

FIG. 5 is an electronic circuit diagram illustrating a power supply which is connected to the electrodes of FIGS. 1-3;

FIG. 6 is a side view of a cell for producing at least parahydrogen including a coil and a pair of electrodes according to a fourth embodiment of the present invention;

FIG. 7 is a side view of a cell for producing at least parahydrogen including a coil and two pairs of electrodes according to a fifth embodiment of the present invention;

FIG. 8 is a side view of a cell for producing at least parahydrogen including a coil and a pair of cylindrical-shaped electrodes according to a sixth embodiment of the present invention; and

FIG. 9 is an electronic circuit diagram illustrating a power supply which is connected to the coil and electrodes of FIGS. 6-8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a first embodiment of the present invention including a cell for producing hydrogen and oxygen. As will be discussed below in conjunction with FIGS. 6-8,

the production of parahydrogen requires an additional coil not shown in FIG. 1. Thus, the hydrogen produced by the first embodiment of FIG. 1 is orthohydrogen.

The cell includes a closed container 111 which is closed at its bottom portion by threaded plastic base 113 and screw thread base 109. The container 111 can be made of, for example, plexiglass and have an exemplary height of 43 cm and an exemplary width of 9 cm. The container 111 holds tap water 110 therein.

The cell further includes a pressure gauge 103 to measure the pressure within the container 111. An outlet valve 102 is connected to the top of the container 111 to permit any gas within the container 111 to escape into an output tube 101.

The cell also includes a pop valve 106 connected to a base 113. The pop valve 106 provides a safety function by automatically releasing the pressure within the container 111 if the pressure exceeds a predetermined threshold. For example, the pop valve 106 may be set so that it will open if the pressure in the container exceeds 75 p.s.i. Since the container 111 is built to withstand a pressure of about 200 p.s.i., the cell is provided with a large safety margin.

A pair of electrodes 105a, 105b are arranged within the container 111. The electrodes 105a, 105b are submerged under the top level of the water 110 and define an interaction zone 112 therebetween. The electrodes 105a, 105b are preferably made of the same material, such as stainless steel.

In order to produce an optimal amount of hydrogen and oxygen, an equal spacing between the electrodes 105a, 105b must be maintained. Moreover, it is preferable to minimize the spacing between the electrodes 105a, 105b. However, the spacing between the electrodes 105a, 105b cannot be positioned excessively close because arcing between the electrodes 105a, 105b would occur. It has been determined that a spacing of 1 mm is optimal spacing for producing hydrogen and oxygen. Spacing up to 5 mm can work effectively, but spacing above 5 mm has not worked well, except with excessive power.

Hydrogen and oxygen gas outputted through output tube 101 can be transmitted by tube 101 to a device 120 using those gases, for example an internal combustion engine, such as shown in FIG. 1. Instead of an internal combustion engine, device 120 may be any device using hydrogen and oxygen, including a reciprocating piston engine, a gas turbine engine, a stove, a heater, a furnace, a distillation unit,

a water purification unit, a hydrogen/oxygen jet, or other device using the gases. With an adequately productive example of the present invention, any such device 120 using the output gases can be run continuously without the need for storing dangerous hydrogen and oxygen gases.

FIG. 2 shows a second embodiment of the present invention which includes more than one pair of electrodes 205a-d. The spacing between the electrodes is less than 5 mm as in the embodiment of FIG. 1. While FIG. 2 shows only one additional pair of electrodes, it is possible to include many more pairs (e.g., as many as 40 pairs of electrodes) within the cell. The rest of the cell illustrated in FIG. 2 remains the same as that illustrated in FIG. 1. The multiple electrodes are preferably flat plates closely spaced, parallel to each other.

FIG. 3 illustrates a cell having a cylindrically shaped electrodes 305a, 305b. The outer electrode 305b surrounds the coaxially aligned inner electrode 305a. The equal spacing of the electrodes 305a, 305b is less than 5 mm and the interactive zone is coaxially arranged between the two electrodes 305a, 305b. While FIG. 3 illustrates the top portion of the container 111 being formed by a plastic cap 301, it will be appreciated to those skill in the art that the cap 301 may be used in the embodiments of FIGS. 1-2 and the embodiment of FIG. 3 can utilize the same container 111 illustrated in FIGS. 1-2. As suggested by FIG. 3, the electrodes can be almost any shape such as flat plates, rods, tubes or coaxial cylinders.

The electrodes 105a, 105b of FIG. 1 (or electrodes 205a-d of FIG. 2 or electrodes 305a, 305b of FIG. 3) are respectively connected to power supply terminals 108a, 108b so that they can receive a pulsed electrical signal from a power supply. The pulsed signal can be almost any waveform and have a variable current level, voltage level, frequency and mark-space ratio (i.e., a ratio of the duration of a single pulse to the interval between two successive pulses). For example, the power supply providing power to the electrodes can be a mains 110 volts to a 12 volt supply or a car battery.

FIG. 4a, FIG. 4b and FIG. 4c illustrate a square wave, a saw tooth wave and a triangular wave, respectively which can be applied to the electrodes 105a, 105b (or 205a-d or 305a, 305b) in accordance with the present invention. Each of the waveforms illustrated in FIGS. 4a-4c has a 1:1 mark-space ratio. As shown in FIG. 4b, the saw tooth wave will only reach a peak voltage at the end of the pulse duration. As shown in FIG. 4c, the triangular wave has a low peak voltage. It has been found that optimal results for producing hydrogen and oxygen in the present invention are obtained using a square wave.

After initiation of the pulsed signal from the power supply, the electrodes 105a, 105b continuously and almost instantaneously generate hydrogen and oxygen bubbles from the water 110 in the interaction zone 112. Moreover, the bubbles can be generated with only minimal heating of the water 110 or any other part of the cell. These bubbles rise through the water 110 and collect in the upper portion of the container 111.

The generated bubbles are not bunched around or on the electrodes 105a, 105b and thus readily float to the surface of the water 110. Therefore, there is no need to add a chemical catalyst to assist the conduction of the solution or reduce the bubble bunching around or on the electrodes 105a, 105b. Thus, only tap water is needed for generation of the hydrogen and oxygen in the present invention.

The gases produced within the container are self-pressurizing (i.e., pressure builds in the container by the