

CLAIMS

1. A shell and tube type heat exchanger comprising:
a shell;
a tube arrangement within said shell, said tube arrangement comprising a flow tube,
wherein said flow tube furcates at a plurality of nodes along its length; and
a tube matrix fluidly coupled to said flow tube.
2. A shell and tube type heat exchanger of claim 1 wherein at a respective node, the flow tube furcates into a plurality of sub-tubes.
3. A shell and tube type heat exchanger of any of the preceding claims wherein said tube arrangement is formed as a tube module.
4. A shell and tube type heat exchanger of claim 3 wherein the heat exchanger comprises a plurality of tube modules.
5. A shell and tube type heat exchanger of claim 4, wherein the plurality of tube modules are arranged about a rotational axis of the shell.
6. A shell and tube type heat exchanger of claim 5 wherein the plurality of tube modules form a generally ring shaped structure.
7. A shell and tube type heat exchanger of claim 6 wherein the ring-shaped structure comprises an aperture defined therethrough and wherein a plug is provided in said aperture.
8. A shell and tube type heat exchanger of any preceding claim when dependent on claim 3, wherein said tube matrix is provided in said module.
9. A shell and tube type heat exchanger of any of the preceding claims wherein the tube matrix comprises a plurality of generally parallel tubes.
10. A shell and tube type heat exchanger of any of the preceding claims wherein at the downstream side of the tube matrix each flow tube consolidates at a plurality of nodes along its length.

11. A shell and tube type heat exchanger of any of the preceding claims wherein the tube matrix is located between and fluidly connected to a furcating tube section or manifold and a consolidating tube section or manifold.
12. A shell and tube type heat exchanger according to claim 11, wherein the furcating tube section is substantially similar in form to the consolidating tube section.
13. A shell and tube type heat exchanger according to any of the preceding claims wherein progressive furcation of the flow tubes into sub-tubes at node points along the length of the flow tube has a fractal or quasi-fractal form.
14. A shell and tube type heat exchanger according to any of the preceding claims, wherein the internal cross-sectional area of the flow tube remains constant or generally constant through a furcation or branching node.
15. A shell and tube type heat exchanger according to any of the preceding claims, wherein the flow tube successively furcates into sub-tubes at nodes which are aligned.
16. A shell and tube type heat exchanger according to claim 15, wherein the respective nodes at which furcation or branching occurs in each sub-tube may be aligned in a common flat plane extending generally perpendicular to the extent of the sub-tubes.
17. A shell and tube type heat exchanger according to claim 15, wherein the respective nodes at which furcation or branching occurs in each sub-tube may be aligned in a curved plane.
18. A shell and tube type heat exchanger according to any of the preceding claims, wherein supporting fins or ribs may be provided at spaced or staggered intervals between adjacent tubes within the matrix.
19. A shell and tube type heat exchanger of any of the preceding claims, wherein a portion of the flow tube arrangement includes a helical tube.
20. A shell and tube type heat exchanger of any of the preceding claims, wherein: the shell is rounded, for example spherical.

21. The shell and tube type heat exchanger of any of the preceding claims wherein the inlet of the shell is in fluid communication with the inner volume of the shell via a diffuser.
22. A shell and tube type heat exchanger of any of preceding claims wherein the shell comprises a thermal liner which substantially conforms to an inner surface of the shell.
23. A shell and tube type heat exchanger of any of the preceding claims, wherein the flow tube has substantially teardrop-like cross section between nodes.
24. A shell and tube type heat exchanger of any of the preceding claims, wherein one or more baffles are provided within said shell providing support to the flow tube and/or tube arrangement.
25. A shell and tube type heat exchanger of any of the preceding claims, wherein the matrix has a curved or circular perimeter.
26. A shell and tube type heat exchanger of any of the preceding claims, wherein the matrix includes a shell adjoining its perimeter.
27. A shell and tube type heat exchanger of any of the preceding claims, wherein the flow tube and matrix are integrally formed, for example, using an additive manufacturing technique.
28. A method of operating a shell and tube type heat exchanger according to any of claims 1 to 27, including the steps of:
supplying a heatant or coolant to the shell to fill said shell; and
supplying a fluid to the tube arrangement in said shell.
29. A method of operating a shell and tube type heat exchanger according to claim 29, wherein a bleed flow of the heatant or coolant may be supplied to a thermal liner.
30. An engine or vehicle comprising a shell and tube type heat exchanger according to any of claims 1 to 27.