

**FORM 2**

THE PATENTS ACT, 1970

(39 of 1970)

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THE PATENTS RULES, 2003

**PROVISIONAL SPECIFICATION**

[See section 10, Rule 13]

**A HYDROGEN GENERATION SYSTEM FOR A VEHICLE;**

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THE FOLLOWING SPECIFICATION DESCRIBES THE INVENTION.

**TITLE:**

A HYDROGEN GENERATION SYSTEM FOR A VEHICLE

**TECHNICAL FIELD OF THE INVENTION:**

5 The present invention relates to a system and method for generating hydrogen to power a vehicle and more particularly to a system and method of generating hydrogen using solar cell.

**BACKGROUND OF THE INVENTION:**

10 Greenhouse effect is the biggest challenge which the environment is facing in the current century. With conventional energy resources depleting fast, to explore the avenues for renewable energy and utilize the renewable energy at its best has become an imperative objective for the humankind. The internal combustion engines running on non-renewable fossil fuels have been found as the major contributor for the global greenhouse effect.

15 With the developments in Vehicle technology, new devices and systems have been developed to harness the energy through various alternate power sources utilizing a renewable source of energy which is considered as environmental friendly. Among these vehicles, hybrid motor vehicles are powered by an internal combustion engine in association with the electric

motors being powered by the battery whereas all electric vehicles are those vehicles which are powered exclusively by an electric driven motor.

Due to the limitations of the driving range of the battery of the electric vehicles, various solutions were proposed in the form of solar powered electric vehicles; wind turbine powered electric vehicles, fuel cell powered electric vehicles etc.

Fuel cell electric vehicles or hydrogen engine vehicles are the vehicles which produces their electricity themselves. It is well known that in the electrolysis process, the hydrogen reacts with the oxygen in the fuel cell whereas the hydrogen is supplied from one or more tanks disposed inside the vehicle and oxygen is extracted from the ambient air. The products of this reaction are electrical energy, heat and water, which are emitted through the exhaust as water vapour. However, the refuelling of the hydrogen into the vehicle has been observed to be a time consuming and an exhausting task.

Some of the existing solutions have proposed the vehicles having inbuilt hydrogen producing plants to produce hydrogen using electricity from photovoltaic panels and electrolyzer by splitting water. However, it has been observed these systems require distilled water as a fuel and also require the installation of distillation unit at fuelling stations which consequently increases the complexities of the process and the operating cost.

It has also been observed that some of the systems require distilled water in combination with Sulphuric acid which is unsafe and not sustainable. Further, the use of Sulphuric acid increases the operating and maintenance cost of the vehicle. The sulphuric acid is a very strong acid and thus the storage and handling also tends a great safety hazard.

Therefore, the present invention solves one or more of the aforementioned problems.

**BRIEF DESCRIPTION OF THE DRAWINGS:**

Reference will be made to embodiments of the invention, example of which may be illustrated in the accompanying figure(s). These figure(s) are intended to be illustrative, not limiting. Although the invention is generally described in the context of these embodiments, it should be understood that it is not intended to limit the scope of the invention to these particular embodiments.

FIG. 1 shows the process of hydrogen generation system to power a vehicle in accordance with an embodiment of the present invention;

FIG. 2 shows the electrolysis process for hydrogen generation in accordance with an embodiment of the present invention;

## **DESCRIPTION OF THE INVENTION:**

Accordingly, the present invention in an embodiment discloses a hydrogen generation system for a vehicle. The system comprises a solar panel mounted at the vehicle; a water distillation unit disposed inside the vehicle for  
5 converting the normal or tap water into the distillation water for electrolysis process. The system comprises a proton exchange membrane based unitized regenerative fuel cell electrolyzer which receives distilled water from the distillation unit and power from the solar panel. The distilled water is electrolyzed into hydrogen and oxygen in the proton exchange membrane of  
10 the unitized regenerative fuel cell-electrolyzer. The system comprises a hydrogen compressor and fuel storage tank. The hydrogen and oxygen released in the electrolysis are passed through a hydrogen compressor and the pressurized gas is stored in intermediate fuel storage tanks for continuous electricity generation for the vehicle. These gases are then circulated back  
15 into the Unitized Regenerative Fuel Cell (URFC) which serves as a hydrogen-powered fuel cell this time.

In accordance with an embodiment of the present invention, the fuel cell is a proton exchange membrane based Unitized Regenerative Fuel Cell (URFC) which produces a high amount of electricity and water which are conserved  
20 and reused in the same process and the electricity generated on the fuel cell mode is used to drive the vehicle.

In accordance with an embodiment of the present invention, the hydrogen compressor is operated by the electrical energy received from the solar panel.

5 In accordance with an embodiment of the present invention, the distillation unit is operated by the power received from the solar panels mounted at the vehicle.

In accordance with an embodiment of the present invention, the distillation unit allows recycling of water discharged from fuel cells.

10 In accordance with another embodiment, the present invention discloses a method of generating hydrogen using solar power. The method includes the steps of: distilling the tap water; electrolyzing the distilled water to decompose into hydrogen and oxygen; compressing the hydrogen gas; storing the hydrogen and oxygen gas; combining hydrogen and oxygen gases in a fuel cell to generate electricity; supplying the discharged water to the distillation unit for recycling.

15 Fig. 1 shows a hydrogen generation system to power a vehicle in accordance with an embodiment of the present invention. The distillation unit includes a reservoir to store the tap or normal water which is fed to the distillation unit. The distilled water received from the distillation unit is supplied to the Proton Exchange Membrane based Unitized Regenerative Fuel Cell. The Unitized  
20 Regenerative Fuel Cell (URFC) receives electrical energy from the solar cells

or solar panel mounted at the vehicle. The Unitized Regenerative Fuel Cell Electrolyzer decomposes the distilled water into the hydrogen gas and oxygen gas. The hydrogen gas is then compressed by a hydrogen compressor. The compressed hydrogen gas is stored into an intermediate fuel storage tank. The oxygen gas is also stored into an auxiliary storage tank. The stored compressed hydrogen gas and the oxygen gas are then supplied back to the Unitized Regenerative Fuel Cell (URFC) for electricity generation. The generated electricity is supplied to the electric motors of the vehicles to drive the vehicle. The water received from the outlet section of the fuel cell is recycled for use through distillation unit of the system.

In accordance with an embodiment of the present invention, the system includes batteries for storing the electricity generated by the fuel cells for driving the electric motors.

Fig. 2 shows the electrolysis process for generating hydrogen in accordance with an embodiment of the present invention. The process includes two phases i.e. electrolysis phase and fuel cell phase. In electrolysis phase, the distilled water received from the distillation unit is fed into the water inlet section of the electrolyzer of the fuel cell. The electrolyzer decomposes the distilled water into the hydrogen and oxygen gas. These gases are compressed and stored in storage tanks. In Fuel cell phase, the stored hydrogen gas and the oxygen gas are supplied to the Unitized Regenerative

Fuel Cell (URFC) which produces high amount of electricity and water. The produced electricity is supplied to the electric motors for powering the vehicle. The water discharged from the water outlet section of the fuel cell is supplied back to distillation unit for recycling.

5 In accordance with an embodiment of the present invention, the solar panel is mounted at the roof of the vehicle. The solar panel provides the power required for operating the hydrogen generation system of the vehicle.

Following are the advantages of the present invention:

10 1. The hydrogen generation system of the present invention uses tap water as the only fuel for the fuel cell which makes the system convenient, safe and easy to use.

15 2. The inbuilt distillation unit of the present invention converts the tap or normal water into distillation water required for electrolysis and also recycles the water received from the fuel cell which makes the system more efficient and eco friendly.

20 3. The system of the present invention provides electricity for distillation and electrolysis process by solar power and thereby saving on conventional energy.



4. The present invention provides a single unit for both electrolysis and electricity generation i.e. the proton exchange membrane unitized regenerative fuel cell (PEM URFC). This is a novel process, which reduces the steps required for a water and solar-powered system, posing significant advantages with the specifications of lighter weight and lesser space.

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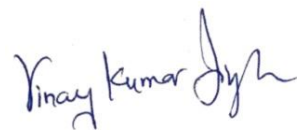
Many modifications may be made without departing from the basic spirit of the present invention. Accordingly, it will be appreciated by those skilled in the art that the invention may be practiced other than that has been specifically described herein.

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Dated this 29<sup>th</sup> day of October 2020

For UDAYA GOEL and SRIMAN GOEL

By their Agent



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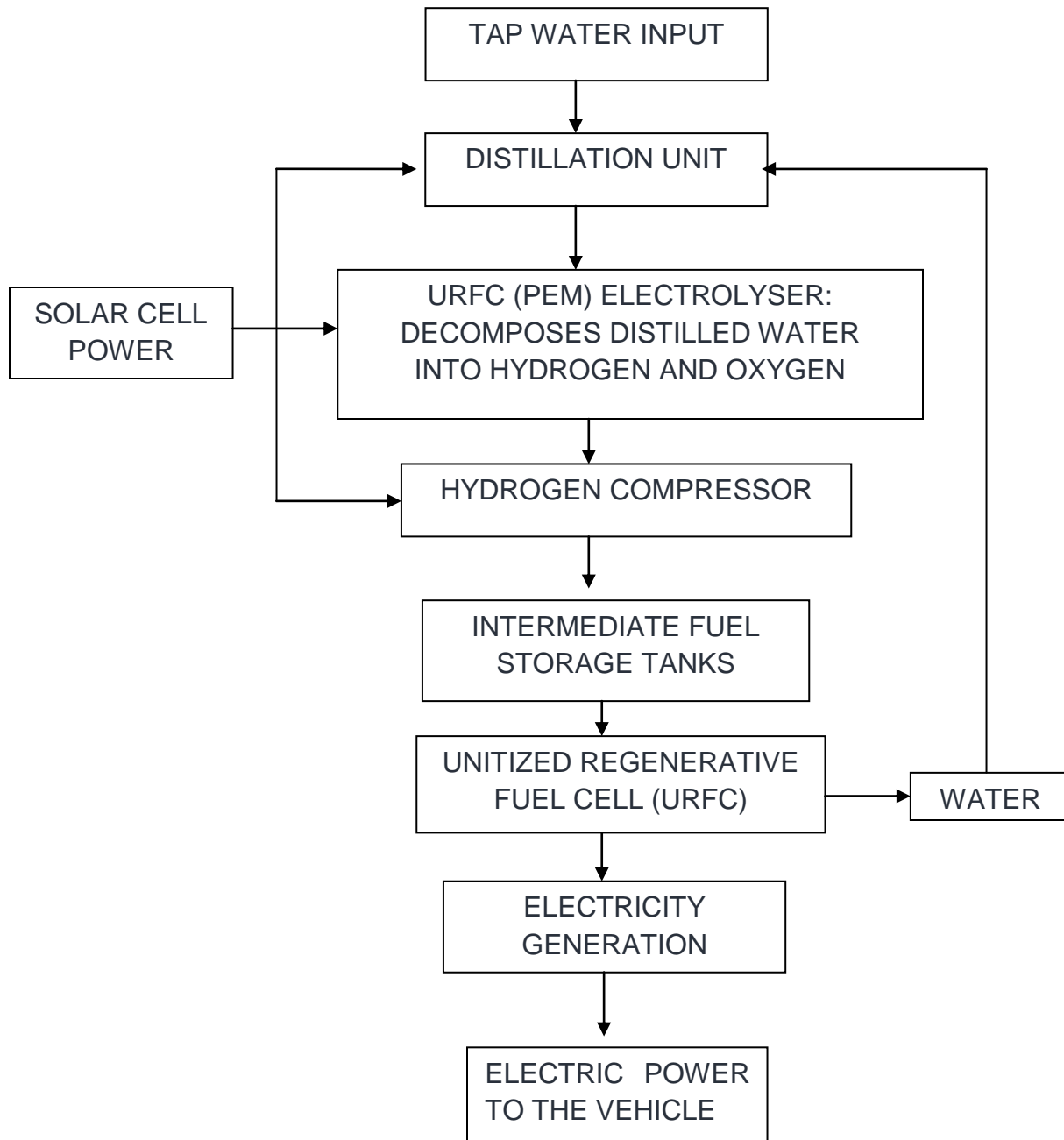


FIG. 1

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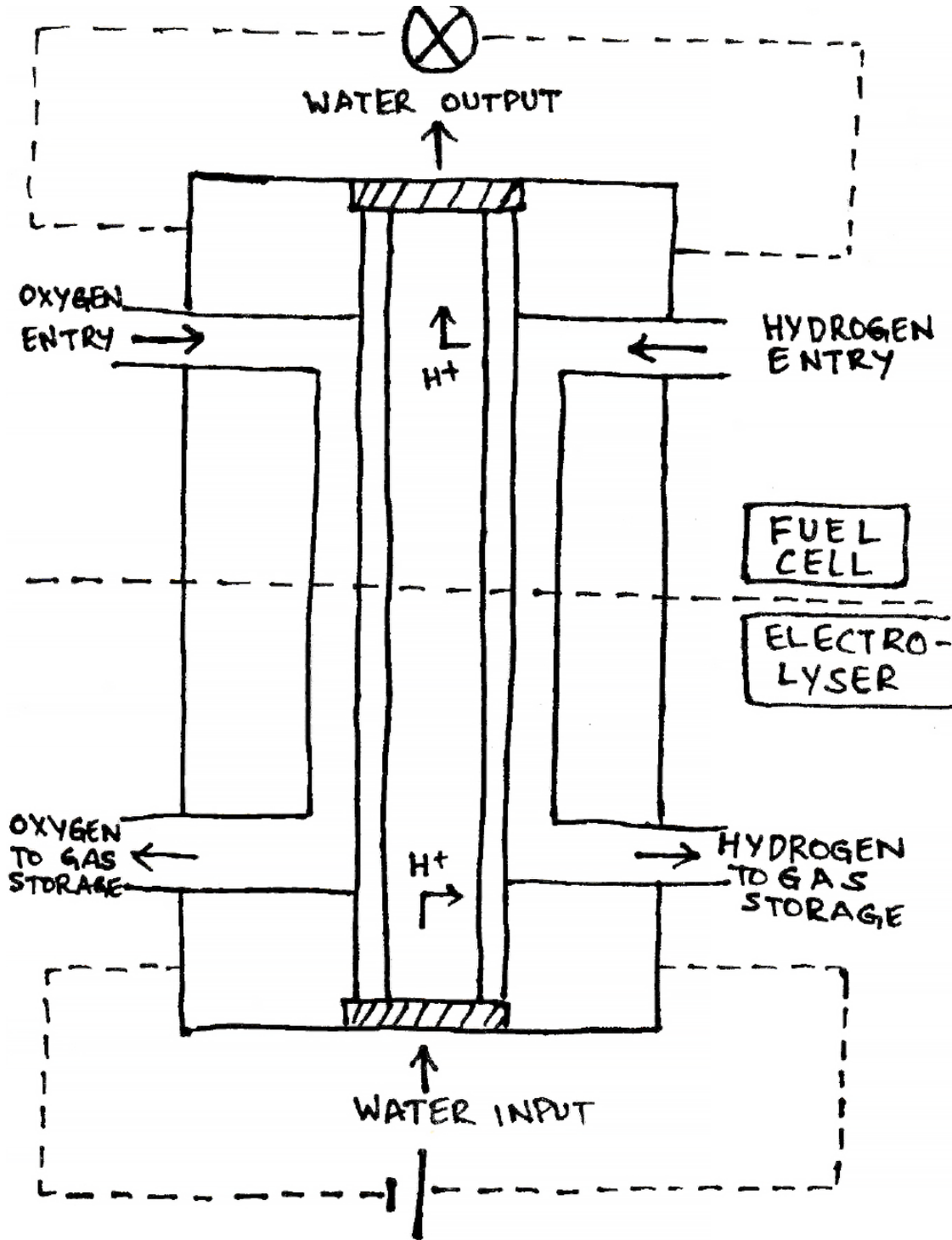


FIG. 2

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