CLAIMS: (CLEAN COPY)

4. An electrolysis cell system according to any preceding claim, wherein the heat transfer arrangement comprises at least one of:

a mesh, preferably a corrugated mesh section;

a perforated sheet; or

a sheet or a plate

5. An electrolysis cell system according to any preceding claim, wherein the heat transfer arrangement is gas permeable, preferably in direction parallel to the longitudinal axis of the membrane electrode assembly.

6. An electrolysis cell system according to any preceding claim, wherein the heat transfer arrangement is formed from metal, preferably nickel or stainless steel, more preferably corrosion resistant stainless steel.

7. An electrolysis cell system according to any one of claims 1 to 6, wherein the electrode gas space including the inlet and the outlet fluidly connected to the recirculating loop is the electrode gas space of the anode and the product gas comprises oxygen.

8. An electrolysis cell system according to any one of claims 1 to 6, wherein the electrode gas space including the inlet and the outlet fluidly connected to the recirculating loop is the electrode gas space of the cathode and the product gas comprises hydrogen.

9. An electrolysis cell system according to any preceding claim, wherein the water supply vessel comprises a humidifier.

10. An electrolysis cell system according to claim 9, wherein the humidifier directly mixes the product gas and water supplied into and flowing through the humidifier.

11. An electrolysis cell system according to any preceding claim, wherein the recirculated oxygen or hydrogen product gas passes through the humidifier and entrains water vapour therein.

12. An electrolysis cell system according to any preceding claim, wherein the heat of vaporisation for water vaporisation is provided by the product gas in the recirculating loop.

13. An electrolysis cell system according to any preceding claim, wherein water is supplied to the water supply vessel at a rate needed to replenish water used in the system by electrolysis.

14. An electrolysis cell system according to any preceding claim, wherein the electrode gas space is housed in an electrode chamber having inlet and outlet openings are located along a gas flow axis which is orientated perpendicular to longitudinal axis of the membrane electrode assembly of the respective electrolysis cell.

15. An electrolysis cell system according to any preceding claim, including at least two electrolysis cells stacked together.

16. A process of producing hydrogen and oxygen from water using at least one electrolysis cell including a membrane electrode assembly which comprises at least one pair of gas permeable electrodes comprising an anode and a cathode, and an ion conductive electrolyte arranged between each pair of anode and cathode, the or each gas permeable electrodes including an electrode gas space on the non-electrolyte side thereof, at least one of the electrode gas spaces of the anode and cathode including an inlet and an outlet, said process comprising:

supplying current and water vapour to the membrane electrode assembly to produce hydrogen gas from the cathode and oxygen gas from the anode;

recirculating a portion of at least one of the produced oxygen gas or hydrogen gas from the outlet of the respective electrode gas space through a recirculating loop to the inlet of said respective gas space and through said respective gas space;

vapourising water supplied into the recirculating loop from a water supply utilising energy provided by at least a portion of the respective oxygen or hydrogen product gas in said recirculating loop to provide the requisite heat of vaporisation; and

transferring heat between the membrane electrode assembly and product gas in said respective electrode gas space using a heat transfer arrangement located in said respective electrode gas space which is in contact with the membrane electrode assembly and also allows for gas circulation between the membrane electrode assembly and said respective electrode gas space.

17. A process according to claim 16, wherein the step of vapourising water occurs in a humidifier.

18. A process according to claim 16 or 17, wherein the step of vapourising water includes mixing water into the recirculating a portion of produced oxygen gas thereby transferring heat from the produced oxygen product gas to water in said mixture for water vaporisation.

19. An electrolysis cell system according to any one of claims 16 to 18, wherein said respective gas space is the electrode gas space of the anode and the product gas comprises oxygen.

20. An electrolysis cell system according to any one of claims 16 to 19, wherein said respective gas space is the electrode gas space of the cathode and the product gas comprises hydrogen.