Claims

1. A separator plate suitable for use in a closed-cathode proton-exchange membrane (PEM) fuel cell, the separator plate comprising a first set of fluid flow channels each extending from an inlet at a first edge portion of the separator plate to an outlet at a second edge portion or manifold aperture portion of the separator plate, wherein:

the first set of fluid flow channels comprises one or more fluid flow channels, where the one or more fluid flow channels extend across the first edge portion;

the fluid flow channels define a flow field, and the separator plate comprises only one or two of the following (i) to (iii):

(i) an integrated cathode inlet manifold aperture that extends beyond the edge of the flow field;

(ii) an integrated anode inlet manifold aperture that extends beyond the edge of the flow field; and

(iii) an integrated coolant inlet manifold aperture that extends beyond the edge of the flow field.

2. The separator plate according to Claim 1, wherein the separator plate is selected from: a cathode separator plate, an anode separator plate, and a coolant separator plate, optionally wherein the separator plate is selected from a cathode separator plate, and a coolant separator plate.

3. The separator plate according to Claim 2, wherein the separator plate comprises the first set of fluid flow channels on a first face of the plate, and a second set of fluid flow channels on a second face of the plate, optionally wherein the first set of fluid flow channels are fluidly separated from the second set of fluid flow channels.

4. The separator plate according to Claim 3, wherein:

(a) the first set of fluid flow channels are cathode or anode fluid flow channels and the second set of fluid flow channels are coolant fluid flow channels, or

(b) the first set of fluid flow channels are cathode fluid flow channels and the second set of fluid flow channels are anode fluid flow channels, where the separator plate further comprises coolant fluid flow channels within the separator plate between the cathode fluid flow channels and the anode fluid flow channels.

5. The separator plate according to any one of Claims 2 to 4, wherein the separator plate is a cathode separator plate.

6. The separator plate according to any one of Claims 2 to 5, wherein:

the separator plate comprises a first corner formed by a first edge and a second edge adjacent to the first edge;

the first edge portion of the separator plate extends substantially to the first edge of the separator plate and substantially to the second edge of the separator plate; and

the first set of fluid flow channels comprises a plurality of fluid flow channels that extend across the first edge portion and substantially to the first and second edges of the separator plate.

7. The separator plate according to any one of the preceding claims, wherein the first set of fluid flow channels each extend to an outlet at a second edge portion of the separator plate.

8. The separator plate according to any one of the preceding claims, wherein the fluid flow channels define a flow field, and the separator plate comprises one or two of the following:

an integrated cathode outlet manifold aperture that extends beyond the edge of the flow field;

an integrated anode outlet manifold aperture that extends beyond the edge of the flow field; and

an integrated coolant outlet manifold aperture that extends beyond the edge of the flow field.

9. The separator plate according to any one of the preceding claims, wherein the separator plate is adapted to connect to a ducting in an appropriately fluidly sealed manner when the separator plate is placed in a fuel cell stack, optionally wherein the separator plate is adapted to connect to a ducting at the first and/or second edge portions.

10. An article comprising a separator plate according to any one of the preceding claims and one ducting plate attached to the separator plate by an interlocking connection, where the ducting plate defines an inner ducting volume in fluid communication with the inlet(s) of the first

set of fluid flow channels of the separator plate, optionally wherein the article comprises one or two additional separator plates and a membrane electrode assembly.

11. A closed-cathode proton-exchange membrane (PEM) fuel cell comprising at least one separator plate as described in any one of Claims 1 to 9 or the article according to Claim 10.

12. The closed-cathode proton-exchange membrane (PEM) fuel cell according to Claim 11, comprising a first ducting having at least one ducting inlet and an inner ducting volume in fluid communication with the at least one ducting inlet,

wherein:

the inner ducting volume of the first ducting is in fluid communication with the inlet(s) of the first set of fluid flow channels of the at least one separator plate as described in any one of Claims 1 to 12; and

the first ducting is formed from one or more interlocking ducting plates.

13. A closed-cathode proton-exchange membrane (PEM) fuel cell stack comprising:

(i) two or more fuel cells, each of the two or more fuel cells comprising:

a first separator plate as described in any one of Claims 1 to 9; and

one or more additional separator plates; and

(ii) a first ducting having at least one ducting inlet and an inner ducting volume in fluid communication with the at least one ducting inlet,

wherein:

the inner ducting volume of the first ducting is in fluid communication with the inlets of the first set of fluid flow channels of the first separator plates; and

the one or more additional separator plates are arranged or adapted to accommodate the presence of the first ducting.

14. The closed-cathode proton-exchange membrane (PEM) fuel cell stack according to Claim 13, wherein the one or more additional separator plates are fluidly separated from said first ducting.

15. The closed-cathode proton-exchange membrane (PEM) fuel cell stack according to any one of Claims 13 or 14, wherein the first separator plates are cathode separator plates.

16. The closed-cathode proton-exchange membrane (PEM) fuel cell stack according to Claim 15, wherein:

the cathode separator plates are separator plates according to Claim 6; and

the inner ducting volume of the first ducting is in fluid communication with the inlets of the first set of fluid flow channels of the first separator plates.

17. The closed-cathode proton-exchange membrane (PEM) fuel cell stack according to any one of Claims 13 to 16, having one or more of the features selected from the following (a) to (k):

(a) wherein the first ducting comprises at least two inlets;

(b) the first ducting is shaped such that fluid approaching the inlets of the first set of fluid flow channels flows in a direction that is substantially parallel to the inlets of one or more of the first set of fluid flow channels with which the inner ducting volume is in fluid communication;

(c) the first ducting is configured to increase or decrease the fluid flow rate through one or more of the fluid flow channels;

(d) the first ducting comprises fins or protrusions configured to direct fluid flowing through the ducting into one or more of the fluid flow channels;

(e) the first ducting is shaped to restrict fluid flow through a portion of the ducting;

(f) the first ducting comprises a recirculation portion configured to direct fluid flowing through a distal portion of the first ducting, relative to the at least one ducting inlet, towards one or more fluid flow channels located proximal to the at least one ducting inlet, relative to the distal portion of the first ducting;

(g) the first ducting comprises a first ducting portion configured to direct a first portion of fluid flowing through the first ducting to a first set of fuel cells, and a second ducting portion configured to direct a second portion fluid flowing through the first ducting to a second set of fuel cells;

(h) the first ducting comprises a humidification means located within the first ducting and the humidification means is configured to humidify gas flowing through the first ducting;

(i) the first ducting comprises at least two inlets, and the closed-cathode proton-exchange membrane (PEM) fuel cell stack comprises a humidification means proximal to the at least two inlets, and where the humidification means is configured to humidify gas flowing through the first ducting;

(j) the closed-cathode proton-exchange membrane (PEM) fuel cell stack comprises a second ducting having at least one second ducting inlet and an inner ducting volume in fluid

communication with the at least one second ducting inlet, where the inner ducting volume of the second ducting is in fluid communication with one or more fluid flow channels other than the fluid flow channels in fluid communication with the inner ducting volume of the first ducting; and
(k) the ducting is formed from a thermally and/or electrically insulating material.

18. The closed-cathode proton-exchange membrane (PEM) fuel cell stack according to any one of Claims 13 to 17, further comprising:
(a) means or apparatus configured to increase the flow of fluid out of the cathode and/or coolant fluid flow channels, optionally wherein said means or apparatus comprises a suction pump, further optionally wherein said suction pump is configured to recirculate fluid to the inlets of the cathode and/or coolant fluid flow channels; or
(b) means or apparatus for restricting the flow of fluid out of the cathode and/or coolant fluid flow channels.

19. The closed-cathode proton-exchange membrane (PEM) fuel cell stack according to any one of Claims 13 to 18, wherein any of the first and/or second ductings, when present, are formed from a plurality of interlocking ducting plates.

20. The closed-cathode hydrogen proton-exchange membrane (PEM) fuel cell stack according to any one of Claims 13 to 19, which is configured to be cooled by air.