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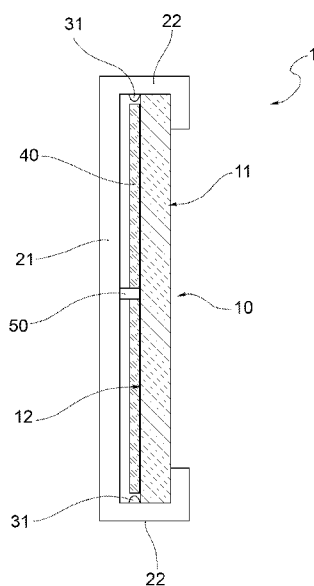


FIG. 3a

(57) Abstract: The present invention relates to a panel lightable from the rear (1), comprising : a screen (10) that may be lighted from the rear defined by a plate of a predefined material, having a first face (11), intended to be visible, and a second face (12), opposite to the first, said predefined material transmitting the light crossing it in a diffuse manner thanks to its physical features and/ or a reduction in its thickness; a support and containment frame (20), extending with a rear portion (21) behind said screen and with a perimeter portion (22) perimetally to said screen - a plurality of light sources (31) adapted to directly or indirectly illuminate said second face (12) of the screen. The light sources are distributed on the perimeter portion (22) of said frame (20); said panel (1) also comprises a light propagator (40) extending on said second face (12) of the screen to guide the light from said light sources to said second face (12), said light propagator (40) being substantially adherent to said second face (12) of the screen. The panel (1) comprises one or more column-shaped connectors (50) that connect said screen (10) directly or indirectly to the rear portion (21) of the support frame (20) according to directions incident to the second face of the screen, wherein said one or more connectors cross the light propagator (40).



PANEL LIGHTABLE FROM THE REAR

DESCRIPTION

FIELD OF APPLICATION

[0001] The present invention relates to a panel
5 lightable from the rear.

[0002] The panel lightable from the rear according to the invention finds particular application in the field of building finishes, furniture, and lighting technology.

10 PRIOR ART

[0003] Recessed lighting systems for closed environments, such as spotlights, installed in plasterboard false ceilings, are widely used, but it is not uncommon to find them also recessed into
15 floors or in the body of uprights, thus creating one or more light points contained in the footprint of the architectural element that receives them.

[0004] Also widely used are partition wall solutions illuminated by a light beam generated by one or more
20 spotlights recessed into the ceiling or floor near the partition wall, which then acts as a reflective element of the artificial light.

[0005] It is as well known to make panels lightable from the rear that comprise a screen associated with
25 a rigid support frame, typically made of wood or

metal, to cover a light source. The reduced local thickness of the screens makes the material locally translucent, providing an accentuated decorative effect when the panel lightable from the rear is switched on.

[0006] The Italian patent for invention No. 102017000132494, filed in the name of the same Applicant, describes a process for making screens for panels lightable from the rear starting from panels of materials such as wood, marble or stone. The process involves numerically controlling the creation of grooves in a panel of material, filling them with transparent binding material, and subsequently reducing the thickness of the panel by removing opaque material under the grooves until the transparent filling and binding material is exposed.

[0007] The Italian patent for invention No. 102020000019348, filed in the name of the same Applicant, describes an alternative method for locally varying the optical properties of a material, obtaining a panel that may be used as a screen in panels lightable from the rear. The panel thus made (when lighted from the rear) becomes a screen because locally it allows the passage of the light wave and is hidden from view when not in use.

[0008] Panels lightable from the rear having features comparable to those obtainable with the above method are described in WO2007/081254A1, ITUD20110200A1 and DE20303610U1.

5 [0009] The common denominator of the family of patents referred to above is the local reduction of the thickness of the panel in favor of the passage of the light wave and therefore the local loss of the original continuity of the panel; compensation is
10 achieved by filling the groove with a transparent binder and/or by coupling the panel in which the grooves are located to a transparent solid support..

[0010] In the first case, filling the groove with transparent binder allows a restoration of any
15 original mechanical performance of the panel which, in any case, depends, in relation to bending, on its thickness; therefore, in order to increase the bending strength, in the case of filling the groove with a transparent binder, it is still necessary to
20 increase the thickness of the panel and consequently the depth or length of the groove, with unfavorable optical consequences.

[0011] In the second case, on the other hand, the coupling with a transparent support presents the
25 well-known problem related to the negative response

of a coupled element to a thermal and/or hygrometric shock, a problem that is inevitable in a lighting system where the heat resulting from the operation of the LEDs is produced and accumulated. Also in this second case, which was already critical with respect to the response to thermal stress, the measurement of the bending strength that the transparent support body offered always depends on the thickness of said transparent support body.

[0012] To date, therefore, there is no possibility of avoiding the thickening of the panel and/or coupled element in the production of large screens, in which case the perimeter constraint of the screen alone offers a limited contrast to the bending.

[0013] In particular, the aforesaid panels lightable from the rear may be equipped with LED-type light sources, positioned according to two possible distribution schemes: edge-lit and back-lit.

[0014] In the edge-lit scheme (illustrated schematically in Fig. 1), the light sources A are distributed perimetrically along the support frame T. The light is brought behind the screen F by means of light guides G.

[0015] In the back-lit scheme (shown schematically in Fig. 2) the light sources are distributed directly

behind the screen.

[0016] In all the aforesaid known embodiments, the screen has been constrained only perimetrically by means of the perimeter support frame to prevent further connections from being the cause of either light interference in the propagation of the light or small light defects due to the perforation of the transparent body of the light guide in the case of the edge-lit scheme.

[0017] Thus, in the state of the art, in order to ensure that the screen panel has adequate mechanical strength, in particular resistance to bending, increasing the extension of the screen must therefore necessarily correspond to an increase in thickness of the screen.

[0018] Beyond certain extensions, however, a screen, if constrained only perimetrically, thus reaches thicknesses that if on the one hand ensure stability, on the other cause anchoring problems related to weight and lighting performance problems related to the thickness of said screen.

[0019] Therefore, there is a justified need to have a panel lightable from the rear that may be made with a screen with large surface dimensions and at the same time that maintains adequate mechanical strength

without necessarily having to have increased thicknesses that negatively compromise the initial performance of the light source.

[0020] In addition to these issues, there is also the issue related to the deformations induced by thermal stress on screens made by coupling different materials.

[0021] The technical verification in the climatic chamber of the screens obtained according to the models of the prior art listed above has shown significant problems of torsion and detachment attributable to a more general phenomenon of thermal deformation to which a body obtained by lamination materials with different thermal expansion coefficients is subjected.

[0022] The final lengthening/shortening of a body following a change in temperature is defined as ΔL , where L stands for final length; The equation that calculates this lengthening/shortening is:

[0023] $\Delta L = K * L1 * \Delta T$

[0024] where K is the thermal expansion coefficient, L1 is the initial length, and ΔT is the change in temperature.

[0025] Two different materials, such as those provided in DE 20303610U1 for example, if subjected to thermal

stress will never be able to balance the two respective final lengthenings/shortenings since their respective thermal expansion coefficients may not be modified.

5 [0026] A further requirement is therefore to create screens by coupling different materials while reducing the aforesaid phenomena of torsion and detachment between different materials in the presence of thermal stress.

10 DISCLOSURE OF THE INVENTION

[0027] Therefore, the main object of the present invention is to eliminate in whole or in part the drawbacks of the aforementioned prior art by providing a panel lightable from the rear that may be
15 made with a screen with large surface dimensions and at the same time that maintains adequate mechanical strength without necessarily having to have increased screen thicknesses.

[0028] A further object of the present invention is to
20 provide a panel lightable from the rear that allows for the correction/masking of any light interference or defects in the light distribution.

[0029] A further object of the present invention is to
25 provide a panel lightable from the rear which, with the same mechanical resistance to bending and

luminous power applied to the source, may offer superior luminous efficacy exiting the screen.

[0030] A further object of the present invention is to provide a panel lightable from the rear which is
5 simple to manufacture.

[0031] A further object of the present invention is to provide a panel lightable from the rear which has a screen that is less subject to deformation due to thermal stress.

10 DESCRIPTION OF THE DRAWINGS

[0032] The technical features of the invention, according to the aforesaid objects, may be clearly seen in the contents of the claims below, and its advantages will become more readily apparent in the
15 detailed description that follows, made with reference to the accompanying drawings, which represent one or more purely exemplifying and non-limiting embodiments thereof, wherein:

[0033] - Fig. 1 is a sectional view of a known type of panel lightable from the rear made in the edge-lit
20 configuration;

[0034] - Fig. 2 is a sectional view of a known type of panel lightable from the rear made in the back-lit configuration;

25 [0035] - Fig. 3A and 3B are two sections of a panel

lightable from the rear according to two alternative embodiments of the invention, relating to an edge-lit and back-lit configuration, respectively;

[0036] – Fig. 3C is a perspective view of a panel lightable from the rear, according to one embodiment of the invention;

[0037] – Fig. 4A and 4B schematically describe the effects of a decrease in the distance between the supports to which a screen is constrained on the dimensioning of the thickness of said screen in relation to maintaining an unchanged bending strength;

[0038] – Fig. 5 schematically shows the effects of the thickness of a screen on the amount of light exiting from an optical channel for the same light source;

[0039] – Fig. 6 schematically shows the relationship between the area of a connector and the total area of the screen;

[0040] – Fig. 7 schematically shows the phenomenon of the diffusive transmission of light through a material;

[0041] – Fig. 8 to 18 schematically show different ways of positioning the connectors in a panel lightable from the rear according to the invention;

[0042] – Fig. 19 a-b show two different types of

connectors that may be used in a panel lightable from the rear according to the invention;

[0043] – Fig. 20 is a section of a panel lightable from the rear according to the invention shown with a connector having an enlarged portion;

[0044] – Fig. 21, 22 and 23 refer to a possibility of connecting a connector in the opposite position to that of connection to the screen.

[0045] The attached figures are not scale representations. Elements or parts of elements common to the embodiments described hereinafter will be indicated with the same numerical references.

DETAILED DESCRIPTION

[0046] With reference to the aforesaid figures, a panel lightable from the rear according to the present invention has been indicated collectively with 1.

[0047] According to a general embodiment of the invention, illustrated in particular in Fig. 3A and 3B, the panel lightable from the rear 1 comprises a screen that may be lighted from the rear 10 defined by a plate of a predefined material.

[0048] The predefined material of which the panel is made is able to transmit the light crossing it in a diffuse manner thanks to its physical features and/or a reduction in its thickness.

[0049] In particular, the aforesaid predefined material may be chosen from the group consisting of marble, wood, resin, opalines.

5 [0050] The screen that may be lighted from the rear 10 has a first face 11, facing the outside of the panel 1 and intended to be visible, and a second face 12, opposite to the first, facing the inside of the panel 1 and therefore not visible from outside the panel 1.

10 [0051] The panel lightable from the rear 1 comprises a support and containment frame 20, which extends with a rear portion 21 behind said screen 10 and with a perimeter portion 22 perimetrically to said screen.

[0052] The screen 10 is mechanically connected to the frame 20 at the perimeter portion 22 of the frame.

15 [0053] In particular, the frame 20 may have an open box shape on one side where the screen 10 is positioned. Advantageously, the support and containment frame 20 may define – in combination with the screen 10 – a closed chamber housing the electrical components of
20 the panel lightable from the rear 1.

[0054] Advantageously, the panel lightable from the rear 1 may be self-supporting. In this case, the support and containment frame 20 is structured to also comprise a base for standing on the ground; for
25 example, the panel 1 may be configured as a totem or

a wall.

[0055] Alternatively, the panel lightable from the rear 1 may not be self-supporting. In this case, the support and containment frame 20 is intended to be anchored to a wall, ceiling, or other structure.

[0056] The panel lightable from the rear 1 further comprises a plurality of light sources 31 and 32 adapted to directly or indirectly illuminate the aforesaid second face 12 of the screen, i.e., the face of the screen that is not visible.

[0057] Operatively, the light emitted by the light sources 31, 32, once it reaches the second face 12 of the screen 10, passes through the thickness of the panel that forms the screen to exit with a diffuse transmission phenomenon at the first face 11 of the screen 10.

[0058] As shown schematically in Fig. 3A, the aforesaid light sources may be distributed on the perimeter portion 22 of said frame 20, according to an EDGE-LIT-type configuration. In this case, the panel 1 also comprises a light propagator 40 that extends on said second face 12 of the screen to guide light from said light sources 31 to said second face 12. The perimeter portion 22 of said frame 20 therefore also acts as a support base for the light sources 31.

[0059] The light propagator 40 is substantially adherent to said second face 12 of the screen. In other words, there is substantially no empty space between the second face 12 of the screen 10 and the light propagator 40.

[0060] A light propagator (or light guide) is known per se to a person skilled in the art and will therefore not be described in greater detail.

[0061] Alternatively, as shown schematically in Fig. 3B, the aforesaid light sources 32 may be distributed on the rear portion 21 of said frame 20, according to a BACK-LIT-type configuration, directly facing said second face 12 of the screen 20 to illuminate it directly. The rear portion 21 of said frame 20 therefore also acts as a support base for the light sources 32.

[0062] In this case, a gap 23 is defined between the second face 12 of the screen and the rear portion 21 of the frame for the propagation of light from the light sources 32 to the second face 12 of the screen 10.

[0063] Preferably, the light sources 31 and 32 (both in edge-lit configuration and in back-lit configuration) are composed of LEDs.

[0064] According to the invention, the panel lightable

from the rear 1 comprises one or more column-shaped connectors 50 which connect said screen 10 – directly or indirectly – to the rear portion 21 of the support frame 20 according to directions incident to the second face 12 of the screen 10.

[0065] Said one or more connectors 50 cross the light propagator 40 (in the case of an edge-lit configuration) at holes made on said light propagator itself or said gap 23 (in the case of a back-lit configuration).

[0066] Each of the aforesaid one or more connectors 50 implements a mechanical constraint for the screen 10 that is added to the perimeter constraint offered to said screen by the perimeter portion 22 of the frame 20.

[0067] Operatively, each connector 50 – t by virtue of being arranged in a direction incident to the second face 12 of the screen 10 – opposes the bending of the screen 10 with respect to a plane parallel to the two faces 11 and 12 of the panel that forms it. The connectors 50 thus allow the screen 10 to be stiffened.

[0068] The effect of the connectors on the rigidity of the screen, thus constrained, may therefore be exploited to obtain:

[0069] – a reduction in the thickness S of the panel with the same bending strength; or

[0070] – an increase in bending stiffness for the same thickness S of the panel.

5 [0071] Once the bending stiffness of the panel has been fixed, the reduction in thickness may be considered proportional to the reduction in the distance between the mechanical constraints and in particular the connectors 50.

10 [0072] By way of example, as shown schematically in Fig. 4A and 4B, by halving the distance between the mechanical constraints that are present between the screen and frame (to be understood generically; the constraints offered by the perimeter portion 22 of
15 the frame and the constraints offered by the connectors 50 are therefore included), the thickness S of the screen may be halved, without any increase in bending deformability.

[0073] Therefore, by virtue of the invention, and in
20 particular by the introduction of the aforesaid one or more connectors 50, it is possible to decrease the thickness S of the panel without loss of bending strength.

[0074] The panel lightable from the rear 1 according to
25 the invention may therefore be made with a screen of

large surface dimensions while maintaining adequate mechanical strength without the screen necessarily having to have increased thicknesses.

[0075] The possibility of reducing the thickness S of the screen 10 also has improving effects on the light performance at the first face 11 of said screen when grooves are formed in the thickness of the screen which act as optical channels to obtain localized lighting effects.

[0076] Such positive effect occurs regardless of the arrangement of the light sources 31, 32 with respect to the screen, i.e., it does not depend on whether the configuration is back-lit or edge-lit.

[0077] More specifically, as schematically shown in Fig. 5, where a simplified two-dimensional and non-solid representation of the behavior of the light is offered when a light wave passes through an optical channel of a screen made of a material that tends to be opaque to light, the increase in the thickness of the screen, which at the same time corresponds to the length of the optical channel contained therein, causes a decrease in the luminous intensity at the first face 11 of the screen 10. This is due to the fact that, for the same width of the optical channel, as the thickness increases the maximum output angle α

of the light decreases.

[0078] The thickness S of the screen is not important only in relation to the maximum output angle α of the light because this thickness S must also be evaluated in relation to what happens to the intensity of the light at increasing distances from the source according to the well-known law of the inverse of the square of the distance. The thickness S is part of the distance separating the light source from the first face 11, and the decrease in its value should be squared in the calculation of luminous intensity.

[0079] With the same mechanical bending strength and luminous power applied to the light source, the panel lightable from the rear 1 according to the invention may therefore offer a higher luminous efficacy exiting the screen (i.e., at the first face 11) thanks to the reduction in thickness S .

[0080] Advantageously, as shown schematically in Fig. 6, the cross-section of said one or more connectors 50 at the connection end to the second face 12 of the screen 10 is a fraction of the total area of the second face 12 of the screen 10. Thanks to this, the adhesion areas of the connectors to the screen may be minimal. It follows that in the presence of thermal stresses, final lengthenings/shortenings will develop

at the connections between the connectors and the screen that are compatible with the elastic moduli of the different materials that form the screen and the connectors. This reduces the mechanical stresses induced by the different thermal expansion between the screen and connectors. Such coupling compatibility is improved in the case where the screen and connectors are coupled through an elastic binder.

[0081] As already highlighted above, the screen that may be lighted from the rear 10 is defined by a panel of a predefined material that is capable of transmitting the light crossing it in a diffuse manner thanks to its physical features and/or a reduction in its thickness.

[0082] Fig. 7 schematically shows the phenomenon of a diffuse transmission of light by a material through which the light passes. Due to the diffuse transmission, the light that exits the material after passing through it is decomposed into a plurality of directions, and this means, at the same time, the decomposition also of any small light peak and/or depression caused by the presence of a connector and/or the hole made on the light guide; decomposing a light peak or depression signifies masking it.

[0083] Such a phenomenon thus makes it possible to attenuate/mask in an extremely significant way any light interference caused by the presence of the connectors in the light path.

5 [0084] In other words, the light possibly conditioned by the presence of holes in the light propagator 40 (light guide) and/or by the presence of the connectors 50 in the gap 23, after reaching the second face 12 of the screen 10, passing through the
10 thickness S of the screen (due to the intrinsic features of the screen itself) is decomposed in many directions, making any light defect imperceptible to a common observer.

[0085] The use of a material which, due to its
15 intrinsic features and/or the processing to which it has been subjected, determines a diffuse light transmission, making the presence of the aforesaid connectors 50 compatible with the functionality of the panel lightable from the rear 1 according to the
20 invention.

[0086] Preferably, in order to minimize interference on the luminous phenomena of the panel by the connectors 50, said connectors are made of material transparent to light, by seeking to use materials with close
25 refractive indices and glues with an indicated

refractive index. In particular, the connectors 50 may be composed of nails/screws made of a material such as glass, methacrylate, transparent resin, opaline resin.

5 [0087] The connectors may, however, also be made of opaque material, since the attenuation of any light interference obtained through the diffuse transmission is so high that even the presence of an opaque body (having a section equal to a very small
10 fraction of the total area of the screen) would give rise to substantially negligible light shielding effects.

[0088] In particular, the connectors 50 may consist of metal nails/screws.

15 [0089] Advantageously, as illustrated in Fig. 8, said one or more connectors 50 may connect directly to said rear portion 21 of said frame 10 by crossing the light propagator 40 at holes or by crossing the gap 23.

20 [0090] Advantageously, as illustrated in Fig. 9, the panel lightable from the rear 1 may comprise one or more first stiffening elements of the frame 210 that are arranged inside said frame 10 between said rear portion 21 of the frame 20 and said light propagator
25 40. In such a case, said one or more connectors 50,

after crossing the light propagator 40, may connect to said one or more first stiffening elements 210 which are integral with said rear portion 21 of the frame. In this way, the screen 10 is indirectly
5 connected to the rear portion 21 of the frame 20 by means of the connectors 50 through said one or more first stiffening elements 210.

[0091] Advantageously, as shown in Fig. 10, the panel lightable from the rear 1 may comprise one or more
10 second stiffening elements of the frame 220 which are arranged outside said frame 20 integral with the rear portion 21 of said frame 20. In this case, said one or more connectors 50, after crossing the light propagator 40 or the gap 23, may connect to said one
15 or more second stiffening elements 220 by crossing said rear portion 21 of the frame. In this way, the screen 10 is indirectly connected to the rear portion 21 of the screen 10 through of the connectors 50 by means of said one or more second stiffening elements
20 220.

[0092] Advantageously, as shown in Fig. 11, said one or more connectors 50 cross the rear portion 21 of said frame to connect to a possible support structure 100 outside the panel lightable from the rear 1.
25 Preferably, in turn, the rear portion 21 of the frame

20 is connected to this support structure 100 outside the panel lighttable from the rear 1. In this way, the screen 10 is indirectly connected to the rear portion 21 of the screen 10 through the connectors 50 by means of said support structure 100 outside the panel lighttable from the rear 1.

[0093] Preferably, as shown in Fig. 12, on said second face 12 of the screen 10 – in the thickness of the plate – a plurality of first grooves 13 may be obtained according to a predefined design that act as optical channels to make the screen 10 locally translucent. The grooves 13 may have a depth less than the thickness of the panel or cross the entire thickness of the panel. Fig. 3C shows from the front the first face 11 of the screen 10, wherein examples of translucencies obtainable from the passage of light in the underlying grooves 13 are schematically represented with lines 16.

[0094] Advantageously, as shown in Fig. 13, said first grooves 13 may be filled at least partially with a transparent binding material 14 which has the function of giving mechanical strength to the panel by compensating for the removal of material in these grooves 13 without impeding the passage of light.

[0095] As shown in Fig. 14, said transparent binding

material 14 may at least partially cover the second face 12 of the screen outside said first grooves 13.

[0096] Said one or more connectors 50 may be anchored to said screen 10 by means of said transparent binding material 14.

[0097] Advantageously, as shown in Fig. 15, said one or more connectors 50 may be anchored to said screen 10 by means of said transparent binding material 14 at said first grooves 13.

[0098] As shown in Fig. 16, said one or more connectors 50 may be anchored to said screen 10 by means of said transparent binding material 14 outside said first grooves 13.

[0099] Advantageously, as shown in Fig. 17, said one or more connectors 50 may be anchored to said screen 10 at second grooves 15 which are obtained on said second face 12 of the screen 1 with a depth less than that of said first grooves 13 so as not to locally create translucency and act as anchoring seats for the connectors 50.

[00100] Advantageously, as shown in Fig. 18, said one or more connectors 50 may be anchored to said screen 10 at the top surface of said second face 12 of the screen 10, for example by screwing and/or gluing in areas without prior milling.

[00101] Said one or more connectors 50 may be composed of cylindrical bodies having a constant cross-section, as shown in Fig. 19a.

5 [00102] Said one or more connectors 50 may have an axially differentiated cross-section. For example, they may have a conical shape, as shown in Fig. 19b, or they may have an enlarged head (nail-like) or they may have an enlarged intermediate portion 53 (as shown in Fig. 20).

10 [00103] Advantageously, as shown in Fig. 20, the axial portion of the connectors 50 that extends from the light propagator 40 to the rear portion 21 of the support frame 20 may have a larger cross-section than the axial portion that extends through the light
15 propagator 40 to the screen.

[00104] The connection of each connector 50 to the rear portion 22 of the frame or to other support/stiffening structures may be made in any way suitable for the purpose, i.e., to mechanically
20 constrain the screen to another structure that is rigid enough to ensure any bending of the screen described above. Various types of coupling may be used for this purpose which are not described in detail as they are known to a person skilled in the
25 art.

[00105] By way of example, as shown in Fig. 21, 22 and 23, the connection may be made with a guillotine method. More specifically, the connector 50 has a groove 51 in a certain axial position. During the assembly step, the end of the connector 50 opposite to that intended to be connected to the screen 10 is inserted within a slot obtained, for example, on the rear portion 21 of the frame 20. The slot 52 in turn has: - a first portion 52' enlarged for the free insertion of the connector 50; - a second narrowed portion 52'' adapted to engage with its edges in the groove 51 of the connector. This provides a stable anchor between the connector and the support structure without the use of adhesives, which may be used to press the components of the panel 1 together.

[00106] Preferably, all the connector passage holes or housing seats are slightly oversized with respect to the connector cross-section so as to compensate for any thermal expansion of the components.

[00107] Advantageously, the panel forming the screen 10 may be provided with a plurality of notches (in particular forming a lattice which may extend to the entire second face 12 of the screen); these notches have a depth less than the thickness S of the panel and have the function of superficially splitting the

panel so as to reduce the intensity of deformations of anisotropic materials due to thermal stress.

[00108] The invention allows numerous advantages to be obtained, which have already been described in part.

5 [00109] The panel lightable from the rear 1 according to the invention may be made with a screen having large surface dimensions and at the same time may maintain adequate mechanical strength without necessarily having to have increased thicknesses of
10 the screen.

[00110] The panel lightable from the rear 1 according to the invention allows for the correction/masking of any light interference or defects in the distribution of the light.

15 [00111] The panel lightable from the rear 1 according to the invention – with the same mechanical bending strength and luminous power applied to the source – may offer a superior luminous efficacy exiting the screen.

20 [00112] The panel lightable from the rear 1 according to the invention is simple to manufacture. In this regard, it is observed that being able to illuminate the same surface with a more than significant decrease in the luminous power of the source leads to
25 a decrease in costs, but above all to a containment

of heat development. The latter, in turn, is perhaps the most important indicator of the durability of the LED and of a screen, especially when the same is made of materials such as wood or marble that are
5 extremely sensitive to thermo-hygrometric changes, and in general also of the general safety of the electrical appliance.

[00113] The panel lightable from the rear 1 according to the invention may use a screen that is less
10 subject to deformation due to thermal stress.

[00114] The invention thus conceived therefore achieves its intended objectives.

[00115] Obviously, in practice it may also assume different forms and configurations from the one
15 illustrated above, without thereby departing from the present scope of protection.

[00116] Furthermore, all details may be replaced with technically equivalent elements, and the dimensions, shapes, and materials used may be any according to
20 the needs.

[00117] The subject-matter of the present invention is a panel lightable from the rear (1), comprising:

[00118] - a rear-lightable screen (10) defined by a plate of a predefined material, having a first face
25 (11), intended to be visible, and a second face (12),

opposite to the first, said predefined material transmitting the light crossing it in a diffuse manner thanks to its physical features and/or a reduction in its thickness;

5 [00119] - a support and containment frame (20), extending with a rear portion (21) behind said screen and with a perimeter portion (22) perimetrically to said screen

[00120] - a plurality of light sources (31; 32) adapted
10 to directly or indirectly illuminate said second face (12) of the screen.

[00121] Said light sources are:

[00122] - either distributed on the perimeter portion (22) of said frame (20), in this case said panel (1)
15 also comprising a light propagator (40) extending over said second face (12) of the screen to guide the light from said light sources to said second face (12), said light propagator (40) being substantially adherent to said second face (12) of the screen;

20 [00123] - or distributed on the rear portion (21) of said frame (20) directly facing said second face (12) of the screen (20) to illuminate it directly, in this case a gap (23) being defined for the propagation of light between said second face (12) of the screen and
25 said rear portion (21) of the frame.

[00124] According to the invention, the panel lightable from the rear (1) comprises one or more column-shaped connectors (50) that connect said screen (10) – directly or indirectly – to the rear portion (21) of the support frame (20) according to directions incident to the second face of the screen. Said one or more connectors cross the light propagator (40) or said gap (23).

[00125] Advantageously, said one or more connectors (50) may connect directly to said rear portion (21) of said frame.

[00126] Alternatively, the panel lightable from the rear (1) may comprise one or more first stiffening elements of the frame (210) that are arranged inside said frame (20) between said rear portion (21) of the frame (20) and said light propagator (40); said one or more connectors (50) are connected to said one or more first stiffening elements (210) integral with said rear portion (21).

[00127] According to a further alternative, the panel lightable from the rear (1) may comprise one or more second stiffening elements of the frame (220) which are arranged outside said frame (20), integral with the rear portion (21) of said frame (20). Said one or more connectors (50) are connected to said one or

more second stiffening elements (220) crossing said rear portion (21) of the frame.

[00128] According to a further alternative, said one or more connectors (50) cross said rear portion (21) of said frame to connect to a possible support structure outside the panel lightable from the rear (1).

[00129] Advantageously, the cross-section of said one or more connectors (50) at the connection end to the second face (12) of the screen (10) is a fraction of the total area of the second face (12) of the screen (10).

[00130] Preferably, said one or more connectors (50) are made of transparent material.

[00131] Advantageously, on said second face (12) of the screen (10) – in the thickness of the panel – a plurality of first grooves (13) may be obtained according to a predefined design that acts as optical channels to make the screen (10) locally translucent.

[00132] Advantageously, said first grooves (13) may be at least partially filled with a transparent binding material (14).

[00133] In particular, said transparent binding material (14) at least partially covers the second face (12) of the screen outside said first grooves (13).

[00134] In particular, said one or more connectors (50) are anchored to said screen (10) by means of said transparent binding material (14).

5 [00135] In particular, said one or more connectors (50) may be anchored to said screen (10) by means of said transparent binding material (14) at said first grooves (13).

10 [00136] Alternatively, said one or more connectors (50) may be anchored to said screen (10) by means of said transparent binding material (14) outside said first grooves (13).

15 [00137] Advantageously, said one or more connectors (50) may be anchored to said screen (10) at second grooves (15) which are obtained on said second face with a depth less than that of said first grooves (13) so as not to locally create translucency and act as anchoring seats.

20 [00138] Advantageously, said one or more connectors (50) may be anchored to said screen (10) at the top surface of said second face, in particular by screwing or gluing in areas without prior milling.

[00139] Advantageously, said one or more connectors (50) may have an axially differentiated cross-section.

25 [00140] In particular, the axial portion of the

connectors (50) extending from the light propagator (40) to the rear portion (21) of the support frame has a larger cross-section than the axial portion extending through the light propagator (40) to the screen.

[00141] Advantageously, the holes made in the light propagator through which said one or more connectors pass may have lapped edges. Lapping reduces edge irregularities and makes the angle of light exiting the hole edges smoother.

[00142] Advantageously, the holes made in the light propagator through which said one or more connectors pass may have painted edges. The paint makes the exit of light from the edges of the hole smoother.

[00143] Advantageously, at the holes made in the light propagator through which said one or more connectors pass, the space between the connector and the edges of the respective hole may be filled with transparent binding material that has a refractive index equal to or close to that of the light propagator or that has diffusive features in order to decrease any light inhomogeneity on the second face (12) of the screen. Said transparent binder also keeps the connector centered on average with respect to the light guide.

[00144] Preferably, as already highlighted, the light propagator 40 is substantially adherent to said second face 12 of the screen. In other words, there is substantially no empty space between the second
5 face 12 of the screen 10 and the light propagator 40.

[00145] However, it is possible to envisage the case wherein the light propagator 40 is spaced from the second face 12 of the screen by means of spacer elements. The spacing of the light propagator (40)
10 from the second face (12) of the screen (10) is provided in the case wherein the light inhomogeneity caused by one or more holes made on the light propagator arriving on the second face 12 of the screen 10 is particularly intense and/or in the case
15 wherein there is an increased need for heat dissipation.

[00146] The usefulness of a millimetric or sub-millimetric spacing may be explained on the basis of the fact that the information conveyed by the light
20 passing through a diffusion screen is not lost, but advantageously decomposed and this decomposition masks the inhomogeneity of the light arriving on the screen.

[00147] In particular, the information conveyed by the
25 light is more decomposed if the light guide, which is

the site of any light inhomogeneity, is moved away from the diffusion screen 10.

On the other hand, with regard to the increase in the dissipation capacity of the system, it is evident
5 that ventilation through the space between the light guide (40) and the screen (10) improves this capacity.

[00148] Advantageously, said one or more connectors may carry within them further connection elements of the
10 types:

[00149] - electrical, such as power cables, PC cables; and/or

[00150] - mechanical, such as steel, fiberglass, carbon fiber cables; and/or

15 [00151] - optical, such as optical fibers.

[00152] Advantageously, the aforesaid additional connection elements may remain confined within the respective connector without reaching the screen, or they may pass over the respective connector and reach
20 the screen or even go beyond it.

[00153] In particular, such connection elements may exit from the first face 11 of the screen to allow further functions. In particular, power cables for additional lighting bodies, PC charging cables,
25 presence sensors may come out at any point of the

screen.

[00154] Advantageously, the connectors 50 may exit from the screen at the first face 11 so as to act as mechanical connection elements. In particular, the connectors may be composed of metallic fastening elements such as screws, threaded bodies or nails, functional for anchoring, for example, brackets, cameras, anti-theft elements, and in general arrangements that otherwise would be relegated to the perimeter of the panel.

[00155] Advantageously, the aforesaid first grooves 13 which act as optical channels to make the screen locally translucent may be partly obscured by the use of darkening binding material and/or by applying a darkening film in adherence to the second face 12 of the screen. In this way, it will also be possible to divide and therefore stabilize a screen made, for example, of solid wood, the expansions and torsions of which depend on the size of the initial sample considered, without the formation of the cuts generating a passage of light. This arrangement allows even very deep cuts to be made, at a depth close to transparency, thus making it possible to also curve the screen, without the passage of light through the grooves. The grooves, otherwise permeable

to light, are in fact masked with a binder opaque to light or with masks selectively opaque to light placed on the second face 12 of the screen or on the bottom of the grooves of the face 12.

5 [00156] Transparent binder with diffusive properties may be used. The use of a transparent binder with diffusive properties within the groove helps to further correct light inhomogeneities arriving on the second face 12 of the screen 10.

10 [00157] Previously, it was highlighted that preferably all the connector passage holes or the housing seats are slightly oversized with respect to the cross-section of the connectors so as to compensate for any thermal expansion of the components.

15 [00158] Preferably, said one or more connectors are connected to the screen by means of transparent binding material which is physically interposed between the connector head and the screen. In other words, the head of the connectors is spaced apart
20 from the screen.

[00159] The use of a connector (50), even if opaque, but spaced apart from the face (12) by a contour of a transparent and/or transparent opaline binder, avoids a shadow on the face (11) of the screen (10) that is
25 perceptible to the naked eye.

[00160] The light coming from the various LED sources is in fact diffused in the space between the head of the connector and the face (12) of the screen (10), the screen characterized in that it is diffusive.

5 [00161] The light that diffuses in the space between the head of the connector (50), even if opaque, and the second face (12) then passes through the thickness of the screen (10) diffusing on the face (11): the information relating to the presence of a
10 connector, even an opaque one, conveyed by the light in proximity to the face (12), is first attenuated by said diffusion of light in the space between the connector (50) and the face (12) and further decomposed by the thickness of the screen (10)
15 provided by the first claim as a diffusion screen.

[00162] As an alternative to fastening the connector to the second face 12 of the screen 10 with a transparent binder, it is possible to provide for the use of a magnet recessed on the second grooves (15)
20 which may advantageously connect to the head of a metal connector.

[00163] Advantageously, the screen 10 may be reinforced on the second face 12 by applying a layer of transparent binder with the addition of glass fiber.

CLAIMS

1. Panel lightable from the rear (1), comprising:
- - a screen that may be lighted from the rear (10) defined by a plate of a predefined material, having a first face (11), intended to be visible, and a second face (12), opposite to the first, said predefined material transmitting the light crossing it in a diffuse manner thanks to its physical features and/or a reduction in its thickness;
 - 10 - a support and containment frame (20), extending with a rear portion (21) behind said screen and with a perimeter portion (22) perimetrically to said screen
 - - a plurality of light sources (31; 32) adapted to directly or indirectly illuminate said second face (12) of the screen,
- wherein said light sources are distributed on the perimeter portion (22) of said frame (20), in this case said panel (1) also comprising a light propagator (40) extending on said second face (12) of the screen to guide
- 20 light from said light sources to said second face (12), said light propagator (40) being substantially adherent to said second face (12) of the screen;
- characterized in that it comprises one or more column-shaped connectors (50) which connect said screen (10) -
- 25 directly or indirectly - to the rear portion (21) of the

support frame (20) according to directions incident to the second face of the screen, wherein said one or more connectors cross the light propagator (40).

2. Panel lightable from the rear (1) according to claim
5 1, wherein said one or more connectors (50) are directly connected to said rear portion (21) of said frame.

3. Panel lightable from the rear (1) according to claim
1, comprising one or more first stiffening elements of the frame (210) that are arranged inside said frame (20)
10 between said rear portion (21) of the frame (20) and said light propagator (40), wherein said one or more connectors (50) are connected to said one or more first stiffening elements (210) integral with said rear portion (21).

15 4. Panel lightable from the rear (1) according to claim 1, comprising one or more second stiffening elements of the frame (220) which are arranged outside said frame (20), integral with the rear portion (21) of said frame (20), wherein said one or more connectors (50) are
20 connected to said one or more second stiffening elements (220) crossing said rear portion (21) of the frame.

5. Panel lightable from the rear (1) according to claim 1, wherein said one or more connectors (50) cross said rear portion (21) of said frame to connect to a possible
25 support structure outside the panel lightable from the

rear (1).

6. Panel lightable from the rear (1) according to any one of the preceding claims, wherein the cross-section of said one or more connectors (50) at the connection end to
5 the second face (12) of the screen (10) is a fraction of the total area of the second face (12) of the screen (10).

7. Panel lightable from the rear (1) according to any one of the preceding claims, wherein said one or more
10 connectors (50) are composed of transparent material.

8. Panel lightable from the rear (1) according to any one of the preceding claims, wherein on said second face (12) of the screen (10) - in the thickness of the plate - a plurality of first grooves (13) is obtained according to
15 a predefined design that act as optical channels to make the screen (10) locally translucent.

9. Panel lightable from the rear (1) according to claim 8, wherein said first grooves (13) are at least partially filled by a transparent binding material (14).

20 10. Panel lightable from the rear (1) according to claim 9, wherein said transparent binding material (14) at least partly covers the second face (12) of the screen outside said first grooves (13).

11. Panel lightable from the rear (1) according to claim
25 9 or 10, wherein said one or more connectors (50) are

anchored to said screen (10) by means of said transparent binding material (14).

12. Panel lightable from the rear (1) according to claim 11, when dependent on claim 9, wherein said one or more
5 connectors (50) are anchored to said screen (10) by means of said transparent binding material (14) at said first grooves (13).

13. Panel lightable from the rear (1) according to claim 11, when dependent on claim 10, wherein said one or more
10 connectors (50) are anchored to said screen (10) by said transparent binding material (14) outside said first grooves (13).

14. Panel lightable from the rear (1) according to any one of claims 1 to 7, wherein said one or more connectors
15 (50) are anchored to said screen (10) at second grooves (15) which are obtained on said second face with a depth less than that of said first grooves (13) so as not to locally create translucency and act as anchoring seats.

15. Panel lightable from the rear (1) according to any
20 one of claims 1 to 7, wherein said one or more connectors (50) are anchored to said screen (10) at the top surface of said second face [by screwing or gluing in areas without prior milling].

16. Panel lightable from the rear (1) according to any
25 one of the preceding claims, wherein said one or more

connectors (50) have an axially differentiated cross-section.

17. Panel lightable from the rear (1) according to claim 16, wherein the axial portion of the connectors (50) extending from the light propagator (40) to the rear portion (21) of the support frame has a larger cross-section than the axial portion extending through the light propagator (40) to the screen.

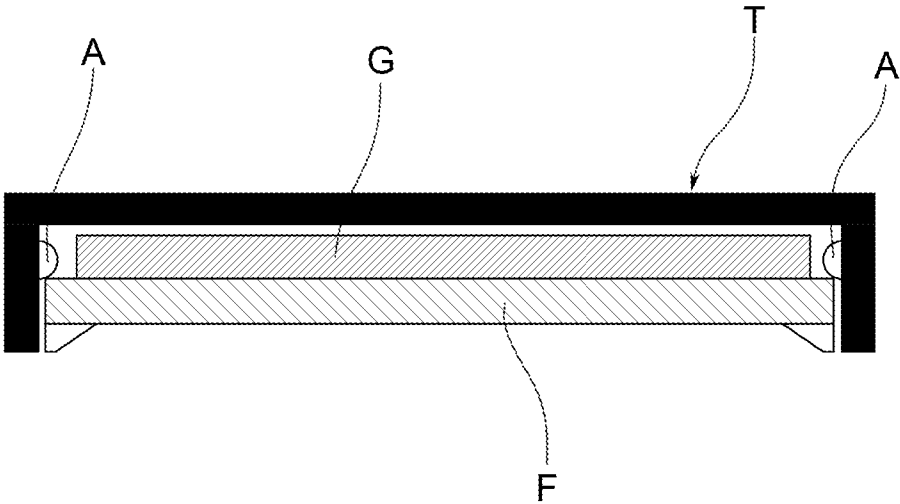


FIG. 1

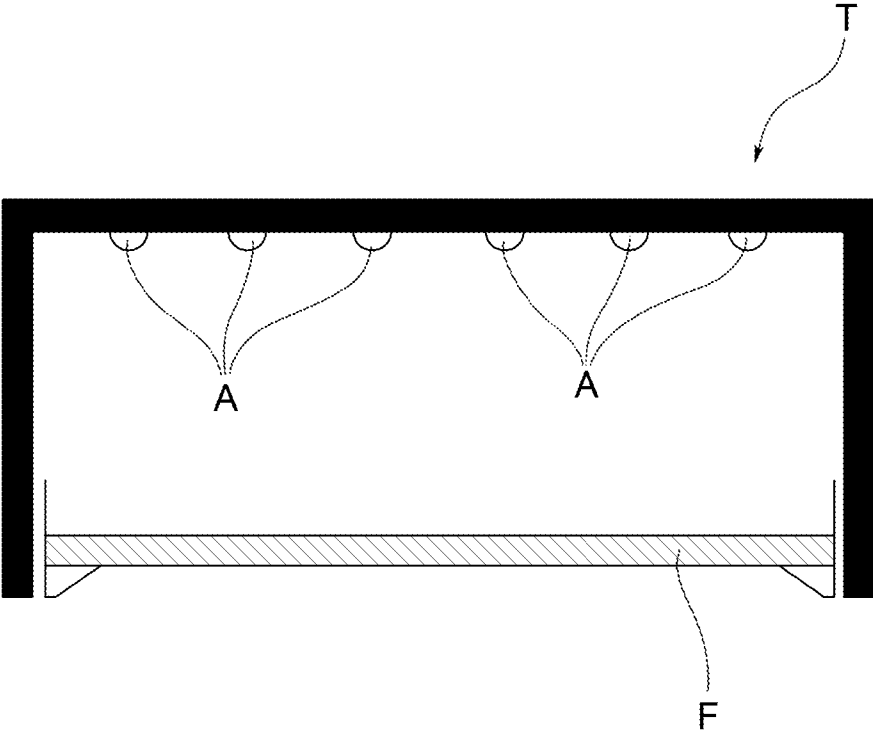


FIG. 2

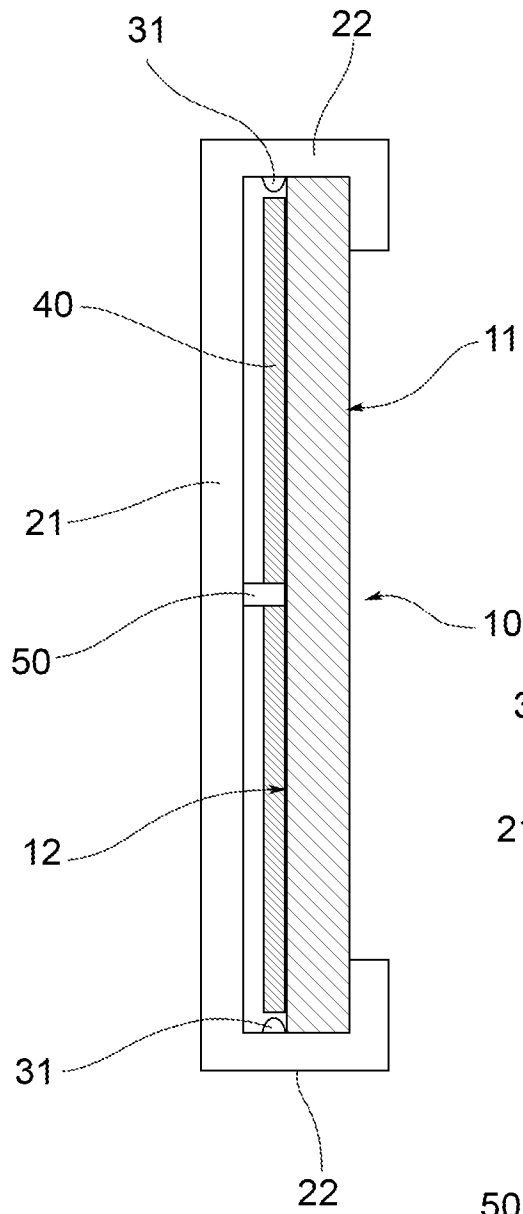


FIG.3a

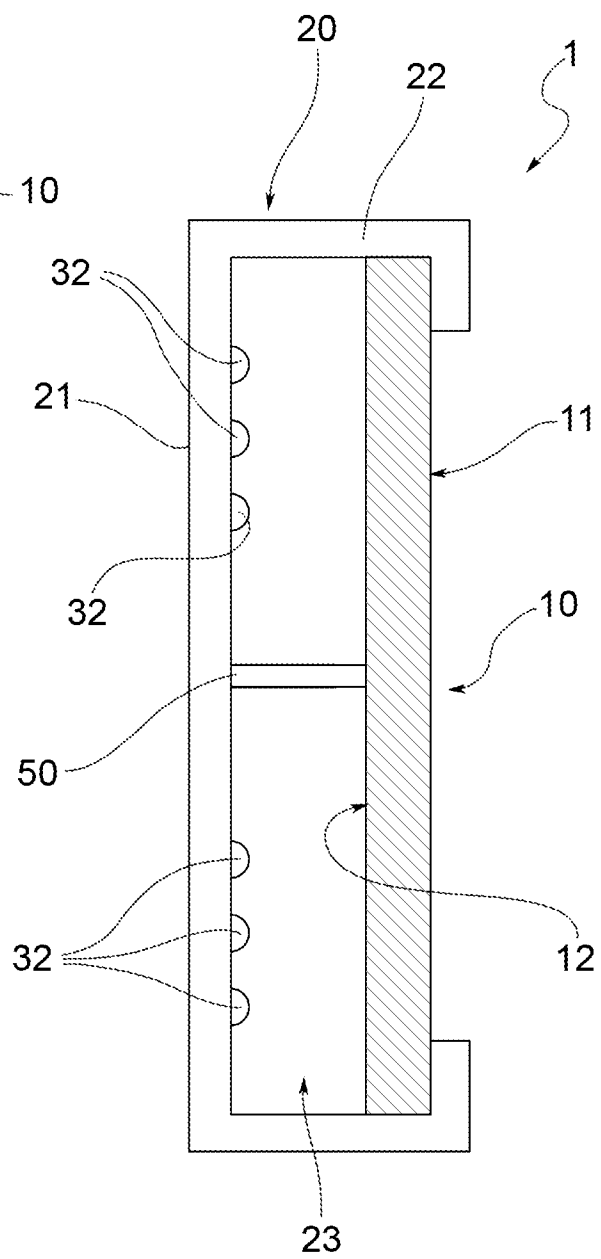


FIG.3b

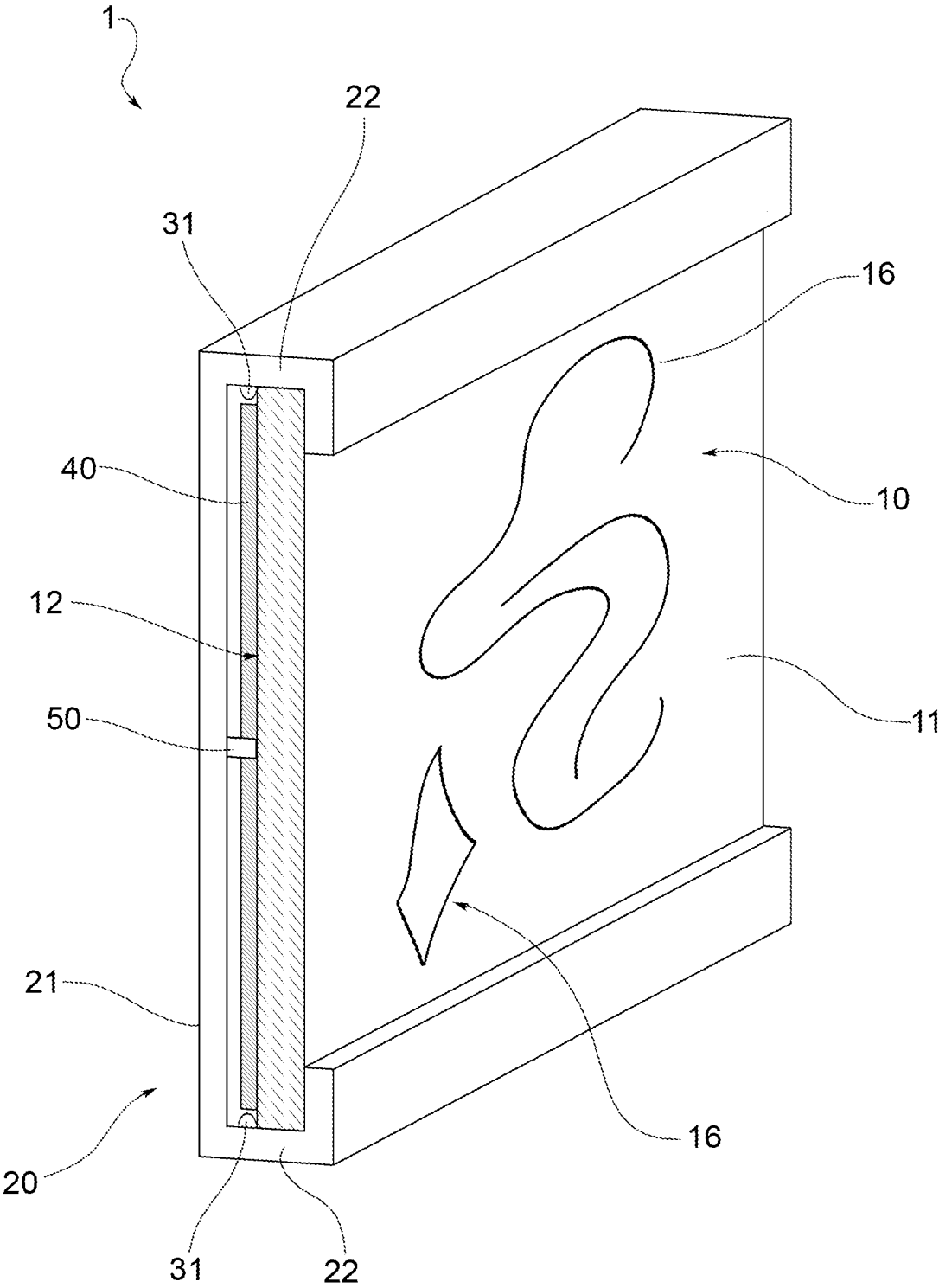


FIG.3c

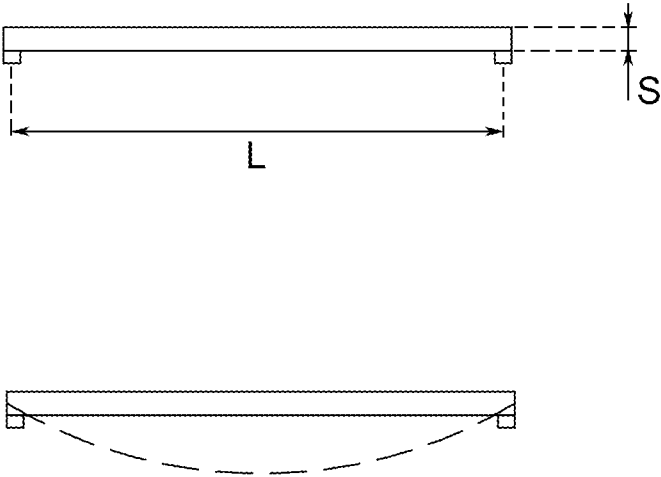


FIG. 4a

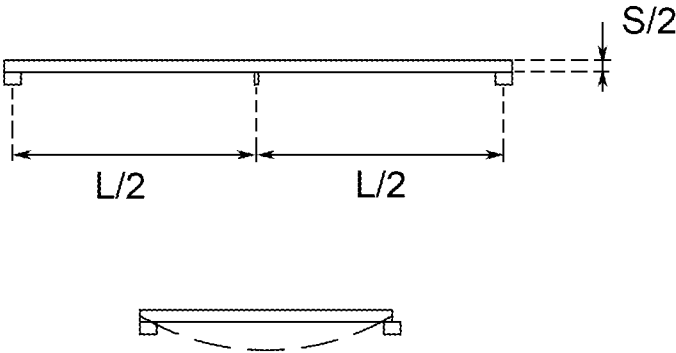


FIG. 4b

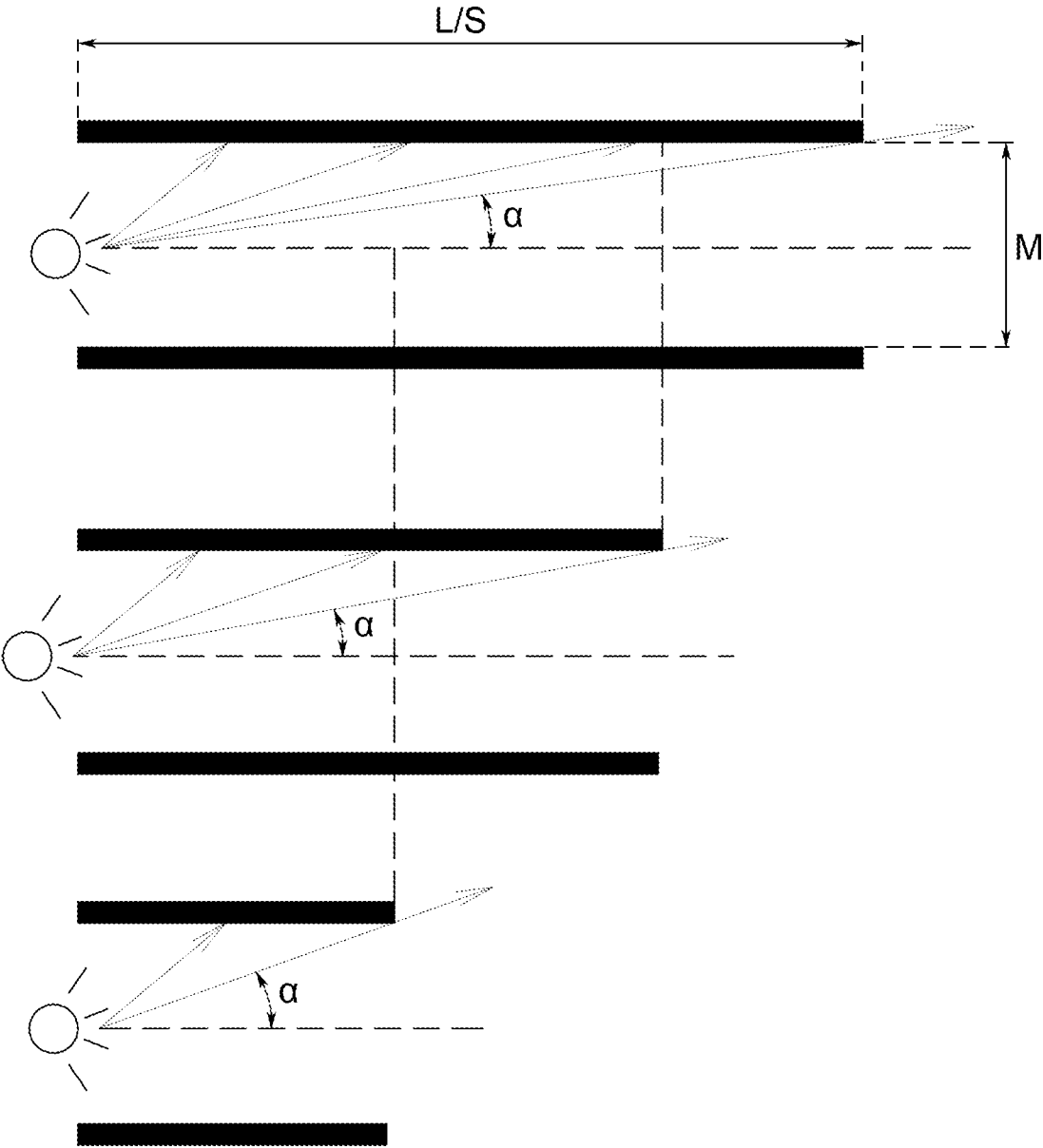


FIG.5

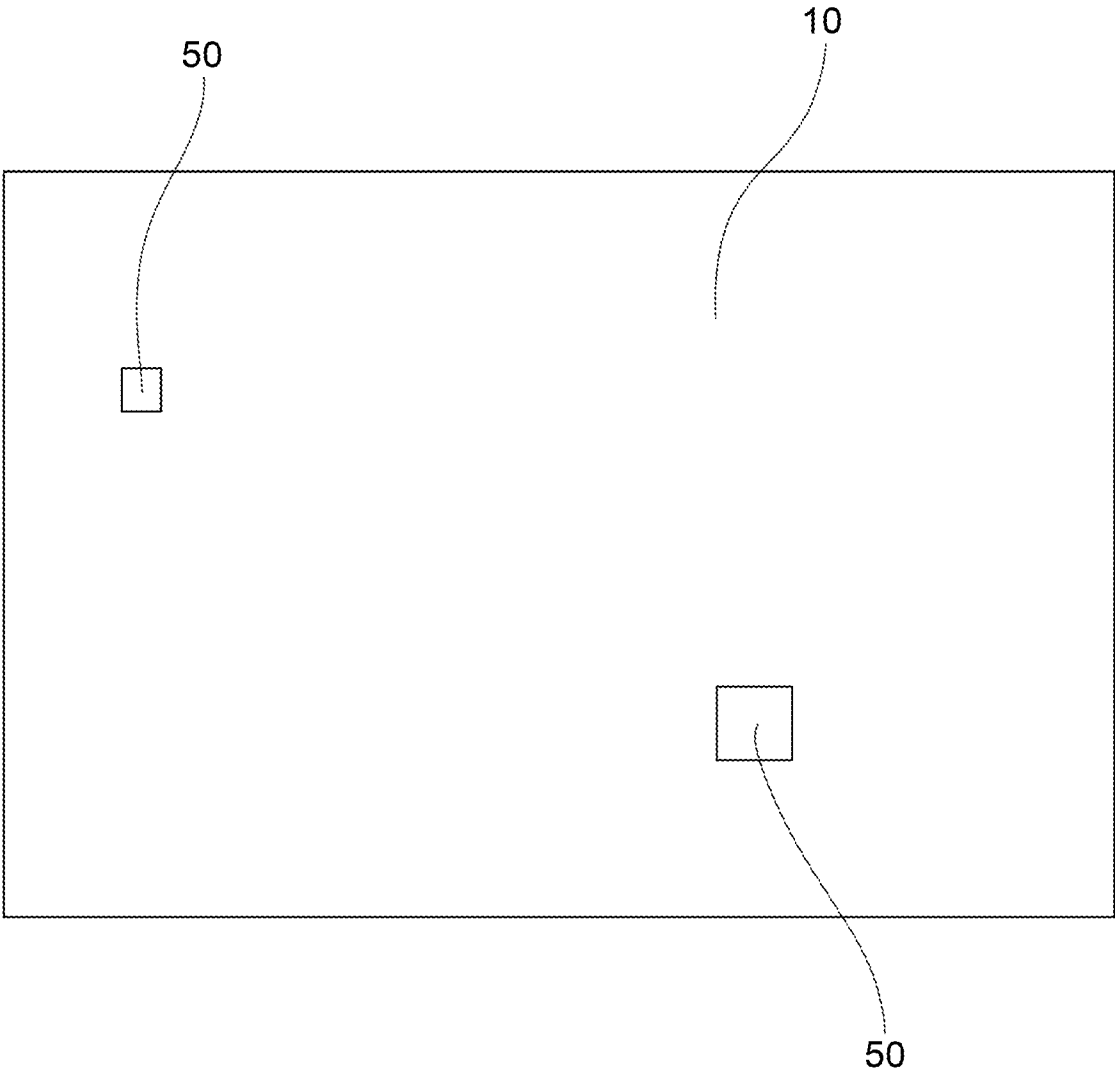


FIG.6

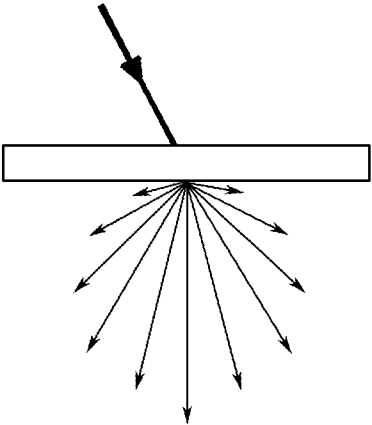


FIG.7

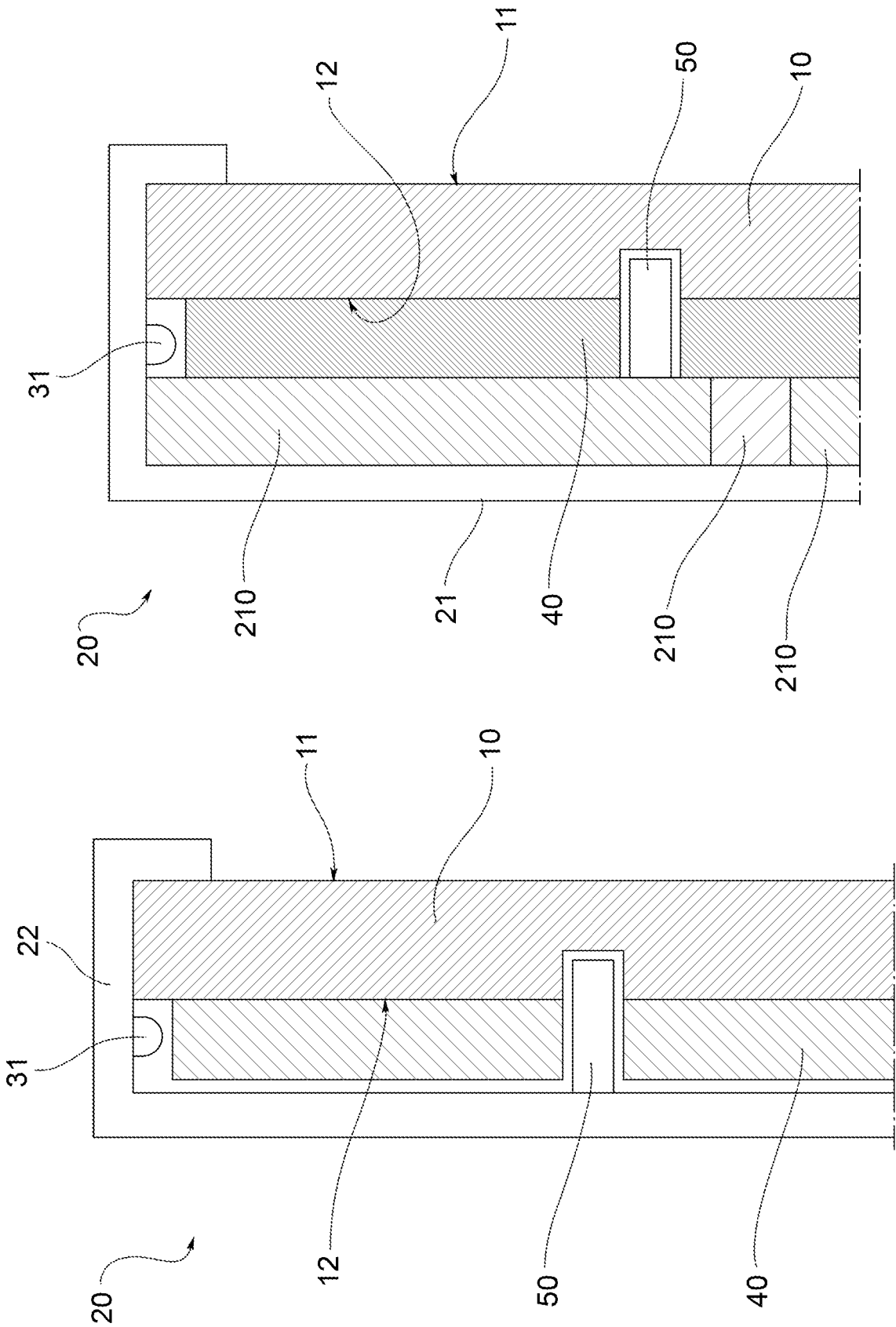


FIG.9

FIG.8

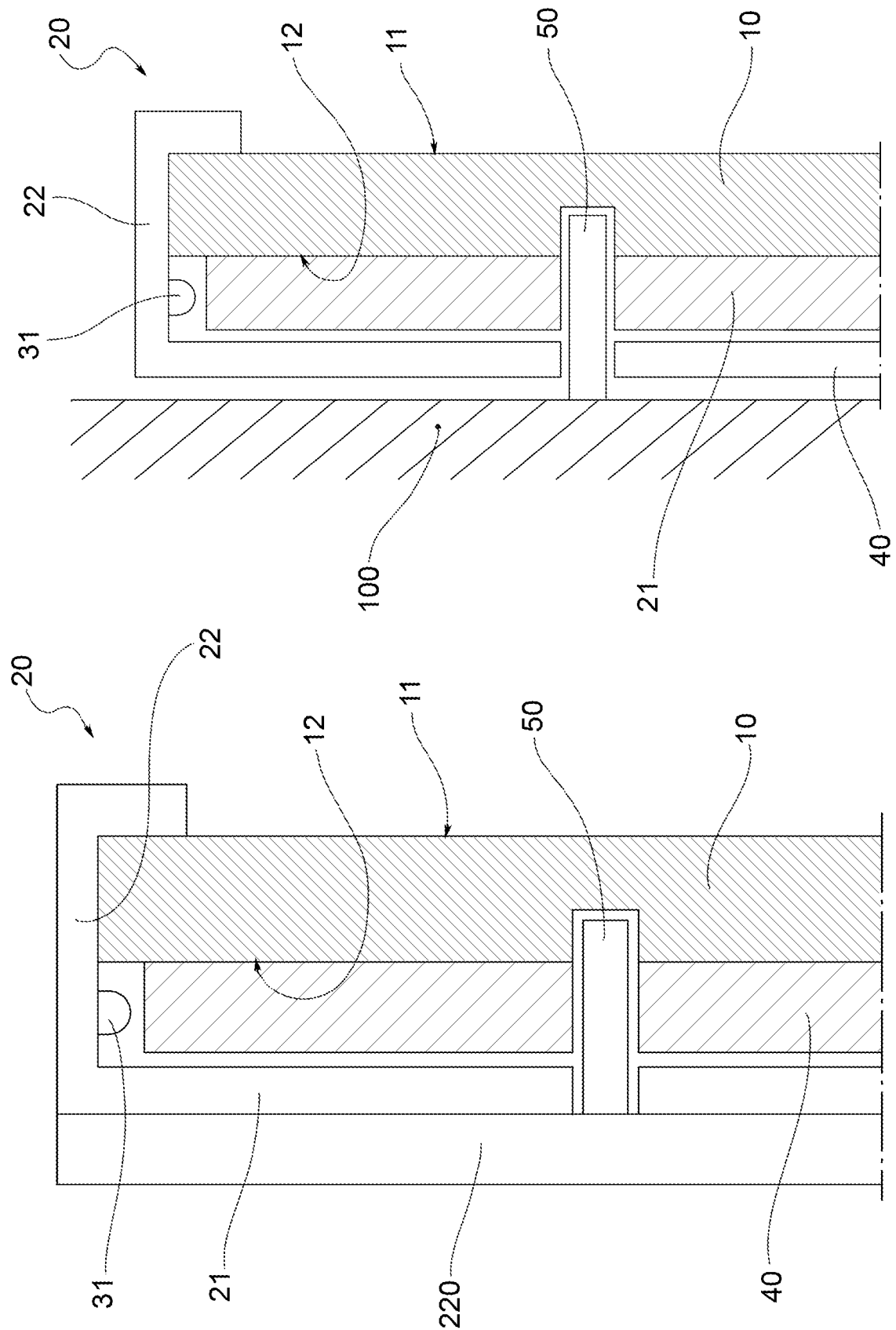


FIG.11

FIG.10

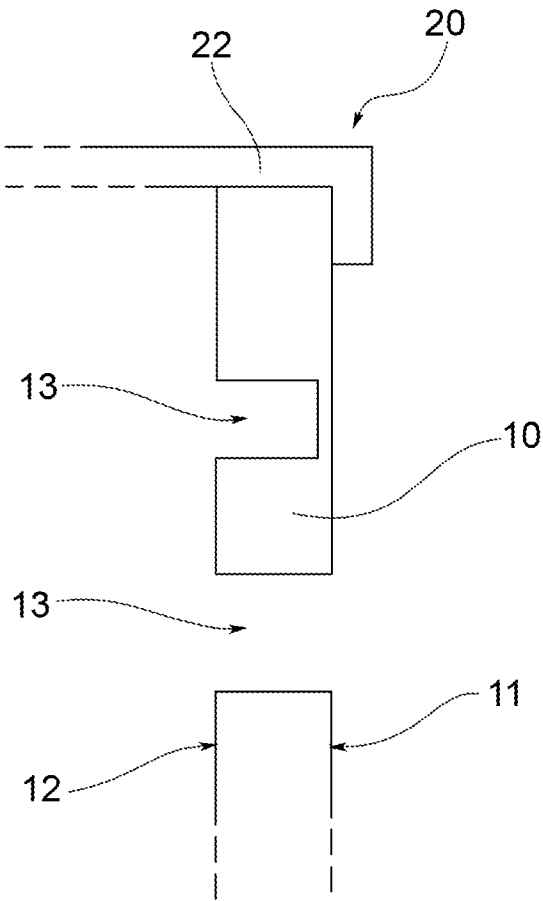


FIG.12

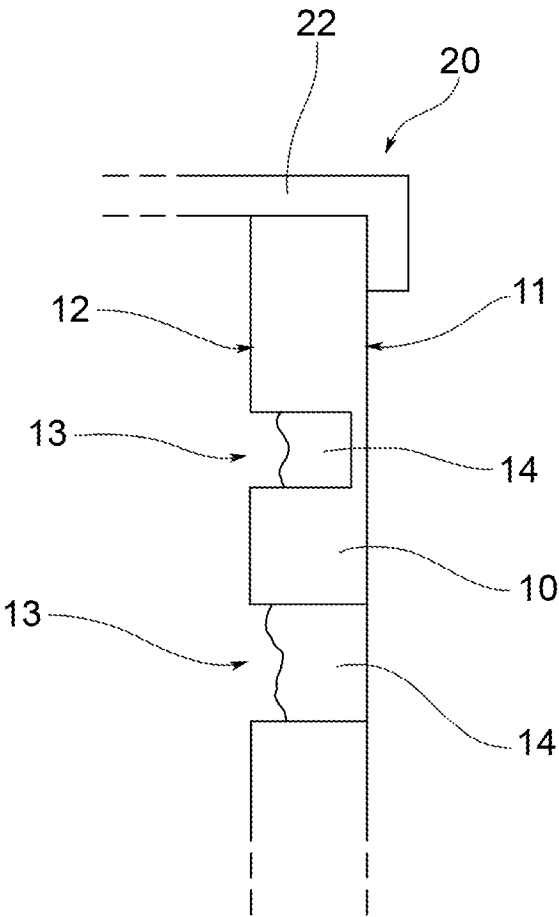


FIG.13

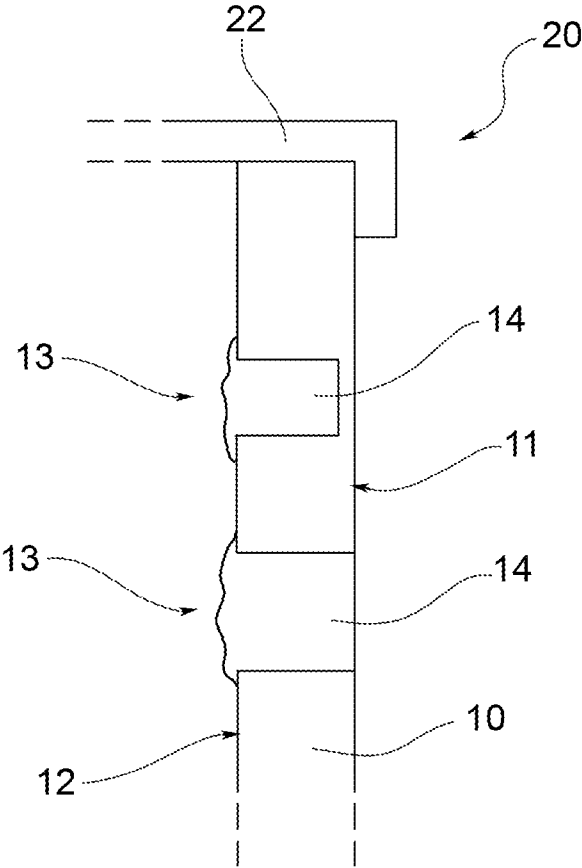


FIG.14

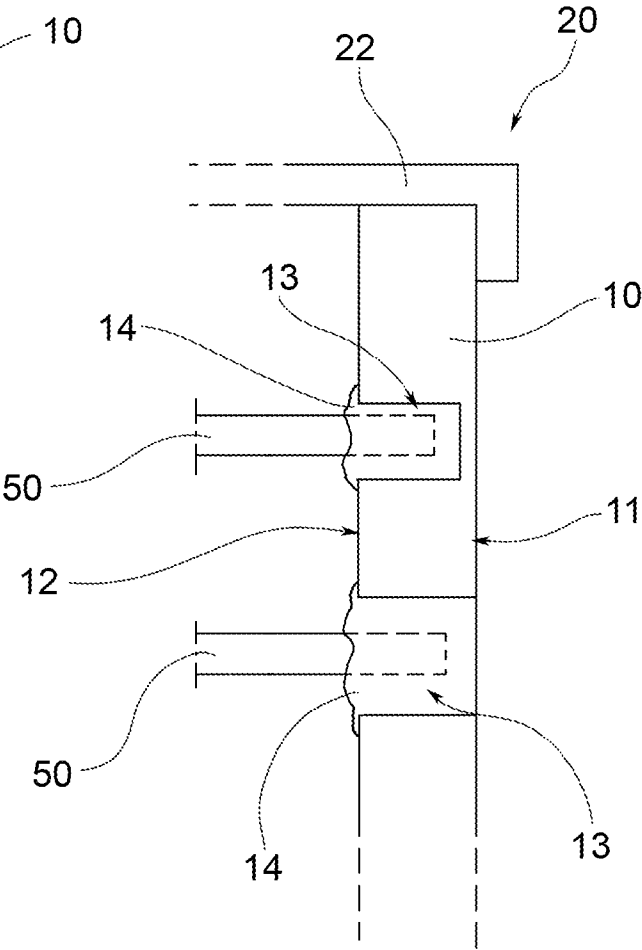


FIG.15

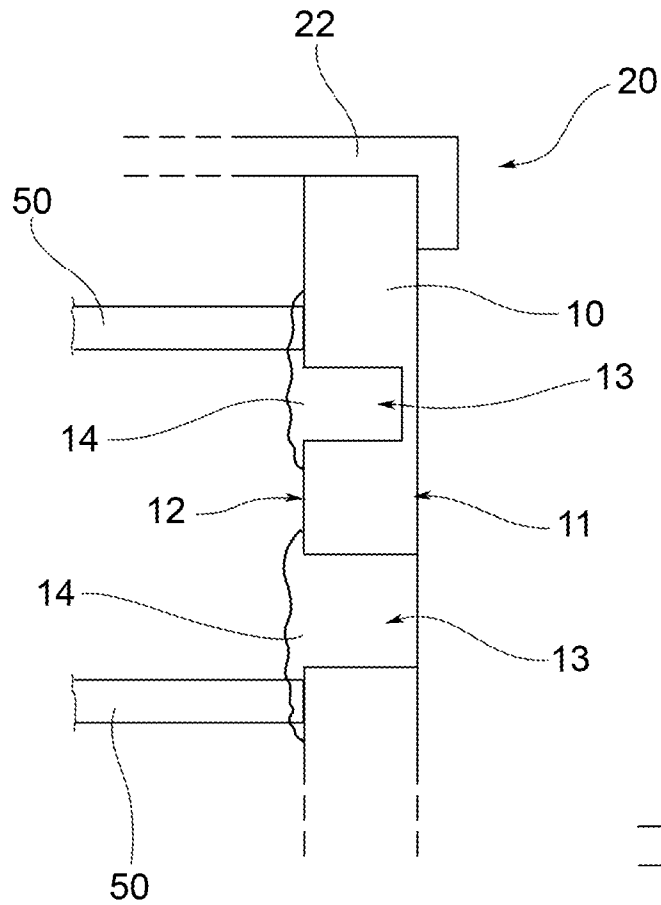


FIG.16

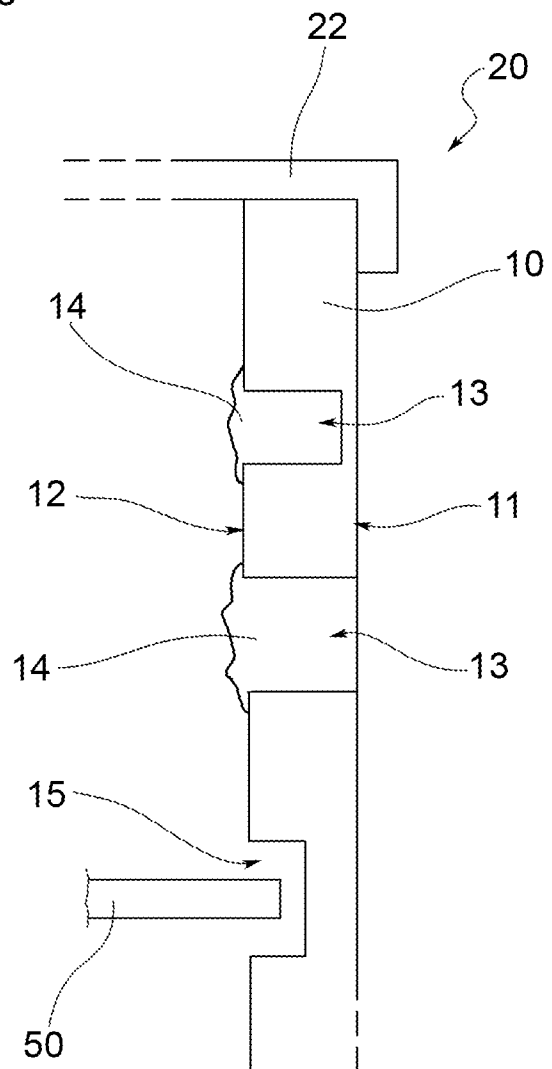


FIG.17

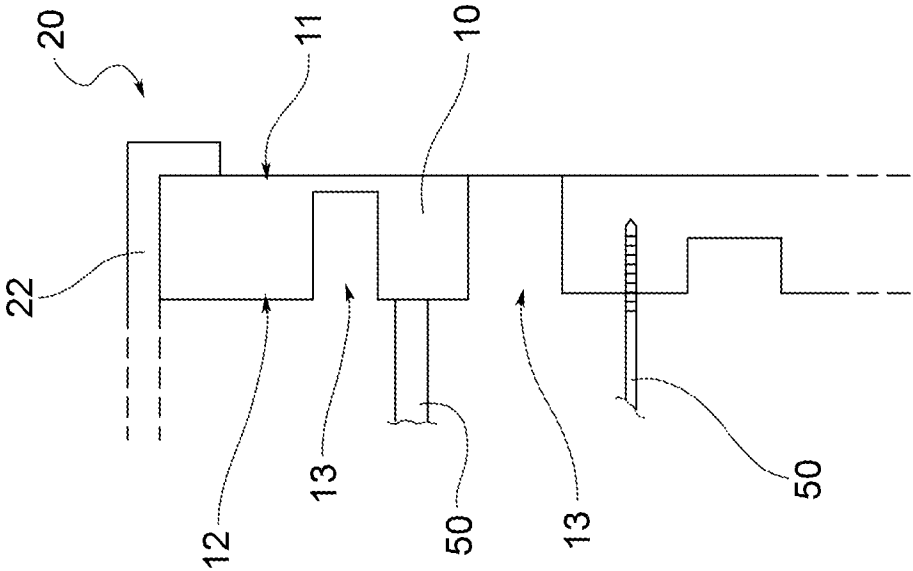


FIG. 18

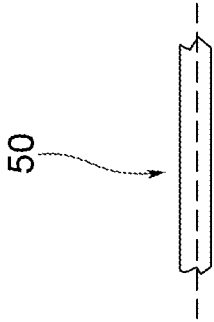


FIG. 19a

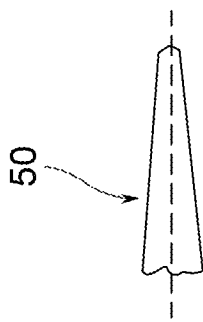


FIG. 19b

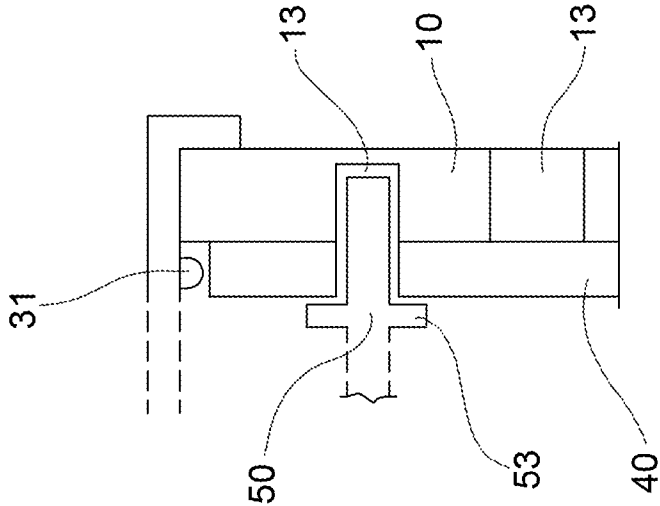


FIG. 20

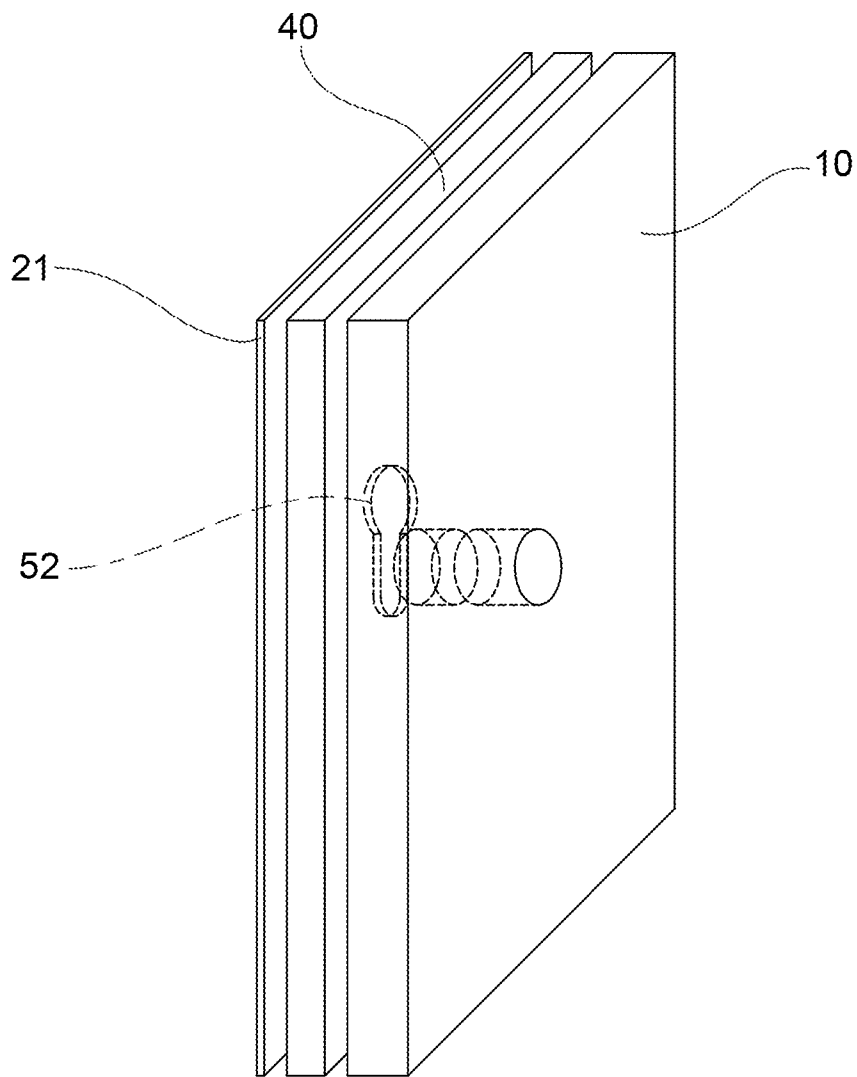


FIG. 21

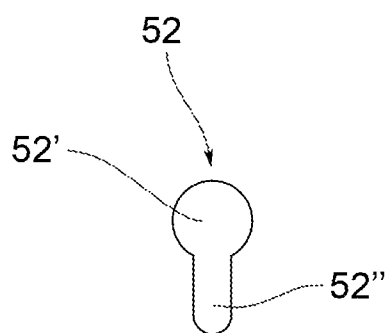


FIG. 22

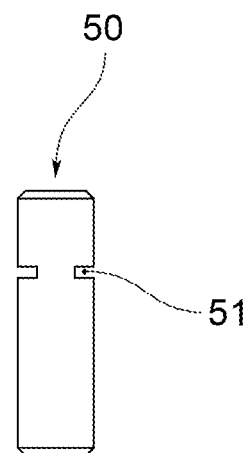


FIG. 23

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/055704

A. CLASSIFICATION OF SUBJECT MATTER

INV. F21S8/02
ADD. F21Y103/20 F21Y105/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F21S F21Y

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	KR 101 194 630 B1 (KIM HYUNG TAI [KR]) 29 October 2012 (2012-10-29) the whole document -----	1,2,5
	-/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

20 September 2024

Date of mailing of the international search report

01/10/2024

Name and mailing address of the ISA/

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Fax: (+31-70) 340-3016

Authorized officer

Krikorian, Olivier

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/055704

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	WO 2012/158894 A2 (PIXI LIGHTING LLC [US]; MYERS RICHARD J [US] ET AL.) 22 November 2012 (2012-11-22) figure 11 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2024/055704

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