(19) DANMARK

Patent- og
Varemærkestyrelsen

(10) **DK/EP 3396263 T3**

(12) Oversættelse af
europæisk patentskrift

(51) Int.Cl.: ***F 24 F 11/30 (2018.01)*** ***F 24 F 11/89 (2018.01)*** ***F 24 F 110/10 (2018.01)***
F 24 F 110/20 (2018.01) ***F 24 F 110/50 (2018.01)*** ***F 24 F 110/64 (2018.01)***
F 24 F 110/70 (2018.01) ***F 24 F 110/76 (2018.01)*** ***F 24 F 120/10 (2018.01)***
F 24 F 120/12 (2018.01)

(45) Oversættelsen bekendtgjort den: **2020-11-23**

(80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2020-09-02**

(86) Europæisk ansøgning nr.: **18167889.7**

(86) Europæisk indleveringsdag: **2018-04-18**

(87) Den europæiske ansøgnings publiceringsdag: **2018-10-31**

(30) Prioritet: **2017-04-18 FI 20175350**

(84) Designerede stater: **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 MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **MULTISENSORENHED, EN ANORDNING OG EN FREMGANGSMÅDE TIL HÅNDTERING AF DE INDENDØRS KLIMABETINGELSER AF ET RUM ELLER AF EN ZONE**

(56) Fremdragne publikationer:
EP-A2- 2 163 832
EP-A2- 2 407 728
US-A1- 2012 064 818
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US-A1- 2016 116 178

DESCRIPTION

FIELD OF THE INVENTION

[0001] The invention relates to the field of building and construction technologies in general and to the field of building indoor climate management, and more particularly to a multisensor unit, an arrangement and a method for managing the indoor climate conditions of a room or of a zone.

BACKGROUND OF THE INVENTION

[0002] In the field of building and construction technologies, the indoor climate management is typically handled with different systems in the same building. In the winter and during the cold season a heating system is used to bring heat and warming to the indoor premises. In the summer and during warm/hot weather conditions the building typically has a cooling system or an air conditioning system for providing cool air to the premises of the building. There also can be a separate air ventilation system in the building providing for suitable fresh air to the premises. Also typically, in a building there is a separate lighting system providing light to the premises.

[0003] The indoor climate conditions of a room or a zone typically depend on the functioning or all the above mentioned different indoor climate management systems, i.e. a heating system, a cooling system, an air conditioning system, an air ventilation system a lighting system. Each of the said indoor climate management systems typically has control system with relevant sensor arrangements in place.

[0004] One example of an indoor climate management system according to the prior art may be seen in European Patent Application document EP 2 407 728 A2, which presents an air conditioner having an indoor unit with a thermopile type infrared sensor for detecting an indoor air temperature, a floor and wall temperature and a ceiling ambient temperature and a control device for controlling the air conditioner. However, the presented prior art air conditioner is only providing temperature measurement data and is not capable managing the indoor climate conditions in relation to the air condition and to air quality.

[0005] In prior art, there has been some arrangements where the different indoor climate management systems are somehow coordinated to bring savings and better coordination for the indoor climate management. However, typically each system typically relies on its own sensors for providing the climate management control.

BRIEF DESCRIPTION OF THE INVENTION

[0006] The object of the invention is to introduce a new solution for managing the indoor climate conditions of a room or of a zone, which would provide a simpler design and bring savings. There is a demand in the market for a more straightforward solution for indoor climate condition management of a room or of a zone in a building.

[0007] It is brought forward a new multisensor unit for managing the indoor climate conditions of a room or of a zone, which multisensor unit comprises a temperature detector for detecting the temperature in said room or said zone, and a thermal imaging sensor arranged to measure temperatures within its detection range in said room or in said zone, to detect the measured temperatures of the ceiling, wall, floor and/or a window in said room or in said zone and the measured skin temperature of human in said room or in said zone, and to detect the presence and/or position of human in said room or in said zone and/or the number of persons present in said room or in said zone, said multisensor unit is attached to the ceiling of said room or said zone, said multisensor unit furthermore comprises at least one air quality detector for detecting one or more parameters relating to the air condition/air quality and/or to the indoor climate conditions of said room or said zone; which multisensor unit is adapted to provide measurement data for said one or more parameters relating to the air condition/air quality and/or to the indoor climate conditions of said room or of said zone to a control unit, said control unit adapted to control indoor climate conditioning units for managing the indoor climate conditions of said room or of said zone. Hereby, one or more of the above-mentioned advantages and/or objectives are achieved. These advantages and/or objectives are further facilitated with the additional preferred features and/or steps described in the following.

[0008] In a preferred embodiment of said multisensor unit, said thermal imaging sensor is an infrared sensor.

[0009] In a preferred embodiment of said multisensor unit, said detection range of said thermal imaging sensor is arranged to cover the entire indoor space of said room or of said zone.

[0010] In a preferred embodiment of said multisensor unit, said thermal imaging sensor is arranged to detect when said room or in said zone is unoccupied.

[0011] In a preferred embodiment of said multisensor unit, said thermal imaging sensor is arranged to detect and provide information on the temperatures of said window for the determination of the outside weather conditions and for the determination whether the curtains, blinds or awnings are covering said window.

[0012] In a preferred embodiment of said multisensor unit, said thermal imaging sensor is arranged to detect the temperature gradient in said room or in said zone.

[0013] In a preferred embodiment of said multisensor unit, said temperature detector is a thermocouple type temperature detector or a thermopile type temperature detector.

[0014] In a preferred embodiment of said multisensor unit, said one or more parameters relating to the air condition/air quality and/or to the indoor climate conditions of said room or of said zone comprise parameters relating e.g. to oxygen content (O_2), to carbon dioxide content (CO_2), to dust particle content, to air purity or to air humidity.

[0015] It is also brought forward a new arrangement for managing the indoor climate conditions of a room or of a zone, which arrangement comprises a multisensor unit according to any of claims 1 to 8, which multisensor unit is adapted to provide measurement data for one or more parameters relating to the air condition/air quality and/or to the indoor climate conditions of said room or of said zone, a control unit, and indoor climate conditioning units.

[0016] In a preferred embodiment of said arrangement, said indoor climate conditioning units comprise a heating unit, a cooling/air conditioning unit, an air ventilation unit and/or a lighting unit.

[0017] It is also brought forward a new method for managing the indoor climate conditions of a room or of a zone, which method comprises the steps of:

- detecting the temperature in said room or said zone with a temperature detector of a multisensor unit according to any of claims 1 to 8, which multisensor unit is attached to the ceiling of said room or said zone,
- detecting one or more parameters relating to the air condition/air quality and/or to the indoor climate conditions of said room or said zone with an at least one air quality detector of said multisensor unit,
- measuring by a thermal imaging sensor of said multisensor unit temperatures within its detection range in said room or in said zone,
- detecting the measured temperatures of the ceiling, wall, floor and/or a window in said room or in said zone by a thermal imaging sensor of said multisensor unit,
- detecting the skin measured temperature of human in said room or in said zone by a thermal imaging sensor of said multisensor unit,
- detecting from said measured temperatures the presence and/or position of human in said room or said zone and/or the number of persons present in said room or in said zone by a thermal imaging sensor of said multisensor unit,
- providing measurement data for said one or more parameters relating to the air condition/air quality and/or to the indoor climate conditions of said room or of said zone by said multisensor unit, and- performing condition management actions by a control unit for controlling indoor climate conditioning units.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In the following, the present invention will be described in more detail by way of

example and with reference to the attached drawings, in which:

Figure 1 illustrates a sectional view depicting a positional relation between a room or a zone and a multisensor unit according to one embodiment of the present invention.

Figure 2 illustrates a perspective view depicting a relation between an indoor space of a room/zone and a sensing area of a thermal imaging sensor of a multisensor unit according to one embodiment of the present invention.

Figure 3 illustrates a diagrammatic representation depicting another embodiment of an installation of a multisensor unit according to the present invention.

Figure 4 illustrates an arrangement for managing the indoor climate conditions of a room or of a zone according to one embodiment of the present invention.

Figure 5 illustrates a method for managing the indoor climate conditions of a room or of a zone according to one embodiment of the present invention.

[0019] The foregoing aspects, features and advantages of the invention will be apparent from the drawings and the detailed description related thereto.

DETAILED DESCRIPTION

[0020] Figure 1 illustrates a sectional view depicting a positional relation between a room or a zone and a multisensor unit according to one embodiment of the present invention. The multisensor unit 1 according to the presented embodiment is attached to the ceiling 2 of a room or a zone. The multisensor unit 1 comprises a temperature detector 3 for detecting the temperature in the room or the zone and a thermal imaging sensor 4 for detecting the presence and/or position of human in the room or in the zone. The temperature detector 3 according to the present invention may e.g. be a thermocouple type temperature detector 3 or a thermopile type temperature detector 3. The thermal imaging sensor 4 according to the present invention may e.g. be an infrared sensor 4. Furthermore, the multisensor unit 1 comprises an at least one air quality detector for detecting parameters relating to the air condition/air quality and/or to the indoor climate conditions of the room or the zone. The said parameters relating to the air condition/air quality may comprise parameters relating e.g. to oxygen content (O_2), to carbon dioxide content (CO_2), to dust particle content, to air purity or to air humidity.

[0021] The thermal imaging sensor 4 of the multisensor unit 1 according to the presented embodiment is arranged to measure temperatures within its detection range in a room or in a zone. The said detection range of said thermal imaging sensor 4 may comprise a plurality of ranges 21-28 arranged perpendicularly to a first axial direction within its detection range in a room or in a zone. The detection range of said thermal imaging sensor 4 may allow the

thermal imaging sensor 4 to detect temperatures of the ceiling 2 as well as temperatures of the wall 5 and the temperatures of the floor 6 in a room or in a zone. Furthermore, the thermal imaging sensor 4 of the multisensor unit 1 according to the presented embodiment is arranged to detect the presence and/or position of human 7 in the room or in the zone. The thermal imaging sensor 4 of the multisensor unit 1 according to the presented embodiment may also detect the temperature gradient in the room or in the zone. Furthermore, said thermal imaging sensor 4 may detect the skin temperature of human 7 in the room or in the zone. Furthermore, the thermal imaging sensor 4 of the multisensor unit 1 according to the presented embodiment may detect the number of persons present in the room or in the zone. Said thermal imaging sensor 4 may also detect when the room or the zone is unoccupied.

[0022] Figure 2 illustrates a perspective view depicting a relation between an indoor space of a room/zone and a sensing area of a thermal imaging sensor of a multisensor unit according to one embodiment of the present invention. The multisensor unit 1 according to the presented embodiment is attached to the ceiling 2 of a room or a zone. The multisensor unit 1 comprises a temperature detector 3 for detecting the temperature in the room or the zone, a thermal imaging sensor 4 for detecting the presence and/or position of human in the room or in the zone and an at least one air quality detector for detecting parameters relating to the air condition/air quality and/or to the indoor climate conditions of the room or the zone.

[0023] The thermal imaging sensor 4 of the multisensor unit 1 according to the presented embodiment is arranged to measure temperatures within its detection range in a room or in a zone. The said detection range of said thermal imaging sensor 4 may comprise a plurality of ranges arranged perpendicularly to a first axial direction within its detection range in a room or in a zone. The detection range of said thermal imaging sensor 4 may allow the thermal imaging sensor 4 to detect temperatures of the ceiling 2 as well as temperatures of the wall 5 and the temperatures of the floor 6 in a room or in a zone. As shown in Figure 2, by rotating the thermal imaging sensor 4 gradually from a first axial direction to a second axial direction said detection range of said thermal imaging sensor 4 may comprise a plurality of ranges 21A-21B, 22A-22B, 23A-23B, 24A-24B, 25A-25B arranged perpendicularly to a first axial direction and to a second axial direction within its detection range in a room or in a zone. Likewise, by rotating the thermal imaging sensor 4 360 degrees the detection range of said thermal imaging sensor 4 is arranged to cover the entire indoor space of a room or of a zone. The multisensor unit 1 according to the present invention may be integrated to a ceiling element of the room or of the zone.

[0024] Figure 3 illustrates a diagrammatic representation depicting another embodiment of an installation of a multisensor unit according to the present invention. The multisensor unit 1 according to the presented embodiment is attached to the ceiling 2 of a room or a zone. The multisensor unit 1 according to the presented embodiment is attached to the ceiling 2 of a room or a zone. The multisensor unit 1 comprises a temperature detector 3 for detecting the temperature in the room or the zone, a thermal imaging sensor 4 for detecting the presence and/or position of human in the room or in the zone and an at least one air quality detector for detecting parameters relating to the air condition/air quality and/or to the indoor climate

conditions of the room or the zone.

[0025] The temperature detector 3 according to the present invention may e.g. be a thermocouple type temperature detector 3 or a thermopile type temperature detector 3. The thermal imaging sensor 4 according to the present invention may e.g. be an infrared sensor 4. Furthermore, the multisensor unit 1 comprises an at least one air quality detector for detecting parameters relating to the air condition/air quality and/or to the indoor climate conditions of the room or the zone. The said parameters relating to the air condition/air quality may comprise parameters relating e.g. to oxygen content (O_2), to carbon dioxide content (CO_2), to dust particle content or to air humidity.

[0026] The thermal imaging sensor 4 of the multisensor unit 1 according to the presented embodiment is arranged to measure temperatures within its detection range in a room or in a zone and to detect the presence and/or position of human 8, 9 in the room or in the zone. The detection range of said thermal imaging sensor 4 may allow the thermal imaging sensor 4 to detect temperatures of the ceiling 2 as well as temperatures of the wall 5 and the temperatures of the floor 6 in a room or in a zone.

[0027] Furthermore, when detecting temperatures of the wall 5 the thermal imaging sensor 4 of the multisensor unit 1 according to the presented embodiment is also arranged to detect the temperatures of a window 10 on the wall 5 in a room or in a zone. The multisensor unit 1 according to the presented invention may be arranged to detect and provide information on the temperatures of a window 10 for the determination of the outside weather conditions and for the determination, whether the curtains, blinds or awnings are covering the window 10. Furthermore, said multisensor unit 1 may be arranged to detect and provide information on the illumination level in a room or in a zone.

[0028] Figure 4 illustrates an arrangement for managing the indoor climate conditions of a room or of a zone according to one embodiment of the present invention. The arrangement for managing the indoor climate conditions of a room or of a zone according to one embodiment of the present invention comprises a multisensor unit 1 attached to the ceiling of a room or a zone, and a control unit 11 for controlling the indoor climate conditions of said room or of said zone. Furthermore, the arrangement for managing the indoor climate conditions of a room or of a zone according to the presented embodiment comprises indoor climate conditioning units 21-24 for managing the indoor climate conditions of said room or of said zone. Said indoor climate conditioning units 21-24 may e.g. comprise a heating unit 21, a cooling/air conditioning unit 22, an air ventilation unit 23 and a lighting unit 24.

[0029] In the arrangement for managing the indoor climate conditions of a room or of a zone according to the presented embodiment the multisensor unit 1 is adapted to provide measurement data for one or more parameters relating to the air condition/air quality and/or to the indoor climate conditions of the room or of the zone to the control unit 11 for the management of the indoor climate conditions of the room or of the zone. Furthermore, in the arrangement for managing the indoor climate conditions of a room or of a zone according to

the presented embodiment the control unit 11 is arranged to receive said measurement data for one or more parameters relating to the air condition/air quality and/or to the indoor climate conditions of said room or of said zone from the multisensor unit 1 and adapted to control said indoor climate conditioning units 21-24 for managing the indoor climate conditions of said room or of said zone. In the presented embodiment, the control unit 11 is adapted to control the heating unit 21, the cooling/air conditioning unit 22, the air ventilation unit 23 and the lighting unit 24.

[0030] Figure 5 illustrates a method for managing the indoor climate conditions of a room or of a zone according to one embodiment of the present invention. In the method for managing the indoor climate conditions of a room or of a zone according to one embodiment of the present invention the temperature in the room or the zone is detected 31 by the temperature detector 3 of the multisensor unit 1. Also, in said method, parameters relating to the air condition/air quality and/or to the indoor climate conditions of the room or of the zone are detected 32 by said at least one air quality detector of said multisensor unit 1. The said parameters relating to the air condition/air quality may comprise parameters relating e.g. to oxygen content (O_2), to carbon dioxide content (CO_2), to dust particle content or to air humidity.

[0031] After carrying out the steps of temperature detecting 31 and air condition/air quality detecting 32 the presence and/or position of human in the room or in the zone is detected 33 by the thermal imaging sensor 4 of the multisensor unit 1.

[0032] After carrying out the steps of temperature detecting 31 and air condition/air quality detecting 32, the multisensor unit 1 may or may not continue 34 with another measurement and repeat steps 31-33. The multisensor unit 1 may be instructed to or may be automated to carry out multiple measurements. In said multiple measurements the multisensor unit 1 may e.g. change the scanning pattern and/or scanning frequency of said thermal imaging sensor 4 in the step of detecting 32 the presence and/or position of human in the room or in the zone.

[0033] After carrying out enough measurements by repeating the steps 31-33, the multisensor unit 1 provides 35 measurement data for one or more parameters to the control unit 11 for determining the need for condition management of a room or of a zone. After receiving one or more parameters for the determination of the need for condition management of the room or of the zone the control unit 11 performs 36 condition management actions and controls the heating unit 21, a cooling/air conditioning unit 22, an air ventilation unit 23 and/or the lighting unit 24 according to said condition management actions.

[0034] With the help of the solution according to the present invention there is provided a new solution for managing the indoor climate conditions of a room or of a zone, which provides a simpler design and bring savings when compared to the prior art indoor climate condition management solutions.

[0035] It is to be understood that the above description and the accompanying Figures are only intended to teach the best way known to the inventors to make and use the invention. It

will be apparent to a person skilled in the art that the inventive concept can be implemented in various ways. The above-described embodiments of the invention may thus be modified or varied, without departing from the invention, as defined by the appending claims. It is therefore to be understood that the invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP2407728A2 [0004]

Patentkrav

1. Multisensorenhed (1) til håndtering af de indendørs klimabetingelser af et rum eller af en zone, hvilken multisensorenhed (1) omfatter:

- en temperaturdetektor (3) til at detektere temperaturen i nævnte rum eller nævnte zone, og

- en termisk afbildningssensor (4) indrettet

- til at måle temperaturer indenfor dens detektionsområde i nævnte rum eller i nævnte zone,

- til at detektere de målte temperaturer af loftet (2), væg (5), gulv (6) og/eller et vindue (10) i nævnte rum eller i nævnte zone og den målte hudtemperatur af menneske (7-9) i nævnte rum eller i nævnte zone, og

- til at detektere tilstedeværelsen og/eller position af menneske i nævnte rum eller i nævnte zone og/eller antallet af personer til stede i nævnte rum eller i nævnte zone,

hvor nævnte multisensorenhed (1) er **kendetegnet ved, at** nævnte multisensorenhed (1) er fastgjort til loftet (2) af nævnte rum eller nævnte zone, og at nævnte multisensorenhed (1) omfatter:

- en mindst en luftkvalitetsdetektor til at detektere et eller flere parametre der relaterer til luftkonditioneringen/luftkvaliteten og/eller til de indendørs klimabetingelser af nævnte rum eller nævnte zone;

- hvilken multisensorenhed (1) er indrettet til at tilvejebringe måledata for nævnte ene eller flere parametre der relaterer til luftkonditioneringen/luftkvaliteten og/eller til de indendørs klimabetingelser af nævnte rum eller af nævnte zone til en styreenhed (11), nævnte styreenhed (11) er indrettet til at styre indendørs klimakonditioneringsenheder (21-24) til håndtering af de indendørs klimabetingelser af nævnte rum eller af nævnte zone.

2. Multisensorenhed (1) ifølge krav 1, hvor nævnte termiske afbildningssensor (4) er en infrarød sensor (4).

3. Multisensorenhed (1) ifølge krav 1 eller krav 2, hvor nævnte detektionsområde af nævnte termiske afbildningssensor (4) er indrettet til at dække hele det indendørs rum af nævnte rum eller af nævnte zone.

4. Multisensorenhed (1) ifølge et hvilket som helst af de foregående krav 1-3, hvor nævnte termiske afbildningssensor (4) er indrettet til at detektere når nævnte rum eller i nævnte zone er ubeboet.

5. Multisensorenhed (1) ifølge et hvilket som helst af de foregående krav 1-4, hvor nævnte termiske afbildningssensor (4) er indrettet til at detektere og at tilvejebringe information om temperaturerne af nævnte vindue (10) til bestemmelsen af de udendørs vejrbetingelser og til bestemmelsen af hvorvidt gardinerne, persienner eller markiser dækker nævnte vindue (10).

6. Multisensorenhed (1) ifølge et hvilket som helst af de foregående krav 1-5, hvor nævnte termiske afbildningssensor (4) er indrettet til at detektere temperaturgradienten i nævnte rum eller i nævnte zone.

7. Multisensorenhed (1) ifølge et hvilket som helst af de foregående krav 1-6, hvor nævnte temperaturdetektor (3) er en termoelementtype temperaturdetektor (3) eller en termosøjletype temperaturdetektor (3).

8. Multisensorenhed (1) ifølge et hvilket som helst af de foregående krav 1-7, hvor nævnte ene eller flere parametre der relaterer til luftkonditioneringen/luftkvaliteten og/eller til de indendørs klimabetingelser af nævnte rum eller af nævnte zone omfatter parametre der relaterer eksempelvis til oxygenindhold (O_2), til kuldioxidindhold (CO_2), til støvpartikelindhold, til luftrenhed eller til luftfugtighed.

9. Anordning til håndtering af de indendørs klimabetingelser af et rum eller af en zone, hvilken anordning omfatter:

- en multisensorenhed (1) ifølge et hvilket som helst af kravene 1 til 8 fastgjort til loftet (2) af nævnte rum eller nævnte zone, hvilken

multisensorenhed (1) er indrettet til at tilvejebringe måledata for et eller flere parametre der relaterer til luftkonditioneringen/luftkvaliteten og/eller til de indendørs klimabetingelser af nævnte rum eller af nævnte zone,

- en styreenhed (11), og

- indendørs klimakonditioneringsenheder (21-24).

10. Anordning ifølge krav 9, hvor nævnte indendørs klimakonditioneringsenheder (21-24) omfatter en varmeenhed (21), en køle-/luftkonditioneringsenhed (22), en luftventilationsenhed (23) og/eller en lysenhed (24).

11. Fremgangsmåde til håndtering af de indendørs klimabetingelser af et rum eller af en zone, hvilken fremgangsmåde omfatter trinnene:

- at detektere (31) temperaturen i nævnte rum eller nævnte zone med en temperaturdetektor (3) af en multisensorenhed (1) ifølge et hvilket som helst af kravene 1 til 8, hvilken multisensorenhed (1) er fastgjort til loftet (2) af nævnte rum eller nævnte zone,

- at detektere (32) et eller flere parametre der relaterer til luftkonditioneringen/luftkvaliteten og/eller til de indendørs klimabetingelser af nævnte rum eller nævnte zone med en mindst en luftkvalitetsdetektor af nævnte multisensorenhed (1),

- at måle med en termisk afbildningssensor (4) af nævnte multisensorenhed (1) temperaturer indenfor dens detektionsområde i nævnte rum eller i nævnte zone,

- at detektere de målte temperaturer af loftet (2), væg (5), gulv (6) og/eller et vindue (10) i nævnte rum eller i nævnte zone med en termisk afbildningssensor (4) af nævnte multisensorenhed (1),

- at detektere den hudmålte temperatur af menneske (7-9) i nævnte rum eller i nævnte zone by en termisk afbildningssensor (4) af nævnte multisensorenhed (1),

- at detektere (33) fra nævnte målte temperaturer tilstedeværelsen og/eller position af menneske i nævnte rum eller nævnte zone og/eller

antallet af personer til stede i nævnte rum eller i nævnte zone af en termisk afbildningssensor (4) af nævnte multisensorenhed (1),

- at tilvejebringe (35) måledata for nævnte ene eller flere parametre der relaterer til luftkonditioneringen/luftkvaliteten og/eller til de indendørs klimabetingelser af nævnte rum eller af nævnte zone af nævnte multisensorenhed (1), og

- at udføre (36) konditioneringshåndteringshandlinger med en styreenhed (11) til styring af indendørs klimakonditioneringsenheder (21-24).

DRAWINGS

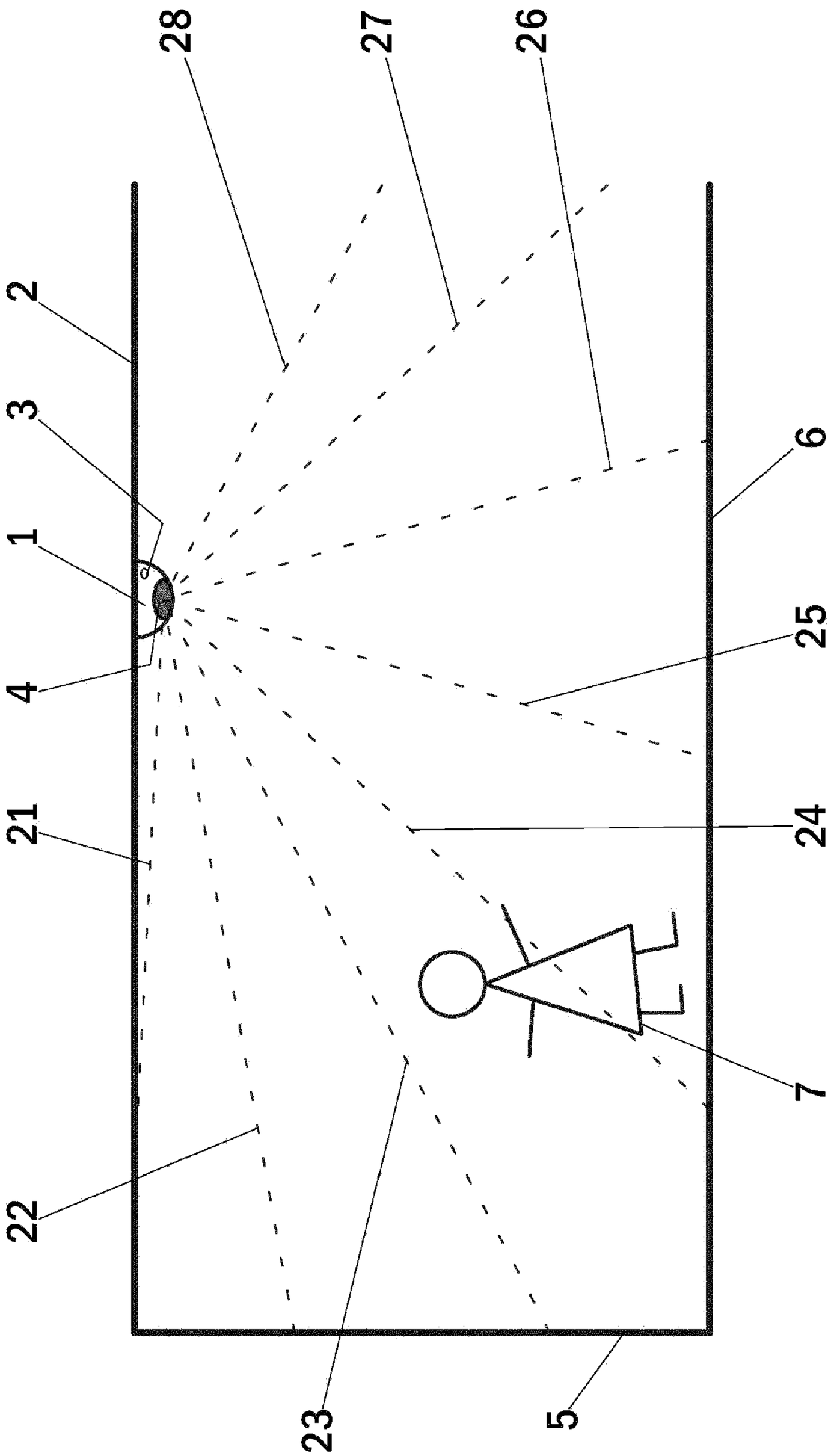

Fig. 1

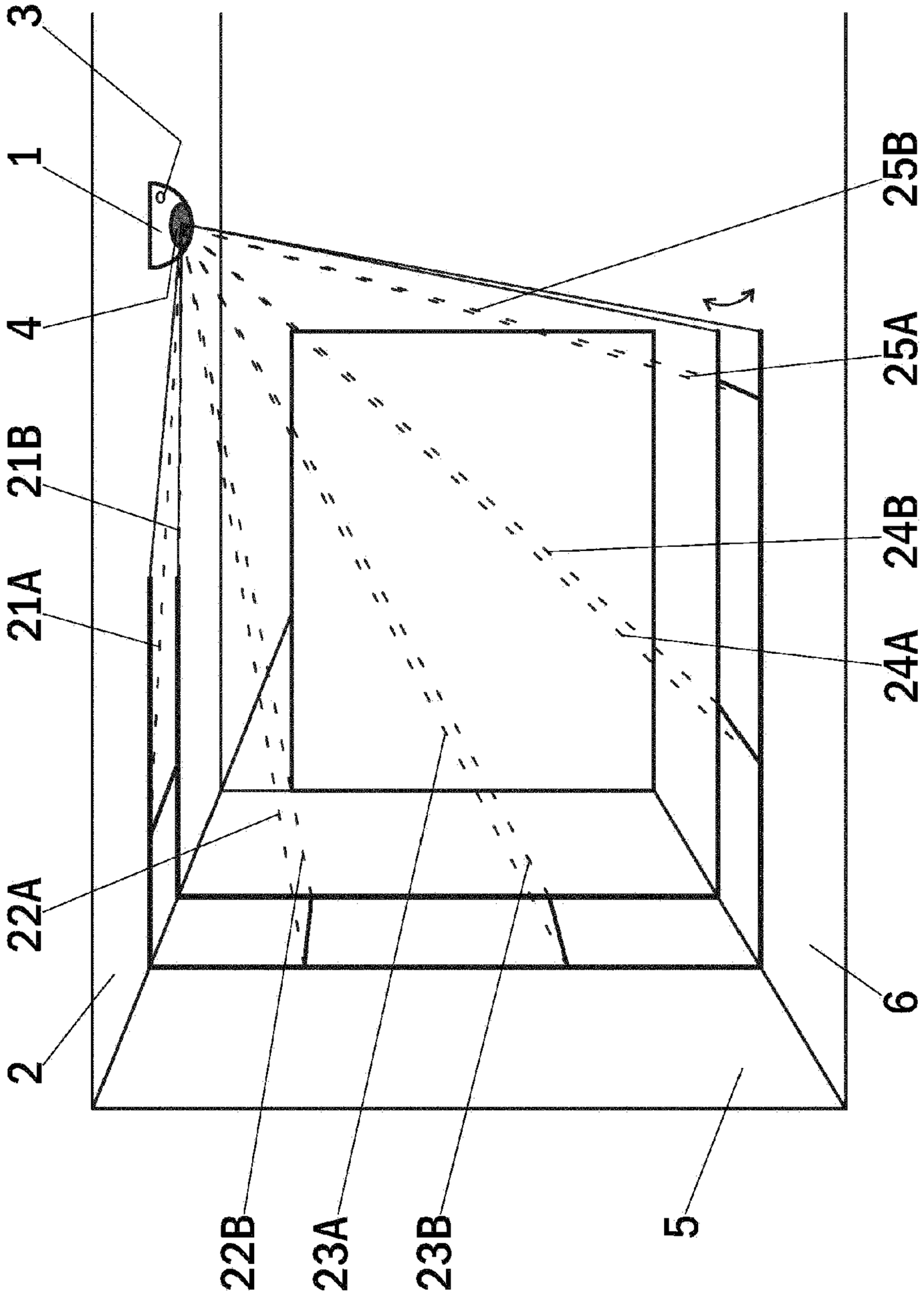

Fig. 2

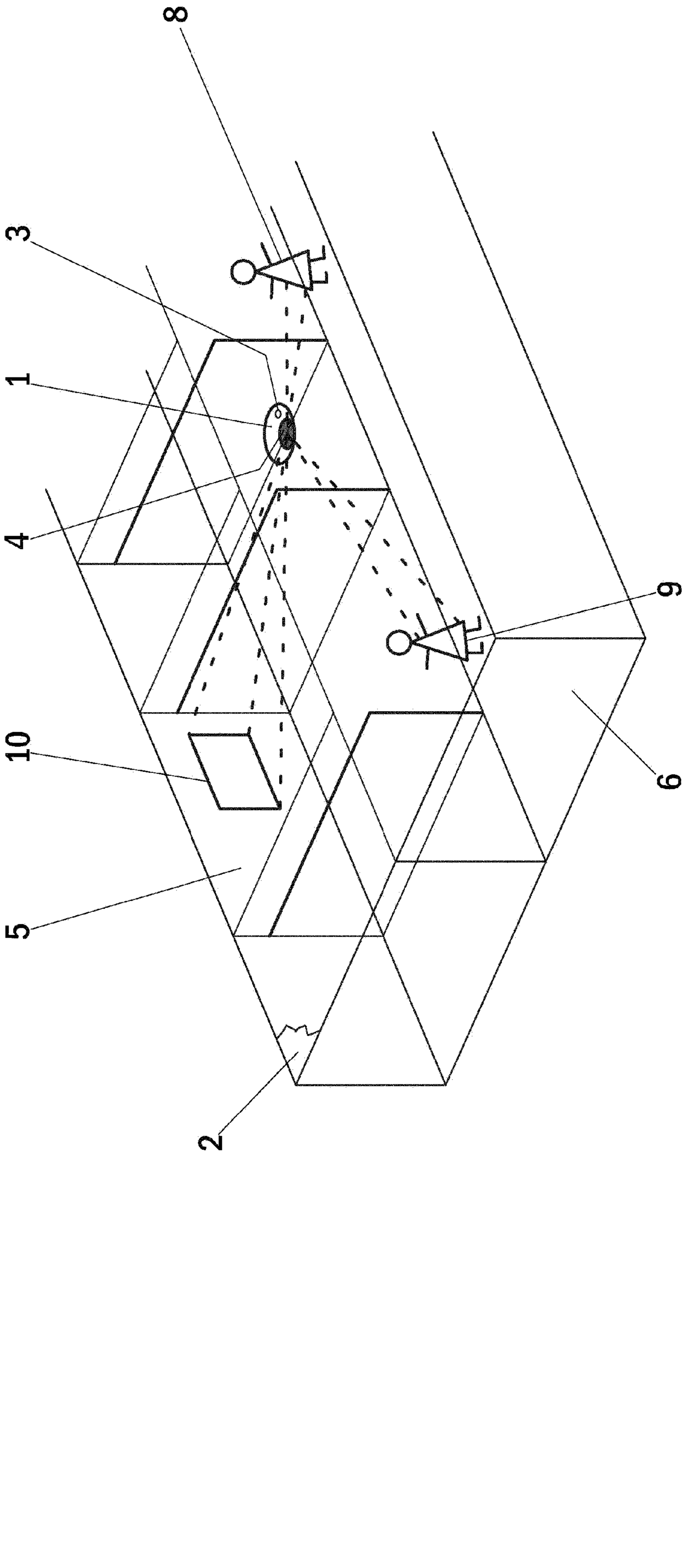

Fig. 3

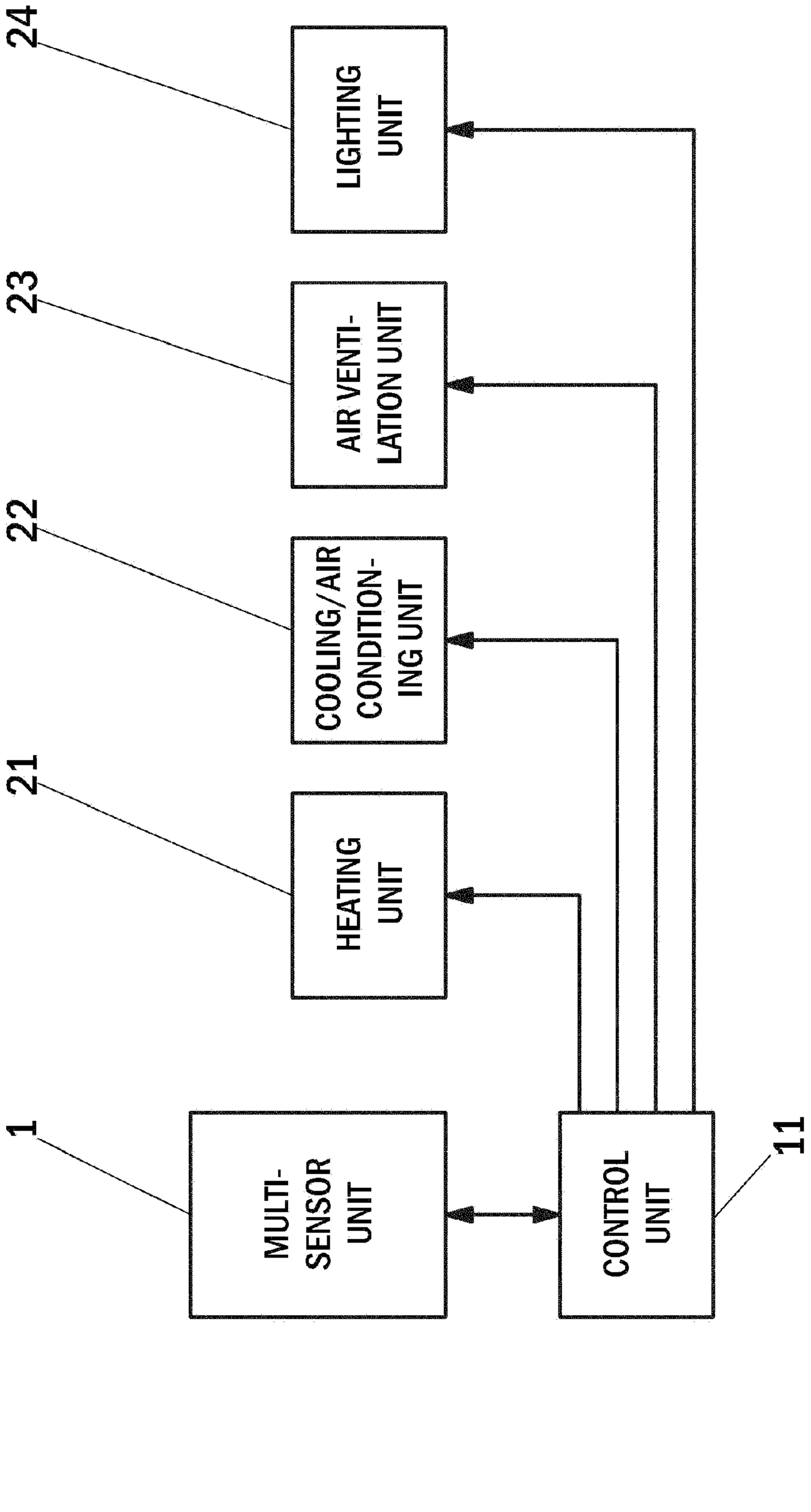
24
LIGHTING UNIT
23
AIR VENTI-LATION UNIT
22
COOLING/AIR CONDITION-ING UNIT
21
HEATING UNIT
1
MULTI-SENSOR UNIT
CONTROL UNIT
11

Fig. 4

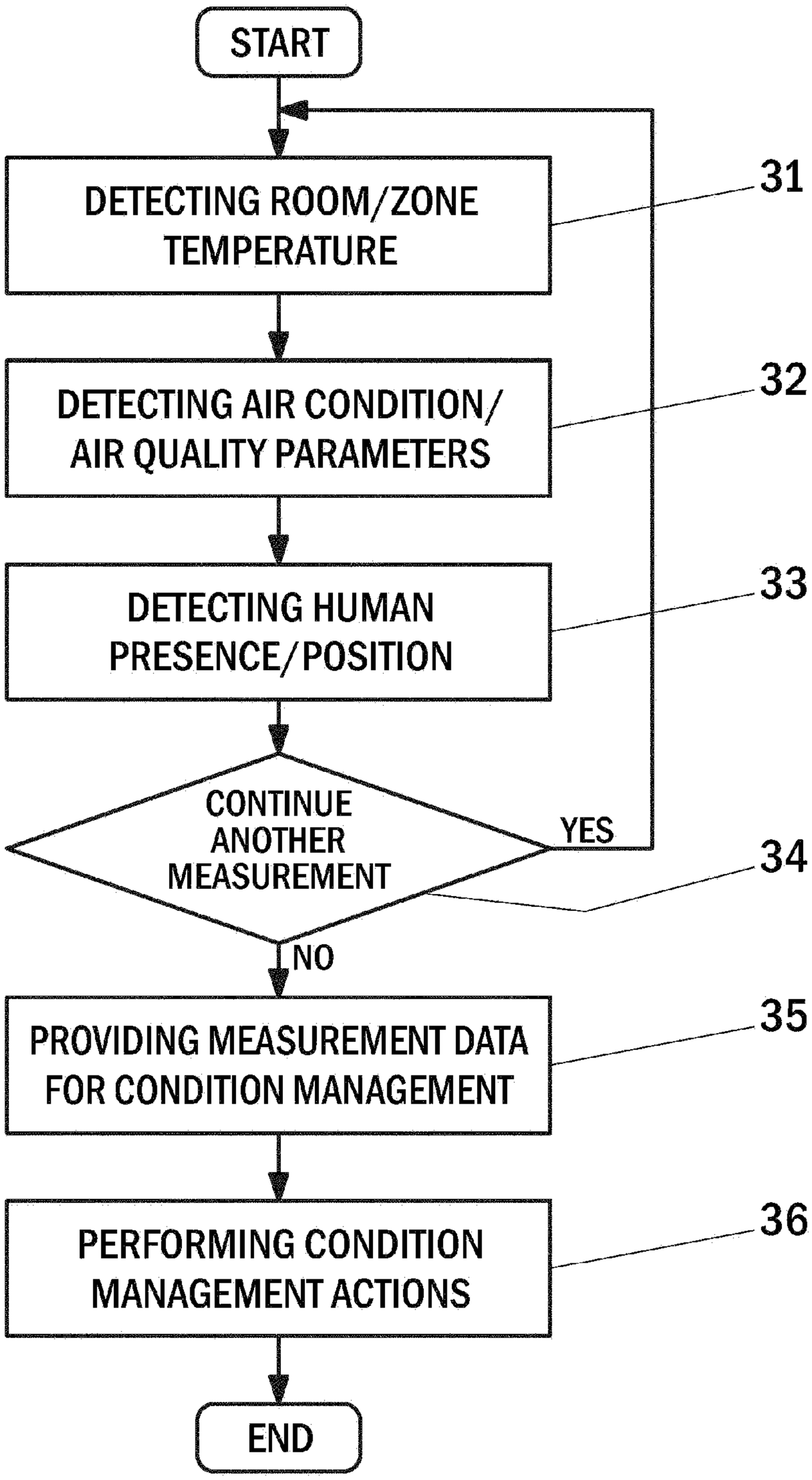
START
DETECTING ROOM/ZONE TEMPERATURE
31
DETECTING AIR CONDITION/ AIR QUALITY PARAMETERS
32
DETECTING HUMAN PRESENCE/POSITION
33
CONTINUE ANOTHER MEASUREMENT
YES
34
NO
PROVIDING MEASUREMENT DATA FOR CONDITION MANAGEMENT
35
PERFORMING CONDITION MANAGEMENT ACTIONS
36
END

Fig. 5