Claims

1. A cold plate comprising:

———a plate body having a thermal conductive side;

———a plurality of parallel hollow fluid channels running inside the plate body;

at least one fluid inlet in direct fluid communication with a first subset of the plurality of parallel hollow fluid channels;

at least one fluid outlet in direct fluid communication with a second subset of the plurality of parallel hollow fluid channels; and

———a porous thermal conductive structure which is arranged inside the plate body to fluidly connect the first subset of the plurality of parallel hollow fluid channels to the second subset of the plurality of parallel hollow fluid channels, and which is in thermal contact with the thermal conductive side of the plate body,

———wherein the porous thermal conductive structure comprises a plurality of elongate fluid contact surface regions, each elongate fluid contact surface region extending continuously lengthwise along a longitudinal side of a respective fluid channel for more than half a length of the longitudinal side to serve as a fluid interface between the porous thermal conductive structure and an interior volume of the respective hollow fluid channel.;

wherein the plate body comprises an inner cavity having a floor surface at the thermal conductive side of the plate body and an opposing ceiling surface with the plurality of parallel hollow fluid channels recessed into the ceiling surface, wherein the porous thermal conductive structure comprises a block structure with a base surface in engagement with the floor surface of the inner cavity and an opposite top surface in engagement with the ceiling surface of the inner cavity, and wherein the plurality of elongate fluid contact surface regions are on the top surface of the porous thermal conductive structure;

wherein the plate body comprises a base part and a top part;

wherein the base part comprises a recessed portion and the floor surface;

wherein the top part comprises the ceiling surface with the plurality of parallel hollow fluid channels recessed into the ceiling surface; and

wherein the recessed portion of the base part together with the ceiling surface of the top part form the inner cavity.

2. The cold plate as claimed in claim 1, wherein the plurality of parallel hollow fluid channels and the porous thermal conductive structure are configured to cooperate in a manner in which fluid flows into the first subset of the plurality of parallel hollow fluid channels, enters the porous thermal conductive structure through a first subset of the plurality of elongate fluid contact surface regions along respective longitudinal sides of the first subset of the plurality of parallel hollow fluid channels to permeate across respective portions of the porous thermal conductive structure so as to cause a transfer of thermal energy between the fluid and the porous thermal conductive structure, and exits the porous thermal conductive structure through a second subset of the plurality of elongate fluid contact surface regions along respective longitudinal sides of the second subset of the plurality of parallel hollow fluid channels into the second subset of the plurality of parallel hollow fluid channels.

3. The cold plate as claimed in claim 1~~ or 2~~, wherein the plurality of parallel hollow fluid channels are arranged in a manner so as to alternate between the first subset of the plurality of parallel hollow fluid channels and the second subset of the plurality of parallel hollow fluid channels.

~~4. The cold plate as claimed in any one of claims 1 to 3, wherein the porous thermal conductive structure comprises one or more elongate portions, each elongate portion having two elongated fluid contact surface regions on two opposite longitudinal sides of the elongate portion.~~

~~5.~~ The cold plate as claimed in claim ~~4, wherein the porous thermal conductive structure comprises a serpentine-shaped thermal conductive structure having at least two parallel elongate portions joined by at least a bend portion in a manner so as to form a single continuous structure.~~

~~6. The cold plate as claimed in claim 4 or 5, wherein the plate body comprises an inner cavity and the porous thermal conductive structure is disposed in the inner cavity of the plate body in a manner so as to divide the inner cavity into the~~ 1, wherein the plurality of parallel hollow fluid channels~~.~~

~~7. The cold plate as claimed in claim 6, wherein the inner cavity has a uniform height and the porous thermal conductive structure has a uniform thickness, and wherein the height of the inner cavity is equal to the thickness of the porous thermal conductive structure.~~

~~8. The cold plate as claimed in claim 6 or 7, wherein the inner cavity has at least one alignment element along a side wall of the inner cavity and the porous thermal conductive structure has a corresponding alignment element.~~

~~9. The cold plate as claimed in any one of claims 1 to 3, wherein the plate body comprises an inner cavity having a floor surface at the thermal conductive side of the plate body and an opposing ceiling surface with the plurality of parallel hollow fluid channels recessed into the ceiling surface, wherein the porous thermal conductive structure comprises a block structure with a base surface in engagement with the floor surface of the inner cavity and an opposite top surface in engagement with the ceiling surface of the inner cavity, and wherein the plurality of elongate fluid contact surface regions~~ are ~~on the top surface of the porous thermal conductive structure~~uniformly spaced apart from each other.

~~10.~~5. The cold plate as claimed in ~~any one of claims~~claim 1 ~~to 9~~, wherein the ~~plate body comprises a~~ base part and ~~a~~the top part are integrally bonded together.

~~11.~~6. The cold plate as claimed in claim ~~10~~5, wherein the porous thermal conductive structure is integrally molded or printed with the base part.

~~12.~~7. The cold plate as claimed in ~~any one of claims~~claim 1 ~~to 11~~, wherein the porous thermal conductive structure is integrally bonded to the plate body.

~~13.~~8. The cold plate as claimed in ~~any one~~claim 1, wherein the block structure fills up the recessed portion of the base part.

9. The cold plate as claimed in claim 1,

wherein the plurality of ~~claims 1~~parallel hollow fluid channels comprise a plurality of openings along the ceiling surface of the plate body that opens to the inner cavity;

wherein each elongate fluid contact surface region of the block structure of the porous thermal conductive structure entirely covers a respective opening of the plurality of openings of the plurality of the parallel hollow fluid channels.

10. The cold plate as claimed in claim 1,

wherein the plurality of parallel hollow fluid channels are recessed into the ceiling surface of the top part so as to ~~12~~form a plurality of channel walls in the top part which laterally separates the first subset of the plurality of parallel hollow fluid channels from the second subset of the plurality of parallel hollow fluid channels.

11. The cold plate as claimed in claim 1,

wherein the base part comprises a first thermal conductive material and the top part comprises a second thermal conductive material that is different from the first thermal conductive material.

12. The cold plate as claimed in claim 1, wherein the thermal conductive side of the plate body comprises one or more temperature sensors.

~~14. A method of manufacturing~~ 13. An active thermal control assembly, comprising:

a cold plate~~, the method~~ comprising

~~integrally bonding a base part of~~ a plate body~~,~~ having a thermal conductive side,

a plurality of parallel hollow fluid channels running inside the plate body,

at least one fluid inlet in direct fluid communication with a first subset of the plurality of parallel hollow fluid channels,

at least one fluid outlet in direct fluid communication with a second subset of the plurality of parallel hollow fluid channels, and

a porous thermal conductive structure~~, and a top part of a~~ which is arranged inside the plate body ~~in a manner~~ to ~~form the cold plate according~~fluidly connect the first subset of the plurality of parallel hollow fluid channels to ~~any one of~~

~~claims 1 to 9.~~the second subset of the plurality of parallel hollow fluid channels, and which is in thermal contact with the thermal conductive side of the plate body,

~~15. The method as claimed in claim 14, further comprising integrally molding or printing the porous thermal conductive structure with the base part of the plate body~~wherein the porous thermal conductive structure comprises a plurality of elongate fluid contact surface regions, each elongate fluid contact surface region extending continuously lengthwise along a longitudinal side of a respective fluid channel for more than half a length of the longitudinal side to serve as a fluid interface between the porous thermal conductive structure and an interior volume of the respective hollow fluid channel;

wherein the plate body comprises an inner cavity having a floor surface at the thermal conductive side of the plate body and an opposing ceiling surface with the plurality of parallel hollow fluid channels recessed into the ceiling surface, wherein the porous thermal conductive structure comprises a block structure with a base surface in engagement with the floor surface of the inner cavity and an opposite top surface in engagement with the ceiling surface of the inner cavity, and wherein the plurality of elongate fluid contact surface regions are on the top surface of the porous thermal conductive structure;

wherein the plate body comprises a base part and a top part;

wherein the base part comprises a recessed portion and the floor surface;

wherein the top part comprises the ceiling surface with the plurality of parallel hollow fluid channels recessed into the ceiling surface;

wherein the recessed portion of the base part together with the ceiling surface of the top part form the inner cavity;

~~16. An active thermal control assembly, comprising~~

~~the cold plate according to any one of claims 1 to 13;~~

a heater member coupled to the cold plate; and

one or more fluid control valves coupled to the at least one fluid inlet of the cold plate.

14. The active thermal control assembly as claimed in claim 13, wherein the plurality of parallel hollow fluid channels of the cold plate and the porous thermal conductive structure of the cold plate are configured to cooperate in a manner in which fluid flows into the first subset of the plurality of parallel hollow fluid channels, enters the porous thermal conductive structure through a first subset of the plurality of elongate fluid contact surface regions along respective longitudinal sides of the first subset of the plurality of parallel hollow fluid channels to permeate across respective portions of the porous thermal conductive structure so as to cause a transfer of thermal energy between the fluid and the porous thermal conductive structure, and exits the porous thermal conductive structure through a second subset of the plurality of elongate fluid contact surface regions along respective longitudinal sides of the second subset of the plurality of parallel hollow fluid channels into the second subset of the plurality of parallel hollow fluid channels.

15. The active thermal control assembly as claimed in claim 13, wherein the plurality of parallel hollow fluid channels of the cold plate are arranged in a manner so as to alternate between the first subset of the plurality of parallel hollow fluid channels and the second subset of the plurality of parallel hollow fluid channels.

16. The active thermal control assembly as claimed in claim 13, wherein the base part and the top part are integrally bonded together.

17. The active thermal control assembly as claimed in claim 16, wherein the porous thermal conductive structure is integrally molded or printed with the base part.

18. The active thermal control assembly as claimed in claim 13, wherein the porous thermal conductive structure is integrally bonded to the plate body.

19. The active thermal control assembly as claimed in claim 13, wherein the thermal conductive side of the plate body comprises one or more temperature sensors.