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(54) SELF-SUPPORTING COOLING MODULE

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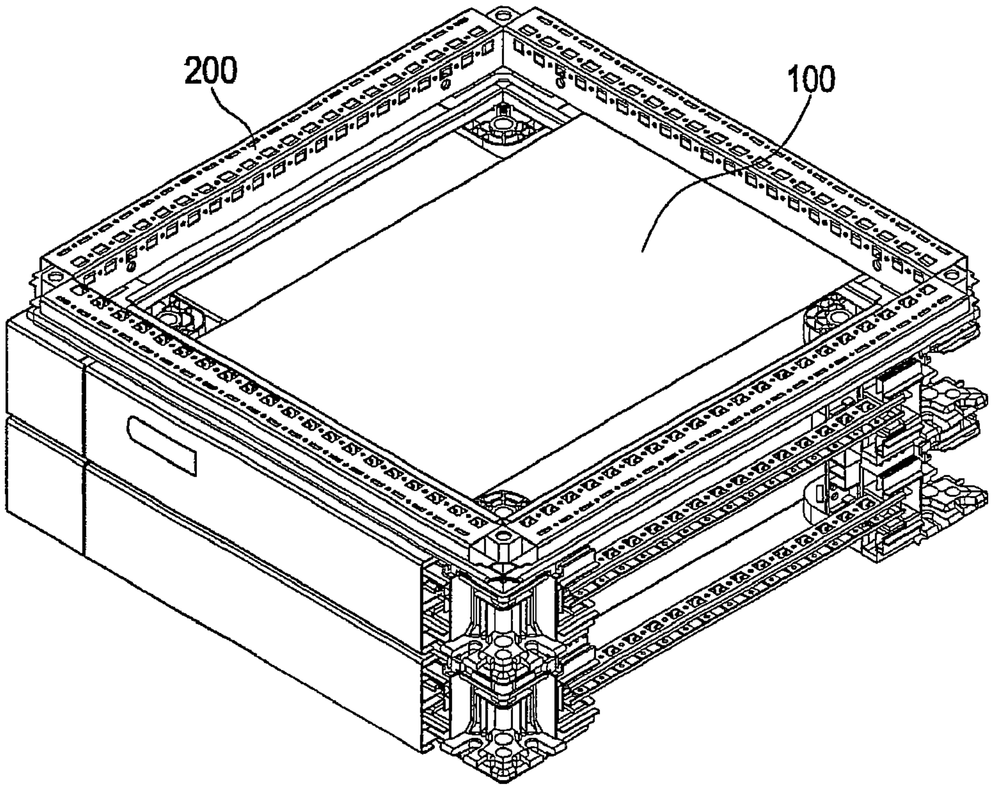
(57) **ABSTRACT**

A self-supporting cooling module, comprising a self-supporting cooling module body which is made of foamed resin material, a reference plane being defined in said cooling module body, wherein components are located in said cooling module body in a first operating position with respect to the reference plane in which all components operably interact, and a plurality of components to be cooled or executing a cooling action, said components executing a cooling action include at least one heat exchanger, characterized in that said components are introduced into said cooling module body such that they operably interact also in a second operating position which, with respect to said first operating position, is rotated by 180° around an axis lying in said reference plane.



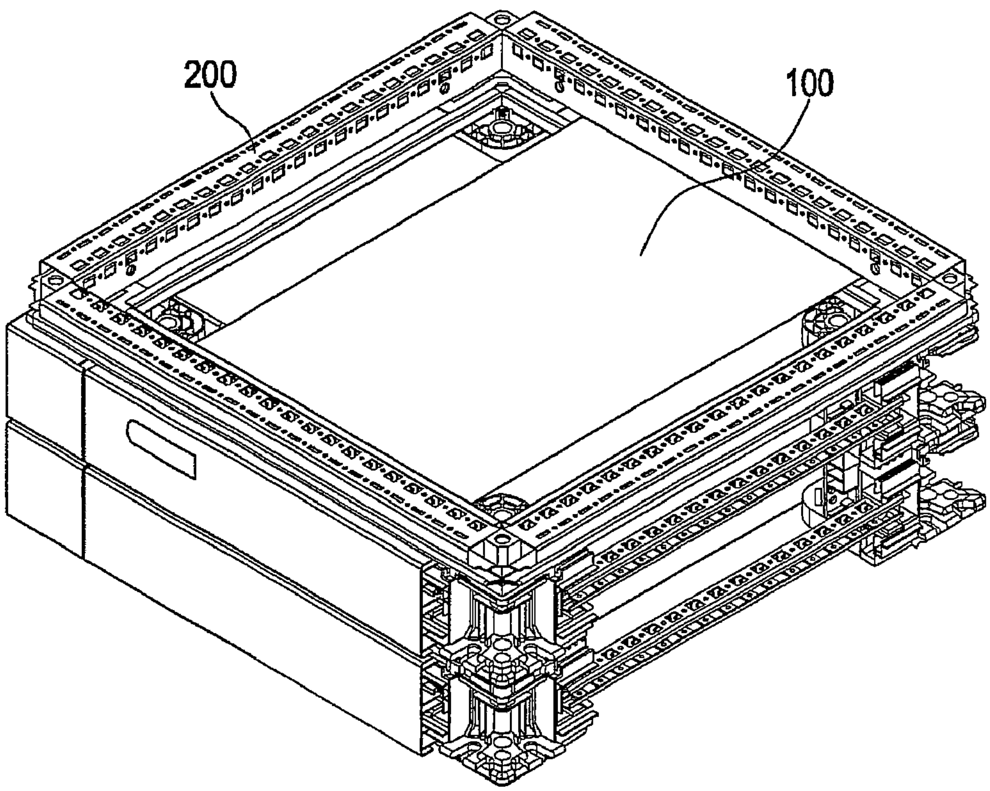


Fig. 1

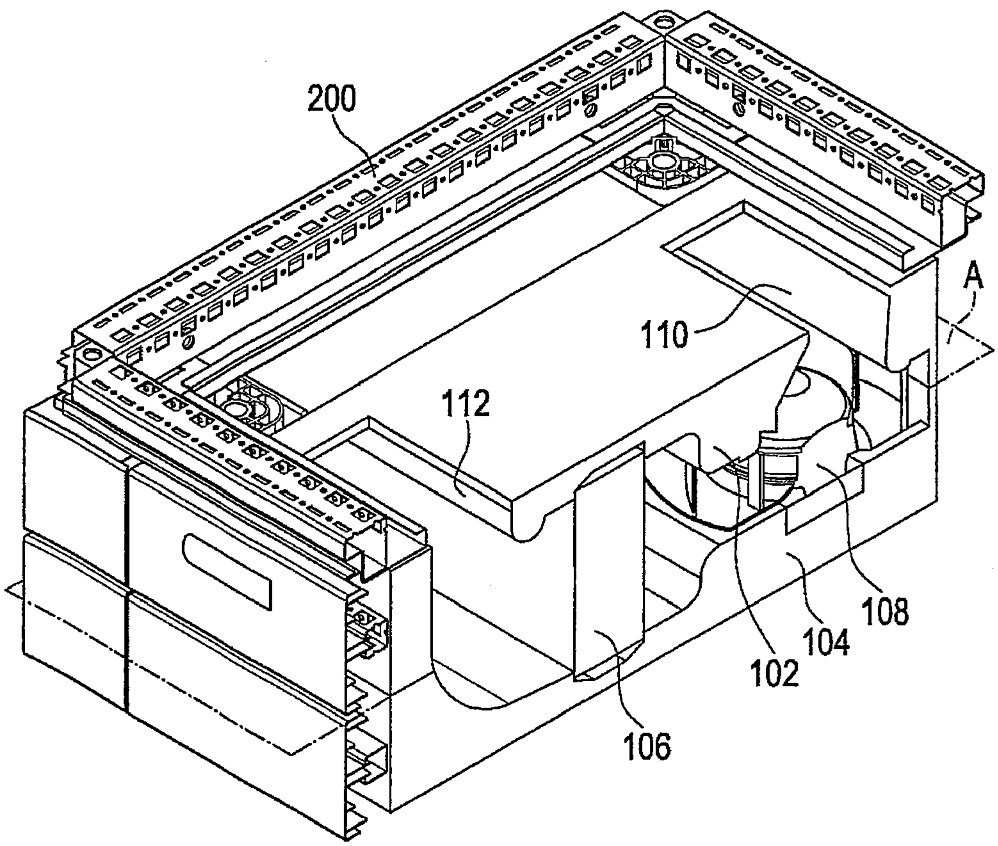


Fig. 2

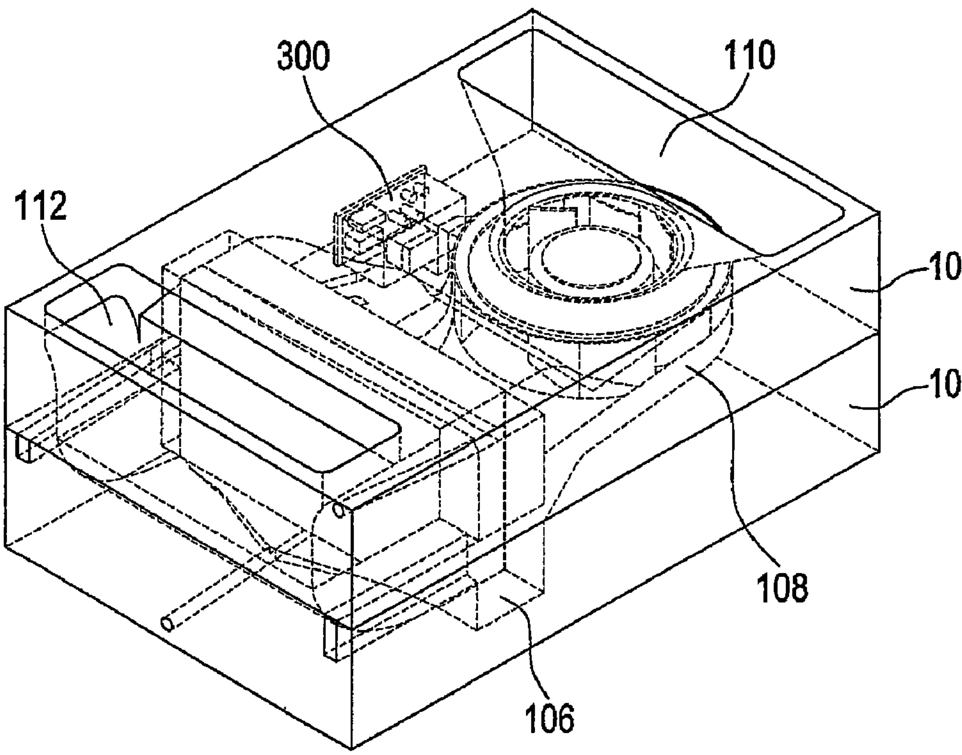


Fig. 3

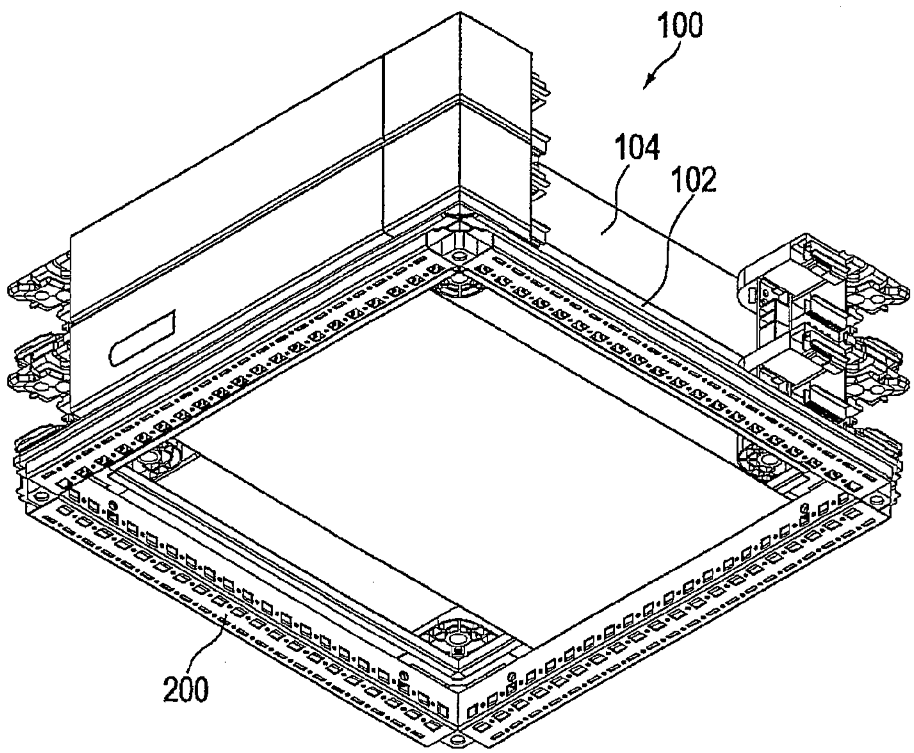


Fig. 4

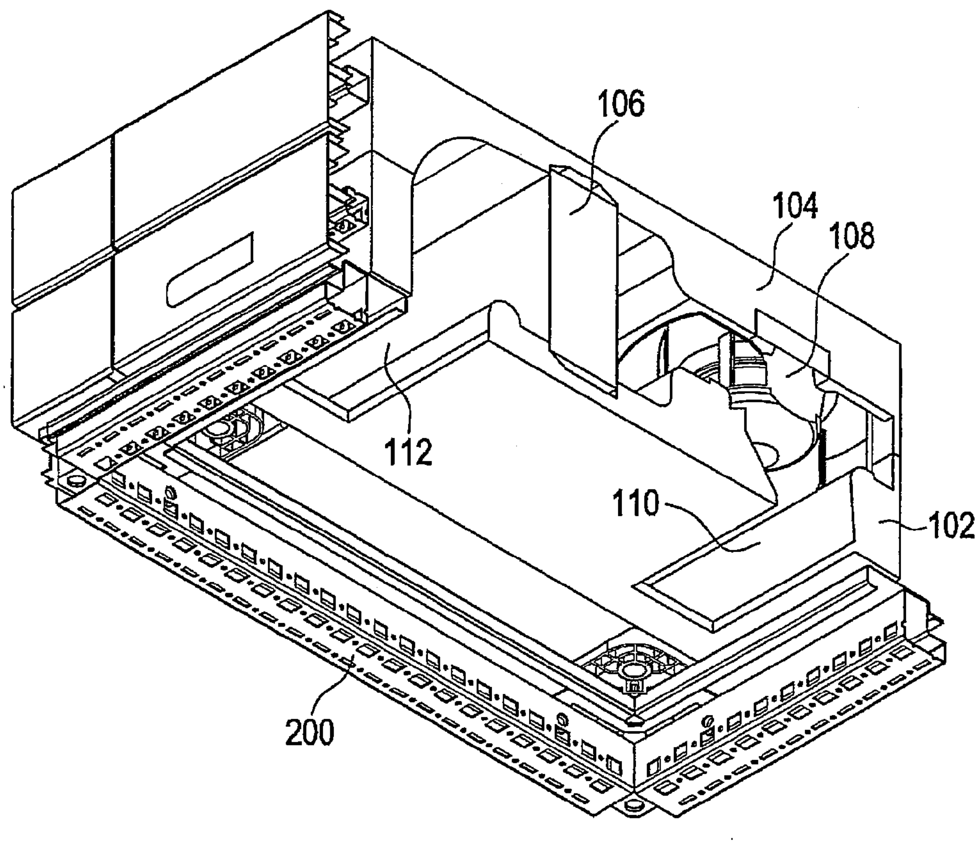


Fig. 5

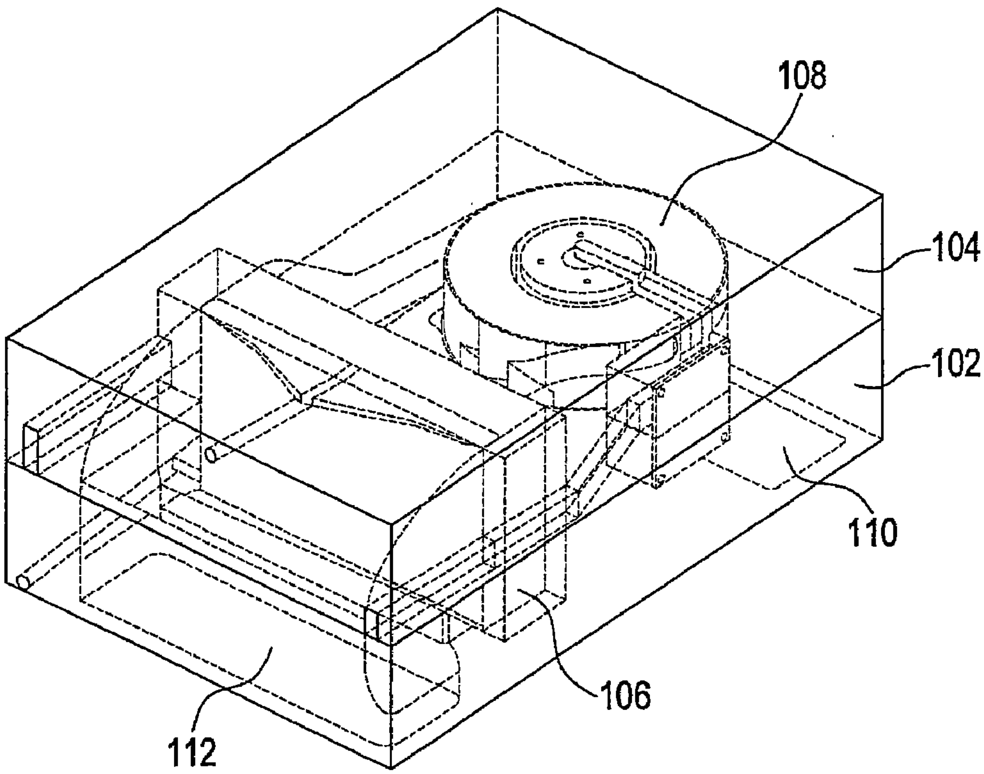


Fig. 6

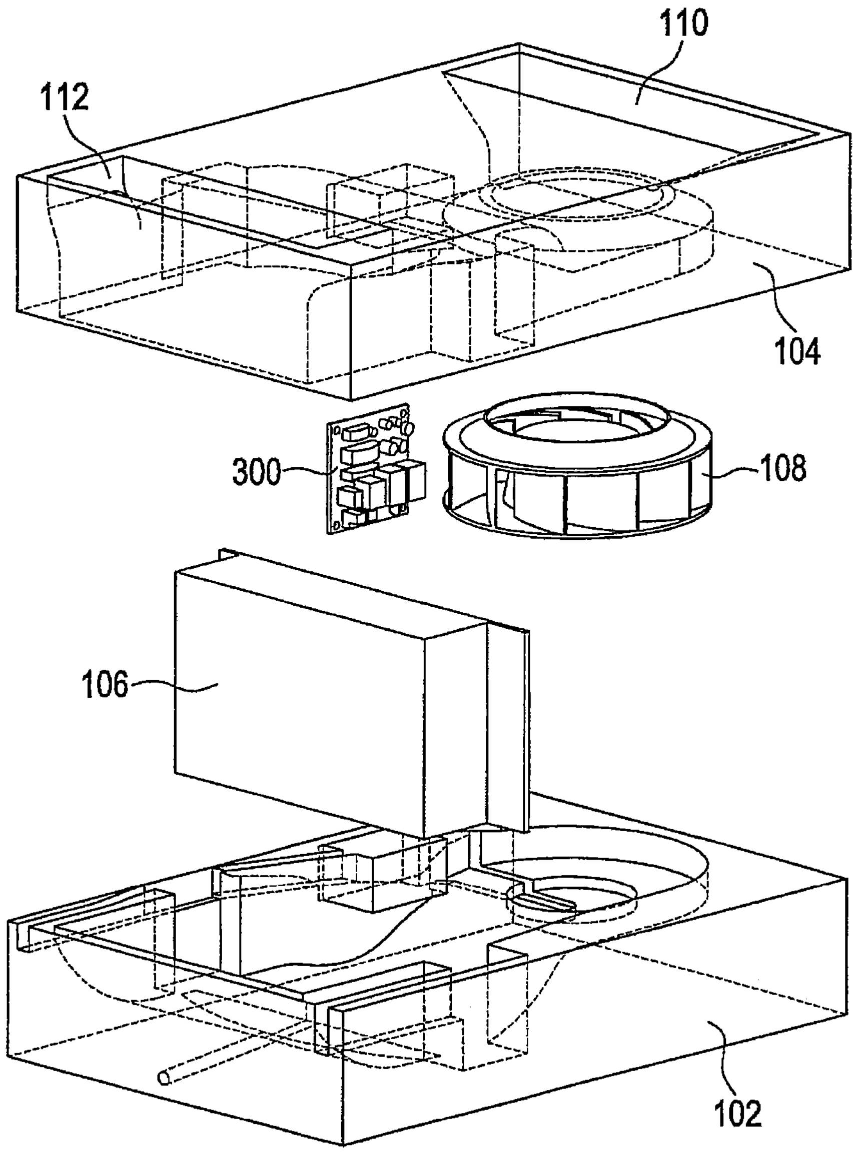


Fig. 7

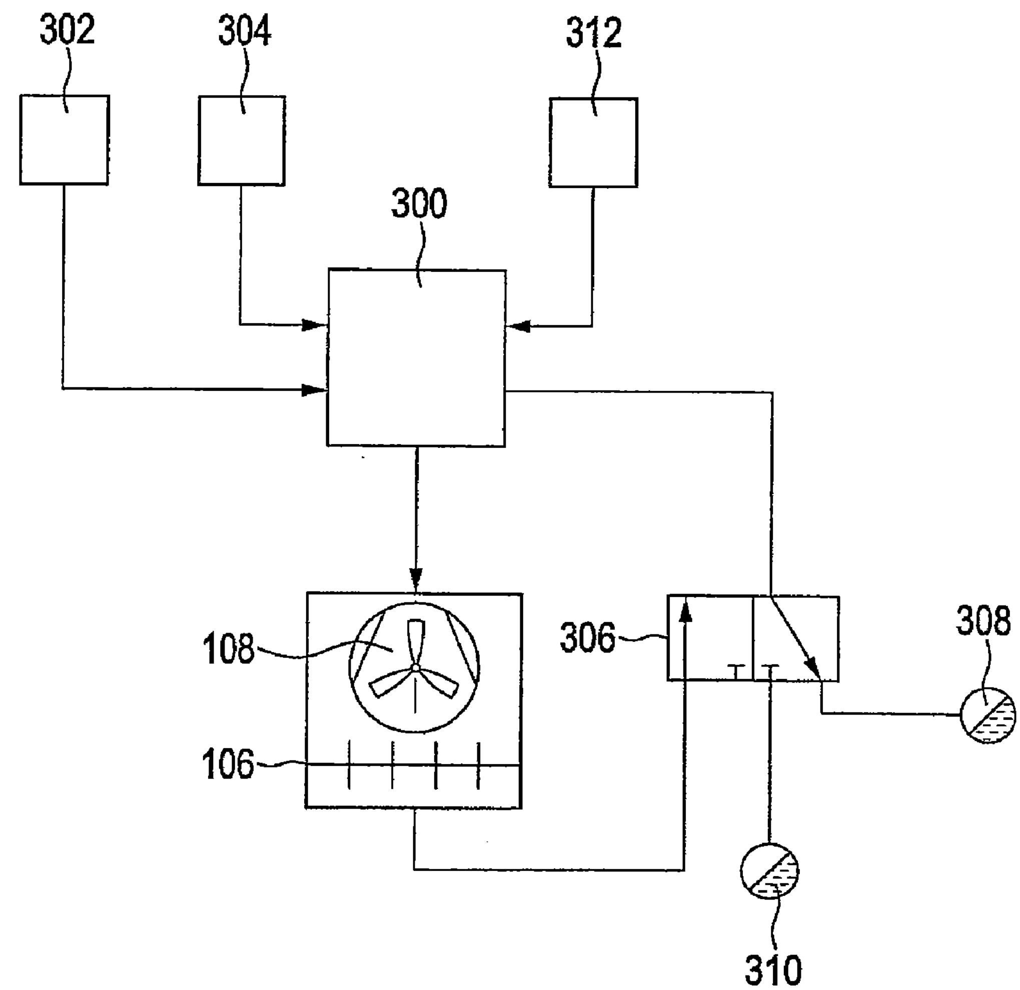


Fig. 8

SELF-SUPPORTING COOLING MODULE

BACKGROUND OF THE INVENTION

[0001] The invention relates to a self-supporting cooling module, comprising a self-supporting cooling module body which is made of foamed resin material, a reference plane being defined in said cooling module body, wherein components are located in said cooling module body in a first operating position with respect to the reference plane in which all components operably interact, and comprising a plurality of components to be cooled or executing a cooling action, said components executing a cooling action including at least one heat exchanger.

[0002] Such a self-supporting cooling module is known from DE 10 2004 032 920 A1. Expanding polypropylene (EPP) is proposed as a foamed resin material which comprises excellent strength characteristics so that it can reliably hold the components. The cooling module body consists of two cooperating shells between which the components are arranged, wherein the shells fixes them in a desired functional position. It is further provided to form a drain pan in the lower one of the two shells in which humidity may accumulate which precipitates possibly at several components of the cooling module.

[0003] A similar cooling module is described in EP 0 547 211 B2 which also uses a double-shell cooling module body made of expanded polypropylene. This cooling module is to be used in an optical device or in a device for analytic chemistry, for example liquid chromatographs.

SUMMARY OF THE INVENTION

[0004] It is the object of the present invention to provide a self-supporting cooling module which may be flexibly used in different mounting situations and which displays its full functionality. In particular, it should operate reliably even under harsh operating conditions.

[0005] This object is solved, according to the invention, by a self-supporting cooling module of the type mentioned in the introductory that the components are introduced into the cooling module body such that they operably the interact also in a second operating position which, with respect to said first operating position, is rotated by 180° around an axis lying in said reference plane.

[0006] According to a preferred embodiment of the invention, the cooling module body is formed as a double-shell wherein the interface between the two shells is parallel to or within said reference plane.

[0007] Preferably, said heat exchanger comprises a condensate drain discharging condensate in a first direction in said first operating position and discharging condensate in a second direction in said second operating position. Therefore, if the cooling module is to be installed in its operating position rotated by 180°, only the respective condensate drain must be closed, so that the device is again functioning and operates failure safe.

[0008] Advantageously, the condensate drain is a two-way-drain which may in particular be configured as being valve-controlled.

[0009] It is appropriate to provide control means which drive those components executing a cooling action in response to signals which are issued to the control means by a least one temperature sensor and/or at least one humidity sensor.

[0010] If such control means are provided, it is further reasonable to provide a position sensor, said control means controlling the valve of the two-way-drain in response to the signals received from the position sensor to discharge the condensate corresponding to the detected position of the cooling module body in the first direction or in the second direction.

[0011] As a resin material for the cooling module according to the invention, expanded polypropylene should be used.

[0012] It is also advantageous to snap the shells of the cooling module body into another in the mounted position, so that no additional fixing devices, such as for example retaining belts are necessary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The invention will be explained below with reference to the accompanying drawings. It is shown in:

[0014] FIG. **1** a cooling module according to the present invention mounted inside a socket of a chassis;

[0015] FIG. **2** a sectional view of the arrangement of FIG. **1**;

[0016] FIG. **3** a perspective view of the cooling module body with components arranged therein;

[0017] FIG. **4** a cooling module according to the present invention mounted in a roof of a chassis;

[0018] FIG. **5** a sectional view of the arrangement of FIG. **4**;

[0019] FIG. **6** a perspective view of the cooling module body with components arranged therein;

[0020] FIG. **7** an overall view of the self-supporting cooling module according to the present invention in an exploded view; and

[0021] FIG. **8** a diagrammatic circuit scheme for controlling the cooling module according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] FIG. **1** illustrates a self-supporting cooling module **100** according to an embodiment of the present invention in a first operating position, mounted in a socket within a chassis **200**. Details of cooling module **100** may be better recognized in the sectional view of FIG. **2**. Cooling module **100** comprises a cooling module body formed by two shells **102**, **104** which are joined in a reference plane A, for example by snap locks, so that no additional fixing devices are necessary. Components of the cooling module according to the invention are arranged in respective recesses formed in shells **102**, **104**, for example a heat exchanger **106** and a fan **108** which may be configured as a radial fan. The shaping of shells **102**, **104** is such that components **106**, **108** are retained failure-proof in a first operating position wherein necessary ventilation ducts are also formed by shaping. In particular, an air inlet **110** is provided close to the fan, furthermore an air outlet **112** for air cooled by heat exchanger **106**.

[0023] Arrangement of the components within cooling module body **102**, **104** may be recognized from the perspective explosion view according to FIG. **3**. Air to be cooled reaches a fan **108** via air inlet **110** which fan directs the air to heat exchanger **106**. Cooled air is discharged from cooling module body **102**, **104** via air outlet **112**. Control means **300** are provided for driving heat exchanger **106** and fan **104**.

[0024] FIG. **4** shows the cooling module according to the present invention mounted in a roof within a chassis **200**. Here, the two-part configuration comprising shells **102**, **104** can be clearly recognized. It is clear that in this second operating position the position of cooling module **100** is rotated by

180° with respect to the illustration of FIG. **1**, wherein rotation is made around an axis line in reference plane A (FIG. **2**). Correspondingly, FIG. **5** shows the reversed arrangement of heat exchanger **106** and fan **108** which operate failure-proof also in this second operating position. Air inlet **110** as well as air outlet **112** are oriented downwardly in the mounted position.

[0025] FIG. **6** shows a perspective view in a ghosted representation which represents very clearly the reversing with respect to FIG. **3**. Air sucked in by fan **108** via air inlet **110** is cooled by heat exchanger **106** and exits via air outlet **112**. FIG. **7** shows a cooling module according to the present invention in an exploded illustration. Components, such as heat exchanger **106**, fan **108** and control means **300**, are inserted into shell **102** and retained therein. Shell **104** which is to be put onto shell **102** includes air inlet **110** and air outlet **112** and is shaped such that it also fixedly holds components **106**, **108**, **300**.

[0026] FIG. **8** shows an example of a circuit diagram showing the functionality of control means **300**. Appropriately mounted sensors, for example a temperature sensor **302** and a humidity sensor **304**, supply signals to control means **300** which evaluates them and drives fan **108** and heat exchanger **106** in response thereto. Condensate forming at heat exchanger **106** is discharged and reaches a two-way-valve **306** which directs it selectively to one of two condensate drains **308**, **310**. Selection occurs corresponding to the operating position the cooling module shall assume in a mounted state. Principally, switching between condensate drain **308** and condensate drain **310** may be performed manually, in a simple way, however, a position sensor **310** is provided which detects the mounting position, i.e. the first or the second operating position and transfers the information to control means **300** which controls two-way-valve **300** correspondingly and opens the path to condensate drain **308** or to condensate drain **310**. The condensate drains are arranged within the cooling module body corresponding to the exit direction as necessary.

[0027] Thereby, a cooling module is provided which may be utilized in different mounting situations without any modification, a probably existing display should, however, be mounted according to the first or second operating position for better readability.

[0028] The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

What is claimed is:

1. A self-supporting cooling module, comprising:

a self-supporting cooling module body which is made of foamed resin material, a reference plane being defined in said cooling module body, wherein components are located in said cooling module body in a first operating position with respect to the reference plane in which all components operably interact, and

a plurality of components to be cooled or executing a cooling action, said components executing a cooling action include at least one heat exchanger,

wherein said components are introduced into said cooling module body such that they operably interact also in a second operating position which, with respect to said first operating position, is rotated by 180° around an axis lying in said reference plane.

2. The self-supporting cooling module of claim **1**, wherein said cooling module body is formed as a double-shell, wherein the interface between the two shells is parallel to or within said reference plane.

3. The self-supporting cooling module of claim **1**, wherein said heat exchanger comprises a condensate drain discharging condensate in a first direction in said first operating position and discharging condensate in a second direction in said second operating position.

4. The self-supporting cooling module of claim **3**, wherein said condensate drain is configured as a two-way-drain.

5. The self-supporting cooling module of claim **4**, wherein said condensate drain is configured as a valve-controlled two-way-drain.

6. The self-supporting cooling module of claim **1**, wherein control means are provided driving said components executing a cooling action in response to signals issued to said control means by at least one temperature sensor and/or by at least one humidity sensor.

7. The self-supporting cooling module of claim **3**, wherein a position sensor is provided wherein said control means controls the valve of the two-way-drain in response to signals received from said position sensor to discharge the condensate in the first direction or in the second direction, depending on the detected position of said cooling module body.

8. The self-supporting cooling module of claim **4**, wherein a position sensor is provided wherein said control means controls the valve of the two-way-drain in response to signals received from said position sensor to discharge the condensate in the first direction or in the second direction, depending on the detected position of said cooling module body.

9. The self-supporting cooling module of claim **5**, wherein a position sensor is provided wherein said control means controls the valve of the two-way-drain in response to signals received from said position sensor to discharge the condensate in the first direction or in the second direction, depending on the detected position of said cooling module body.

10. The self-supporting cooling module of claim **1**, wherein said resin material is expanded polypropylene.

11. The self-supporting cooling module of claim **2**, wherein the shells of said cooling module body snap into another in a mounted position.

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