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(54) **OPTICAL GROUP FOR LIGHTING APPARATUS AND LIGHTING APPARATUS COMPRISING SAID OPTICAL GROUP**

(57) A light emission device for lighting apparatuses configured for optimizing the lighting produced both in the near field, allowing to avoid unwanted rings or shadow areas or even portions of ground which are too intensely illuminated, as well as in the far field, producing a lighting having a direct "shot" and sized so as to optimize the number of lighting apparatuses per surface unit. The device uses a lens comprising a first inlet surface of the light flow, a second internal reflection surface and a third outlet surface of the light flow produced.

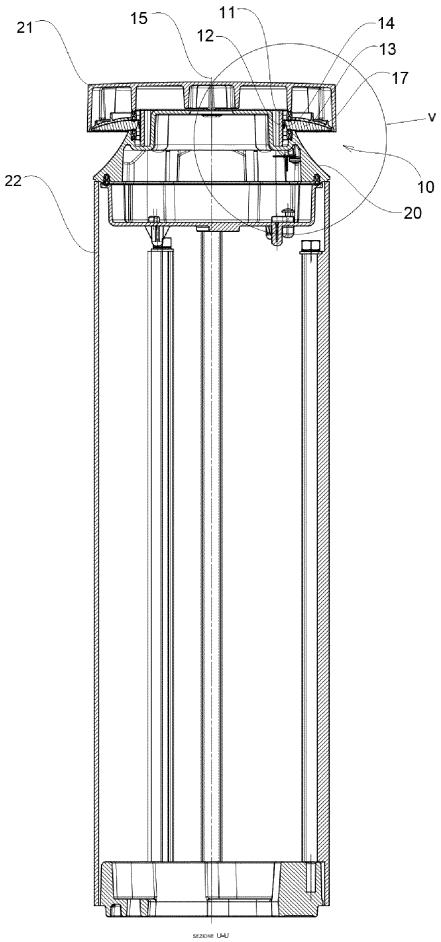


Fig. 2

EP 3 772 608 A1

Description

FIELD OF THE INVENTION

[0001] The field of the present invention relates to lighting apparatuses for ground or floor mounting, in particular to lighting apparatuses commonly known as "bollards" or "lighting poles" or "lighting bollards", and to lighting apparatuses commonly known as "post-tops".

BACKGROUND ART

[0002] In the background art, lighting apparatuses for ground mounting are known. These lighting apparatuses comprise, for example, the apparatuses, commonly known as bollards or lighting poles or lighting bollards, characterized by a reduced height and by the emission of a light beam directed towards the ground, and comprise the lighting apparatuses, known as "post-tops", configured for mounting on higher supports and adapted to supply lighting with a wider radius in public and private urban areas.

[0003] These apparatuses, hereinafter simply defined bollards or post-tops, are commonly used, for example, to illuminate paths or pedestrian areas in urban areas. The aforesaid apparatuses generally comprise an optical group comprising, in turn, one or more light sources configured to illuminate a predetermined field of surrounding ground, or a plurality of optical groups comprising one or more light sources configured to illuminate the same area or different areas of the space surrounding the apparatus. These illuminated areas may belong to a portion of the ground immediately adjacent to the base of the lighting apparatus (known as near field, particularly important for the apparatuses of the bollard type) or to a portion of the ground distant with respect to the base of the apparatus (known as far field, particularly important for the apparatuses of the post-top type).

[0004] In this type of apparatuses available in the background art, the illumination of the surrounding ground is never optimal and presents major uniformity issues. Usually, in fact, the light emission of these lighting apparatuses creates rings on the floor, or unwanted shaded areas or even portions of illuminated ground which are too bright and therefore annoying for passers-by.

[0005] In addition to this, the luminous efficiency of the lighting apparatuses of the bollard type is always rather low since suitable shielding must be provided for the fraction of light emission having wide, almost horizontal, angles, to avoid possible passers-by dazzling phenomena. This shielding necessarily translates into a substantial lowering of the overall luminous efficiency of the apparatus.

[0006] Therefore, it is an object of the present invention to overcome some of the issues and defects of the background art and to introduce an optical group capable of improving and optimizing the light emission both in the near field and in the far field.

SUMMARY OF THE INVENTION

[0007] The present description relates to an optical group for lighting apparatuses for ground mounting, for example, of the type commonly known as bollard or of the type commonly known as post-top, used for the lighting of public and private urban areas. The bollards comprise a main support having an elongated body with the axis substantially perpendicular to the ground and a base equipped with means for anchoring to the ground, and an optical group, located at the upper end of the main support, in turn comprising a plurality of LED lighting sources arranged so as to produce a direct main emission in a substantially radial direction with respect to the axis of the lighting apparatus.

[0008] The optical unit according to the present description further comprises means for shaping the light emission of said LED lighting sources, adapted to suitably direct the resulting light flow towards the ground surrounding the bollard.

[0009] Said means for shaping the light emission comprise at least one lens, made and sized so as to collect the emission of the LED lighting sources and divert it towards the ground.

[0010] The lens comprises a plurality of surfaces including an inlet surface facing the lighting sources of the LED type, an internal reflection surface, preferably associated with at least one reflector, and an outlet surface, preferably provided with suitable light mixing means adapted to optimize the extraction of light from the lens while, at the same time, mixing the light emission exiting the lens in a random manner on the surface to be illuminated. These light mixing means help avoiding patches of light forming on the surface to be illuminated and ensure that also the base of the bollard is evenly illuminated without the presence of annoying dark rings.

[0011] The lens of the optical group according to the present description may be advantageously configured so as to emit a light flow only over a certain angle. To this end, suitable shielding inserts may be inserted into the lens profile so as to shield the light emission towards unwanted directions. Said inserts may be black and opaque or they may be provided with a reflecting side to reflect the light towards the emitting part of the lens. In another embodiment, the lens may be provided with an opaque screen adapted to cover part of the lens outlet surface, thus limiting the emission to a certain sector and to a certain angle. Said screen may also be made by means of a layer of matt paint.

[0012] The optical group according to the present description may find advantageous application, as mentioned, also in lighting apparatuses other than bollards, for example, in apparatuses commonly known as pole-tops for urban lighting applications, allowing to obtain an optimized lighting both in the near field, in the immediate surroundings of the ground support, as well as in the far field, corresponding to the ends of the polar curve of the light emission. By using the optical group according to

the present description, the optimized lighting obtained in the near field allows to avoid unwanted rings or shadow areas or even portions of ground which are too intensely illuminated and therefore annoying. In the far field, instead, it is possible to produce a lighting with a direct "shot", and sized so as to optimize the number of lighting apparatuses per surface unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Further features and advantages of the invention will become apparent from the following detailed description provided by way of example and not by way of limitation, with the aid of the Figures shown in the accompanying drawings, in which:

Figure 1 shows a side view of a preferred embodiment of the optical group according to the present invention, associated with a lighting apparatus of the bollard type;
Figure 2 shows a sectional view of a preferred embodiment of the optical group according to the present invention, associated with a lighting apparatus of the bollard type;
Figure 3 shows a detail of the section of a preferred embodiment of the optical group according to the present invention, associated with a lighting apparatus of the bollard type;
Figure 4 shows a side view of a lighting apparatus of the post-top type, comprising a preferred embodiment of the optical group according to the present invention;
Figure 5 shows a sectional view of a detail of a preferred embodiment of the optical unit according to the present invention, with the indication of the path of part of the light emission produced;
Figure 6 shows a diagram relating to the photometric curve of the light emission produced by a preferred embodiment of the optical group according to the invention;
Figure 7 shows a detail of a preferred embodiment of the optical group according to the present invention, in which shielding inserts are present; and
Figure 8 shows a detail of a preferred embodiment of the optical group according to the present invention, in which an opaque screen is provided, adapted to cover part of the outlet surface of the lens.

[0014] The following description of exemplifying embodiments refers to the attached drawings. The same reference numbers in the various drawings identify the same elements or similar elements. The following detailed description does not limit the invention. The scope of the invention is defined by the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

[0015] Lighting apparatuses for ground mounting, comprising, for example, the apparatuses commonly known as "bollards" and apparatuses commonly known as post-tops, are generally used to illuminate paths or pedestrian areas in urban areas. To do this, they are designed so as to direct the lighting produced towards the surrounding ground. Often, however, the lighting produced fails to be homogeneous and pleasant to users and has irregularities, patches of light, shadow rings or even emission portions facing the horizontal, and such to cause unwanted dazzling.

[0016] The optical group 10 according to the present description comprises a structure and an optical compartment optimized to solve the above issues. Said optical group 10 has a structure which allows the light emission in a radial direction with respect to the axis 15 of the lighting apparatus, substantially perpendicular to the ground. The light emission may have an angle of 360° but also reduced angles, so as to favor lighting towards preferred directions.

[0017] With reference to the attached Figures, a first preferred embodiment of the lighting apparatus according to the present description comprises a main support 22, preferably cylindrical, in turn comprising, at the lower end, suitable means for fixing to the ground and, at the upper end, an optical group 10 adapted to generate a direct light emission in a radial direction with respect to the axis of the apparatus and mainly directed towards the ground. Preferably, the optical group 10 is configured so as to emit light at 360° with respect to the axis of the device and is protected by a cover 21.

[0018] In other preferred embodiments of the apparatus according to the present description, the main support 22 may have different sections, for example, it may have a square or elliptical section, and the structure of said optical group 10 may develop on an arc subtended by an angle selected from a group preferably but not exclusively comprising angles of 90°, 180°, 270° and 360°. In other words, said optical group 10 may be configured so as to generate a 360° direct light flow around the axis 15 or according to reduced emission angles, for example at 90°, or at 180°, or at 270°.

[0019] With reference to Figure 2 attached, the optical group 10 of the lighting apparatus according to the invention comprises a central support 11 adapted to house a plurality of LED light emission devices 12 arranged so as to orient the main emission in a direction substantially radial with respect to the axis of the apparatus 15 which is, at least in the cases relating to the embodiments provided below, substantially orthogonal to the ground. The LEDs 12 of the aforesaid plurality of LEDs are preferably equally spaced with respect to each other so as to make the emitted lighting substantially the same in every direction.

[0020] The optical group 10 of the bollard lighting apparatus according to the present description further comprises a lens 13, associated with the LEDs 12 of the aforesaid plurality of LEDs. In further detail, the lens 13 comprises a first inlet surface 14, facing the LEDs 12. The

inlet surface 14 of the lens 13 may be straight, curved (concave or convex) or shaped (for example, S-shaped), and is preferably inclined, with respect to the axis of the apparatus 15, by a certain angle α preferably comprised between 0° and 45°. In a preferred embodiment of the bollard apparatus according to the present description, the angle α is equal to 19° ±10%.

[0021] The lens 13 comprises a second internal reflection surface 16, preferably having a curvature with the concavity facing downwards. This second internal reflection surface 16 is at least in part covered by an outer reflector 17 adapted to reflect the part of the light flow emitted by the LEDs 12 which passes through the lens body and exits from the lens itself through said internal reflection surface 16.

[0022] Said reflector 17 may be made of plastic or metal reflecting material and the reflecting surface facing the lens 13 may be smooth or wrought if favoring the mixing of the reflected light is desired.

[0023] Said lens 13 further comprises a third outlet surface 18, substantially normal to said axis 15, through which the light flow reflected by the internal reflection surface 16 and by the outer reflector 17, exits the lens and is directed towards the base of the apparatus.

[0024] Preferably, the outer reflector 17 and the lens 13 are, at least for a part of the extension thereof, slightly spaced apart from one another, so that a small gap is formed between said reflector 17 and said lens 13. Thereby, when the light beams emitted by the LEDs 12 propagate inside the lens 13 and reach the internal reflection surface 16, with an angle of incidence with respect to the normal greater than the critical angle $\theta c = \arcsin\left(\frac{n2}{n1}\right)$ in which n1 and n2 are the refractive indices of the two means in which the light propagates, said beams are totally reflected towards said third outlet surface 18 and there is a total reflection inside the lens 13.

[0025] In the case where the angle of incidence with respect to the normal is lower than the critical angle θc, then part of the light beam is refracted towards the outer reflector 17 to be reflected back towards the lens 13 and therefore towards said third outlet surface 18.

[0026] In a preferred embodiment of the invention, said third oulet surface 18 is suitably wrought, or sculpted, so as to optimize the extraction of the light from the lens 13 while, at the same time, directing the light emission exiting the lens 13 in a random manner on the surface to be illuminated on the ground. The fact that the third outlet surface 18 is wrought helps avoiding patches of light forming on the surface to be illuminated and ensures that the ground surrounding the base of the bollard is evenly illuminated without the presence of annoying dark rings. The third outlet surface 18 may be fully or partially wrought. The relationship between wrought surface and smooth surface affects the amount of lighting which is "shot" farther with respect to the main support 22 of the lighting apparatus and therefore the extension of the photometric curve of the light emission produced. In a preferred embodiment of the invention described herein, said third outlet surface 18 of the lens 13 is partially wrought with the unwrought surface less than or equal to 10% of the total surface.

[0027] Finally, the wrought surface may not be uniform. For example, there may be a greater percentage of unwrought surface at the part of the surface closest to the axis 15 of the main support 22 of the lighting apparatus.

[0028] Finally, preferably, the lens 13 has an extension in a radial direction greater than the extension in a radial direction of the main support 22 of the lighting apparatus. This allows, in the case of apparatuses of the bollard type, to favor the illumination of the ground immediately surrounding the base of the main support 22 of the apparatus. The radial extension of the lens 13 may be greater than the extension in a radial direction of the main support 22 even by just a few millimeters, for example, it may be greater than 3 mm.

[0029] With reference to Figure 7 attached, to configure said optical group 10, so as to generate a direct light flow according to reduced emission angles (for example at 90°, or at 180°, or at 270°) the LEDs 12 are arranged at the light emission sector and, furthermore, at least one shielding insert 23 may be inserted into the profile of the lens 13 so as to shield the light emission towards undesired directions. Said inserts 23 may be black and opaque or they may be provided with a reflecting side to reflect the light towards the light emission sector of the optical group.

[0030] In another preferred embodiment, the lens may be provided with an opaque screen 24 adapted to cover part of the lens outlet surface 18 thus limiting the emission to a certain sector and to a certain angle. Said screen 24 may also be made by means of a layer of matt paint.

[0031] In a preferred embodiment, the optical group 10 may further comprise a recess 19 placed immediately below the lens 13. The lower surface 20 of this recess, which is preferably connected to the surface of the main support 22 of the lighting apparatus, is adapted to collect part of the light emission exiting the lens 13 and provides a further opportunity to shape the emitted light flow. In fact, if said lower surface 20 of the recess 19 is made of opaque black material, it is such to minimize the light emission upwards, increasing the visual comfort of the users.

[0032] In another preferred embodiment, said lower surface 20 of the recess 19 is made of white or colored material so as to have a moderate reflective power such as to direct part of the incident light emission upwards.

[0033] Finally, in a further preferred embodiment, said lower surface 20 of the recess 19 is made of reflective material, possibly wrought with finishings such as to increase the reflecting capacity thereof, so as to achieve a significant overall reflective power, and such as to direct a significant part of the incident light emission upwards.

Claims

1. A light emission device comprising
a support (11) having a central axis (15) adapted to house a plurality of LED light emission devices (12) arranged so as to direct the emitted light flow in a substantially radial direction with respect to said axis (15);
a lens (13) comprising

a first inlet surface (14), facing the LEDs (12) and inclined with respect to said axis (15) by an angle α comprised from 0° to 45°;
a second internal reflection surface (16) having a curvature with the concavity facing downwards and covered, at least in part, by a reflector (17);
a third outlet surface (18), substantially normal to said axis (15), adapted to emit the light flow exiting the lens (13).

2. A device according to the preceding claim, **characterized in that** said reflector (17) is made of plastic or metal reflecting material.

3. A device according to the preceding claim, **characterized in that** the reflecting surface of said reflector (17) comprises a processing adapted to mix the light reflected.

4. A device according to one or more of the preceding claims, **characterized in that** the outer reflector (17) and the lens (13) are spaced apart from each other at least for a part of the extension thereof, so as to form a gap between said reflector (17) and said lens (13).

5. A device according to one or more of the preceding claims, **characterized in that** at least part of said third outlet surface (18) comprises a processing adapted to mix the light exiting therefrom.

6. A device according to the preceding claim, **characterized in that** part of said third outlet surface (18) comprising a processing adapted to mix the light exiting therefrom, is greater than, or equal to 90% of the total.

7. A device according to one or more of claims from 5 to 6 **characterized in that** said processing is not uniform.

8. A device according to one or more of the preceding claims, **characterized in that** said angle α is equal to 19° $\pm$10%.

9. A device according to one or more of the preceding claims, **characterized in that** it comprises at least one shielding insert (23) inserted into the lens (13) so as to shield the light emission towards undesired directions.

10. A device according to one or more of the preceding claims, **characterized in that** said lens (13) comprises an opaque screen (24) adapted to cover part of the outlet surface (18) of the lens (13), thus limiting the light emission to a certain angle.

11. A device according to the preceding claim, **characterized in that** said opaque screen (24) is made by means of a layer of matt paint.

12. A lighting apparatus comprising
a support (22) having a central axis (15);
means for fixing to the ground associated with the lower end of said support (22);
an optical unit (10) associated with the upper end of said support (22) and adapted to generate a direct light emission mainly towards the ground, **characterized in that** said optical unit (10) comprises a light emission device according to one or more of claims from 1 to 8.

13. An apparatus according to the preceding claim, **characterized in that** the structure of said optical unit (10) develops on an arc subtended by an angle selected from a group comprising angles of 90°, 180°, 270° and 360°.

14. An apparatus according to one or more of claims from 12 to 13 **characterized in that** the optical group (10) comprises a cavity (19) placed immediately below the lens (13) and joined to the support surface (22) said cavity (19) comprising a lower surface (20) adapted to collect part of the light emission exiting the lens (13).

15. An apparatus according to the preceding claim, **characterized in that** said lower surface (20) of the cavity (19) is made of a black opaque material.

16. An apparatus according to claim 14, **characterized in that** said lower surface (20) of the cavity (19) is made of a white or colored material.

17. An apparatus according to claim 14, **characterized in that** said lower surface (20) of the cavity (19) is made of a reflecting material.

18. An apparatus according to one or more of claims from 12 to 17 **characterized in that** the lens (13) has an extension in a radial direction, which is greater than the extension, in a radial direction, of the support (22).

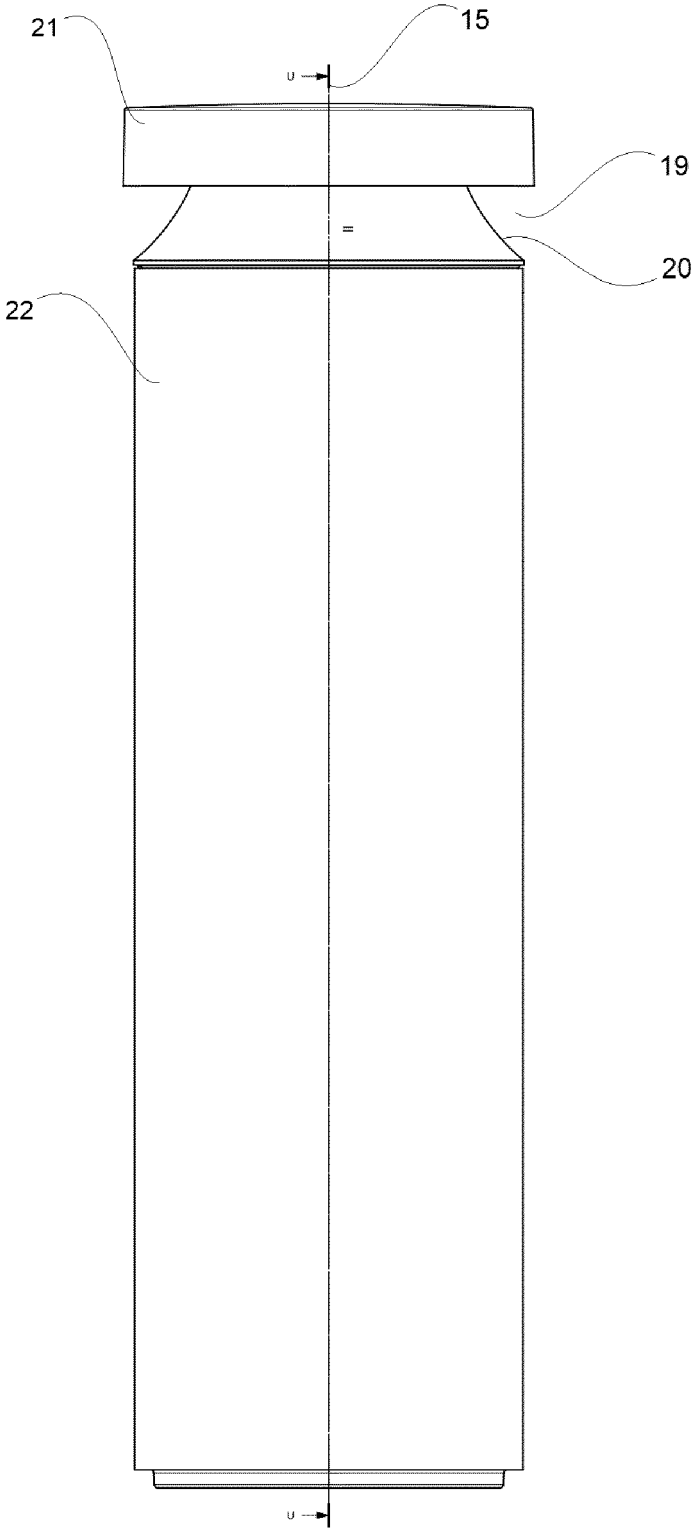


Fig. 1

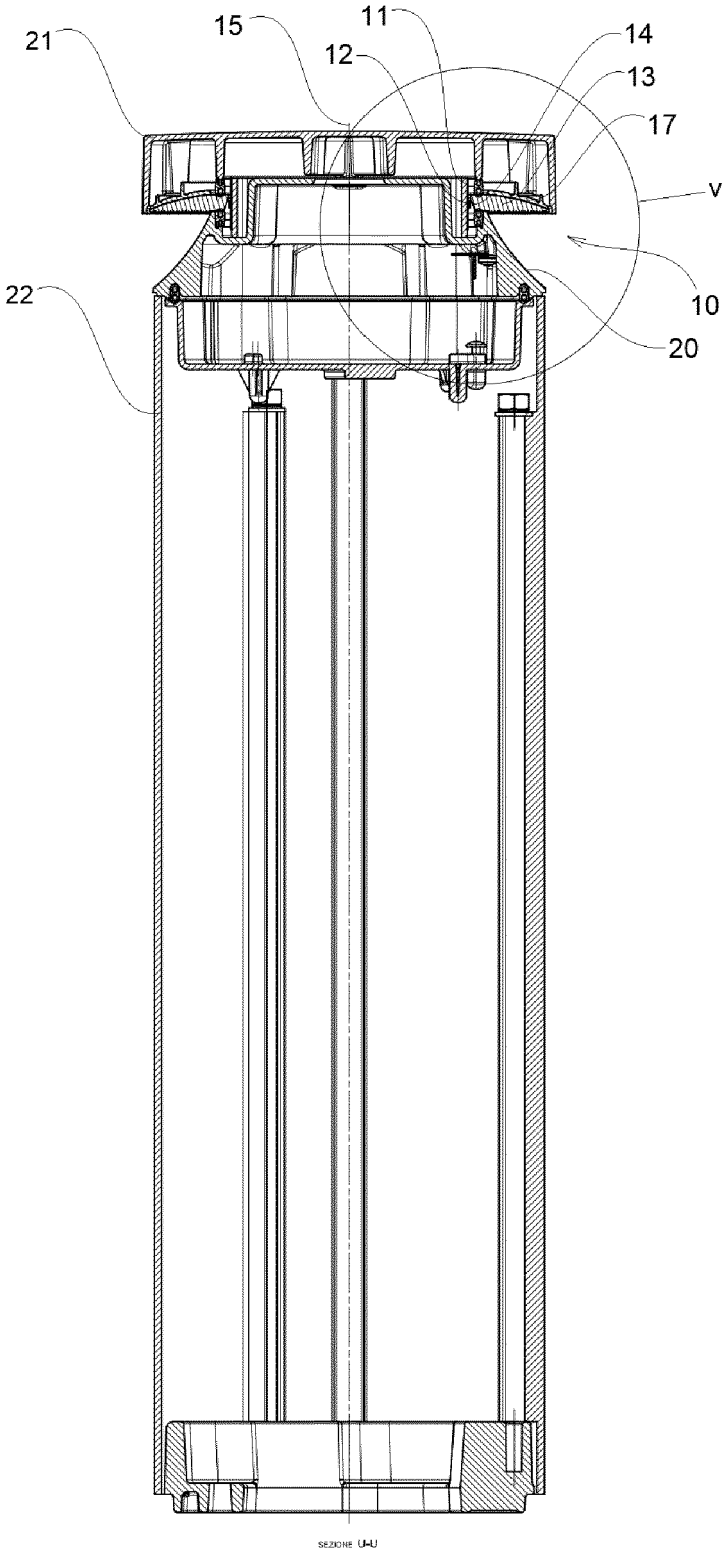


Fig. 2

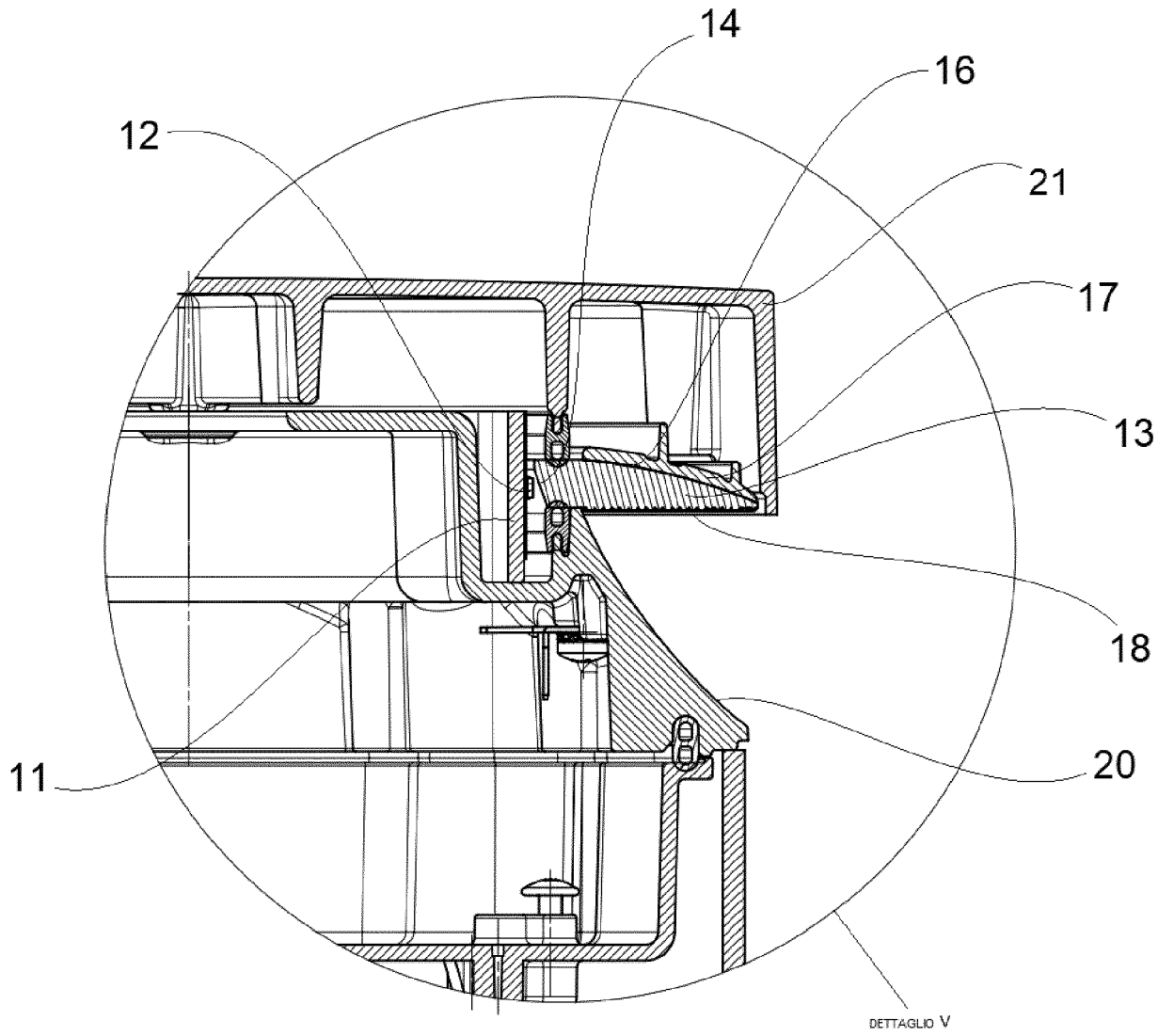


Fig. 3

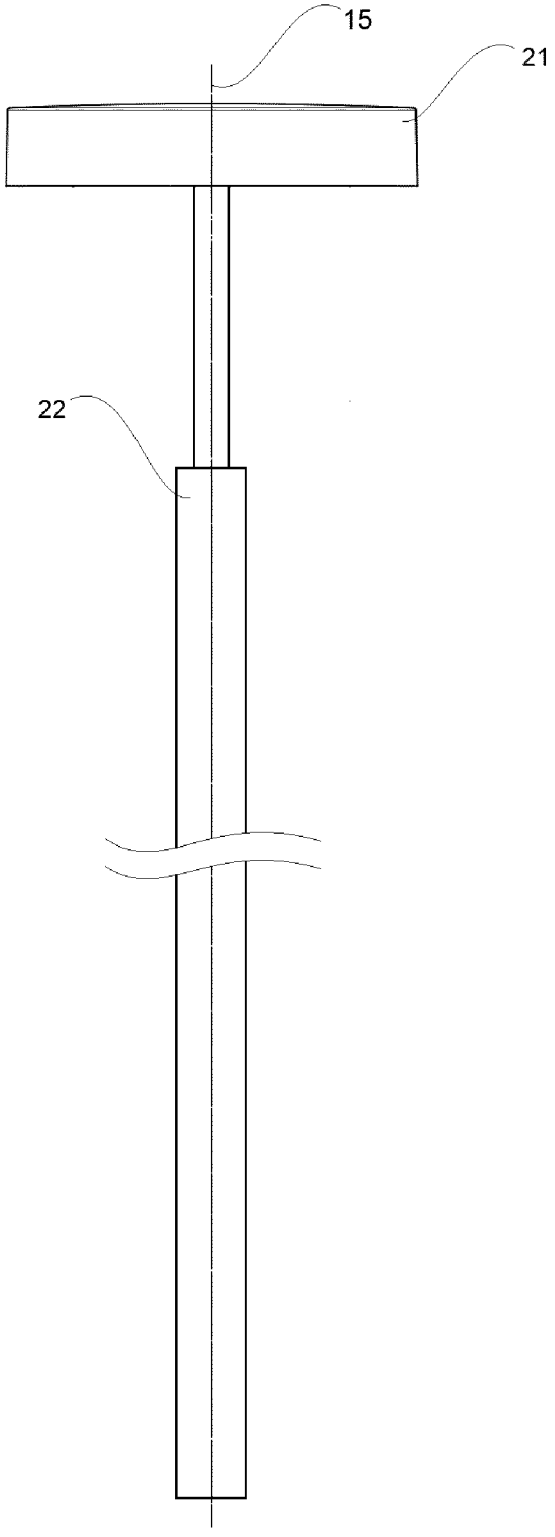


Fig. 4

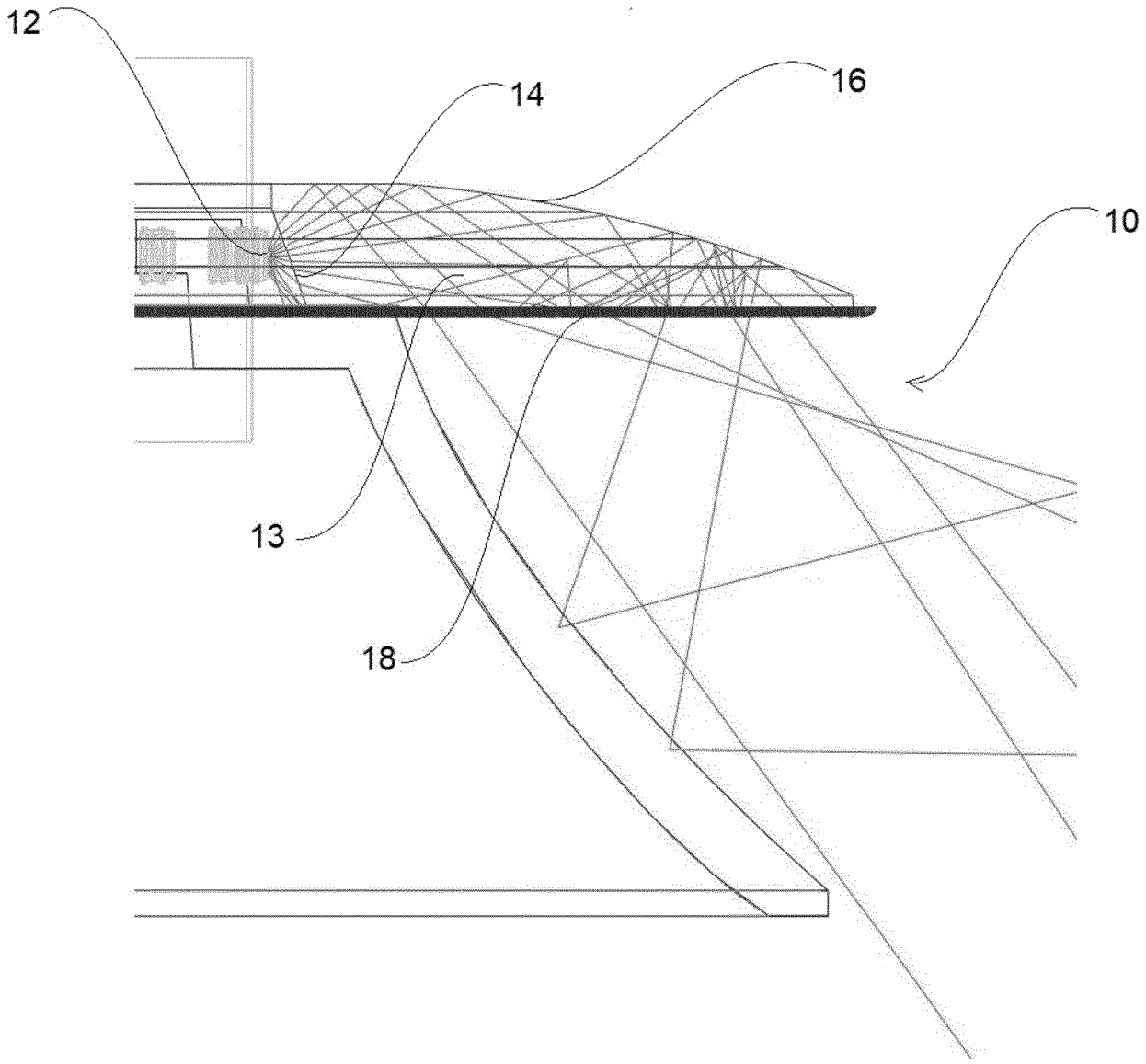
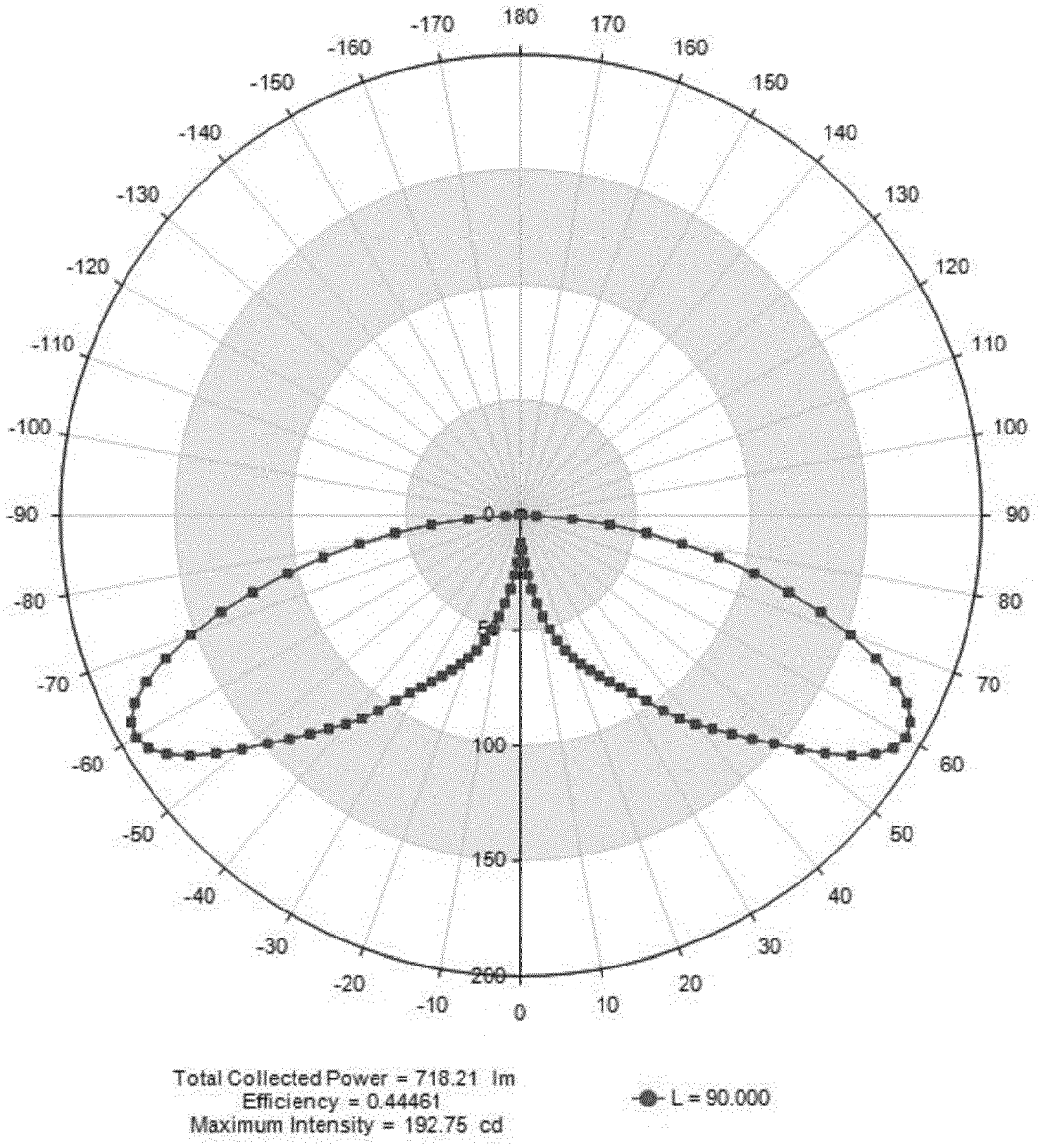


Fig. 5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-10
10
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50
100
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200
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Efficiency = 0.44461
Maximum Intensity = 192.75 cd
L = 90.000

Fig. 6

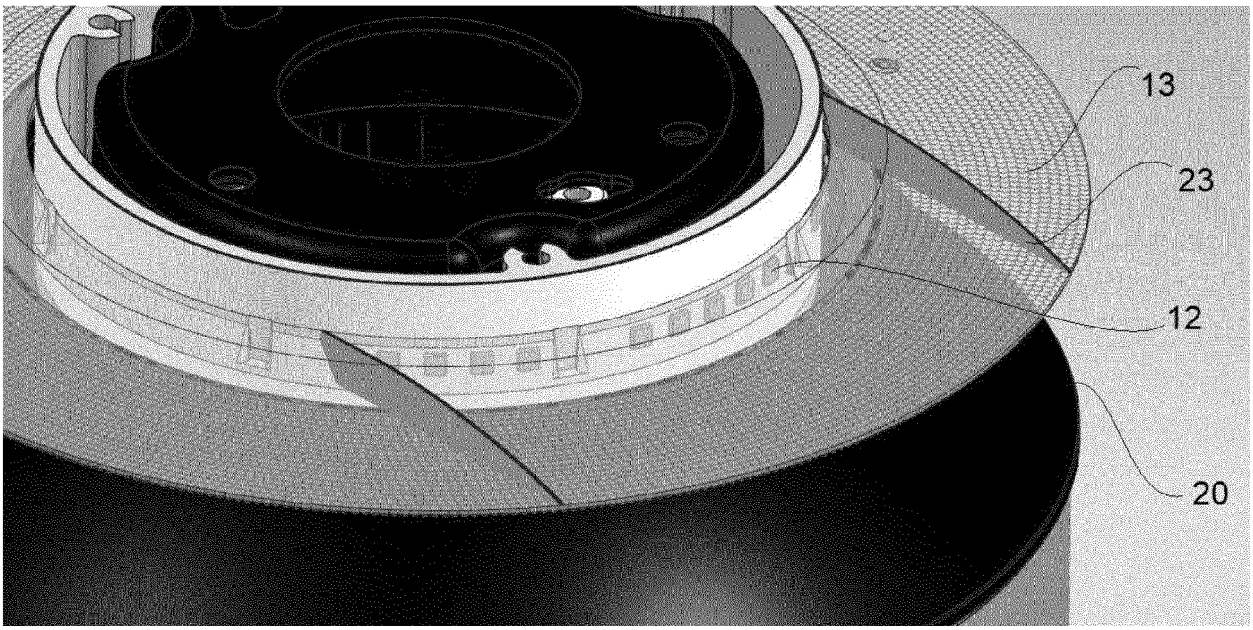

Fig. 7

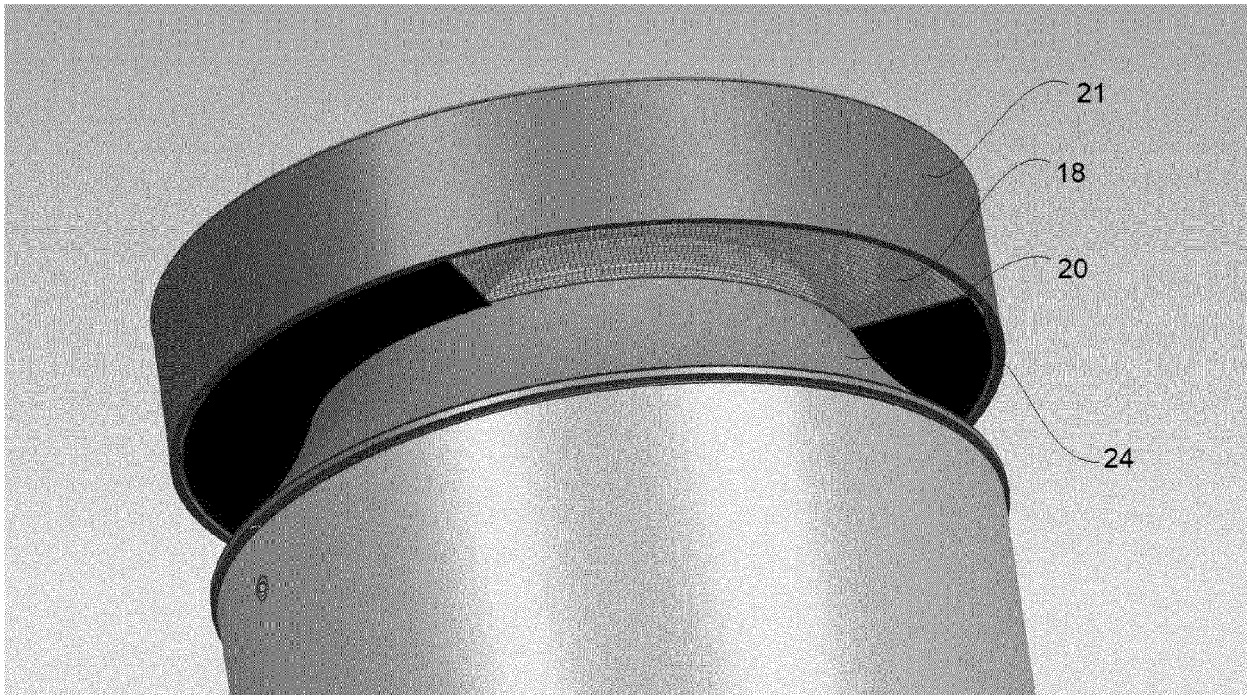

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 20 18 9135

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 October 2020	Demirel, Mehmet

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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