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(54) **Illumination device**

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Description

[Field of the Invention]

[0001] The present invention relates to an illumination device using an EL element.

[Background Art]

[0002] An electroluminescence (EL) element is constituted by forming on a transparency substrate a light-emitting part sandwiching a light-emission layer by an anode and a cathode, and when a voltage is applied between the electrodes, emits light due to an exciton generated by recombination of a hole with an electron implanted as a carrier into the light-emission layer.

[0003] The EL element is roughly classified into: an organic EL element using an organic material for a fluorescent material of the light-emission layer and an inorganic EL element using an inorganic material. Specifically, the organic EL element has characteristics that are a high-intensity light can be emitted at a low voltage, various emission colors of the light can be obtained depending on types of the fluorescent materials, and additionally manufacturing as a planar light emitter can be easily realized.

[0004] For example, as an application using the characteristics as the planar light emitter of the EL element, an illumination device formed by jointing a sub panel rotatably to each side of a rectangular organic EL panel is known, the sub panel being formed in the same shape as that of the organic EL panel (for example JP 2008-186599 A). The illumination device is able to be deformed to a desired shape such as a flat type and a box type by rotating the sub panel. In addition, an illumination device formed by jointing tile-type flat panels each other with a hinge-type connector is known (for example JP 2005-536708 A). According to the illumination device, a range in which the light is irradiated can be adequately adjusted by changing a joint form of the plurality of panels and by adequately lighting them.

[0005] EP 1 548 830 A2 discloses an illumination device comprising a plurality of transparent electroluminescent (EL) panels. The panels are provided in a common housing. The EL panels overlap each other and irradiate light which is created by superimposing the light of the plurality of EL panels. The EL panels are fixed to the housing by either gluing or by clamping the edges of the substrates of the EL panels between two housing sections.

[0006] US 2010/0157585 A1 shows an illumination device having a substantially transmissive luminous means. The luminous means contains a substrate, two electrodes and an organic layer stack. A plurality of such luminous means can be arranged adjacent with each other in an illumination device. Pins can be provided for mechanical and/or electrical connecting of the luminous means with a carrier. It is also possible to connect adja-

cent luminous means with each other so as to crate large surface of such luminous means.

[0007] EP 1 954 103 A2 discloses an illumination device having a main panel and sub-panels. The sub-panels are pivotably connected with the main-panel. In so doing the irradiation direction of a sub-panels can be changed to create different illumination effects.

[Disclosure of the Invention]

[Problems to be solved by the Invention]

[0008] However, although the illumination devices described in the above-mentioned documents JP 2008-186599 A and JP 2005-536708 A can change the irradiation range of light by changing the joint form of the plurality of panels, each of the panels individually emits light, and accordingly an emission intensity of the light cannot be switched depending on usage of the illumination devices.

[0009] The present invention is to solve the above-mentioned problem, and intends to provide an illumination device where the emission intensity of light can be adequately switched depending on the usage of the illumination device by a user.

[Means adapted to solve the Problems]

[0010] To solve the above-mentioned problems, the present invention includes: a plurality of transparent EL panels each including: a transparent EL element configured by stacking on a transparent substrate in turn an anode formed of a transparent conducting film; a light emission layer; and a cathode formed of the transparent conducting film; and a fixture body for retaining the transparent EL panels so that light emission regions of the plurality of transparent EL panels can overlap each other, and irradiating light of superposed emission lights of the plurality of transparent EL panels.

[0011] In the above-mentioned illumination device, the plurality of transparent EL panels are configured so as to be freely detachable with each other, and when overlapped, irradiates light of superposed emission lights of the transparent EL panels.

[0012] In the above-mentioned illumination device, the transparent EL panel is provided with: an anode terminal and a cathode terminal on one surface; and terminal reception parts corresponding respectively to the anode terminal and the cathode terminal on the other surface.

A plurality of electric circuits is incorporated in each of the terminals and in the terminal reception parts to independently connect each of the plurality of overlapped EL panels to a control part of a power source unit, and to control each of the EL panels to be individually lighted. A control part is provided for individually controlling the plurality of transparent EL panels to be lighted.

[0013] In the above-mentioned illumination device, it is preferred that the fixture body includes a chassis for

the plurality of transparent EL panels.

[0014] In the above-mentioned illumination device, it is preferred that in the chassis, a pressing member is fitted into a groove part provided on an internal surface of the chassis, and the pressing member retains the transparent EL panels at the groove part..

[0015] In the above-mentioned illumination device, it is preferred that the fixture body has a light reflectivity at a portion opposed to the transparent EL panels.

[0016] In the above-mentioned illumination device, it is preferred to further include: an EL panel including a light reflective layer, and preferred that the EL panel having the light reflective layer is arranged at the outermost portion of the plurality of overlapped transparent EL panels.

[0017] In a first alternative embodiment of the illumination device, that is alternative to the present invention, it is preferred that the plurality of transparent EL panels are jointed to be freely foldable, and when overlapped, irradiate light of superposed emission lights of the transparent EL panels.

[0018] In the above-mentioned first alternative illumination device, it is preferred that the plurality of transparent EL panels are retained rotatably with respect to the fixture body, and when overlapped, irradiate light of superposed emission lights of the transparent EL panels.

[0019] In a second alternative embodiment of the illumination device, that is alternative to the present invention, it is preferred that the plurality of transparent EL panels are configured so as to freely slide with each other, and when overlapped, irradiate light of superposed emission lights of the transparent EL panels.

[0020] In the above-mentioned second alternative illumination device, it is preferred that the fixture body includes a plurality of slide grooves provided in parallel to a direction perpendicular to a slide direction of the transparent EL panels.

[0021] In the above-mentioned second alternative illumination device, it is preferred that the transparent EL panel is arranged in a window portion of a slide door.

[0022] In the above-mentioned second alternative illumination device, it is preferred that a sliding door is composed of the transparent EL panel.

[0023] In the above-mentioned illumination device, it is preferred that the plurality of transparent EL panels emit different colors, respectively.

[0024] In the above-mentioned illumination device, it is preferred that emission colors of lights of the plurality of transparent EL panels include RGB three primary colors.

[0025] In the above-mentioned illumination device, it is preferred that the plurality of transparent EL panels have a different area of the light emission surface from each other.

[Effect of the Invention]

[0026] According to an illumination device of the

present invention, an emission intensity of light can be adequately switched by changing the number of overlapping transparent EL panels.

5 [Brief Description of the Drawings]

[0027]

[Fig. 1] Fig. 1 is an exploded perspective view of an illumination device according to a first embodiment of the present invention.

[Figs. 2 (a) and (b)] Figs. 2 (a) and (b) are side cross-section views of the illumination device.

[Fig. 3] Fig. 3 is a side cross-section view showing a schematic configuration of an EL element used for the illumination device.

[Figs. 4 (a) and (b)] Figs. 4 (a) and (b) are exploded perspective views showing other configurations of the illumination device.

[Fig. 5] Fig. 5 is a side cross-section view showing another configuration of the illumination device.

[Fig. 6] Fig. 6 is an exploded perspective view showing another configuration of the illumination device.

[Fig. 7] Fig. 7 is a side cross-section view showing another configuration of the illumination device.

[Figs. 8 (a) and 8 (b)] Fig. 8 (a) is an exploded perspective view showing another configuration of the illumination device, and Fig. 8 (b) is a side cross-section view of the same.

[Fig. 9] Fig. 9 is an exploded perspective view showing another configuration of the illumination device.

[Fig. 10] Fig. 10 is a side cross-section view showing another configuration of the illumination device.

[Figs. 11 (a) and (b)] Figs. 11 (a) and (b) are exploded perspective views showing other configurations of the illumination device.

[Fig. 12] Fig. 12 is an exploded perspective view showing another configuration of the illumination device.

[Figs. 13 (a) and (b)] Figs. 13 (a) and (b) are exploded perspective views showing other configurations of the illumination device.

[Figs. 14 (a), (b), (c) (d), (e), and (f)] Figs. 14 (a) and (c) are perspective views of an illumination device according to a second embodiment which is not part of the present invention, and Figs. 14 (b), (d), (e), and (f) are side cross-section views of the same.

[Figs. 15 (a) and (b)] Figs. 15 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Figs. 16 (a) and (b)] Figs. 16 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Figs. 17 (a) and (b)] Figs. 17 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present

invention.

[Figs. 18 (a) and (b)] Figs. 18 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Figs. 19 (a) and (b)] Figs. 19 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Figs. 20 (a) and (b)] Figs. 20 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Figs. 21 (a) and (b)] Figs. 21 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Figs. 22 (a), (b) and (c)] Figs. 22 (a) and (b) are side views showing another configuration of the illumination device, and (c) is a perspective view of the same which is not part of the present invention.

[Figs. 23 (a) and (b)] Figs. 23 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Figs. 24 (a) and (b)] Figs. 24 (a) and (b) are perspective views of an illumination device according to an alternative embodiment which is not part of the of the present invention.

[Fig. 25] Fig. 25 is a perspective view showing another configuration of the illumination device which is not part of the present invention.

[Figs. 26 (a) and (b)] Figs. 26 (a) and (b) are perspective views of an illumination device according to a fourth embodiment which is not part of the present invention.

[Figs. 27 (a) and (b)] Figs. 27 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Figs. 28 (a) and (b)] Figs. 28 (a) and (b) are perspective views showing another configuration of the illumination device which is not part of the present invention.

[Best Mode for Carrying Out the Invention]

[0028] Referring to Figs. 1 to 3, an illumination device according to a first embodiment of the present invention will be explained. Here, an illumination device 1 according to the present invention is explained on the basis of a configuration to be used as an embedded-type downlight that is embedded in a ceiling C. In addition, a downward direction in the drawings is a leading direction of light. As shown in Figs. 1, 2(a), and 2(b), the illumination device 1 includes: a plurality of transparence EL panels 2; and a fixture body 3 for retaining the EL panels 2 so that light emission regions of the plurality of EL panels 2

can be overlapped each other. Each of the EL panels 2 has the same shape, and is configured so as to be freely detachable with each other.

[0029] The EL panels 2 are configured as one module by installing a transparence EL element 20 formed in a disk shape into a ring-shaped panel frame 21. As described later, since the EL element 20 is transparence, the EL panel 2 becomes luminous itself to emit light in a state where the plurality of panels are overlapped, and transmits the light emitted from the other EL panels 2. Accordingly, in a case where the illumination device 1 is used as a downlight, the overlapped-lower EL panels 2 irradiate light where light of the overlapped-upper EL panels 2 are superposed.

[0030] The panel frame 21 is provided with: an anode terminal 22a and a cathode terminal 22b on one surface; and terminal reception parts 23a and 23b corresponding respectively to the anode terminal 22a and the cathode terminal 22b on the other surface. Each of the terminals 22a and 22b are formed in a convex shape, the terminal reception parts 23a and 23b are formed in a convex shape, and thus the EL panels 2 are electrically connected with each other by fitting each of the terminals 22a and 23b into the terminal reception parts 23a and 23b. In addition, each of the anode terminal 22a and the cathode terminal 22b is formed in a different shape: the anode terminal 22a is configured so as not to be fitted into the terminal reception part 23b for the negative terminal, and the cathode terminal 22b is configured so as not to be fitted into the terminal reception part 23a for the positive terminal. In examples of the drawings, the anode terminal 22a is formed in a cylindrical shape, the cathode terminal 22b is formed in a slightly-elongated tablet shape, and each of the terminal reception parts 23a and 23b is formed in a corresponding shape to the terminals. In this manner, when overlapping the plurality of EL panels 2, it can be prevented that a user incorrectly connects the respective terminals. In addition, the panel frame 21 is provided with through holes 24 so as to avoid a position of the light emission part (details will be described later) of the EL element 20, and the EL panel 2 is retained to the fixture body 3 by screws 31 inserted into the through holes 24.

[0031] The fixture body 3 includes: a cylindrically-shaped chassis 32 for housing the plurality of transparence EL panels; a base part 33 to which the EL panels 2 contact, the base part dividing an inside of the chassis 32 into two housing spaces; and a flange part 34 contacting to the ceiling C. The plurality of EL panels 2 are accommodated in the one space of the inside of the chassis 32 divided by the base part 33, and the other space accommodates a power source unit 4 incorporating a lighting circuit, a microcomputer for control (a control part), and the like for controlling the EL panel 2 to be lighted. The base part 33 is tightly fixed to an inner circumference surface of the chassis 32 by bonding or welding. The power source unit 4 is connected to a commercial power source (not shown in the drawing) by a con-

ducting wire 41. The fixture body 3 is provided with a fixture fixing part (not shown in the drawing) on an outer surface side of the chassis 32, and the fixture body 3 is fixed to the ceiling C by sandwiching a plate member configuring the ceiling C with the fixture fixing member and the flange part 34. In addition, the outer surface of the chassis 32 may be provided with a plurality of radiator fins (not shown in the drawings) for improving the radiation performance.

[0032] The base part 33 is provided with body terminal reception parts 33a and 33b having the same shape as those of the terminal reception parts 23a and 23b of the EL panel 2, and the body terminal reception parts 33a and 33b are connected to the power source unit 4 by a circuit wiring (not shown in the drawings) included in the base part 33. In addition, the anode terminal 22a and the cathode terminal 22b are of the EL panel 2 are fitted into the body terminal reception parts 33a and 33b, respectively, and thereby the power source unit 4 is electrically connected to the EL panel 2. Additionally, in order to fix the EL panel 2 to the fixture body 3, the base part 33 is provided with a screw fixation hole 33c into which the screw 31 is inserted. Meanwhile, as shown in the present example, in the configuration to fix the EL panel 2 to the fixture body 3 with use of the screw 31, when the number of the EL panels 2 to be used is small, the screw 31 sometimes substantially projects toward an upper direction of the base part 33. For this reason, it is desired that the power source unit 4, the conducting wire 41, and the like are arranged on an upper surface side of the base part 33 so as to avoid a position where the screw fixation hole 33c is formed.

[0033] As shown in Fig. 3, the EL element 20 forms a light emission part 26 on a substrate 25 having the transparency, and has a configuration where the outer side is covered with a sealing member 27. The light emission part 26 is formed by laminating in turn: an anode 26a formed of a transparent conducting film, a light emission layer 26b having a light emission function, and a cathode 26c formed of a transparent conducting film on the substrate 25. The transparent conducting film forming the anode 26a and the cathode 26 includes a transparent conducting material such as ITO (Indium Tin Oxide), SnO₂ (Tin Oxide), ZnO (Zinc oxide), and the like. The sealing member 27 is composed of a transparent material, is covered so that a part of each electrode can be exposed, and these exposed portions of the electrodes are electrically connected to the anode terminal 22a or to the cathode terminal 22b directly or via the lead wire and the like.

[0034] The substrate 25 includes transparent glass such as soda-lime glass and alkali-free glass or of a transparent resin material and the like, and is formed in a disk shape.

[0035] The anode 26a is an electrode to implant a hole into the light emission layer 26b, an electrode material made of metal, alloy, and conductive compound each having a large work functions or of a mixture of them is

used, and preferably the material whose work function is 4eV or more. Specifically, the transparent conductive material such as ITO, SnO₂ (Tin oxide), and ZnO (Zinc oxide) is preferred. The anode 26a is formed by performing the film formation and the patterning of these electrode materials on a surface of the substrate 25 due to, for example, the vacuum deposition method, the sputtering method, and the like.

[0036] The light emission layer 26b uses an organic fluorescent material able to emit a desired white light, and, for example, uses: anthracene, naphthalene, pyrene, tetracene, coronene, perylene, fthaloperylene, naphthaloperylene, diphenylbutadiene, tetraphenylbutadiene, coumalin, oxadiazole, bisbenzoxazoline, bisstyryl, cyclopentadiene, quinoline metal complex, tris (8-hydroxyquinolate) aluminum complex, tris (4-methyl-8-quinolate) aluminum complex, tris (5-phenyl-8-quinolate) aluminum complex, aminoquinoline metal complex, benzoquinoline metal complex, tri-(p-terphenyl-4-yl)amine, 1-aryl-2,5-di(2-thienyl)pyrrol derivative, pyran, quinaldine, rubrene, distillbenzene derivative, distillallylene derivative, and mixture materials of: compounds, polymer materials, various types of fluorescent dye, and the like each having a group composed of these light emission compounds in a part of the molecular structure.

[0037] The light emission layer 26b is formed by performing the film formation and the patterning of the above-mentioned compounds on a surface of the anode 26a, for example, due to the vacuum deposition method. Meanwhile, the light emission layer 26b may be a layer where the plurality of different materials are stacked, and may intermediately laminate a buffer layer for adjusting an electric potential between these plurality of layers.

[0038] The cathode 26c is an electrode for implanting electrons to the light emission layer 26b, and is formed of the transparency conductive material, ITO, SnO₂, ZnO, and the like as is the case with the anode 26a. In addition, the anode 26c is also formed in the same manner as that of the cathode 26a. A hole implantation-transfer layer (not shown in the drawings) for promoting an efficiency of the hole implantation from the anode 26a to the light emission layer 26b may be provided between the anode 26a and the light emission layer 26b. Additionally, it is preferred that an electron implantation-transfer layer (not shown in the drawings) for promoting an efficiency of the electron implantation from the cathode 26c to the light emission layer 26b may be provided between the light emission layer 26b and the cathode 26c.

[0039] In the EL element 20 configured in the above-mentioned manner, a predetermined electric power is supplied to the anode 26a and the cathode 26c via the respective terminals 22a and 22b of the panel frame 21 (refer to Fig. 1 and Fig. 2), and thereby the light emission layer 26b emits light. The emitted light transmits the anode 26a and the cathode 26c and is derived outside the EL element 20. Meanwhile, on an upper surface of the EL element 20, a diffusion layer (not shown in the drawing) and the like for improving a derivation efficiency of

light from the substrate 25 may be provided for some extents not to deteriorate the transparency.

[0040] According to the illumination device 1 of the present embodiment, since the plurality of EL panels 2 is freely detachable to the fixture body 3, the number of EL panels 2 to be overlapped can be easily changed. And, in the case of increasing an emission brightness of the illumination device 1, the number of EL panels 2 to be overlapped is increased, and in the case of reducing the emission brightness, the number of EL panels 2 to be overlapped is reduced. In this manner, on the basis of usage of the illumination device 1, a user can arbitrarily switch the emission brightness of the illumination device 1. In addition, since each of the EL panels 2 is modularized in the same shape, a manufacturer can reduce the number of model numbers, and can improve a manufacturing efficiency. Further, since there is no need to search a product of the model number suitable for the fixture body, the user can purchase the product without any efforts.

[0041] In the base part 33, it is preferred that a portion opposed to the EL panel 2 is configured so as to have the reflectivity by: being painted by a white paint, and forming a reflective film and the like, for example. In this manner, since light emitted from the EL panel 2 toward the base part 33 is reflected on a surface of the base part 33 to travels to the derivation direction of the light, a use efficiency of the light can be improved.

[0042] In addition, a reflective EL panel (not shown in the drawings) that is formed in the same shape as that of the EL panel 2 and that is configured so as to have a light reflectivity by using a light reflective material such as aluminum for the cathode 26c may be separately arranged at an outermost part of the plurality of overlapped EL panels 2. In the present example, a light reflective EL panel is arranged at a position abutting to the base part 33. In this manner, as is the same with the above-mentioned case, the light emitted toward the base part 33 is reflected to travel to the derivation direction of the light, and accordingly the use efficiency of light can be improved.

[0043] In addition, it is preferred to configure so as to incorporate a plurality of electric circuits in each of the terminals 22a and 22b and in the terminal reception parts 23a and 23b, to independently connect each of the plurality of overlapped EL panels 2 to the control part of the power source unit 4, and to control each of the EL panels 2 to be individually lighted. In this manner, of the overlapped EL panels 2, the emission brightness can be arbitrarily switched without detaching the EL panels 2 by changing the number of the EL panels 2 to be lighted. Moreover, for example, in the case of reducing the emission brightness, the lower EL panels 2 are lighted. That is, in transmitting through the lower EL panel 2, the light emitted from the upper EL panel 2 is slightly lost due to the total reflection and the like. Accordingly, when the EL panels 2 are preferentially lighted from the lower EL panel 2, the loss of the light caused by the transmission of the

other EL panel 2 can be suppressed, and thus a light use (light derivation) efficiency can be improved.

[0044] In addition, each of the plurality of EL panels 2 may be configured so that the emission color can be different from each other. In this case, the emission color of the plurality of EL panels 2 is, for example, configured so as to include three primary colors. In this configuration, the full color illumination including a white light can be realized by adjusting each output of the EL panels 2, and for example, an illumination rendering to change a color rendering property of the irradiated light on the basis of a situation of a space where the illumination device 1 is used can be performed.

[0045] Next, referring to Fig. 4 to Fig. 13, other configurations of the illumination device 1 according to the present embodiment, especially, a retention structure of the EL panel 2, the shapes of the EL panel 2 and the fixture body 3, the configuration other than the above-mentioned embedded-type downlight, and the like will be explained.

[0046] Fig. 4 (a) and (b) show a configuration where a retention flange for retaining the EL panel 2 in the chassis 32. The configuration shown in Fig. 4 includes a ring-shaped retention flange 51 formed in the same shape as that of the flange part 34 of the fixture body 3. Screw holes 34a and 51a are formed in both of the flange part 34 and the retention flange 51, and when the screws 31 are inserted into the screw holes 34a and 51a, the flange part 34 and the retention flange 51 are jointed. In addition, a ring-shape clearance adjustment member 52 having elasticity and formed in the substantially-same shape as that of the panel flange 21 of the EL panel 2 is arranged in the chassis 32. That is, the EL panel 2 is pressed by the clearance adjustment member 52 having elasticity in a space sandwiched between the base part 33 and the retention flange 51 and thereby is retained in the fixture body 3.

[0047] Additionally, the configuration shown in Fig. 4(b) includes the retention flange 53 having: a cylindrical part 53a having a slightly-larger internal diameter than an external diameter of the EL panel 2; and a rim part 53b forming an opening, the opening having substantially the same shape as that of the EL element 20. A screw groove is formed on the inner circumference surface of the chassis 32, and a screw groove is also formed on an outer circumference surface of the cylindrical part 53a. Then, when the cylindrical part 53a is inserted into the chassis 32 in a screwing manner, the retention flange 53 is fixed to the fixture body 3. As the result, in the space between the base part 33 and the rim part 53b, the EL panel 2 is retained in the fixture body 3. Meanwhile, as is the same with the configuration shown in Fig. 4 (a), the clearance adjustment member 52 may be arbitrarily arranged. Additionally, instead of the retention flange 53, a ring-shape spring (not shown in the drawings) having a slightly-larger circumference than the circumference of the screw groove may be fitted to the screw groove formed on the inner circumference surface of the chassis

32, and thus the EL panel 2 may be retained by the ring-shape spring.

[0048] Fig. 5 shows a configuration that: a plurality of groove parts 35 are formed to be the same width as a thickness of the EL panel 2 on the inner circumferential surface of the chassis 32; a part of a spring chip 54 is fitted as a pressing member into the groove part 35; and the EL panel 2 is retained by the spring chip 54. The spring chip 54 is formed so that a portion projecting from the groove part 35 can be biased to the base part 33 side in the state of being fitted into the groove part 35. And, the biased spring chip 54 supports a lower surface side of the panel flame 21 of the EL panel 2, and thereby the EL panel 2 is retained in the chassis 32 at a position where the spring chip 54 is fitted. In this configuration, it is desired that a spring reception part (not shown in the drawings) is formed in the panel flame 21. Meanwhile, the above-mentioned configuration shows that the EL panel 2 is in the disk shape and that the chassis 32 is in the cylindrical shape; however, as shown in Fig. 6, the EL panel 2 may be in a rectangular shape and the chassis 32 may be in a box shape. In this case, as the structure to retain each of the EL panels 2, the configurations shown in the above-mentioned Fig. 4(a) and Fig. 5 can be employed.

[0049] In addition, the illumination device 1 can be used not only as the above-mentioned ceiling embedded-type downlight but also as, as shown in Fig. 7, an embedded-type illumination fixture embedded into a floor surface F, for example. In this configuration, each of the EL panels 2 is positioned by: each of the terminals 22a and 22b, and each of the terminal reception parts 23a, 23b, 33a, 33b, and is retained due to its own weight by the fixture body 3, and accordingly other retention structures are not required. The flange part 34 is embedded in the floor F, and thus the embedded-type illumination device 1 is installed so as not to project upward over the floor F. In addition, to the flange part 34, a protection cover 36 to protect the EL panel 2 is attached.

[0050] Figs. 8(a) and 8(b) show a configuration where the illumination device 1 is used as a ceiling light. In this configuration, the fixture body 3 is directly fixed to the ceiling C by the screws 31. In addition, the terminal reception parts 23a, 23b, 32a, and 32b formed in a combined shape of a circular hole and an elongate hole, called a daruma hole shape are formed on lower surfaces of: the panel flame 21 of the EL panel 2; and the fixation body 3. On the other hand, each of the terminals 22a and 22b formed in a screw head shape is formed on lower surfaces of: the panel flame 21 of the EL panel 2; and the fixation body 3. Then, after inserting each of the terminals 22a and 22b into circular hole portions of the terminal reception parts 23a, 23b, 32a, and 32b, the EL panel 2 to be attached is slightly rotated. In this manner, each of the terminals 22a and 22b formed in the screw head shape are fitted to the elongate hole portions of the terminal reception parts 23a, 23b, 32a, and 32b, and thus the fixture body 3 and the EL panel 2 are fixed, or the EL

panels 2 are fixed each other. According to the configuration, the EL panel 2 can be fixed to the fixture body 3 without using other retention members, and thus the lower EL panel 2 can be directly attached to the upper EL panel 2. Meanwhile, it is desired that, of the EL panels 2 to be overlapped, the EL panel 2a having no terminal reception parts 23a and 23b is attached as a lowest panel.

[0051] In addition, in the ceiling light, as shown in Fig. 9, the rectangular EL panel 2 can be used. In this case, a configuration where: a hook member 55 is provided on a side portion of the fixture body 3 and then the EL panel 2 is retained by the hook member 55 may be employed. Moreover, as shown in the drawings, a configuration where: a corner flame 56 is engaged to the hook member 55 and then the EL panel 2 is retained by sandwiching the EL panel 2 with the corner flame 56 and the fixture body 3 may be employed.

[0052] Fig. 10 shows a configuration where the fixture body 3 is fixed to the ceiling C via a bottom surface of an enclosure flame 57 and then the EL panels 2 are retained in the enclosure flame 57. As a concrete retention structure, any one of the above-described configurations is employed. Additionally, also in this case, as shown in Figs. 11(a) and 11(b), the circular EL panel 2 and the rectangular EL panel 2 both may be employed.

[0053] Furthermore, the plurality of EL panels 2 may have a different area of the light emission surface from each other. In this case, as shown in Fig. 12, it is desired that the EL panel 2 having a large area of the light emission surface is attached as the upper panel and then the EL panels 2 having a smaller area of the light emission surface are attached so that the areas can be gradually small toward the lower panel. In addition, in the configuration, an electric connection between the fixture body 3 and each of the EL panels 2 is realized by a lead wire and the like, for example.

[0054] Figs. 13(a) and 13(b) show a configuration where the illumination device 1 is used as a spotlight. In this configuration, the fixture body 3 is fixed to the ceiling C via a support axis 58, a hinge part 61 is provided between the fixture body 3 and the support axis 58, and thus the fixture body 3 can freely oscillate. Also in this case, the EL panel 2 to be overlapped may be the circular plate shown in Fig. 13(a) and may be the rectangular plate shown in Fig. 13(b). In addition, each of the EL panels 2 may be incorporated in the chassis 32 of the fixture body 3 and may be stacked toward the outside of the chassis 32.

[0055] Next, referring to Figs. 14 to 23, an illumination device according to a second embodiment which is not part of the present invention will be explained. In the illumination device 1 according to the present embodiment, the plurality of EL panels 2 are jointed to be freely foldable and when the panels are overlapped, irradiates light of superposed emission lights of the respective EL panels 2.

[0056] Figs. 14(a) to 14(f) show a configuration where

the illumination device 1 is used as the ceiling light attached to the ceiling C. In the illumination device 1, a pair of support members 63 is jointed to a pedestal part 37 (the fixture body 3) fixed to the ceiling C via a cylindrical axis reception part 62, and the EL panels 2 are fixed to each of the support members 63, respectively. The axis reception part 62 incorporates a bending axis (not shown in the drawings), and is able to freely bend the pair of support members 63 and the EL panels 2 within a range from 0° to 180°. In the support member 63, a panel insertion groove 64 is formed on a joint portion with the axis reception part 62 and on an opposite side surface. In the pedestal part 37 or the axis reception part 62, a power source unit (not shown in the drawings) is incorporated, and is electrically connected to a terminal reception part (not shown in the drawings) formed inside the panel insertion groove of the support member 63 by the lead wire and the like. In addition, an electrode terminal (not shown in the drawings) is provided on a side portion of the EL panel 2, and when the EL panel 2 is inserted to the panel insertion groove 64, the EL panel 2 is fixed to the support member 63 and is electrically connected to the power source unit. Meanwhile, as shown in Figs. 15(a) and 15(b), the configuration can be also employed as a suspended ceiling light that is suspended by the support axis 58. In this case, instead of the pedestal part 37, the illumination device 1 is fixed to the ceiling C via the support axis 58.

[0057] As shown in Figs. 14(a), 14(b), and 15(a), in the present embodiment, when the respective EL panels 2 are horizontally arranged, low-brightness light can be irradiated in a wide range. In addition, since the EL panel 2 emits light from both surfaces, the EL panel 2 can irradiates light to both directions of the ceiling C and the floor. Moreover, as shown in Figs. 14(a), 14(b), and 15(a), when the respective EL panels 2 are vertically arranged, high-brightness light can be irradiated in a narrow range. Furthermore, as shown in Figs. 14(e) and 14(f), the bending angles of the respective EL panels 2 are arbitrarily determined, and when the bending angle is changed a user can arbitrarily change the irradiation range and the brightness of light.

[0058] Figs. 16 to 18 show configurations where the illumination device 1 is used as a stand light (a desk lamp). Figs. 16(a) and 16(b) show a configuration where a support arm 59 bent in an L-shape is erected rotatably with respect to the fixture body 3 and then a pair of EL panels 2 is attached to an upper side of the support arm 59 via the hinge part 61. In addition, Figs. 17(a) and 17(b) show a configuration where one side of the rectangular EL panel 2 is attached to the fixture body 3 so that the angle can be freely changed and then another side is jointed to the other EL panel 2 via the hinge part 61. Meanwhile, as shown Figs. 18(a) and 18(b), each of the EL panels 2 to be jointed may be in a different shape from each other. According to the configuration, as shown in Fig. 16(a), 17(a), and 18(a), when the bending angle of the respective EL panels 2 is set to 180°, low-

brightness light can be irradiated in a wide range. In addition, as shown in Figs. 16(a), 17(a), and 18(a), when the respective EL panels 2 are overlapped, high-brightness light can be irradiated in a narrow range. Meanwhile, white arrows in Figs. 16(a) and 16(b) shows a brightness change of an irradiated light from the EL panel 2 as images.

[0059] Figs. 19 to 23 show configurations where the illumination device 1 has two or more bending parts. Figs. 19 and 20 are the same as those of the ceiling light shown in Figs. 14 and 15, and show configurations where two pieces of the EL panels 2 are attached to the fixture body 3 via the hinges 61, respectively. Figs. 19(a) and 19(b) show a configuration where the fixture body 3 is fixed to the ceiling 3, and Figs. 20(a) and 20(b) show a configuration of a suspending manner using support axes 58. In the configuration shown in Figs. 20(a) and 20(b), since the fixture body 3 is separated from the ceiling, it is desired that as shown in the drawings, the hinge part 61 is provided to the side portion of the fixture body 3. In this manner, each of the EL panels 2 can be turned in a wider range.

[0060] Figs. 21(a) and 21(b) show a configuration where: the support axis 58 is erected on the pedestal part 37 (the fixture body 3) mounted on the floor surface F, an upper bottom part 65 is arranged on an upper end of the support axis 58, and the pair of EL panels 2 is attached to the upper bottom part 65 via the hinge parts 61, respectively. According to the configuration, as shown in Fig. 21(a), in a state where the EL panels 2 are spread, the configuration can function as a table doubling as an illumination. In addition, as shown in Fig. 21(b), in a state where the EL panels 2 are folded, the configuration can function as a messaging board.

[0061] Figs. 22(a) to 22(c) show a configuration where the illumination device 1 is used as a floor stand light (a floor light). In the illumination device 1, the long support axis 58 is erected on the pedestal part 37 (the fixture body 3) on the floor surface F, the EL panels 2 is horizontally arranged on an upper end of the support axis 58, and the EL panels 2 are provided on sides opposed to the EL panels 2 via connection parts 66a and 66b. Each of the connection parts 66a and 66b incorporate a hinge, and joint the respective EL panels 2 to be freely foldable. In addition, since one connection part 66b is formed to be longer by a thickness of the EL panel 2 than the other connection part 66a, as shown in Fig. 22(b), the EL panel 2 jointed by the connection part 66b can be smoothly folded after folding the EL panel 2 jointed by the connection part 66a.

[0062] Figs. 23(a) and 23(b) show a configuration where the plurality of EL panels 2 are jointed via the plurality of hinge parts 61. Each of the EL panels 2 may be in the same shape as that shown in Fig. 23(a), and may be in a different shape from each other as shown in Fig. 23(b). As is the same with the above-mentioned configuration, in the illumination device 1, when the bending angle of the hinge part 61 is changed, a user can arbi-

trarily change the irradiation range and the brightness of light. In addition, when bended as shown in an example of the drawings, the device can be used as a "lighting folding screen".

[0063] Next, referring to Figs. 24 and 25, an illumination device according to a third embodiment which is not part of the present invention will be explained. In the illumination device 1 according to the present embodiment, the plurality of EL panels 2 are retained to be freely turned with respect to the fixture body 3, and when overlapped, irradiate light of superposed emission lights of the respective EL panels 2.

[0064] Figs. 24(a) and 24(b) show a configuration where the illumination device 1 is used as the stand light. In the illumination device 1, the two support arms 59 bent in an L-shape are rotatably erected respectively with respect to the fixture body 3 and then each of the EL panels 2 is attached to an end of bending portion of the support arm 59. A configuration where: heights of the respective support arms 59 are different by the thickness of the EL panel 2 from each other, lengths of the bend portions are also different depending on the erection positions on the fixture body 3, and thus as shown in Fig. 24 (b), one EL panel 2 can be overlapped with the other EL panel 2 can be employed. Moreover, Fig. 25 shows a configuration where the illumination device 1 is used as a chandelier type illumination. In the drawings, an example where three pieces of the EL panels 2 are attached is shown; however, four or more pieces of the EL panels 2 may be attached. According to the configuration, when the EL panels 2 are turned with respect to the fixture body 3, the user can arbitrarily change the irradiation range and the brightness of light as is the same with the above-mentioned embodiment.

[0065] Next, referring to Figs. 26 to 28, an illumination device according to a fourth embodiment which is not part of the present invention will be explained. In the illumination device 1 according to the present embodiment, when the plurality of EL panels 2 are configured so as to freely slide with each other and overlapped, the illumination device 1 irradiates light of superposed emission lights of the respective EL panels 2.

[0066] Figs. 26 (a) and 26 (b) show a configuration where the illumination device 1 is used as the stand light. In the illumination device 1, the EL panels 2 are attached to the fixture body 3 so that the angle of the EL panel 2 can be variable via the hinge part 61, and a pair of slide rails 38 is provided to both side parts of the EL panel 2. And, another EL panel 2 is retained so as to freely slide due to the slide rails 38. According to the configuration, as shown in Fig. 26 (a), when the freely-slidable EL panel 2 is slid toward ends of the slide rails, low-brightness light can be irradiated in a wide range. In addition, as shown in Fig. 26 (b), when the respective EL panels 2 are overlapped, high-brightness light can be irradiated in a narrow range.

[0067] Figs. 27 (a) and 27 (b) show a configuration where the illumination device 1 is used as a suspended

ceiling light. The illumination device 1 includes a plurality of slide grooves 39 provided in parallel to a direction perpendicular to a slide direction of the EL panel 2 on an internal side surface of the fixture body 3. Since the respective EL panels 2 are retained by the fixture body 3 at differential heights by the thickness of the EL panel 2, as shown in Fig. 27 (a), low-brightness light can be irradiated in a wide range by sliding the EL panel 2 along the slide grooves 39. In addition, as shown in Fig. 27 (b), when the respective EL panels 2 are overlapped, high-brightness light can be irradiated in a narrow range.

[0068] Fig. 28(a) shows a configuration where the EL panels 2 are arranged in a window portion of the slide doors 7. A slide frame 71 retaining the slide door 7 incorporates a power supply line (not shown in the drawings), and an electric power is supplied from the power supply line to the EL panel 2. In this configuration, since transmitting light, the EL panel 2 functions as a window for daylighting when turned off and functions as the illumination device when turned on. In addition, when the slide doors 7 is slid to overlap the EL panels 2, as is the same with the above-mentioned configuration, high-brightness light can be irradiated. Moreover, Fig. 28(b) shows an example where a sliding door 81 of a piece of storage furniture includes the EL panel 2. Also in this configuration, as is the same with the above-mentioned configuration, when the EL panels 2 are slid, the user can arbitrarily change the irradiation range and the brightness of light.

[0069] Meanwhile, the present invention can be variously modified without being limited to the above-mentioned embodiments. When a diameter or a size of one side is relatively small, for example, is approximately 200mm, the EL panel 2 includes a flat-surface light emission part 26 (see Fig. 3). However, in the case of the size or more, it is preferred to use the device where the plurality of light emission parts 26 are arranged in a matrix shape so as not to generate unevenness of light due to stepping-down of the voltage. Additionally, in the case, it is further preferred to design the wiring and the like so that the plurality of light emission parts 26 can be individually controlled, respectively.

[Description of Reference Numerals]

[0070]

1	Illumination device
2	EL panel (Transparent EL panel)
22a	Anode terminal
22b	Cathode terminal
23a	(for anode) terminal reception part
23b	(for cathode) terminal reception part
3	Fixture body
32	Chassis
33	Base part (Portion opposed to the EL panel)
35	Groove part
39	Slide groove

- 4 Power source unit
- 54 Spring chip (pressing member)
- 7 Slide door
- 81 Sliding door

Claims

1. An illumination device comprising: a plurality of transparent EL panels (2) each including: transparent EL element configured by stacking on a transparent substrate (25) in turn an anode (26a) formed of a transparent conducting film, a light emission layer (26b), and a cathode (26c) formed of the transparent conducting film; and a fixture body (3) for retaining the transparent EL panels (2) so that light emission regions of the plurality of transparent EL panels (2) can overlap each other, and irradiating light of superposed emission lights of the plurality of transparent EL panels (2),
the plurality of transparent EL panels (2) are configured so as to be freely detachable with each other, and when overlapped, irradiates light of superposed emission lights of the transparent EL panels (2),
characterized in that each of the transparent EL panels (2) is provided with: an anode terminal (22a) and a cathode terminal (22b) on one surface and terminal reception parts (23a, 23b) corresponding respectively to the anode terminal (22a) and the cathode terminal (22b) on the other surface, wherein a plurality of electric circuits is incorporated in each of the terminals (22a and 22b) and in the terminal reception parts (23a and 23b) to independently connect each of the plurality of overlapped EL panels (2) to a control part of a power source unit (4), and to control each of the EL panels (2) to be individually lighted.
2. The illumination device according to claim 1, wherein the fixture body (3) includes a chassis (32) for the plurality of transparent EL panels (2).
3. The illumination device according to claim 2, wherein in the chassis (32), a pressing member (54) is fitted into a groove part (35) provided on an internal surface of the chassis (32), and the pressing member (54) retains the transparent EL panels (2) at the groove part (35).
4. The illumination device according to any one of claims 1 to 3, wherein the fixture body (3) has a light reflectivity at a portion opposed to the transparent EL panels (2).
5. The illumination device according to any one of claims 1 to 3, further comprising:

an EL panel (2) including a light reflective layer,

wherein

the EL panel (2) having the light reflective layer is arranged at an outermost portion of the plurality of overlapped transparent EL panels (2).

6. The illumination device according to any one of claims 1 to 5, wherein the plurality of transparent EL panels (2) emit different colors, respectively.
7. The illumination device according to any one of claims 1 to 6, wherein emission colors of lights of the plurality of transparent EL panels (2) include RGB three primary colors.
8. The illumination device according to any one of claims 1 to 7, wherein the plurality of transparent EL panels (2) have a different area of the light emission surface from each other.

Patentansprüche

1. Beleuchtungsvorrichtung aufweisend: eine Mehrzahl von transparenten EL-Scheiben (2) jeweils enthaltend: eine transparente EL-Scheibe, die dadurch gebildet ist, das auf ein transparentes Substrat (25) eine aus einem transparenten leitenden Film gebildete Anode (26a), eine Lichtemissionsschicht (26b) und eine aus einem transparenten leitenden Film gebildete Kathode (26c) gestapelt sind; und einen Gehäusekörper (3) zum Halten der transparenten EL-Scheiben (2), so dass lichtemittierende Bereiche der Mehrzahl von transparenten EL-Scheiben (2) einander überlappen können und Licht aus den überlagerten Lichtemissionen der Mehrzahl von transparenten EL-Scheiben (2) abstrahlen, wobei die mehreren transparenten EL-Scheiben (2) frei trennbar voneinander ausgeführt sind und bei Überlappung Licht aus der überlagerten Lichtemission der transparenten EL-Scheiben (2) abstrahlen, **dadurch gekennzeichnet, dass** jede der transparenten EL-Scheiben (2) aufweist: einen Anodenanschluss (22a) und einen Kathodenanschluss (22b) auf der einen Oberfläche und Anschlussaufnahmeteile (23a, 23b) auf der anderen Oberfläche, die jeweils mit dem Anodenanschluss (22a) bzw. dem Kathodenanschluss (22b) korrespondieren, wobei eine Mehrzahl von elektrischen Schaltkreisen in den Anschlüssen (22a und 22b) und in den Anschlussaufnahmeteilen (23a und 23b) enthalten ist, um jede der mehreren sich überlappenden EL-Scheiben (2) unabhängig mit einem Steuerteil einer Energieversorgungseinheit (4) zu verbinden, und jede der EL-Scheiben (2) zu steuern, um es individuell zu beleuchten.

2. Beleuchtungseinrichtung nach Anspruch 1, wobei der Gehäusekörper (3) ein Gehäuseteil (32) für die mehreren transparenten EL-Scheiben (2) aufweist.
3. Beleuchtungsanordnung nach Anspruch 2, wobei in dem Gehäuseteil (32) ein Druckelement (54) in einem Nutteil (35) angeordnet ist, der an einer inneren Fläche des Gehäuseteils (32) voranden ist und wobei das Druckelement (54) die transparenten EL-Scheiben (2) an dem Nutteil (35) hält.
4. Beleuchtungsanordnung nach einem der Ansprüche 1 bis 3, wobei der Gehäusekörper (3) an einem Abschnitt entgegengesetzt zu den transparenten EL-Scheiben (2) lichtreflektieren ist.
5. Beleuchtungsanordnung nach einem der Ansprüche 1 bis 3, ferner aufweisend:
 - eine EL-Scheibe (2) aufweisend eine lichtreflektierende Schicht,
 - wobei die EL-Scheibe (2), das die lichtreflektierende Schicht aufweist, an einem äußersten Bereich der mehreren sich überlappenden transparenten EL-Scheiben (2) angeordnet ist.
6. Beleuchtungsanordnung nach einem der Ansprüche 1 bis 5, wobei die mehreren transparenten EL-Scheiben (2) jeweils unterschiedliche Lichtfarben emittieren.
7. Beleuchtungsanordnung nach einem der Ansprüche 1 bis 6, wobei die emittierten Lichtfarben der mehreren transparenten EL-Scheiben (2) die drei primären Farben RGB enthalten.
8. Beleuchtungsanordnung nach einem der Ansprüche 1 bis 7, wobei die mehreren transparenten EL-Scheiben (2) sich voneinander unterscheidende Flächeninhalte der lichtemittierenden Oberflächen aufweisen.

Revendications

1. Dispositif d'éclairage comprenant : une pluralité de plaques EL (2) transparentes, comportant chacune : un élément EL transparent configuré par empilement sur un substrat (25) transparent, en alternance, d'une anode (26a) formée d'un film conducteur transparent, d'une couche d'émission de lumière (26b) et d'une cathode (26c) formée du film conducteur transparent; et un corps d'appareil d'éclairage (3) destiné à retenir les plaques EL (2) transparentes, de manière à ce que des régions d'émission de lumière de la pluralité de plaques EL (2) transparentes puissent se recouvrir les unes les autres, et à

rayonner la lumière de lumières d'émission superposées de la pluralité de plaques EL (2) transparentes, la pluralité de plaques EL (2) transparentes sont configurées de manière à être librement séparables les unes des autres et, lorsqu'elles se recouvrent, rayonnent la lumière de lumières d'émission superposées des plaques EL (2) transparentes, **caractérisé en ce que** chacune des plaques EL (2) transparentes est pourvue d'une borne d'anode (22a) et d'une borne de cathode (22b), sur une surface, et d'éléments de réception de borne (23a, 23b) correspondant respectivement à la borne d'anode (22a) et à la borne de cathode (22b), sur l'autre surface, dans lequel une pluralité de circuits électriques sont incorporés dans chacune des bornes (22a et 22b) et dans les éléments de réception de borne (23a et 23b) pour connecter de façon indépendante chaque plaque de la pluralité de plaques EL (2) qui se recouvrent à un élément de commande d'une unité de source d'énergie (4), et pour commander chacune des plaques EL (2) pour être éclairées de façon individuelle.

2. Dispositif d'éclairage selon la revendication 1, dans lequel le corps d'appareil d'éclairage (3) comprend un châssis (32) pour la pluralité de plaques EL (2) transparentes.
3. Dispositif d'éclairage selon la revendication 2, dans lequel, dans le châssis (32), un organe de pression (54) est inséré dans une portion formant rainure (35) prévue sur une surface interne du châssis (32), et l'organe de pression (54) retient les plaques EL (2) transparentes sur la portion formant rainure (35).
4. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 3, dans lequel le corps d'appareil d'éclairage (3) a un pouvoir de réflexion de la lumière dans une portion opposée aux plaques EL (2) transparentes.
5. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 3, comprenant en outre :
 - une plaque EL (2) comportant une couche réfléchissant la lumière, dans laquelle la plaque EL (2) dotée de la couche réfléchissant la lumière est disposée dans une portion située le plus à l'extérieur de la pluralité de plaques EL (2) transparentes se recouvrant.
6. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 5, dans lequel la pluralité de plaques EL (2) transparentes émettent

respectivement des couleurs différentes.

7. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 6, dans lequel l'émission de couleurs de lumières de la pluralité de plaques EL (2) transparentes englobe trois couleurs primaires RVB. 5
8. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 7, dans lequel la pluralité de plaques EL (2) transparentes ont des zones de surface d'émission de lumière différentes les unes des autres. 10

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Figure 1

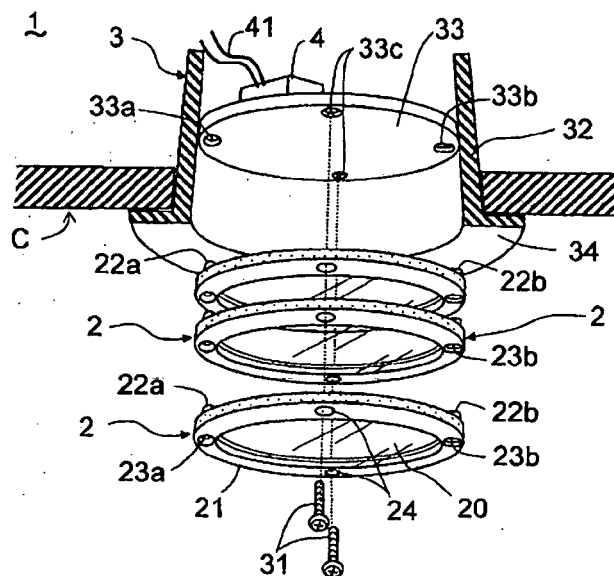


Figure 2

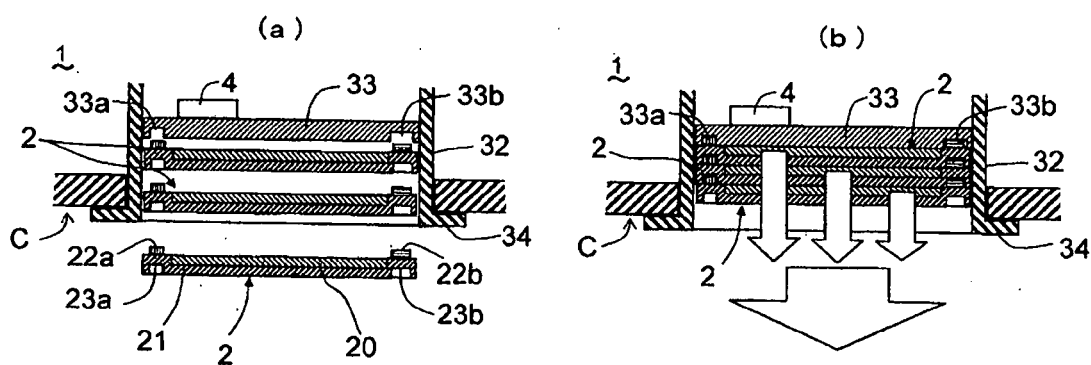


Figure 3

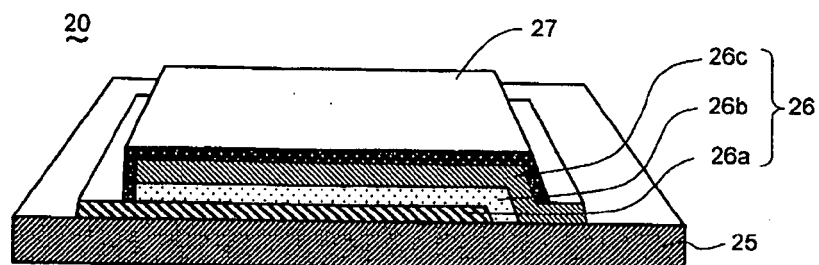


Figure 4

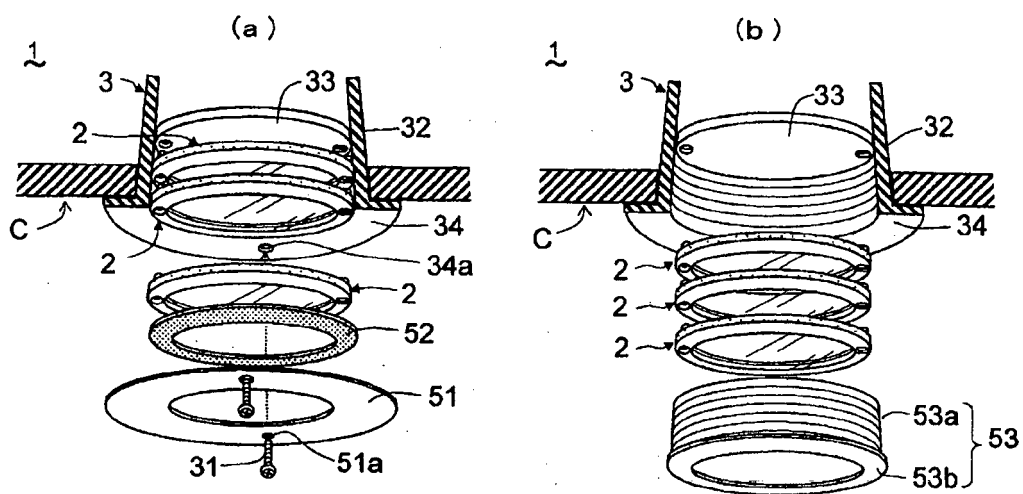


Figure 5

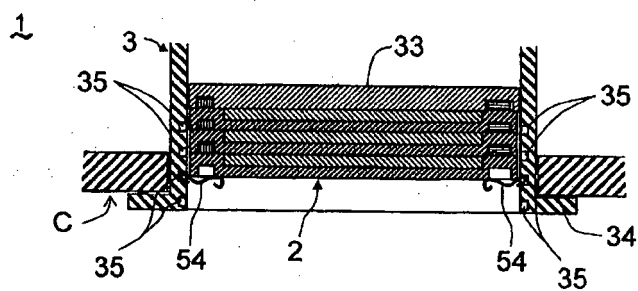


Figure 6

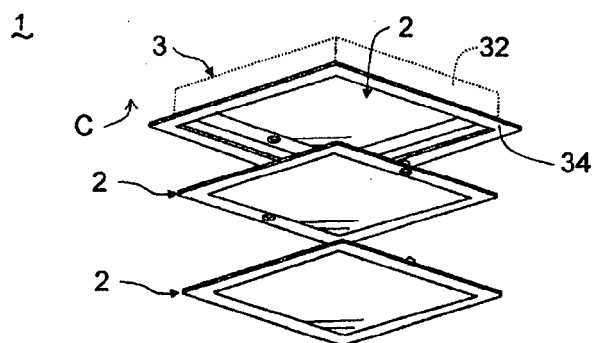


Figure 7

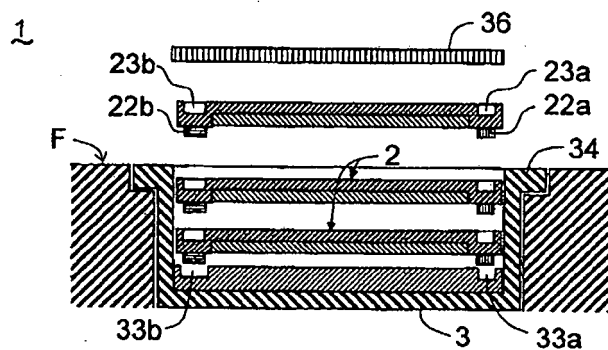


Figure 8

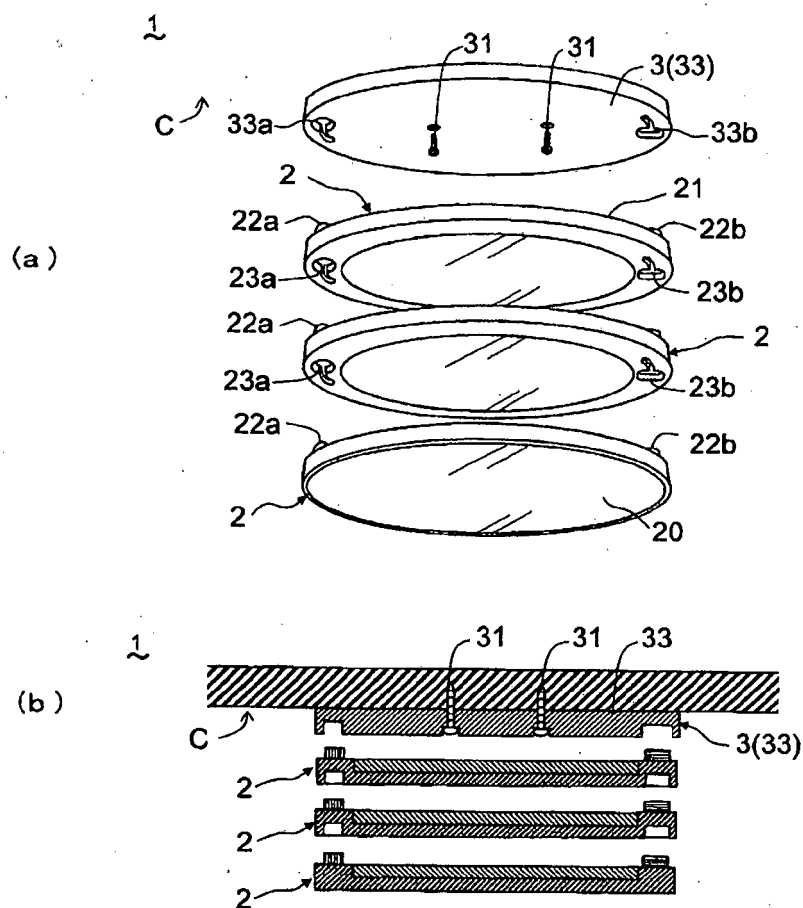


Figure 9

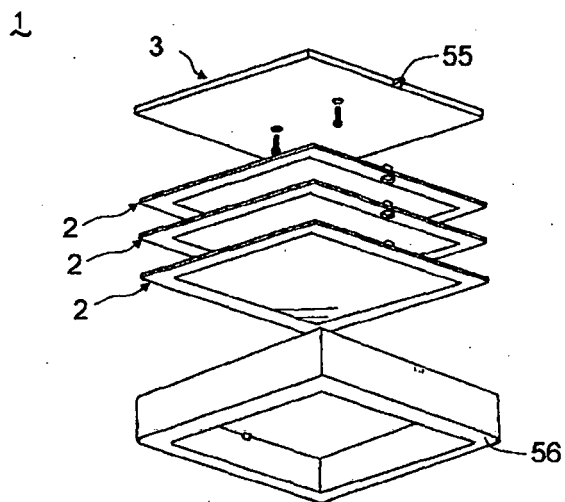


Figure 10

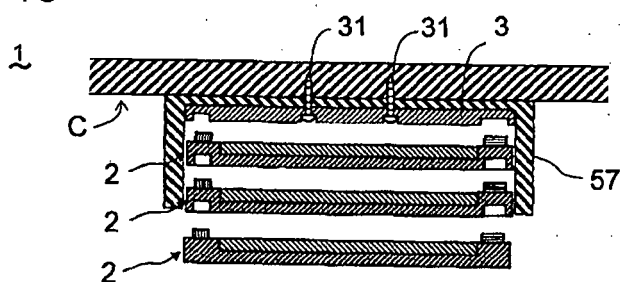


Figure 11

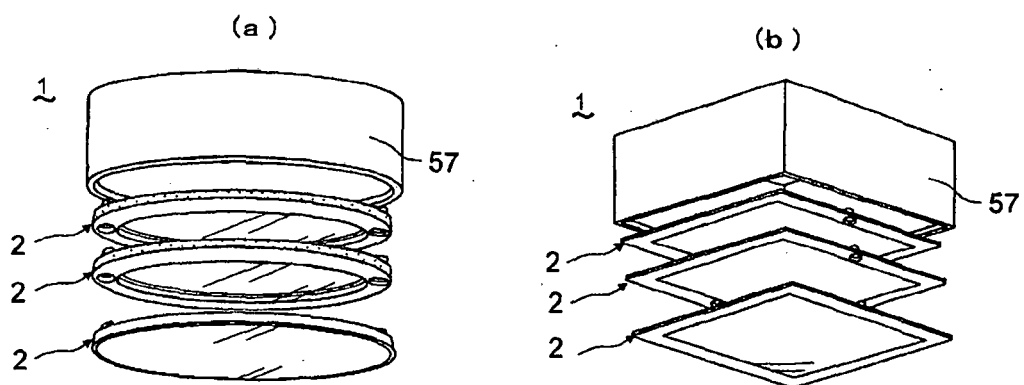


Figure 12

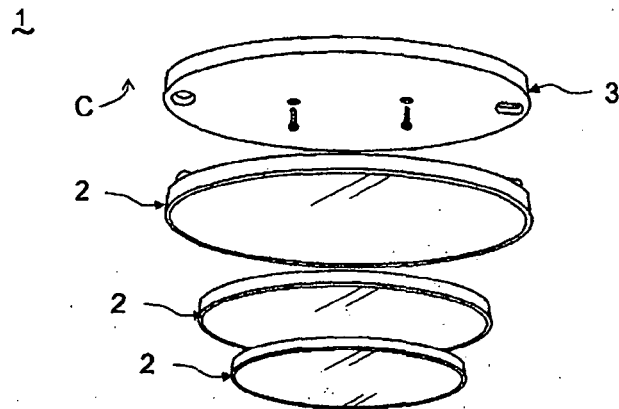


Figure 13

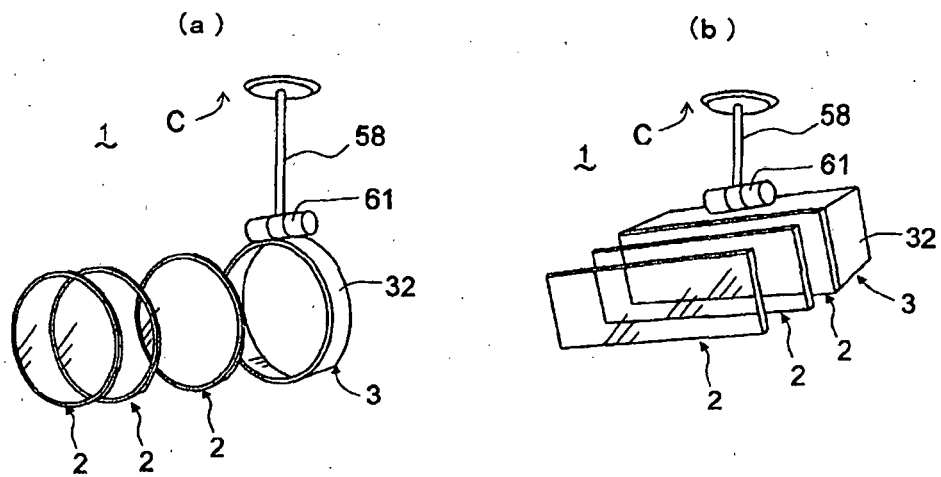


Figure 14

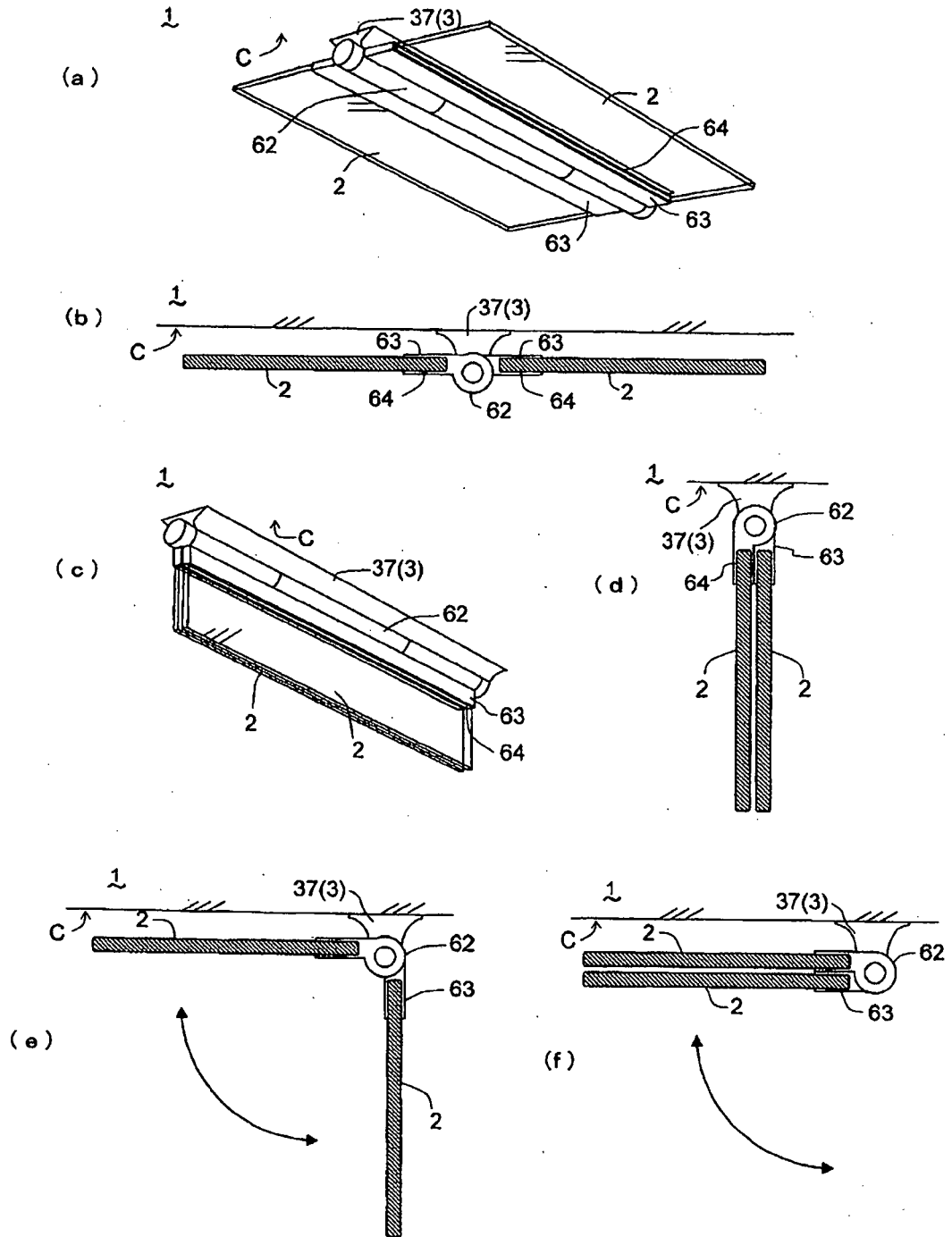


Figure 15

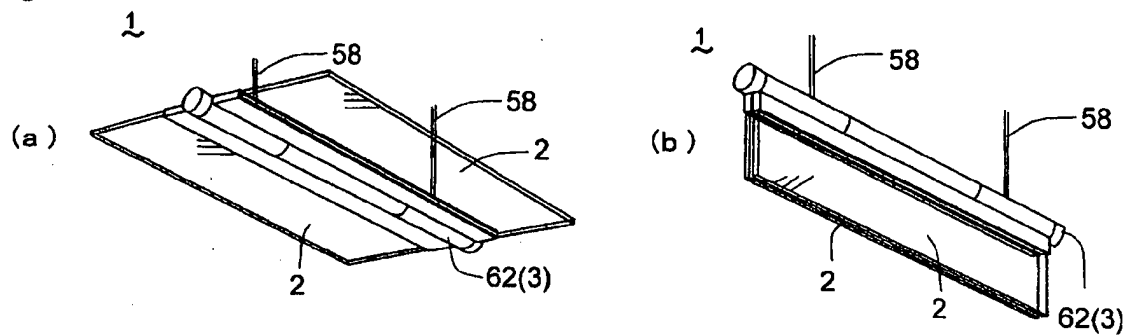


Figure 16

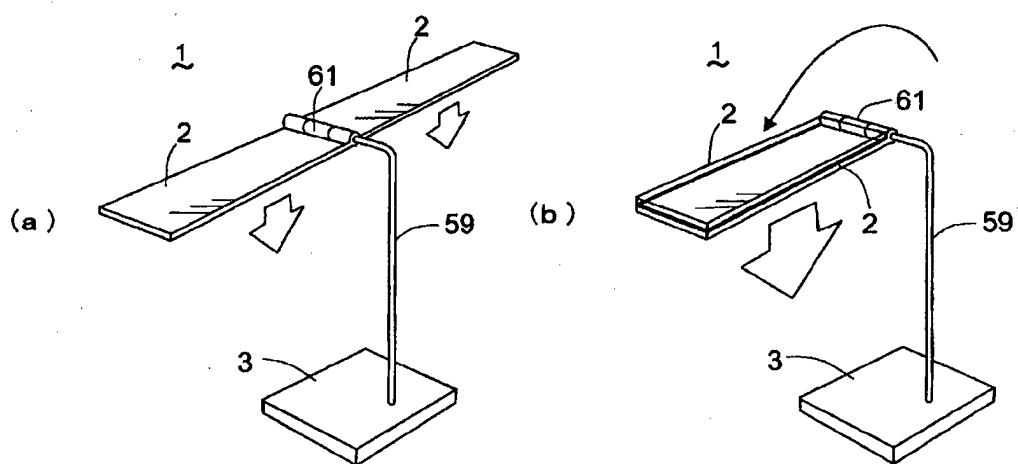


Figure 17

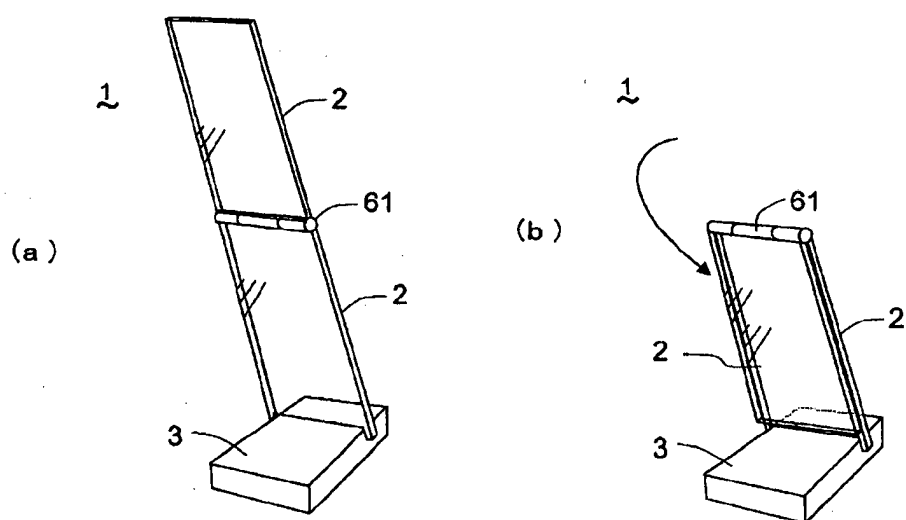


Figure 18

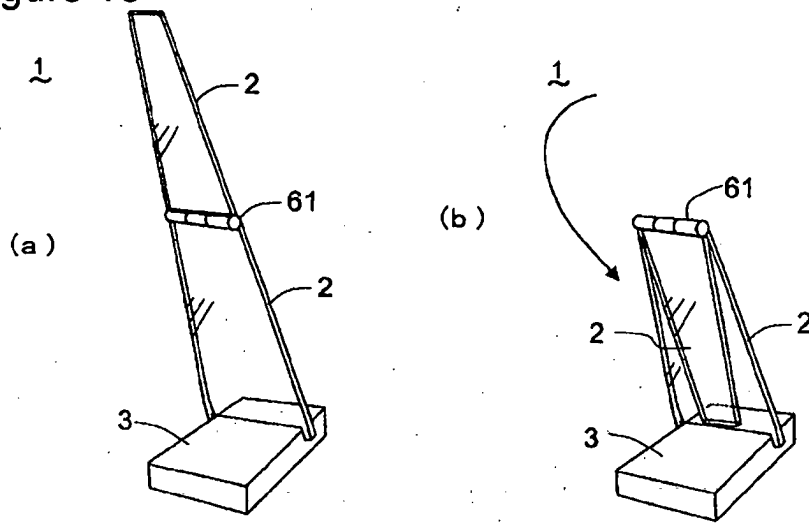


Figure 19

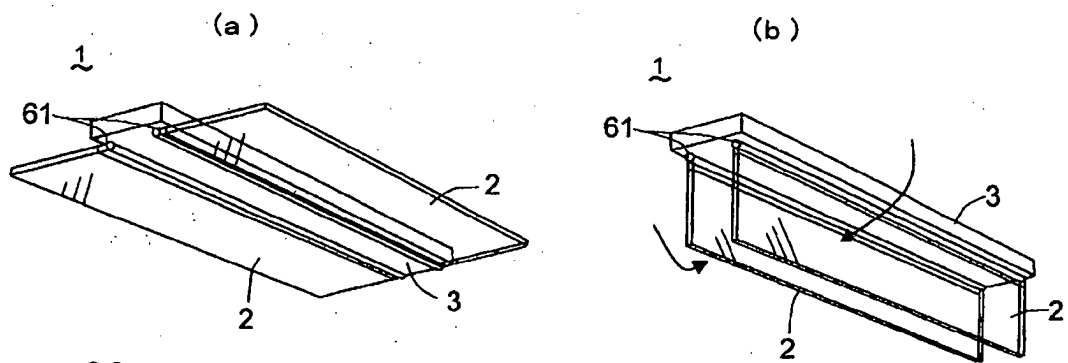


Figure 20

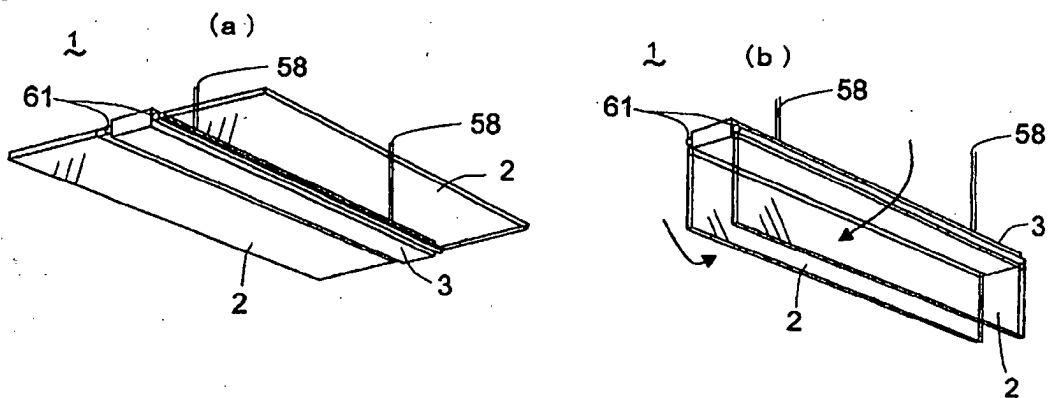


Figure 21

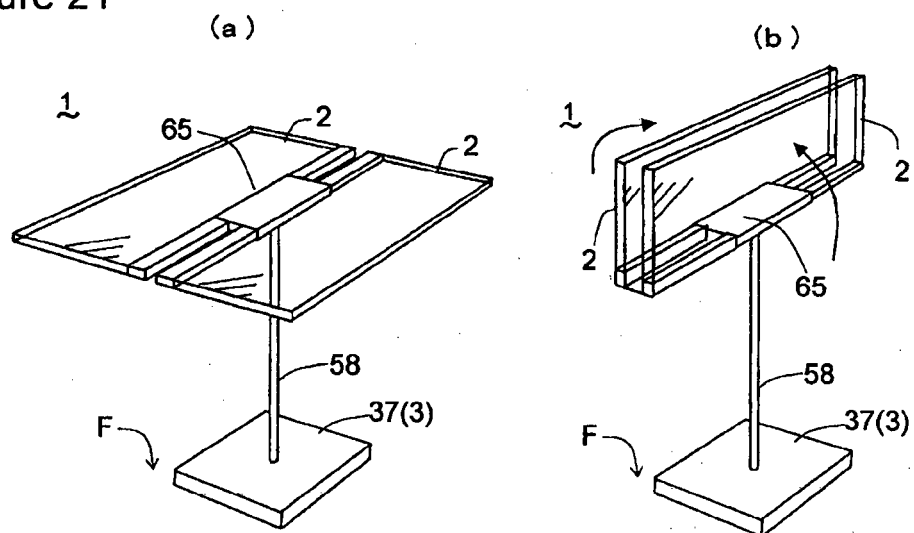


Figure 22

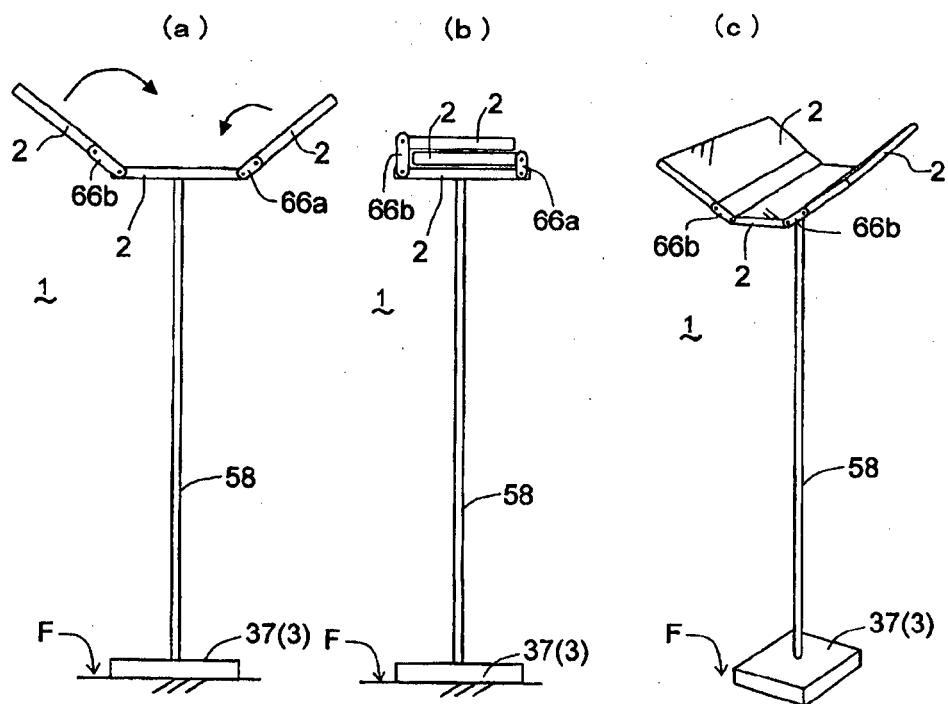


Figure 23

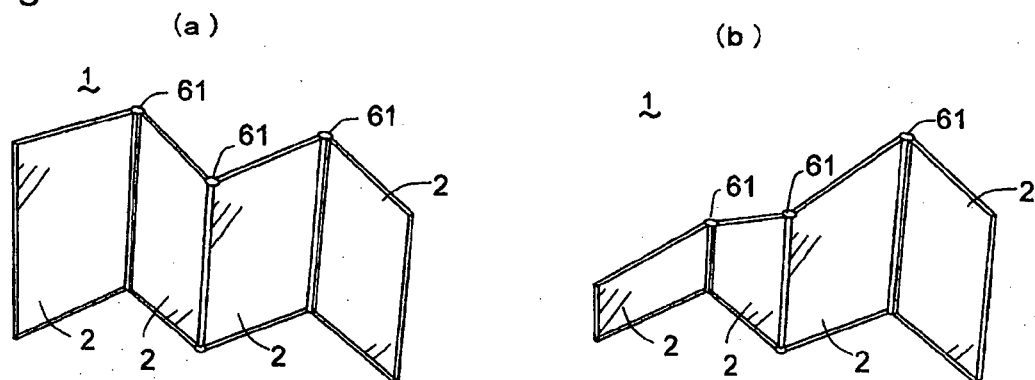


Figure 24

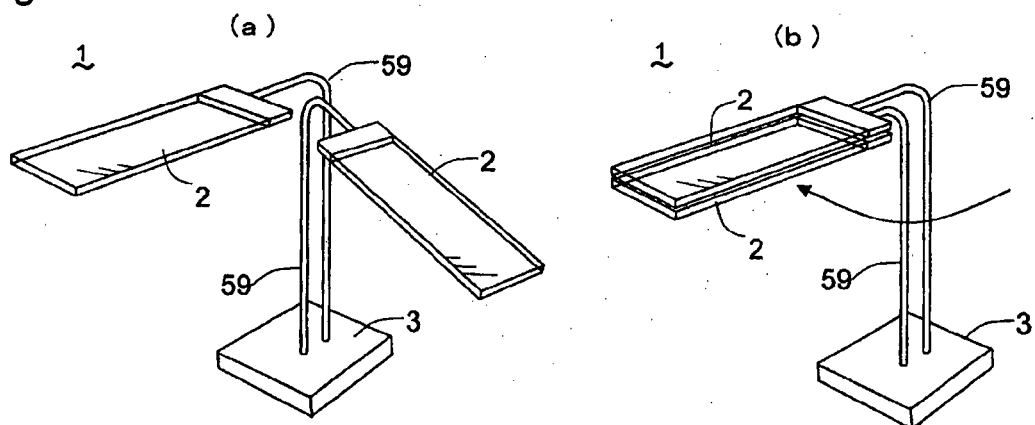


Figure 25

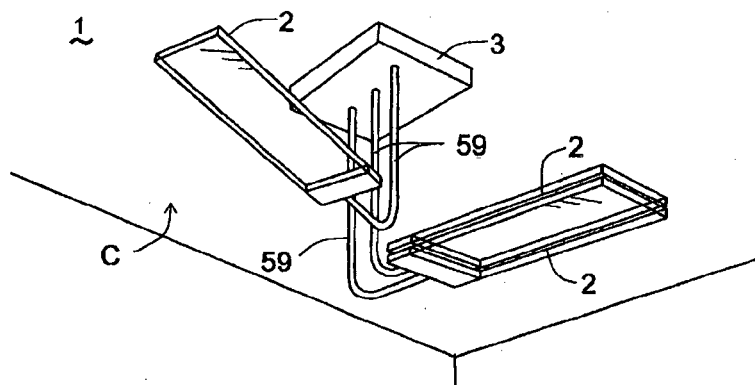


Figure 26

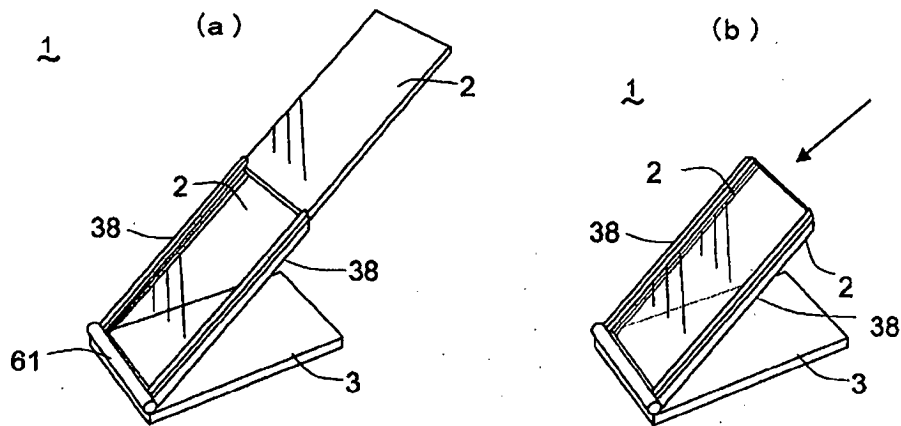


Figure 27

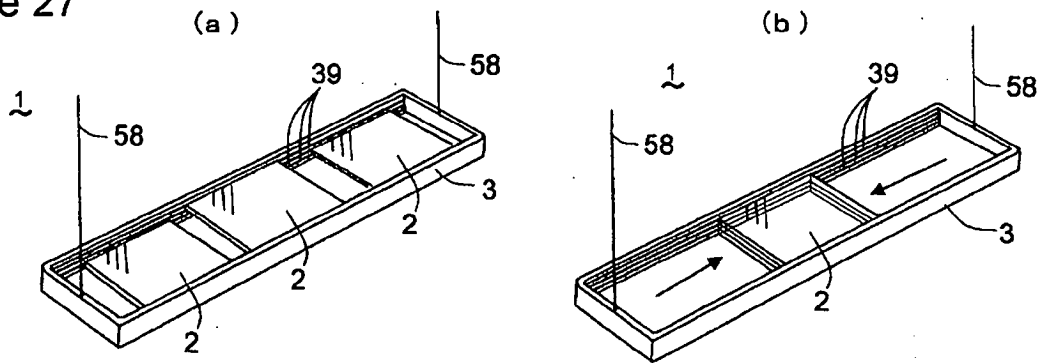
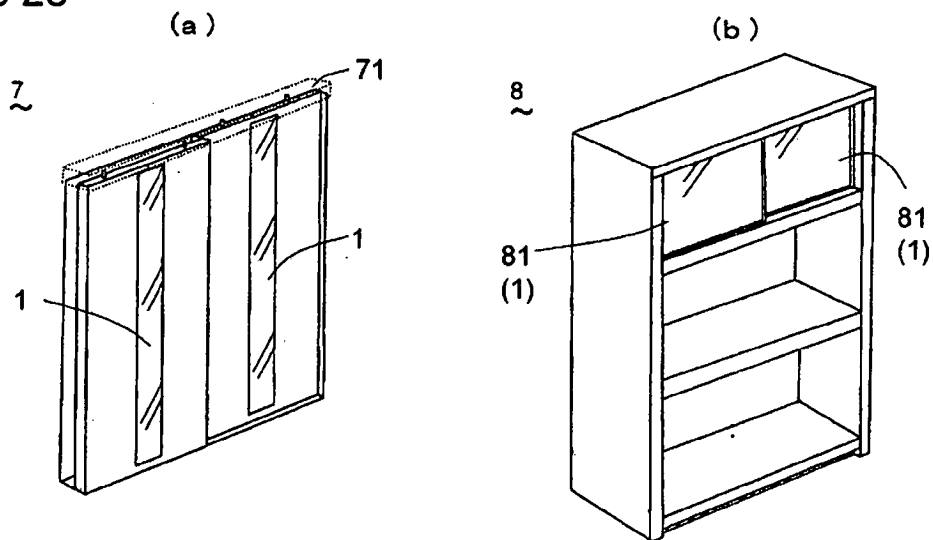


Figure 28



REFERENCES CITED IN THE DESCRIPTION

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