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(54) **Sector light**

(57) Sector light, which comprises a light source unit (100), which comprises light source parts (301, 302, 303) one above another, which form layers one above another, for each color of at least one light source part. A light source part comprises a light source (101, 102, 103), the light of which is refracted with a lens (104, 105, 106) or mirror to be omnidirectional in at least mainly the horizontal direction. The sector light also comprises a cover for the light source unit, which cover is fitted in connection with the light source unit (100), and an obscuring wall unit (110), which comprises a light-impermeable obscuring wall (116). The obscuring wall (116) comprises light apertures (111, 112, 113, 114), from which light is visible in each layer in the desired direction in such a way that the desired sector or sectors of horizontal light remain in each layer. The obscuring wall unit (110) can be fixed to its mounting base (130) and the light source unit (100) can be detachably fixed, with fixing means, inside the obscuring wall unit (110) in such a way that the layers of the light source unit (100) and the layers of the obscuring wall unit (110) are face-to-face. The light source unit (100) can be replaced and/or removed from inside the obscuring wall unit (110) without needing to remove the obscuring wall unit (110) from its mounting base (130).

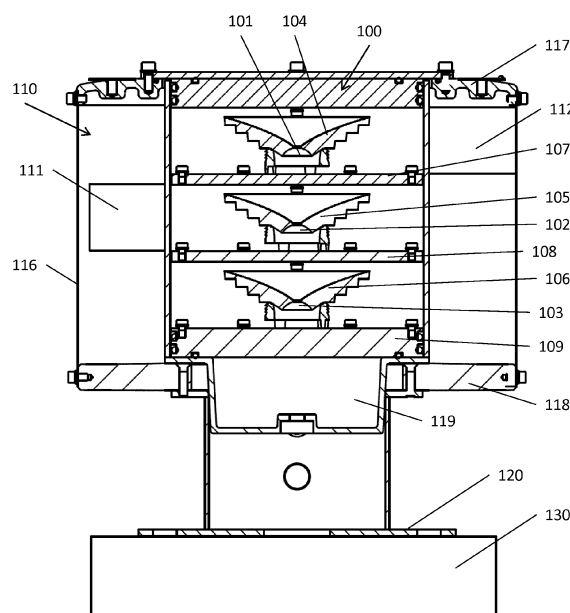


Fig. 1

Description

Field of the invention

[0001] The object of the present invention is a sector light to be used in the guidance of waterborne traffic.

Background of the invention

[0002] Nowadays sector lights based on incandescent light sources, such as on incandescent lamps and other corresponding light sources, are still used in the guidance of waterborne traffic. A problem with sector lights based on incandescent light sources, such as on incandescent lamps and other corresponding light sources, in addition to a large power requirement and comparatively short service life, is generally the mechanical arrangements of the sector plates, which arrangements generally cannot be included in the actual light device if accuracy is required, but instead they must be arranged outside the light device in which case in practice the whole light is installed inside a light housing. The installation and adjustment of sector glasses is precision mechanics work. Also the construction and maintenance of a light housing is expensive.

[0003] In order for a sector light to be effective and reliable, the zone of uncertainty must also be as small as possible, in which case the boundary between the sectors at different distances from the sector light is also accurate when viewed from the longer distances and the determination of position, *et cetera*, when using sector lights is therefore safe and reliable.

[0004] In addition, one of the worst deficiencies of sector lights based on incandescent light sources is a reduction of the light intensity of the colored sectors. In a conventional solution the colored light zones are formed by filtering from white light, using colored glass plates as filters. The use of filters reduces the light intensity of a red and green color typically to a level as low as 25% compared to the light intensity of a white color.

[0005] When using conventional solutions based on incandescent light sources, the rather large size and servicing requirement of lights also becomes a problem, because conventional light sources require space and they must also be serviced, i.e. the bulbs or the like in them must be replaced comparatively often.

[0006] Methods known in the art for using LED technology in sector lights are based on the fact that many low-power LED light sources are placed in a circle in such a way that the optical axis of the LED light sources is in the direction of the horizontal plane. The LED light sources are generally disposed inside a drum lens, by means of the drum lens the vertical angle of the light can be reduced. Sectors are created by disposing LED light sources of different colors on the same rim and by installing intermediate plates that are impermeable to light between the different-colored LED zones as sector boundaries, which plates are directed in the direction of

a radius leaving from the center point of the sector light. This method also has a number of limitations and problems. LEDs of different colors must be installed, for each specific sector, on the circuit board already in the manufacturing phase, so these types of sector lights are individual in terms of their light sources. In order to achieve even reasonable zones of uncertainty between different color sectors, the intermediate plates must be installed both inside and outside the drum lens of the light device, the outside intermediate plates with their support structures must be fabricated individually for each sector light. For achieving sufficient light intensity and sufficient homogeneity of the light intensity in the zone of the color sector in question, the minimum angle of an individual color sector is typically more than 20 degrees, depending on the number of LED light sources. The imprecision of a sector boundary is typically in the order of 1 degree or more, in addition the light intensity of a color zone typically decreases approaching the sector boundary.

[0007] Known in the art also is the sector light described in application FI20041703, which sector light is based on high-power LEDs. In the sector light of FI20041703 there is one or more LED light sources per each color, the light of which light source is refracted with a lens or mirror to be omnidirectional in at least mainly the horizontal direction. The sector light of FI20041703 is made up in the vertical direction, in which each color is on its own layer. For each layer (color) the number and width of the sectors can be freely selected in such a way that by moving sector plates, which are installed around the LED light sources and which prevent light passing through, the desired width and position of the sector is obtained. The number of sector plates can be selected freely. The sector plates can be moved, and the sector plates can also be adjusted in the field.

[0008] With known LED sector technology also a fully completed and measured sector light can be manufactured in the factory. All the sectors are preadjusted, but in order for the sectors to be aligned in the correct directions, the sector light must be rotated into the correct direction at the installation site.

[0009] After installation of a sector light, the owner (e.g. a marine navigation authority) performs a sector inspection. The sector inspection is performed at night by piloting a ship in the fairway in those directions in which the colors of a sector change. Generally the piloting is started from afar and the ship is piloted towards the sector light obliquely in such a way that the sector boundary is crossed. When, according to the visual assessment of the sector inspector, the color has changed, the position is recorded and the course is turned and the ship is piloted back over the sector boundary. This is generally done, according to the industry standard, four times at four different distances from the light. Typically it is necessary to inspect all sector boundaries. In one sector light there can be up to 9 - 10 sector boundaries to be inspected.

[0010] Inspecting sector boundaries is therefore laborious and incurs high costs. In prior-art solutions sector

inspections have always to be carried out if the sector light has to be detached from its fixings, e.g. for repairing the light sources or for replacing the light sources. Also, by means of prior-art solutions based on LED light sources, it is not possible to use in different sector lights one, or only a few, light source types, the storage of which would be easy, because each sector light according to prior art is tailored to be suitable only for its own position.

Brief description of the invention

[0011] The aim of the solution according to the invention is to eliminate or reduce known problems and to achieve a sector light, for use more particularly in the guidance of waterborne traffic, the light source of which sector light can be detached, e.g. for repair, and fixed back without the sector light having to be aligned and the sector boundaries having to be inspected again.

[0012] The sector light of the solution according to the invention comprises a light source unit, which comprises light source parts one above another, which form layers one above another, for each color of at least one light source part. A light source part comprises a light source, the light of which is refracted with a lens or mirror to be omnidirectional in at least mainly the horizontal direction and a cover for the light source unit, which cover is fitted in connection with the light source unit. The cover for the light source unit protects the light source unit from external stresses. The sector light also comprises an obscuring wall unit, which comprises an obscuring wall that does not let light pass through, comprising light apertures in a number of layers, from which light is visible from each layer of the light source unit in the desired direction to outside the sector light in such a way that the desired sector or sectors of horizontal light remain in each layer. The obscuring wall unit can be fixed to its mounting base and the light source unit can be detachably fixed, with fixing means, inside the obscuring wall unit in such a way that the layers of the light source unit and the light apertures of the obscuring wall unit corresponding to the layers are face-to-face. The light source unit can be replaced and/or removed from inside the obscuring wall unit without needing to detach the obscuring wall unit from its mounting base.

[0013] In one embodiment of the invention the light source, e.g. a high-power LED light source, which can be a few watts in its output, in the sector light is placed on the horizontal plane directed directly upwards or downwards. An optical lens and/or reflector is used in connection with the light source, which lens or reflector turns the light in the direction of the horizontal plane with the desired vertical distribution of the light. The light radiates in the horizontal plane symmetrically to an area of 360 degrees and is visible through the lens or mirror as a vertical and narrow line-shaped light. The vertical opening angle of the light can also be affected with the lens or reflector. The lens or reflector is either separate or integrated as a part of the light source.

[0014] By means of the invention a sector light is achieved that is extremely precise in its sector boundaries, is simple and is extremely reliable in operation, and which is suited particularly for use in the guidance of waterborne traffic, and the light source unit of which can be replaced without the sector boundaries needing to be inspected after the refastening of the light source unit.

[0015] By means of the solution according to the invention the same kinds of light source units can also be used in many different sector lights, unlike in solutions based on LED light sources known in the art, in which the light source units are individual, because in the solution of the present invention the sectors of the sector light are determined by means of an obscuring wall unit fixed to its mounting base. This enables the storage of many spare light sources of one type that are suited to a different sector light and the utilization of them when it is desired to replace the light source units of a sector light. Updating light sources to a newer model or more effective version is also easy, because a light source unit can be replaced in a sector light without changing and inspecting the sector zones.

[0016] The characteristic features of the apparatus according to the invention are presented in detail in the claims below.

Brief description of the figures

[0017] In the following, the invention will be described in more detail by the aid some embodiments with reference to the drawings 1 -4, wherein

Fig. 1 presents a cross-section of an exemplary embodiment of a sector light according to the invention;

Fig. 2 presents a cross-section of an exemplary embodiment of a sector light according to the invention, the light source unit of which is being detached from the obscuring wall unit;

Fig. 3 presents a side view of a light source unit of a sector light according to the invention;

Fig. 4 presents an obscuring wall unit of a sector light according to the invention.

Detailed description of the invention

[0018] According to Fig. 1 the sector light comprises a light source unit 100 and an obscuring wall unit 110. In the structure formed by the light source unit 100 and the obscuring wall unit 110 is at least one layer for each color, and in each layer of the light source unit is one or more vertically radiating light source 101, 102, 103. The light source 101, 102, 103 is a LED light source and e.g. a high-power LED of at least 1 W output. The light of the light source 101, 102, 103 is refracted with a lens 104, 105, 106 to be omnidirectional in at least mainly the hor-

horizontal direction. The functionality of the sector light according to the invention is therefore based on the shape of the light visible through the lens or via the reflector. As viewed through the lens, the light source receives a vertical and narrow shape. The narrower the light source is, the more precise the boundary of the sector will be. The light source unit 100 comprises a level 107, 108, 109 between the different layers and/or below them that does not let light through.

[0019] In the obscuring wall unit 110 of the sector light, at each height corresponding to a layer of the light source unit, is at least one light aperture that lets light through, through which a part of the horizontal light is allowed to pass in such a way that the desired sector or sectors remain, i.e. the light apertures from which light is visible from each layer of the light source unit in the desired direction. The position and number of the light apertures in the obscuring wall unit of the sector light determine where the light sources of each layer are visible. The position and number of light apertures can be selected e.g. in the manufacturing of the obscuring wall. The obscuring wall unit comprises a fixing part, e.g. a fixing base 120, by the aid of which the obscuring wall unit, and at the same time the whole sector light, can be fixed with fixing means to the mounting base 130.

[0020] The light source part of the sector light according to Fig. 1 has three different layers, at corresponding heights to which in the obscuring wall is a light aperture 111, 112, from which the light of the light source 101, 102, 103 of the layer in question is visible outside the sector light. The light aperture of the obscuring wall unit that is at the height of the lowermost layer is not presented in Fig. 1. Different colors are visible from the light apertures 111, 112 that are at different heights, e.g. in such a way that white light is visible from the uppermost light aperture 112, green light from the light aperture 111 below the white, and red from the lowermost light aperture (which is not presented in Fig. 1). The colors can, however, also be other than green, red and white. The light apertures 111, 112 are conventionally arranged in such a way that they are precisely staggered, but they can also be arranged in such a way that there is a certain distance between the apertures 111, 112. There can also be more than one aperture 111, 112 per each layer.

[0021] The light source unit 100 can be installed and fixed in the center of the obscuring wall unit 110 in such a way that the layers of the light source unit and the light apertures of the obscuring wall unit are face-to-face. The fixing of the light source unit 100 inside the obscuring wall unit 110 can be carried out with fixing means, such as e.g. with screws or with other corresponding detachable fixing means. When the light source unit is fixed to the center of the obscuring wall unit, the distance of the light sources of the light source unit in the horizontal direction from the obscuring wall 116 of the obscuring wall unit is typically the same around the sector light. The distance of the obscuring wall 116 from the light sources can also vary according to the accuracy requirements of

the sector. Additional optics can be used in the sector light at the point of the light apertures 111, 112 disposed in the obscuring wall 116, by the aid of which optics the vertical light distribution of a light sector radiated by each light aperture can be narrowed or broadened according to need.

[0022] The obscuring wall unit 110 of the sector light also comprises support structure parts 117, 118, onto which the obscuring wall 116 can be fixed. The structure formed by the support structure parts 117, 118 and the obscuring wall 116 is essentially rigid. The support structure parts 117, 118 of the obscuring wall unit 110 can also function as a lateral support and/or a support in the vertical direction for the light source unit 100 installed inside the obscuring wall unit 110.

[0023] In one embodiment of the invention in the bottom part of the light source unit is a space 119, in which e.g. the electronics used in the control of the light sources can be disposed. The connectors for the electricity supply of the light source part can also be disposed in connection with the space 119.

[0024] Fig. 2 presents how the light source unit 100 is detachable from the obscuring wall unit 110. Although the light source unit 100 is detached from the obscuring wall unit 110, the obscuring wall unit 110 does not need to be detached from its fixing surface. When the light source unit 100 is re-installed, it can be installed inside the obscuring wall unit 110 in any position whatsoever around its own vertical axis, because the light sources are omnidirectional in the horizontal direction and because the obscuring wall unit 110 fixed to its mounting base determines the light sector coming to the different sectors. For this reason, when the obscuring wall unit 110 is fixed to its base, there is no need after replacement of the light source unit 100 to carry out a verifying measurement of the alignment of the sectors because the light apertures of the obscuring wall unit 110, which determine the light sectors, are in the same position as before the replacement of the light source unit.

[0025] Fig. 3 presents a light source unit 100 according to one embodiment of the invention. The light source unit is formed from three light source parts 301, 302, 303 one above another. On the bottom part of the light source parts 301, 302, 303 is a plane 107, 108, 109 that does not let light through. In one embodiment of the invention a light source possessing a symmetrical radiation beam in relation to the optical axis of a light source part 301, 302, 303 is installed in the sector light in such a way that the optical axis of it is in a vertical direction, i.e. directed directly upwards or directly downwards.

[0026] In one embodiment of the invention the plane 107, 108, 109 on the bottom part of the light source parts 301, 302, 303 comprises a base plate, onto which the light sources, e.g. LED light sources, of the sector light are installed. The base plate can be e.g. a circuit board. The circuit board can be installed on a heat sink. For achieving good thermal conductivity, often aluminium or a ceramic material is used as the material of the circuit

board, but also the use of a conventional glass fiber circuit board is possible. The light sources can also be fixed directly to the surface of a heat sink.

[0027] On top of a light source radiating in a vertical main direction is installed separately, or is integrated into the light source, an optical lens 104, 105, 106 or a conical mirror which turns the light into the horizontal plane. It is characteristic therefore for the light to be visible through a lens 104, 105, 106 or mirror as a vertical and narrow line-shaped light. The width of a light beam directed towards a viewer depends on the optics and it is typically less than 2 mm. The narrower the beam of light is, the better it is.

[0028] In the solution according to the invention a number of LEDs of the same color can be added one on top of another in layers in which case the range of the light can be increased.

[0029] In connection with the light source unit, e.g. around the light source unit, a cover 320 is arranged, which protects the light source unit from external stresses. The cover 320 surrounding the light source unit from the sides can be cylindrical and an essentially transparent material, e.g. polycarbonate, is used as the material of it. The cover of the light source unit can, together with the top part and bottom part of the light source unit, form an essentially sealed space.

[0030] The amount of light radiated by each color layer can be optically monitored with the electronics to be used in the control of the light sources and if it is detected that the light output of one color layer has decreased with respect to the other color layers, the monitoring automatics can extinguish the light diodes of all the layers or alternatively adjust the light output of the other color layers to correspond to the reduced light output of the malfunctioning color layer. The electronics to be used in the control of the light sources can also adjust the possible flashing of the light sources and the light intensity of the light sources. By means of the electronics of the light sources, the settings of a light source can also be changed by programming the desired settings, e.g. for the light intensity of light sources and for the flashing of light sources, into the electronics. Programming of the desired settings into the electronics can be carried out e.g. always when the light source unit is taken into use in a new sector light.

[0031] The light intensities of the color sectors do not decrease when approaching the sector boundaries before reaching the zone of uncertainty. The amount or width of the light apertures of each specific layer does not affect the energy consumption of the sector light.

[0032] In the solution presented by the invention alternatively e.g. the white sector can also be fabricated by combining the red and the green light into the same sector, in which case with correctly selected color coordinates the combination of the two colors is white.

[0033] In one embodiment of the invention in the light source unit, e.g. on the top surface of it, there can be means that facilitate the lifting of the light source unit from

inside the obscuring wall unit. The means for facilitating lifting can be e.g. a handle.

[0034] Fig. 4 presents an obscuring wall unit 110 of a sector light according to the invention, from inside which obscuring wall unit the light source unit has been removed. The obscuring wall unit 110 comprises light apertures 112, 113, 114, from which light is visible in the desired sectors. The location and size of the light apertures 112, 113, 114 affect the sector zones. The support structure parts 117, 118 of the obscuring wall unit are also presented in Fig. 4. The obscuring wall unit 110 also comprises a fixing and support means for the light source unit, by the aid of which the light source unit can be detachably fixed to the obscuring wall unit 110. For example, acid-resistant steel can be used as a material of the obscuring wall unit. The obscuring wall unit 110 and/or the light source unit can comprise connectors, by means of which current is supplied to the light source unit. The top part of the structure formed by the obscuring wall unit 110 and/or the obscuring wall unit 110 and the light source unit installed into its position is essentially sealed and thus protects the sector light from water and from snow, preventing the access of them from the top part to inside the sector light. The bottom part of the obscuring wall unit 110 can be open, so that water and snow possibly penetrating inside does not stay inside the sector light. In the light apertures of the obscuring wall unit or around the obscuring wall unit can be covers, e.g. glass surfaces or plastic surfaces, but cover plates are not necessarily needed in the light apertures particularly if it is desired to maximize the amount of light coming out of the apertures. If a protective structure is used in the light apertures of the obscuring wall unit or around the obscuring wall unit, the bottom part of the obscuring wall unit can also form, together with the light source unit fixed to it, an essentially sealed structure from the bottom part of the sector light.

[0035] It is obvious to the person skilled in the art that the different embodiments of the invention are not either limited solely to the examples described above, and that they may for these reasons be varied within the scope of the claims presented below. The characteristic features possibly presented in the description in conjunction with other characteristic features can if necessary be used separately to each other.

Claims

1. Sector light, which comprises:

a light source unit (100), which comprises light source parts (301, 302, 303) one above another, which form layers one above another, for each color of at least one light source part, wherein a light source part comprises a light source (101, 102, 103) and means for refracting light, by the aid of which means the light is refracted to be

omnidirectional in mainly the horizontal direction,

a transparent cover (320), and

an obscuring wall unit (110), which comprises a light-impermeable obscuring wall (116), in which are light apertures (111, 112, 113, 114), from which light is visible in the desired direction from each layer of the light source unit in such a way that the desired sector or sectors of horizontal light remain in each layer of the light source unit, wherein the obscuring wall unit (110) can be fixed to its mounting base (130),

characterized in that

a transparent cover (320) is fitted around the light source unit (100),

the light source unit (100), having a surrounding cover (320), forms an integral and sealed structure in such a way that

the light source unit can be detachably fixed, with fixing means, inside the obscuring wall unit (110) in such a way that the layers of the light source unit (100) and the corresponding light apertures of the obscuring wall unit are face-to-face, and

the light source unit (100) can be replaced and/or removed from inside the obscuring wall unit (110) without needing to detach the obscuring wall unit from its mounting base (130).

2. Sector light according to claim 1, wherein the light source unit (100) and the obscuring unit (110) are essentially separate parts.
3. Sector light according to claim 1, wherein the light source unit (100) forms an essentially sealed structure.
4. Sector light according to any of the preceding claims, wherein the light source unit (100) comprises a light-impermeable level (107, 108, 109) between the different layers.
5. Sector light according to any of the preceding claims, wherein a light source part (301, 302, 303) comprises a base plate and a light source fitted onto it.
6. Sector light according to any of the preceding claims, wherein the light sources (101, 102, 103) of the light source unit (100) are high-power LED light sources of at least 1 W output.
7. Sector light according to any of the preceding claims, wherein the top part of the structure formed by the light source unit (100) installed inside the obscuring wall unit and the obscuring wall unit (110) is essentially sealed.
8. Sector light according to any of the preceding claims,

wherein the end structure of the bottom part of the obscuring wall unit (110) is open.

9. Sector light according to any of the preceding claims, wherein the obscuring wall unit (110) comprises support means for the light source unit.
10. Sector light according to any of the preceding claims, wherein the means for refracting the light of a light source (101, 102, 103) to be omnidirectional in mainly the horizontal direction is a lens (104, 105, 106) or a mirror.
11. Sector light according to claim 10, wherein light is visible through a lens (104, 105, 106) or mirror as a vertical and narrow line-shaped light.

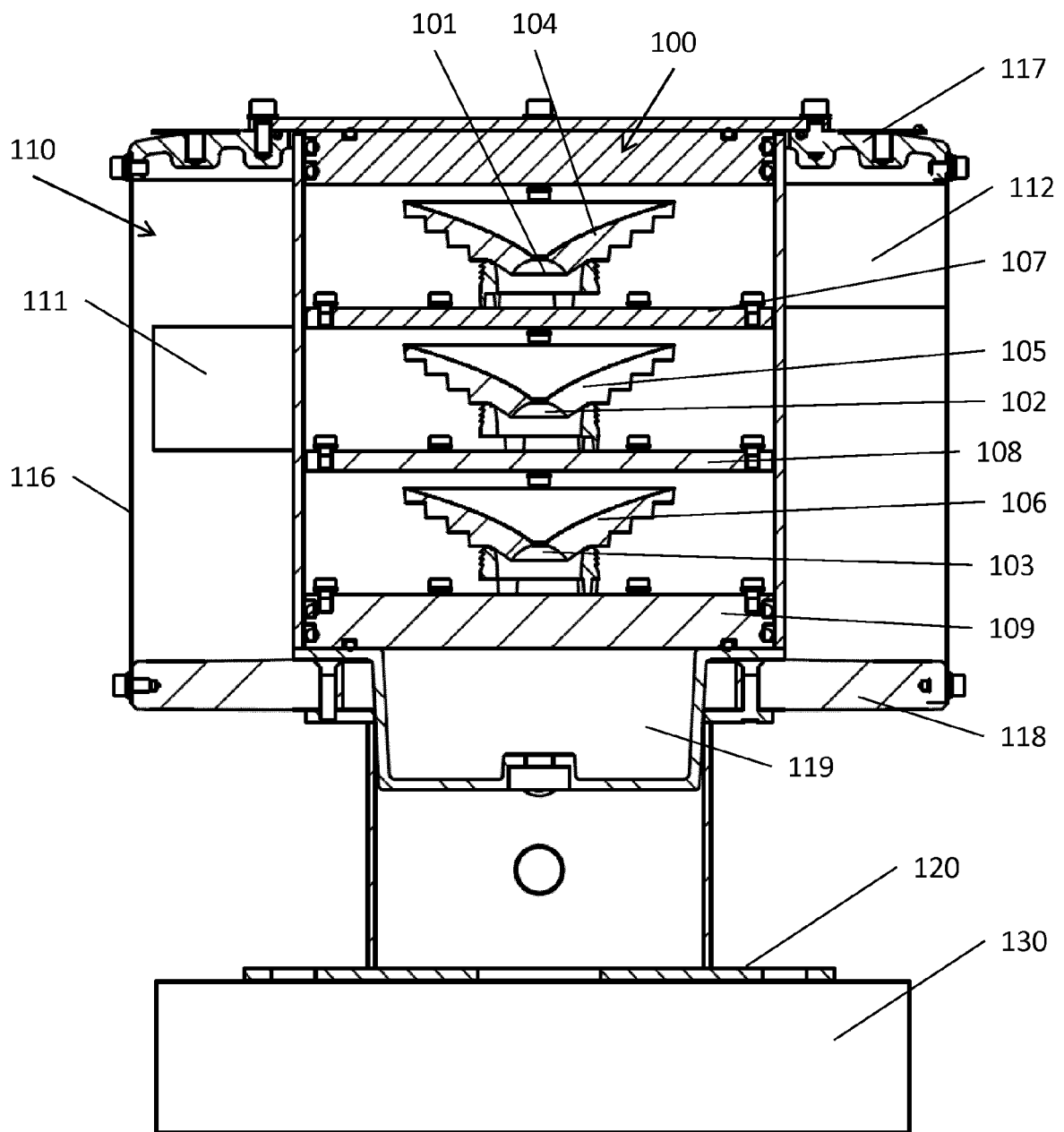


Fig. 1

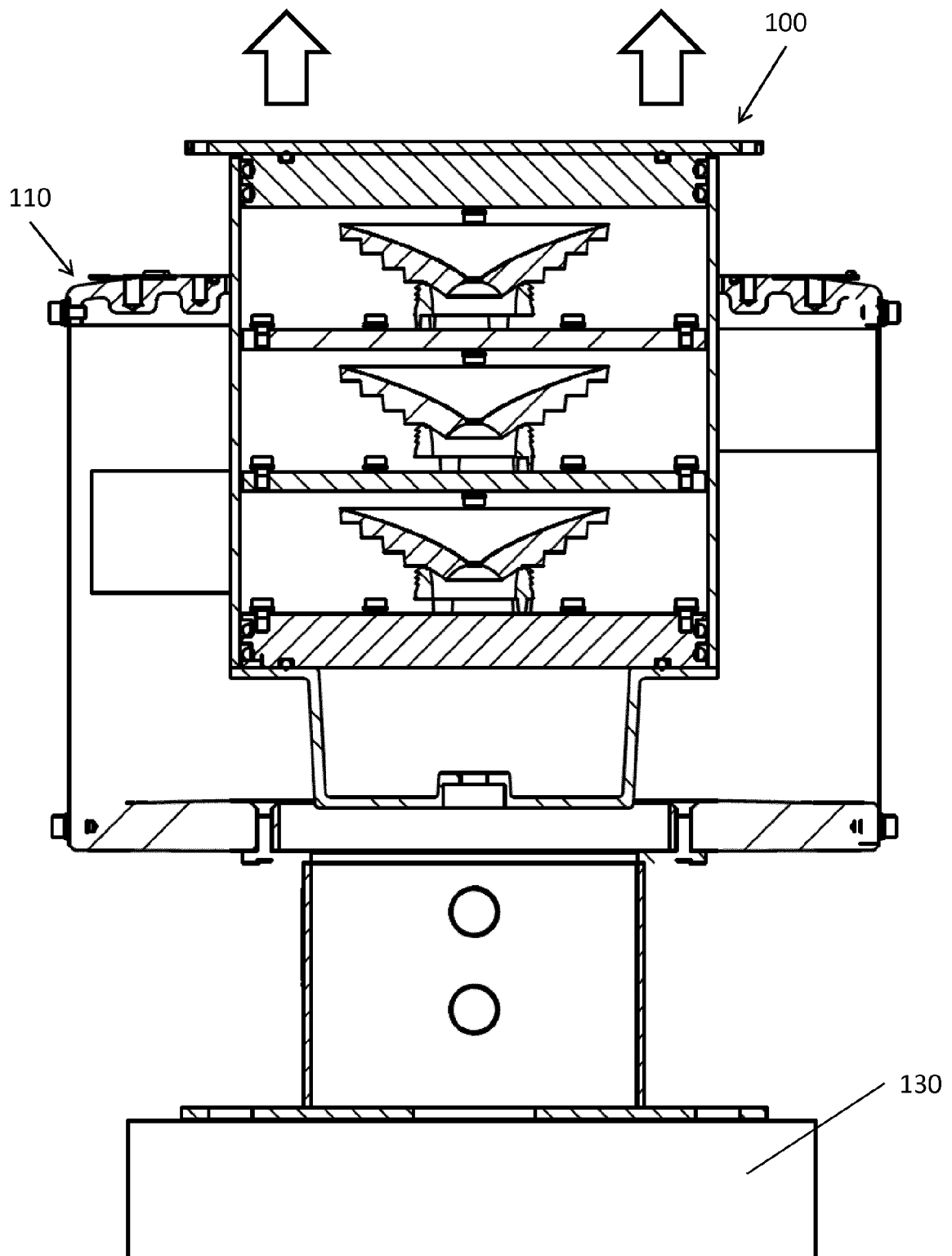


Fig. 2

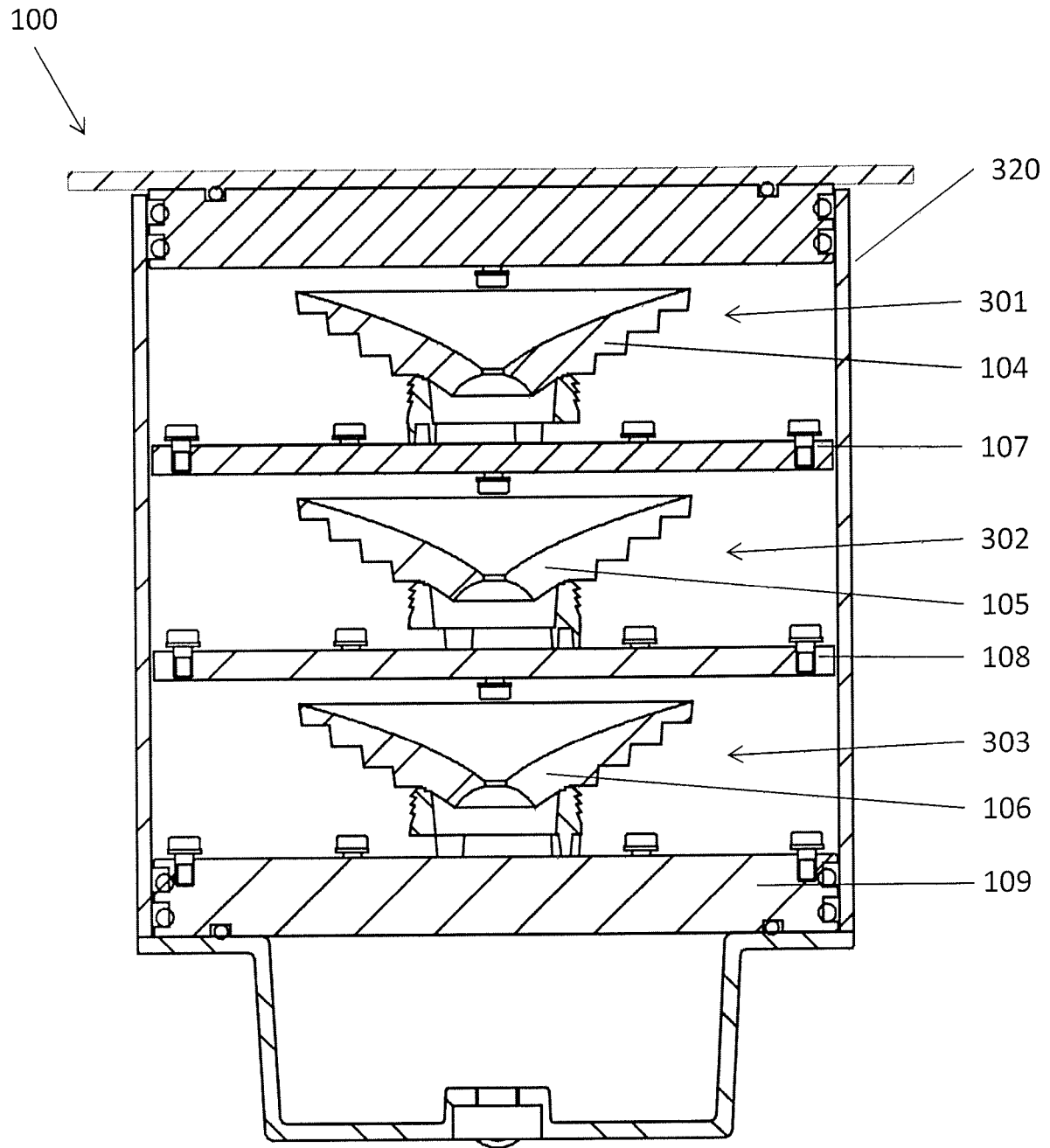


Fig. 3

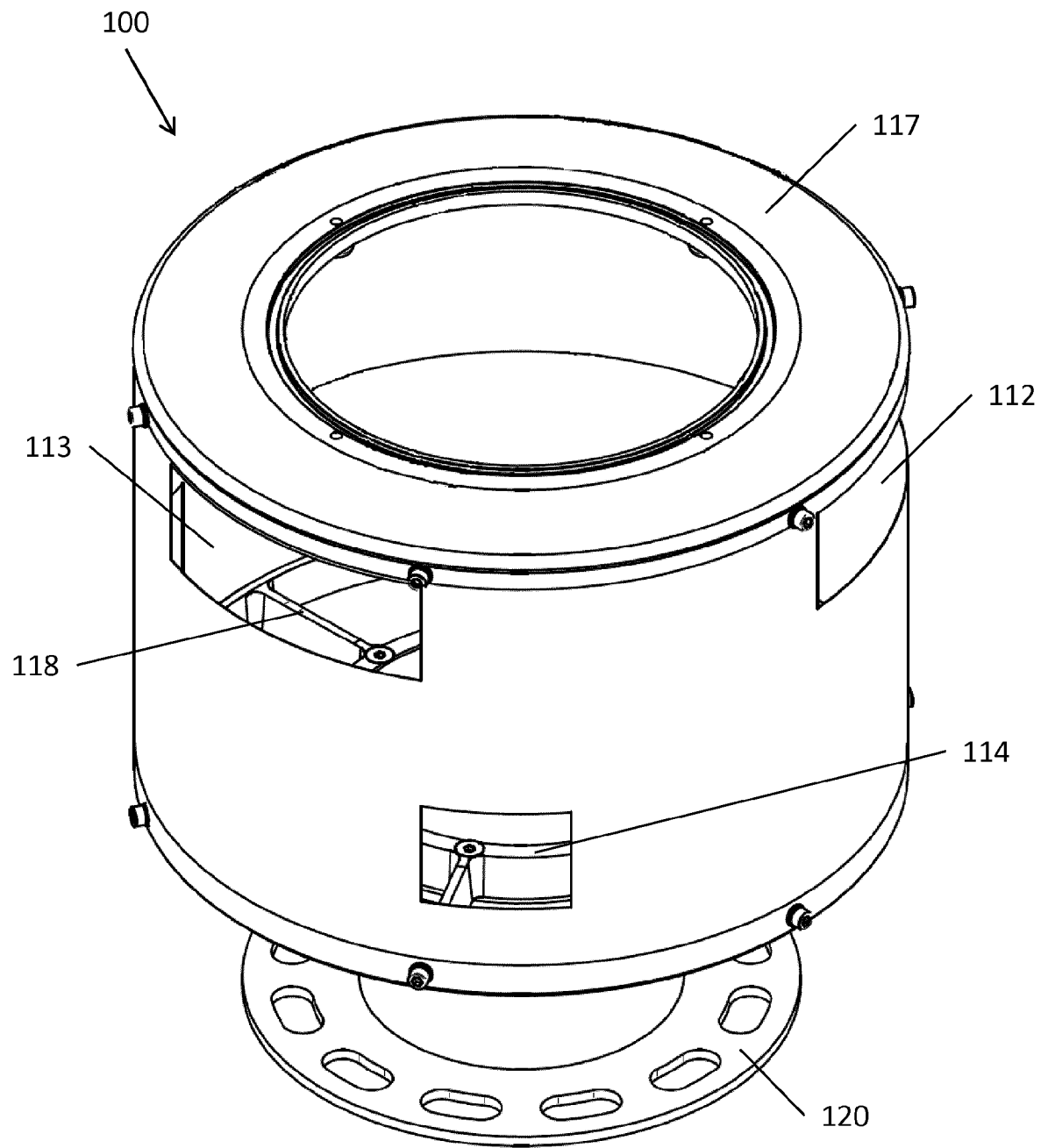


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 13 18 6167

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			F21V F21W F21Y B63B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 November 2013	Examiner Schulz, Andreas
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 18 6167

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26-11-2013

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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