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(54) OPTICAL SIGNALING DEVICE FOR FIRE ALARM SYSTEMS

(57) An optical signaling device for fire alarm systems, which comprises a base (12) which supports first light source means (14a, 14b, 14c) which are associated with first reflective surfaces (16a', 16a", 16b', 16b", 16c', 16c") in order to illuminate, with a minimum lighting level, at least one portion of a first nominal volume (M') with the base (12) oriented in a first position, and second light source means (14d, 14e) which are associated with second reflective surfaces (16d, 16e) in order to illuminate at least one portion of a second nominal volume (M") with the base (12) oriented in a second position which is inclined about a horizontal axis with respect to the first position. The first light source means (14a, 14b, 14c) and the first reflective surfaces (16a', 16a", 16b', 16b", 16c', 16c") also illuminate the portion of the second nominal volume (M") that might not be illuminated by the second light source means (14d, 14e) and by the second reflective surfaces (16d, 16e) when the base (12) is oriented in the second position, and vice versa when the base (12) is oriented in the first position.

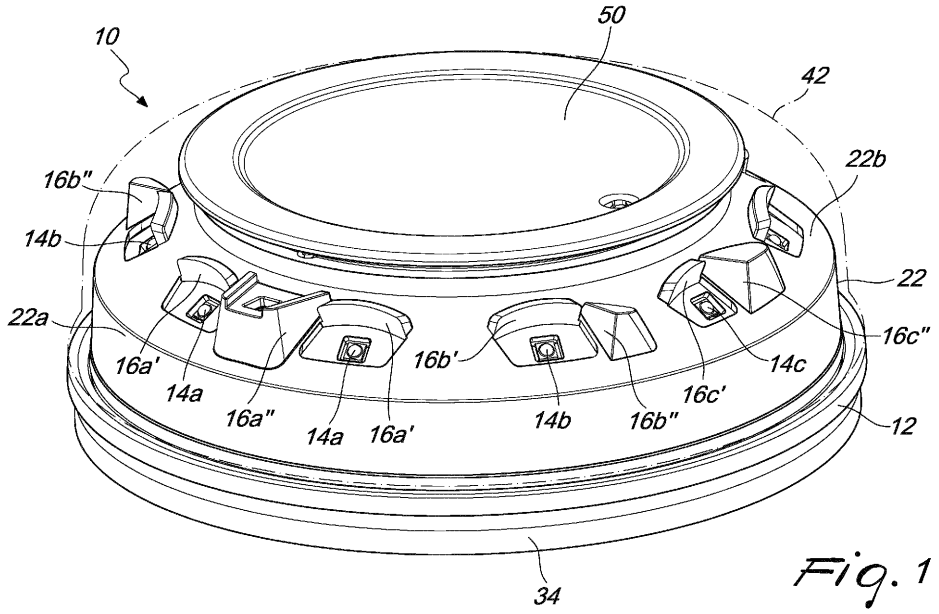


Fig. 1

EP 4 332 930 A1

Description

[0001] The present invention relates to an optical signaling device for fire alarm systems.

[0002] As is known, fire alarm systems can be installed in residential and work environments, the purpose of which is to alert the occupants in the event of danger.

[0003] Such fire alarm systems can comprise acoustic signaling devices and/or optical signaling devices and/or combined signaling devices which have both an acoustic component and an optical component. The signaling devices can be activated automatically by sensors of various types connected to the alarm system, e.g., smoke detectors, temperature sensors, and the like.

[0004] The optical signaling devices and combined signaling devices known today can generally comprise a light source, which in more recent systems is typically based on LEDs (Light Emitting Diodes), and a lens arranged so as to diffuse the light emitted by the light source in the area of interest.

[0005] As is well known to the person skilled in the art, in order to optimize the visibility of the light signal in accordance with the parameters laid down by the safety regulations, in conventional signaling devices the light source and the lens are configured differently according to whether the device is intended to be wall-mounted or ceiling-mounted.

[0006] This situation is undesirable because, on the one hand, it requires the manufacturer to produce two different versions of the signaling device, with an increase in production costs, and on the other hand it requires the installation technician to design the exact arrangement (wall-mounted or ceiling-mounted) in advance for all the signaling devices, with no possibility to modify the arrangement during installation work if contingent needs require it.

[0007] The aim of the present invention is to provide an optical signaling device for fire alarm systems that have greater versatility with respect to conventional devices, particularly with regard to the possibility of being installed both wall-mounted and ceiling-mounted on the basis of requirements, but in both cases observing the lighting parameters that ensure the necessary visibility to meet the safety regulations.

[0008] Within this aim, an object of the invention is to optimize the electric power consumption of the optical signaling device on the basis of the installation configuration, wall-mounted or ceiling-mounted, and on the basis of any particular conditions/geometries of the installation environment, e.g., with regard to any areas that are not covered or are blocked by an obstacle.

[0009] Another object of the invention is to provide an optical signaling device that can incorporate an acoustic component for the generation of an alarm sound signal.

[0010] This aim and these and other objects which will become clearer from the description that follows are achieved by an optical signaling device that has the characteristics of claim 1, while the dependent claims define other advantageous characteristics of the invention.

[0011] The invention will be described in greater detail, with reference to a preferred but not exclusive embodiment thereof, which is illustrated as a non-limiting example in the accompanying drawings, wherein:

Figure 1 is a perspective view of an optical signaling device according to the invention;
Figure 2 is an exploded perspective view of the optical signaling device according to the invention;
Figure 3 is an enlarged-scale view of a first portion of Figure 2;
Figure 4 is an enlarged-scale view of a second portion of Figure 2;
Figure 5 is a plan view of the optical signaling device according to the invention;
Figure 6 is a cross-sectional view taken along the plane VI-VI in Figure 5;
Figure 7 is a cross-sectional view taken along the plane VII-VII in Figure 5;
Figure 8 schematically illustrates the optical signaling device according to the invention, installed wall-mounted in a generic room;
Figure 9 schematically illustrates the optical signaling device according to the invention, installed ceiling-mounted in the same room as Figure 8.

[0012] With reference to Figure 1, an optical signaling device according to the present invention, generally designated by the reference numeral 10, is adapted to be installed in a generic environment for generating a visual alarm (and, in a preferred embodiment described and illustrated herein, advantageously an acoustic signal as well) in the event of fire.

[0013] In particular, the optical signaling device 10 can be connected to a generic fire alarm system (not shown) which monitors the above-mentioned environment.

[0014] As is known, in order to observe specific safety regulations, a generic optical signaling device must be capable of ensuring a minimum lighting level in all points inside a predetermined space, in particular, a first nominal volume if the device is intended to be installed wall-mounted, and a second nominal volume if the device is intended to be installed ceiling-mounted.

[0015] With reference now to Figures 2-5, the optical signaling device 10 comprises a base 12, which in the embodiment described herein is made of plastic material, and luminous signaling means 14 mounted on the base 12.

[0016] According to the invention, the luminous signaling means 14 comprise first light source means 14a, 14b, 14c which are associated with first reflective surfaces 16a', 16a", 16b', 16b", 16c', 16c" in a configuration that is such as to illuminate, with the above-mentioned minimum lighting level, at least one portion of a first nominal volume M' with the base 12 oriented in a first position, and second light source means 14d, 14e which are associated with second reflective surfaces 16d, 16e in a

configuration that is such as to illuminate, with the minimum lighting level, at least one portion of a second nominal volume M" with the base 12 oriented in a second position which is inclined about a horizontal axis with respect to the first position, wherein the first light source means 14a, 14b, 14c and the first reflective surfaces 16a', 16a", 16b', 16b", 16c', 16c" are furthermore configured to illuminate, with the minimum lighting level, the portion of the second nominal volume M" that might not be illuminated by the second light source means 14d, 14e and by the second reflective surfaces 16d, 16e when the base 12 is oriented in the second position, and vice versa when the base 12 is oriented in the first position; that is to say, the second light source means 14d, 14e and the second reflective surfaces 16d, 16e are configured to illuminate, with the minimum lighting level, the portion of the first nominal volume M' that might not be illuminated by the first light source means 14a, 14b, 14c and by the first reflective surfaces 16a', 16a", 16b', 16b", 16c', 16c" when the base 12 is oriented in the first position.

[0017] In the embodiment described herein, the first position is inclined at 90° with respect to the second position.

[0018] In particular:

- the first position refers to mounting the optical signaling device 10 with the base 12 arranged vertically in order to be fixed parallel to a vertical wall (known as "wall-mounted"). In this case, the first nominal volume that must be illuminated in observance of the parameters typically required by the safety regulations has a prismatic profile, as indicated by the reference letter M' in Figure 8;
- the second position refers to mounting the optical signaling device 10 with the base 12 oriented horizontally in order to be fixed parallel to a horizontal wall, typically a ceiling, a beam, or another structure that extends horizontally, obviously with the luminous part directed downward (known as "ceiling-mounted"). In this case, the second nominal volume that must be illuminated in observance of the parameters typically required by the safety regulations has a cylindrical profile, as indicated by the reference letter M" in Figure 9.

[0019] Advantageously, in this embodiment, the second light source means 14d, 14e and the second reflective surfaces 16d, 16e are configured to illuminate only a portion of the second nominal volume M" if the optical signaling device is ceiling-mounted (that is to say, with the base 12 oriented in the second position), while the first light source means 14a, 14b, 14c and the first reflective surfaces 16a', 16a", 16b', 16b", 16c', 16c" are configured to illuminate completely the first nominal volume M' if the optical signaling device is wall-mounted (that is to say, with the base 12 oriented in the first position), as well as the portion of the second nominal volume M" that is not illuminated by the second light source means 14d, 14e and by the second reflective surfaces 16d, 16e if the optical signaling device is ceiling-mounted.

[0020] Preferably, the first light source means 14a, 14b, 14c and the second light source means 14d, 14e can be activated independently of each other.

[0021] In this regard, in the embodiment described herein, the second light source means 14d, 14e are activated advantageously only if the optical signaling device is ceiling-mounted, since if the optical signaling device is wall-mounted it is not adapted to adequately illuminate the first nominal volume M'. As the person skilled in the art will be able to appreciate, this makes it possible to optimize the electric power consumption of the optical signaling device 10 on the basis of the installation configuration, according to one of the intended aims.

[0022] In the embodiment described herein and illustrated as an example, the first light source means 14a, 14b, 14c and the second light source means 14d, 14e comprise overall a plurality of light sources which are arranged substantially in a circle about an axis A (Figures 6 and 7), each one of such light sources having respective reflective surfaces associated therewith.

[0023] Advantageously, the individual light sources can be deactivated individually and/or in groups in order to optimize the energy consumption of the device with regard to any areas that are not covered or which are blocked by an obstacle, e.g., a wall.

[0024] Preferably, each one of the light sources consists of a light emitting diode (LED) of a per se conventional type.

[0025] In this embodiment, with reference to Figure 3, the light sources 14a, 14b, 14c, 14d, 14e are mounted on a printed circuit 18 which has an annular portion 18a which extends about the axis A and a plurality of flaps 18b which extend radially outward from the annular portion 18a and are connected thereto so that they can flex about an axis that is tangential to the annular portion, each one of such flaps 18b carrying a respective light source.

[0026] Each one of the flaps 18b is pressed against a respective post 20 which rises monolithically from the base 12, by a contoured locking element 25 which is screwed to the post 20 by way of a first screw V1 (Figures 2, 3 and 7). The contoured locking element 25 has a hole 25a aligned with the respective light source in order to allow the passage of the light generated by the light source.

[0027] In particular, each one of the posts 20 has a resting surface 20a (Figure 3), on which the flap 18b rests, which is inclined with respect to the axis A at an angle a (Figure 7). The angle a is calculated so as to conveniently direct the light emitted by the light source toward the respective reflective surfaces, so that the light reflected by the latter covers a predetermined portion of the nominal volume which the respective light source is intended to illuminate.

[0028] In the embodiment described herein, the resting surfaces 20a are all inclined at the same angle, equal to

55°. As the skilled person will easily grasp, according to the profile and the arrangement of the reflective surfaces, the angle a can be varied between 0° and 90°, although it has been found in practice that an inclination comprised between 20° and 75° facilitates optimization of the profiles of the reflective surfaces.

[0029] Each one of the contoured locking elements 25 is provided with a pair of centering pins 25b which can be engaged in corresponding centering seats 20b of the respective post 20 in order to ensure the correct positioning (Figure 3).

[0030] With particular reference now to Figures 3 and 6, an additional flap 18c extends radially outward parallel to the plane of the annular portion 18a of the printed circuit 18 and supports an indicator light 21 which indicates the operating status of the optical signaling device 10. The additional flap 18c rests on, and is screwed to, a turret 23 which rises from the base 12 between the light sources of the first pair, 14a.

[0031] With particular reference now to Figure 5, in the embodiment described and illustrated herein, if the circle defined by the light sources is divided into four quadrants Q1, Q2, Q3, Q4, the first light source means 14a, 14b, 14c comprise a first group of light sources which are uniformly distributed at mirror-symmetrical positions on a first quadrant Q1 and on a second quadrant Q2 which is adjacent to the first; similarly, the second light source means 14d, 14e comprise a second group of light sources which are uniformly distributed at mirror-symmetrical positions on a third quadrant Q3 and on a fourth quadrant Q4 which is adjacent to the third.

[0032] With reference to the first quadrant Q1 and to the second quadrant Q2, the first group of light sources comprises:

- a first pair of mirror-symmetrical light sources 14a, which is angularly spaced apart from the plane of symmetry by a first angle b' which, in this embodiment, is substantially equal to 18°,
- a second pair of mirror-symmetrical light sources 14b, which is angularly spaced apart from the plane of symmetry by a second angle b" which, in this embodiment, is substantially equal to 54°,
- a third pair of mirror-symmetrical light sources 14c, which is angularly spaced apart from the plane of symmetry by a third angle b‴ which, in this embodiment, is substantially equal to 90°.

[0033] Each one of the light sources of the first pair 14a, has:

- a first reflective surface associated therewith with cylindrical-parabolic geometry 16a' with its concavity directed outward, and
- a first flat reflective surface 16a" which extends obliquely both with respect to the axis A and with respect to the radial direction, between the respective light source 14a and the plane that divides the first quadrant Q1 from the second quadrant Q2.

[0034] Each one of the light sources of the second pair 14b, has:

- a second reflective surface associated therewith with cylindrical-parabolic geometry 16b' with its concavity directed outward, and
- a second flat reflective surface 16b" which extends obliquely both with respect to the axis A and with respect to the radial direction, between the respective light source and the light source of the third pair 14c, in the same quadrant Q1 or Q2.

[0035] Each one of the light sources of the third pair 14c, has:

- a third reflective surface associated therewith with cylindrical-parabolic geometry 16c' with its concavity directed outward, and
- a third flat reflective surface 16c" which extends on a respective plane that is substantially parallel to the axis A and is oblique with respect to the radial direction, between the respective light source and the light source that is closest to the adjacent quadrant between the third quadrant Q3 and the fourth quadrant Q4.

[0036] With reference to the third quadrant Q3 and to the fourth quadrant Q4, the second group of light sources comprises:

- a fourth pair of mirror-symmetrical light sources 14d, which is angularly spaced apart from the plane of symmetry by a fourth angle g' which, in this embodiment, is substantially equal to 18°, and
- a fifth pair of mirror-symmetrical light sources 14e, which is angularly spaced apart from the plane of symmetry by a fifth angle g" which, in this embodiment, is substantially equal to 54°.

[0037] Each one of the light sources of the fourth pair 14d, has a fourth reflective surface associated therewith with cylindrical-parabolic geometry 16d with its concavity directed outward.

[0038] Each one of the light sources of the fifth pair, 14e, has a fifth reflective surface associated therewith with parabolic geometry 16e with its concavity directed outward.

[0039] In this embodiment, the vertex generatrices of all the reflective surfaces with cylindrical-parabolic geometry lie on respective planes containing the axis A and axially passing through the respective light sources, and are inclined with respect to the axis A by an angle d (see Figure 7 with reference to the third reflective surface with cylindrical-parabolic geometry 16c') which is substantially equal to 22°.

[0040] In this embodiment, each one of the reflective

surfaces with cylindrical-parabolic geometry of the first quadrant Q1 and of the second quadrant Q2 has a profile that is non-symmetrical, in the sense that the side that extends from the vertex generatrix toward the respective flat reflective surface is shorter. By contrast, each one of the reflective surfaces with cylindrical-parabolic geometry of the third quadrant Q3 and of the fourth quadrant Q4 has a symmetrical profile.

[0041] In the embodiment described herein as an example, the reflective surfaces are provided monolithically on a dome 22 which lies above the light sources. The dome 22 can be advantageously molded from plastic material and made shiny using a chromium-plating process.

[0042] With particular reference to Figure 4, the dome 22 has a perimeter wall 22a that is substantially cylindrical, a connecting wall 22b that is frustum-shaped, and an end wall 22c that is flat.

[0043] The light sources 14a, 14b, 14c, 14d, 14e face onto respective windows 24 which are provided on the connecting wall 22b.

[0044] In this embodiment, the windows 24 have substantially quadrilateral differentiated profiles, and the reflective surfaces rise from the connecting wall 22b proximate to a side or to two adjacent sides of the respective windows 24, according to the light source with which they are associated.

[0045] The printed circuit 18 is functionally connected to a circuit board 26 which is screwed to the base 12 by way of a pair of second screws V2 (Figure 3).

[0046] The circuit board 26 is provided with a control unit (not shown) which controls the operation of the device and can be set using dip switches 27 or by the remote control unit (not shown) of the fire alarm system.

[0047] The dome 22 is screwed to the base 12 by way of a set of three third screws V3 (Figure 6).

[0048] In the preferred embodiment described and illustrated herein, the optical signaling device 10 is also provided with acoustic signaling means which are activated simultaneously with the luminous signaling means.

[0049] In more detail, and with particular reference to Figures 3 and 7, the acoustic signaling means comprise a piezoelectric disk 32 accommodated in a cylindrical seat 28 provided on the base 12 and closed by a lid 29, with interposition of a first gasket 29a. The piezoelectric disk 32 is functionally connected to the circuit board 26. The base 12 has a hole 30 in the center of the cylindrical seat 28 for the egress of the sound generated by the piezoelectric disk 32.

[0050] The base 12 is adapted to be connected to a fixing plate 34 provided with slits 36 in order to be fixed to a vertical wall or to a ceiling by way of a pair of fourth screws V4, illustrated in Figure 3. For its connection to the fixing plate 34, the base 12 is provided with respective contoured projections 38 (Figures 3 and 6) which are adapted to engage corresponding engagement seats 40 of the fixing plate 34 with a bayonet-like rotary action about the axis A.

[0051] The contoured projections 38 and the engagement seats 40 of the fixing plate 34 keep the base 12 spaced apart from the fixing plate 34, so as to allow the egress of the acoustic signal generated by the loudspeaker 32.

[0052] The optical signaling device 10 is provided with a transparent protective canopy 42, which can also be made of plastic material. The protective canopy 42 rests on the rim of the base 12, with interposition of a second annular gasket 44 which is seated in a corresponding perimeter groove 46 of the base 12 (Figure 3), and is fixed to the dome 22 by way of a set of three fifth screws V5 (Figure 6). The protective canopy 42 has a central opening 48 which is closed by a plate 50, with interposition of a third annular gasket 52 seated in a corresponding annular seat 54 which surrounds the central opening 48. The plate 50 is screwed to the dome 22 by way of a sixth screw V6 (Figures 4 and 7).

[0053] When installed, the optical signaling device 10 can be connected to a generic fire alarm system provided with sensors such as smoke detectors, temperature sensors and the like, so as to be automatically activated upon the triggering of one of such sensors. The electronics that manages the operation of the optical signaling device 10 forms part of the normal knowledge of the person skilled in the art and can be of per se conventional type, and therefore it will not be discussed further here.

[0054] With reference to Figure 8, the optical signaling device 10 can be wall-mounted with the first quadrant Q1 and the second quadrant Q2 directed downward. Using the dip switches 27, or remotely, the technician sets the operation corresponding to wall-mounted installation which, in the event of an alarm, as mentioned previously entails powering on only the light sources of the first quadrant Q1 and of the second quadrant Q2.

[0055] The light generated by the light sources of the first quadrant Q1 and of the second quadrant Q2, by being reflected in the respective reflective surfaces, illuminates the prismatic first nominal volume M' defined by the dimensions x, y and z in Figure 8.

[0056] With particular reference to the use of LEDs of conventional type, it has been found in practice that by varying the power supply current of the six LEDs of the first quadrant Q1 and of the second quadrant Q2, the level of illumination of each point of prismatic nominal volumes that have the dimensions x, y and z shown in the following table is greater than or equal to 0.4 lux:

Current (mA)	x (m)	y (m)	z (m)
100	2,4	4,4	3,5
150	2,4	5,4	4,6
200	2,7	6,2	5,2

[0057] With reference now to Figure 9, the optical signaling device 10 can also be installed ceiling-mounted (therefore, in a position inclined by 90° with respect to

the wall-mounted installation, about an axis that is parallel to the line separating the first quadrant Q1 and the second quadrant Q2 from the third quadrant Q3 and from the fourth quadrant Q4), and the operation can be set correspondingly using the dip switches 27 or remotely.

[0058] In this configuration, as mentioned previously, in the event of an alarm all the light sources of all the quadrants Q1, Q2, Q3 and Q4 will be activated. The light generated by the four light sources of the third quadrant Q3 and of the fourth quadrant Q4, by being reflected in the respective reflective surfaces, illuminates a portion of the cylindrical volume defined by the height H and by the radius R in Figure 9, while the light generated by the six light sources of the first quadrant Q1 and of the second quadrant Q2, by being reflected in the respective reflective surfaces, illuminates the remaining portion.

[0059] In this case too, with particular reference to the use of LEDs of conventional type, it has been found in practice that by varying the power supply current of the ten LEDs, the level of illumination of each point of cylindrical nominal volumes that have the dimensions height H and radius R shown in the following table is greater than or equal to 0.4 lux:

Current (mA)	H (m)	R (m)
100	3	2,4
150	3	2,9

[0060] Therefore it has also been found in practice that the optical signaling device 10 according to the invention fully achieves the set aims, in that it can be installed both wall-mounted and ceiling-mounted on the basis of requirements, but in both cases observing the lighting parameters that make it possible to ensure the necessary visibility to meet the safety regulations.

[0061] Furthermore, it has been shown that the preferred embodiment described herein makes it possible to optimize the electric power consumption of the optical signaling device on the basis of the installation configuration (wall-mounted or ceiling-mounted).

[0062] A preferred embodiment of the invention has been described, but obviously the person skilled in the art may make various modifications and variations, all of which are within the scope of protection of the claims.

[0063] For example, in the embodiment described herein the first light source means and the first reflective surfaces are configured to illuminate the entire nominal volume with the base 12 oriented in the first position (wall-mounted installation, in the example described herein), as well as a portion of the nominal volume with the base 12 oriented in the second position (ceiling-mounted installation, in the example described herein), while the second light source means and the second reflective surfaces are configured to illuminate the remaining part of the nominal volume with the base 12 oriented in the second position. Obviously, the person skilled in the art can devise a solution in reverse, in which the first light source means and the first reflective surfaces are configured to illuminate a part of the nominal volume with the base 12 oriented in the first position, while the second light source means and the second reflective surfaces are configured to illuminate the entire nominal volume with the base 12 oriented in the second position, as well as the remaining portion of the nominal volume with the base 12 oriented in the first position.

[0064] In another embodiment, the optical signaling device could have a group of light sources and of reflective surfaces that are used exclusively when mounted in the first position (wall-mounted installation), and a group of light sources and of reflective surfaces that are used exclusively when to mounted in the second position (ceiling-mounted installation), each one of the two groups being capable of illuminating the entire nominal volume.

[0065] Obviously, the number of light sources can be increased or reduced on the basis of the light intensity of the single source and of the parameters laid down by local regulations.

[0066] Furthermore, the control unit can be programmed to power on the light sources according to particular combinations and/or sequences, e.g., in order to signal malfunctions, give feedback during programming, and the like.

[0067] In order to further increase the versatility of the device, the latter could be provided with a number of light sources that is such as to meet the most stringent safety regulations, but allow the activation of only a part thereof if the installation is in an environment where the safety regulations are less stringent.

[0068] The disclosures in Italian Patent Application No. 102022000016281 from which this application claims priority are incorporated herein by reference.

[0069] Where the technical features mentioned in any claim are followed by reference numerals and/or signs, those reference numerals and/or signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference numerals and/or signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference numerals and/or signs.

Claims

1. An optical signaling device for fire alarm systems, which comprises a base (12) and luminous signaling means (14) mounted on said base (12), **characterized in that** said luminous signaling means (14) comprise first light source means (14a, 14b, 14c) which are associated with first reflective surfaces (16a', 16a", 16b', 16b", 16c', 16c") in a configuration that is such as to illuminate, with a minimum lighting level, at least one portion of a predetermined first nominal volume (M') with the base (12) oriented in a first position, and second light source means (14d,

14e) which are associated with second reflective surfaces (16d, 16e) in a configuration that is such as to illuminate, with said minimum lighting level, at least one portion of a second nominal volume (M") with the base (12) oriented in a second position which is inclined about a horizontal axis with respect to said first position, said first light source means (14a, 14b, 14c) and said first reflective surfaces (16a', 16a", 16b', 16b", 16c', 16c") being furthermore configured to illuminate, with said minimum lighting level, a portion of said second nominal volume (M") that might not be illuminated by said second light source means (14d, 14e) and by said second reflective surfaces (16d, 16e) when the base (12) is oriented in said second position, and vice versa when the base (12) is oriented in said first position.

2. The optical signaling device according to claim 1, **characterized in that** said second position is inclined at 90° with respect to said first position.

3. The optical signaling device according to claim 1 or 2, **characterized in that** said second light source means (14d, 14e) and said second reflective surfaces (16d, 16e) are configured to illuminate only a portion of said second nominal volume (M") when the base (12) is oriented in said second position, while said first light source means (14a, 14b, 14c) and said first reflective surfaces (16a', 16a", 16b', 16b", 16c', 16c") are configured to illuminate completely said first nominal volume (M') when the base (12) is oriented in said first position, and the portion of said second nominal volume (M") that is not illuminated by said second light source means (14d, 14e) and said second reflective surfaces (16d, 16e) when the base (12) is oriented in said second position.

4. The optical signaling device according to one of claims 1-3, **characterized in that** said first light source means (14a, 14b, 14c) and said second light source means (14d, 14e) can be activated independently of each other.

5. The optical signaling device according to one of claims 1-4, **characterized in that** said first light source means (14a, 14b, 14c) and said second light source means (14d, 14e) comprise overall a plurality of light sources which are arranged substantially in a circle around an axis (A), each one of said light sources having respective reflective surfaces associated therewith.

6. The optical signaling device according to claim 5, **characterized in that**, by dividing said circle defined by said light sources into four quadrants (Q1, Q2, Q3, Q4), said first light source means comprise a first group of light sources (14a, 14b, 14c) which are uniformly distributed at mirror-symmetrical positions on a first quadrant (Q1) and on a second quadrant (Q2) which is adjacent to the first, and said second light source means comprise a second group of light sources (14d, 14e) which are uniformly distributed at mirror-symmetrical positions on a third quadrant (Q3) and on a fourth quadrant (Q4) which is adjacent to the third.

7. The optical signaling device according to claim 6, **characterized in that** said first group of light sources comprises:

- a first pair of mirror-symmetrical light sources (14a), which is angularly spaced apart by a first angle (b') from the plane of symmetry,
- a second pair of mirror-symmetrical light sources (14b), which is angularly spaced apart by a second angle (b") from the plane of symmetry,
- a third pair of mirror-symmetrical light sources (14c) which is angularly spaced apart by a third angle (b‴) from the plane of symmetry.

8. The optical signaling device according to claim 7, **characterized in that** said first angle (b') is substantially equal to 18°, said second angle (b") is substantially equal to 54°, and said third angle (b‴) is substantially equal to 90°.

9. The optical signaling device according to claim 7 or 8, **characterized in that** each one of the light sources of the first pair (14a) has:

- a first reflective surface associated therewith with cylindrical-parabolic geometry (16a') with its concavity directed outward, and
- a first flat reflective surface (16a") which extends obliquely both with respect to said axis (A) and with respect to the radial direction, between the respective light source (14a) and the plane that divides said first quadrant (Q1) from said second quadrant (Q2),

each one of the light sources of the second pair (14b) has:

- a second reflective surface associated therewith with cylindrical-parabolic geometry (16b') with its concavity directed outward, and
- a second flat reflective surface (16b") which extends obliquely both with respect to the axis (A) and with respect to the radial direction, between the respective light source and the light source of the third pair (14c) in the same quadrant (Q1, Q2),

each one of the light sources of the third pair (14c) has:

- a third reflective surface associated therewith with cylindrical-parabolic geometry (16c') with its concavity directed outward, and
- a third flat reflective surface (16c") which extends on a respective plane that is substantially parallel to said axis (A) and is oblique with respect to the radial direction, between the respective light source and the light source that is closest to the adjacent quadrant between said third quadrant (Q3) and said fourth quadrant (Q4),

wherein the vertex generatrices of said reflective surfaces with cylindrical-parabolic geometry lie on respective radial planes axially passing through the respective light sources, and are inclined with respect to said axis (A) by an inclination angle (d).

10. The optical signaling device according to one of claims 6-9, **characterized in that** said second group of light sources comprises:

- a fourth pair of mirror-symmetrical light sources (14d), which is angularly spaced apart by a fourth angle (g') from the plane of symmetry, and
- a fifth pair of mirror-symmetrical light sources (14e), which is angularly spaced apart by a fifth angle (g") from the plane of symmetry.

11. The optical signaling device according to claim 10, **characterized in that** said fourth angle (g') is substantially equal to 18° and said fifth angle (g") is substantially equal to 54°.

12. The optical signaling device according to claim 10 or 11, **characterized in that**:

- each one of the light sources of the fourth pair (14d) has a fourth reflective surface associated therewith with cylindrical-parabolic geometry (16d) with its concavity directed outward, and
- each one of the light sources of the fifth pair (14e) has a fifth reflective surface associated therewith with parabolic geometry (16e) with its concavity directed outward,

wherein the vertex generatrices of said reflective surfaces with cylindrical-parabolic geometry lie on respective planes containing the axis (A) and axially passing through the respective light sources, and are inclined with respect to said axis (A) by an angle (d).

13. The optical signaling device according to claim 9 or 12, **characterized in that** said inclination angle (d) is substantially equal to 22°.

14. The optical signaling device according to one of claims 5-13, **characterized in that** said light sources (14a, 14b, 14c, 14d, 14e) are mounted on a printed circuit (18) which has an annular portion (18a) and a plurality of flaps (18b) which extend radially outward from said annular portion (18a) and are connected thereto so that they can flex about an axis that is tangential to the annular portion (18a), each one of said flaps (18b) having a respective light source mounted thereon and being pressed against a resting surface (20a) which is integral with said base (12) and is inclined with respect to said axis (A) by an angle (a) that is calculated so as to direct the light emitted by the light source toward the respective reflective surfaces, so that the light reflected by them covers a part of the nominal volume that is designed to be illuminated by them.

15. The optical signaling device according to one of claims 1-14, **characterized in that** said reflective surfaces are provided monolithically on a dome (22) which lies above the light sources and is provided with windows (24) which are faced by said light sources (14a, 14b, 14c, 14d, 14e).

16. The optical signaling device according to one of claims 5-15, **characterized in that** said light sources can be deactivated individually and/or in groups.

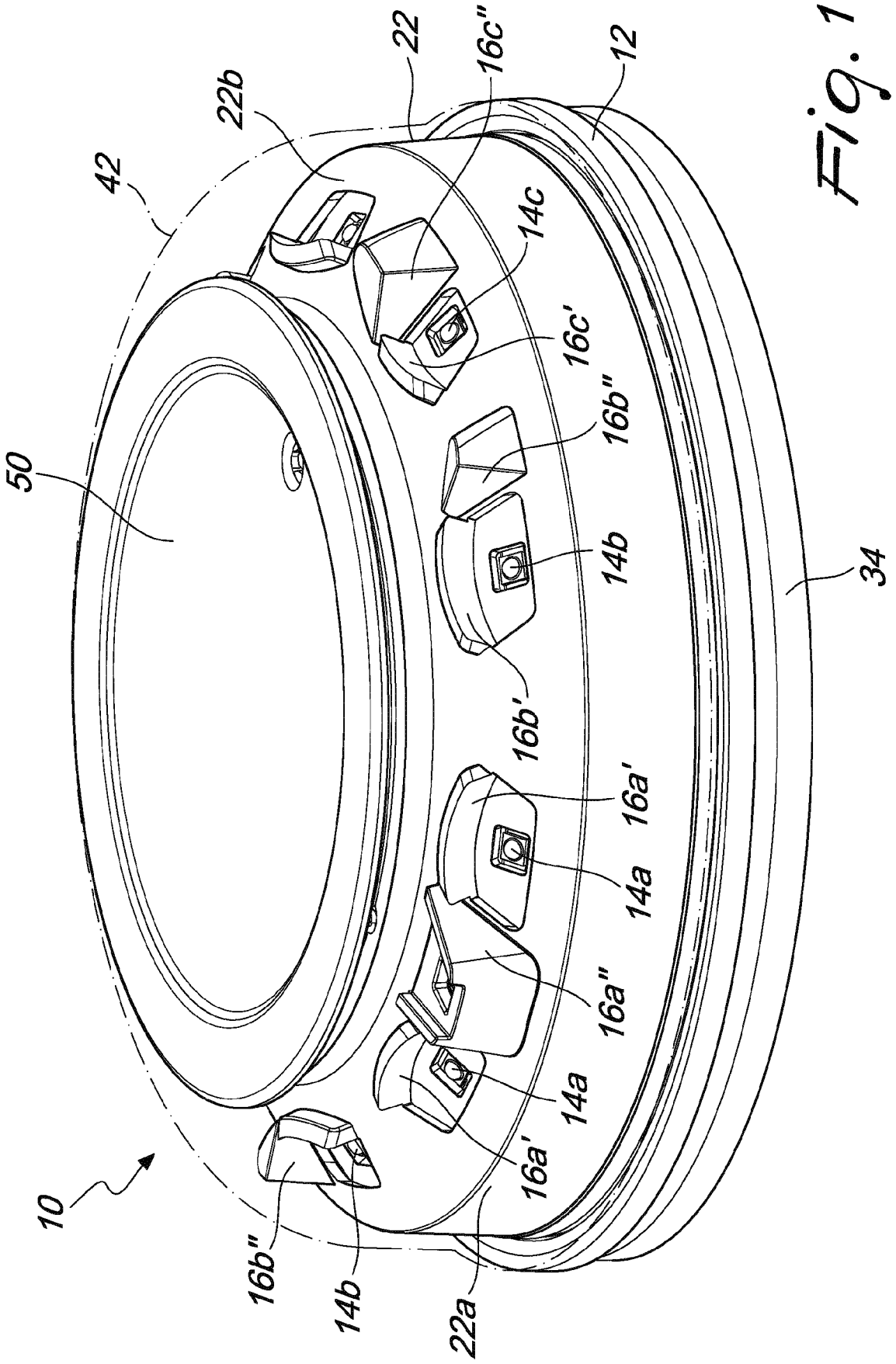
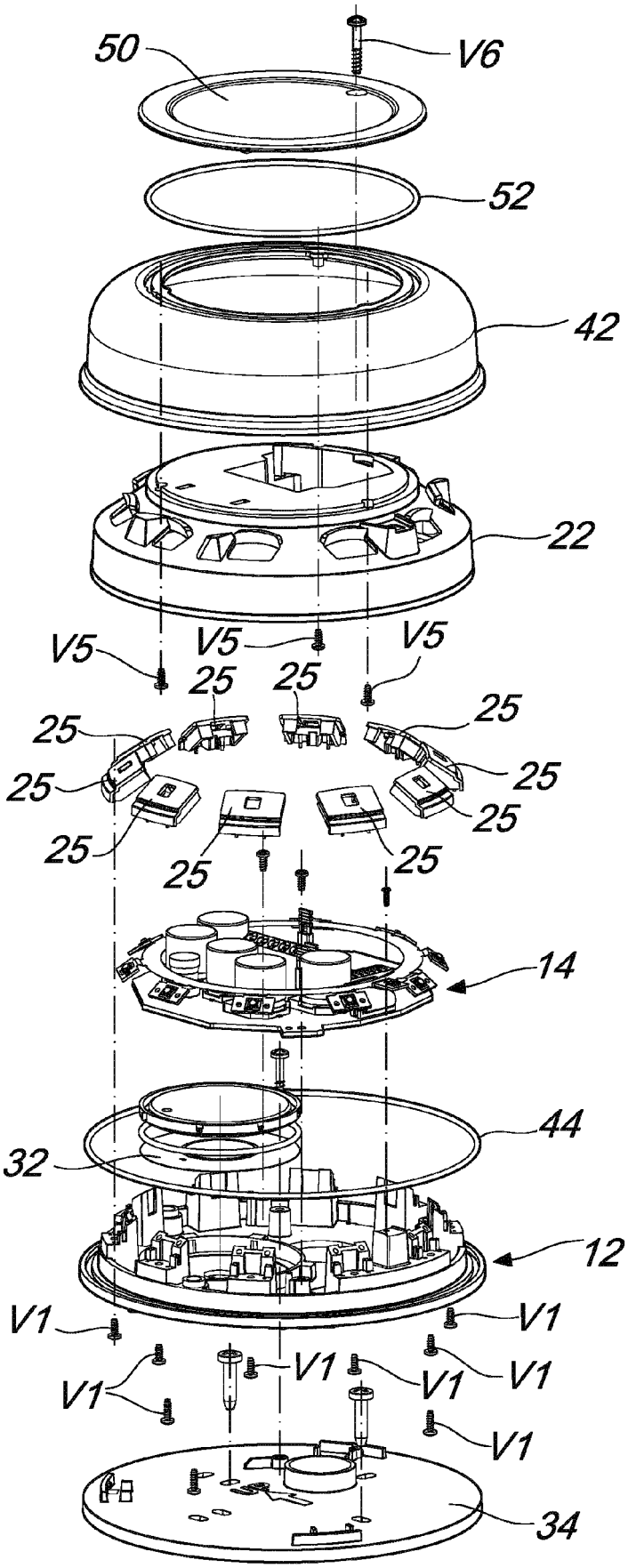

22
16c"
12
22b
42
14c
16c'
16b"
50
14b
34
16b'
16a'
14a
16a"
14a
16a'
10
16b"
14b
22a

Fig. 1


50
V6
52
42
22
V5
V5
V5
25
25
25
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25
25
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25
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44
32
12
V1
V1
V1
V1
V1
V1
V1
34

Fig. 2

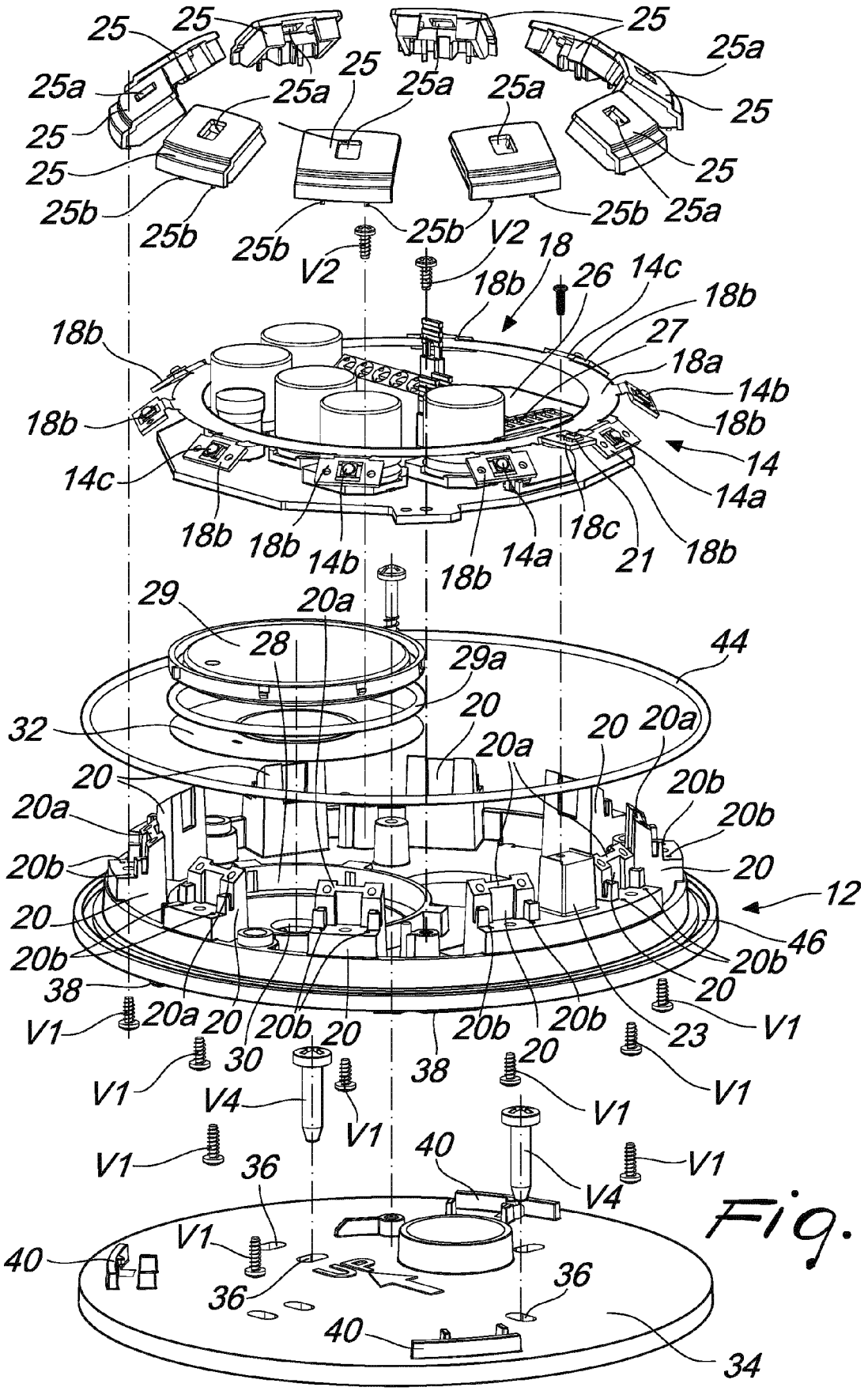
25
25a
25b
V2
18
18b
26
14c
27
18a
14b
14
14a
18c
21
29
20a
28
29a
44
32
20
20b
12
46
38
V1
30
V4
36
40
34

Fig. 3

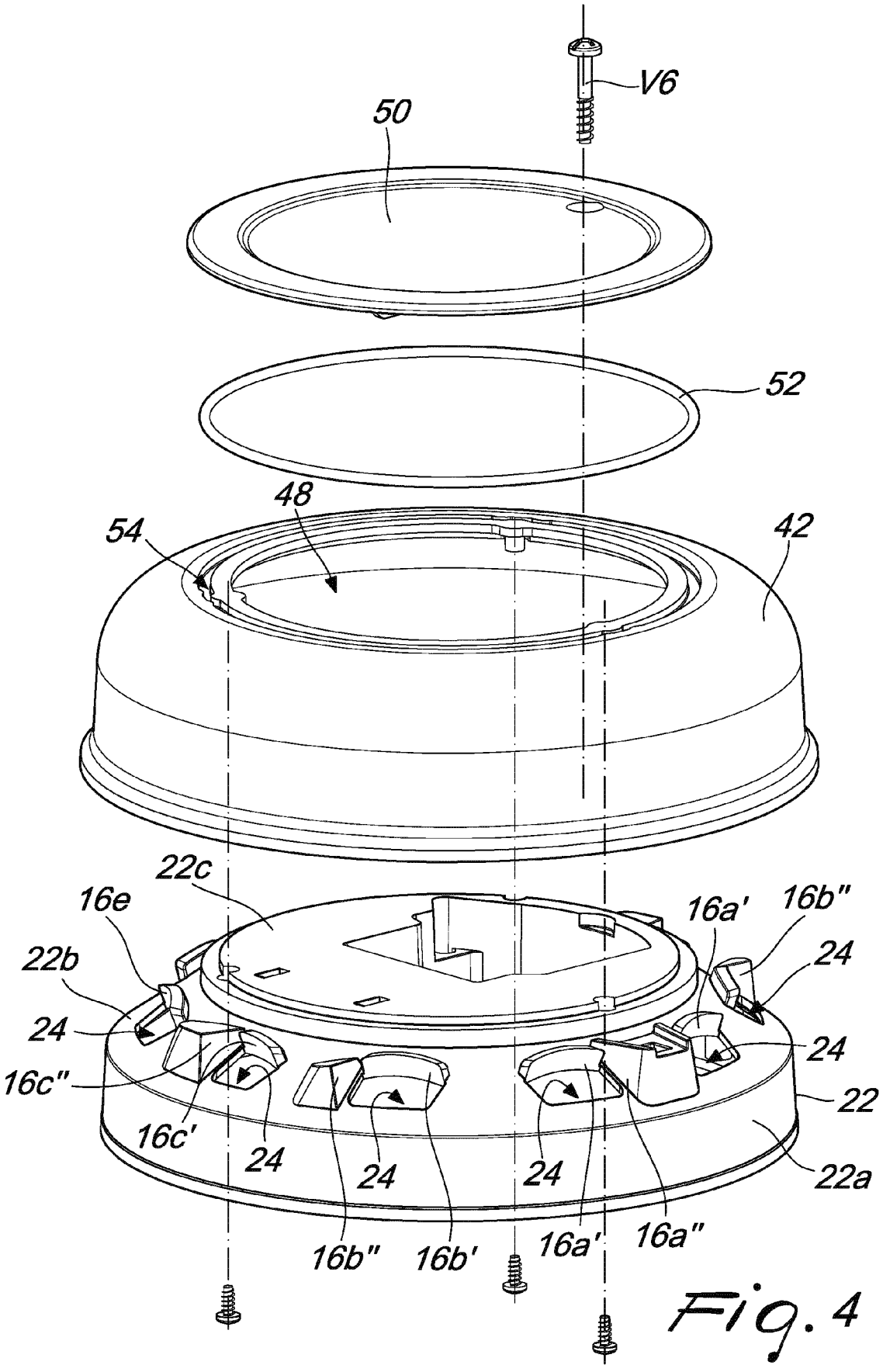
V6
50
52
48
54
42
22c
16e
22b
24
16c"
16c'
24
24
24
24
16b"
16b'
16a'
16a"
16a'
16b"
24
24
22
22a

Fig. 4

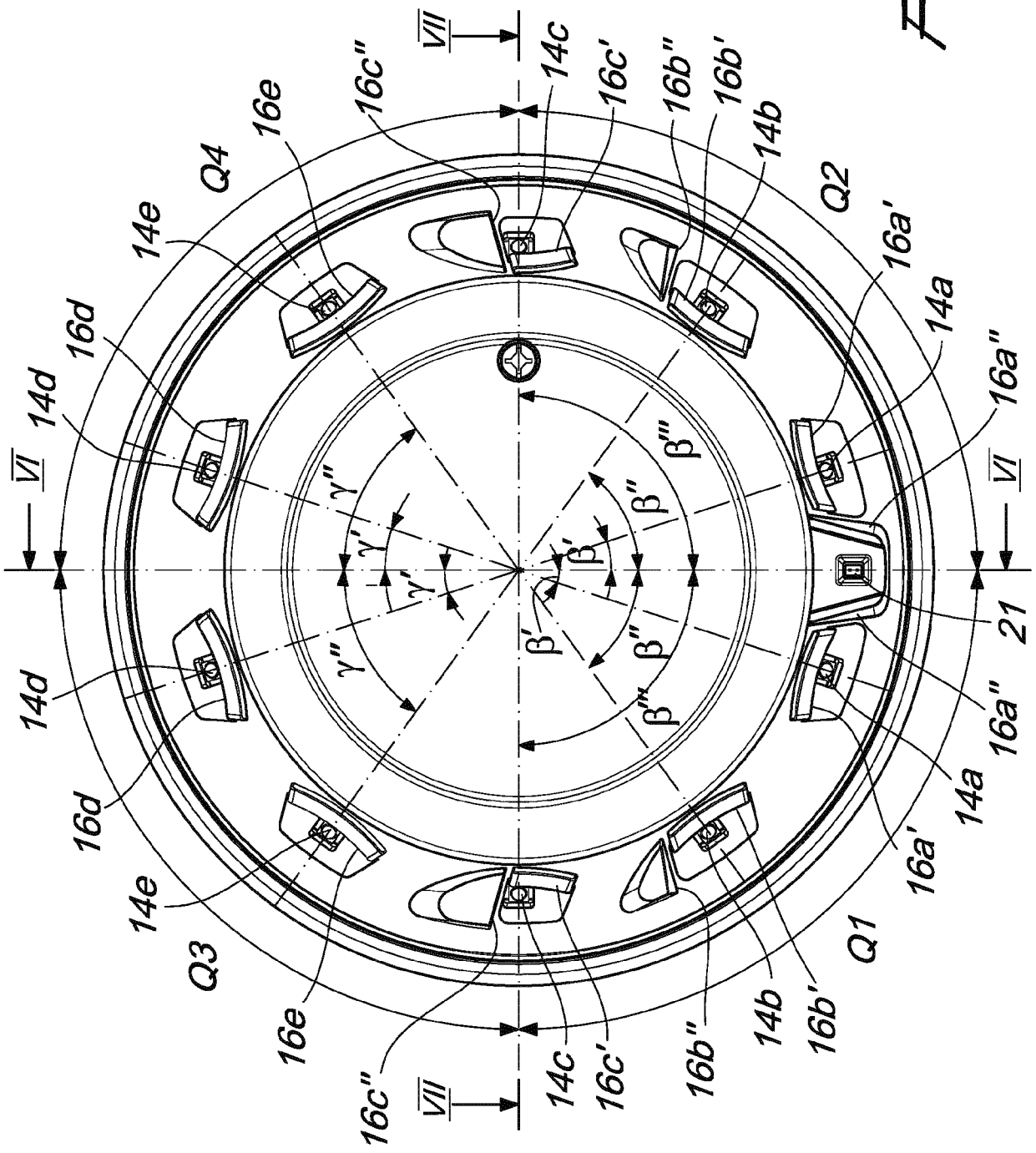
VII
VII
VIII
VIII
Q1
Q2
Q3
Q4
14a
14b
14c
14d
14e
16a'
16a"
16b'
16b"
16c'
16c"
16d
16e
21
β'
β"
β'''
γ'
γ"

Fig. 5

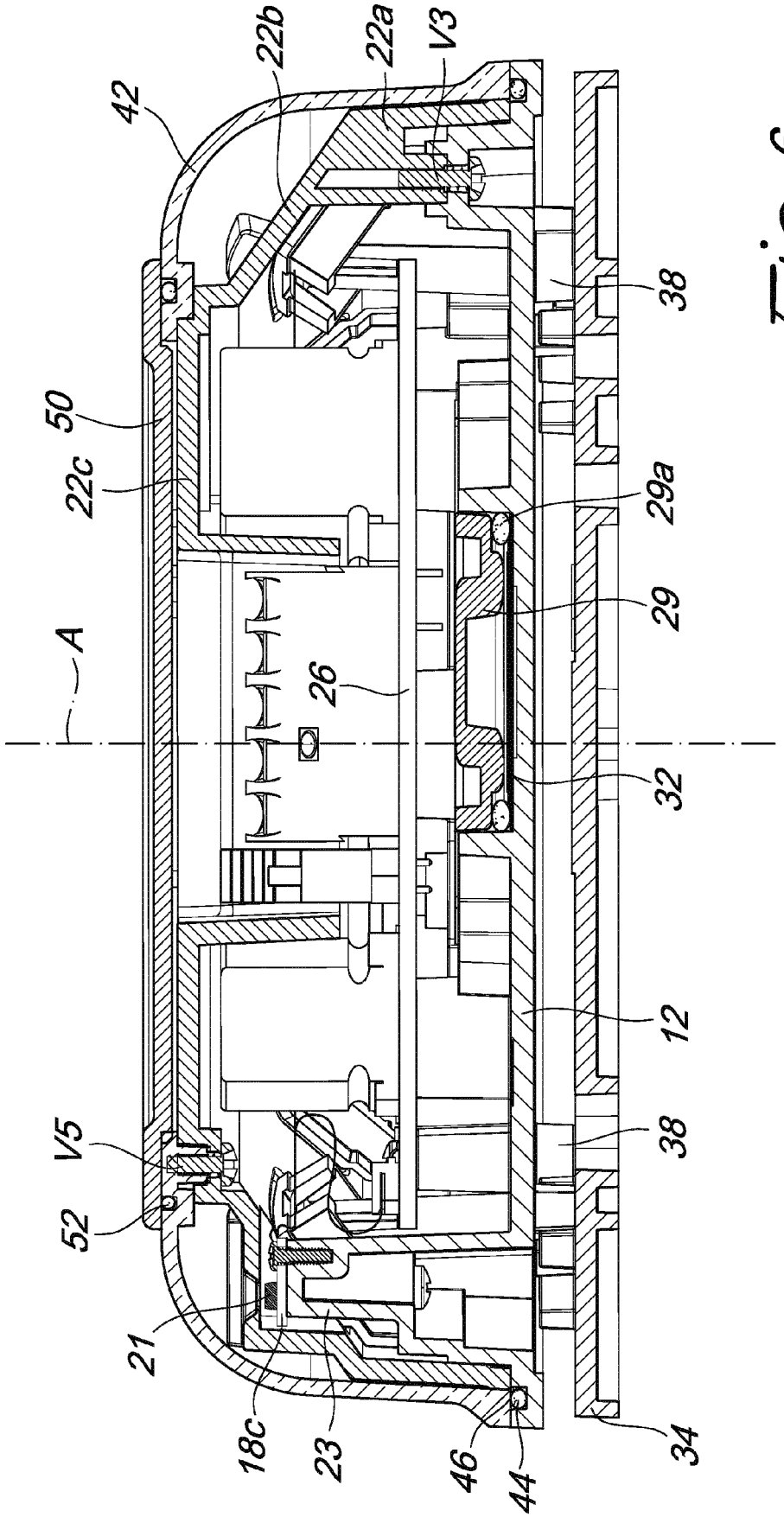

Fig. 6

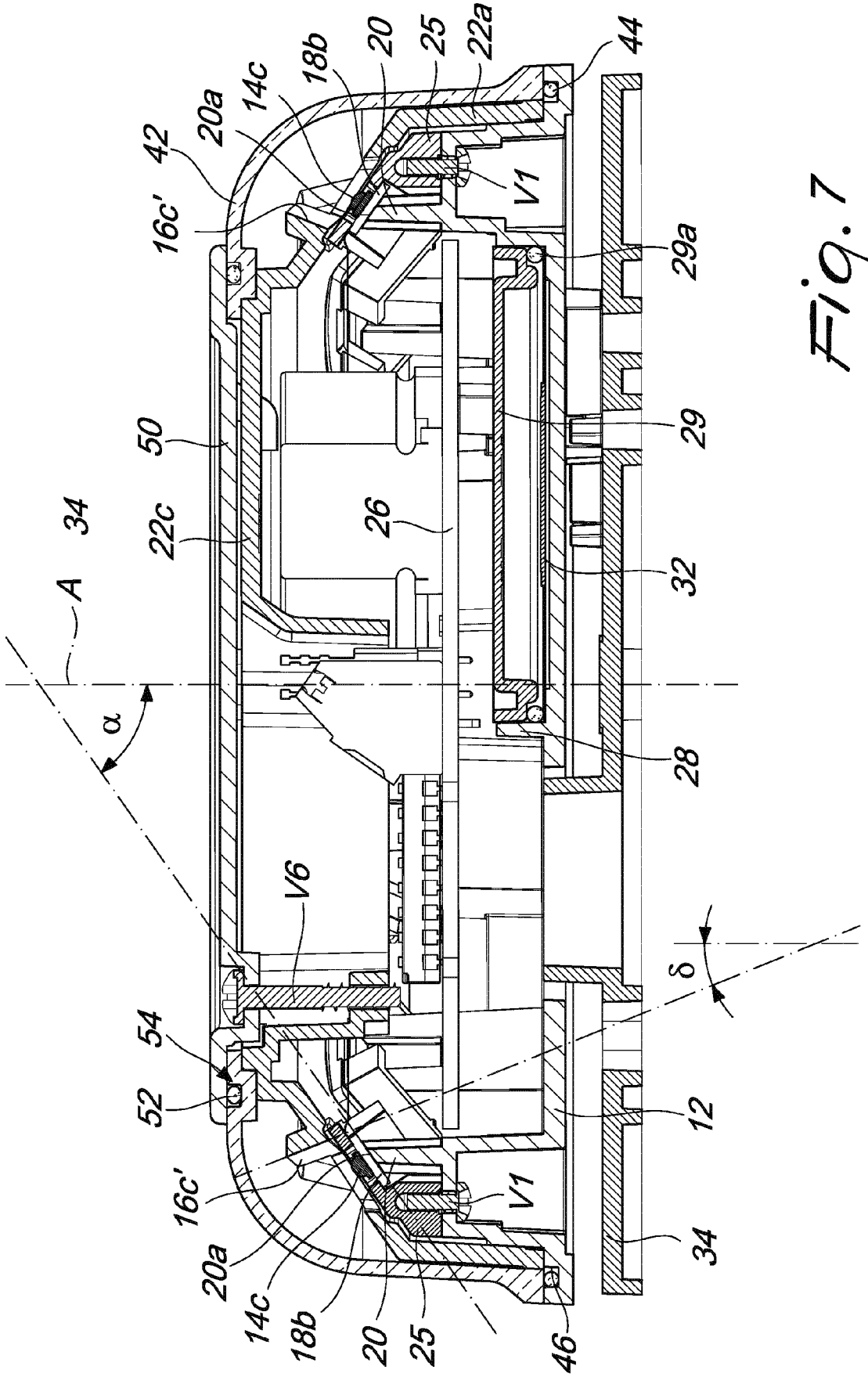
A
α
δ
V1
V6
42
16c'
20a
14c
18b
20
25
22a
44
29a
29
50
34
22c
26
32
28
54
52
12
46

Fig. 7

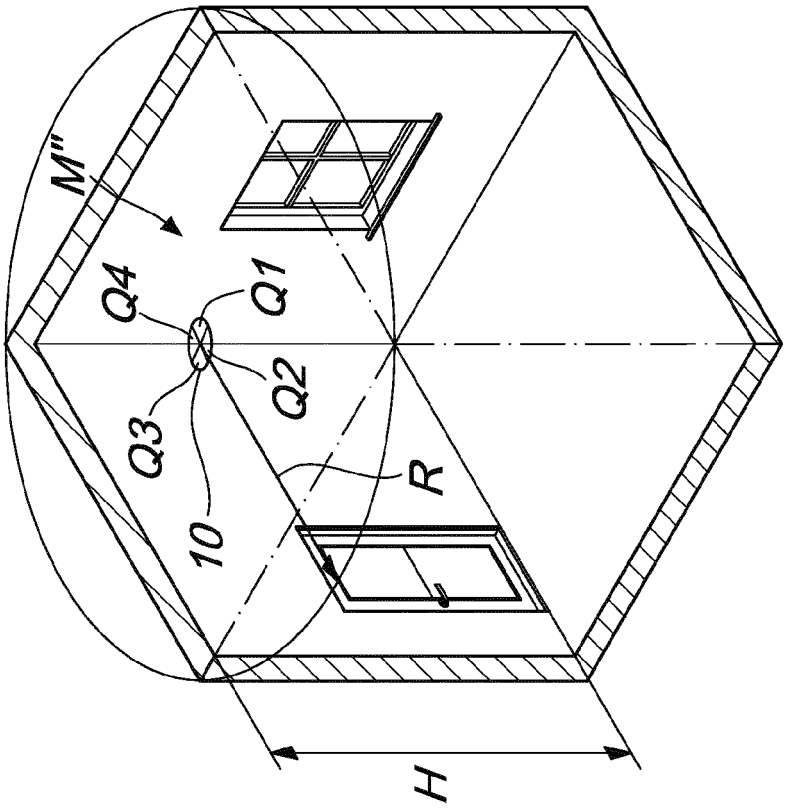

Fig. 9

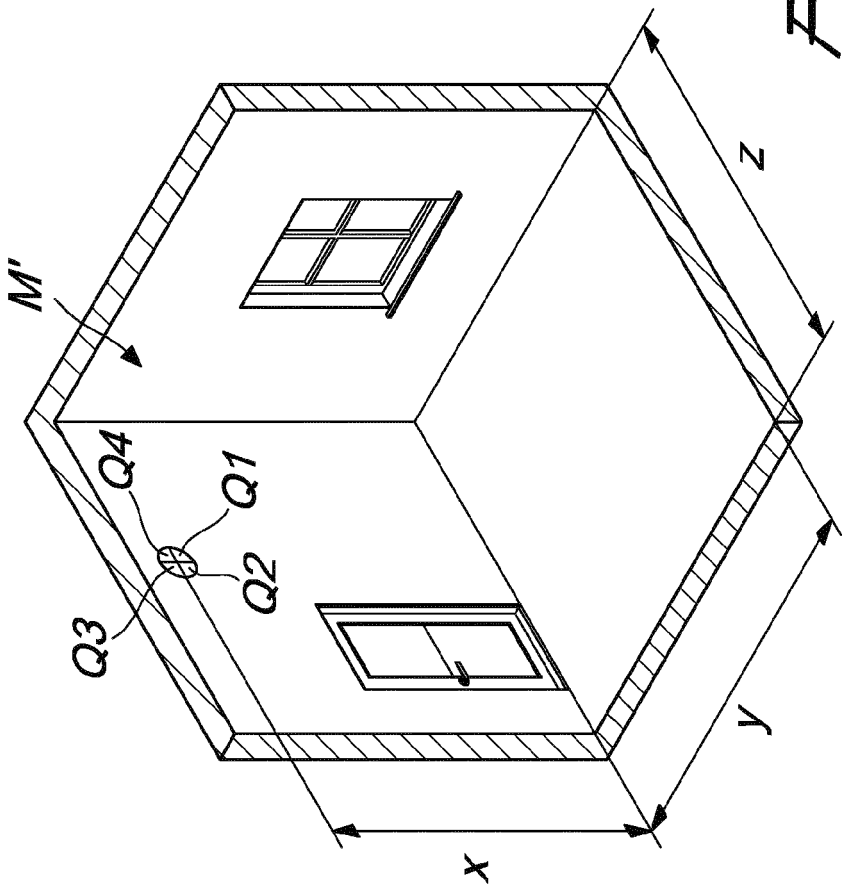

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 23 18 8207

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2020/250941 A1 (BARSON MICHAEL [GB]) 6 August 2020 (2020-08-06) * paragraphs [0001] - [0005], [0019], [0021] - [0031], [0045], [0046], [0049] - [0053]; figures 1,7,9 *	1-7,10, 14-16	INV. G08B5/36 G09F13/14
A	EP 3 321 898 A1 (SIEMENS SCHWEIZ AG [CH]) 16 May 2018 (2018-05-16) * paragraphs [0001] - [0010], [0023] - [0029], [0032] - [0035], [0037], [0039]; figures 1-3,4a,4b,4c,5a *	1,5-7, 14,15	
A	US 2005/128748 A1 (SUWA YOSHIKAZU [JP]) 16 June 2005 (2005-06-16) * paragraphs [0002], [0004], [0013], [0055], [0057], [0058], [0061] - [0065], [0069], [0071], [0072]; figures 1-3,5,16 *	1,2,6,15	
			TECHNICAL FIELDS SEARCHED (IPC)
			G08B G09F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	29 November 2023	Russo, Michela

CATEGORY OF CITED DOCUMENTS

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29-11-2023

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Patent documents cited in the description

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