CLAIMS

1. A shell and tube type heat exchanger comprising:

a shell;

a tube arrangement within the shell, the tube arrangement comprising a flow tube, in which the flow tube furcates at a plurality of nodes along its length, and in which the tube arrangement is formed as a tube module and the tube module comprises a furcating tube section; and

a tube matrix fluidly coupled to the flow tube;

in which at a respective node, the flow tube furcates into a plurality of sub-tubes, the flow tube successively furcates into sub-tubes at nodes which are aligned, and in which the respective nodes at which furcation occurs in each sub-tube are aligned in a common flat or curved plane extending generally perpendicular to the extent of the sub-tubes; and

in which the tube module inlet and tube module outlet are aligned on an axis generally parallel with the longitudinal axis of the shell.

2. A shell and tube type heat exchanger according to Claim 1, in which the heat exchanger comprises a plurality of tube modules and in which the tube matrix is provided in the module.

3. A shell and tube type heat exchanger according to Claim 2, in which the plurality of tube modules are arranged about a rotational axis of the shell and may form a generally ring shaped structure; and in which the ring-shaped structure may comprise an aperture defined therethrough and a plug is provided in the aperture.

4. A shell and tube type heat exchanger according to Claim 1, 2 or 3, in which the tube matrix comprises a plurality of generally parallel tubes.

5. A shell and tube type heat exchanger according to any preceding claim, in which at the downstream side of the tube matrix each flow tube consolidates at a plurality of nodes along its length.

6. A shell and tube type heat exchanger according to any preceding claim, in which the tube matrix is located between and fluidly connected to a furcating tube section or manifold and a consolidating tube section or manifold.

7. A shell and tube type heat exchanger according to any preceding claim, in which 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.

8. A shell and tube type heat exchanger according to any preceding claim, in which the internal cross-sectional area of the flow tube remains constant or generally constant through a furcation or branching node.

9. A shell and tube type heat exchanger according to any preceding claim, in which a portion of the flow tube arrangement includes a helical tube.

10. A shell and tube type heat exchanger according to any preceding claim, in which the shell is spherical.

11. A shell and tube type heat exchanger according to any preceding claim, in which the inlet of the shell is in fluid communication with the inner volume of the shell via a diffuser and in which the shell may comprise a thermal liner which substantially conforms to an inner surface of the shell.

12. A shell and tube type heat exchanger according to any preceding claim, in which the flow tube has substantially teardrop-like cross section between nodes.

13. A shell and tube type heat exchanger according to any preceding claim, in which the flow tube and matrix are integrally formed, for example, using an additive manufacturing technique.

14. A method of operating a shell and tube type heat exchanger according to any of Claims 1 to 13, including the steps of:

supplying a heatant or coolant to the shell to fill the shell; and

supplying a fluid to the tube arrangement in the shell;

in which a bleed flow of the heatant or coolant may be supplied to a thermal liner.

15. An engine or vehicle comprising a shell and tube type heat exchanger according to any of Claims 1 to 13.