

CLAIMS

1. A refrigeration system for compact equipment, ~~such as the equipment~~ comprising electronic circuits and internally provided with a heat source (F) to be cooled, said systems comprising:

a) a heat dissipation device (10) mounted in the equipment and including a heat absorbing portion (11), absorbing heat from the heat source (F), and

- a heat dissipation portion (12) disposed so as to release the heat absorbed from the heat source (F) to an environment external to the equipment (E), ~~said systems being characterized in that wherein~~

b) the heat dissipation portion (11) is accessible through the exterior of the equipment (E) and in that it further comprises an auxiliary refrigeration circuit (CA), external to the equipment (E) and having: a heat absorbing means (20) to be selectively coupled to the heat dissipation portion (12), to receive therefrom, by conduction, at least part of the heat received from the heat source (F) and to be dissipated by the heat dissipation portion (12); and a heat dissipation means (30) to release the heat to the environment external to the equipment (E),

c) the heat dissipation device (10) is defined by any system of the type: heat conduction in a solid medium, heat-pipe, thermosiphon, circulating fluid pumping and mechanical vapor compression, in order to transfer heat from the heat absorbing portion (11) to the heat dissipation portion (12),

d) the heat dissipation portion (12) defines at least one heat exchange housing (40) formed, at least in part, by a heat exchange wall (40a), whilst the heat

absorbing means (20) comprises at least one plug element (50) formed, at least in part, by an outer heat exchange surface (50a), said plug element (50) being tightly removably fitted in the interior of a respective heat exchange housing (40), so as to provide the coupling of the heat absorbing means (20) to the heat dissipation portion (12) and to allow heat exchange, by conduction, to occur between the heat exchange wall (40a) and the outer heat exchange surface (50a) of said parts,

e) the heat exchange housing (40) is an elongated hole (41) provided in a body (C) made of a high thermal conductivity material and which is thermally connected to the heat dissipation portion (12), the heat exchange wall (40a) of said elongated hole (41) tightly surrounding and contacting the heat exchange surface (50a) of the plug element (50) when the latter is fitted in the interior of the elongated hole (41),

f) the auxiliary refrigeration circuit (CA) is provided in an interior of a compact casing (CC),

g) the auxiliary refrigeration circuit (CA) is a refrigeration circuit containing a working fluid to thermally connect the heat absorbing means (20) to the heat dissipation means (30) and the auxiliary refrigeration circuit (CA) is a refrigeration circuit by mechanical compression of a refrigerant fluid, including: a compressor (70); a condenser (31) defining the heat dissipation means (30), receiving refrigerant fluid from the compressor (70) and releasing it to an expansion device (80) and, subsequently, to an evaporator (21) defined by the plug element (50) of the heat absorbing means (20),

h) the plug element (50) is defined by a refrigerant fluid tube (51) having an inlet end (51a) and an outlet end (51b) and longitudinally and internally comprises a plurality of peripheral channels (53) and a central channel (54), a first end (53a) of the peripheral channels (53) being connected to the inlet end (51a) of the refrigerant fluid tube (51), whilst a second end (53b) of the peripheral channels (53) is open to a first end (54a) of the central channel (54), a second end (54b) of the central channel (54) being open to the outlet end (51b) of the refrigerant fluid tube (51).

2. The refrigeration system, as set forth in claim 1, characterized in that the heat dissipated by the heat dissipation portion (12) and not absorbed by the heat absorbing means (20), is dissipated, to the environment external to the equipment (E), by at least one of the thermal energy transfer modes defined by radiation, by natural convection and by forced air-flow convection.

3. The refrigeration system, as set forth in claim 2, characterized in that it comprises a fan (V) provided internally to the equipment (E) and which dissipates the heat not absorbed by the heat absorbing means (20), by forced air-flow convection.

4. The refrigeration system, as set forth in any of claims 1, 2 or 3, characterized in that the equipment (E) comprises at least one window (1) open outwardly

from the latter, with the heat dissipation portion (12) incorporating fins (12a) disposed adjacent to said window (1) of the equipment (E).

~~5. The refrigeration system, as set forth in any of claims 1 and 2, characterized in that the heat dissipation device (10) is defined by any refrigeration system of the type: heat conduction in a solid medium, heat-pipe, thermosiphon, circulating fluid pumping and mechanical vapor compression, in order to transfer heat from the heat absorbing portion (11) to the heat dissipation portion (12).~~

~~6. The refrigeration system, as set forth in claim 5, characterized in that one of the parts of heat dissipation portion (12) and heat absorbing means (20) defines at least one heat exchange housing (40) formed, at least in part, by a heat exchange wall (40a), whilst the other of said parts comprises at least one plug element (50) formed, at least in part, by an outer heat exchange surface (50a), said plug element (50) being tightly removably fitted in the interior of a respective heat exchange housing (40), so as to provide the coupling of the heat absorbing means (20) to the heat dissipation portion (12) and to allow heat exchange, by conduction, to occur between the heat exchange wall (40a) and the outer heat exchange surface (50a) of said parts.~~

~~7. The refrigeration system, as set forth in claim 6, characterized in that the heat exchange housing (40) is an elongated hole (41) provided in a body (C) made of a high thermal conductivity material and which is thermally connected to one of the parts of heat dissipation portion (12) and heat absorbing means (20), the heat exchange wall (40a) of said elongated hole (41) tightly surrounding and contacting the heat exchange surface (50a) of the plug element (50) when the latter is fitted in the interior of the elongated hole (41).~~

~~8. The refrigeration system, as set forth in claim 7, characterized in that the auxiliary refrigeration circuit (CA) is a refrigeration circuit containing a working fluid to thermally connect the heat absorbing means (20) to the heat dissipation means (30).~~

~~9. The refrigeration system, as set forth in claim 8, characterized in that the auxiliary refrigeration circuit (CA) is a refrigeration circuit by mechanical compression of a refrigerant fluid, including: a compressor (70); a condenser (31) defining the heat dissipation means (30), receiving refrigerant fluid from the compressor (70) and releasing it to an expansion device (80) and, subsequently, to an evaporator (21) defined by the plug element (50) of the heat absorbing means (20).~~

~~10. The refrigeration system, as set forth in any of claims 8 and 9, characterized in that the plug element (50) is defined by a refrigerant fluid tube (51) having an inlet end (51a) and an outlet end (51b) and longitudinally and internally comprises a plurality of peripheral channels (53) and a central channel (54), a first end (53a) of the peripheral channels (53) being connected to the inlet end (51a) of the refrigerant fluid tube (51), whilst a second end (53b) of the peripheral channels (53) is open to a first end (54a) of the central channel (54), a second end (54b) of the central channel (54) being open to the outlet end (51b) of the refrigerant fluid tube (51).~~

~~115. The refrigeration system, as set forth in claim 10, characterized in that the first end (53a) of the peripheral channels (53) is open to the interior of a tubular head (55) attached to the body (C) and presenting a nozzle (55a) which defines the inlet end (51a) of the refrigerant fluid tube (51).~~

~~126. The refrigeration system, as set forth in claim 511, characterized in that the second end (54b) of the central channel (54) projects through the tubular head~~

(55), outwardly from the latter.

~~137~~. The refrigeration system, as set forth in any of claims ~~10~~, ~~511~~ or ~~126~~, characterized in that the second end (53b) of the peripheral channels (53) is open to the interior of a portion of tubular casing (56), with a closed end (56a) and an open end (56b) attached against the body (C).

~~148~~. The refrigeration system, as set forth in claim ~~713~~, characterized in that the tubular casing (56) is surrounded by an end portion of the body (C).

~~915~~. The refrigeration system, as set forth in claim ~~814~~, characterized in that one of the parts of tubular casing (56) and central channel (54) carries an axial tubular hub (57) having an end (57a) connected to the first end (54a) of the central channel (54) and a second end (57b) provided with a radial opening (57c) turned to the interior of the tubular casing (56).

~~1610~~. The refrigeration system, as set forth in any of claim ~~1~~ or any of claims ~~67~~ to ~~159~~, characterized in that the body (C), provided with the elongated hole (41) which defines the heat exchange housing (40) is thermally connected to the heat dissipation portion (12) through at least one heat conduct (13) containing circulating fluid.

~~117~~. The refrigeration system, as set forth in claim ~~511~~, characterized in that the heat dissipation device (10) is defined by a primary refrigeration circuit comprising a primary evaporator (11a) which defines the heat absorbing portion (11), and a primary condenser (12b) which defines the heat dissipation portion (12) and which is thermally connected to the heat absorbing portion (11), by at least one heat conduct (13) which receives, by an inlet end, a circulating fluid, which is vaporized in the primary evaporator (Ha) and which releases, in an outlet end and back to the primary evaporator (11a), the circulating fluid.

~~128~~. The refrigeration system, as set forth in claim ~~117~~, characterized in that the body (C) presents a pair of

cradles (C1), each presenting a thermal contact surface against which is seated and retained a corresponding portion of the outer surface of the heat conduct (13), said cradles (C1) being spaced from each other and from the elongated hole (41) by portions of the body (C).

139. The refrigeration system, as set forth in claim 128, characterized in that the cradles (C1) are defined by respective elongated channels (C1a).