CLAIMS

1. A hydrogen fuel cell unit comprising, in order

(i) a first bipolar plate having a front face and a rear face, the rear face being an anode in the unit,

(ii) a first membrane electrode assembly,

(iii) a second bipolar plate having a front face and a rear face, the front face being a cathode in the unit and the rear face being an anode in the unit,

wherein the first membrane electrode assembly is between the first and second bipolar plates, and a flow path is provided between the rear face of the first bipolar plate and the first membrane electrode assembly for flow of hydrogen, and a flow path is provided between the front face of the second bipolar plate and the first membrane electrode assembly for flow of oxygen,

(iv) a second membrane electrode assembly, and

(v) a third bipolar plate having a front face and a rear face, the front face being a cathode in the unit,

wherein the second membrane electrode assembly is between the second and third bipolar plates, and a flow path is provided between the rear face of the second bipolar plate and the second membrane electrode assembly for flow of hydrogen, and a flow path is provided between the front face of the third bipolar plate and the second membrane electrode assembly for flow of oxygen,

wherein the bipolar plates comprise channels for flow of oxygen and wherein the oxygen flow channels of adjacent plates repeatedly diverge and converge across the plate,

wherein the bipolar plates further comprise channels for flow of hydrogen and wherein the hydrogen and oxygen flow channels are substantially transverse to each other, and

wherein the oxygen flow channels are formed by an indentation in the bipolar plate and transverse hydrogen flow channels comprise a notch in the indentation that forms the oxygen flow channels, or vice versa, i.e. wherein hydrogen flow channels are formed by an indentation in the bipolar plate and transverse oxygen flow channels comprise a notch in the indentation that forms the hydrogen flow channels.

2. A hydrogen fuel cell unit according to claim 1, wherein the oxygen flow channels of adjacent plates diverge and converge across the plate in a criss-cross pattern.

3. A hydrogen fuel cell unit according to claim 1 or claim 2, wherein the oxygen flow channels diverge and converge in a regular pattern.

4. A hydrogen fuel cell unit according to any preceding claim, wherein each oxygen flow channel comprises an inlet and an outlet and a conduit between its inlet and its outlet, and wherein the oxygen conduits of adjacent plates in the fuel cell are not vertically aligned along the whole of their length such that the adjacent plates do not nest together when held in a stack that is part of the fuel cell unit.

5. A hydrogen fuel cell unit according to claim 4, wherein the membrane electrode assemblies are clamped in place between the bipolar plates.

6. A hydrogen fuel cell unit according to any preceding claim, wherein the plates comprise channels for flow of hydrogen, each channel having an inlet and an outlet, wherein the respective inlets and outlets of hydrogen flow channels of adjacent plates in the fuel cell are vertically aligned.

7. A hydrogen fuel cell unit according to any preceding claim, wherein the hydrogen flow channels further comprise a conduit between its inlet and outlet, wherein the conduits of channels of adjacent plates in the fuel cell are not vertically aligned along the whole of their length.

8. A hydrogen fuel cell unit according to any preceding claim, wherein the oxygen flow channels each have an inlet and an outlet, wherein the respective inlets and outlets of oxygen flow channels of adjacent plates in the fuel cell are vertically aligned.

9. A hydrogen fuel cell unit according to any preceding claim, wherein with plates stacked vertically on top of each other a horizontal cross-section of any plate passes through both hydrogen and oxygen flow channels.

10. A hydrogen fuel cell unit according to any preceding claim, wherein the first and/or second and/or third bipolar plates do not have rotational symmetry about a line through the centre of the plate in the vertical direction of plate stacking.

11. A hydrogen fuel cell unit according to claim 10, wherein the first and/or second and/or third bipolar plate comprises two or more manifold apertures and there is rotational symmetry of the manifold apertures on each plate.

12. A hydrogen fuel cell unit according to any preceding claim, wherein each of the first, second and third bipolar plates are the same design.

13. A hydrogen fuel cell unit according to claim 12, wherein adjacent bipolar plates are rotated 180 degrees with respect to each other.

14. A bipolar plate according to any preceding claim, stamped from a single sheet of metal or alloy, e.g. steel.

15. A method of making a bipolar plate, comprising

(i) providing a sheet of metal or alloy;

(ii) stamping the sheet to form a bipolar plate comprising a plurality of hydrogen flow channels and a plurality of oxygen flow channels,

wherein the bipolar plates can be used to make a hydrogen fuel cell unit according to any of claims 1 to 13.

16. A method of making a hydrogen fuel cell, comprising

(i) providing a first bipolar plate having a front face and a rear face, the rear face being an anode, and a second bipolar plate having a front face and a rear face, the front face being a cathode and the rear face being an anode,

(ii) locating a first membrane electrode assembly between the first and second bipolar plates,

wherein when the first membrane electrode assembly is between the first and second bipolar plates a flow path is provided between the rear face of the first bipolar plate and the first membrane electrode assembly for flow of hydrogen, and a flow path

is provided between the front face of the second bipolar plate and the first membrane electrode assembly for flow of oxygen,

(iii) providing a third bipolar plate having a front face and a rear face, the front face being a cathode, and

(iv) locating a second membrane electrode assembly between the second and third bipolar plates,

wherein when the second membrane electrode assembly is between the second and third bipolar plates:

a flow path is provided between the rear face of the second bipolar plate and the second membrane electrode assembly for flow of hydrogen,

a flow path is provided between the front face of the third bipolar plate and the second membrane electrode assembly for flow of oxygen, and

the flow path for flow of hydrogen and the flow path for flow of oxygen are substantially transverse to each other,

wherein the bipolar plates comprise channels for flow of hydrogen and channels for flow of oxygen and wherein the hydrogen and oxygen flow channels are substantially transverse to each other, and

wherein the oxygen flow channels are formed by an indentation in the bipolar plate and transverse hydrogen flow channels comprise a notch in the indentation that forms the oxygen flow channels, or vice versa, i.e. wherein hydrogen flow channels are formed by an indentation in the bipolar plate and transverse oxygen flow channels comprise a notch in the indentation that forms the hydrogen flow channels.

17. A method according to claim 16, wherein the bipolar plates are all of the same design, adjacent plates being rotated 180 degrees with respect to each other.