(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 170 269 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.04.2023 Bulletin 2023/17

(21) Application number: **22202455.6**

(22) Date of filing: **19.10.2022**

(51) International Patent Classification (IPC):
F25D 29/00 *(2006.01)* ***F25D 27/00*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F25D 29/00; F25D 27/005; F25D 2400/40

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **19.10.2021 IT 202100026828**

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(54) ELECTRONIC THERMOREGULATOR CONFIGURED TO CONTROL A PROFESSIONAL REFRIGERATION APPLIANCE

(57) Electronic thermoregulator (1) comprising first output terminals (7) connected to electrical/electronic loads/devices (5), a second output terminal (8) connected to an LED lighting device (6), a first circuit branch (9) having a first power supply voltage (VI), an SMPS switched-mode power supply (10) which is designed to supply a second voltage (V2) corresponding to a low direct voltage less than the first voltage (VI), a second circuit branch (11) which is electrically connected to the output terminal of the SMPS switched-mode power supply (10), of the relays (12) to connect the first circuit branch (9) to a first output terminal (7), an electronic switch (13) configured to switch on the basis of a relative second command signal (SI) in order to connect the second circuit branch (11) to the second output terminal (8), and a control module (14) which generates the first command signals (Ki) and the second command signal (SI) to switch the relays (12) and the electronic switch (13).

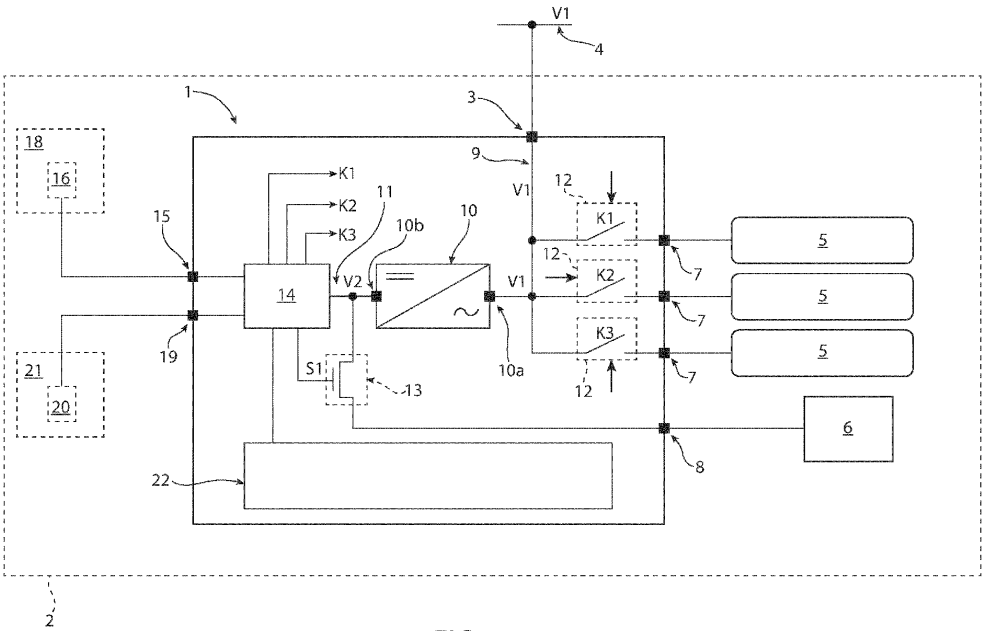

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102021000026828 filed on October 19, 2021 the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates to an electronic thermoregulator for controlling a professional refrigeration appliance.

[0003] In particular, the present invention concerns an electronic thermoregulator which is designed to control an LED lighting device and a plurality of electrical/electronic loads or devices in a professional refrigeration appliance; use to which the following discussion will explicitly refer without thereby losing generality.

BACKGROUND

[0004] As is known, the operation of the electrical and electronic devices present in a professional refrigeration appliance is handled by an electronic control device, commonly indicated as electronic thermoregulator.

[0005] Commonly, electronic thermoregulators are provided with a series of inputs connected to temperature sensors and to state switches from which they receive temperature signals relative to the temperature present in the internal refrigeration cells or compartments and respectively state signals indicative, for example, of the open/closed state of the doors of the refrigeration cells, and a plurality of control outputs, which are connected to the electrical/electronic loads or devices and through which the control of the latter occurs.

[0006] The circuit architectures of the above-mentioned thermoregulators are numerous and commonly provide for a power supply input connected to the external power supply electric network for receiving therefrom a first voltage corresponding to an alternating voltage of medium value, for example 230V, and a series of internal relays, each of which is arranged in the thermoregulator along a relative line for driving the electrical/electronic load or device, designed to connect the power supply input to a control output to which the electrical/electronic load to be controlled is connected.

[0007] In use, a microcontroller commands the switching of the internal relays on the basis of the refrigeration operation to be implemented, for selectively supplying the first voltage on the control outputs as a function of the electrical/electronic loads to be activated.

[0008] A criticality present in the above-described thermoregulators is the fact that normally the control outputs, connected downstream of the internal relays, are prearranged for exclusively powering electrical loads operating with the first voltage, and are thus unsuitable for powering electronic loads which instead operate with voltages which are much lower than the first voltage.

[0009] One of the electronic loads present in the professional refrigeration appliances of recent generation, corresponds for example to the LED lighting device. The LED lighting sources present in the LED lighting device, in use, are turned on for lighting the refrigeration cells or compartments when the relative closing doors are opened for enabling the access to the cell and the viewing of the content thereof. The LED lighting sources in fact operate at a second voltage lower than the first voltage, generally a low direct voltage of about 12 or about 24 V.

[0010] With the aim to overcome such criticality, some solutions have been designed which provide for using external electronic voltage adapter appliances, which are connected between the control output of the thermoregulator and the LED lighting device to be controlled and are configured to transform the first voltage into the second voltage.

[0011] If on the one hand, the use of the external electronic voltage adapter appliances has conveniently enabled maintaining the traditional architecture of the above-described thermoregulators, on the other hand it is a solution which is not completely satisfactory.

[0012] Tests carried out by the Applicant have shown, for example, that in the above-described thermoregulators, the internal relay connected to the LED lighting device by means of the external electronic voltage adapter appliance, is subject to a current absorption peak during the turning on of the LED lighting device. Such absorption peak is mainly due to the load variation of the capacities present inside the adapter and affects the life time of the internal relay actuated.

SUMMARY

[0013] The object of the present invention is thus to provide an electronic thermoregulator which overcomes the above-described drawbacks.

[0014] In accordance with these objectives, according to the present invention, an electronic thermoregulator for professional refrigeration appliances is provided according to what defined in the relative independent claims and preferably, but not necessarily, in any one of the claims dependent thereon.

BRIEF DESCRIPTION OF THE FIGURES

[0015] The present invention will now be described with reference to the accompanying drawings, which illustrate a non-limiting example embodiment thereof, wherein:

- Figure 1 is a circuit block diagram of the electronic thermoregulator for professional refrigeration appliances, manufactured according to the teachings of the present invention;
- Figure 2 schematically shows, with parts removed

for clarity, a possible internal arrangement on a PCB board of the electronic components of an electronic thermoregulator for professional refrigeration appliances, manufactured according to the teachings of the present invention.

DESCRIPTION OF EMBODIMENTS

[0016] The present invention will now be described in detail with reference to the accompanying figures for enabling a person skilled in the art to manufacture it and use it. Various modifications to the described embodiments will be immediately apparent to the persons skilled in the art and the general principles described can be applied to other embodiments and applications without thereby departing from the scope of protection of the present invention, as defined in the appended claims. Therefore, the present invention is not to be considered limited to the described and illustrated embodiments, but is to be granted the broadest scope of protection in conformity with the principles and the characteristics described and claimed herein.

[0017] With reference to Figure 1, reference numeral 1 schematically indicates, as a whole, an electronic thermoregulator which is configured to control electrical/electronic loads of a professional refrigeration appliance 2.

[0018] The professional refrigeration appliance 2 (schematically shown in Figure 2 with a dashed line) can optionally correspond, for example, to one of the following appliances: a professional refrigerator cabinet, a professional refrigerator counter, a professional refrigerated showcase, or the like provided with at least one compartment or cell 18.

[0019] With reference to Figure 1, the electronic thermoregulator 1 comprises a first input terminal 3 which is designed, in use, to be electrically connected to an electric power supply line 4 of an external electric network having a first voltage V1. The first voltage V1 corresponds to an alternating medium voltage. The alternating medium voltage can preferably correspond to a network voltage between about 115 V and about 230 V.

[0020] The electrical/electronic loads of the professional refrigeration appliance 2 controlled by the electronic thermoregulator 1 can comprise one or more electrical/electronic devices 5 designed to be powered by means of the first voltage V1, and at least one LED lighting device 6 designed to be powered with a second voltage V2 less than the first voltage V1. The second voltage V2 can be a low direct voltage. The low direct voltage V2 is a direct voltage between about 12 and about 24 volts.

[0021] The electrical/electronic devices 5 can comprise for example: a compressor assembly, a ventilation assembly provided with one or more fans, a defrost assembly provided for example with one or more electric heater devices (electric resistors).

[0022] The LED lighting device 6 comprises one or more light emitting diodes - LEDs or the like.

[0023] With reference to Figure 1, the electronic thermoregulator 1 further comprises a series of first output terminals 7 which are designed, in use, to be respectively connected to the electrical/electronic devices 5.

[0024] The electronic thermoregulator 1 further comprises at least a second output terminal 8 which is designed, in use, to be electrically connected to a relative LED lighting device 6.

[0025] With reference to Figure 1, the electronic thermoregulator 1 further comprises a first circuit branch 9 which is electrically connected to the first input terminal 3.

[0026] The electronic thermoregulator 1 further conveniently comprises a switched-mode power supply 10 i.e. an SMPS power supply.

[0027] The switched-mode power supply 10 has an input 10a connected to the first circuit branch 9 and an output designed to supply the second voltage V2.

[0028] The switched-mode power supply 10 is configured to transform/convert the first alternating voltage V1 received at input into the second voltage V2 supplied at an output 10b.

[0029] With reference to Figure 1, the electronic thermoregulator 1 further comprises a second circuit branch 11 which is electrically connected to the output 10b of the switched-mode power supply 10 for having, in use, the second voltage V2.

[0030] The electronic thermoregulator 1 further comprises a plurality of coil (solenoid) electromechanical switches, i.e. relays 12, each of which is configured in order to switch on the basis of a respective command signal Ki (i between 1 and n, where n=3 in Figure 1) between an open state and a closed state in which it electrically connects the first power supply circuit branch 9 to a relative first output terminal 7.

[0031] The electronic thermoregulator 1 further comprises at least an electronic switch 13, which is electrically connected between the second circuit branch 11 and the second output terminal 8 and is configured to switch on the basis of a relative command signal S1 in order to electrically connect the second circuit branch 11 to the second output terminal 8.

[0032] The electronic thermoregulator 1 further comprises a control module 14, for example a microprocessor device comprising a series of terminals electrically connected to corresponding command terminals of the relays 12 (not illustrated) for supplying the same with command signals Ki in order to selectively switch the relays 12 between an open state and a closed state, and vice versa.

[0033] The control module 14 further comprises a terminal electrically connected to the electronic switch 13 for supplying the same with the command signal S1 designed to switch the electronic switch 13 between an open state and a closed state, in which it electrically connects the second circuit branch 11 to the second output terminal 8.

[0034] Preferably, the electronic switch 13 can comprise an electronic transistor. According to a possible embodiment, the electronic switch 13 comprises a field ef-

fect transistor (MOS transistor). Preferably, the field effect transistor can have a gate terminal connected to the control module 14 for receiving the command signal S1, and drain and source terminals electrically connected to the second circuit branch 11 and to the second output terminal 8.

[0035] It is understood that the field effect transistor is designed to switch from the open state to the closed state on the basis of the signal S1, in order to electrically connect, by means of the second output terminal 8, the LED lighting device 6 between two terminals having two different potentials, one of which can be associated with the second voltage V2 and the other one with a reference potential for example the earth potential. It is further understood that the present invention is not limited to an electronic switch 13 corresponding to a field effect transistor, but can provide, in accordance with alternative embodiments, for example, for a bipolar transistor or the like. The combined use of the SMPS switched-mode power supply 10 and of the electronic switch 13 has the technical effect of making directly available on the output of the thermoregulator the low voltage of about 12V or of about 24 V.

[0036] With reference to Figure 1, the electronic thermoregulator 1 can further comprise one or more second input terminals 15 (only one of which is shown in Figure 1), which are designed to be electrically connected in a selective manner to respective temperature sensors 16 of the professional refrigeration appliance 2 for receiving from the same signals indicative of the internal temperature(s) of a refrigeration cell 18.

[0037] Each second input terminal 15 is electrically connected to a terminal of the control module 14 for supplying it, in use, with the relative temperature signal. The control module 14 is configured to control the electrical/electronic devices 5 on the basis of the temperature signal(s), according to a pre-established refrigeration program.

[0038] With reference to Figure 1, the electronic thermoregulator 1 can further comprise one or more third input terminals 19 (only one of which is shown in Figure 1) each of which is designed, in use, to be connected to a relative detector device 20 for receiving a state signal indicative of the open/closed state of a door 21 of the professional refrigeration appliance 2 actuatable for closing/opening the refrigeration cell 18.

[0039] It is understood that the electronic thermoregulator 1 can comprise a plurality of more third input terminals 19 and that the relative signals are not limited to the signals indicative of the state of the door but could be relative to other signals such as, for example, command signals given by the user through an interface 22.

[0040] In the illustrated example, the third input terminal 19 is electrically connected to a terminal of the control module 14 for supplying it, in use, with the state signal. The control module 14 is configured to control the LED lighting device 6 on the basis of the state signal. For example, the control module 14 is configured to turn on the LED lighting device 6 when the state signal is indicative of the opening of the door 21 (and thus of the cell 18).

[0041] With reference to Figure 1, the electronic thermoregulator can comprise/integrate a user interface panel 22, and the control module 14 can have at least one terminal electrically connected to a user interface panel 22. The user interface panel 22 can comprise, for example, at least one display and a command keyboard.

[0042] Figure 2 schematically shows an exemplifying embodiment of the above-described electronic thermoregulator 1 wherein the latter comprises an external container or shell 23 containing a PCB printed electric circuit 24. On the PCB printed electric circuit 24 the following are stably arranged: the first input terminal 3, the first output and power supply terminals 7, the second output terminal 8, the first circuit branch 9, the SMPS switched-mode power supply 10, the second circuit branch 11, the relays 12, the electronic switch 13 and the control module 14.

[0043] The advantages of the above-described electronic thermoregulator are the following: the thermoregulator simplifies the wiring since the LED lighting device connects directly to the thermoregulator.

[0044] The thermoregulator, thanks to its architecture, eliminates the need to use an additional very low voltage power supply external to the thermoregulator for adapting the first voltage to the second voltage of the LED lighting device. The thermoregulator has a reduced energy consumption. On the one hand, it is no longer necessary to energize the coil of the relay dedicated to the control of the lighting module and on the other hand the energy consumption for activating the MOSFET is extremely reduced. Furthermore, the life time of the thermoregulator is increased, since the command relay of the LED lighting device is replaced by the electronic switch which is not subject to the problems of the relay.

Claims

1. Electronic thermoregulator (1) configured to control a professional refrigeration appliance (2), said electronic thermoregulator comprises:

   a first input terminal (3) designed to be connected to an external main power supply line (4) having a first voltage (VI) corresponding to an alternating medium voltage,
   a plurality of first output terminals (7) designed to be respectively connected to electrical/electronic loads/devices (5),
   a second output terminal (8) designed to be connected to an LED lighting device (6),
   a first circuit branch (9) which is electrically connected to said first input terminal (3),
   an SMPS switched-mode power supply (10) which has an input terminal (10a) connected to said first circuit branch (9) and an output terminal

(10b) designed to supply a second voltage (V2) corresponding to a low direct voltage less than said first voltage (VI),
a second circuit branch (11) which is electrically connected to said output terminal (10b) of said SMPS switched-mode power supply (10),
a plurality of relays (12), each of which is configured in order to switch on the basis of a respective first command signal (Ki) to connect said first circuit branch (9) to a relative first output terminal (7),
an electronic switch (13) which is electrically connected between said second circuit branch (11) and said second output terminal (8) and is configured to switch on the basis of a relative second command signal (S1) in order to electrically connect said second circuit branch (11) to said second output terminal (8),
a control module (14) configured in order to generate said first command signals (Ki) and said second command signal (S1) to selectively switch said relays (12) and respectively said electronic switch (13).

2. Electronic thermoregulator according to claim 1 wherein said electronic switch (13) comprises an electronic transistor.

3. Electronic thermoregulator according to claim 2 wherein said electronic switch (13) comprises a field effect transistor.

4. Electronic thermoregulator according to claim 3, wherein said electronic switch (13) comprises a gate terminal connected to said control module (14) for receiving said second command signal (S1), and drain and source terminals connected to said second circuit branch (11) and to said second output terminal (8).

5. Electronic thermoregulator according to claim 2, wherein said electronic switch (13) comprises a bipolar transistor.

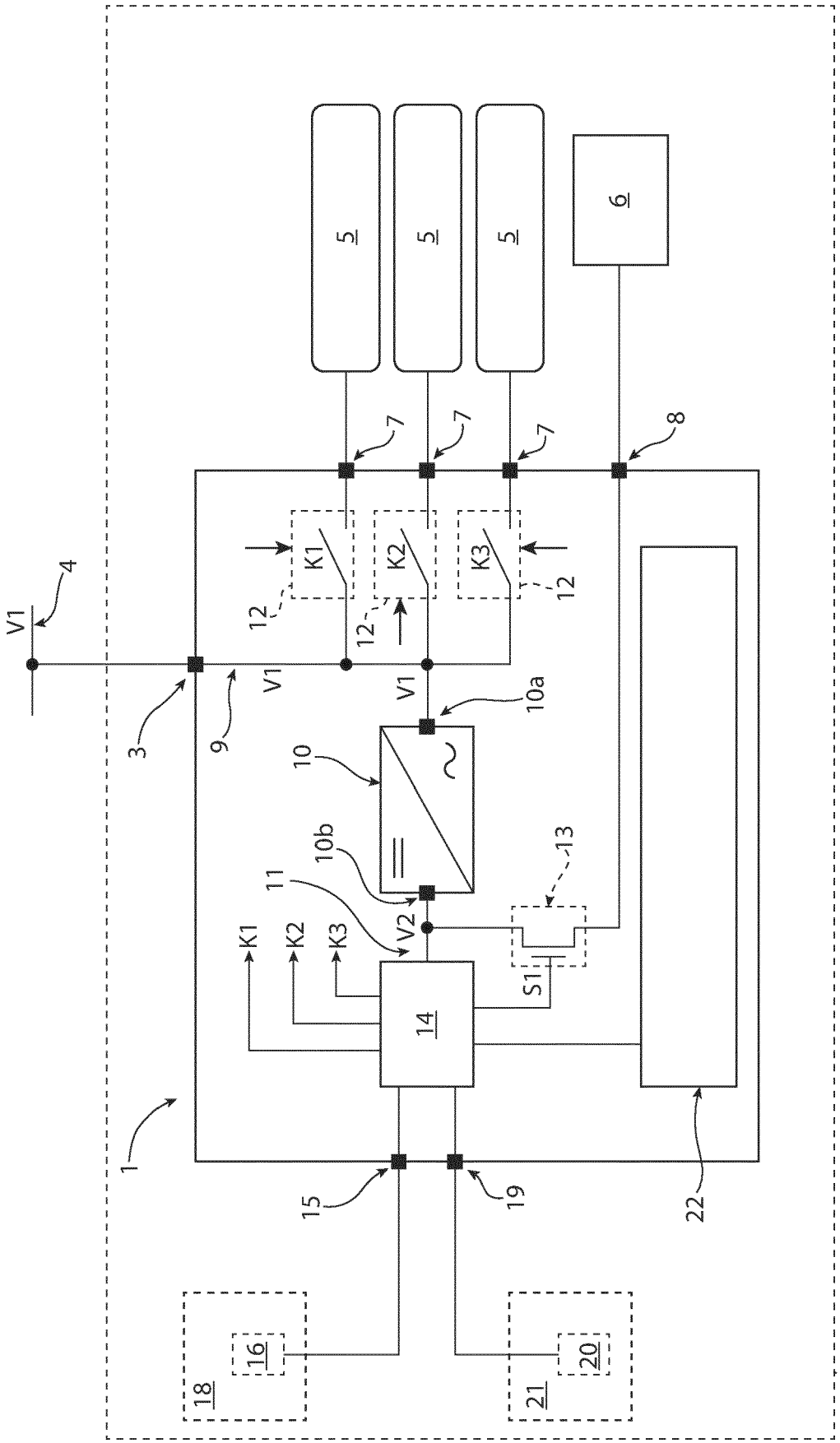
6. Electronic thermoregulator according to any one of the preceding claims, wherein said second voltage (V2) is optionally: about 12 V or about 24 V.

7. Electronic thermoregulator according to any one of the preceding claims, wherein said first voltage (VI) is between about 115 V and about 230V.

8. Electronic thermoregulator according to any one of the preceding claims, comprising a PCB board (24); and wherein said first input terminal (3), said first output terminals (7), said second output terminal (8), said first circuit branch (9), said SMPS switched-mode power supply (10), said second circuit branch (11), said relays (12), said electronic switch (13), said control module (14) being fixed stably on, and supported by said PCB board (24).

9. Electronic thermoregulator according to any one of the preceding claims, wherein said LED lighting device (6) comprises one or more LEDs.

10. Electronic thermoregulator according to any one of the preceding claims, comprising at least a second input terminal (15) designed to be connected to a temperature sensor (16) to receive a signal indicative of at least one internal temperature of a refrigeration cell (18) of said professional refrigeration appliance.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K1
K2
K3
12
12
12
4
V1
3
9
V1
V1
10a
10
10b
11
13
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22
18
16
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2

FIG. 1

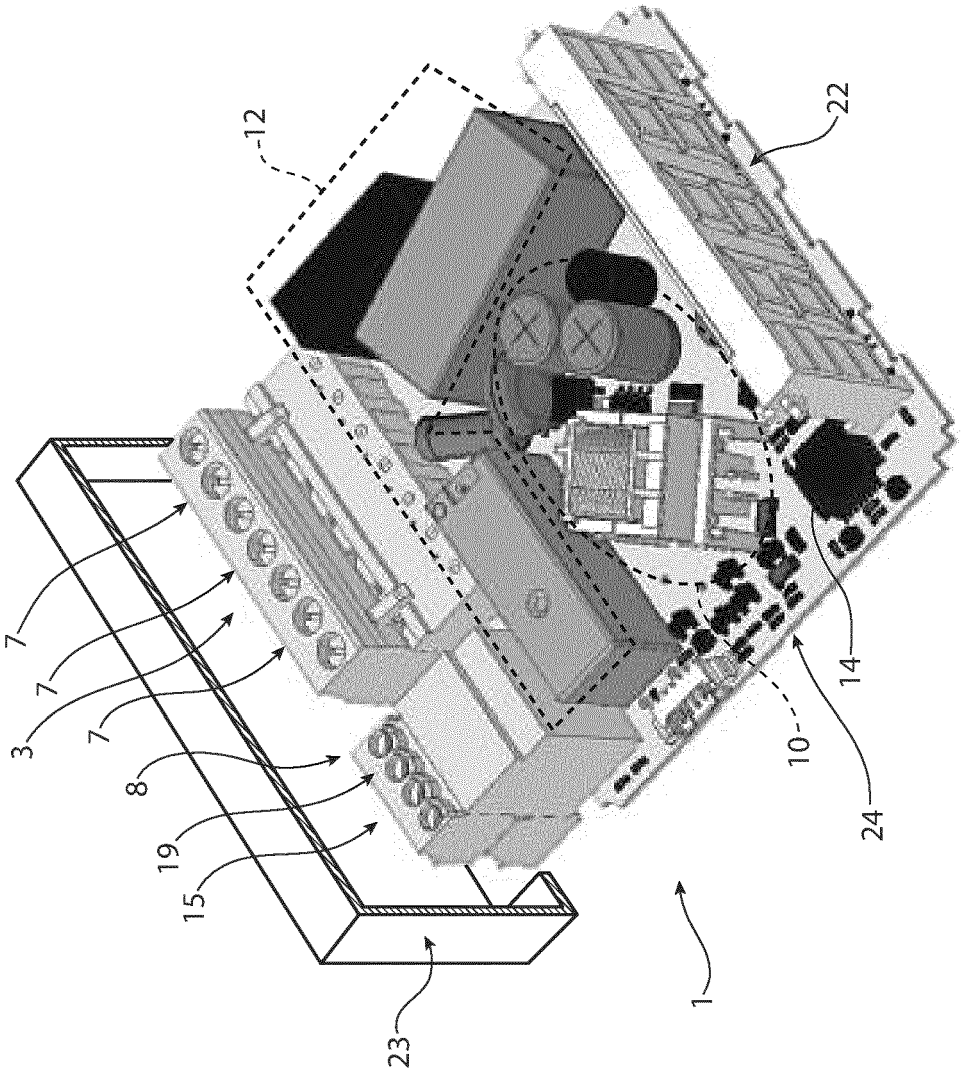

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 2455

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			TECHNICAL FIELDS SEARCHED (IPC) F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 February 2023	Bejaoui, Amin

CATEGORY OF CITED DOCUMENTS

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