Claims

1. A server rack cooling arrangement, comprising:

a server rack enclosure which defines a single undivided interior volume of space and which is configured to be sealable to isolate the interior volume of space;

two or more open-frame-server-units which are disposed within the interior volume of space and which are arranged in a multi-level arrangement, wherein heat-producing-electronic-components of respective open-frame-server-units are exposed to environmental conditions of the interior volume of space;

a central condenser disposed within the interior volume of space and towards a rear of the server rack enclosure;

a coolant reservoir disposed with respect to the central condenser within the interior volume of space in a manner so as to collect condensate from the central condenser;

at least one nozzle in fluid communication with the coolant reservoir, wherein the at least one nozzle is configured to deliver coolant droplets into the interior volume of space for impingement on the heat-producing-electronic-components; and

at least one fan configured to generate an air-vapour flow within the interior volume of space and through the two or more open-frame-server-units from a front of the server rack enclosure to the rear of the server rack enclosure in a manner so as to carry coolant vapour generated from impingement of the coolant droplets on the heat-producing-electronic-components to the central condenser.

2. The arrangement as claimed in claim 1, wherein the at least one nozzle comprises a first nozzle and a second nozzle.

3. The arrangement as claimed in claim 2, wherein the first nozzle is oriented with a spray axis perpendicular to a surface of a first heat-producing-electronic-component, and/or wherein the first nozzle is oriented with a spray axis perpendicular to the air-vapour flow.

4. The arrangement as claimed in claim 2 or 3, wherein the second nozzle is oriented with a spray axis inclined or parallel with respect to the air-vapour flow, and/or wherein

the second nozzle is oriented with a spray axis inclined or parallel to a surface of a second heat-producing-electronic-component.

5. The arrangement as claimed in any one of claims 2 to 4, wherein the first nozzle comprises a direct spray impingement nozzle and the second nozzle comprises a mist spray nozzle.

6. The arrangement as claimed in any one of claims 2 to 5, wherein the first nozzle is disposed within a first of the two or more open-frame-server-units, and the second nozzle is disposed within a second of the two or more open-frame-server-units.

7. The arrangement as claimed in any one of claims 1 to 6, further comprising a return duct connecting the rear of the server rack enclosure to the front of the server rack enclosure in a manner so as to recirculate air-vapour mixture which has passed through the central condenser back into the interior volume of space.

8. The arrangement as claimed in claim 7, further comprising at least one circulation fan coupled along the return duct.

9. The arrangement as claimed in any one of claims 1 to 8, further comprising an air-to-liquid heat exchanger coupled to the central condenser.

10. The arrangement as claimed in any one of claims 1 to 9, further comprising a liquid-to-liquid heat exchanger connected between the coolant reservoir and the at least one nozzle.

11. The arrangement as claimed in claim 10 in combination with claim 9, wherein the air-to-liquid heat exchanger is also coupled to the liquid-to-liquid heat exchanger.

12. The arrangement as claimed in any one of claims 1 to 11, wherein each of the two or more open-frame-server-units comprises a first opening directed towards the front of the server rack enclosure and a second opening directed towards the rear of the server rack enclosure.

13. The arrangement as claimed in any one of claims 1 to 12, wherein the server rack enclosure comprises at least one pressure relief valve configured to release air-vapour mixture from the interior volume of space of the server rack enclosure.

14. The arrangement as claimed in claim 13, further comprising a vapour recovery tank fluidly coupled to the pressure relief valve.

15. The arrangement as claimed in claim 14, wherein the vapour recovery tank contains a cooling medium, and wherein the vapour recovery tank comprises

a cooling coil immersed in the cooling medium contained inside the vapour recovery tank,

an inlet conduit extending from the pressure relief valve into the cooling medium contained inside the vapour recovery tank,

a fluid outlet at the bottom of the vapour recovery tank, and

an air vent at the top of the vapour recovery tank.

16. A method of operating the server rack cooling arrangement according to any one of claims 1 to 15 to regulate a pressure of the interior volume of space enclosed by the server rack enclosure, the method comprising:

varying a coolant flow rate through the at least one nozzle in a manner so as to vary a rate of vaporization of the coolant within the server rack enclosure with respect to a rate of condensation of the coolant vapour at the central condenser.

17. A method of operating the server rack cooling arrangement according to any one of claims 1 to 15 to regulate a pressure of the interior volume of space enclosed by the server rack enclosure, the method comprising:

varying a temperature of a coolant supply to the at least one nozzle in a manner so as to vary a rate of vaporization of the coolant within the server rack enclosure with respect to a rate of condensation of the coolant vapour at the central condenser.