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(54) **Lighting method and system for display cabinets of the frozen or chilled type**

(57) Lighting system for display cabinet provided with one or more openings A, comprising for each opening at least one pair of lighting elements 10, 20 for lighting the loading space of the display cabinet at least at the opening. The two elements are arranged into the display cabinet on two portions L1, L2 of the opening perimeter opposite relative to a centre line plane Z in the space com-

prised between the opening and the first target plane P1.

The system is **characterised in that** each lighting element is suitable for generating a light beam having an emission profile substantially of the Gaussian type with optical axis x, y and in that the two lighting elements are arranged so that the optical axes x, y of the light beams generated thereby cross each other and cross the centre line plane Z before intercepting the first target plane P1.

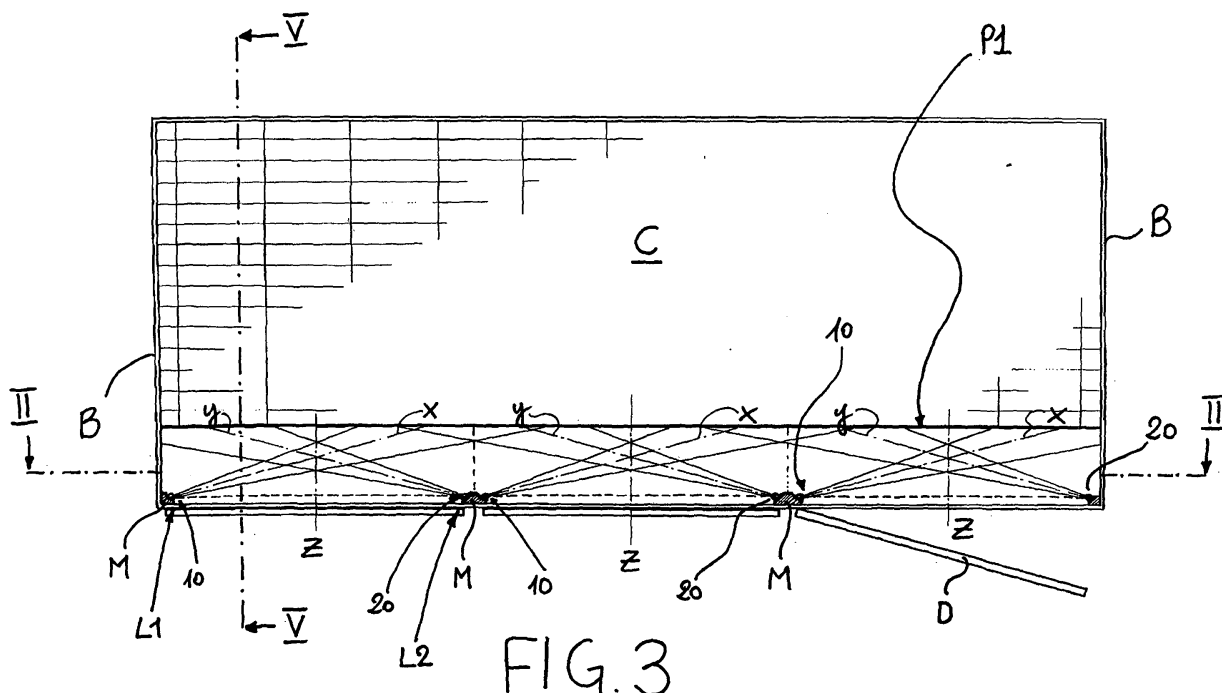


FIG. 3

Description

Field of application

[0001] The present invention relates to a lighting method and system for display cabinets of the frozen or chilled type.

[0002] By frozen type display cabinets it is meant low temperature cabinets or cabinets capable of ensuring product storage temperatures below zero (typically not higher than -18°C).

[0003] By chilled type display cabinets it is meant medium temperature cabinets or cabinets capable of ensuring product storage temperatures above zero (typically comprised between 0°C and 4°C).

Prior art

[0004] As known, for reasons of energy efficiency, frozen display cabinets having a vertical development are usually completely closed so as to obtain a suitable thermal barrier between the loading space and the external environment.

[0005] To this end, such display cabinets are provided with glazed doors that while closing the loading space, allow viewing the goods displayed therein. In order to obtain a sufficient thermal insulation level, double-glazing with multiple layers is normally used.

[0006] Frozen type display cabinets having a horizontal development are normally provided with an open loading space due to the tendency of cold to go downwards, although the use of transparent closing doors, for example sliding, is widespread by now.

[0007] Traditionally, chilled type display cabinets (both with vertical and horizontal development) have an open loading space. Recently, due to an ever increasing need of energy saving, also for this type of display cabinets, versions with loading space completely closed by glazed doors are being proposed on the market.

[0008] As known, the presence of glazed doors in display cabinets makes the illumination of the goods by light sources located outside the cabinet itself difficult, if not impossible. This lighting method in fact is not very efficient since at each crossing of glazed surface (double glazing layers), a share of the incident light is lost by reflection and/or diffusion.

[0009] If not with few exceptions, all the lighting systems for display cabinets (of the frozen type and of the chilled type in closed versions) currently present on the market are therefore provided with light sources located into the loading space.

[0010] Generally, light sources are arranged at the elements that make the support structure of the glazed doors, either wing-like or sliding, so as to use the blind corner defined by such structural elements, which among the other things cannot be eliminated and whereon anti-condensation resistors are also located due to the non-perfect thermal insulation.

[0011] The most currently widespread lighting systems for vertical display cabinets are provided with neon or fluorescent lamps arranged on the two sides of each door at the stopping elements of the doors themselves.

[0012] As known, such lighting system does not allow an even illumination of the loading space.

[0013] If for example we consider a vertical display cabinet, taking as a reference a plane passing by the goods arranged on the shelves of a display cabinet (that is, the goods closest to the door windows), a plane that hereinafter for simplicity will be called first target plane, in fact on said plane at the central zone of the door an illuminance level (lux) considerably lower than that of the side zones closer to the source is noted.

[0014] The above phenomenon - hereinafter called "illumination gap at the centre of the door" for simplicity - is essentially due to the fact that using isotropic light sources (as neon can be considered) the light propagation occurs by rectilinear paths and follows the laws of geometrical optics, in particular the inverse square distance law.

[0015] Given a light source (that emits evenly, for example with spherical or cylindrical symmetry, for example like a neon tube) and set the illuminance intensity (measured in Lux) that can be obtained on the first target plane at a first distance from the source equal to 1, the illuminance level that can be obtained on the same target plane but at a triple distance from the source is equal to $1/9$.

[0016] This phenomenon, that hits just the most important zone of display cabinets in terms of visibility (i.e. the central zone), accentuates more as the target plane is closer to the sources (hypothesis of shelves full with goods) and progressively attenuates considering planes increasingly farther from the source plane, that is, approaching the back of the display cabinet (hypothesis of half-empty shelves with goods at middle distance). This is essentially explained by the fact that the ratios between minimum and maximum distance of the target from the source decrease considering target planes increasingly farther from the light sources and by the fact that light diffusion and reflection phenomena occur into the loading space that favour the distribution thereof.

[0017] The phenomenon described above is highlighted in Figure 1 which refers to a display cabinet with traditional neon lighting system (without improvements but in any case widespread on the market) with 694 mm wide openings and shows the course of the lighting level on two different parallel target planes, arranged at different distances from the plane of the light sources. A plane is arranged at 150 mm from the source plane, whereas the other is arranged at 450 mm. The lighting is defined with relative values compared to the maximum illuminance value in the plane arranged at 150 mm.

[0018] Besides the preferential lighting of the side door zones relative to the central one (i.e. illumination gap at the centre of the door), the traditional lighting systems do not allow a good distribution of light in the central zone of the door itself.

[0019] By central zone of opening A it is meant the area centred on the centre line axis of opening A along its main development dimension and that extends transversally to the centre line axis by about 80% of the total extension of the opening in such direction. By side zones it is meant the residual portions of the opening not included in the central zone.

[0020] A measure of the unevenness of light distribution may be given by the illuminance oscillation factor (ratio between minimum and maximum illuminance level in Lux) on the first target plane in the central zone of the door along the width dimension.

[0021] A good illumination should allow obtaining an illuminance level in the top central zone higher than that of the side zones (absence of gap at the centre of the door), and taking as a reference a first target plane at a distance comprised between 10 and 15 cm from the source plane, an oscillation factor in the central zone higher than 0.3.

[0022] In the prior art solutions, the oscillation factor in the central zone is not higher than 0.2 and as already described above, in the side zones there is a higher lighting level than in the central zone.

[0023] An attempt at solving the problem has been made by distributing the light of each light source on all the target plane or at least on the portion of target plane that relative to the centre line of the door is closer to the source, by especially designed lenses or reflecting surfaces. These solutions allow obtaining improvements but not such as to eliminate the illumination gap at the centre of the door. Moreover, the cost of the lenses to use makes these solutions little advantageous from the economic point of view.

[0024] Over the last years for the lighting of frozen (but also chilled) display cabinets, LED (Light Emitting Diode) light sources are becoming increasingly widespread, much more efficient than neon both in terms of operating flexibility and of operation, and in terms of energy efficiency.

[0025] As known, in fact, LEDs have a luminous efficacy (lumen/Watt) that increases as temperature decreases (therefore ideal for applications in frozen and chilled display cabinets), unlike the neon for which a drastic drop of the luminous efficacy occurs for temperatures below nominal ones (between 25 and 35°C).

[0026] The LEDs emit light at a much lower temperature than neon. As a consequence, the IR radiation share emitted is lower, with clear advantage for the thermal efficiency of the frozen display cabinet.

[0027] The LEDs moreover have a much longer useful life than that of common neon.

[0028] As regards the simplicity of integration in the structures of display cabinets, in particular, the fact that the single LEDs, unlike neon tubes, have very limited dimensions, takes much importance. The smaller dimensions of LEDs have therefore allowed making more compact lighting systems.

[0029] Another element to underline is the emission

angle of the single LEDs, markedly lower than that of neon tubes, that normally emit evenly from all the surface of the tube or with cylindrical symmetry (360°).

[0030] The LEDs substantially exhibit an emitting surface and in the first instance they may be compared to light sources that emit on a single hemisphere. Generally, the LED emission profile exhibits symmetries relative to the optical axis, which is normally orthogonal to the emitting surface of the semiconductor material. For some types of LEDs, the optical axis coincides with the direction wherein the light is transmitted with the maximum intensity. Generally, LEDs do not emit on all the hemisphere but with angles comprised between 140° and 70°, although solutions with greater or smaller emission angles exist. Thanks to this, it is possible to use the light emitted by the light source without necessarily having to adopt special reflectors as in the case of neon tubes.

[0031] LED lighting systems for display cabinets known today offer better performance in terms of energy efficiency compared to neon lighting systems, but still have the problem, although smaller, of the "illumination gap at the centre of the door" and do not allow improving decidedly the light distribution evenness on the first target plane.

[0032] The known solutions adopted in LED systems in fact are substantially similar to those already adopted for neon lighting systems, that is, they envisage distributing the light of each light source on all the target plane or at least on half the target plane that relative to the centre line of the door is closer to the source, by especially designed lenses. Moreover, the lens cost is to the disadvantage of the inexpensiveness of the solutions.

Disclosure of the invention

[0033] The object of the present invention therefore is to eliminate the disadvantages of the prior art mentioned above by providing a lighting system for frozen or chilled display cabinets which should allow obtaining an even illumination of the first target plane, in particular eliminating the illumination gap at the centre of the door while obtaining an oscillation factor above 0.3 in the central zone.

[0034] A further object of the present invention is to provide a lighting system for frozen or chilled display cabinets which should be simple and inexpensive to make.

[0035] A further object of the present invention is to provide a method for evenly lighting the loading space of a frozen or chilled display cabinet.

Brief description of the drawings

[0036] The technical features of the invention, according to the above objects, are clearly found in the contents of the claims below and the advantages of the same will appear more clearly from the following detailed description, made with reference to the annexed drawings, which show a purely exemplifying and nonlimiting embodiment

thereof, wherein:

[0037] - Figure 1 shows, with reference to a display cabinet provided with a traditional lighting system, the course of the illuminance level on two target planes arranged at different distances from the light source surface;

[0038] - Figure 2a shows a front view of a frozen or chilled display cabinet provided with a lighting system according to the invention;

[0039] - Figure 2b shows a cutaway view of the display cabinet of figure 2a according to a plane parallel to the front face of the cabinet itself according to line II-II indicated in Figure 3;

[0040] - Figure 3 shows a cutaway plan view of the display cabinet of Figure 2a according to the line III - III indicated therein;

[0041] - Figure 4a shows a detail of the plan section of Figure 3;

[0042] - Figure 4b shows the same detail of Figure 4a and a partial front view (on a vertical plane) of an opening of the display cabinet, with highlighted the limits of a central area and of a centre line area of the opening itself;

[0043] - Figure 5 shows a vertical side view of the display cabinet of Figure 1 according to the line V - V indicated in Figure 3;

[0044] - Figures 6a e 6b show an example of emission profile of a lighting element of the system object of the present invention respectively on a horizontal emission plane and on a vertical emission plane;

[0045] - Figure 6c shows the emission profile of a LED light source used in a particular embodiment solution of the present invention;

[0046] - Figure 7 shows the course of the illuminance level into a display cabinet provided with the lighting system according to a particular solution of the invention on the first target plane and on target planes arranged at distances from the plane of the lighting elements greater than the first one;

[0047] - Figure 8 shows a LED device with relative container and built-in primary lens;

[0048] - Figure 9 shows a lighting element of the lighting system according to a preferred embodiment of the invention that envisages the adoption of an elliptical lens as secondary lens;

[0049] - Figure 10 shows two lighting elements shown in Figure 9 associated to a mullion of a display cabinet;

[0050] - Figure 11 shows a lighting element of the lighting system according to a preferred embodiment of the invention that envisages the adoption of a reflector as secondary lens;

[0051] - Figures 12 and 13 respectively show two different arrangements of the lighting element shown in Figure 11 in relation to a mullion of a display cabinet; and

[0052] - Figures 14 and 15 with the relevant Tables 1 and 2 show a comparison between a solution according to the invention and a solution of the prior art.

Detailed description

[0053] With reference to the annexed drawings, reference numeral 1 globally denotes a frozen or chilled display cabinet provided with a lighting system for the loading space according to the invention.

[0054] The expression "frozen display cabinet" refers to a display cabinet suitable for ensuring product storage temperatures below zero, typically not higher than -18°C.

10 The expression "chilled display cabinet" refers to a display cabinet suitable for ensuring product storage temperatures above zero, typically comprised between 0°C and 4°C.

15 **[0055]** The present invention is preferably applied to display cabinets (frozen or chilled type) with vertical development.

[0056] Advantageously, the invention may also be applied to display cabinets (frozen or chilled type) with horizontal development.

20 **[0057]** The invention may further be applied to display cabinets of the combined type, that is, comprising a portion of vertical display windows with glazed doors and a horizontal tank portion.

25 **[0058]** The application of the invention should not be understood as limited to display cabinets of the closed type (that is, provided with closing doors of the loading space), as it may advantageously be applied to open cabinets also, since the arrangement of the lighting system into the cabinet may in any case be advantageous from the construction point of view.

30 **[0059]** Advantageously, the lighting system according to the present invention may be used to replace the traditional lighting systems in retrofitting operations for display cabinets already manufactured or present on the market.

35 **[0060]** More in detail, as can be seen in Figure 2, display cabinet 1 is provided with three openings A, each closed by a transparent surface T consisting of a glazed door D of the wing type.

40 **[0061]** Advantageously, the doors may be also of the sliding type. The display cabinets may be provided with one or more doors, as their number is not binding. The frozen display cabinets may further have any size and in particular they may be either with mainly vertical development or with mainly horizontal development.

45 **[0062]** Here and in the following description, the terms "horizontal" and "vertical" refer to the installation plane of the display cabinet, that is, they refer to the display cabinet in operating condition.

50 **[0063]** In Figure 1, openings A of display cabinet 1 have a rectangular shape and they lay on a substantially vertical plane, with closing doors provided with a flat glazed surface.

55 **[0064]** Advantageously, the lighting system according to the present invention may also be applied to display cabinets having openings of any shape and in particular, square or with slightly curved sides. The glazed surface of the walls should not necessarily be flat, as it may for

example be concave or convex in some portions or the entirety thereof.

[0065] As can be seen in Figure 2a and in particular in Figure 3, the display cabinet 1 is provided with a frame B that internally delimits a loading volume C for the display of goods. Such volume C is divided into compartments S by a plurality of shelves R. Advantageously, the number and height distribution of the shelves is not binding for the purposes of the present invention.

[0066] More in detail, frame B frontally comprises a shaped structure E that defines the perimeter of the above openings A. Such structure E in particular comprises a vertical mullion M between one opening and the other that acts as stopping element for the doors.

[0067] Constructively, due to the heaviness of the doors, they are not hinged directly to the mullions, but to the bearing structure of frame B. The seals provided along the door edges sealingly compress along the external portions of openings A and thus also along the mullions.

[0068] As already mentioned before, openings A may have any dimensions. However, particular reference shall be made to the dimensions currently selected by the market, which for a single rectangular opening envisage a width approximately comprised between 600 mm and 800 mm. These width dimensions allow a good compromise between the need of easy access to the loading space and the need of a limited space occupied by the doors in opening.

[0069] The lighting system according to the invention provides for the loading space to be lighted from the interior. To this end, the lighting system according to the invention comprises for each opening A at least one pair of lighting elements 10, 20 suitable for lighting the loading space at least at opening A.

[0070] The expression "at least at the opening" is understood to indicate that the main function of such elements 10 and 20 is to light the loading space within the limits defined by the opening perimeter projected orthogonally onto the loading space, but that nevertheless such elements may optionally contribute to lighting the loading space also at adjacent openings, as may happen for example in the case of display cabinets provided with more than one opening (see figure 3).

[0071] Advantageously, a plurality of pairs of lighting elements 10, 20 may be provided for each opening A, with a variable number according to the dimensions of the same, as will be explained in detail hereinafter.

[0072] According to a preferred embodiment, illustrated in Figures 2b and 5, for each opening A the plurality of pairs of lighting elements is organised on at least two rows F1 and F2 arranged on the above two opposite portions L1, L2 of the perimeter of opening A, with the elements aligned in pairs transversally to the direction of said rows.

[0073] Hereinafter, however, reference is made for simplicity to a pair of lighting elements 10, 20 without this meaning limiting thereof.

[0074] As can be seen in Figure 3, inside display cabinet 1 there is a free space comprised between the plane whereon the opening lie and a vertical plane passing in the proximity of the front edges of shelves R, that is, the plane that defines the front limit of the loading space C.

[0075] In the case of horizontal display cabinet there is a free space between the substantially horizontal plane whereon the openings lie and the horizontal plane that defines the maximum filling level of the display cabinet.

[0076] According to the invention, the lighting elements 10, 20 are suitable to be arranged inside display cabinet 1 in such free space.

[0077] According to the preferred embodiment illustrated in particular in figure 2b, the lighting elements 10, 20 are associated to the stopping mullions M of the closing doors.

[0078] Advantageously, according to the preferred embodiment illustrated in Figures 9 and 10 or according to the alternative embodiment illustrated in Figures 12 and 13, the lighting elements 10, 20 are integrated in the structure of mullion M.

[0079] In the following description, the plane that delimits the loading space C at the front will be called "first target plane P1", since it defines the closest position that the displayed goods can take relative to openings A or to the lighting elements 10, 20.

[0080] In the case of vertical display cabinets with all the shelves vertically aligned, the first target plane will be one.

[0081] In the case of vertical display cabinets wherein, for aesthetic or construction reasons, the edges of the shelves are staggered relative to each other, for example are progressively farther from the windows going up from the display cabinet base towards the top thereof, the first target plane will be suitably defined for each shelf or group of aligned shelves.

[0082] The target plane as defined above is considered as reference for the effects of illumination since it is the most important for the display purpose and since, as already mentioned, the maximum phenomenon of the illumination gap at the centre of the door is on this plane (minimum distance of the goods from the light sources). In fact, the phenomenon attenuates progressively considering target planes increasingly farther from the openings, that is, from the lighting elements.

[0083] According to an essential aspect of the invention, the two lighting elements 10, 20 of each pair are suitable for being arranged on two opposite portions L1 and L2 of perimeter M of opening A relative to a centre line plane (indicated with Z in the annexed Figures) of the opening itself.

[0084] By centre line plane Z it is meant, in general, a plane substantially orthogonal to the first target plane P1 passing through opening A along the prevailing development direction of the latter, so as to divide it into two portions having a substantially similar area.

[0085] In the particular case of symmetrically shaped openings (for example rectangular or square openings,

as in the example illustrated in the annexed Figures, see Figures 2b and 4b), such centre line plane Z divides the opening into two identical portions.

[0086] According to another essential aspect of the present invention, each of the above two lighting elements 10, 20 is suitable for generating a light beam having an emission profile of the substantially Gaussian type, with optical axis x, y.

[0087] The emission profile defines the course of the absolute or relative light intensity (for example, relative to the maximum intensity value) based on the angle of emission relative to the maximum emission direction.

[0088] The expression "substantially Gaussian type" means, in general, the emission profiles that exhibit a maximum of light intensity along at least one direction of emission (i.e., the optical axis), deviating wherefrom with increasingly angled emission directions the light intensity decreases, following a course comparable to a bell (symmetrical or asymmetrical). An example of this type of emission is shown in Figures 6a and 6b. The definition is understood to include emission profiles with courses exhibiting irregularities, such as oscillations or local maximum and minimum, or asymmetries relative to the optical axis.

[0089] One of the values that characterise a Gaussian type profile is the Full Width at Half Maximum (FWHM). Assuming a profile substantially symmetrical relative to the maximum, the FWHM value being known, the angle of emission relative to the optical axis at which the light has an intensity equal to 50% of the maximum intensity is equal to 1/2 FWHM.

[0090] As will be better explained hereinafter in detail, according to a preferential aspect of the invention, the emission profile of each lighting element is adjusted on the basis of the illuminance level to be obtained on the first target plane.

[0091] Advantageously, as will be described in detail hereinafter, the emission profile may also be differentiated according to the emission plane of the light.

[0092] Figures 6a and 6b refer to the emission profile of the same lighting element according to a preferred embodiment, wherein in particular the diagram of Figure 6a refers to the profile on a first emission plane (horizontal), whereas the diagram of Figure 6b refers to the profile on a second emission plane (vertical).

[0093] Preferably, each lighting element 10, 20 comprises a light source at the solid state.

[0094] According to a particularly preferred solution, such light source consists of a LED.

[0095] More in detail, the LEDs may be compared in the first instance to light sources that emit on a single hemisphere, with emission profile "substantially Gaussian type". Relative to the optical axis, the LED can emit up to angles comprised between 140° and 70°, although solutions with greater or smaller emission angles exist.

[0096] Figure 6c shows the emission profile of a LED used in a particular embodiment of the invention, wherein an FWHM equal to about 120° is seen.

[0097] Advantageously, in the present invention, it is envisaged to use in particular LEDs suitably encapsulated into containers or package (indicated with reference numeral 100 in Figure 8) suitable for being welded on printed circuit plates with surface mounting or through rheophore technology, as well as to use LEDs mounted using the "chip on board" technology, which allows the direct mounting of the semiconductor on the plates intended for providing support for the electrical supply circuit also.

[0098] The LEDs are supplied by the manufacturers already provided with a primary lens (indicated with reference numeral 110 in the annexed Figures) which is substantially suitable for offering a first concentration of the LED emission profile and which mechanically integrates with the container or package of the LED.

[0099] Advantageously, as will be explained hereinafter, the use of the primary lens supplied by the LED manufacturer is possible but not necessary.

[0100] Preferably, according to the invention, LED with white emission are used, characterised by a specific color temperature preferably, but not necessarily comprised between 4,000 and 6,500 K.

[0101] Advantageously, as an alternative, it is possible to combine coloured LEDs to obtain a white light.

[0102] Advantageously, as will be explained in detail hereinafter, each lighting element 10, 20 comprises optical means suitable for modifying the emission profile of the light source. In particular, such optical means may also be suitable for differentiating the emission profile with reference to different emission planes.

[0103] According to a further essential aspect of the present invention, the lighting elements 10, 20 of each pair are arranged so that the optical axes x, y of the light beams generated thereby cross each other and cross the centre line plane Z before intercepting the first target plane P1, as illustrated in Figure 4a that refers to a preferred embodiment of the invention.

[0104] As already mentioned, the centre line plane Z divides the first target plane P1 into two portions, whereof we will call "first portion" P1' the one closest to the first element 10 of a pair of lighting elements, and "second portion" P1" the remaining portion, that is, the one closest to the second element 20 (see Figure 4b).

[0105] Considering the definitions just given, in other words, according to the invention, the lighting elements 10, 20 of each pair are arranged so that the first element 10 is suitable for mainly lighting the second portion P1" (that is, intercepts it with its optical axis x), and vice versa that the second element 20 is suitable for mainly lighting the first portion P1' (that is, intercepts it with its optical axis y).

[0106] Surprisingly, it has been found that with the lighting system according to the invention it is possible to obtain a illuminance level in the central zone higher than that of the side zones (thus solving the phenomenon of the illumination gap at the centre of the door) while obtaining an oscillation factor in the central zone higher

than 0.3 (referring to a first target plane located at a distance from the lighting elements comprised between 10 and 15 cm).

[0107] As already mentioned before, by central zone AC of opening A it is meant the area arranged astride of the centre line axis of opening A (i.e. trace of the centre line plane Z on the plane of opening A) along its main development dimension and that extends transversally to the centre line axis by about 80% of the total extension of the opening in such cross direction.

[0108] Such results may be qualitatively assessed from the diagrams of Figure 7, which - for a particular embodiment of the invention - show the course of the illuminance level on different target planes located at different distances from the alignment axis of the lighting elements 10, 20. (a) indicates the curve relative to a target plane arranged at 100 mm, with (b) at 200 mm, with (c) at 300 mm, with (d) at 400 mm and with (e) at 500 mm. The illuminance is expressed with relative values compared to the maximum illuminance level obtained in the target plane arranged at 100 mm (curve (a)).

[0109] It should be noted that the diagrams in Figure 7 were made with a simulator and do not take into account the favourable contributions in terms of distribution evenness due to the phenomena of diffusion and reflection of light into the display cabinet.

[0110] Moreover, it has been noted (as can be qualitatively understood from Figure 7) that considering more restricted central zones than that defined above, the oscillation factor tends to increase. This indicates an even distribution of the lighting just in the most important zone of the door in terms of product visibility.

[0111] In fact, as can be seen from the diagram of Figure 7, if for a central zone AC having cross extension equal to 80% of the opening (AC 80%) the oscillation factor is about 0.4, for a central zone having a cross extension of 60% (AC 60%) the oscillation factor is higher than 0.6.

[0112] Advantageously, according to a preferred solution the phenomenon just described is favourably increased when the lighting elements 10 and 20 are arranged so that the optical axes x and y meet the first target plane P1 within the limits defined by the orthogonal projection of perimeter M of opening A on the first target plane P1.

[0113] The results that can be obtained with the present invention may be explained by the fact that with the lighting system according to the present invention it is possible to synergically and favourably combine - for illumination purpose - both the effects due to the decrease of the light intensity as the distance from the source increases, and the effects related to the decrease of the light intensity for angled emission directions relative to the optical axis (Gaussian type emission profile).

[0114] To better explain the results obtained with the invention, with reference to Figure 4b, we define a centre line area AZ as the area of the first target plane P1 arranged astride of the centre line axis and laterally delimit-

ed by two lines Y1 and X1 parallel to such axis and respectively passing by the intercept of the optical axis x of the first lighting element 10 on the first target plane and by the intercept of the optical axis y of the second lighting element 20. Side areas AL on the other hand, mean the residual areas not included in the centre line area AZ.

[0115] In the particular case of an opening A of rectangular shape, the centre line area AZ is rectangular and the above two lines X1 and Y1 are two vertical lines, as illustrated in figure 4b.

[0116] In the first place, the crossing of the optical axes x, y makes the emitted beams strike in a non orthogonal manner on the first target plane. In this way, if the light with the highest intensity at the source (that is, that emitted for example within the FWHM) is taken into account of a light beam, the centre line area AZ - relative to the lighting element - is always at a smaller distance relative to the side area AL with emission angle relative to the optical axis x, y being equal.

[0117] In other words, taking into account a first lighting element 10 and the second portion P1" of the first target plane P1 (mainly illuminated by such first element 10), the emission angle relative to the optical axis x being equal, the light that intercepts the centre line area AZ has covered a smaller distance than the light that intercepts the side zone AL. This has the positive effect of favouring the lighting of the centre line zone AZ and thus reduce the illumination gap phenomenon.

[0118] In the second place, in addition to the positive effect just described, the crossing of the optical axes allows obtaining greater evenness of distribution of the light on all the target plane compared to the prior art solutions that on the contrary do not envisage the beam crossing. In fact, the beam crossing allows attenuating the effect related to the fact that different points of a same target half plane are at different distances from the main lighting element (intended as the element primarily dedicated to the lighting of the half plane considered).

[0119] In solutions with crossing (i.e. according to the invention) compared to solutions without crossing (i.e. prior art) the points of a same half plane are at greater distances from the main lighting element, but the difference of the respective distances from the main lighting element is less strong with advantageous effect for the light distribution evenness.

[0120] To better explain the above, reference is made to figures 14 and 15, comparing the distances L of two points (identified with superscripts 1 and 2) in the case of crossing (subscript C) and in the case without crossing (subscript D). In particular in Figure 14 the two end points of the half plane have been considered, while in Figure 15 two pairs of intermediate points of the target plane arranged at the same distance have been considered. The numerical values are expressed in mm.

[0121] If we consider the ratio between distances L of each pair of points it is possible to see (see Tab. 1 and Tab. 2) that in the case of crossing (according to the

invention), such ratio is closer to 1 than in the case without crossing (prior art). This gives an indication of the fact that thanks to the crossing there occurs an attenuation of the effect due to the difference of the distances from the sources to the advantage of a greater illumination evenness on the target half planes.

[0122] According to a particularly preferred solution of the invention, the emission profile of each of the two lighting elements 10, 20 is defined so that on the first target plane P1, parallel to the segment that connects the intercepts of the optical axes x, y to the first target plane P1, the lower intensity of the light emitted along angled directions relative to the optical axis x, y is compensated by the smaller distance between the above lighting element 10, 20 and the first target plane P1 along the above angled directions, as well as the contribution resulting from the overlapping with the light beam emitted by the other lighting element (20, 10) in order to obtain a lighting oscillation factor higher than 0.3.

[0123] To graphically indicate the emission profile course, in Figures 3, 4a and 4b for the beam of each lighting element the optical axis x, y and the direction of FWHM (emission angle relative to the optical axis, where the intensity of the emitted light is equal to 50% of that along the optical axis) have been traced out.

[0124] Preferably, the lighting elements 10, 20 generate restricted light beams on an emission plane orthogonal to the first target plane P1 and passing by the alignment axis W of two coupled lighting elements (meaning that their axes intersect). By restricted beam it is meant a beam corresponding to an emission profile with FWHM below 20° in a predefined emission plane.

[0125] Preferably, the two lighting elements (10, 20) are arranged on opposite portions L1, L2 of the perimeter of the opening A between which the distance is minimal.

[0126] Advantageously, in this way it is possible to minimise the portion of target plane that must be covered by a pair of lighting elements.

[0127] According to a preferred embodiment of the invention, illustrated in particular in Figure 3, which refers to display cabinets with rectangular openings having a main development in vertical direction, that is, in the direction of the height, the two lighting elements 10 and 20 of every single pair are associated to mullions M of the closing doors of openings A, aligned in the direction of width L of openings A (horizontally).

[0128] Advantageously, if openings A have a horizontal main development, the lighting elements 10 and 20 of each pair are preferably aligned in the direction of height H of openings A (vertically).

[0129] Advantageously, if openings A are square or in any case the ratio between height H and length L is close to 1, the lighting elements 10 and 20 may be aligned without distinction in vertical direction or in horizontal direction.

[0130] According to the preferred embodiment illustrated in the annexed Figures, the two lighting elements of each pair are aligned parallel to the first target plane

P1 and are arranged so that their optical axes x, y cross each other on the centre line plane Z.

[0131] In this way, the lighting elements are arranged symmetrically relative to the centre line plane Z of the opening. The lighting obtained has a course substantially symmetrical and centred on the centre line plane Z of opening A.

[0132] Advantageously, to this end it is preferable for the two lighting elements (10, 20) to be identical to each other, at least by emission profile and power.

[0133] Advantageously, however, embodiments may be envisaged wherein the lighting elements are not identical and are not arranged and orientated symmetrically relative to the centre line plane Z of opening A. This situation may occur in the case of display cabinets having asymmetrical frames (in the case of innovative designs) where two coupled lighting elements may not be placed at the same distance from the first target plane.

[0134] In this case, the emission profile and the power of the single lighting elements as well as the orientation of the optical axes shall be suitably adjusted so as to obtain an illumination of the first target plane P1 having a course substantially symmetrical and centred on the centre line plane Z of opening A.

[0135] According to the embodiment illustrated in the annexed Figures, relating to a display cabinet with openings with mainly vertical development, that is, with vertical dimension (height) greater than the horizontal dimension (width), the optical axes x and y of each pair of lighting elements 10, 20 lie on a horizontal plane.

[0136] Advantageously in the case of display cabinets with openings having a mainly horizontal development (width > height), the optical axes lie on vertical planes.

[0137] Advantageously, alternative embodiments may be envisaged wherein the optical axes lie on inclined planes (neither horizontal nor vertical).

[0138] As already mentioned, it is preferable for the crossing between optical axes to involve only pairs of lighting elements, and even more preferably, pairs of elements arranged on two opposite sides of the perimeter of the opening between which the distance is minimal.

[0139] Advantageously, it is also possible to envisage embodiments wherein the crossing of the optical axes involves more than two lighting elements (for example two pairs of overlapped elements).

[0140] Advantageously, it is also possible to envisage crossings of optical axes of pairs of lighting elements interfaced and reciprocally crossing not only in horizontal, but also in vertical so as to obtain a better distribution of the luminous flux.

[0141] Advantageously, it is also possible to envisage crossing the optical axes of pairs of lighting elements staggered from one another.

[0142] According to the preferred embodiment illustrated in the annexed Figures (lighting system for display cabinet with vertical rectangular openings) for each opening A there is provided a plurality of lighting elements organised on two rows F1 and F2 along the two greater

sides of the opening. Elements 10, 20 are horizontally aligned in pairs, that is, in the direction of the width.

[0143] Advantageously, the lighting elements may be provided not only in single rows, but also in matrices.

[0144] Advantageously, however, alternative embodiments may be envisaged wherein the lighting elements of the two rows are staggered from one another.

[0145] According to the above mentioned preferred embodiment, the crossing of the optical axes x and y is only provided in the horizontal direction (width), where in combination with the crossing it is suitable to arrange restricted light beams. In fact, the lighting in horizontal direction has the constraint given by the width dimension of the opening, a dimension that sets the minimum inter-distance possible in horizontal direction between the lighting elements, unless elements are provided in the opening gap.

[0146] In the vertical direction, this constraint does not exist since there is no discontinuity in the structural element (for example, the door mullion) intended to support the lighting elements. As a consequence, depending on the dimensions of the single lighting elements it is possible to envisage in vertical direction a number of elements sufficiently high to ensure lighting evenness. In the vertical direction therefore it is also possible not to provide the crossing of the optical axes.

[0147] As regards the beam width, in the vertical direction there is the opposite need compared to the horizontal dimension. In fact, the more restricted are the beams, the smaller is the area lighted by the single beam, and therefore the greater must be the number of lighting elements to use to ensure suitable lighting evenness, to the disadvantage of the inexpensiveness.

[0148] According to a preferred aspect of the invention, each lighting element 10, 20 comprises optical means suitable for differentiating the emission profile of the light source (preferably but not necessarily a LED) relative to a main plane, passing by the alignment axis w of two lighting elements 10, 20 and by the optical axis x , y , and relative to a secondary plane, incident said main plane along the optical axis x , y preferably in orthogonal direction.

[0149] In the embodiment solution illustrated in the annexed figures, the optical axes x , y lie on a horizontal plane and the alignment axis w is horizontal. The main plane therefore is a horizontal plane, while the secondary plane is a vertical plane.

[0150] Preferably, in order to differentiate the emission profile in the primary plane and in the secondary plane, the optical means comprise at least one elliptical lens 120, according to the preferred embodiment of the invention illustrated in figures 9 and 10.

[0151] Advantageously, always in order to differentiate the emission profile in the primary plane and in the secondary plane, the optical means may comprise a reflector 130 as an alternative to the elliptical lens according to the alternative embodiment of the invention illustrated in figures 11 to 13.

[0152] Advantageously, it is possible to envisage alternative solutions (not shown in the annexed Figures) wherein elliptical lenses and reflectors are combined.

[0153] As mentioned before, the elliptical lens 120 and/or the reflector 130 may be associated to the LED also retaining the primary lens 110 provided by the manufacturer. However, it is also possible to use only the elliptical lens and/or the reflector without applying the primary lens 110.

[0154] Advantageously, the optical means (which may comprise or not the primary lens 110) are selected so that the emission profile on the main plane exhibits a value of FWHM lower than the value of FWHM on the secondary plane.

[0155] Functionally, the optical means may be selected so that the emission profile on the secondary plane exhibits an FWHM as wide as possible.

[0156] Advantageously, elliptical lenses and reflectors of the commercial type, widespread on the market, may be used to the advantage of the inexpensiveness of construction.

[0157] Preferably, considering a distance between the first target plane P1 and the lighting elements comprised between 100 mm and 150 mm, values of FWHM comprised between 35° and 120°, and even more preferably between 40° and 90° are preferable for the emission profile on the secondary plane.

[0158] Advantageously, the interdistance between two lighting elements of a same row is comprised between 55mm and 200 mm, and preferably between 75 mm and 125 mm.

[0159] The display cabinets currently widespread on the market envisage one or more openings with mainly vertical development (height > width), preferably of rectangular shape, the perimeter whereof comprises two vertical parallel sides (opposite portions L1 and L2) distant between 600 mm and 800 mm from each other. The above sides are defined by structural elements (mullions) suitable for acting as stop for the seals of the closing doors and lying on a plane parallel to the first target plane P1 and distant between 100 mm and 150 mm from the latter.

[0160] Preferably, with display cabinets having these features, the lighting system according to the invention provides for the lighting elements to be organised on two rows F1 and F2 along the vertical sides L1 and L2 of the openings, aligned in pairs in the width direction. The optical axes x , y of each lighting element 10, 20 form with the first target plane P1 an inclination angle θ_x , θ_y comprised between 7° and 18°, and preferably between 8° and 16°.

[0161] Preferably, for display cabinets having the features defined above, lighting elements are provided suitable for generating an emission profile on a horizontal plane having an FWHM comprised between 6° and 20°, and preferably between 10° and 16°.

[0162] Preferably, as already mentioned before, adopting optical means comprising elliptical lenses

and/or reflectors, the lighting elements exhibit an emission profile on a vertical plane different from the profile on the horizontal plane. Preferably, on the vertical plane the emission profile exhibits an FWHM comprised between 35° and 120°, and even more preferably between 40° and 90°.

[0163] Advantageously, with values of FWHM on a vertical plane as defined above, the interdistance between two lighting elements of a same row F1, F2 is preferably comprised between 55 mm and 200 mm, and even more preferably between 75 mm and 125 mm.

[0164] The diagrams of Figure 7 were obtained on a display cabinet with rectangular openings having a width of about 700 mm and height of about 1700 mm, with first target plane arranged at about 150 mm from the plane of the openings. The lighting system according to the invention provides each opening two rows of LEDs arranged on the greater sides of the openings. Each row comprises 20 lighting elements distributed vertically on a length of about 1500 mm.

[0165] More in detail, the lighting elements are identical to each other and are oriented so that their optical axes x and y lie on horizontal planes and, crossing each other in the centre line plane, they form an inclination angle θ_x , θ_y of about 11° with the first target plane P1. Each lighting element comprises a LED and an elliptical lens 15X40, that is, suitable for generating an emission profile with horizontal FWHM of 15° and with vertical FWHM of 40°.

[0166] More in detail, in this particular embodiment, a white light LED was used as a LED, with color temperature of 5200 Kelvin which if powered at 350mA DC, absorbs a power of about 1.2 W.

[0167] As illustrated in Figures 9 and 10, the optical means comprise the primary lens 110 supplied by the manufacturer (which in particular determines the emission profile illustrated in Figure 6c) and an elliptical lens suitable for differentiating the emission in the primary plane and in the secondary plane (as illustrated for example in the diagrams of Figures 6a and 6b).

[0168] More in detail, a lens moulded of plastic material was used as elliptical lens with external dimensions corresponding to a cube of about 11 mm side. This type of lenses is set up in particular to be glued to the printed circuit where the LED is mounted with a surface mounting welding process.

[0169] As can be observed from the diagrams of Figure 7, the invention allows obtaining a good illumination evenness. In fact, the problem of the illumination gap at the centre of the door was solved and a illuminance oscillation factor higher than 0.3 was obtained in the central zone.

[0170] An object of the present invention is a method for lighting the loading space of a frozen or chilled display cabinet as defined above.

[0171] Such method comprises an operating step (a) of arranging for each opening A at least a pair of lighting elements 10, 20 into the display cabinet on two portions

L1, L2 of the opening perimeter opposite relative to a centre line plane Z. Such elements are arranged in the space comprised between opening A and the first target plane P1.

[0172] Each of said two lighting elements 10, 20 generate a light beam having an emission profile of the substantially Gaussian type, with optical axis x, y.

[0173] The method further comprises an operating step (b) of orientating the optical axes x, y of the light beams generated by the two lighting elements 10, 20 so that the optical axes x, y cross each other and cross the centre line plane Z before intercepting the first target plane P1.

[0174] Advantageously, the method comprising the operating step (c) of adjusting the emission profile of each lighting element 10, 20 so that on the first target plane P1, parallel to the segment that connects the intercepts of the optical axes x, y with the above first target plane, the lower intensity of the light emitted along angled directions relative to the optical axis x, y is compensated by the smaller distance between the lighting element 10, 20 and the first target plane P1 along the above angled directions, as well as by the contribution resulting from the overlapping with the light beam emitted by the other lighting element 20, 10 so as to obtain an illuminance oscillation factor higher than 0.3.

[0175] Advantageously, during step (a), a plurality of pairs of lighting elements 10, 20 is arranged for each opening, the first and second elements 10 and 20 of each pair being respectively arranged on a first row F1 and on a second row F2. The two rows F1, F2 are arranged on two opposite portions L1, L2 of the perimeter of opening A.

[0176] Advantageously, each lighting element 10, 20 comprises a light source at the solid state, preferably a LED.

[0177] Preferably, during the step (c) of adjusting the emission profile, each light source is associated to optical means suitable for differentiating the emission profile of the light source relative to a main plane, passing by the alignment axis w of two lighting elements 10, 20 and by the optical axis x, y, and relative to a secondary plane, incident said main plane along the optical axis x, y preferably in orthogonal direction.

[0178] Preferably, the emission profile on the main plane exhibits an FWHM value below the FWHM value on the secondary plane.

[0179] The invention thus conceived thus achieves the intended purposes. Of course, in the practical embodiment thereof, it may take shapes and configurations differing from that illustrated above without departing from the present scope of protection. Moreover, all the parts may be replaced by technically equivalent ones and the sizes, shapes and materials used may be whatever according to the requirements.

Claims

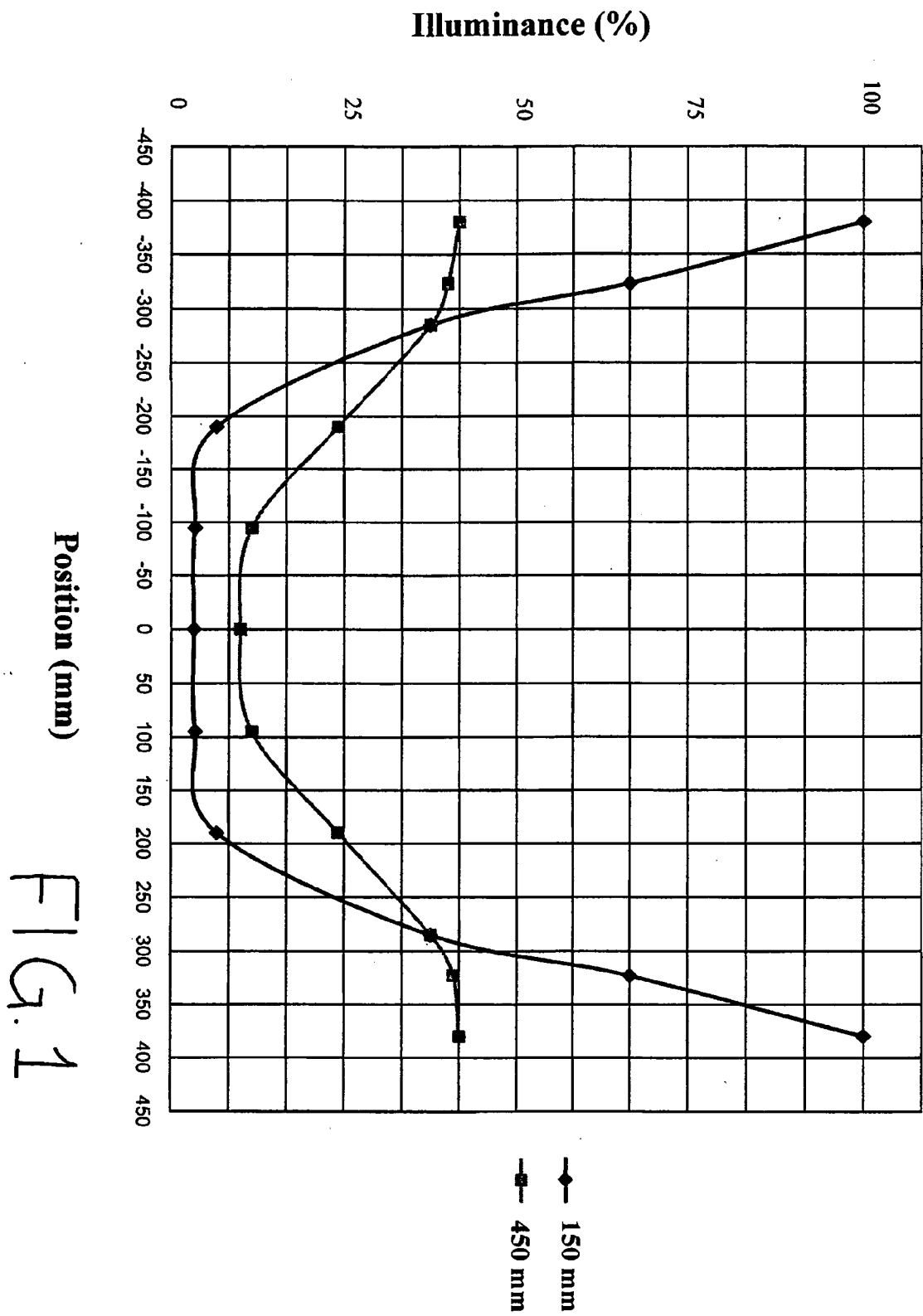
1. Lighting system for frozen or chilled display cabinet, said cabinet being provided with one or more openings (A) for making the loading space visible from the outside, said system comprising for each opening (A) at least one pair of lighting elements (10, 20) suitable for lighting said loading space at least at said opening (A), said two elements (10, 20) being intended for being arranged into said display cabinet, on two opposite portions (L1, L2) of the perimeter of said opening (A) relative to a centre line plane (Z) of said opening (A), in the space comprised between said opening (A) and the first target plane (P1) of said display cabinet, said lighting system being **characterised in that** each of said two lighting elements (10, 20) is suitable for generating a light beam having an emission profile substantially of the Gaussian type, with optical axis (x, y) and **in that** said two lighting elements (10, 20) are arranged so that the optical axes (x, y) of the light beams generated thereby cross each other and cross said centre line plane (Z) before intercepting said first target plane (P1). 5
2. Lighting system according to claim 1, wherein the emission profile of each of said two lighting elements (10, 20) is defined so that on said first target plane (P1) parallel to the segment that connects the intercepts of said optical axes (x, y) with said first target plane (P1) the lower intensity of the light emitted along angled directions relative to the optical axis (x, y) is compensated by smaller distance between said lighting element (10, 20) and said first target plane (P1) along said angled directions and by the contribution resulting from the overlapping with the light beam emitted by the other lighting element (20, 10) in order to obtain an illuminance oscillation factor higher than 0.3. 10
3. Lighting system according to claim 1 or 2, wherein said optical axes (x, y) meet said first target plane (P1) within the orthogonal projection of the perimeter of said opening (A) on said target plane (P1). 15
4. Lighting system according to any one of the previous claims, wherein said two lighting elements (10, 20) are arranged on opposite portions (L1, L2) of the perimeter of said opening (A) between which the distance is minimal. 20
5. Lighting system according to any one of the previous claims, wherein said lighting elements (10, 20) are arranged parallel to said first target plane (P1) and are arranged so that the optical axes (x, y) cross each other on said centre line plane (Z). 25
6. Lighting system according to any one of the previous claims, wherein said two lighting elements (10, 20) are identical to one another at least by emission profile and power. 30
7. Lighting system according to any one of the previous claims, wherein each lighting element (10, 20) comprises a light source at the solid state, preferably a LED. 35
8. Lighting system according to claim 7, wherein each lighting element (10, 20) comprises optical means (12, 22) suitable for differentiating the emission profile of said light source relative to a main plane, passing by the alignment axis (w) of two lighting elements (10, 20) and by said optical axis x, y, and relative to a secondary plane, incident said main plane along said optical axis (x, y) preferably in orthogonal direction. 40
9. Lighting system according to the previous claim, wherein the emission profile on said main plane exhibits an FWHM value below the FWHM value on said secondary plane. 45
10. Lighting system according to claim 8 or 9, wherein said optical means comprise at least one elliptical lens. 50
11. Lighting system according to claim 8, 9 or 10, wherein said optical means comprise at least one reflector. 55
12. Lighting system according to any one of the previous claims, comprising a plurality of pairs of said lighting elements (10, 20), the first (10) and the second (20) elements of each pair being respectively arranged on a first row (F1) and a second row (F2), said two rows (F1, F2) being arranged on said two opposite portions (L1, L2) of the perimeter of said opening (A). 60
13. Lighting system according to any one of the previous claims, wherein said two opposite portions (L1, L2) define two parallel sides of the perimeter of said opening (A), which are distant between 600 mm and 800 mm from each other and lie on a plane parallel to said first target plane (P1) and distant from the latter between 100 mm and 150 mm, the optical axes (x, y) of said two lighting elements (10, 20) being horizontal and forming with said first target plane (P1) an inclination angle (θ_x, θ_y) comprised between 7° and 18°, and preferably between 8° and 16°. 65
14. Lighting system according to claim 13, wherein on a horizontal plane the emission profile of each of said lighting elements (10, 20) has an FWHM comprised between 6° and 20°, and preferably between 10° and 16°. 70
15. Lighting system according to claim 13 or 14, wherein on a vertical plane the emission profile of each of 75

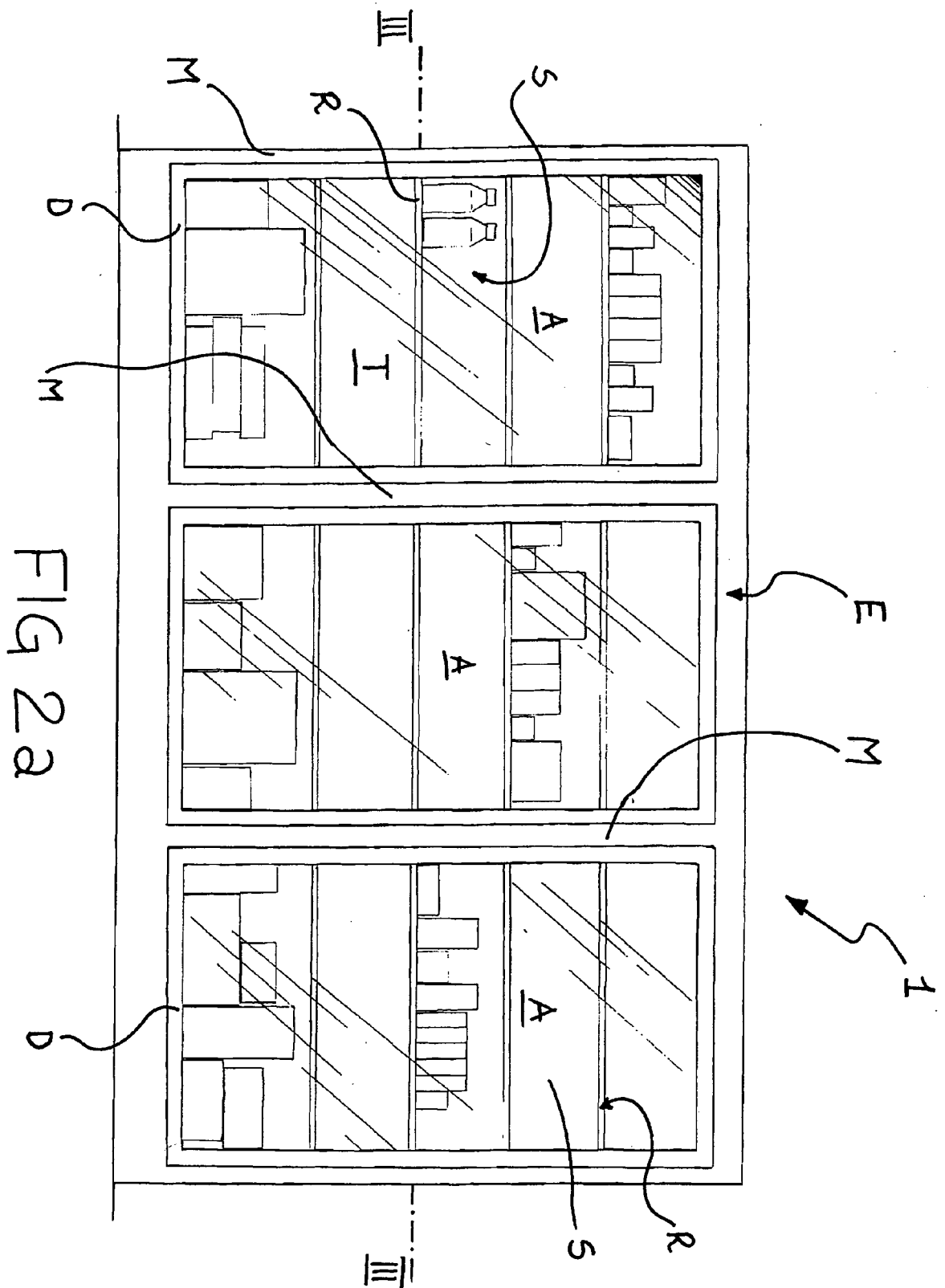
said lighting elements (10, 20) has an FWHM comprised between 35° and 120°, and preferably between 40° and 90°.

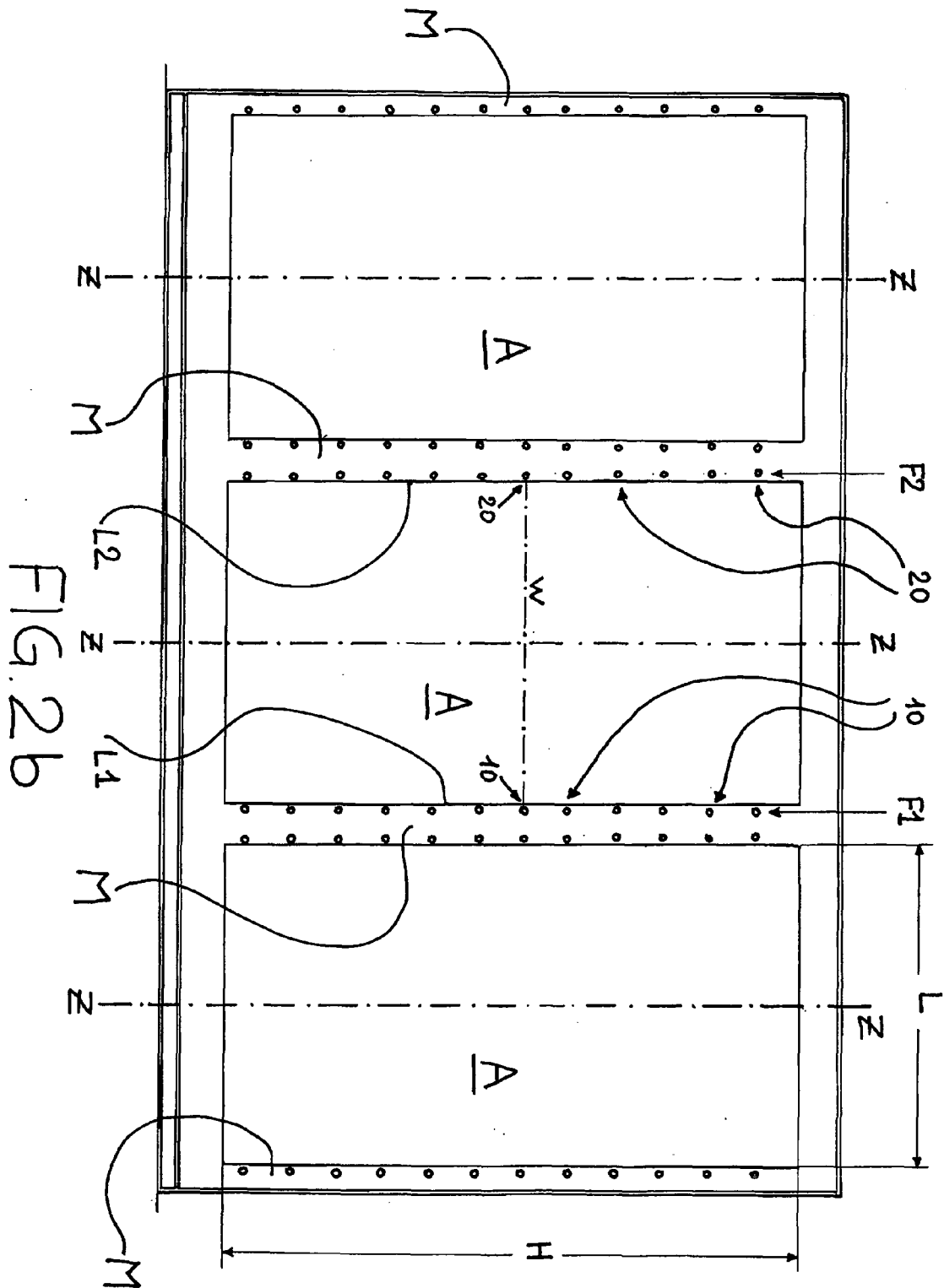
16. Lighting system according to claims 12 and 15, wherein the lighting elements (10, 20) of a same row (F1, F2) are arranged at a distance (D2) between each other comprised between 55 mm and 200 mm, and preferably between 75 mm and 125 mm.
17. Display cabinet of the frozen or chilled type comprising one or more openings (A) for making the loading space visible from the outside, each being preferably closed by a transparent surface, said display cabinet being provided with a lighting system according to any one of claims 1 to 16.
18. Display cabinet according to claim 17, wherein said transparent surface consists of a glazed door of the wing type or of the sliding type, said lighting elements (10, 20) being arranged at the mullion and at the stop body for said door.
19. Method for lighting the loading space of a frozen or chilled display cabinet at one or more openings (A) obtained on the display cabinet itself for making the loading space visible from the outside, comprising the following operating steps:
 - (a) arranging for each opening (A) at least a pair of lighting elements (10, 20) into said display cabinet on two portions (L1, L2) of the perimeter of said opening (A) opposite relative to a centre line plane (Z) of said opening (A), in the space comprised between said opening (A) and the first target plane (P1) of said display cabinet, each of said two lighting elements (10, 20) generating a light beam having an emission profile substantially of the Gaussian type with optical axis (x, y);
 - (b) orientating the optical axes (x, y) of the light beams generated by said two lighting elements (10, 20) so that the optical axes (x, y) cross each other and cross said centre line plane (Z) before intercepting said first target plane (P1).
20. Method according to the previous claim, comprising the operating step (c) of adjusting the emission profile of each lighting element (10, 20) so that on said first target plane (P1) parallel to the segment that connects the intercepts of said optical axes (x, y) with said first target plane (P1) the lower intensity of the light emitted along angled directions relative to the optical axis (x, y) is compensated by the smaller distance between said lighting element (10, 20) and said first target plane (P1) along said angled directions and by the contribution resulting from the overlapping with the light beam emitted by the other light-

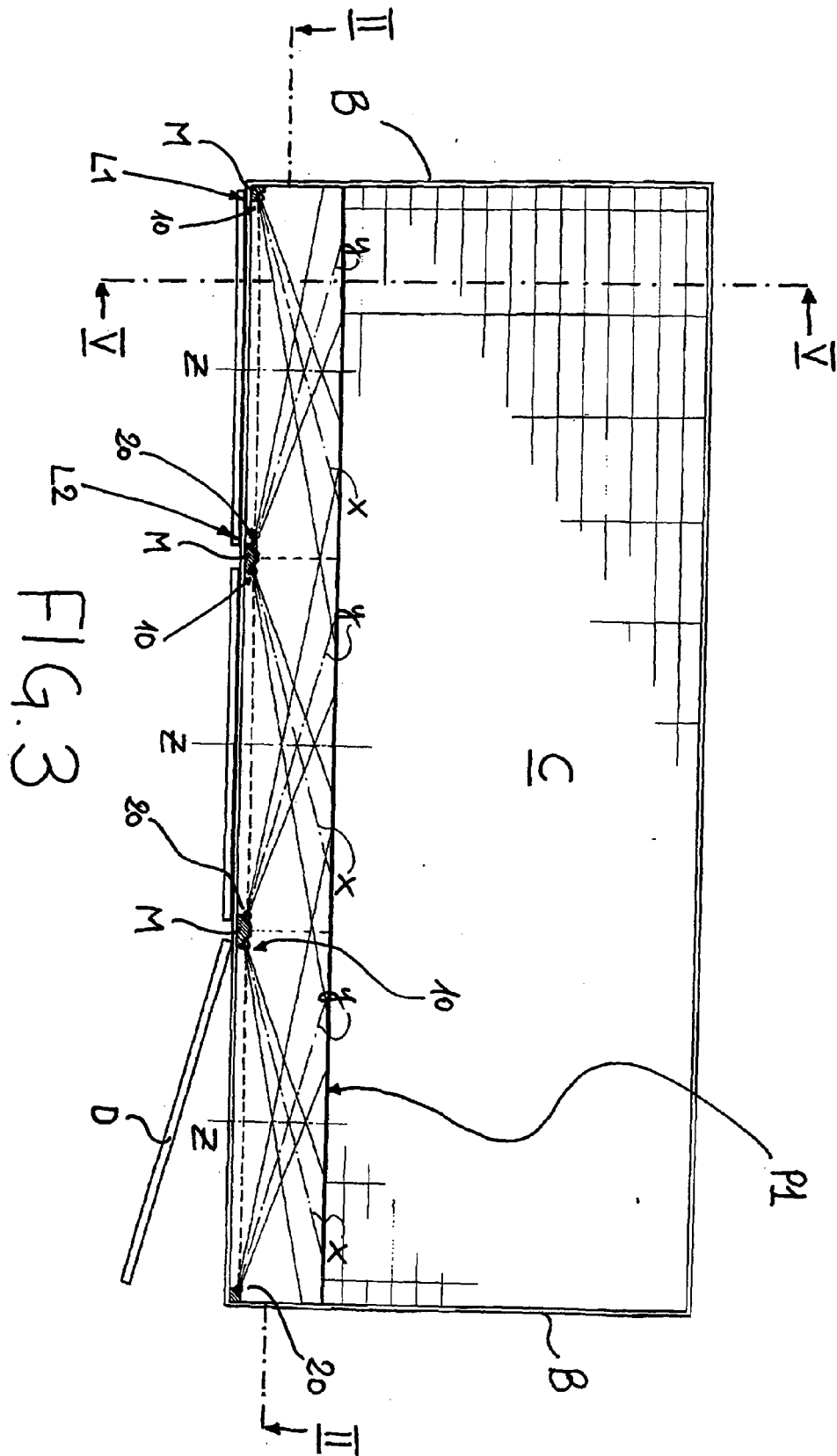
ing element (20, 10) in order to obtain an illuminance oscillation factor higher than 0.3.

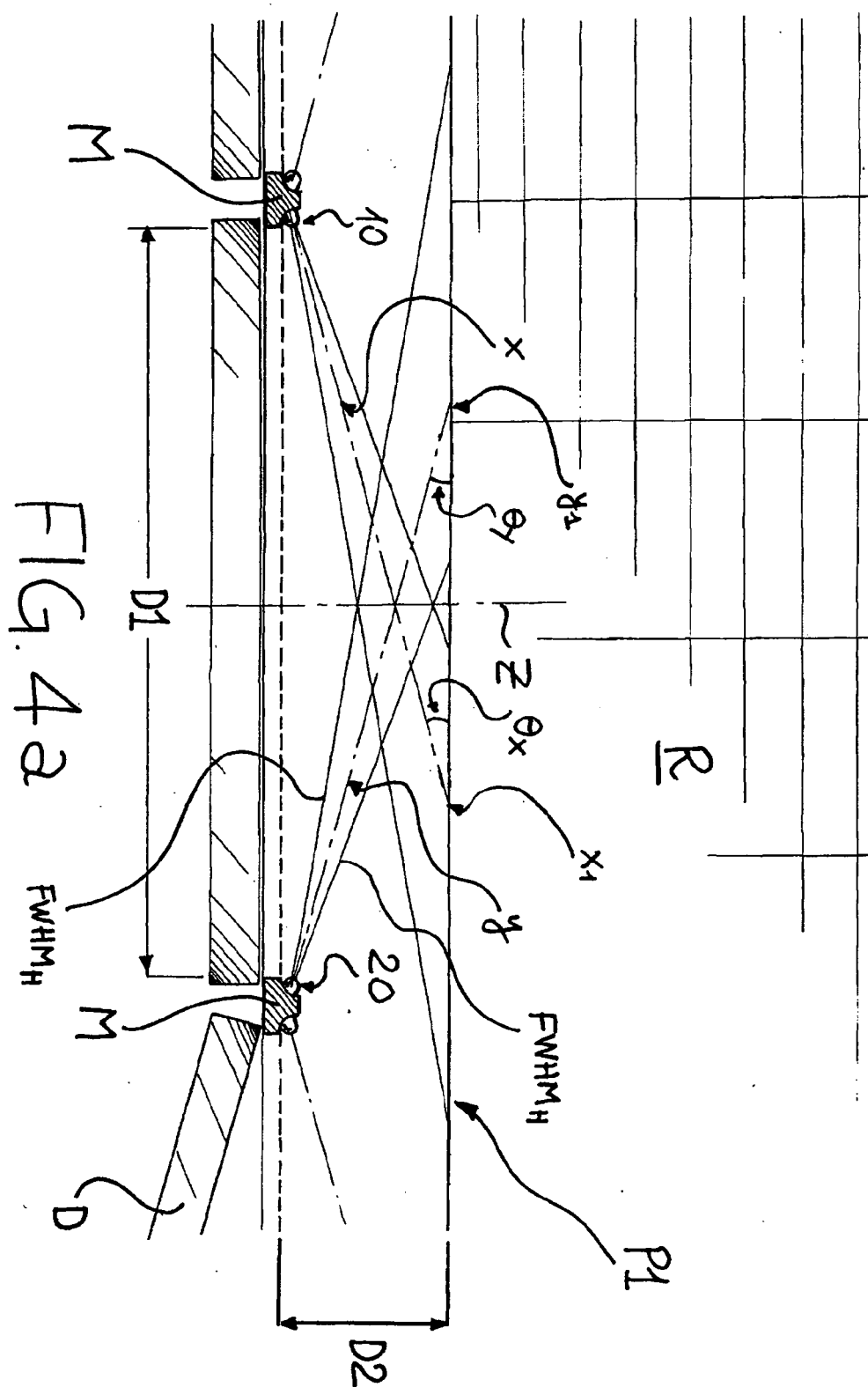
21. Method according to any one of the previous claims, wherein during said step (a), a plurality of pairs of said lighting elements (10, 20) are set up for each opening (A), the first (10) and the second (20) elements of each pair being respectively arranged on a first row (F1) and a second row (F2), said two rows (F1, F2) being arranged on said two opposite portions (L1, L2) of the perimeter of said opening (A).
22. Method according to any one of the previous claims, wherein each lighting element (10, 20) comprises a light source at the solid state, preferably a LED.
23. Method according to any one of the previous claims, wherein in said step (c) of adjusting the emission profile of each lighting element (10, 20) each light source is associated to optical means (12, 22) suitable for differentiating the emission profile of said light source relative to a main plane, passing by the alignment axis (w) of two lighting elements (10, 20) and by said optical axis x, y, and relative to a secondary plane, incident said main plane along said optical axis (x, y) preferably in orthogonal direction.
24. Method according to the previous claim, wherein the emission profile on said main plane exhibits an FWHM value below the FWHM value on said secondary plane.
25. Method according to claim 23 or 24, wherein said optical means comprise at least one elliptical lens and/or at least one reflector.











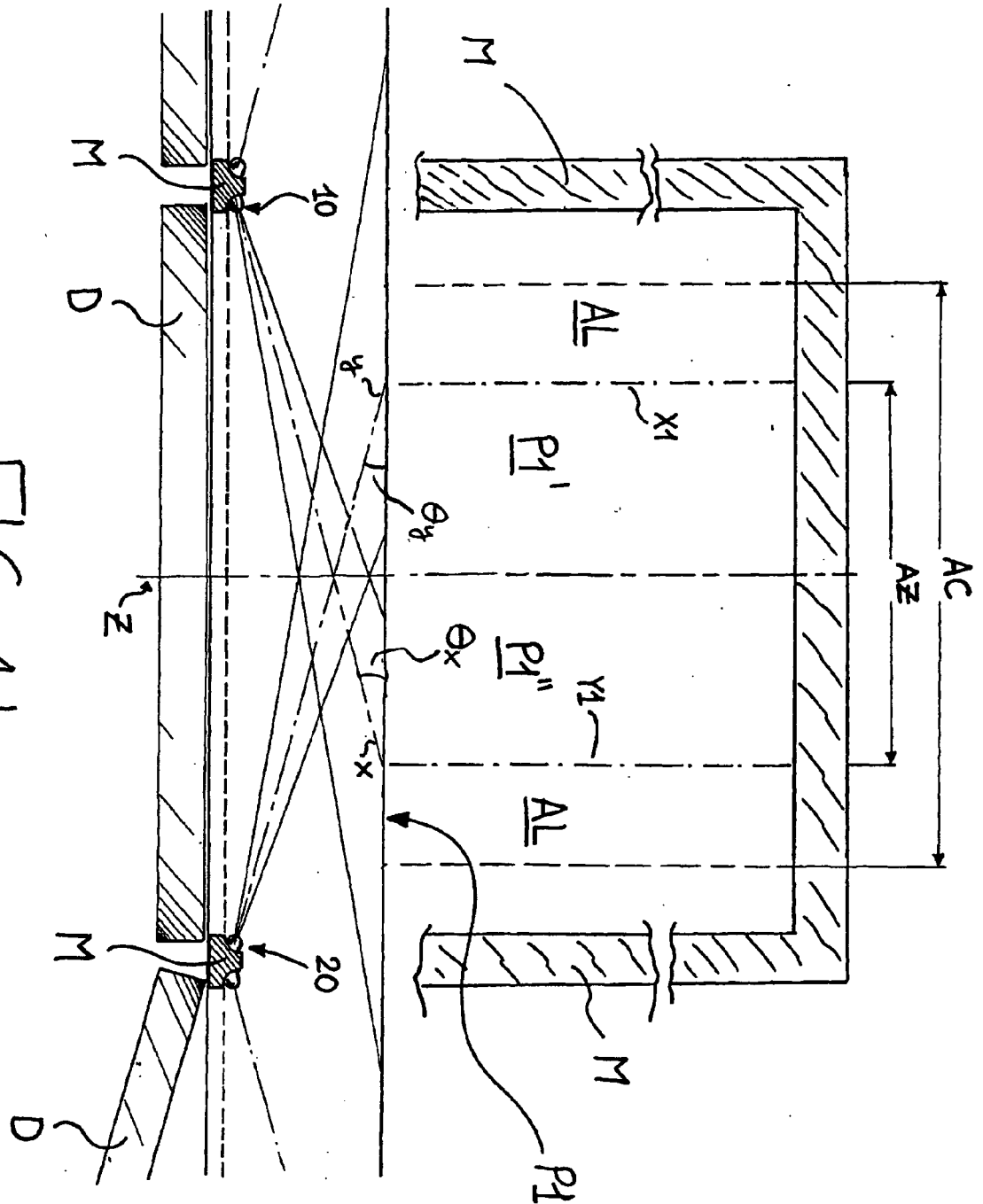


FIG. 4b

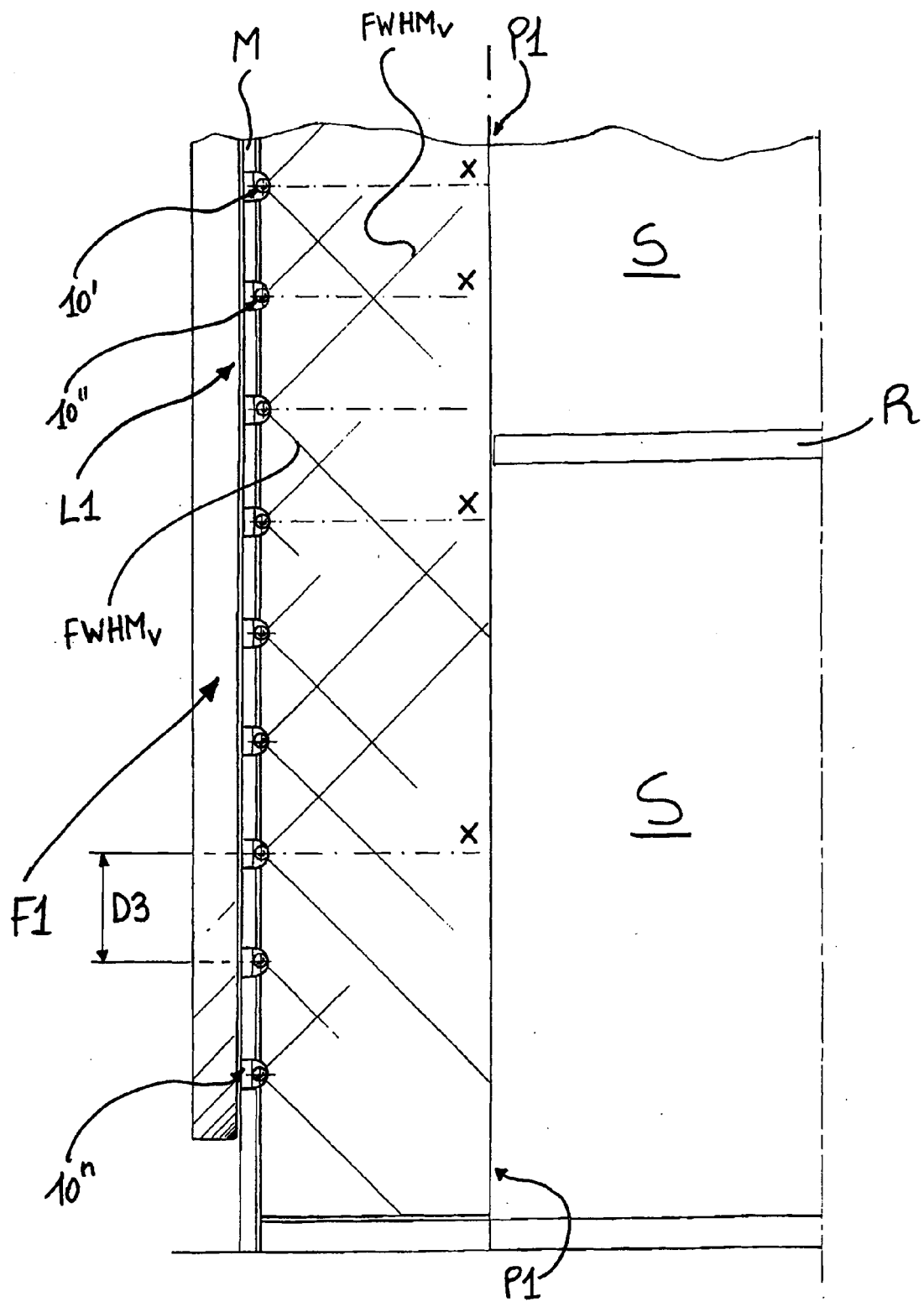


FIG 5

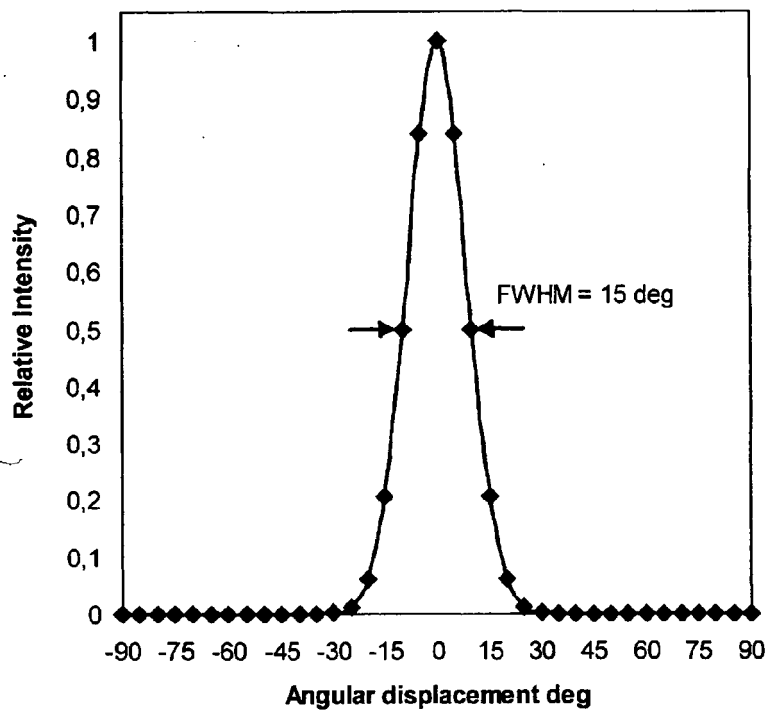


FIG. 6a

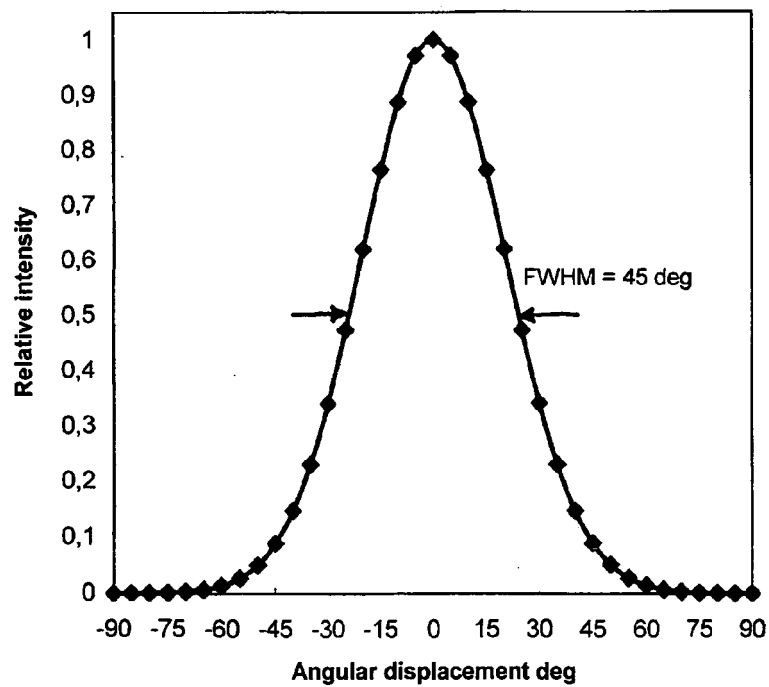


FIG. 6b

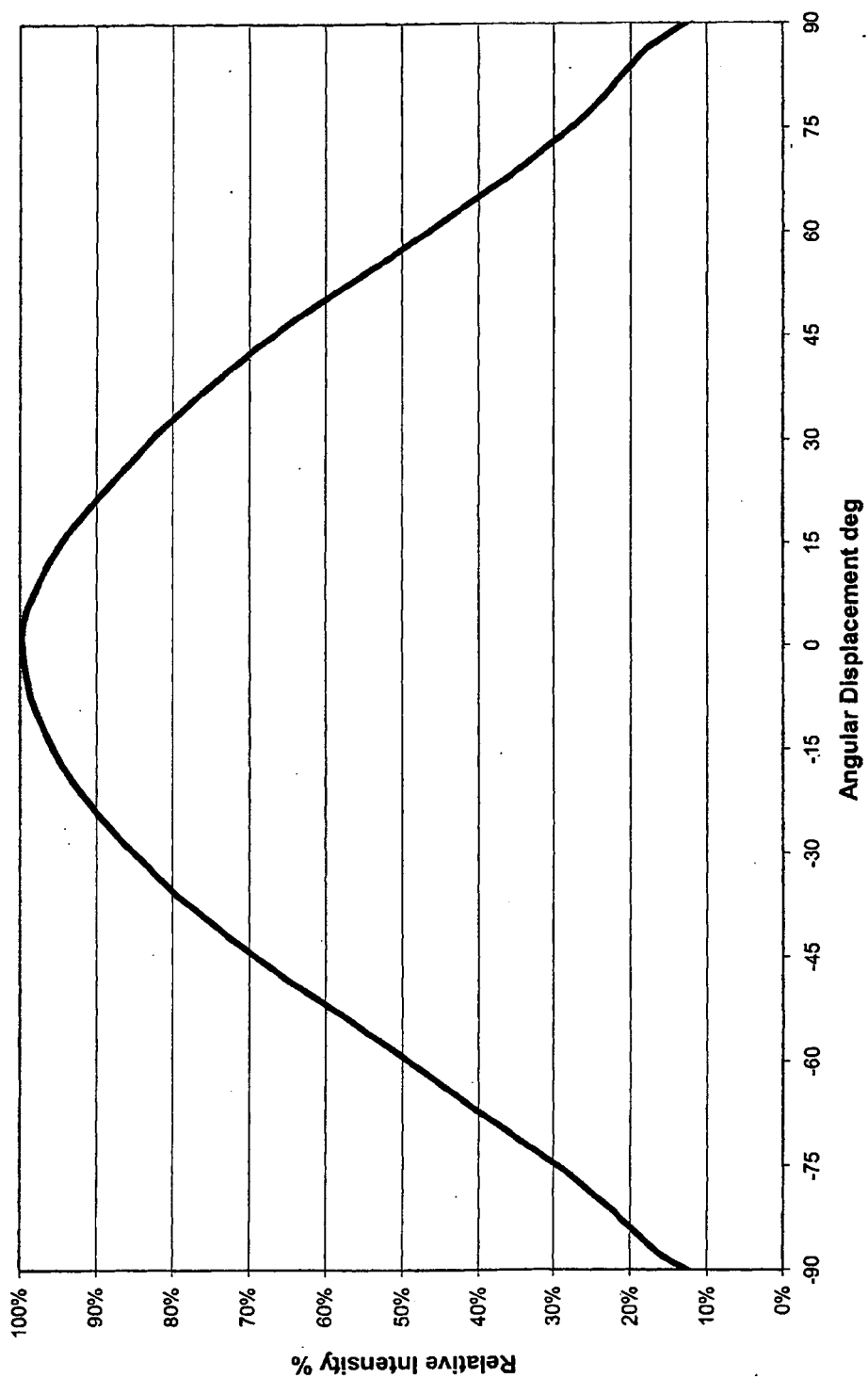


FIG. 6C

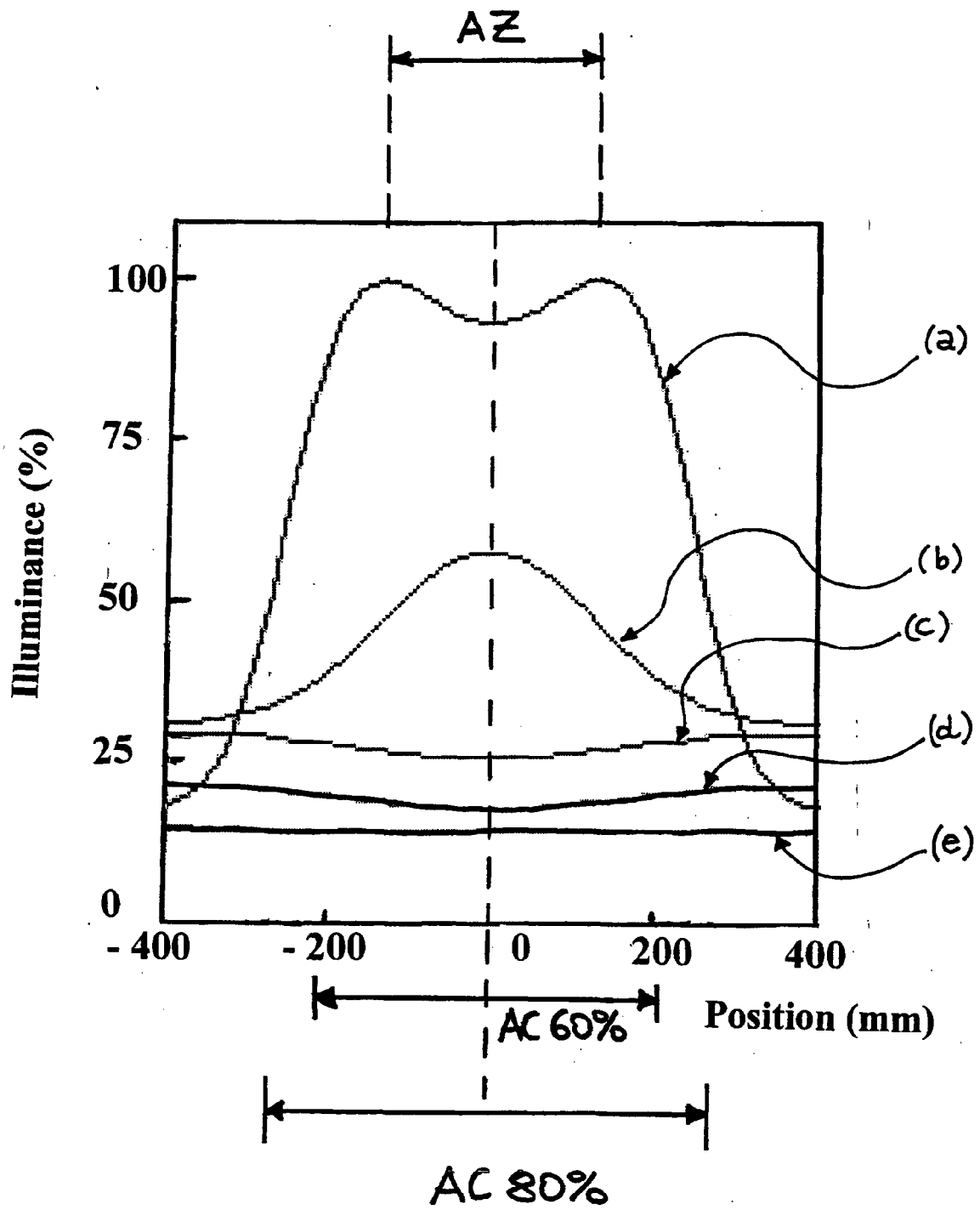


FIG. 7

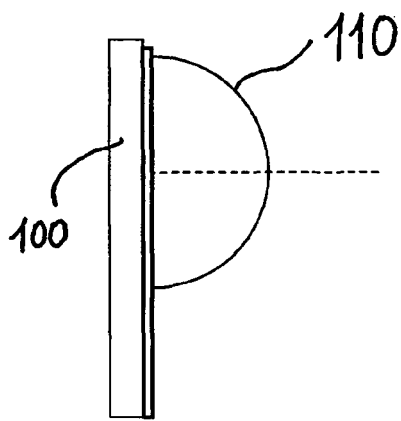


FIG. 8

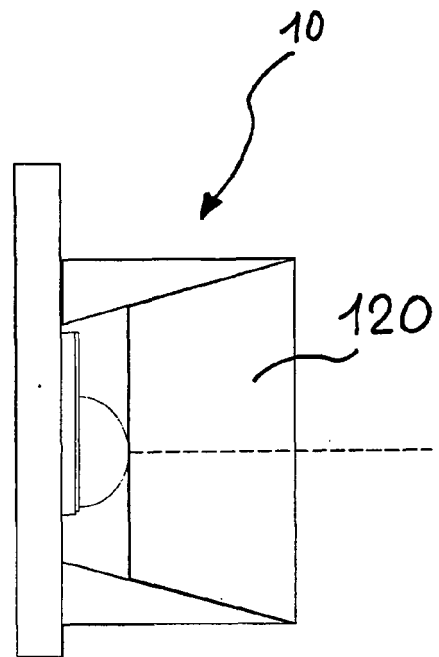


FIG. 9

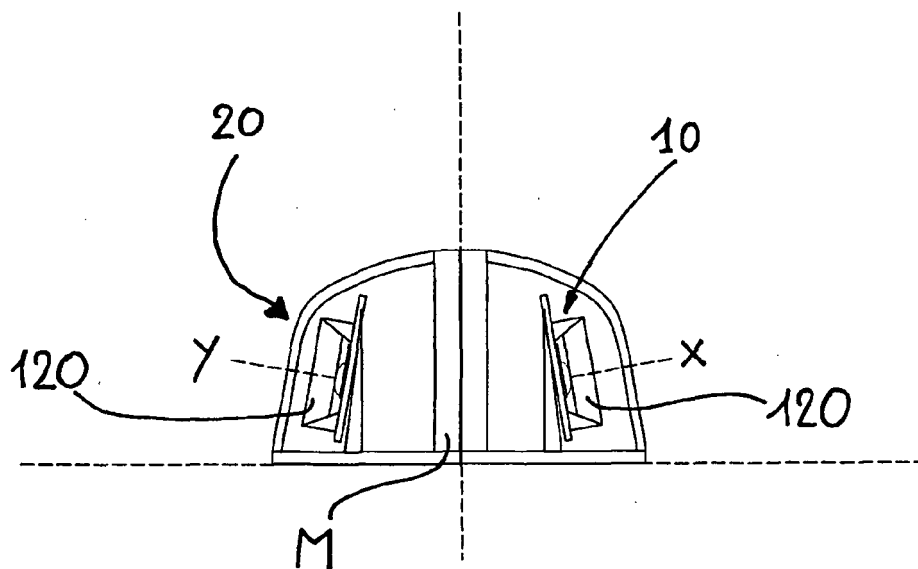
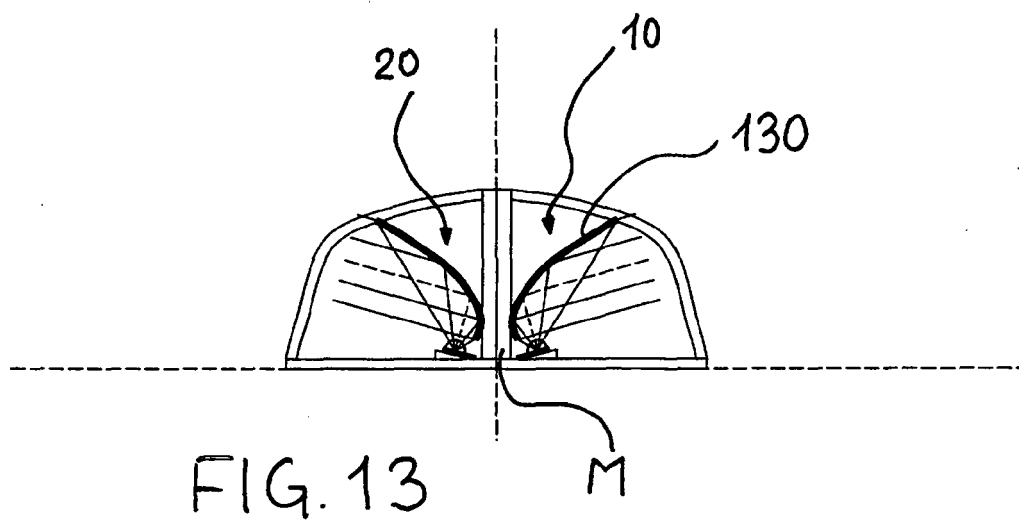
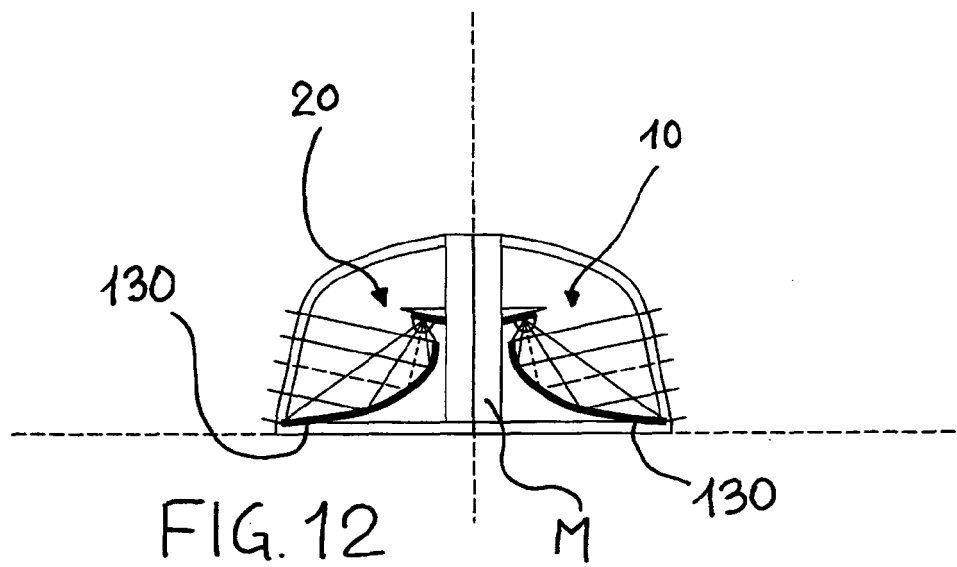
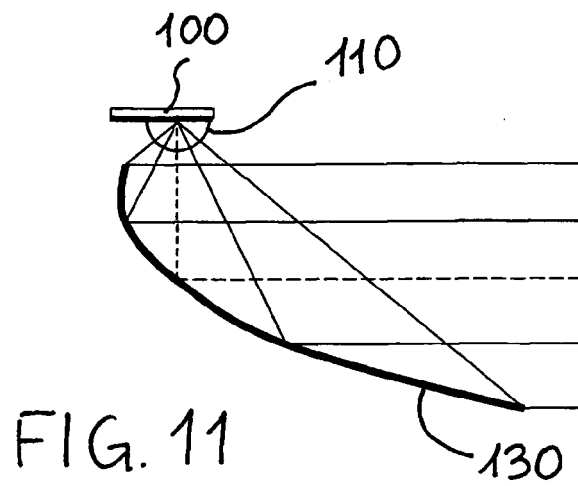


FIG. 10



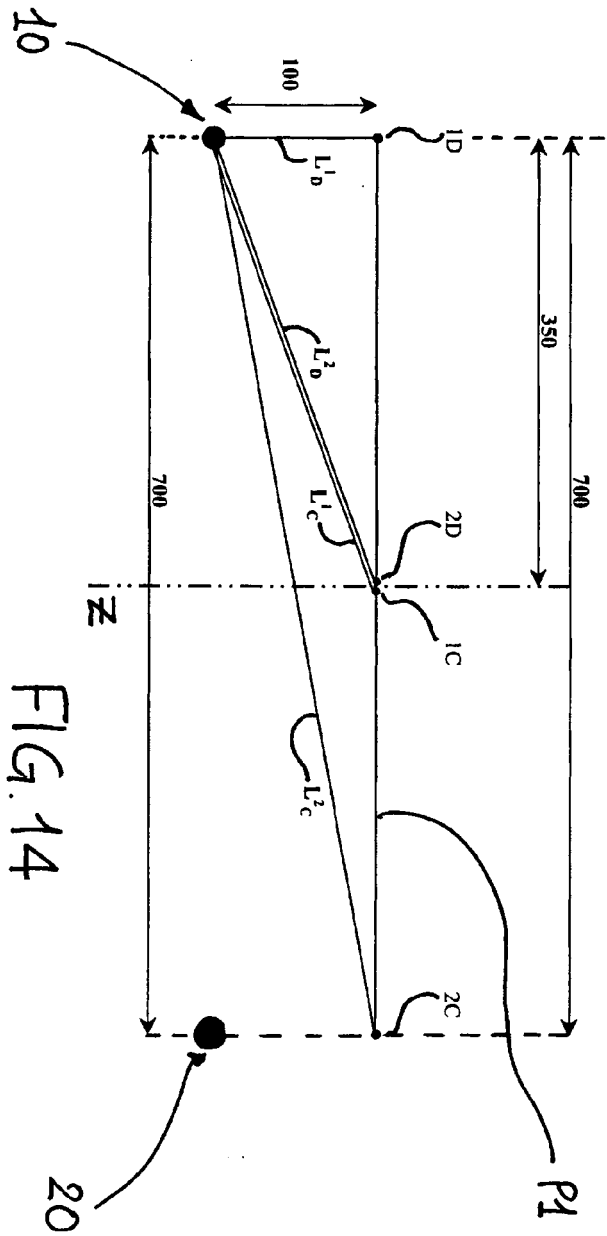
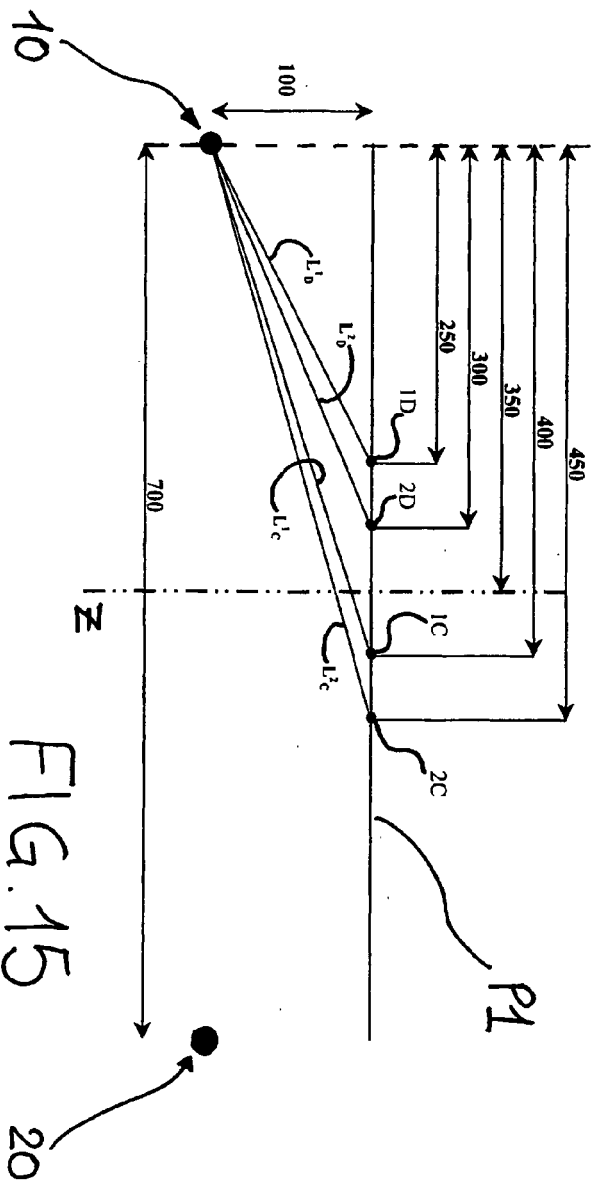


FIG. 14

		L^1/L^2
L_D^1	100	0,274
L_D^2	364	
L_C^1	364	0,515
L_C^2	707	

Tab. 1



		L^1/L^2
L^1_D	269	0,851
L^2_D	316	
L^1_C	412	0,895
L^2_C	460	

Tab. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5102

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 01/56336 A (A & T ENGINEERING COMPANY INC [US]) 2 August 2001 (2001-08-02) * the whole document *	1-25	INV. A47F3/00 A47F3/04
A	DE 10 2005 057154 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 31 May 2007 (2007-05-31) * the whole document *	1-25	
A	US 2005/265019 A1 (SOMMERS MATHEW [US] ET AL) 1 December 2005 (2005-12-01) * the whole document *	1-25	
A	US 6 578 978 B1 (UPTON RONALD D [US] ET AL) 17 June 2003 (2003-06-17) * the whole document *	1-25	
A	WO 2006/126250 A (ITL CORP [JP]; SAKUMA SHIGERU [JP]; ARIMOTO KAZUHIKO [JP]) 30 November 2006 (2006-11-30) * the whole document *	1-25	
			TECHNICAL FIELDS SEARCHED (IPC)
			A47F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 July 2008	Examiner Cardan, Cosmin
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 08 42 5102

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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