(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 April 2012 (05.04.2012)

PCT

(10) International Publication Number
WO 2012/042247 A1

(51) International Patent Classification:
F24F 11/00 (2006.01)

(21) International Application Number:
PCT/GB2011/051807

(22) International Filing Date:
23 September 2011 (23.09.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1016200.6 27 September 2010 (27.09.2010) GB

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

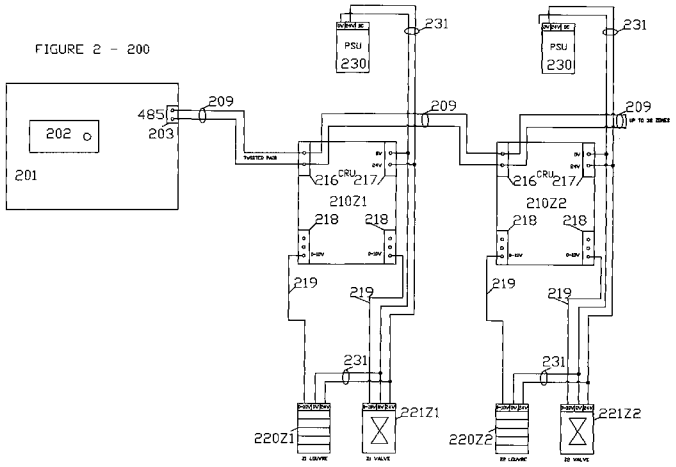
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

[Continued on next page]

(54) **Title**: IMPROVEMENTS RELATING TO CLIMATE CONTROL SYSTEMS



(57) **Abstract**: A climate control system (200) is provided with a building master controller (201) and in each zone (z1, z2) is provided with a combined zone unit (210z1, 210z2). A CO_2 sensor (211) and a temperature sensor (212) are integrated into the combined zone units (210z1, 210z2). Additionally provided in each zone (z1, z2) is a louvre actuator (220z1, 220z2) and a valve (221z1, 221z2). The respective louvre actuators (220z1, 220z2) and valves (221z1, 221z2) are connected to the local combined zone units (210z1, 210z2) via single core cables (219) and communication connectors (218). Additionally, the local combined zone units (210z1, 210z2), louvre actuators (220), and valves (221), are connected directly to a local power supply unit (230z1, 230z2) by a power supply cable (231). The combined zone units (210z1, 210z2) are provided with a power supply connector (217) for receiving the power supply cable (231). The combined zone units (210z1, 210z2) are each connected to each other and the building master controller (201) via successive lengths of a twisted 2 core cable (209). At the central controller (201), the cables (209) are connected to a single intelligent combined zone unit connection (203) provided as part of the central controller (101). At each combined zone unit (210z1, 210z2) the cables (209) are connected to a communicator connection (216). The cables (209) enable communication between the central controller (201) and the respective combined zone units (210z1, 210z2). In order to enable communications from the central controller (201) to reach a desired combined zone unit (210z1, 210z2) and to enable the central controller (201) to identify communications received from each combined zone unit (210z1, 210z2) each combined zone unit (210z1, 210z2) incorporates a processing unit (215).

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Improvements Relating To Climate Control Systems

The present invention relates to climate control systems for buildings and in particular zone control of such systems.

Many modern multi-room buildings incorporate climate control. Typically such systems comprise a central control unit connected to a plurality of climate sensors (typically temperature sensors) disposed in individual zones throughout the building and also connected to a similarly dispersed plurality of climate control units. The climate control units may be active heating or cooling units or may be passive heating or cooling units. Such passive units may include window actuators for opening windows and controllable actuated louvres (or other similar ventilation means) for naturally ventilating a zone. By sending control signals to the climate control units in response to the output signals of associated temperature sensors, the temperature of individual zones in the building can be maintained at a desired level.

Many such systems also allow the users of individual zones to override the climate control system within the zone. In order to facilitate this override, a zone controller is provided. Typically, this comprises a wall mounted unit providing user actuable override inputs and is integrated and wired with the zone temperature sensor. In response to the user override input, the wall mounted unit sends an override signal to a central control unit. The central control unit can evaluate the received override signal and may in response send a control signal to climate control units associated with the same zone to thereby adjust the zone temperature as required.

As described above, the climate control units and climate sensors in each zone are connected to the central controller via individual direct wired connections. This allows the building operator to maintain overall control of the system and also to monitor operation of the system thereby gaining an indication of potential climate control difficulties as they occur. In order to provide the requisite functionality and reliability throughout a building, zone controllers, climate sensors and climate control units are connected to the central controller by hard wired links. These links provide both a power supply and carry control signals and output signals. However, providing

direct links to individual zone controllers, climate sensors and climate control units requires a considerable complexity of wiring and master controller information gathering input / output modules. Furthermore, since both power and signals must be carried by each connecting wire, multi-core wires are required to provide these connections. Accordingly, climate control systems of this type are relatively complex and expensive to fit.

It is therefore an object of the present invention to provide a climate control system which at least partially overcomes, or alleviates, some or all of the above problems.

According to a first aspect of the present invention, there is provided a combined zone unit for a climate control system for a building having a plurality of climate controlled zones, each climate controlled zone having a combined zone unit, wherein the combined zone unit comprises: an integrated climate sensor; a power supply connection means; one or more connection means for providing connection to any further climate sensors provided within the zone and connection to one or more climate control units provided within the zone; master control connection means for providing a wired connection to the building master control unit; wherein the combined zone unit is additionally provided with a processing unit operable both to communicate with the building master controller and to direct the operation of the one or more climate control units in response to the output of the integrated climate sensor and any further climate sensors to maintain zone climate within a desired range; and wherein the processing unit has a unique addressing identifier and is operable to send and receive communications incorporating the unique identifier and to ignore communications omitting the unique identifier such that a plurality of combined zone units may be separately addressed by the building master controller when connected together and to the building master controller in series.

According to a second aspect of the present invention, there is provided a climate control system for a building, the system comprising: a building master controller; a plurality of climate controlled zones, each climate controlled zone having a combined zone unit according to the first aspect of the present invention and at least

one climate control unit, wherein the combined zone units are connected to each other and to the building master controller in series.

By providing combined zone unit in accordance with the first aspect of the present invention, it is possible to implement a building climate control system using less complex components, less extensive and less expensive wired connections. Additionally, separating the power supply from the communications link to the building master controller enables the use of a local power supply for the combined zone unit further reducing the complexity, extent and cost of the required wiring.

The wired connection between the combined zone unit and the building master controller may be a two core communications cable. Similarly, the wired connection between the combined zone unit and the climate sensors and/or the climate control units may be a two core communications cable. Alternatively and preferably, the wired connection between the combined zone unit and the climate sensors and/or the climate control units may be a single core communications cable.

The power supply connection means may enable direct connection to the building power supply. Alternatively, the power supply connection means may enable connection to a power supply unit operable independently of either the building power supply or another internal or external power source. The climate sensors and/or the climate control units may each be directly connected to the building power supply or to a power supply unit as desired or as appropriate.

The combined zone unit may be provided with a user interface. The interface may enable the user to control the operation of the combined zone unit and hence the zone climate. The interface may be operable to change specific thresholds for directing operation of the climate control units. Alternatively, the interface may provide for user override of the operation of the climate control units. The user interface may comprise one or more user actuable controls. The user interface may additionally comprise one or more visual indicators. The visual indicators may comprise one or more indicator lamps and/or a display unit. The display unit may be operable to display indicators or alphanumeric information, if required or desired.

The processing unit may be operable to communicate to the building master controller details relating to the output of the climate sensors. The processing unit may be operable to direct operation of the climate control units in response to communications received from the building central control unit. These communications may be generated in response to communications relating to the climate sensors. The communications received from the building master controller may have the effect of reprogramming the operation of the combined zone unit. The communications received from the building master controller may take precedence over or may cede precedence to the user interface.

The climate sensors may be any sensor operable to output an electronic signal in response to climatic conditions within a zone. In particular, suitable climate sensors include but are not limited to: temperature sensors, carbon dioxide sensors, carbon monoxide sensors, humidity sensors, lux sensors, occupation sensors or similar.

The climate control units may be any units operable to control the climatic conditions of a zone in response to an electrical signal. In particular, suitable climate control units include but are not limited to plant and equipment such as: heating means (such as hot water radiators, zone control valves, electric heating, gas fired boilers, fan heaters and the like), cooling means (such as air cooling units, refrigerating units, fans, motorised louvres/windows and the like), ventilation means (such as ducted fans, louvers, windows and the like) or combined units operable to provide a combination of heating, cooling and ventilation.

The combined zone unit may be provided within a protective housing. One or more of the climate sensors may be co-located within the protective housing. The protective housing may comprise a two piece housing having a `pluggable` base and a lid. The housing may be adapted for wall mounting. In such embodiments, the base may be attached to the wall or an electrical conduit fitting by suitable fixing means that may include, but are not limited to, screws, bolts, nails, pins, adhesives and snap fitting elements. The lid may be releasably attached to the base by means of suitable

fixing means that may include, but are not limited to, screws, bolts, nails, pins, adhesives and snap fitting elements.

The base may provide the one or more connection means. The processing unit (and in appropriate embodiments) the user interface and the co-located climate sensors may be mounted on or connected to a printed circuit board (PCB) within the lid enclosure.

The building may be provided with a combined zone unit in every room or only in selected rooms. The building may be a domestic residence such as a house or a plurality of domestic residences such as an apartment block. The building may be a public building such as offices, industrial units, a hotel, schools or similar.

An embodiment of the invention will now be described, by way of example only, with reference to accompanying drawings, in which:

Figure 1 is a schematic diagram of the wiring connections of a climate control system for a building according to the prior art;

Figure 2 is a schematic diagram of the wiring connections of a climate control system for a building according to the present invention;

Figure 3 is a schematic diagram of a combined zone unit according to the present invention; and

Figure 4 shows one potential embodiment of an interface on the lid of a housing for a combined zone unit according to the present invention.

Referring now to Figure 1 an example of the wiring of a prior art climate control system 100 for a building is shown. For the sake of clarity, the illustrated system controls only two zones z1, z2. It will of course be appreciated that such systems may control many more than two zones.

The system 100 is provided with a building master controller 101 and in each zone z1, z2 is provided with a zone controller 110z1, 110z2, a CO_2 (Carbon Dioxide)

sensor 111z1, 111z2, a louvre actuator 120z1, 120z2 and a valve 121z1, 121z2. The valves 121z1, 121z2 are typically central heating flow valves and might for example be 2 or 3 port valves or picc valves (pressure independent characterised control valve; operable to provide a constant flow of water and/or shut off a flow of water within a hot water based heating system).

The zone controller, 110z1, 110z2 may incorporate temperature sensing means.

The zone controllers 110z1, 110z2 and CO_2 sensors 111z1, 111z2 are each connected to the building master controller 101 via a 4 core cable 109. The cables 109 are connected in turn to zone controller connections 103, provided as part of the central controller 101. The cables 109 hence provide power to the zone controllers 110z1, 110z2 and CO_2 sensors 111z1, 111z2. Additionally, the cables 109, transport signals from the zone controllers 110z1, 110z2 and CO_2 sensors 111z1, 111z2 to the central controller 101.

Similarly, the louvre actuators 120z1, 120z2 and the valves 121z1, 121z2 are each connected to the building master controller 101 via a 4 core cable 119,. The cables 119 are connected in turn to zone controller connections 104, provided as part of the central controller 101. The cables 119 hence provide both power and control signals to the louvre actuators 120z1, 120z2 and the valves 121z1, 121z2.

A central processing unit 102 receives input from each of the zone controllers 110z1, 110z2 and CO_2 sensors 111z1, 111z2 so as to monitor climatic conditions in each zone z1, z2. If necessary the central processing unit 102 sends control signals to the louvre actuators 120z1, 120z2 and the valves 121z1, 121z2. This enables the climate in each zone z1, z2 to be controlled by appropriate operation of the louvre actuators 120z1, 120z2 and the valves 121z1, 121z2.

This arrangement has the drawback that each zone controller 110z1, 110z2, and CO_2 sensor 111z1, 111z2, louvre actuator 120z1, 120z2 and valve 121z1, 121z2

requires direct connection to the central controller for both power and control signals. As a result, installing such a system is complex and expensive.

Turning now to Figures 2 and 3 an example of the wiring of a climate control system 200 for a building according to the present invention is shown. For the sake of clarity, the illustrated system shows only two zones z1, z2. It will of course be appreciated that such systems may control many more than two zones.

The system 200 is provided with a building master controller 201 and in each zone z1, z2 is provided with a combined zone unit 210z1, 210z2. In the present example a CO_2 (Carbon Dioxide) sensor 211 (see figure 3) and a temperature sensor 212 (see figure 3) are integrated into the combined zone units 210z1, 210z2. Additionally provided in each zone z1, z2 is a louvre actuator 220z1, 220z2 and a valve 221z1, 221z2.

The respective louvre actuators 220z1, 220z2 and valves 221z1, 221z2 are connected to the local combined zone units 210z1, 210z2 via single core cables 219 and communication connectors 218. Additionally, the local combined zone units 210z1, 210z2, louvre actuators 220, and valves 221, are connected directly to a local power supply unit 230z1, 230z2 by a power supply cable 231. The combined zone units 210z1, 210z2 are provided with a power supply connector 217 for receiving the power supply cable 231.

The combined zone units 210z1, 210z2 are each connected to each other and the building master controller 201 via successive lengths of a twisted 2 core cable 209. At the central controller 201, the cables 209 are connected to a single intelligent combined zone unit connection 203 provided as part of the central controller 101. At each combined zone unit 210z1, 210z2 the cables 209 are connected to a communicator connection 216.

The cables 209 enable communication between the central controller 201 and the respective combined zone units 210z1, 210z2. In order to enable communications from the central controller 201 to reach a desired combined zone unit 210z1, 210z2

and to enable the central controller 201 to identify communications received from each combined zone unit 210z1, 210z2 each combined zone unit 210z1, 210z2 incorporates a processing unit 215 (see figure 3).

The processing unit 215 stores a unique addressing identifier which it includes in every communication. The central controller 201 scans every received communication for an addressing identifier to enable it to identify the specific combined zone unit 210z1, 210z2 that has issued the communication. Similarly, central controller 201 addresses each issued communication with an addressing identifier and each processing unit 215 scans every received communication to determine whether it contains the correct addressing identifier. If so, the processing unit 215 processes the communication. If not, the processing unit 215 ignores the communication. In such cases, the communication travels along the cable 209 to the specifically addressed combined zone unit 210.

The processing unit is also connected to the power connector 217 and the communication connectors 218. As can be seen in figure 3, communication connectors 218 are also provided to connect the processing unit to CO_2 (Carbon Dioxide) sensor 211 and temperature sensor 212. A further communication connector 218 is provided to connect the processing unit to a user interface 250.

The processing unit 215 is operable to locally monitor the sensors 211, 212 within its zone and to control the associated louvre actuators 220z1, 220z2 and valves 221z1, 221z2 to control the climate in the zone. Periodically, the processing unit will communicate a status report to the central controller via cable 201. The central processing unit 202 of the central controller can thus monitor operation of each combined zone unit 210z1, 210z2. If necessary, an override communication can be communicated along cable 209 to a specific combined zone unit 210z1, 210z2.

In this manner, since each combined zone unit 210z1, 210z2 is provided with a processing unit operable to store a unique addressing identifier the complexity of wiring linking combined zone units 210z1, 210z2 to the central controller 201 can be

reduced. Additionally, the processing unit 215 enables an combined zone unit 210z1, 210z2 to locally process and control louvre actuators 220z1, 220z2 and valves 221z1, 221z2 thus reducing the computational burden on central controller 201 as well as the wiring complexity. Further reductions in the wiring complexity are enabled by the local provision of a power supply 230.

Typically, the combined zone units 210 can be provided within a protective housing 240. The housing might typically comprise a base adapted for attachment to a wall or the like and a lid adapted to be releasably attached to the base and to provide a user interface 250. The base may typically incorporate fittings for retaining the various connector means 216, 217, 218 and access openings for the various cables 209, 219 and 231. The base may additionally provide fittings for retaining one or more printed circuit board (PCB). Upon the PCB may be mounted the processing unit 215 and, if appropriate any of the CO_2 sensor 211, temperature sensor 212 or the circuitry relating to the interface 250.

Turning now to figure 4, one example of a simple user interface 250 is shown. The interface 250 comprises a CO_2 indicator 251 and a temperature control panel 252. The CO_2 indicator comprises three indicator lamps 251a, 251b 251c. The lamps 251a, 251b 251c may be LEDs and are adapted to emit green, amber and red light respectively. The colour of the lit lamp 251a, 251b 251c corresponds to CO_2 level as measured by the CO_2 sensor 211. For instance, green is equivalent to low levels of CO_2, amber is equivalent to intermediate levels of CO_2 and red is equivalent to high levels of CO_2. Typically, the thresholds for these lamps 251a, 251b 251c are the same as those used by the processing unit to control operation of the respective louvre actuators 220z1, 220z2 and valves 221z1, 221z2.

The temperature control panel 252 comprises three indicator lamps 252a, 252b 252c. The lamps 252a, 252b, 252c may be LEDs. Lamp 252b when lit indicates that a target temperature for the zone is under automatic control. Adjacent to lamps 252a and 252c are provided user controls 253a and 253c. By pressing on the respective user controls 253a, 253c the target temperature for the zone can be raised or lowered

by a user. When pressing each control 253a, 253c the respective lamp 252a, 252c flashes. If, after the user is finished, the target temperature is still raised or lowered then the corresponding lamp 253a, 252c remains lit.

It is of course to be understood that the present invention is not to be restricted to the details of the above embodiment which is described by way of example only.

Claims

1. A combined zone unit for a climate control system for a building having a plurality of climate controlled zones, each climate controlled zone having a combined zone unit, wherein the combined zone unit comprises: an integrated climate sensor; a power supply connection means; one or more connection means for providing connection to any further climate sensors provided within the zone and connection to one or more climate control units provided within the zone; master control connection means for providing a wired connection to the building master control unit; wherein the combined zone unit is additionally provided with a processing unit operable both to communicate with the building master controller and to direct the operation of the one or more climate control units in response to the output of the integrated climate sensor and any further climate sensors to maintain zone climate within a desired range; and wherein the processing unit has a unique addressing identifier and is operable to send and receive communications incorporating the unique identifier and to ignore communications omitting the unique identifier such that a plurality of combined zone units may be separately addressed by the building master controller when connected together and to the building master controller in series.
2. A combined zone unit as claimed in claim 1 wherein the wired connection between the combined zone unit and the building master controller is a two core communications cable.
3. A combined zone unit as claimed in claim 1 or claim 2 wherein the wired connection between the combined zone unit and the climate sensors and/or the climate control units is a two core communications cable.
4. A combined zone unit as claimed in claim 1 or claim 2 wherein the wired connection between the combined zone unit and the climate sensors and/or the climate control units is a single core communications cable.
5. A combined zone unit as claimed in any preceding claim wherein the power supply connection means enable direct connection to the building power supply.

6. A combined zone unit as claimed in any preceding claim wherein the power supply connection means enable connection to a power supply unit operable independently of either the building power supply or another internal or external power source.

7. A combined zone unit as claimed in any preceding claim wherein the combined zone unit is provided with a user interface comprising one or more user actuable controls.

8. A combined zone unit as claimed in claim 7 wherein the user interface comprises one or more indicator lamps and/or a display unit operable to display indicators or alphanumeric information.

9. A combined zone unit as claimed in any preceding claim wherein the processing unit is operable to communicate to the building master controller details relating to the output of the climate sensors.

10. A combined zone unit as claimed in any preceding claim wherein the processing unit is operable to direct operation of the climate control units in response to communications received from the building central control unit.

11. A combined zone unit as claimed in claim 10 wherein the communications received from the building master controller have the effect of reprogramming the operation of the combined zone unit.

12. A combined zone unit as claimed in claim 10 or claim 11 wherein the communications received from the building master controller take precedence over or may cede precedence to the user interface.

13. A combined zone unit as claimed in any preceding claim wherein the climate sensors are any of: temperature sensors, carbon dioxide sensors, carbon monoxide sensors, humidity sensors, lux sensors or occupation sensors.

14. A combined zone unit as claimed in any preceding claim wherein the climate control units are any of: hot water radiators, zone control valves, electric heating, gas fired boilers, fan heaters, air cooling units, refrigerating units, fans, motorised louvres/windows, ducted fans, louvers, windows or combined units operable to provide a combination of heating, cooling and ventilation.

15. A combined zone unit as claimed in any preceding claim wherein the combined zone unit is provided within a protective housing.

16. A combined zone unit as claimed in claim 15 wherein the housing is adapted for wall mounting.

17. A combined zone unit as claimed in claim 15 or claim 16 wherein one or more of the climate sensors is co-located within the protective housing.

18. A combined zone unit as claimed in any one of claims 15 to 17 wherein the protective housing may comprises a two piece housing having a `pluggable` base and a lid.

19. A combined zone unit as claimed in claim 18 wherein the lid is releasably attached to the base by any of: screws, bolts, nails, pins, adhesives or snap fitting elements.

20. A combined zone unit as claimed in claim 18 or claim 19 wherein the base provides the one or more connection means.

21. A combined zone unit as claimed in any one of claims 18 to 20 wherein the processing unit, the user interface and the co-located climate sensors are mounted on or connected to a printed circuit board (PCB) within the lid enclosure.

22. A climate control system for a building, the system comprising: a building master controller; a plurality of climate controlled zones, each climate controlled zone having a combined zone unit according to any one of claims 1 to 21 and at least one climate control unit, wherein the combined zone units are connected to each other and to the building master controller in series.

23. A climate control system as claimed in claim 22 wherein the building is provided with a combined zone unit in every room or only in selected rooms.

24. A climate control system as claimed in claim 22 or claim 23 wherein the building is a domestic residence, a plurality of domestic residences, an office or offices, an industrial unit or units, a hotel or a school.

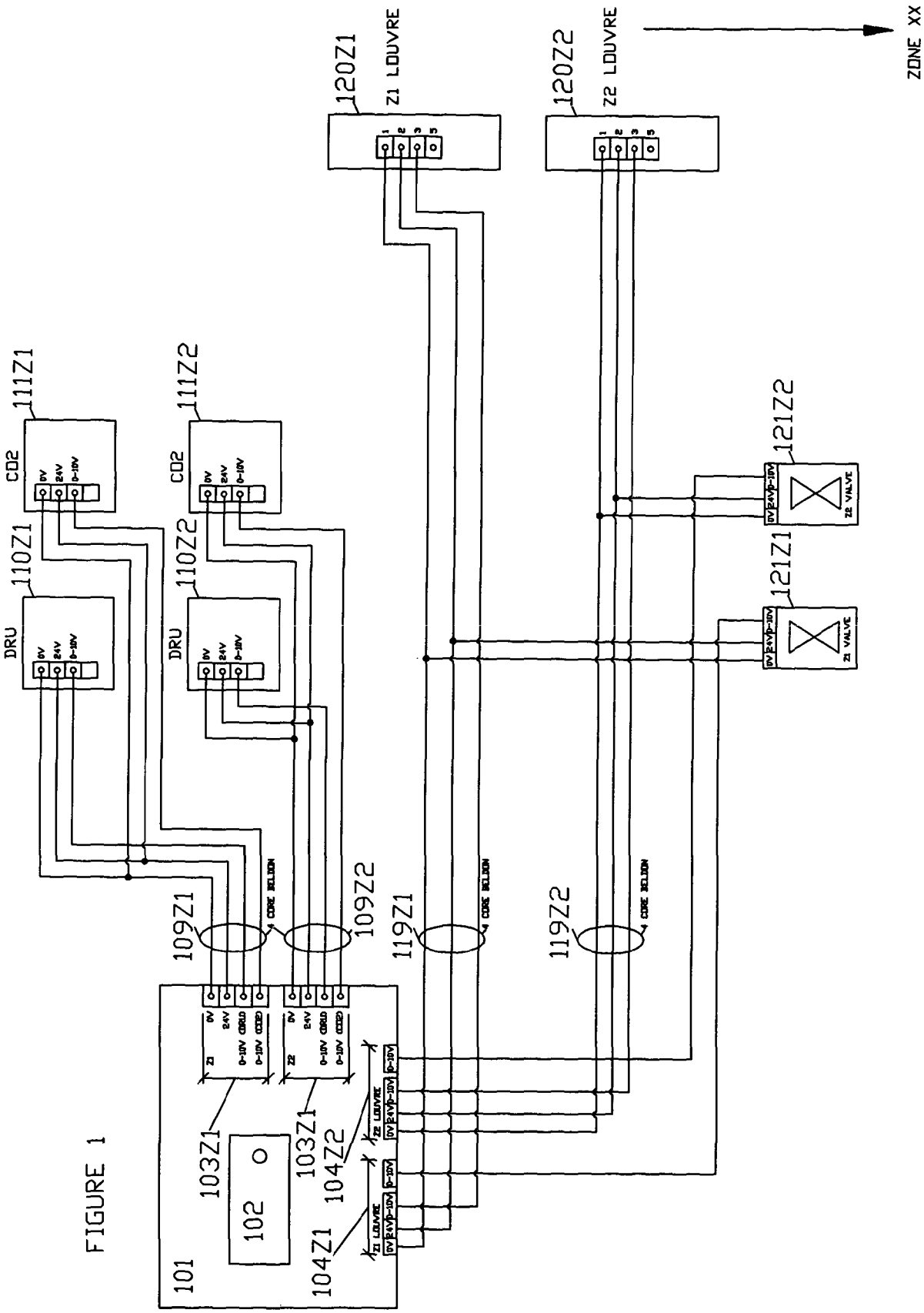
ZONE XX
120Z1
Z1 LOUVRE
120Z2
Z2 LOUVRE
111Z1
111Z2
CO2
DRU
110Z1
110Z2
121Z2
121Z1
Z2 VALVE
Z1 VALVE
109Z1
109Z2
119Z1
119Z2
CORE RELIGN
103Z1
104Z2
104Z1
102
101

FIGURE 1

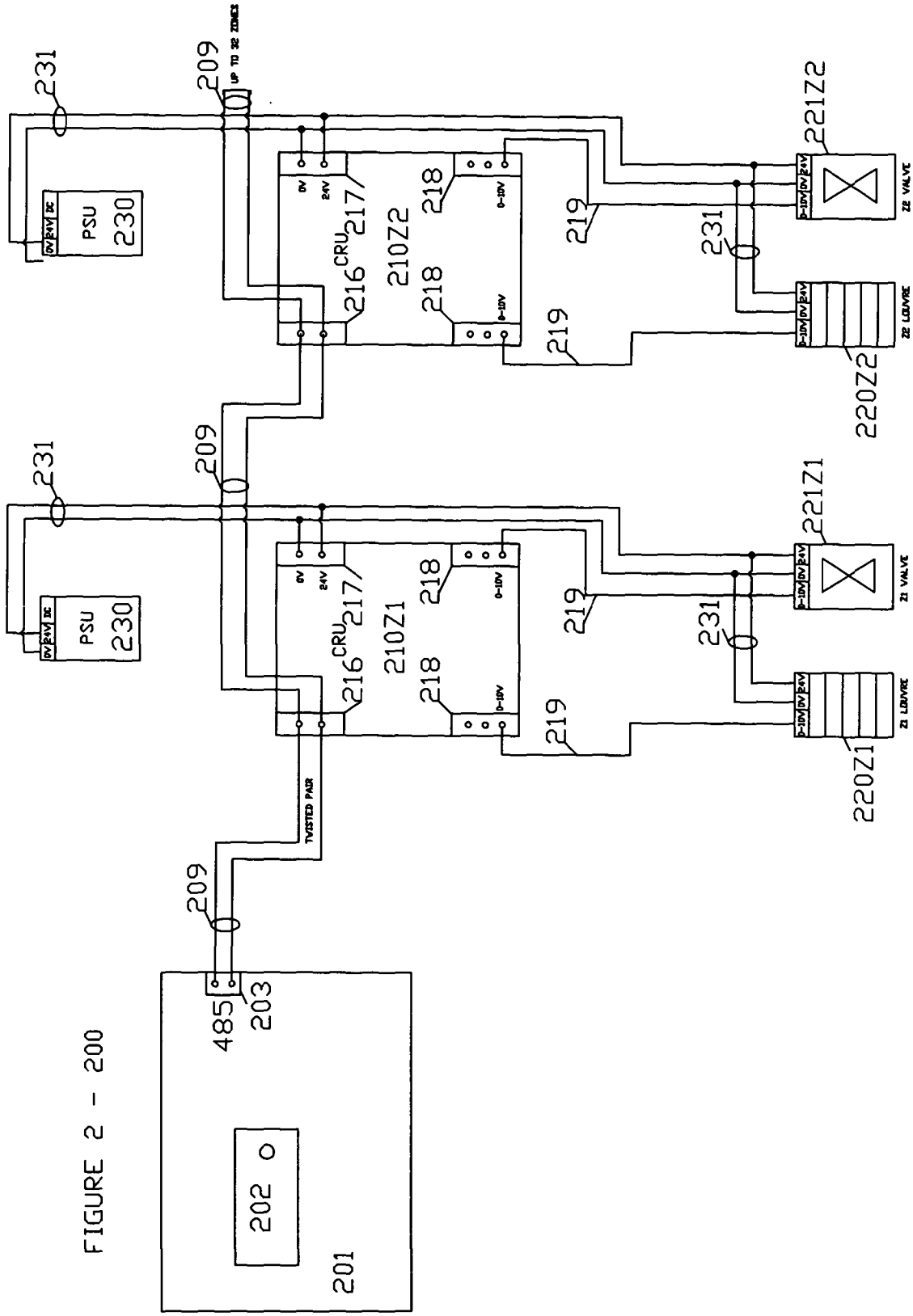
231
209
UP TO 32 ZONES
PSU
230
0V
24V DC
0V
24V
CRU
216
217
210Z2
218
0-10V
219
221Z2
Z2 VALVE
Z2 LOUVRE
220Z2
231
209
PSU
230
210Z1
221Z1
Z1 VALVE
Z1 LOUVRE
220Z1
TWISTED PAIR
209
485
203
202
201

FIGURE 2 - 200

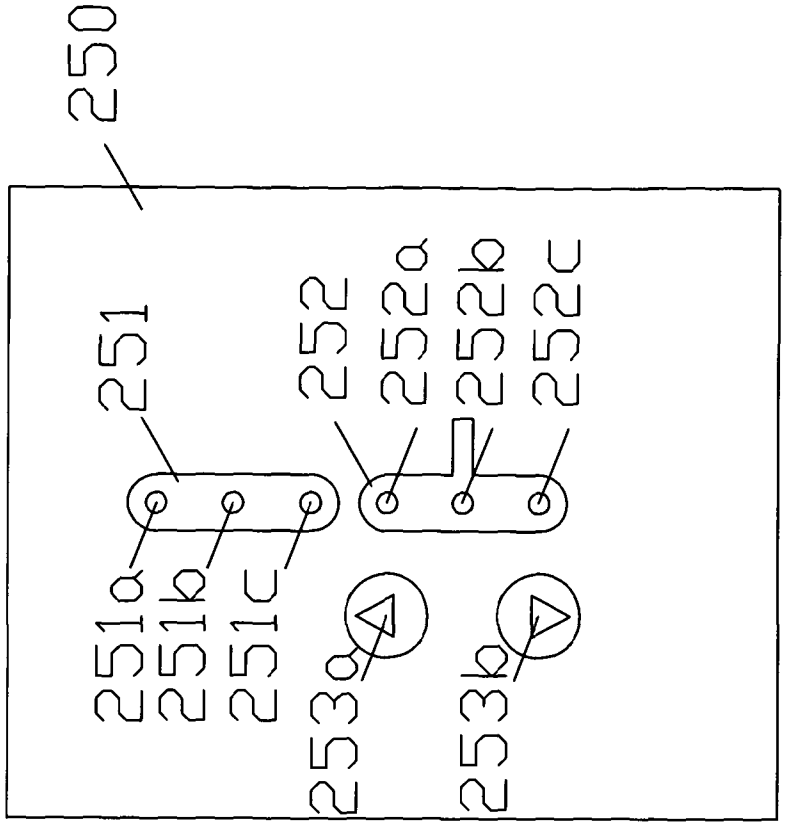

FIGURE 4

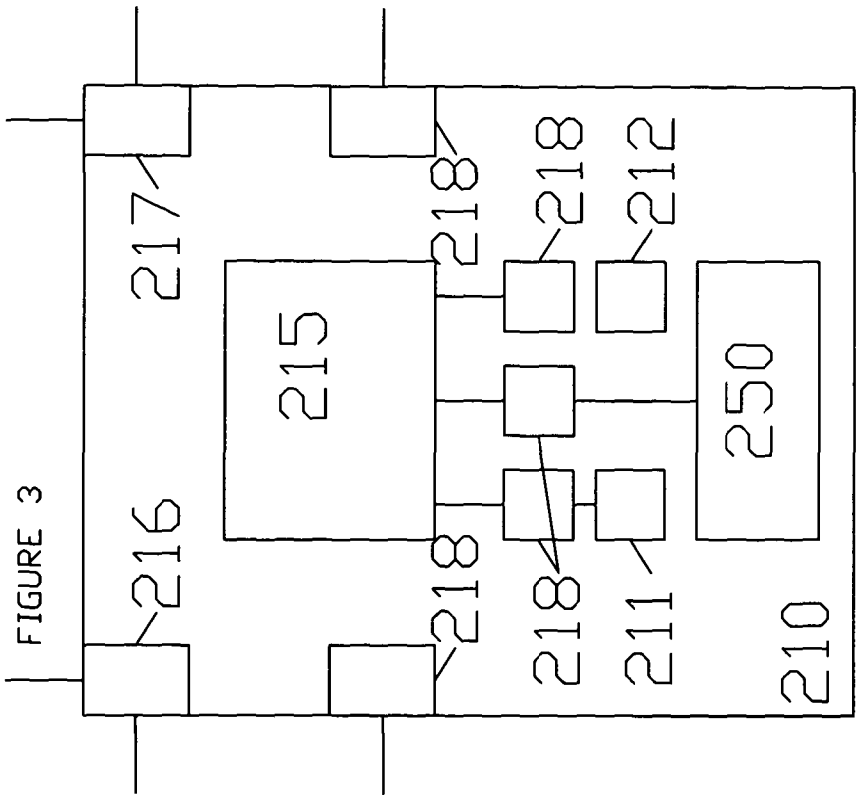

FIGURE 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/051807

A. CLASSIFICATION OF SUBJECT MATTER
INV. F24F11/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F G05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 751 572 A (MACIULEWICZ STEPHEN M [US]) 12 May 1998 (1998-05-12) column 2, line 54 - column 8, line 33; figures	1-24
A	JP 8 159541 A (SANYO ELECTRIC CO) 21 June 1996 (1996-06-21) abstract; figures	1-24
A	JP 2009 293826 A (DAIKIN IND LTD) 17 December 2009 (2009-12-17) abstract; figures	1-6
A	US 5 103 391 A (BARRETT MICHAEL R [US]) 7 April 1992 (1992-04-07) the whole document	1

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 January 2012	08/02/2012

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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/051807

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 661 914 A (MULOKEY WILLIAM P [US] ET AL) 28 April 1987 (1987-04-28) the whole document -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2011/051807

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5751572 A	12-05-1998	NONE	
JP 8159541 A	21-06-1996	JP 3630744 B2	23-03-2005
		JP 8159541 A	21-06-1996
JP 2009293826 A	17-12-2009	NONE	
US 5103391 A	07-04-1992	NONE	
US 4661914 A	28-04-1987	NONE	