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April 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

- The collaboration between HyCentA and AVL highlights the importance of robust quality control and safety standards for hydrogen technologies. These standardized testing methods have the potential to become a cornerstone for regulatory frameworks, influencing policy and investment across the hydrogen sector.

- INOX's project demonstrates the benefits of integrating green hydrogen into heavy industrial processes, signaling a trend where industries with high thermal needs will increasingly adopt on-site green hydrogen. This highlights the role of green hydrogen as a decarbonization tool, extending beyond just mobility.

- Kawasaki's development of a centrifugal hydrogen compressor emphasizes the need for efficient hydrogen handling and transportation infrastructure. As the hydrogen market scales, innovations in liquefaction and compression will be critical for reducing energy losses and costs.

- Tata Motor's dual-track approach H2-ICE (Internal Combustion Engine) and H2-FCEV (Fuel Cell Electric Vehicle) signifies a more practical approach for deploying hydrogen in heavy-duty trucking. This allows for flexibility in meeting diverse operational needs and infrastructure limitations.

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

    - Fuel cell's operational optimization can be achieved using variable bipolar plates to improve heat management and water drainage. Additionally, molten carbonate fuel cells (MCFCs) can generate power and simultaneously capture CO2 from onboard combustion sources.
    - The refueling process is being improved to allow efficient, simultaneous refueling of multiple hydrogen vehicles. Additionally, advancements in nozzle assembly design minimize plastic deformation under varying fluid pressures.

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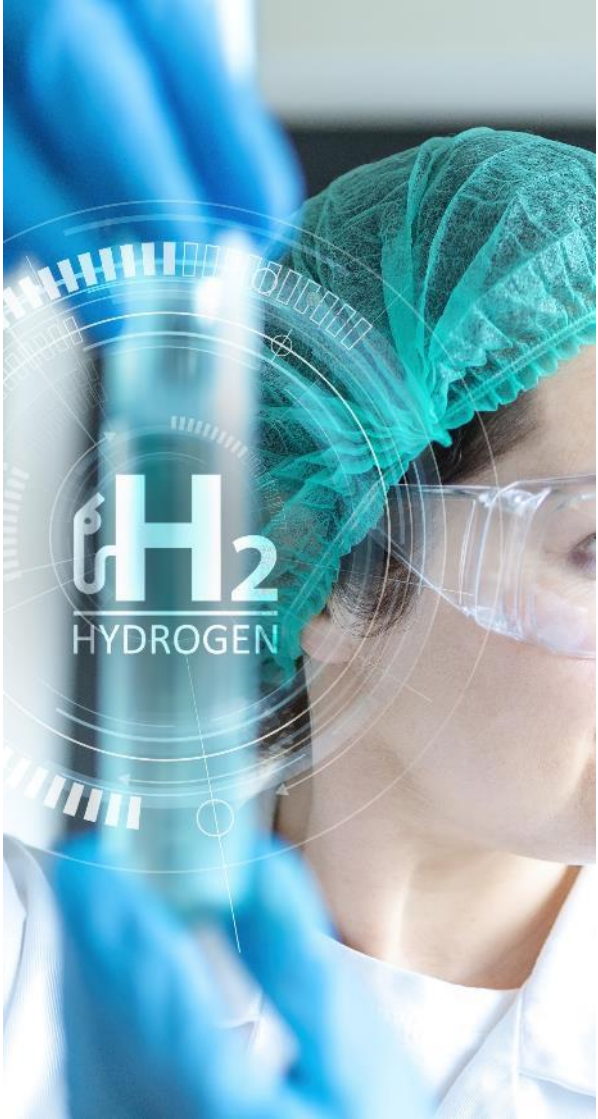
Industry News

Hydrogen Tech Testing

HyCentA and AVL Collaborate to revolutionize hydrogen technology testing

The collaboration between HyCentA and AVL through the ReMET project (Revolutionary Measurement and Testing Technologies for Hydrogen Applications) aims to advance hydrogen technology by developing innovative measurement and testing methods for electrolyzers, fuel cells, and hydrogen storage systems. This initiative will focus on analyzing electrolyzer degradation, implementing precise hydrogen system monitoring, assessing material compatibility for safety, integrating online health diagnostics for fuel cells, and utilizing simulation and AI for performance optimization and predictive maintenance. Ultimately, the project seeks to establish standardization and certification for the safe and efficient deployment of hydrogen technologies in both industry and mobility sectors.



Source: AVL

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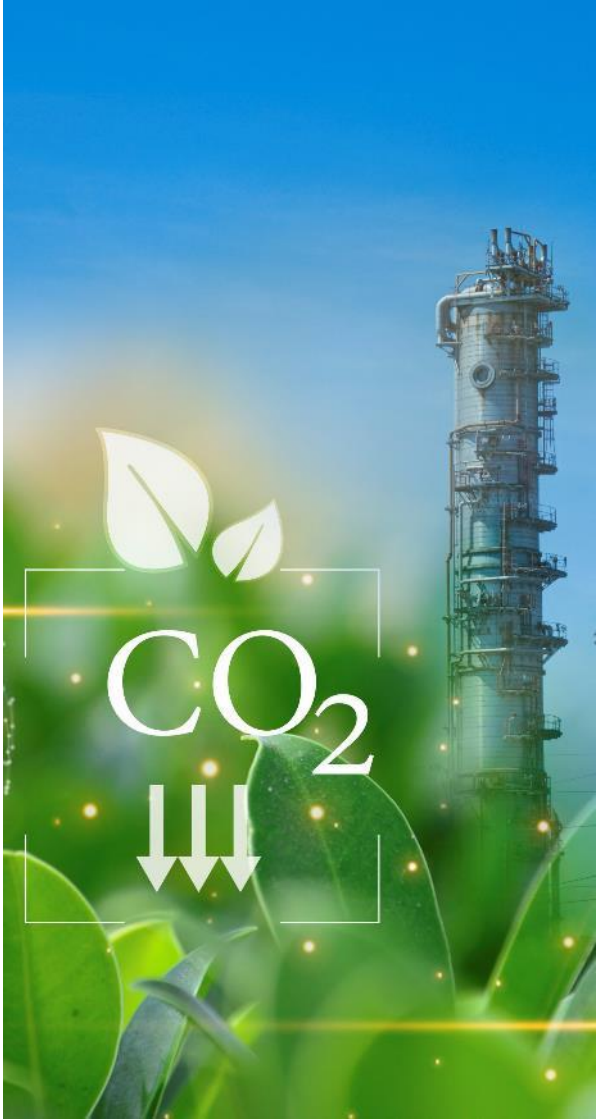
Industry News

Decarbonizing Glass Production

INOX Air Products commissions its first Green Hydrogen Plant at Asahi India's Soniyana facility at Chittorgarh

INOX Air Products has commissioned India's first Green Hydrogen manufacturing plant at Asahi India Glass's (AIS) new float glass facility in Rajasthan, marking the first instance of green hydrogen use in Indian float glass production. Powered by solar energy, the plant will supply AIS with up to 190 tons of green hydrogen annually under a 20-year agreement, with an initial supply of 95 TPA (Tonnes Per Annum). This collaboration allows AIS to significantly reduce its CO2 emissions by an estimated 1250 MTPA, contributing to sustainable glass manufacturing and aligning with India's decarbonization goals and net-zero ambitions. AIS's solar investment powers green hydrogen, boosting sustainability and reducing its glass manufacturing carbon footprint.



Source: Inox Air Products

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Industry News

Fueling Green Flight

AERO Hydrogen & Battery Summit: Bosch Aviation Technology presents concept for ground-breaking hydrogen aircraft engine

Bosch Aviation Technology is exploring hydrogen as a viable alternative for aircraft propulsion. They've demonstrated this potential by successfully modifying a standard BRP-Rotax gasoline engine to operate on hydrogen. In just four months, they converted a 1.4-liter turbo engine to run on hydrogen, achieving near-equivalent performance to its gasoline counterpart on the test bench, currently delivering 115 kilowatts of maximum power. By adapting established engine designs and leveraging Bosch's readily available hydrogen system components, this method presents potential benefits in terms of quicker development, lower expenses, and streamlined approvals for future aviation projects, ultimately contributing to reduced carbon emissions in general aviation.

Source: Bosch Aviation

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Industry News

Hydrogen Compressor Demo

Kawasaki starts construction of a demonstration facility for the world's first centrifugal hydrogen compressor for hydrogen liquefaction plants

Kawasaki Heavy Industries has begun constructing a demonstration facility for its KM Comp-H_2, the world's first centrifugal hydrogen compressor designed for hydrogen liquefaction plants. This development, part of a NEDO-sponsored Green Innovation Fund project, aims to improve the efficiency of hydrogen liquefaction by boosting the pressure of refrigerant hydrogen gas. The compressor boasts high efficiency, high pressure boost, and a compact design due to newly developed impellers and a centrifugal structure. The technology developed for this compressor will also be applied to hydrogen supply pipelines, contributing to Kawasaki's broader efforts in establishing a comprehensive hydrogen supply chain for a carbon-neutral future.

Source: Kawasaki

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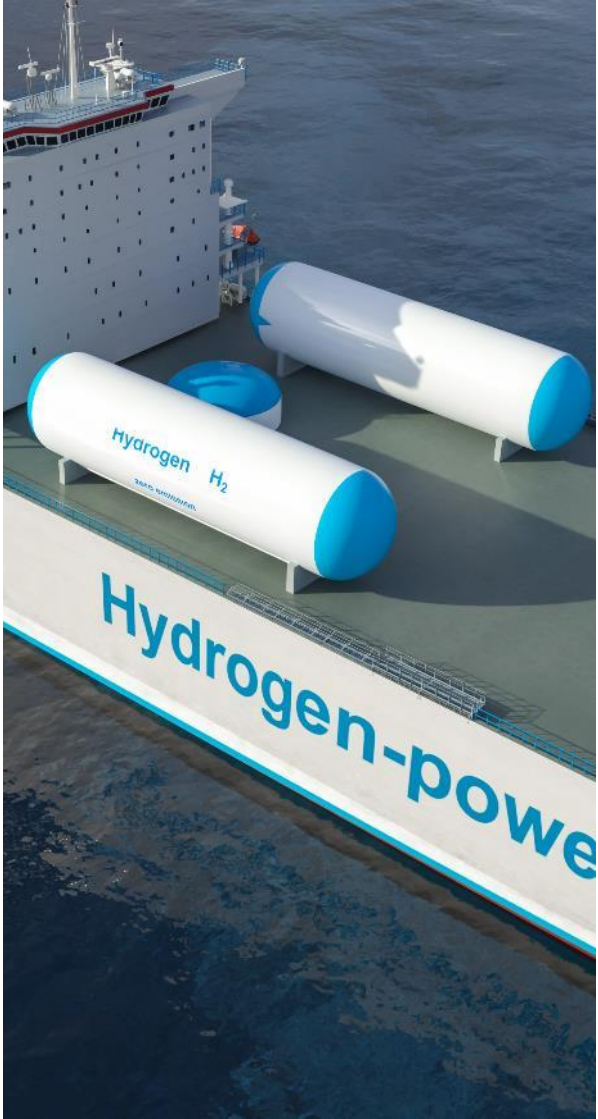
Industry News

Hydrogen Maritime Study

Rux Energy and Serco collaborate on groundbreaking hydrogen storage project funded by Connected Places Catapult

At the Connected Places Summit, Rux Energy and Serco announced the successful completion of a UK-based study, funded by Connected Places Catapult, which demonstrated the economic feasibility and operational integration of a localized green hydrogen supply chain for maritime applications. The study utilized Rux Energy's innovative nanoporous material for hydrogen storage, allowing for safer and more cost-effective storage at moderate temperatures and lower pressures compared to traditional methods. The findings, based on Serco's workboat energy demand data, confirmed hydrogen's viability as a competitive alternative to marine diesel for crew transfer and short sea vessels, leading to the signing of an MoU between the two companies to further collaborate on decarbonizing the maritime sector.

Source: Rux Energy



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Industry News

Heavy-Duty Hydrogen Trial

Tata Motors drives India's green future with country's first hydrogen truck trials

Tata Motors has initiated trials for its hydrogen-powered heavy-duty trucks, featuring both Hydrogen Internal Combustion Engines (H2-ICE) and Hydrogen Fuel Cell Electric Vehicle (H2-FCEV) technologies. The trial fleet includes Tata Prima H.55S prime movers utilizing both H2-ICE and H2-FCEV powertrains, as well as the Tata Prima H.28 H2-ICE truck. These advanced vehicles boast an operational range of 300-500 km and are designed for sustainable, cost-efficient, long-distance cargo transportation. They are equipped with the premium Prima cabin and advanced driver-assist safety features, aiming to enhance driver comfort and safety while testing the viability of these technologies on prominent Indian freight routes.

Source: Tata Motors

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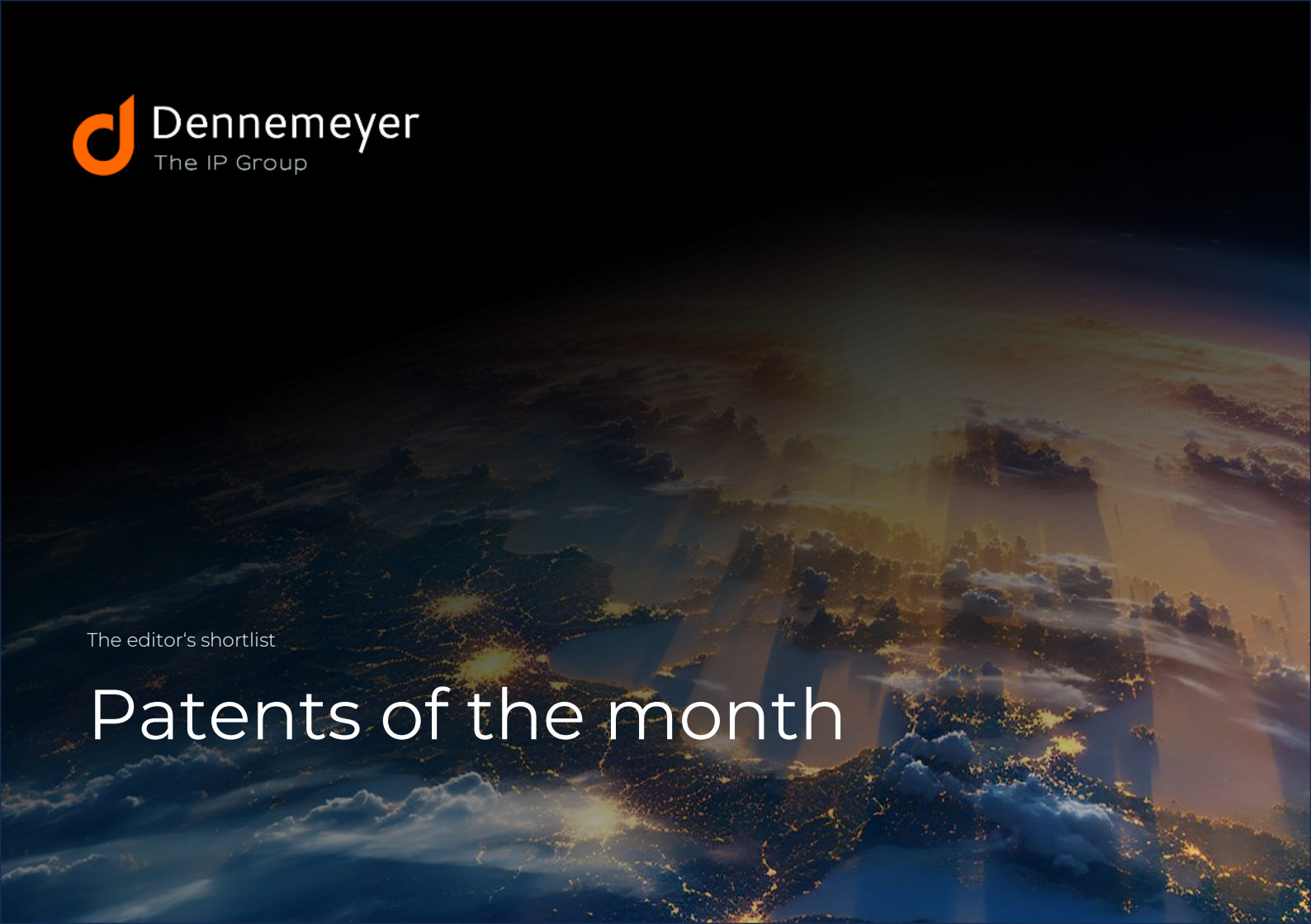

The editor's shortlist

Patents of the month

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

Patents of the month

Published in March 2025

Shortlisted and summarized by our analyst

- US12255359B2 - Fuel cell stack comprising variable bipolar plates Green
  Assignee: Audi AG (Germany)
- US2025101613A1 - Electrolyser system and method of electrode manufacture Green
  Assignee: SungreenH2 (Denmark)
- US2025096294A1 - Marine onboard carbon capture using molten carbonate fuel cells Green
  Assignee: ExxonMobil Technology & Engineering Company (USA)
- US2025079487A1 - System and method for operating a fuel cell
  Assignee: GM Global Technology Operations (USA) Green
- EP4517153A1 – Method and system for simultaneously refueling a plurality of vehicles with hydrogen
  Assignee: Linde AG (Germany)
- IN202517002879A - Electrochemical device suitable to work both as electrolyser and fuel cell
  Assignee: National Research Council, Miprons SRL (Italy)
- JP2025033214A - Electrodes, membrane electrode assemblies, electrochemical cells, stacks, electrolyzers Green
  Assignee: Toshiba Energy System & Solution Corp (Japan)
- DE102023209363A1 - Offshore electrolysis system and method for operating an offshore electrolysis system Green
  Assignee: Siemens Energy Global (Germany)
- EP4516408A1 - Nozzle assembly for vehicle Green
  Assignee: Hyundai Motor Co Ltd, Kia Corp (Korea)
- EP4316903A4 - Method and apparatus for determining endurance mileage, and vehicle
  Assignee: Great Wall Motors Co Ltd (China)

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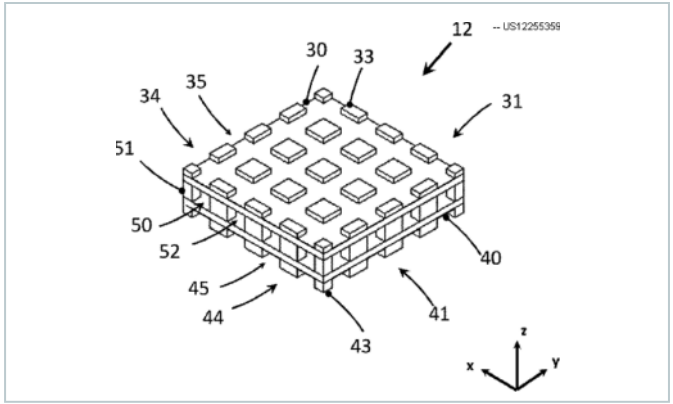
Latest patents

US12255359B2 Green

Fuel cell stack comprising variable bipolar plates



Company name	Audi AG (Germany)
Inventors	Jilani Adel, Kumar Sanjiv, Bradean Radu P, Voigt Sebastian
Priority date	29-Apr-2019
Publication date	18-Mar-2025

The patent addresses challenges in fuel cell stacks related to heat management and water drainage. Traditional bipolar plates, made of two joined halves with fixed designs, struggle with effectively removing the produced water and managing heat, leading to performance issues. This patent introduces a new fuel cell stack design where the bipolar plates have independently designed anode and cathode sides with varying depths in their flow channels along the stack. By making these channel depths different in subsequent plates, especially towards the ends of the stack compared to the middle, the fuel cell can better control water drainage and heat removal, as these processes differ throughout the stack.

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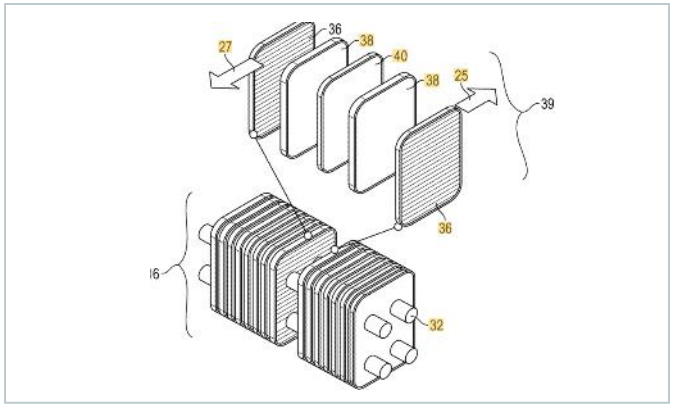
Latest patents

US2025101613A1 Green

Electrolyser system and method of electrode manufacture



Company name	SungreenH2 (Denmark)
Inventors	Masudy Panah Saeid
Priority date	22-Jul-2021
Publication date	27-Mar-2025

This invention focuses on electrolysis for producing hydrogen using renewable energy. It aims to address the challenges of electrolyser stability and the high cost of electrode materials. The invention introduces a new design for these electrodes, potentially using cheaper materials instead of costly ones like platinum. These new electrodes are made with tiny holes to work better. The method to create these electrodes involves layering different materials and then removing one to create the necessary porous structure. The goal is to make hydrogen production more affordable and efficient by reducing electricity needs and lowering the cost of the electrode materials while maintaining or even improving their performance.

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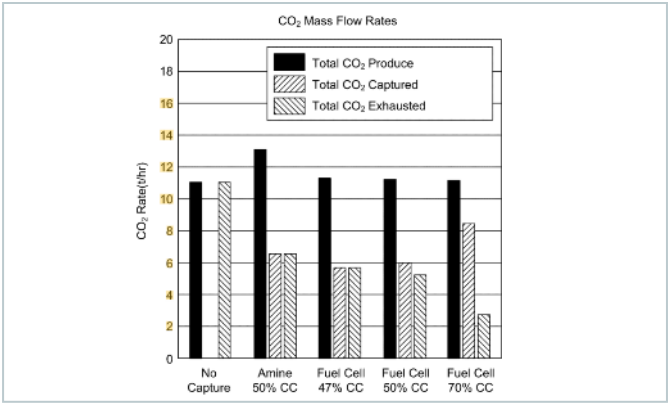
Latest patents

US2025096294A1 Green

Marine onboard carbon capture using molten carbonate fuel cells



Company name	ExxonMobil Technology & Engineering Company (USA)
Inventors	Sattler Aaron, Mettler Matthew S, Skoulidas Anastasios I, Sutton Clay R, Kar Kenneth C H
Priority date	14-Sep-2023
Publication date	20-Mar-2025

The patent tackles the problem of reducing CO2 emissions from marine vessels, where conventional carbon capture methods are impractical due to size and weight constraints. The proposed solution involves utilizing molten carbonate fuel cells (MCFCs) that operate with high fuel utilization to generate power and simultaneously capture CO2 from onboard combustion sources. This approach offers key improvements by minimizing unburned fuel in exhaust, capturing a significant amount of CO2 without needing extra power generation, and limiting the added weight on the vessel by focusing on capturing a portion of the emissions to meet regulatory targets.

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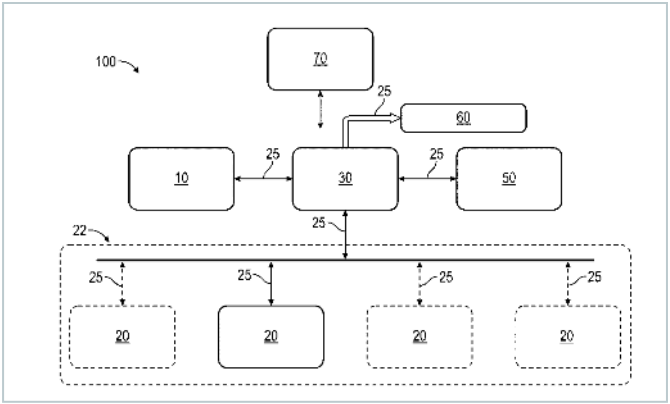
Latest patents

US2025079487A1 Green

System and method for operating a fuel cell



Company name	GM Global Technology Operations (USA)
Inventors	Edamana Biju, Sinha Manish, Venkadasamy Venkatesh, Pettit William H, Rhodes Rodney J
Priority date	01-Sep-2023
Publication date	06-Mar-2025

Summarized by Dennemeyer

This invention addresses the problem of optimizing the lifespan of the fuel cell membrane in a hybrid vehicle system that includes a fuel cell, a high-voltage battery, and an electric drive unit. It has a controller that analyzes the power demand of the vehicle and determines an "optimal membrane life power" for the fuel cell. Instead of constantly adjusting the fuel cell output to match the immediate power needs, the controller directs the fuel cell to operate within a range, between this optimal power level and a second power level. When the vehicle's power demand is lower than the optimal level, the excess fuel cell power is used to charge the battery. The strategy aims for optimal fuel cell membrane life by running the cell near its peak efficiency, avoiding power fluctuation.

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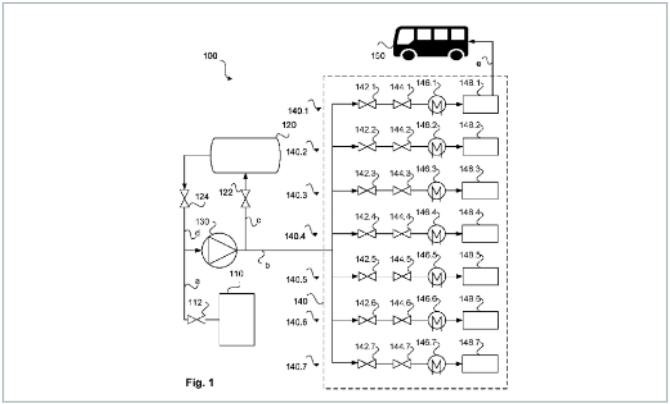
Latest patents

EP4517153A1

Method and system for simultaneously refueling a plurality of vehicles with hydrogen

Company name	Linde AG (Germany)
Inventors	Fahrner Daniel, Vidic Karl Jojo, Lang Sabrina
Priority date	28-Aug-2023
Publication date	25-Mar-2025



This invention proposes efficiently refueling of multiple hydrogen vehicles simultaneously at a filling station. It aims to reduce the costs and time associated with traditional hydrogen refueling, which often requires significant pre-cooling. It uses a compressor to supply compressed hydrogen to several vehicles at once through multiple refueling lines. It can incorporate a medium-pressure storage tank to optimize hydrogen delivery and manage energy use, particularly when the hydrogen is produced on-site. By carefully controlling the flow rate based on temperature limits, the system allows for simultaneous refueling of multiple vehicles, potentially up to seven, and ensuring the vehicle tanks don't overheat. This approach streamlines the refueling process, making it suitable for fleet operations.

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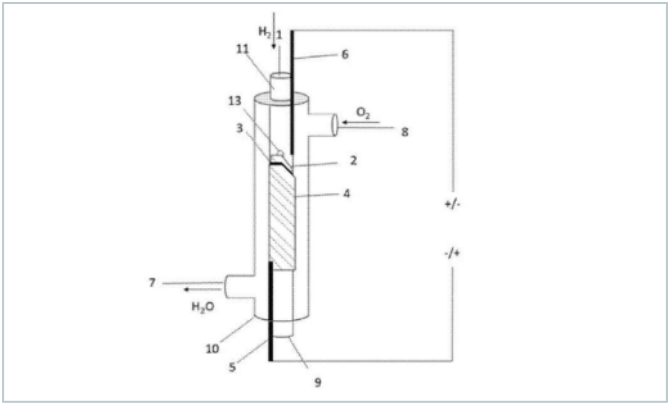
Latest patents

IN202517002879A

Electrochemical device suitable to work both as electrolyser and fuel cell



Company name	National Research Council, Miprons SRL (Italy)
Inventors	Figoli Alberto, Jansen Johannes Carolus, Fontanano Va Enrica, Esposito Elisa, Jerace Roberto, Longo Mariagiulia, Minotti Angelo
Priority date	07-Jun-2022
Publication date	07-Mar-2025

This invention describes a compact electrochemical device designed to function both as an electrolyser (to produce hydrogen) and a fuel cell (to generate electricity). The device features a central tubular electrode surrounded by a gas diffusion layer, an ion exchange membrane wound in a tubular or spiral structure for high packing density, and a second gas diffusion layer. This configuration aims to overcome the limitations of traditional flat membrane electrolysers, which require large surface areas and result in bulky devices. The tubular structure enables high energy efficiency in a smaller unit, allowing potential on-site hydrogen creation. Moreover, it simplifies design and lowers costs by integrating gas collection for a self-pressurizing system.

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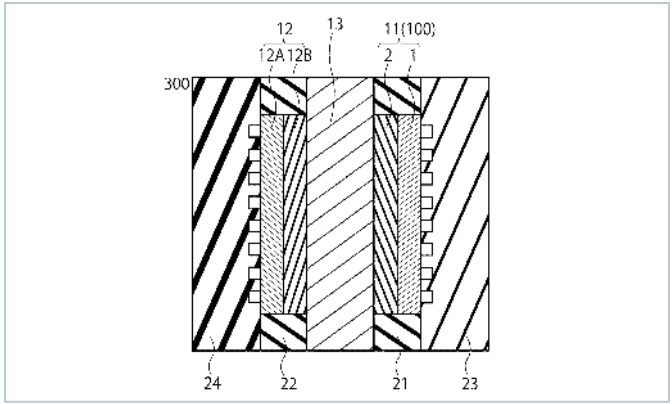
Latest patents

JP2025033214A

Green

Electrodes, membrane electrode assemblies, electrochemical cells, stacks, electrolyzers



Company name	Toshiba Energy System & Solution Corp (Japan)
Inventors	Fukami Hiroshi, Nakano Takahiko, Yoshinaga Norihiro
Priority date	29-Aug-2023
Publication date	13-Mar-2025

This invention describes a new type of electrode designed for electrochemical cells, particularly for applications like hydrogen production in polymer electrolyte membrane electrolysis cells (PEMEC) and electrolysis of carbon dioxide. The electrode consists of a substrate coated with a special catalyst layer made of alternating thin layers ("sheet layers") and spaces ("gap layers"). This catalyst layer contains a mix of at least one "first metal" (like iridium, ruthenium, or platinum) and at least one "second metal" (like nickel, cobalt, or iron). The catalyst layer has two areas with different oxidation states of the first metal and varying ratios of the second metal, aiming to boost electrochemical efficiency and durability.

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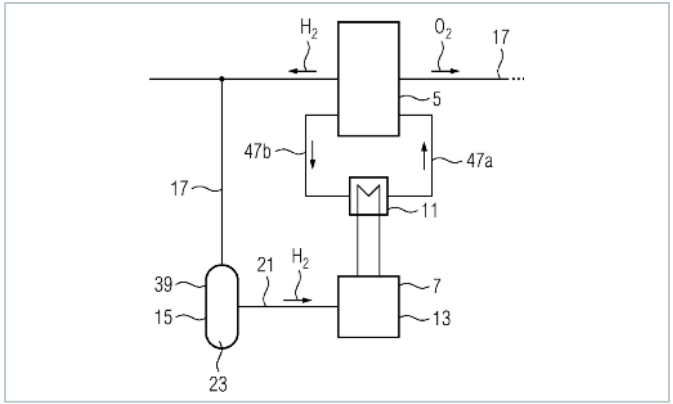
Latest patents

DE102023209363A1 Green

Offshore electrolysis system and method for operating an offshore electrolysis system



Company name	Siemens Energy Global (Germany)
Inventors	Krause Ralf, Fleck Robert, Plobner Roland, Bartmann Andreas, Eckert Helmut
Priority date	26-Sep-2023
Publication date	27-Mar-2025

Summarized by Dennemeyer

To prevent freezing and ensure continuous operation of offshore hydrogen production plants, the invention offers a self-sufficient heating solution using a heat supply device with combustion and a fuel reservoir. This system utilizes hydrogen generated during normal electrolysis operation as fuel, storing it in a reservoir (which can be a dedicated tank, the product gas pipeline itself, or a gas storage facility within the wind turbine structure). When renewable power is unavailable and the electrolysis process halts, this stored hydrogen is then combusted, either directly via a burner or indirectly through a fuel cell powering a heating element. This generated heat is transferred to the electrolysis system, maintaining a critical minimum temperature to safeguard water-bearing components from frost damage.

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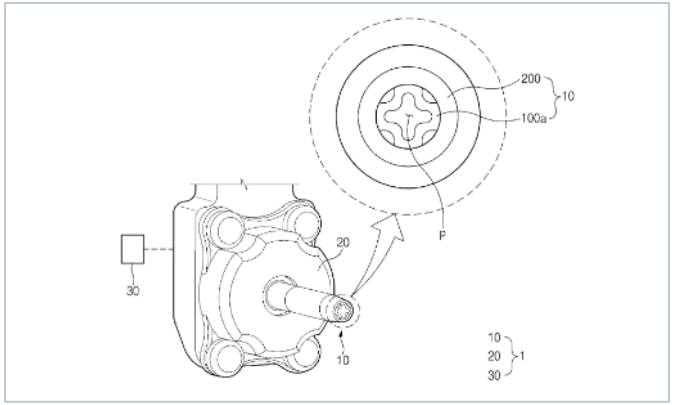
Latest patents

EP4516408A1 Green

Nozzle assembly for vehicle



Company name	Hyundai Motor Co Ltd, Kia Corp (Korea)
Inventors	Kitayev Anna, Tal-gutelmacher Ervin, Azra Charly David, Smirnova Viktoria
Priority date	29-Aug-2023
Publication date	05-Mar-2025

This patent describes a nozzle assembly for hydrogen fuel cell vehicles, designed to minimize plastic deformation under varying fluid pressures for improved durability. The new nozzle assembly uses a two-part design: an inner nozzle with specially shaped recessed ("spacing") and protruding ("attachment") areas, surrounded by an outer supporting nozzle. These shapes, particularly the curved inner surfaces, allow the inner nozzle to expand under high pressure. The outer nozzle provides support during expansion and helps the inner nozzle return to its original shape when pressure drops. This clever design distributes stress, preventing the nozzle from permanently deforming, thus ensuring it lasts longer and functions reliably despite fluctuating high pressures in the hydrogen fuel system.

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Latest patents

EP4316903A4

Method and apparatus for determining endurance mileage, and vehicle

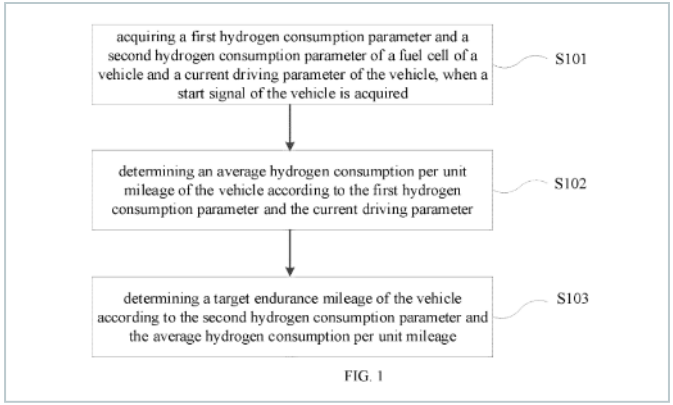
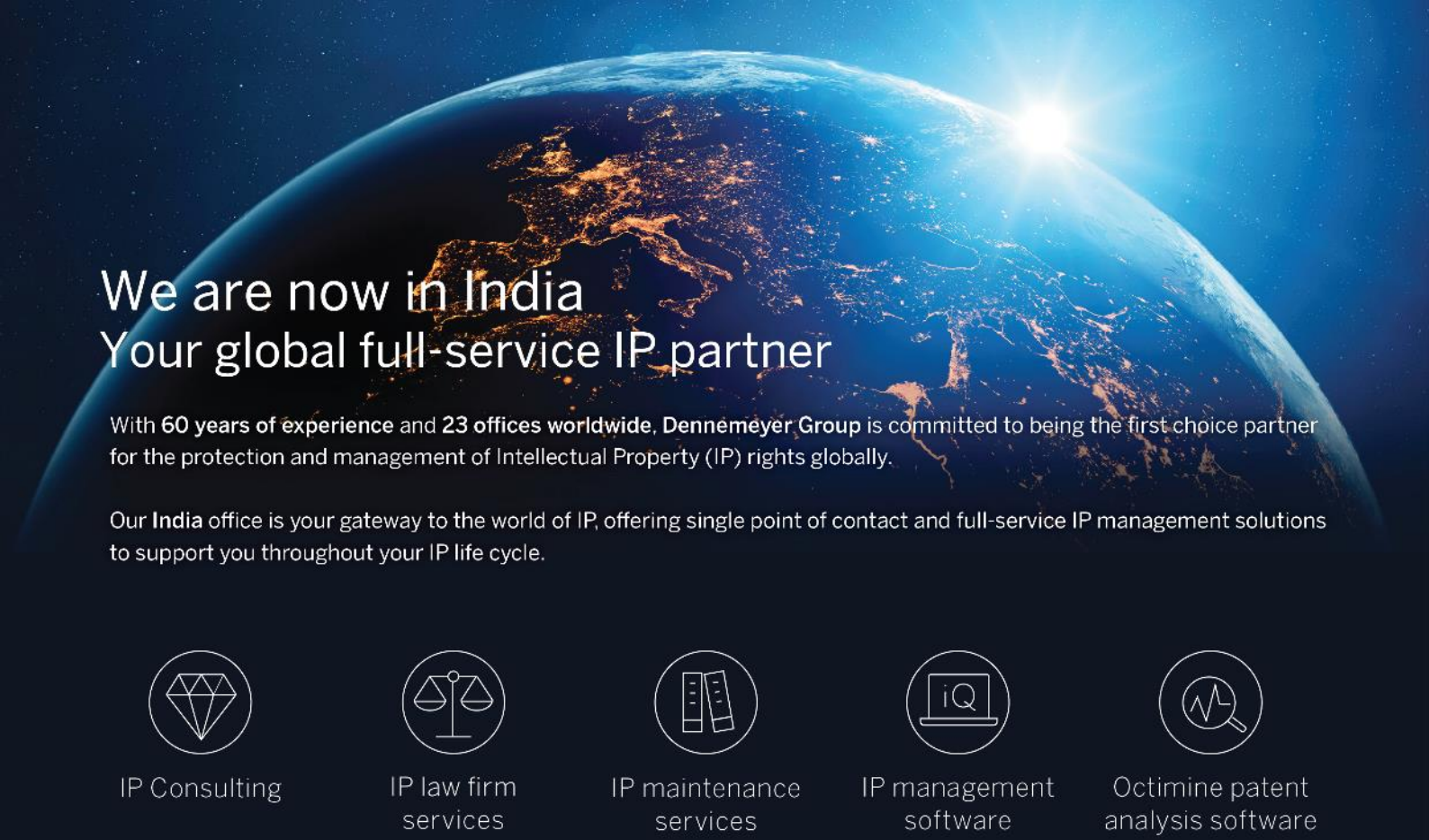


FIG. 1

Company name	Great Wall Motors Co Ltd (China)
Inventors	Wu Maiqing, Liu Ximing, Shi Xu, Yan Gang , Li Xuejing
Priority date	24-Mar-2021
Publication date	26-Mar-2025

The invention addresses the problem of inaccurate endurance mileage estimations in hydrogen fuel cell vehicles, which rely on instantaneous hydrogen consumption and are susceptible to sensor errors. This invention solves this by calculating the estimated driving range based on the average amount of hydrogen the car has used since it started, along with how much hydrogen is left. It takes into account both the initial amount of hydrogen and mileage when the car started, and the current usage and distance traveled. This gives a more stable and accurate prediction of how much further you can drive. The system also considers the car's current situation whether it's stopped, driving, or being refueled, to further refine the range displayed to the driver.



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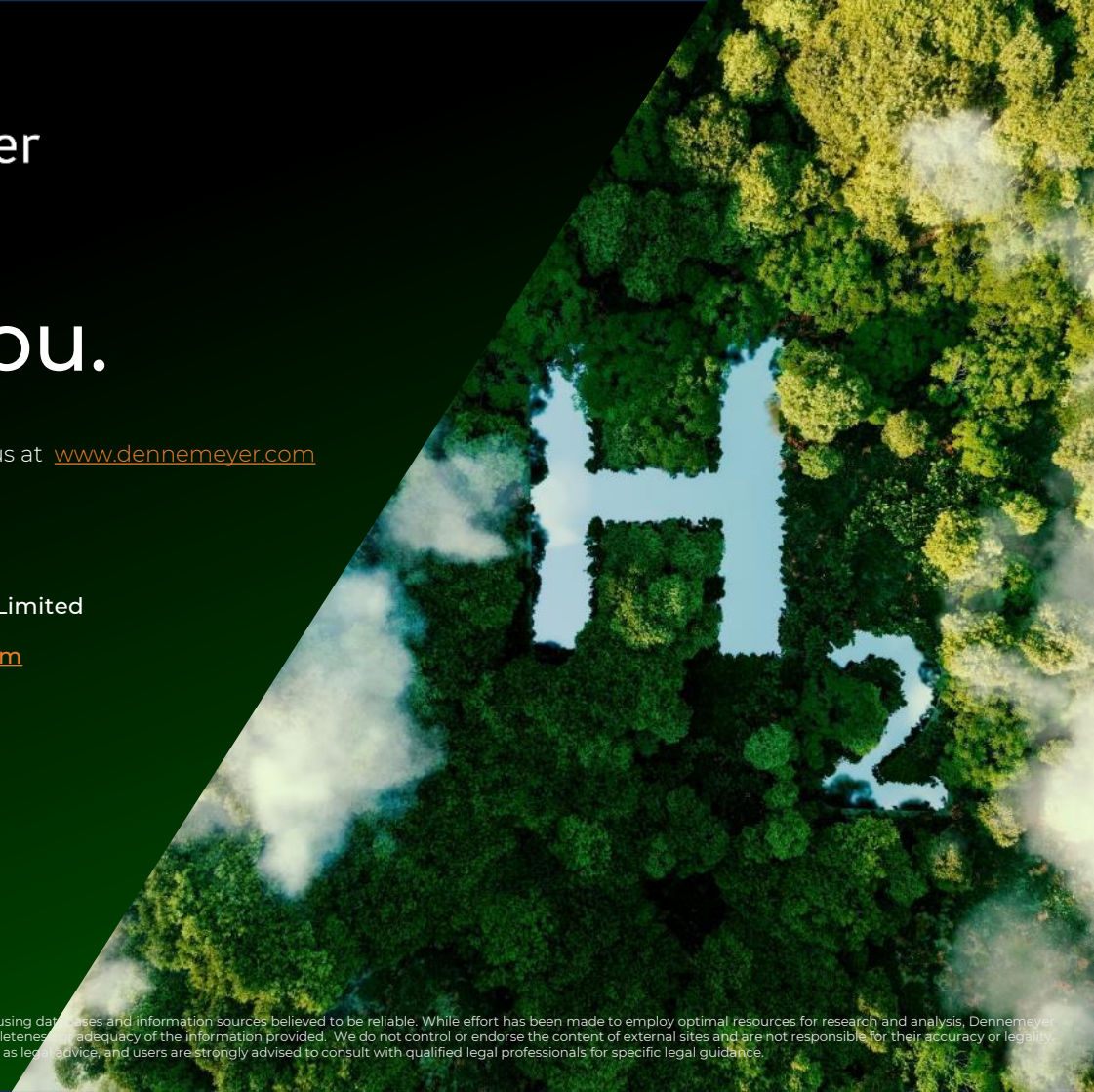

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