green
  Assignee: Mitsubishi Gas Chemical Company Inc (Japan)
- US12195864B2 - Electrolysis system with a buffer tank Green
  Assignee: Stiesdal Hydrogen AS (Denmark)
- US12191544B2 - Membrane electrode assembly, electrochemical device, and electrochemical system Green
  Assignee: Panasonic Intellectual Property Man Co Ltd (Japan)
- EP4498457A2 - System for a fuel cell vehicle, an exhaust fluid processing device, the fuel cell vehicle, and methods for handling a fuel cell exhaust fluid of a fuel cell system of the fuel cell vehicle
  Assignee: Volvo Truck Corp (Sweden) Green
- EP4493429A1 - Method for operating a fuel-cell electric vehicle, and fuel-cell electric vehicle
  Assignee: Stellantis Auto SAS (France)
- JP2025009142A - Fuel supply systems and ships
  Assignee: Kawasaki Heavy Ind Ltd (Japan)
- DE102023116805A1 - Device for storing cryogenic hydrogen, and motor vehicle Green
  Assignee: Daimler Truck (Germany)
- IN202431104871A - Hydrogen storage tank for two or three wheeled vehicles
  Assignee: Birla Institute of Technology Mesra (India)
- WO2025007347A - Support ring and unit for water electrolysis cell or fuel cell
  Assignee: Schaeffler Technologies AG (Germany)
- CN119267777A - Liquid hydrogen storage device for locomotive and hydrogen supply method
  Assignee: Sichuan Shudao Equipment Technology Co. Ltd (China)

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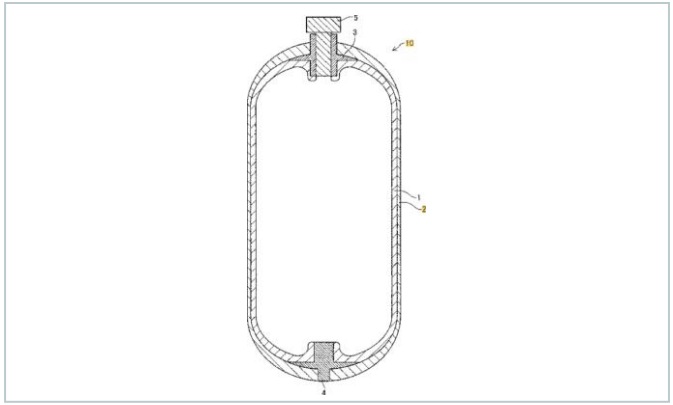
Latest patents

US2025012403A1 Green

Liner and pressure vessel



This invention describes a liner, and a pressure vessel designed to improve performance, particularly for storing gases like hydrogen. Current pressure vessels made with polyamide resins can collapse when depressurized due to gaps between the liner and outer layer. The invention solves this by strategically distributing a "toughness improver" within the liner. Specifically, the liner has a higher concentration (5-20 mass%) of the toughness improver on one side (either inner or outer) and a much lower concentration (0.5 mass% or less) on the other. This design improves the liner's shape retention during depressurization, while also providing excellent pressure resistance and gas barrier properties.

Company name	Mitsubishi Gas Chemical Company Inc (Japan)
Inventors	Ito Keisuke, Matsumoto Nobuhiko
Priority date	05-Nov-2021
Publication date	09-Jan-2025

Summarized by Dennemeyer

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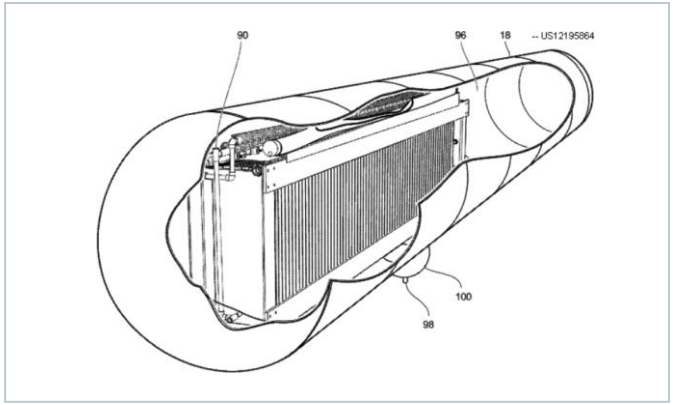
Latest patents

US12195864B2 Green

Electrolysis system with a buffer tank



Company name	Stiesdal Hydrogen AS (Denmark)
Inventors	Schibsbye Karsten, Stiesdal Henrik
Priority date	22-Jan-2021
Publication date	14-Jan-2025

Summarized by Dennemeyer

This patent describes an improved electrolysis system for producing and storing hydrogen. The system includes an electrolysis stack enclosed within a single chamber that acts as a buffer container. This simplifies the storage by eliminating external pumps and complex piping. Hydrogen gas produced in the stack flows directly into this buffer container for storage. The container may include an oxygen sensor (especially at the bottom where oxygen might accumulate) and a valve for removing excess oxygen to prevent explosions. The hydrogen outlet is designed to separate any electrolyte solution from the hydrogen gas. The volume capacity of the buffer container is significantly greater than that of the stack, providing effective storage while minimizing risks associated with pressure buildup.

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Latest patents

US12191544B2

Green

Membrane electrode assembly, electrochemical device, and electrochemical system

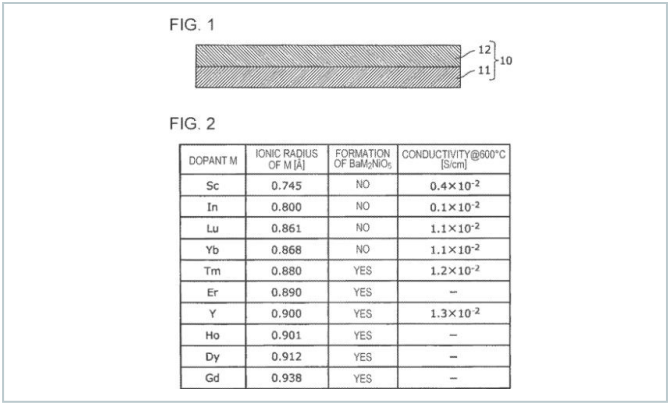
FIG. 1

FIG. 2

DOPANT M	IONIC RADIUS OF M [Å]	FORMATION OF BaM_2NiO_5	CONDUCTIVITY@600°C [S/cm]
Sc	0.745	NO	0.4×10^{-2}
In	0.800	NO	0.1×10^{-2}
Lu	0.861	NO	1.1×10^{-2}
Yb	0.868	NO	1.1×10^{-2}
Tm	0.880	YES	1.2×10^{-2}
Er	0.890	YES	–
Y	0.900	YES	1.3×10^{-2}
Ho	0.901	YES	–
Dy	0.912	YES	–
Gd	0.938	YES	–

Company name	Panasonic Intellectual Property Man Co Ltd (Japan)
Inventors	Onuma Shigenori, Kuroha Tomohiro
Priority date	26-Apr-2019
Publication date	07-Jan-2025

This patent addresses the problem of low power generation efficiency in electrochemical devices, such as solid oxide fuel cells, at low operating temperatures (below 600°C). Current devices often require high temperatures (700°C or more) due to the solid electrolyte materials used, leading to increased costs and reduced reliability. The invention proposes a new membrane electrode assembly with an electrolyte membrane containing a specific compound, BaZr1-xMxO3-γ (where M is a rare earth element), as the solid electrolyte. This new material allows the electrochemical device to operate efficiently at lower temperatures, improving power generation efficiency and addressing the limitations of existing technologies.

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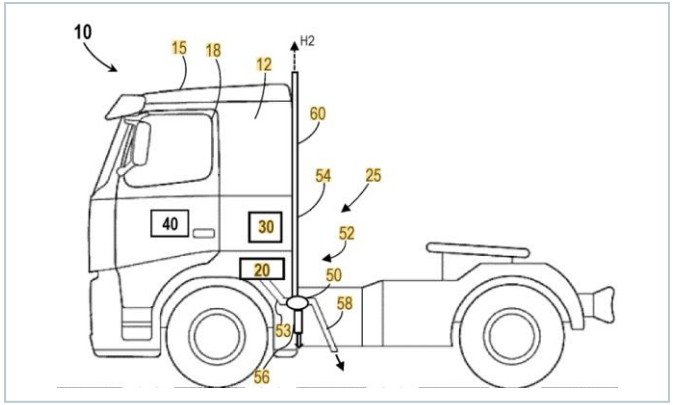
Latest patents

EP4498457A2 Green

System for a fuel cell vehicle, an exhaust fluid processing device, the fuel cell vehicle, and methods for handling a fuel cell exhaust fluid of a fuel cell system of the fuel cell vehicle

Company name	Volvo Truck Corp (Sweden)
Inventors	Lowstedt Carl, Rahm Fredrik, Hrustic Adnan, Gona Bala Narasimha Reddy
Priority date	25-Jul-2023
Publication date	29-Jan-2025

Summarized by Dennemeyer



Fuel cell vehicles use a chemical reaction to create electricity, but they also produce exhaust that includes water (both liquid and steam), hydrogen, and other gases. This patent describes a new system to handle this exhaust. It uses an exhaust fluid processing device with a centrifugal separator to divide the exhaust into three separate flows: liquid water, dry vapor, and hydrogen gas. The liquid water and dry vapor are expelled from the bottom of the vehicle, similar to traditional combustion engine vehicles, while the hydrogen gas is released from the top of the vehicle through a dedicated conduit. This separation and controlled release addresses issues, such as steam obstructing visibility and uncontrolled hydrogen accumulation. This approach offers a more efficient and safer way to manage fuel cell exhaust.

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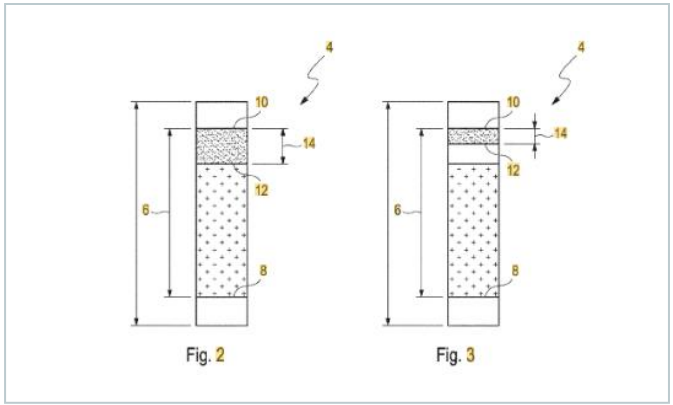
Latest patents

EP4493429A1

Method for operating a fuel-cell electric vehicle, and fuel-cell electric vehicle



Company name	Stellantis Auto SAS (France)
Inventors	Freimuth Marcel, Lang Marion
Priority date	14-Mar-2022
Publication date	22-Jan-2025

This patent describes a method and fuel cell electric vehicle (FCEV) that improves battery usage, particularly during follow-up operations after energy generation. Fuel cell electric vehicles often waste battery capacity by reserving a large charge for worst-case scenarios (i.e., vehicle that has been parked for a long time is only put into operation for a short time) during post-operation clean-up cycles. This invention optimizes the reserve by dynamically calculating a "target charging reserve" based on fuel cell temperature, ambient temperature, and the after-run's duration and energy generated. This allows for a smaller actual reserve when conditions are favorable, maximizing usable battery capacity.

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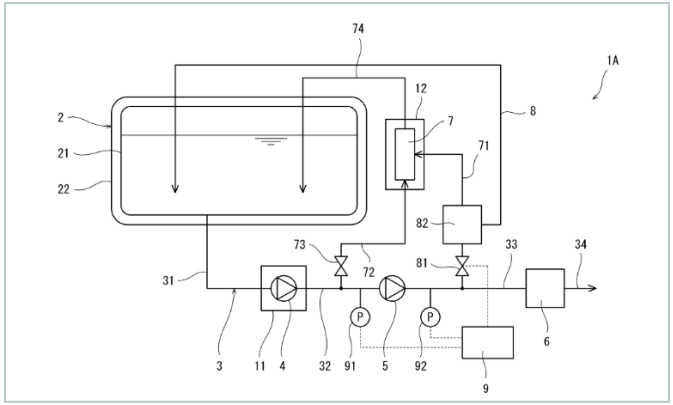
Latest patents

JP2025009142A

Fuel supply systems and ships



Company name	Kawasaki Heavy Ind Ltd (Japan)
Inventors	Nakao Shinshi; Miyoshi Chonggong
Priority date	07-Jul-2023
Publication date	20-Jan-2025

This invention is a fuel supply system for internal combustion engines on ships that uses liquefied hydrogen as fuel. It addresses the problem of efficiently returning excess hydrogen fuel back to the storage tank after it's been pressurized. The system uses a two-pump setup: one to move the liquefied hydrogen and another to increase its pressure above the critical point. A reflux line with a pressure reducing valve returns excess fuel. Crucially, a gas-liquid separator and an agitator are used to condense any hydrogen gas produced during decompression back into liquid form before it's returned to the tank. This prevents an increase in boil-off gas in the tank, improving the efficiency and safety of hydrogen storage. The invention also includes a ship equipped with this fuel supply system.

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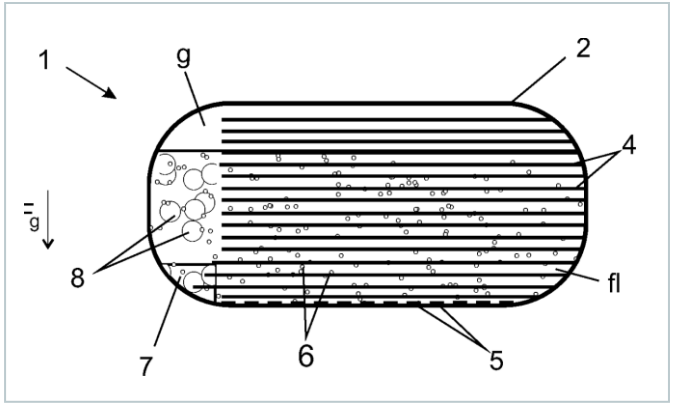
Latest patents

DE102023116805A1 Green

Device for storing cryogenic hydrogen, and motor vehicle



Company name	Daimler Truck (Germany)
Inventors	Mandry Nicolas, Stanzel Nicolas
Priority date	27-Jun-2023
Publication date	02-Jan-2025

The invention describes a device for storing cryogenic hydrogen, particularly for use in vehicles. Current storage methods struggle with hydrogen heating up and evaporating (boil-off), leading to loss and short storage life. This invention aims to improve storage time with a simple design. The container's inner surface has projections (like ribs or pins) and/or a rough surface. The projections increase surface area and distribute heat, while the rough surface creates numerous points for small vapor bubbles to form, ensuring even heating and mixing. A tank heater with a smooth surface is used for hydrogen extraction; this creates larger bubbles for quick pressure increase during extraction while minimizing heat transfer to the rest of the liquid hydrogen. The projections and rough surfaces are preferably located at the bottom of the container.

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Latest patents

IN202431104871A

Hydrogen storage tank for two or three wheeled vehicles

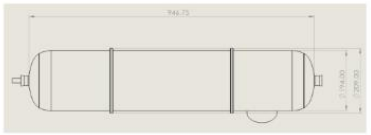

Figure 1

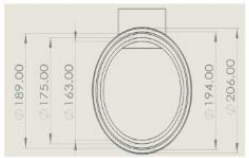

Figure 2

Company name	Birla Institute of Technology Mesra (Ranchi)
Inventors	Dr. Om Prakash, Banerjee Sounav, Dr. Lakhbir Singh Brar, Dr. Anil Kumar
Priority date	31-Dec-2024
Publication date	10-Jan-2025

This invention describes a new type of hydrogen storage tank designed specifically for two and three-wheeled vehicles like motorcycles and scooters. The main problem it solves is how to store enough hydrogen safely and efficiently in these small vehicles, which have limited space and weight capacity. The novel part of this invention is its multi-layered design. It uses a special combination of materials like stainless steel, Kevlar aerogel, and polyurethane insulation, along with a vacuum-sealed layer, to keep the hydrogen at the right temperature and pressure. This design allows the tank to hold a significant amount of hydrogen at high pressure (up to 1050 bar) in a compact size, making it suitable for small vehicles.

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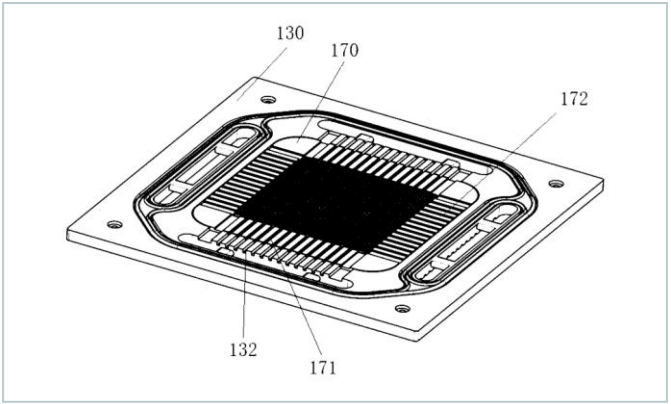
Latest patents

WO2025007347A1

Support ring and unit for water electrolysis cell or fuel cell



Company name	Schaeffler Technologies AG (Germany)
Inventors	Li Ding, Liu Xin, Wei Jianfei
Priority date	06-Jul-2023
Publication date	09-Jan-2025

This patent describes a support ring and unit for water electrolyzers or fuel cells that reduces catalyst membrane wear, preventing dangerous mixing of substances like hydrogen and oxygen. This wear occurs due to friction between components during operation. The support ring is a sheet-shaped annular frame with flow channels for connecting fluids. The unit includes this support ring, along with electrode plates, a frame, the catalyst membrane, carbon paper, and a sealing ring. The support ring supports the sealing ring, which prevents mixing of substances on either side of the catalyst membrane. The support ring stabilizes the sealing ring, minimizing carbon paper/catalyst membrane friction, reducing wear, and improving unit and water electrolyzer/fuel cell durability.

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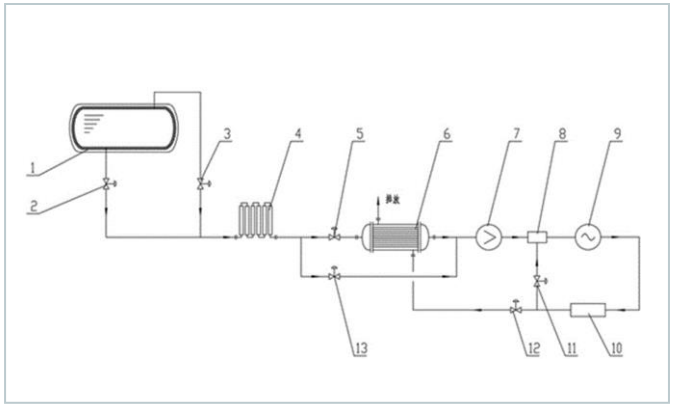
Latest patents

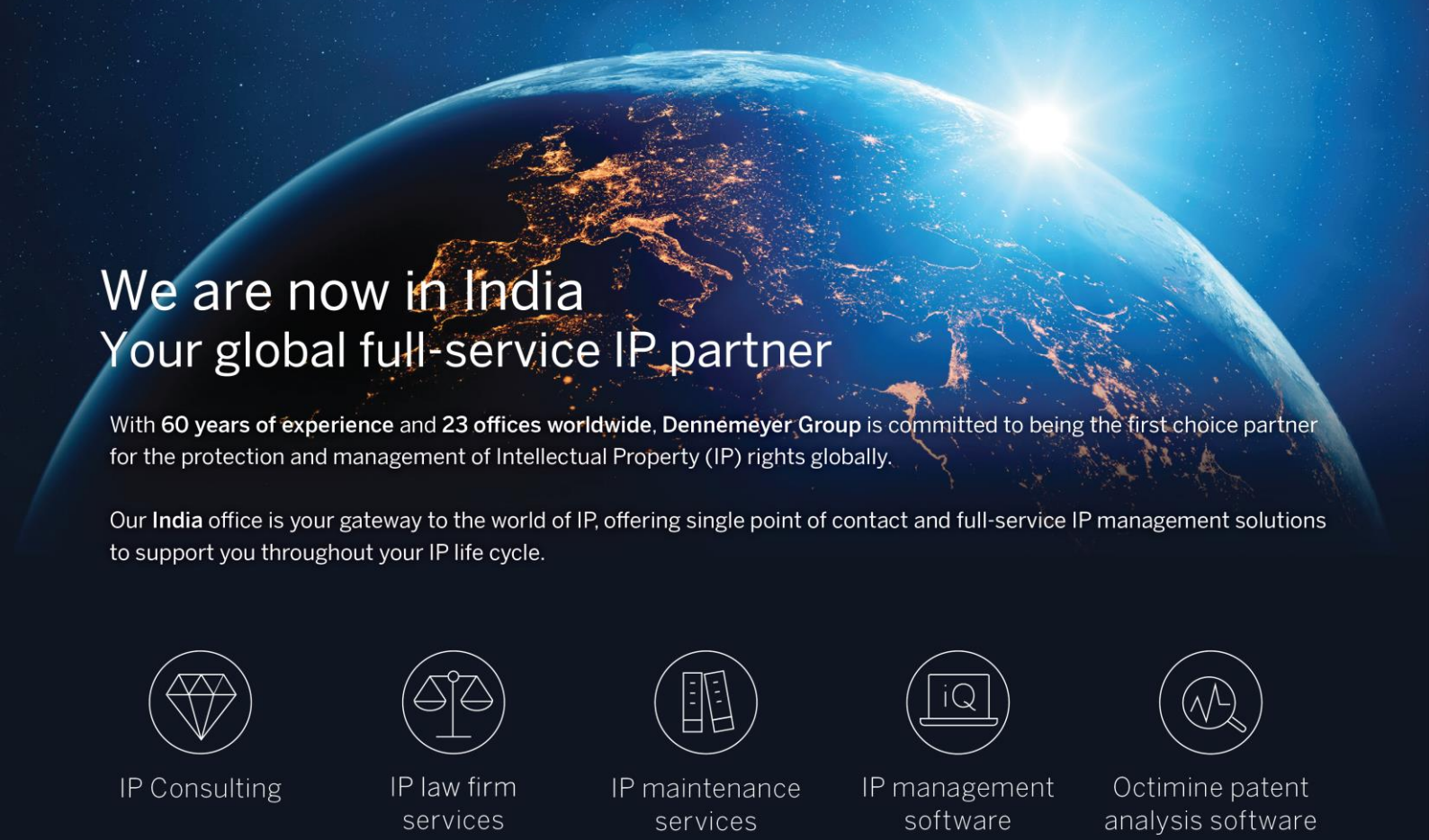
CN119267777A

Liquid hydrogen storage device for locomotive and hydrogen supply method



Company name	Sichuan Shudao Equipment Technology Co. Ltd (China)
Inventors	Huang Bo, Ma Jigang, Cao Weihua, Cui Jianghan, Tang Yu
Priority date	15-Nov-2024
Publication date	07-Jan-2025

The patents describes a liquid hydrogen storage device and hydrogen supply method for locomotives, aiming to replace older diesel locomotives with cleaner hydrogen-powered options. The device includes a specialized, well-insulated liquid hydrogen storage tank designed to minimize evaporation. It also features a two-stage heat exchanger system, using both ambient heat and waste heat from the engine to gasify the liquid hydrogen. The method involves using liquid hydrogen as the primary fuel source, switching to gaseous hydrogen from the tank when pressure gets too high, and then using the heat exchangers and booster pump to prepare the hydrogen for the engine. The goal is to provide a safe, economical, and environmentally friendly hydrogen-powered locomotive.



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