CLAIMS

1. A heat exchanger configured for use in a cryogenic system for the separation of electrolytically produced oxygen and hydrogen, the heat exchanger being configured to exchange heat between a mixed gas stream, hydrogen, and oxygen,

the heat exchanger comprising a plurality of cells formed by a stack of alternate planar flow-guide plates and heat transfer plates,

each heat transfer plate having at least three apertures therethrough, each aperture defining a part of a respective one of at least three fluid flow paths in the heat exchanger,

each flow-guide plate having apertures therethrough corresponding to at least two of the flow paths and a larger aperture therethrough configured to guide fluid in the remaining flow path across the face of the heat transfer plates between which the flow-guide plate is located,

each successive flow-guide plate in the stack forming part of a different flow path from the preceding one in the stack.

2. A heat exchanger according to Claim 1, further comprising a pair of end plates between which the stack of alternate planar flow-guide plates and heat transfer plates are clamped by means of tie rods.

3. A heat exchanger according to Claim 2, wherein the tie rods are threaded tie rods, and the stack of alternate planar flow-guide plates and heat transfer plates are clamped by means of the threaded tie rods and nuts.

4. A heat exchanger according to Claim 2 or Claim 3, further comprising alignment pins extending between the end plates to hold the plates in alignment.

5. A heat exchanger according to any of Claims 2 to 4, wherein the end plates have flow connections therethrough.

6. A heat exchanger according to Claim 5, comprising connecting spigots, provided on each end plate for connecting the three flow paths within the heat exchanger to external gas flow pipes.

~~2. A heat exchanger according to Claim 1, wherein at least some of the cells include a turbulence-inducing matrix therein.~~

~~3. A heat exchanger according to Claim 2, wherein the matrix comprises a welded or woven mesh insert within the cell.~~

~~4. A heat exchanger according to Claim 2, wherein the matrix comprises a formation on the surface of at least one of the heat transfer plates between which the cell is defined.~~

~~5. A heat exchanger according to any preceding claim, wherein the plates are formed from stainless steel.~~

~~6. A heat exchanger according to Claim 5, wherein the plates are bonded together by copper brazing.~~

~~7. A heat exchanger according to any preceding claim, wherein the plates are rectangular in plan.~~

~~8. A heat exchanger according to any preceding claim, comprising a pair of end plates between which the stack of plates is clamped, the end plates having flow connections therethrough.~~

7~~9~~. A heat exchanger according to any preceding claim, wherein the cells in the stack are not equally divided between the three flow paths.

8. A heat exchanger according to any preceding claim, wherein the three fluid flow paths comprise one mixed gas stream flow path, one hydrogen flow path, and one oxygen flow path, the mixed gas flow path and the oxygen flow path being longer than the hydrogen flow path.

910. A heat exchanger according to ~~Claim 4~~any preceding claim, wherein the direction of flow across the face of the heat transfer plates in each of the flow paths changes along the length of the stack.

~~11. A heat exchanger according to any preceding claim, comprising 48 to 200 cells.~~

~~12. A heat exchanger according to any preceding claim, having three flow paths therethrough.~~

1013. An a~~A~~pparatus for separating hydrogen and oxygen from a mixed gas stream, comprising:

a mixed gas inlet connected to a condensing coil at least partially submerged in liquid nitrogen in an insulated container,

a liquid oxygen reservoir connected to the condensing coil, a hydrogen gas outlet from the condensing coil,

an oxygen flow control valve connected to the liquid oxygen reservoir, and

a heat exchanger according to ~~Claim 12~~any preceding claim, having three flow paths therethrough,

wherein the mixed gas inlet is connected to a first flow path in the heat exchanger, the hydrogen gas outlet is connected to a second flow path in the heat exchanger and the oxygen flow control valve is connected to the third flow path in the heat exchanger.

1114. Apparatus according to Claim 1013, wherein the heat exchanger is mounted within a vacuum chamber above the liquid nitrogen container.

1215. Apparatus according to Claim 1013 or 1114, wherein the mixed gas stream is generated by the decomposition of water by electrolysis.

13. A cryogenic system for the separation of electrolytically produced oxygen and hydrogen, comprising a heat exchanger according to any of the preceding claims.

14. The cryogenic system of Claim 13, comprising a liquid oxygen reservoir connected to the oxygen flow path.

15. The cryogenic system of Claim 13 or Claim 14, comprising an electrolyser connected to the mixed gas flow path.