CLAIMS

1. A phase change material (PCM) heat battery (600) comprising:

a PCM enclosure (603) capable of holding PCM;

PCM located in the PCM enclosure (603);

an electronic control system for controlling the PCM heat battery (600);

at least one or a plurality of heating devices (611) located in the PCM heat battery (600);

wherein the at least one or plurality of heating devices (611) are capable of heating and/or charging the PCM;

a plurality of sensors (610) located in different vertical locations of the PCM heat battery (600) capable of monitoring the physical characteristics and/or temperature of the PCM and other parts of the heat battery (600);

wherein the at least one or plurality of heating devices (611) are located within the PCM enclosure (603) and therefore in direct contact and immersed in the PCM;

at least one or a plurality of thermal conductors are substantially vertically inserted into the heat battery case (601) and which are immersed or partially immersed into the PCM;

the at least one or a plurality of thermal conductors are substantially vertically inserted into a heat exchanger (604) and extend into the PCM;

and

wherein the electronic control system controls the physical characteristics and/or temperature of the PCM by applying heat directly to the PCM through the at least one or plurality of heating devices (611).

2. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there are heating devices (611) located at different vertical levels within the PCM enclosure (603).

3. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there is a battery controller along with a battery charge status signal and a battery charging control signal.

4. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there is an overheat safety cut-off thermostat S0 and a range of temperature sensors (610) distributed throughout different vertical locations of the heat battery (600) to obtain a temperature across the whole working medium and the PCM and/or heat exchanger (604).

5. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein the heating device (611) is located in the upper half of the PCM enclosure (603) and immersed in the PCM.

6. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein the electronics control system comprises a battery controller allowing the heating device (611) to be completely controlled and/or switched on and/or off when required and wherein the amount of power and/or heating being delivered by the heating device (611) is also controlled depending on the measurement of sensors (610) located in the PCM enclosure (603) and PCM.

7. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there is a plurality of electric heating devices (611) located at different heights within the PCM enclosure (603) and/or PCM.

8. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there is a first heating device located in the upper half of the PCM enclosure and a second heating device located in the lower half of the PCM enclosure (603), both the first and second heating device being immersed in PCM.

9. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein the heating device (611) is a tubular elongate heating device immersed in the PCM and integrated into a bulkhead connection ring the heating device to transfer heat to the PCM via a large surface area and provide instant heating to the PCM.

10. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there are thermal plates which are substantially vertically oriented and extend into or at least partially into a heat exchanger core (e.g. a heat exchanger finned core) and extend into a heated zone of the heat battery (600) below or substantially below a heat exchanger (604).

11. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there is at least one or a plurality of heating devices (611) which are embedded into a heat exchanger core (620) which comprises conducting elements e.g. conducting tubes such as copper tubes.

12. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there is at least one or a plurality of heating devices (611) which are embedded and/or located in a housing containing material which is able to efficiently transfer and/or spread heat.

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13. A phase change material (PCM) heat battery (600) according to any preceding claim, wherein there is at least one or plurality of heating devices located externally to the PCM enclosure and internal to an outer casing for the PCM heat battery.

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14. A phase change material (PCM) heat battery (1200) according to claim 1, wherein there is at least one or a plurality of removable cartridge heating devices (1213) located within an internally immersed conductive block wherein the conductive block is within the PCM enclosure and below a heat exchanger.

15. A phase change material (PCM) heat battery (1400) according to any preceding claim, wherein the heating devices are in the form of heater element networks (1420).

16. A method of applying thermal energy to a phase change material (PCM) heat battery (600) comprising:

providing a PCM enclosure (603) capable of holding PCM;

providing PCM located in the enclosure (603);

providing an electronics control system for controlling the PCM heat battery (600);

providing at least one or a plurality of heating devices (611) located in the PCM enclosure (603) and immersed in the PCM;

wherein the at least one or plurality of heating devices (611) are capable of heating and/or charging the PCM;

providing a plurality of sensors (610) located in different vertical locations of the PCM heat battery (600) capable of monitoring the physical characteristics and/or temperature of the PCM and other parts of the heat battery (600);

wherein the at least one or plurality of heating devices (611) are located within the PCM enclosure (603) and therefore in direct contact and immersed in the PCM;

at least one or a plurality of thermal conductors substantially vertically inserted into the heat battery case (601) and which are immersed or partially immersed into the PCM;

the at least one or a plurality of thermal conductors are substantially vertically inserted into a heat exchanger (604) and extend into the PCM;

and

wherein the electronic control system controls the physical characteristics and/or temperature of the PCM by applying heat through the at least one or plurality of heating devices.