Self-Regulating Water-Separator System for Fuel Cells

This system would not depend on hydrophobic or hydrophilic surfaces.

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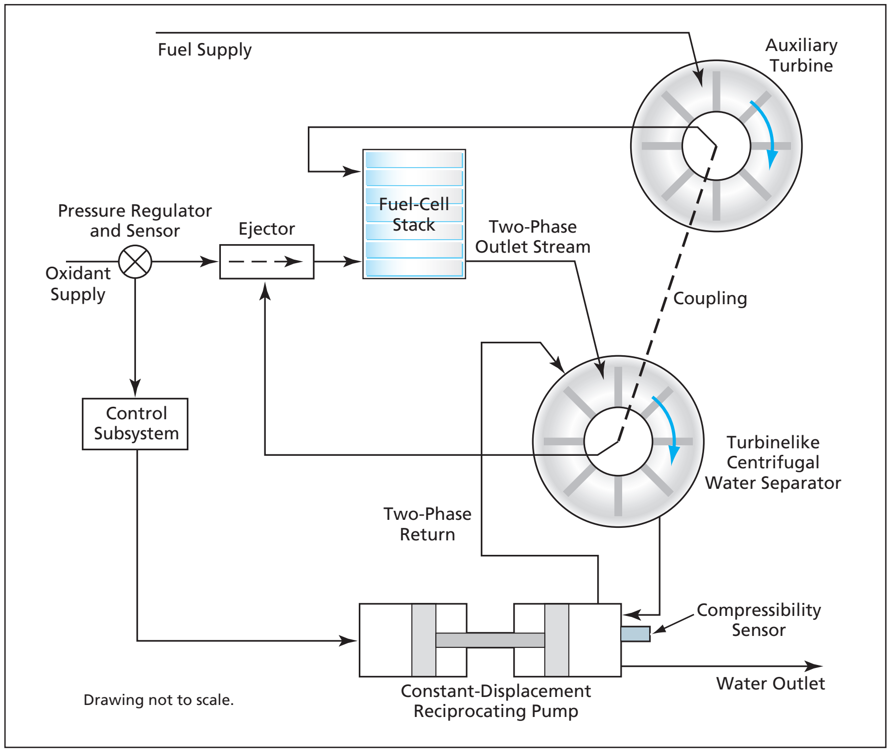
A proposed system would perform multiple coordinated functions in regulating the pressure of the oxidant gas (usually, pure oxygen) flowing to a fuel-cell stack and in removing excess product water that is generated in the normal fuel-cell operation. The system could function in the presence or absence of gravitation, and in any orientation in a gravitational field.

Unlike some prior systems for removing product water, the proposed system would not depend on hydrophobicity or hydrophilicity of surfaces that are subject to fouling and, consequently, to gradual deterioration in performance. Also unlike some prior systems, the proposed system would not include actively controlled electric motors for pumping; instead, motive power for separation and pumping away of product water would be derived primarily from the oxidant flow and perhaps secondarily from the fuel flow. The net effect of these and other features would be to make the proposed system more reliable and safer, relative to the prior systems.

The proposed system (see figure) would include a pressure regulator and sensor in the oxidant supply just upstream from an ejector reactant pump. The pressure of the oxidant supply would depend on the consumption flow. In one of two control subsystems, the pressure of oxidant flowing from the supply to the ejector would be sensed and used to control the speed of a set of a reciprocating constant-displacement pump so that the volumetric flow of nominally incompressible water away from the system would slightly exceed the rate at which water was produced by the fuel cell(s).



The **Self-Regulating Water-Separator System** would derive its pumping and water-separating power from the flow of oxidant gas to the fuel-cell stack. Optionally, the fuel flow could be utilized as an auxiliary power source during operation of the fuel cell at low power.

The two-phase (gas/liquid water) outlet stream from the fuel cell(s) would enter the water separator, a turbinelike centrifugal separator machine driven primarily by the oxidant gas stream. A second control subsystem would utilize feedback derived from the compressibility of the outlet stream: As the separator was emptied of liquid water, the compressibility of the pumped stream would increase. The compressibility would be sensed, and an increase in compressibility beyond a preset point (signifying a decrease in water content below an optimum low level) would cause the outflow from the reciprocating pump to be diverted back to the separator to recycle some water.

This work was done by Arturo Vasquez, Kerri McCurdy, and Karla F. Bradley of **Johnson Space Center**.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-0837. Refer to MSC-23668.