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(54) Emergency lighting unit, lighting apparatus and method for lighting a floor surface in a space

(57) An emergency lighting unit, comprising an emergency light source for lighting a floor surface in a space from above, and an optic. The optic is arranged for operatively focusing a light beam issuing downwards from the emergency light source, which light beam is located in a first, upper zone and is incident on the optic, onto a second, adjoining zone located below this. The first and second zone are each, on a lower side, bounded by conical surfaces which are located concentrically with respect to the normal of the floor surface.

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Description

[0001] The invention relates to an emergency lighting unit, inter alia for use in a lighting apparatus, comprising an emergency light source for lighting a floor surface in a space from above.

[0002] Such an emergency lighting unit is, for instance, activated when the power supply of the lighting apparatus, such as an electricity supply, is interrupted. The emergency lighting unit then lights the floor surface, so that persons present in this space can still orient themselves in spite of the occurring failure and can leave the space in a more or less orderly manner. This prevents panic from breaking out. It is further possible that the emergency lighting unit is permanently activated. Such units may also be used for optically marking and/or lighting escape routes.

[0003] A disadvantage of known emergency lighting units is the inefficiency with which the floor surface is lighted, given the total available light flow of the emergency lighting source. The emergency lighting units are usually mounted in a lighting apparatus provided with at least one light source and an optic. The optic is arranged such that, during normal use, the at least one light source optimally lights a limited space. As the light issuing from the emergency light source is also influenced by the optic, the activated emergency lighting unit also lights only a limited space, so that it is necessary to place relatively many emergency lighting units in the space in order to guarantee a predetermined minimum lighting intensity over the whole floor surface of a space. Moreover, this involves high costs for purchase and installation.

[0004] The invention contemplates an emergency lighting unit of the type referred to in the introduction, where, while preserving the advantages, the disadvantages mentioned are avoided. In particular, the invention contemplates obtaining an emergency lighting unit, where the number of required units can be reduced without compromising the guarantee of the predetermined minimum lighting intensity on the floor surface. For this purpose, the emergency lighting unit according to the invention comprises a compact emergency light source and an optic arranged for lighting a relatively large surface.

[0005] By use of an optic which is arranged for distributing light issuing from the emergency light source over a relatively large surface, it is achieved that the light from the light source, such as for instance an LED, still reaches a large floor surface. With unchanged requirements concerning the lighting intensity, this reduces the number of required emergency lighting units for lighting the floor surface. By use of a compact emergency light source, such as for instance an LED, generally, an efficient light source is obtained as well. This is favorable for realizing a low energy consumption at the time of a voltage drop in the electricity grid. Moreover, this allows the optic to have a compact design, so that costs are saved and the complete emergency lighting unit takes up a relatively modest volume. This allows the unit to be easily and discretely integrated into a lighting apparatus. When placed as a separate unit, also called 'stand alone', the unit can also be disposed relatively inconspicuously due to the small dimensions.

[0006] It is noted that patent publication DE 197 47 078 describes an emergency lighting unit in which a plurality of LEDs have been provided.

[0007] It is further noted that patent publication WO 01/71244 describes an emergency lamp which is provided with a matrix of LEDs and which is arranged to be received in a fitting instead of a common light bulb.

[0008] In addition, it is noted that patent publication WO 02/16826 likewise describes an emergency lighting unit in which a plurality of LEDs have been provided.

[0009] Preferably, the emergency lighting unit according to the invention comprises an optic which is arranged for operatively focusing a light beam issuing downwards from the emergency light source, which light beam is located in a first, upper zone and is incident on the optic, onto a second, adjoining zone located below this, while the first and the second zone are each bounded, on the lower side, by conical surfaces which are concentrically located with respect to the normal of the floor surface passing through the emergency light source.

[0010] By using such an optic, it is achieved that a light beam issuing from the emergency light source which propagates in a direction with a large lateral component, corresponding with the first zone, is focused in a direction with a smaller lateral component, corresponding with the second zone, so that a ring, at least a ring segment around a central light spot, is extra lighted with the aid of a light flow which, in the known emergency lighting unit, issues more or less laterally and provides no significant contribution to the lighting intensity on the floor surface. As a result, the total light flow of the emergency light source is better utilized, and the lighting intensity outside the central spot reduces less rapidly, so that a more uniform light distribution on the floor surface is obtained. As a result, the emergency light source lights a larger area without making concessions to the predetermined minimum lighting intensity in this area. This means a saving in the number of emergency lighting units which need to be placed in a space.

[0011] It is noted that, in this application, floor surface is also understood to mean a surface which is located at some distance, for instance about 10 cm, above the actual floor surface.

[0012] By choosing the conical surfaces bounding the first and second zone such that these surfaces make a first and a second angle, respectively, with respect to the normal of the floor surface, it is achieved that the zones are rotationally symmetrical with respect to the normal of the floor surface passing through the emergency light source, so that rotationally symmetrical, at least segments of rotationally symmetrical, lighting profiles can be obtained. This simplifies the optimization of

the number of emergency lighting units and the positioning of the units during the installation thereof.

[0013] Preferably, the optic comprises reflecting walls for focusing the light issuing from the emergency light source along a principal axis which is substantially parallel to the floor surface. What is thereby achieved is that the light flow issuing from the emergency light source is completely utilized for lighting the floor surface along the principal axis, so that, in an efficient manner, an elongated floor surface, for instance a more or less rectangular or elliptical surface, is lighted. It is noted that an optic with reflecting walls for focusing light along a principal axis which is substantially parallel to the floor surface cannot only be advantageously used in focusing the light beam located in the upper zone onto the adjoining second zone lying below this, but also in general in an emergency lighting unit comprising an emergency light source for lighting a floor surface in a space from above.

[0014] Preferably, the surface of the reflecting walls is formed by adjoining segments, whose longitudinal axes are oriented substantially parallel with respect to the normal of the floor surface. What is thereby achieved is that, in the case that light beams with different colors are generated in the emergency lighting unit, these colors are better mixed, so that the light issuing from the emergency lighting unit has a more or less uniform color distribution. In addition, the segments limit undesired contrasts, also called gradients, in a direction transverse to the longitudinal axis in the area in which the more or less uniform lighting intensity has been obtained. In addition, due to the occurring overlap in the image, the requirements with regard to the exact positioning of the reflecting surfaces are less stringent, which simplifies the manufacturing process. The segments may, for instance, contain a convex or concave cylinder casing or have a different profile, such as for instance a triangular profile.

[0015] In an advantageous embodiment according to the invention, the optic of the emergency lighting is also arranged for focusing a light beam issuing. from the emergency light source onto the second zone, which light beam is located in a third, lower zone enclosed by the second zone and is incident on the optic. What is thereby achieved is that an issuing light beam from a light cone which propagates in a direction with a small lateral component, and hence with a large downward component, corresponding with the third zone, is focused in a direction with a more lateral component, corresponding with the second zone, so that the central light spot on the floor surface is less lighted in favor of the ring, at least the ring segment around the light spot. Thereby, the overmeasure of light in the light spot is partly focused onto the nearby, ring-segment-shaped area. Consequently, on the floor surface, a lighting intensity is obtained which is still more uniform, so that the light issuing from the emergency light source is utilized still more efficiently. This results in a still smaller number of emergency lighting units which are required for lighting a floor surface in a space during failure of the normal lighting, while no concessions are made to predetermined minimum lighting intensities on the floor surface.

[0016] In an elegant embodiment, the optic comprises a lens, so that a simple, inexpensive embodiment of the focusing optic is obtained.

[0017] Preferably, the lens has a rotationally symmetrical design and the lens has an upper and lower surface, which are each provided with a cavity. By having the wall thickness of the lens, viewed from the center of the upper surface in a direction with decreasing angle with respect to the normal of the floor surface substantially increase, i.e. not having it decrease, initially at least in a first part, and then having it decrease, i.e. not having it increase, in a last part, at least two angle segments can be distinguished in that direction. In a first segment, the incident light deflects downwards due to prism effect. In a second, last segment, the light is laterally deflected, also due to prism effect. Due to the optical effect of the lens, light beams from the first and third zone are thus focused onto the second zone in an advantageous manner.

[0018] In another embodiment according to the invention, the lower edges of the reflecting walls are positioned such that the light issuing from the emergency light source is, from the first zone, incident on the reflecting walls. In an advantageous manner, the reflecting walls form the optic for focusing the light beam located in the first zone. In this simple embodiment which can inexpensively be manufactured, during focusing, the walls reflect the light beam in a surprising manner in an opposite direction, so that still a symmetrical light profile is obtained.

[0019] In an advantageous manner, the optic is arranged such that the light beam to be focused is located in a sector of the upper zone which is substantially enclosed by two planes which are transversely oriented with respect to the floor surface and which substantially intersect in the normal of the floor surface passing through the emergency light source. What is thereby obtained is a lighting profile which is more uniform in one particular direction than in other directions. With such an emergency lighting unit, a more rectangular floor surface, for instance a hallway, can be lighted.

[0020] Preferably, the reflecting walls are built up from adjoining strips extending in a direction which is substantially parallel to the floor surface, and where the angle of the walls with respect to the normal of the floor surface decreases when traversing the strips from top to bottom. Due to the specific orientation of the walls built up from strips, a focusing of the light beam onto the second zone takes place, so that the separate strips effect a more or less uniform lighting intensity on the floor surface.

[0021] The invention further relates to a lighting apparatus to which an emergency lighting unit is attached.

[0022] The invention also relates to a method for light-

ing a floor surface in a space.

[0023] Further advantageous embodiments of the invention are described in the subclaims.

[0024] The invention will now be elucidated in more detail with reference to exemplary embodiments shown in the drawing, in which drawing:

Fig. 1 shows a diagrammatic perspective bottom view of a first embodiment of an emergency lighting unit according to the invention;
Fig. 2 shows a diagrammatic perspective top view of the emergency lighting unit of Fig. 1;
Fig. 3 shows a diagrammatic cross section of a detail of the optic associated with the emergency lighting unit of Fig. 1 in side elevational view;
Fig. 4 shows a diagrammatic bottom view of an optic associated with a second embodiment of an emergency lighting unit according to the invention;
Fig. 5 shows a diagrammatic perspective bottom view of the optic of Fig. 4;
Fig. 6 shows a polar light diagram of the light intensity generated by a diffuse light source;
Fig. 7 shows a polar light diagram of the light intensity generated by the emergency lighting unit of Fig. 1;
Fig 8 shows a polar light diagram of the light intensity generated by the emergency lighting unit of Fig. 4;
Fig. 9 shows a diagrammatic perspective view of zones in which the light beams are located; and
Fig. 10 shows a diagrammatic top plan view of a lighted floor surface.

[0025] The Figures are only diagrammatic representations of preferred embodiments of the invention. In the Figures, same or corresponding parts are designated by the same reference numerals.

[0026] Figs. 1 and 2 show a first embodiment of an emergency lighting unit 1 with an emergency light source, here designed as an LED (not visible), which is provided on a foot 2. Such an emergency lighting unit may, for instance, serve as anti-panic lighting or as escape route lighting. On the foot, terminals 3 are attached for supplying the LED with electric energy, for instance with the aid of batteries, accumulators or another emergency energy supply. The foot 2 is positioned above a floor surface in a space, for instance to a lighting apparatus. The foot 2 may further be provided with cooling means for discharging heat generated by the emergency light source, such as for instance a cooling plate 4 (see Fig. 2) or cooling ribs. Over the LED, a standard rotationally symmetrical optic 5 is provided. The rotationally symmetrically optic 5 is attached on the foot 2, for instance with a glue connection. However, other types of attachment are possible, for instance a clamp connection or a connection which is created in a plastic molding process. Around the rotationally symmetrical optic 5, a lens 6 is provided which functions as an optic for generating a specific light distributing on the floor surface, as is described hereinafter in more detail. Further, the emergency lighting unit 1 is provided with substantially V-shaped reflecting walls 7 for focusing the issuing light in a direction which is parallel to the floor surface.

[0027] As emergency light source in the emergency lighting unit, a compact light source, such as an LED, preferably a power LED, may be chosen. Compared to other light sources, an LED consumes relatively little electrical energy, has a long life and is relatively compact. The diameter of a power LED is about 6-8 mm. The standard optic 5 which is provided over the emergency light source then has a diameter of about 10 mm. However, other emergency light sources are also possible, such as for instance a halogen lamp or a miniature gas-discharge lamp. The emergency light source can be fed externally with the aid of a central emergency power supply of via a local supply unit, for instance a compartment with batteries, for feeding a small group of emergency lighting units. The emergency light source may also comprise its own emergency supply means, so that it forms an autonomous system. With use of local emergency supply means it is particularly desirable that the emergency light source is economical and that the light issuing from the emergency light source is efficiently utilized, as, in this case, the energy means are scarce.

[0028] The emergency lighting unit preferably comprises only a few emergency light sources so that, by utilizing the optic in an efficient manner, still a relatively large surface can be lighted. In this context, a few emergency light sources are understood to mean a limited number of emergency light sources, for instance fewer than ten, such as one emergency light source or two emergency light sources of which the issuing light lights the floor surface. It is of course possible to include a few more emergency light sources in the emergency lighting unit, for instance to still be able to generate light in the case of unexpected failure of an emergency light source or to emit different colors of light, for instance green and orange light in order to simulate white light. Thus, the emergency lighting unit may comprise three emergency light sources or some pairs of green and orange emergency light sources.

[0029] With the aid of the standard rotationally symmetrical optic 5 slid around the emergency light source, the emergency light source functions as a diffuse Lambertian radiator, creating a cosine-shaped light profile, as shown in Fig. 6. On the right and bottom side of the polar light diagram, the angles are shown of an issuing light beam with respect to the normal passing through the emergency light source. On the left side, the measured light intensity, i.e. the light flow per solid angle, is shown in the unit Candela. The light diagram clearly shows that, at a central point directly below such a light source - without use of the lens 6 - more light is present than at a location which is remote from the central point. The lighting intensity, i.e. the light flow per surface, ex-

pressed in lux, will therefore rapidly decrease from the central point.

[0030] By use of the lens 6, a light profile is created on the floor surface in which the lighting intensity is more or less uniform over a relatively large area, so that relatively few of such emergency lighting units are needed for lighting a floor, while, during operation of the emergency light source, at each location on the floor surface, a lighting intensity is present which meets a predetermined level. The lens 6 has a substantially disc-shaped design from an optically transparent material, such as glass or plastic, for instance polycarbonate or polymethyl acrylate, with a refractive index between, for instance, 1.40 and 1.50. The lens 6 further comprises a side edge 15, an upper surface 16 and a lower surface 17, as shown in Fig. 3. The upper and lower surface 16, 17 are provided with a cavity 18, 19. Here, the cavity 18 in the upper surface preferably has a bell-shaped profile. Further, the side edge 15 is beveled off inwards near the lower side of the lens 6. Viewed from the center of the upper surface 16 in a direction with decreasing angle with respect to the normal of the floor surface, the wall thickness 20 of the lens 6 substantially increases, i.e. hardly decreases, at least in a first part, then remains substantially constant over an angle segment, and then substantially decreases, i.e. hardly increases, at least in a last part.

[0031] The effect of the lens 6 is elucidated with reference to Figs. 3, 7, 9 and 10. Fig. 3 shows three light beams 11, 12, 13 which issue from the emergency light source and are incident on the lens 6 from different directions. The different directions are each divided into a zone shown in Fig. 9. The first, upper zone 21 is, on the upper side, bounded by an upper surface 10 which is parallel to the floor surface 9 and in which the emergency light source 14 is located. On the lower side, the first zone 21 is bounded by a first conical surface 24 which is concentrically located with respect to the normal 8 of the floor surface 9 passing through the emergency light source 14. A second, adjoining zone 22 located below this is, on the upper side, bounded by the first conical surface 24 and, on the lower side, by a second conical surface 25 which is also concentrically located with respect to the normal 8. In a first approach, the tops of the conical surfaces 24, 25 coincide in the emergency light source 14, as shown in Fig. 9. Further, the conical surfaces 24, 25 each make a constant angle with respect to the normal 8. A third, lower zone is formed as a cone 23 which is traced by the second conical surface 25. As shown in Fig. 10, each of the zones 21, 22, 23 lights a part of the floor surface 9. Thus, the light cone located in the third zone 23 lights a central light spot 26 directly below the emergency light source 14. Light beams located in the second zone 22 substantially light a ring-shaped part 27, at least a ring segment around the light spot 26. The area 28 outside the ring-shaped part 27 is substantially lighted by light beams located in the first zone 21.

[0032] As Fig. 3 shows, the upper light beam 11 located in the first zone 21 is deflected downwards by the prism effect of the lens 6 which locally has a wall thickness 20 increasing downwards. Thereby, the light beam 11 is focused onto the second zone 22. As the wall thickness 20 for the middle light beam 12, which is incident on the lens 6 from the second zone 22, remains substantially constant, the direction of this light beam 12 remains substantially unchanged. The wall thickness 20 of the lens decreases for the lower light beam 13 which is incident on the lens 6 from the third zone 23, so that this light beam 13 is deflected upwards and also ends up in the second zone 22. This effect can also be observed by comparing the polar light diagrams in Fig. 6 (without lens) with the polar light diagram in Fig. 7 (with lens). Because both the upper and the lower light beam 11, 13 are deflected to the second zone 22, the light intensity in this zone is the greatest, so that the ring-shaped part 27, at least the ring segment around the light spot 26, is extra lighted. This means that, in a relatively large area, namely the light spot 26 including the ring-shaped part 27, at least the ring segment 29 around the light spot 26, a relatively uniform lighting intensity, for instance with variations of only 25% or even 15%, is obtained over a length of, for instance, 8.0 meters, or even 10.8 meters when the emergency lighting unit is positioned at a height of approximately 2.5 - 2.0 meters. Thus, with a relatively small power, a relatively large surface is illuminated.

[0033] In a practical embodiment, the angle which the first conical surface 24 makes with the normal 8 is in an interval between approximately 65° - 75°, preferably approximately 75°, and the angle which the second conical surface 25 makes with the normal 8 is in an interval between approximately 45° - 55°, preferably approximately 45°. Further, due to the deflection of the upper and lower light beams 11, 13, the imaginary light source shifts somewhat upwards and downwards, respectively. Accurately considered, the second zone in which these light beams 11, 13 are focused is hence bounded by conical surfaces whose tops are somewhat shifted along the normal 8. As, however, the lens 6 is positioned close to the emergency light source 14, i.e. much closer to the emergency light source 14 than to the floor surface 9, this is a secondary effect which hardly has any effect on the trace of the optics.

[0034] The substantially V-shaped reflecting walls 7 are substantially transversely oriented with respect to the floor surface and, although not well visible in Figs. 1 and 2, they have parabola segment-shaped profiles in a cross section parallel to the floor surface. More in particular, legs of the V-shaped profiles corresponding with each other form substantially segments of a parabola. In the embodiment shown, the profiles are positioned substantially symmetrically with respect to the emergency light source, so that light distributions are obtained which are point-symmetrical with respect to the emergency light source. The profiles focus the light is-

suing from the emergency light source along a principal axis H, as Fig. 10 shows, which axis is parallel to the floor surface, so that the generated light profile on the floor surface is not rotationally symmetrical, but is completely utilized for forming a more or less elongated profile, for instance for uses in a hallway. The more or less elongated profile is created in that, after reflection against the parabola segment-shaped profiles, light beams leave the emergency lighting unit in a substantially parallel or somewhat divergent manner. Without the substantially reflecting walls 7, the emergency lighting unit is more suitable for lighting a space whose length approximately corresponds with its width, such as for instance a working space or a reception lodge.

[0035] The surface of the reflecting walls is formed by adjoining segments with an angular reduction of, for instance, 10°, whose longitudinal axes are oriented substantially parallel with respect to the normal of the floor surface. The segments may also have a very small design, so that a more or less continuous curve is obtained. This prevents the creation of contrasts in a direction which is substantially transverse to the principal axis H. Further, any light beams with different colors generated by different emergency light sources are better mixed. The reflecting layer on the walls is formed by applying reflecting material, for instance a metal or a plastic, on a carrier, for instance with the aid of a spraying or vapor deposition process.

[0036] Figs. 4 and 5 show an optic 36 of a further embodiment of an emergency lighting unit 6 according to the invention. The optic 36 is built up from an upper plate 31, in which attachment openings 32 have been provided for attachment above the floor surface, and two openings 33 for providing emergency light sources, such as for instance power LEDs, and four walls to be described in more detail, so that a cap-shaped dissymmetrical optic 36 is formed.

[0037] It is of course possible to provide three or more emergency light sources. By using more than one emergency light source, a number of advantages are obtained. First of all, operation is more reliable, as, upon failure of an emergency light source, another source can take over its function. Further, in general, a more intense light image is generated compared with one emergency light source. Further, emergency light sources can be used which generate different colors of light. Thus, LEDs which generate green and orange light, respectively, can together form light which is perceived as more or less white by a human observer.

[0038] The optic 36 further comprises two opposite reflecting walls 37 which are each built up from adjoining strips 34 extending in a direction which is substantially parallel to the floor surface, and where the angle of the walls 37 with respect to the normal of the floor surface decreases when traversing the strips from top to bottom, for instance with a reduction of approximately 10° per strip. The lower edges 35 of the reflecting walls 37 are positioned such that the light issuing from the emergency light source is incident on the reflecting walls 37 from the first, upper zone 21 and is thereby, in a surprising manner, deflected in opposite direction to the second zone 22. So, the lighting intensity on the floor surface is for one part, namely the light spot 26, realized with the aid of direct light incidence and for another part, namely the ring-shaped part 27, at least the ring segment 29 around the light spot 26, realized with the aid of reflected light. Due to the specific orientation of the strips 34, light beams from the first zone 21 are more or less uniformly distributed over the second zone 22, so that a more or less optimum lighting intensity on the floor surface is obtained. Before reflection of the light beam, this light beam was located in a sector 29 of the upper zone 21 which is enclosed by two planes 20 which are transversely oriented with respect to the floor surface and which intersect in the normal of the floor surface passing through the emergency light source, as Fig. 10 shows. In this manner, the light in the sector 29 is used for lighting a floor surface formed in a more or less elongated manner, for instance for uses in hallways. Just like the substantially V-shaped reflecting walls 7 with the lens 6, the surface of the reflecting walls 37 is formed by adjoining segments 38, whose longitudinal axes L are oriented substantially parallel with respect to the normal of the floor surface. Further, the reflecting walls 37 preferably have a parabola segment-shaped profile in order to obtain a parallel or somewhat diverging light beam.

[0039] The reflecting walls 37 of the optic 36 are, at ends 39, connected with the aid of reflecting screening walls 40, so that the optic 36, viewed in a cross section parallel to the floor surface, encloses the emergency light source. The screening walls 40 prevent lighting of a wall in an elongated space and stimulate an optimum lighting of the floor surface. Further, on the lower side, the reflecting walls 37 are, substantially in the center, provided with a recess for optimally lighting the floor surface in the direction of the principal axis H.

[0040] As the optic does not have a rotationally symmetrical design, the light profile is not rotationally symmetrical either. This can also be inferred from the polar light diagram, as shown in Fig. 8. The continuous line 41 indicates the light intensity of the light issuing from the emergency lighting unit 1 in a direction along the principal axis H. The broken line 42 relates to the light intensity of the light in a direction transverse to the principal axis H. Compared to the polar light diagram of the emergency light source without the lens 6 or cap-shaped optic, as shown in Fig. 6, it is clear that the light in the second zone, corresponding with the ring 27, at least a ring segment 29 around the light spot 26, is extra lighted.

[0041] The dimensions of the optic 36 are related to the dimensions of the emergency light source and are, for instance, approximately a length of about 20-25 mm, a width of about 20 mm and a height of about 10-15 mm. Of course, other dimensions are also possible.

[0042] It is noted that it is not necessary for the emer-

gency lighting unit to comprise an optic for focusing a light beam issuing downwards from the emergency light source, which light beam is located in the first zone and is incident on the optic, onto a second zone. In a further embodiment according to the invention, the light issuing from the emergency light source transforms in such a manner, for instance with the aid of reflectors, that a substantially conical light beam is created, with a top angle which is, for instance, between approximately 10° and approximately 45°. The thus formed light cone then passes an optical system which comprises transparent material, such as for instance glass or transparent plastic, and which distributes the beam in at least one direction, for instance in the direction of the principal axis H, to directions which have a larger angle with respect to the normal of the floor surface than the conical wall of the light cone, while the beam is virtually not influenced in other directions. This results in a light beam which lights a more or less elongated surface, for instance a hallway, with a more or less uniform lighting intensity. The optical system is preferably provided with a prism structure extending in a predetermined direction according to the Fresnel lens principle, where curved lens profiles repeat themselves. The optical system is also called linear diffuser or linear light diffuser. In an advantageous manner, the diffuser is manufactured from plastic with the aid of a mold.

[0043] The emergency lighting unit comprises attachment means (not shown) for attachment to a lighting apparatus which is arranged to be positioned in a space in order to light this space. Thereby, the emergency lighting unit can easily be attached above the floor surface in practically any space, and the unit can also be mounted as an extra module in spaces which have already been provided with lighting apparatuses. When a voltage cutoff occurs in a central electricity grid which feeds the lighting apparatus, the emergency lighting unit can light the floor surface with the aid of an emergency light source and a separate power supply, for instance batteries, accumulators or a central emergency power supply.

[0044] Preferably, at least the light optic of the emergency light source is attached to the light source so as to be adjustable via a bracket with respect to the light source, so that the light beam of the emergency light source can be set, and, upon installation of the lighting apparatus, a choice can be made for a part of the floor surface to be irradiated. Here, in an embodiment according to the invention, the bracket is provided with a hinge. In a further embodiment, the bracket is provided with clamping lugs which can clamp around a part of the lighting apparatus, for instance around a tubular light source, such as a fluorescent tube. Optionally, the bracket can be fixed after installation to guarantee a permanently correctly set beam.

[0045] The light issuing from the emergency light source can be directly incident on the optic. Optionally, however, the emergency light source may also be provided with an optical guide which guides the light issuing from the emergency light source over a distance and then guides it outwards, for instance in the proximity of the optic. This makes it possible in an advantageous manner to hide a larger part of the emergency lighting unit, including the emergency light source, electrical conductors and any cooling fins from view, which is aesthetically attractive. The visible volume of the emergency lighting unit is considerably reduced in this manner. The optical guide is, for instance, assembled from transparent plastic, such as polymethyl metacrylate (PMMA). However, use of other materials, such as glass or glass fibers is also possible. Further, the guide may have a stiff or flexible design. In the case of a flexible guide, the light can easily be guided along a bend, which may have advantages for a simple, compact construction of the emergency lighting unit.

[0046] Preferably, the emergency lighting unit is arranged such that, directly after the switching on thereof, the emergency light source generates an amount of light which is comparable with the amount of light which the lighting apparatus generates during normal operation, and where the emergency light source is further arranged to make the generated amount of light gradually decrease after switching on until a predetermined lighting intensity has been reached. What is thereby achieved is that the voltage cutoff of the central electricity grid does not lead to an abrupt reduction of the light in the space, so that the risk of panic reactions is reduced.

[0047] In order to provide the emergency light source with energy, the emergency lighting unit is, for instance, connected to an emergency supply system, so that, during a voltage cutoff of the central electricity grid, the emergency light source can still function. The emergency light source can function permanently or be activated, for instance with the aid of a switch. Incidentally, the emergency lighting unit may be provided with a local energy capacity, for instance batteries, so that the energy supply is less dependent on, or even independent of, external supply systems. Thus, batteries can supply energy to the unit during a voltage drop in the electricity grid. Preferably, the batteries are rechargeable, so that their energy capacity can be replenished, for instance via an external supply system. Optionally, a package of batteries serves a group of emergency lighting units. Due to the use of a local energy capacity, it is not necessary to connect the emergency lighting unit to an emergency supply system. The central electricity grid is suitable for this as well.

[0048] Upon connection to the central electricity grid, it is found that, in practice, a relatively large number of electrical connecting wires need to be fed to the lighting apparatus. First of all, these are the feed wires to connect the electricity grid with the supply terminals of the unit. These comprise a neutral conductor and a phase conductor. In the case that the emergency lighting unit is coupled to a lighting apparatus, a switch to be manu-

ally operated can be included in the phase conductor, which is then also called switch wire. In addition to the wires already mentioned, optionally, an extra earth wire is present to protect a housing of the emergency lighting unit or the lighting apparatus, which housing is provided with metal parts, for instance in the case of class I apparatuses. It is conventional to also connect at least one so-called voltage detection wire. This voltage detection wire connects voltage detection means with the central electrical mains and serves to detect the electric voltage on the central power supply for the purpose of activating the emergency lighting unit. The voltage detection wire may be a wire which electrically connects the detection means with the central electrical mains, so that detection can take place by means of detection means in the emergency lighting unit or in the lighting apparatus. It is also possible to place the voltage detection means outside the apparatus, for instance near the switch. But also in this situation, a wire is needed to provide the lighting apparatus with a detection signal, so that the emergency lighting unit can be activated. Hence, the minimum number of wires is three. For a good voltage failure detection, sometimes an extra earth wire is necessary to serve as reference voltage for the voltage on the voltage detection wire. The total number of electrical connecting wires which are to be fed to the emergency lighting apparatus and/or the lighting apparatus can thus amount to five or more.

[0049] Such a large number of electrical connecting wires is not desirable. This is because this can cause problems during installation, such as complex wiring diagrams, increased risk of installation errors and space problems.

[0050] Optionally, the emergency lighting unit is therefore provided with voltage detection means for detecting a voltage cutoff on supply terminals of the unit and/or the lighting apparatus to which the emergency lighting unit has been attached. The emergency lighting unit is also further arranged to switch on the emergency light source upon detection of the voltage cutoff. What is thereby achieved is that the emergency lighting system can still function without an extra voltage detection wire and optional corresponding earth wire needing to be fed from the central electricity grid to the unit and/or the apparatus.

[0051] It is noted that the detecting of a voltage cutoff at the supply terminals and the subsequent switching on of the emergency light source is not limited to the emergency light source with the optic described herein, but can also be used independently thereof, for instance in an emergency lighting unit comprising a compact emergency light source for lighting a floor surface in a space from above, and an optic arranged for operatively lighting a relatively large surface.

[0052] According to the invention, the emergency light source is switched on after a voltage cutoff at the supply terminals. This voltage cutoff occurs with a dead central grid, or upon manually switching off a switch included in the feed lines. Because the latter situation occurs most often, the time during which the emergency light source is active after the voltage cutoff is called the afterglow period. In the case of a calamity, however, the emergency light source often needs to have a minimum burning time, herein referred to as a minimum emergency lighting period.

[0053] In an advantageous manner, the emergency lighting system of the lighting apparatus according to the invention is provided with emergency supply means, which are arranged for feeding the emergency light source during a period of time which comprises at least a afterglow period and an emergency lighting period. By providing the emergency supply means, for instance rechargeable batteries, with a capacity which is sufficient for realizing a burning time which is the sum of the afterglow period and the emergency lighting period, it is achieved that the emergency supply means can provide sufficient energy to bridge both a afterglow period after manually switching off the apparatus and a subsequent emergency lighting period. This scenario occurs, for instance, if, following the afterglow period which follows the manual switching off of the lighting apparatus, the light source is switched on and directly after this a voltage drop occurs in the central electrical mains. The latter marks the beginning of the emergency lighting period.

[0054] Preferably, the functioning of the emergency lighting unit, such as for instance the emergency light source and/or the emergency supply means, is tested. This may, for instance, take place with the aid of a so-called self-test where the emergency lighting unit is provided with testing means for carrying out this test, such as for instance an integrated (micro)processor. If the result of the test does not meet predetermined requirements, the testing means generate warning signals, such as for instance optical signals with warning LEDs. In this manner, the functioning of the emergency lighting unit can be better guaranteed in case of failure of the voltage in the electricity grid.

[0055] The testing may also take place centrally with the aid of an electronic bus to which the emergency lighting unit is connected. Then, such a bus system cannot only be used for, for instance, switching on and off, dimming and grouping activated lighting apparatuses, but also for activating and testing, for instance, the emergency light sources and/or the emergency supply means. If such a bus system has already been installed at the location, for instance with connections in lighting apparatuses, it is very easy to connect emergency lighting units to it, as the physical electrical infrastructure for this is already present. Then, the occurrence of a voltage drop does not necessarily need to be detected at the location of the emergency lighting unit, for instance with the aid of detection wires.

[0056] In an advantageous manner, the emergency lighting unit is provided with an optical sensor for detecting the local light intensity, so that the need for additional light can be determined. By not switching on the emer-

gency light source when a voltage cutoff occurs and sufficient light is present, energy can be saved.

[0057] It is noted that the LED, the attachment means for attachment to a lighting apparatus, the voltage detection means, the optical sensor and other aspects of the emergency lighting unit described herein can be used independently of the optic. Such measures are also more generally applicable to emergency lighting units, for instance to an emergency lighting unit comprising a compact emergency light source for lighting a floor surface in a space from above, and an optic arranged for operatively lighting a relatively large surface. Such measures can be considered an invention in themselves.

[0058] The invention is not limited to the exemplary embodiments described herein. Many variants are possible. For instance, an emergency light source can be provided in the cap-shaped optic in combination with the described lens for forming a still better defined light profile. This is because practically every light beam present in the first zone is deflected by the cap-shaped optic, including light beams which still remain in the first zone due to imperfections in the lens. In addition, light beams from the third, lower zone are deflected to the second zone by means of the lens.

[0059] It is also possible to form the cap-shaped optic such that the reflecting screening walls are formed just like the reflecting walls which are built up from strips. Thereby, a more or less square surface is provided with a more or less uniform lighting intensity.

[0060] Such variants will be clear to a skilled person and are understood to be within the scope of the invention as set forth in the following claims.

Claims

1. An emergency lighting unit, comprising a compact emergency light source for lighting a floor surface in a space from above, and an optic which is arranged for operatively lighting a relatively large surface, wherein the emergency lighting unit comprises only a few emergency light sources.

2. An emergency lighting unit according to claim 1, wherein the optic is arranged for operatively focusing a light beam issuing downwards from the emergency light source, which light beam is located in a first, upper zone and is incident on the optic, onto a second, adjoining zone located below this, wherein the first and the second zone are each, on a lower side, bounded by conical surfaces which are concentrically located with respect to the normal of the floor surface passing through the emergency light source.

3. An emergency lighting unit according to claim 2, wherein the conical surfaces bounding the first and the second zone make a first and second angle, respectively, with respect to the normal of the floor surface.

4. An emergency lighting unit according to claim 3, wherein the first and the second angle are in intervals between approximately 65° - 75° and 45° - 55°, respectively.

5. An emergency lighting unit according to any one of the preceding claims, wherein the optic comprises reflecting walls for focusing the light issuing from the emergency light source along a principal axis which is substantially parallel to the floor surface.

6. An emergency lighting unit according to claim 5, wherein the reflecting walls are substantially transversely oriented with respect to the floor surface and have substantially parabola segment-shaped profiles in a cross section parallel to the floor surface.

7. An emergency lighting unit according to claim 5 or 6, wherein the surface of the reflecting walls is formed by adjoining segments, whose longitudinal axes are oriented substantially parallel with respect to the normal of the floor surface.

8. An emergency lighting unit according to any one of claims 2-7, wherein the optic is further arranged for focusing a light beam issuing from the emergency light source, which light beam is located in a third, lower zone enclosed by the second zone and is incident on the optic, onto the second zone.

9. An emergency lighting unit according to claim 8, wherein the optic comprises a lens.

10. An emergency lighting unit according to claim 9, wherein the lens has a wall thickness which, viewed from above in a direction with decreasing angle with respect to the normal of the floor surface, substantially increases initially at least in a first part and then substantially decreases at least in a last part.

11. An emergency lighting unit according to claim 10, wherein the lens is substantially disc-shaped, and wherein the side edge is beveled off inwards near the lower side of the lens.

12. An emergency lighting unit according to any one of claims 8-11, wherein the reflecting walls, viewed in a cross section parallel to the floor surface, comprise two substantially oppositely positioned V-shaped profiles, wherein legs of the V-shaped profiles corresponding with each other form substantially segments of a parabola.

13. An emergency lighting unit according to any one of claims 5-7, wherein the lower edges of the reflecting walls are positioned such that the light issuing from the emergency light source is, from the first zone, substantially incident on the reflecting walls.

14. An emergency lighting unit according to claim 13, wherein the light beam is in a sector of the upper zone which is substantially enclosed by two planes which are transversely oriented with respect to the floor surface and which substantially intersect in the normal of the floor surface passing through the emergency light source.

15. An emergency lighting unit according to claim 13 or 14, wherein the reflecting walls are built up from adjoining strips extending in a direction which is substantially parallel to the floor surface, and wherein the angle of the walls with respect to the normal of the floor surface substantially decreases when traversing the strips from top to bottom.

16. An emergency lighting unit according to any one of claims 13-15, wherein the reflecting walls are, at ends, connected with each other with the aid of screening walls, so that the optic, viewed in a cross section parallel to the floor surface, encloses the emergency light source.

17. An emergency lighting unit according to any one of claims 13-16, wherein the reflecting walls are, on the lower side, substantially in the center, provided with a recess.

18. An emergency lighting unit according to any one of the preceding claims, comprising an LED.

19. An emergency lighting unit according to any one of the preceding claims, comprising more than one emergency light source.

20. An emergency lighting unit according to claim 19, wherein two LEDs are arranged for generating mutually different colors of light.

21. An emergency lighting unit according to claim 20, wherein the two LEDs are arranged for generating green and orange light, respectively.

22. An emergency lighting unit according to any one of the preceding claims, comprising attachment means for attachment to a lighting apparatus.

23. An emergency lighting unit according to claim 22, wherein at least the optic of the emergency light source is, via a bracket, adjustably attached with respect to the light optic of a light source in the lighting apparatus.

24. An emergency lighting unit according to any one of the preceding claims, wherein the emergency lighting unit is provided with an optical guide for guiding the lighting issuing from the emergency light source over a distance.

25. An emergency lighting unit according to any one of the preceding claims, wherein the emergency lighting unit is provided with voltage detection means for detecting only a voltage cutoff on the supply terminals of the emergency lighting unit or of the lighting apparatus connected to an electricity grid, and wherein the emergency lighting unit is further arranged to switch on the emergency light source upon detection of the voltage cutoff.

26. An emergency lighting unit according to any one of the preceding claims, wherein the emergency lighting unit is provided with an optical sensor for detecting the local light intensity.

27. An emergency lighting unit according to any one of the preceding claims, wherein the emergency lighting unit is arranged such that, directly after switching on, the emergency light source generates an amount of light which is comparable with the amount of light generated by the lighting apparatus during normal operation, and wherein the emergency light source is further arranged to make the generated amount of light decrease gradually to a predetermined light intensity after the switching on.

28. An emergency lighting unit according to any one of the preceding claims, wherein the emergency lighting unit is connected to a bus.

29. A lighting apparatus for positioning in a space in order to light this space, which lighting apparatus is connectable to an electricity grid by means of supply terminals, and wherein, to the lighting apparatus, an emergency lighting unit according to claim 1 is attached for generating light on a floor surface in this space from above during a voltage cutoff of the electricity grid.

30. A method for lighting a floor surface in a space, wherein a downwardly directed light beam located in a first, upper zone is focused onto a second, adjoining zone located below this, wherein the first and the second zone are each, on a lower side, bounded by conical surfaces which are located concentrically with respect to a normal of the floor surface.

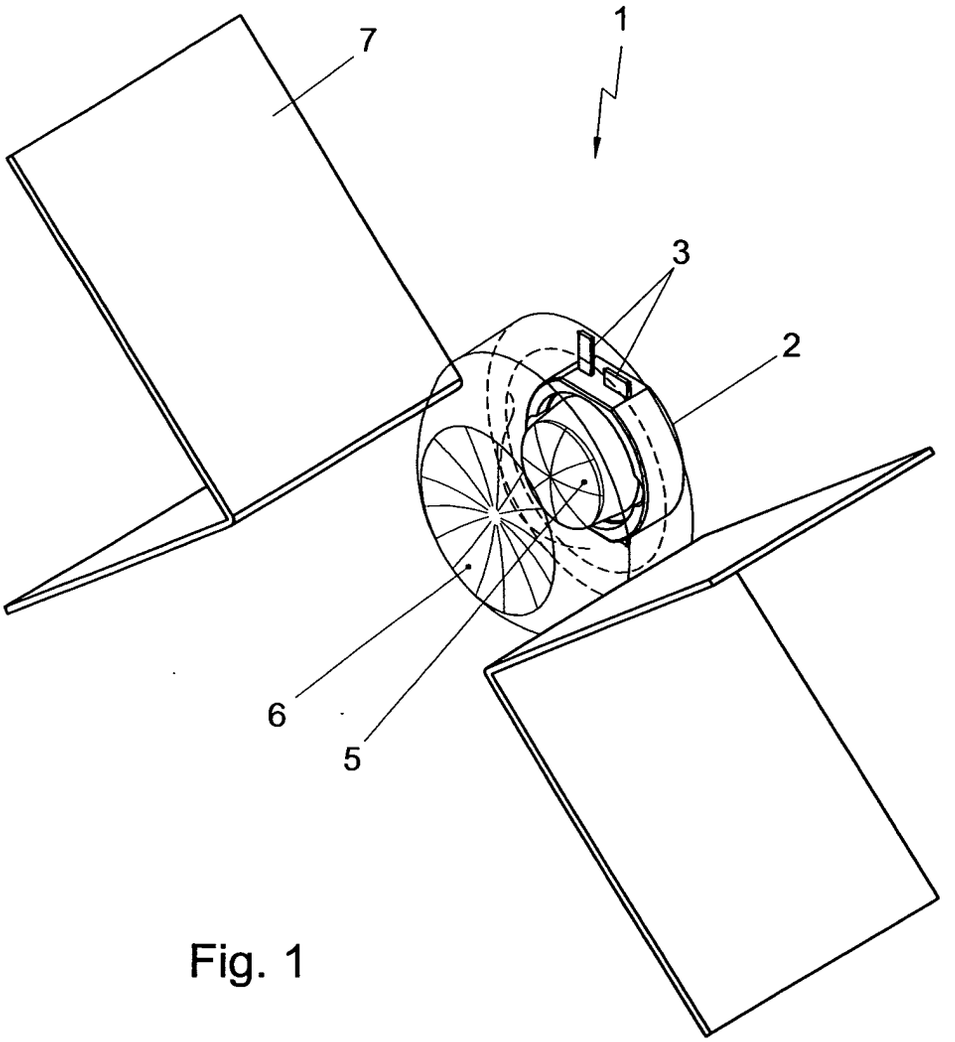

Fig. 1

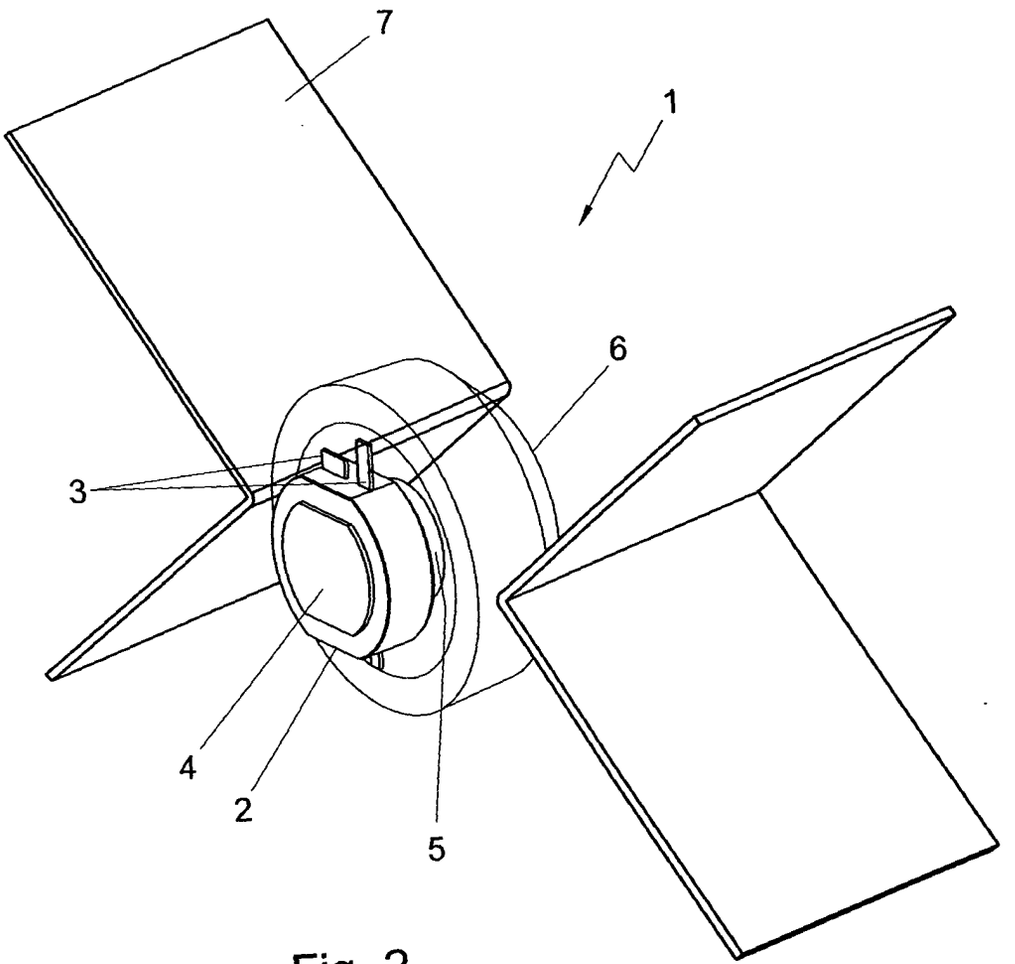

Fig. 2

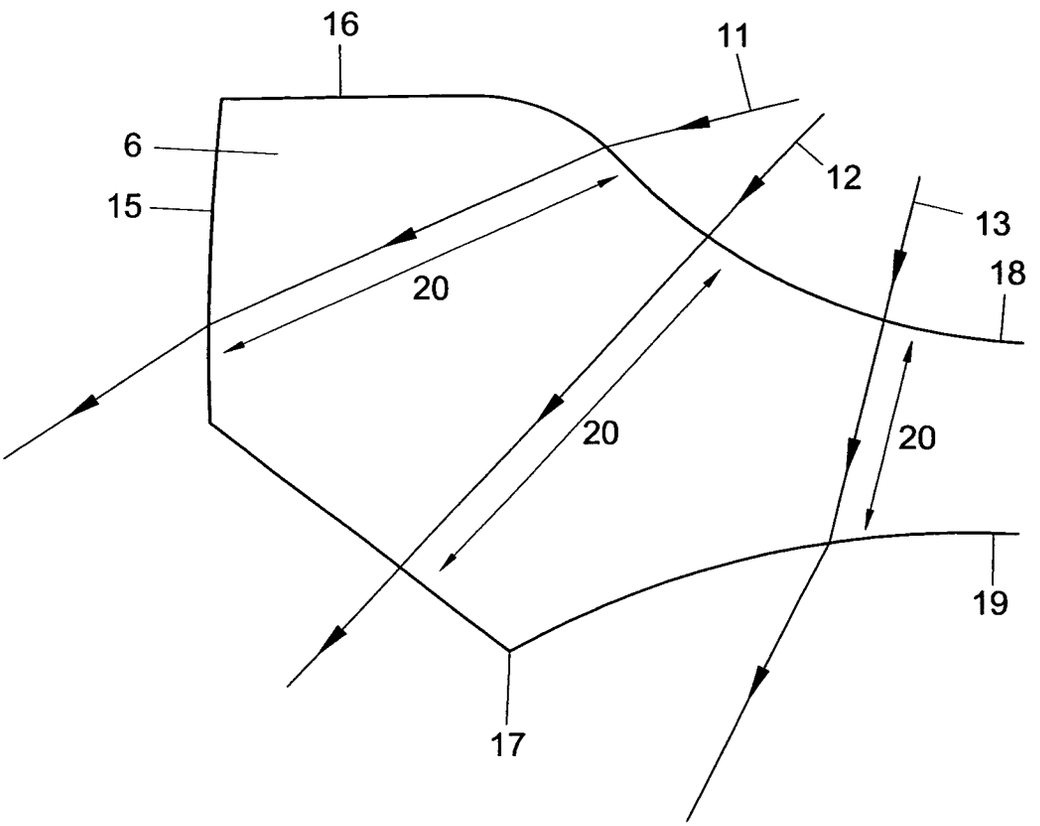

Fig. 3

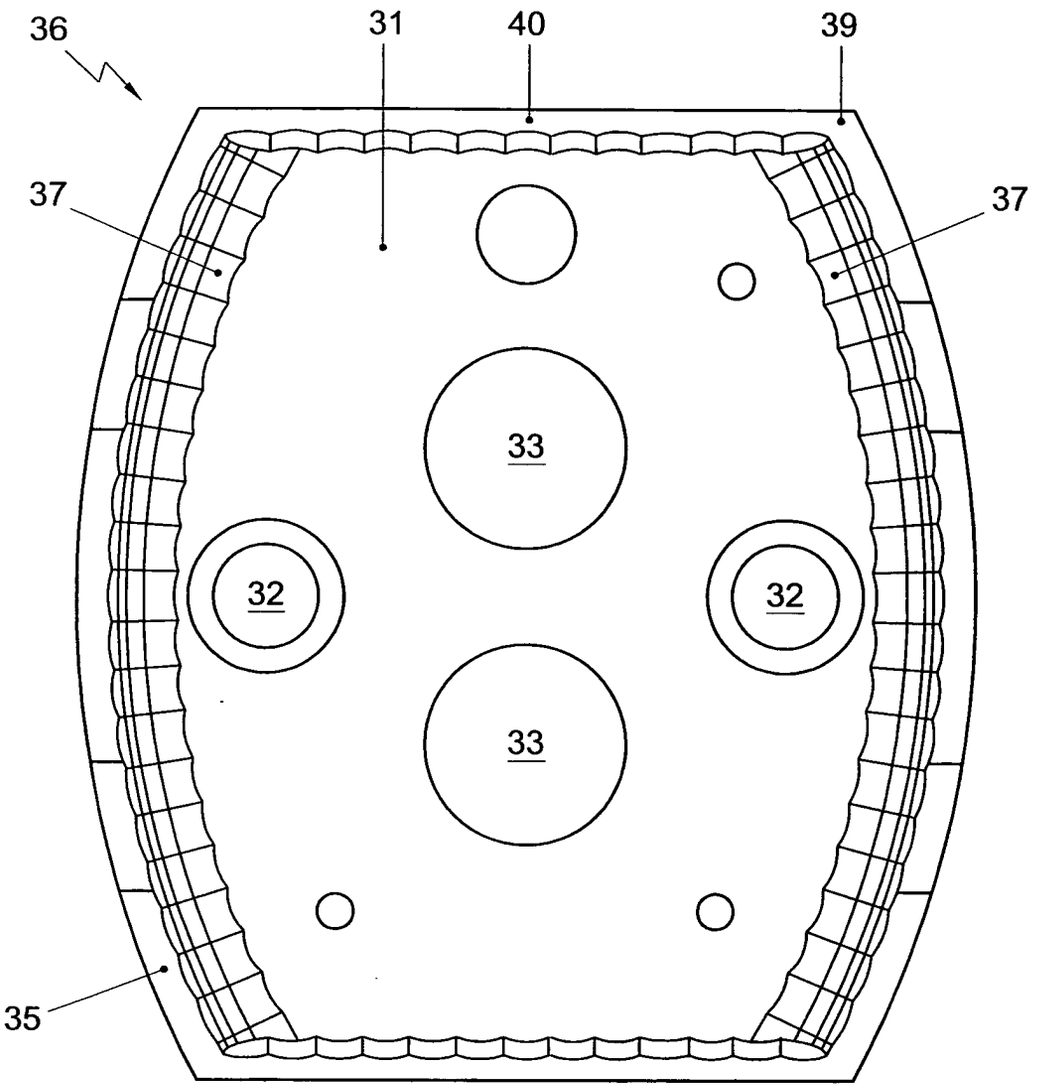

Fig. 4

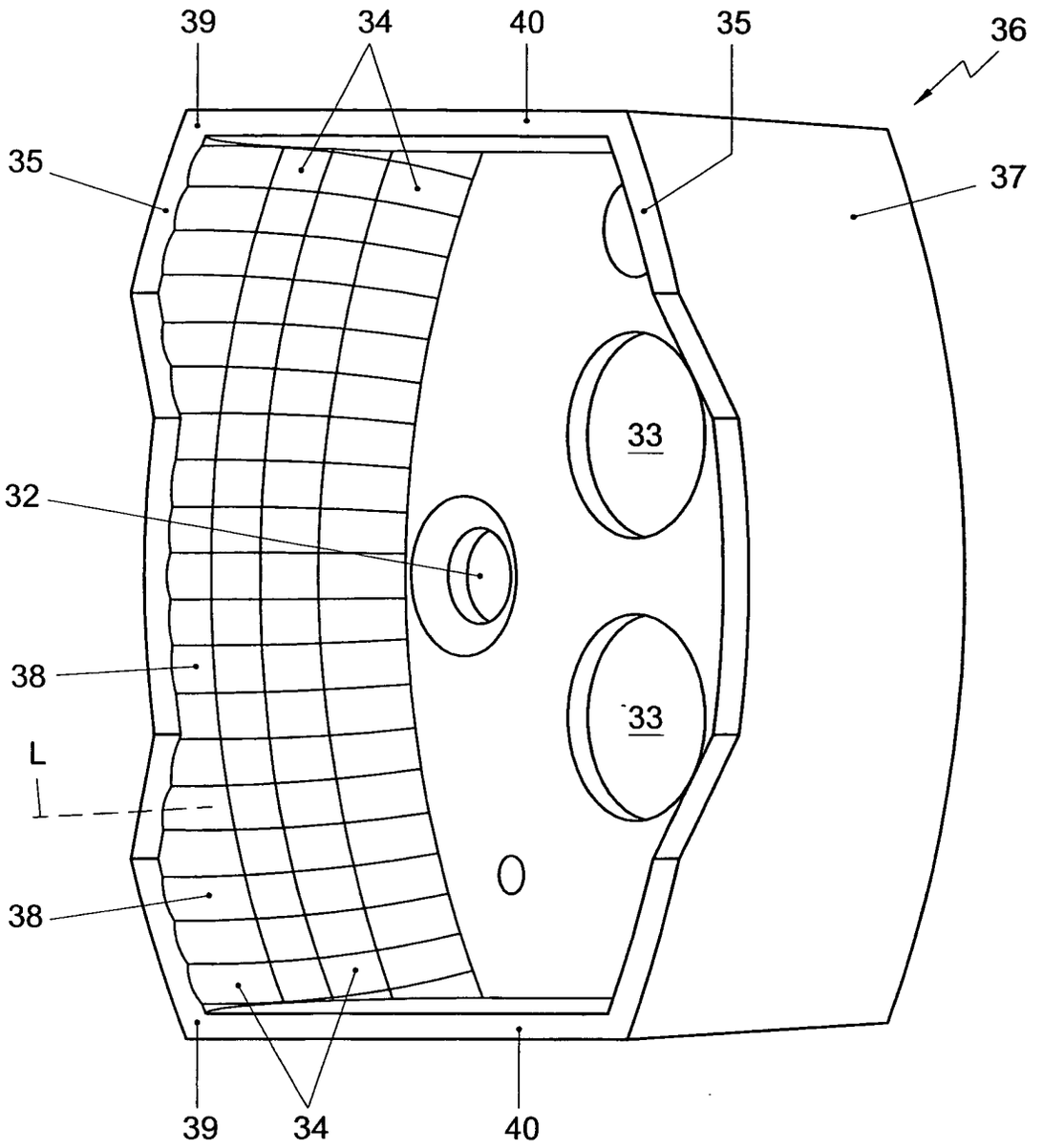

Fig. 5

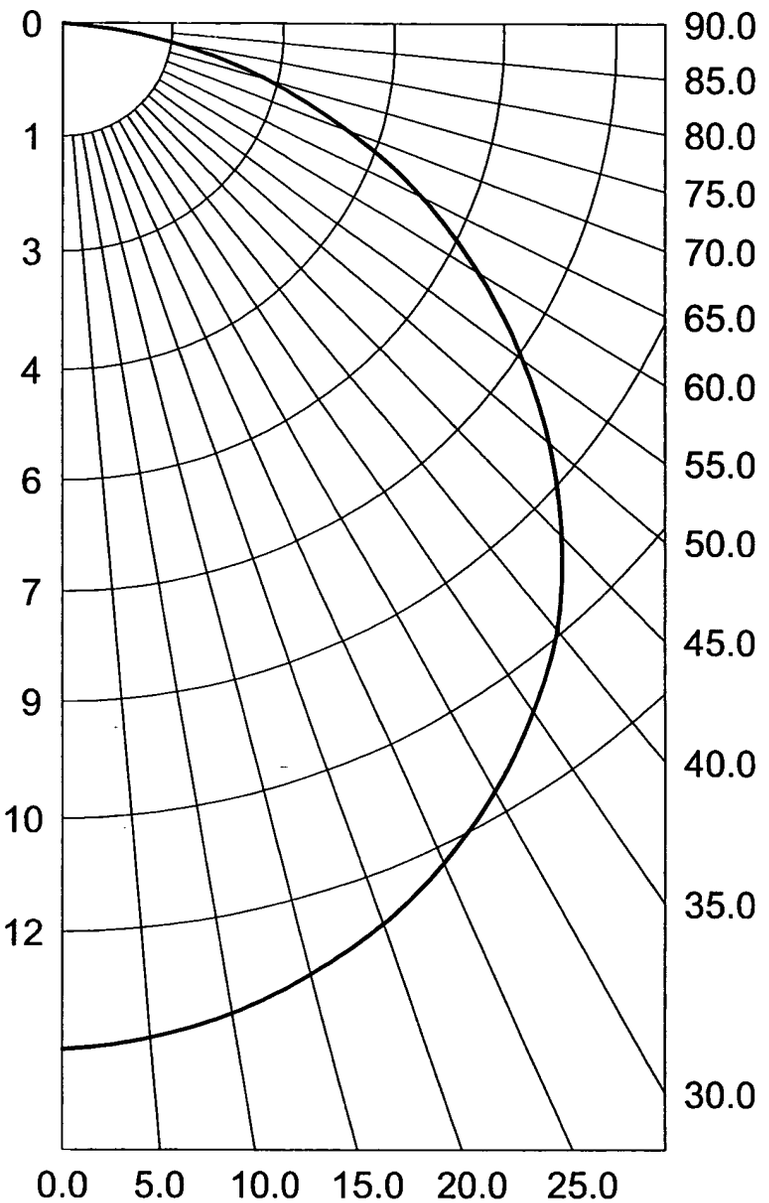
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Fig. 6

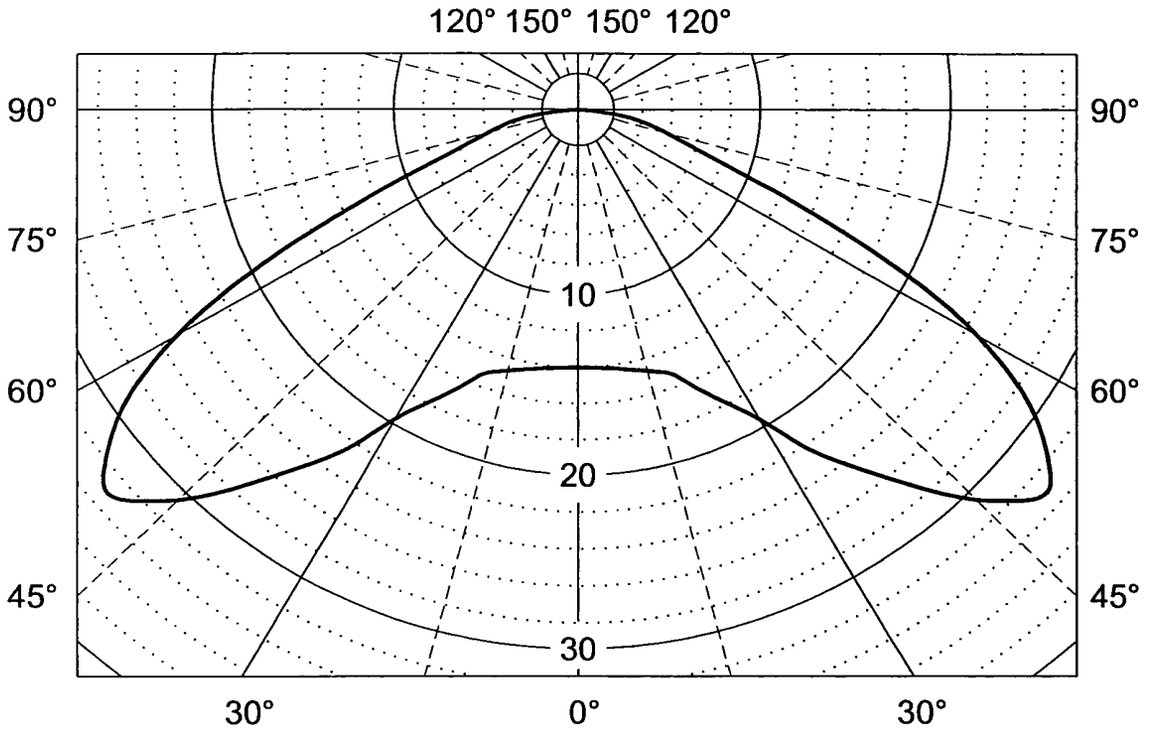
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Fig. 7

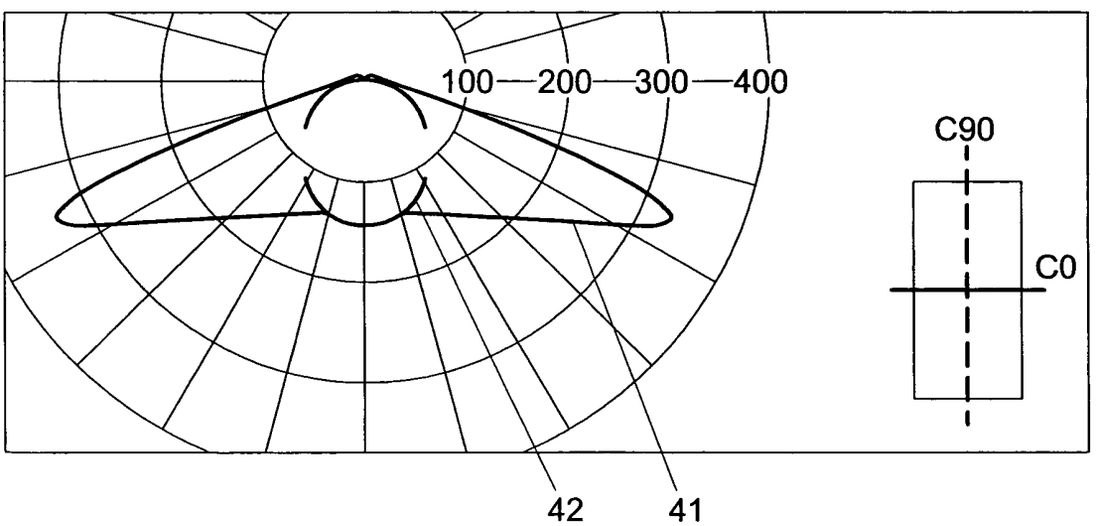
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Fig. 8

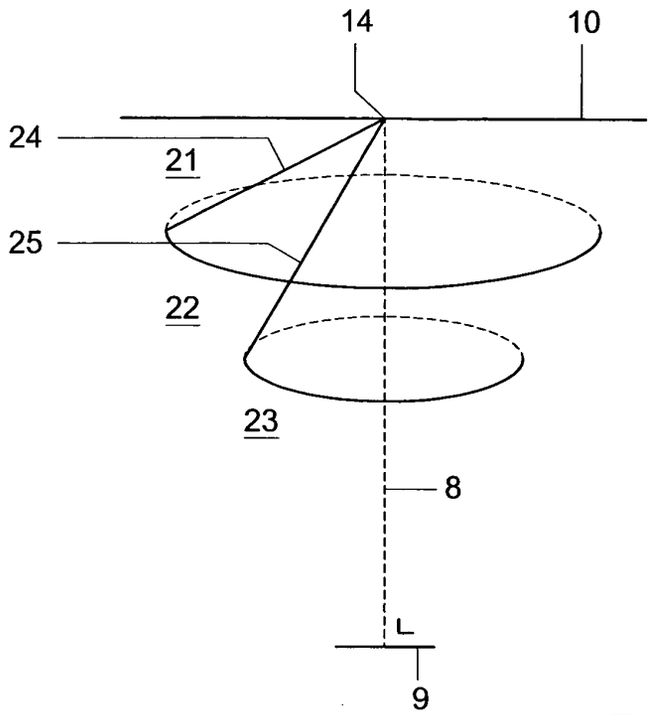

Fig. 9

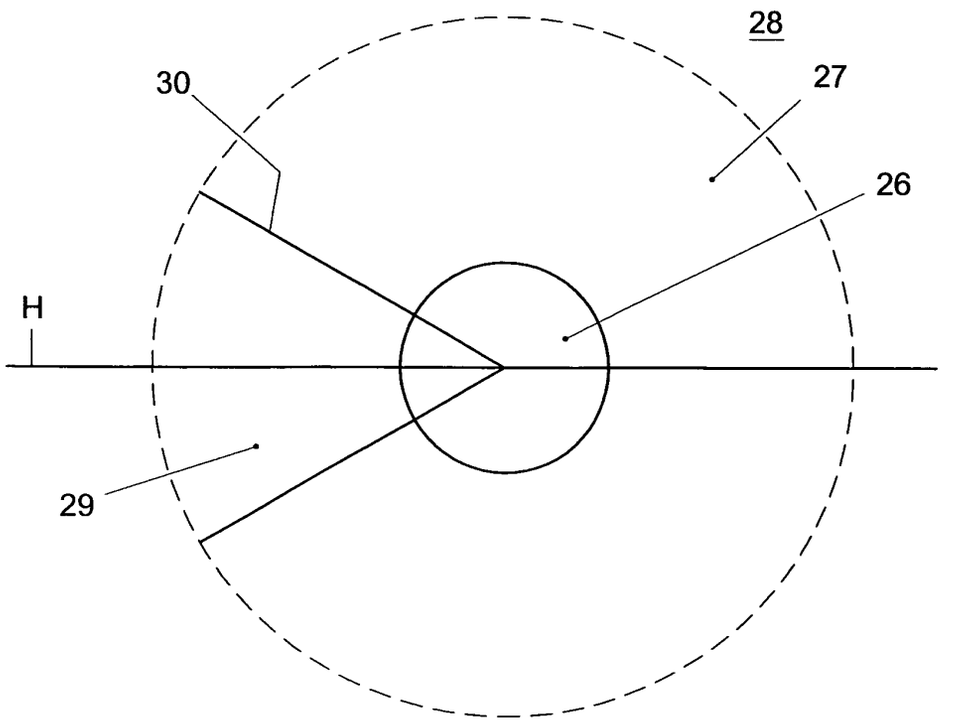

Fig. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 07 7638

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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	6 January 2005	Prévot, E

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EUROPEAN SEARCH REPORT

Application Number
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