(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 738 654 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
18.11.2020 Bulletin 2020/47

(21) Application number: **18899417.2**

(22) Date of filing: **25.12.2018**

(51) Int Cl.:
A63F 7/02 *(2006.01)*

(86) International application number:
PCT/JP2018/047496

(87) International publication number:
WO 2019/138860 (18.07.2019 Gazette 2019/29)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **11.01.2018 JP 2018002612**

(71) Applicant: **SEKISUI CHEMICAL CO., LTD.**
Osaka-shi
Osaka
530-8565 (JP)

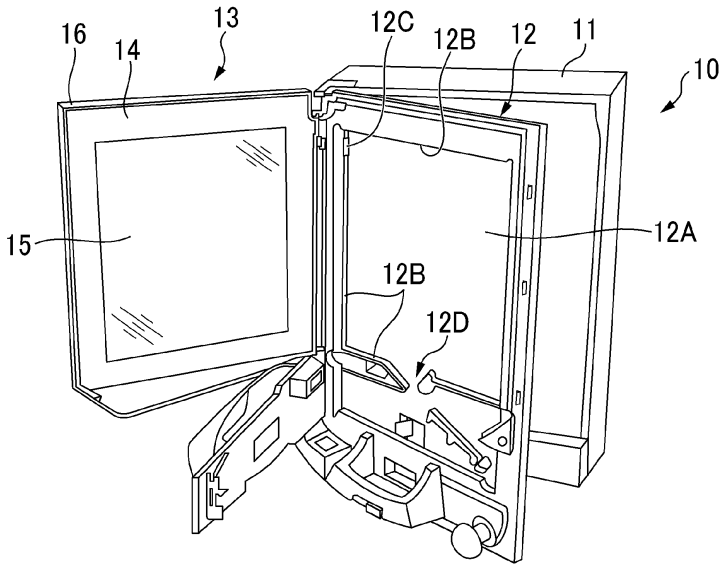
(72) Inventors:
- **NAKAJIMA, Daisuke**
  Koka-shi, Shiga 528-8585 (JP)
- **OOTA, Yuusuke**
  Koka-shi, Shiga 528-8585 (JP)
- **NOHARA, Atsushi**
  Koka-shi, Shiga 528-8585 (JP)

(74) Representative: **Ter Meer Steinmeister & Partner Patentanwälte mbB**
Nymphenburger Straße 4
80335 München (DE)

(54) **GAME MACHINE AND EFFECT PRODUCING METHOD FOR GAME MACHINE**

(57) A game machine 10 includes a game board 12 and a glass unit 15 disposed in front of the game board 12. The glass unit 15 contains a luminescent material that emits visible light having a wavelength of 380 to 780 nm by excitation light.

Fig. 1



EP 3 738 654 A1

Description

Technical Field

[0001] The present invention relates to a game machine such as a pachinko machine or a slot machine, and a presentment method performed by the game machine.

Background Art

[0002] In game machines such as pachinko machines and slot machines, various presentments are performed to enhance amusement properties. For example, a game machine is widely known in which a liquid crystal display is provided on a game board and various images are displayed on the liquid crystal display. In addition, a game machine is also known in which various decorations are provided on a game board and light sources such as LEDs are attached to the decorations to allow the decorations to emit light.

[0003] In recent years, a variety of presentments have been required for a game machine, and it has been considered to use not only a game board but also a protective glass unit attached to a front surface of the game board. For example, PTL 1 discloses a game machine in which a main surface of a glass unit facing a game board has a print or a concavo-convex shape, light emitted from a light emitting device provided on a lateral surface of the glass unit is reflected on the main surface, and patterns corresponding to the print or the concavo-convex shape are displayed.

[0004] In addition, PTL 1 further discloses a glass unit including a pair of transparent substrates and an electro-optical functional layer sandwiched between the transparent substrates. The electro-optical functional layer can allow light to pass therethrough when a voltage is applied and can allow light to be scattered when a voltage is not applied. Therefore, letters and drawings can be displayed on the glass unit by adjusting a voltage in such a way that the voltage is applied or not.

Citation List

Patent Literature

[0005] PTL 1: JP 2017-86196 A

Summary of Invention

Technical Problem

[0006] However, with the game board disclosed in PTL 1, only fixed letters and drawings can be displayed and it is also difficult to adjust the contrast of images, and therefore, a variety of presentments cannot be performed. In addition, since it is necessary to provide the electro-optical functional layer or to apply a print on the glass unit, a structure of the glass unit may become complicated, which degrades viewability of the glass unit.

[0007] An object of the present invention is to provide a game board capable of performing various presentments with a simple configuration using a glass unit on a front surface of the game board.

Solution to Problem

[0008] The inventors have found that the above problems can be solved by allowing the glass unit to contain a predetermined luminescent material, thereby accomplishing the present invention below. The gist of the present invention is [1] to [8] below.

[1] A game machine comprising:

a game board; and
a glass unit disposed in front of the game board, the glass unit containing a luminescent material that emits visible light having a wavelength of 380 to 780 nm by excitation light.

[2] The game machine according to [1], further comprising:
a light source that irradiates the glass unit with excitation light.
[3] The game machine according to [2], wherein the light source irradiates the glass unit with the excitation light from an outer circumferential surface side of the glass unit, or irradiates the glass unit with the excitation light from the game board side.

[4] The game machine according to [2] or [3], wherein the light source is an LED light source or an LD light source which is capable of irradiating the glass unit with light having an excitation wavelength, or a light source medium that emits light having the wavelength, and may constitute a projection system.
[5] The game machine according to any one of [1] to [4], wherein
the glass unit has a multilayer structure in which at least one transparent plate and a resin layer are laminated, and the resin layer contains a resin and a luminescent material that emits the abovementioned visible light by an incident excitation light.
[6] The game machine according to any one of [1] to [5], wherein
the glass unit includes two transparent plates and an interlayer film provided between the two transparent plates, and has a glass structure in which the two transparent plates are bonded via the interlayer film, and
the interlayer film includes one or more resin layers, and at least one of the resin layers is a light emitting layer containing a resin and a luminescent material that emits the visible light by an incident excitation light.
[7] The game machine according to any one of [1] to [6], wherein when any game operation selected from the group consisting of prize-winning, winning, reaching, losing, occurrence of probability variation, mode change due to change of probability variation or the like, end of probability variation, and end of winning period is performed, a state of light emission of the glass unit is changed.
[8] A presentment method of a game machine including a game board and a glass unit disposed in front of the game board, the glass unit containing a luminescent material that emits visible light having a wavelength of 380 to 780 nm by excitation light, the method comprising:
irradiating the glass unit with excitation light to emit the visible light.

Advantageous Effects of Invention

[0009] The present invention can provide a game board capable of performing various presentments with a simple configuration using a glass unit on a front surface of the game board.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a perspective view showing an overall structure of a game machine.
[Fig. 2] Fig. 2 is a plan view of a front cover for showing positions where light sources are disposed in a first embodiment.
[Fig. 3] Fig. 3 is a perspective view of a glass unit for showing the positions where the light sources are disposed in the first embodiment.
[Fig. 4] Fig. 4 is a schematic diagram showing a specific example of a presentment performed by the glass unit.
[Fig. 5] Fig. 5 is a perspective view of a glass unit for showing a position where a light guide is disposed in a second embodiment.
[Fig. 6] Fig. 6 is a schematic cross-sectional view of a game machine for showing positions where light sources are disposed in a third embodiment.
[Fig. 7] Fig. 7 is a schematic diagram showing a specific example of a presentment performed by the glass unit.
[Fig. 8] Fig. 8 is a schematic diagram showing an example of a light source unit used in a fourth embodiment.
[Fig. 9] Fig. 9 is a schematic diagram showing a specific example of a presentment performed by the glass unit.
[Fig. 10] Fig. 10 is a schematic diagram showing a specific example of a presentment performed by the glass unit.
[Fig. 11] Fig. 11 is a schematic diagram showing a specific example of a presentment performed by the glass unit.
[Fig. 12] Fig. 12 is a schematic diagram showing a specific example of a presentment performed by the glass unit.
[Fig. 13] Fig. 13 is a flowchart showing an example of a light emission control routine of the glass unit.

Description of Embodiments

[Structure and Presentment of Game Machine]

[0011] Hereinafter, structures of game machines and presentment displayed on a glass unit of the present invention will be described in detail below using first to fourth embodiments with reference to the drawings.

(First Embodiment)

[0012] Fig. 1 is a perspective view illustrating an example of a game machine.

[0013] A game machine 10 includes a housing 11, a game board 12 disposed inside the housing 11, and a front cover 13 attached to a front surface of the game board 12. The front cover 13 is disposed so as to close an opened front surface of the housing 11 and is attached to the housing 11 so as to be openable and closable.

[0014] The front cover 13 includes a frame body 14 and a glass unit 15 disposed so as to be fitted into a frame of the frame body 14 and supported by the frame body 14. The glass unit 15 is disposed in front of the game board 12 and protects the game board 12. An example of the game machine 10 is a pachinko machine shown in Fig. 1, but may be a slot machine.

[0015] The front surface of the game board 12 has a game area 12A in which a game is played, and the game area 12A is visibly recognized from the outside through the glass unit 15. In the pachinko machine, the game area 12A is provided with an outside wall surface (outer wall surface) 12B that partitions the game area 12A. In the pachinko machine, the game area 12A is an area that can be a path from when pachinko balls fed from a guide port 12C are dropped by gravity until the pachinko balls are discharged from an out port 12D.

[0016] The glass unit 15 contains a luminescent material that emits visible light having a wavelength of 380 to 780 nm due to excitation light. Accordingly, when the glass unit 15 is irradiated with the excitation light from a light source 16 which will be described below, the visible light is emitted by the irradiation of the excitation light.

[0017] As shown in Fig. 2, in this embodiment, a light source 16 is provided around the glass unit 15 in the front cover 13 to be irradiated with the excitation light. The light source 16 is not particularly limited as long as being a light source medium capable of irradiating the glass unit 15 with light having an excitation wavelength that can excite the luminescent material, and includes laser light sources, LED light sources, xenon lamps, and the like. Preferably, LED light sources or LD light sources (semiconductor laser light sources) are used as the light source. When the LED light sources, the LD light source, and the like are used, an arrangement space of the light source 16 becomes small, and the increase in size of the game machine 10 due to the light source 16 provided therein can be prevented. The excitation light with which the light sources 16 irradiate the glass unit 15 needs only to be able to allow the glass unit 15 to emit visible light through its incidence into the glass unit 15.

[0018] The maximum wavelength of the light with which the light sources 16 irradiate the glass unit 15 is not specifically limited but is preferably 430 nm or less, more preferably 420 nm or less, further preferably 410 nm or less. Further, it is preferably 300 nm or more, more preferably 350 nm or more, further preferably 365 nm or more.

[0019] By adjusting the maximum wavelength of the light with which the light sources 16 irradiate the glass unit 15 to such a lower limit or more and such an upper limit or less, the glass unit 15 can emit visible light more efficiently by the excitation light from the light sources 16.

[0020] Further, the luminescent material may emit the visible light as described above, but preferably emits visible light having a maximum emission wavelength of 440 nm or more and can express blue, green, and red. Further, for example, when visible light having a wavelength of 570 nm or more is used, the visible light expresses yellow or red, which is suitable as a color that arouses a player's feelings and indicates that a winning is approaching or that the winning has occurred.

[0021] The light source 16 provided around the glass unit 15 causes excitation light to enter the glass unit 15 from an outer circumferential surface 15X side of the glass unit 15. Here, a plurality of light sources 16 are provided, and preferably provided so as to surround the glass unit 15 as shown in Fig. 2.

[0022] The light source 16 may be attached to the outer circumferential surface 15X of the glass unit 15, or may be attached to the frame body 14.

[0023] Fig. 3 is a schematic perspective view showing the glass unit 15 of this embodiment in more detail. As shown in Fig. 3, the glass unit 15 is, for example, laminated glass including two transparent plates 15A and 15B, and an interlayer film 15C disposed therebetween, in which the transparent plates 15A and 15B are bonded by the interlayer film 15C. In the glass unit 15, the interlayer film 15C may be composed of a resin layer (light emitting layer) containing a luminescent material or may include two or more resin layers (light emitting layers) at least one of which is resin layer containing a luminescent material. The two or more resin layers may be laminated in a multi-layered manner in a thickness direction.

[0024] However, the glass unit 15 is not limited to such a configuration, and may have any configuration as long as at least one layer is a light emitting layer that emits light as will be described below in detail.

[0025] As shown in Fig. 3, the light sources 16 may be provided so that their output ends 16A are opposed to the outer circumferential surfaces 15X of the glass unit 15. Further, the output ends 16A of the light sources 16 are preferably disposed so as to be opposed to or in contact with the light emitting layer of the glass unit 15 (in Fig. 3, the interlayer film 15C), in order to enhance the light emission efficiency in the glass unit 15.

[0026] Further, an optical axis of the light source 16 may be parallel to a surface directing of the glass unit 15, but may be appropriately inclined with respect to the surface direction. When the optical axis is inclined, the excitation light from the light source 16 is difficult to enter the inside, so that only outer circumferential portion of the glass unit 15 is likely to emit light.

[0027] Further, when the interlayer film 15C having a light emitting layer is provided between the two transparent plates 15A and 15B, the light sources 16 may be, for example, composed of LED chips and disposed between the

transparent plates 15A and 15B on the outer circumferential surfaces 15X or in the vicinity of the outer circumferential surfaces 15X. In this case, the light sources 16 may be, for example, attached to the transparent plates 15A and 15B or embedded inside the resin layer 15C. Further, diffusion lenses or the like may be provided on the output ends 16A of the light sources 16, so that the excitation light from the light sources 16 is diffused and incident upon the glass unit 15.

[0028] Here, the excitation light with which the light sources 16 irradiate the glass unit 15 enters from the outer circumferential surface 15X sides so that the excitation light penetrates into the glass unit 15 with the amount of light being attenuated. Accordingly, adjusting the amount of light of the excitation light such that the light does not penetrate into the center of the glass unit 15 makes it possible that the outer circumferential portion of the glass unit 15 is allowed to emit light without emitting light in the center of the glass unit 15. In this embodiment, various presentments can be performed by allowing the outer circumferential portion of the glass unit 15 to emit light.

[0029] Note that not emitting the light in the center here does not strictly mean not emitting the light at all, and also includes a mode in which the light is emitted only to an extent that cannot be visually detected.

[0030] In this embodiment, for example, the light emission of a part of the light sources 16 makes it possible to allow a part of the outer circumferential portion of the glass unit 15 (hereinafter, referred to as "light emitting region 15E") to emit light, as shown in Figs. 4(A) and 4(B). In addition, for example, the light emission of all of the light sources 16 makes it possible to allow the outer circumferential portion to emit light over the whole periphery, as shown in Fig. 4(C). The light emitting region 12E may have various shapes, for example, a wavy pattern as shown in Fig. 4, but the pattern is not particularly limited and may be any pattern.

[0031] Here, when an irradiation intensity of the light source 16 is adjusted, it is possible to change a range in which the excitation light penetrates from the light sources 16 and to appropriately change a size of the light emitting region 15E as shown in Figs. 4(A) and 4(B). In addition, adjustment of light-emitting time (that is, irradiation time of the light sources 16) makes it possible to adjust a view of the light emitting region 12E (pattern). Further, the glass unit 15 emits light with various colors depending on the luminescent material contained therein.

[0032] Accordingly, for example, it is also possible to make an expression such that a cloud or an aurora exists on the outer periphery of the glass unit 15 or to present as if a flash is seen to be generated by light emission of the light sources 16 for a short time.

[0033] As described above, according to the first embodiment, various presentments can be performed using the outer circumferential portion of the glass unit 15. However, in the first embodiment, the excitation light emitted from each of the light sources 16 is adjusted so as to irradiate the central portion of the glass unit 15, and the central portion of the glass unit 15 may also be allowed to emit light to perform various presentments.

[0034] Further, the light sources 16 are disposed so as to surround the whole periphery of the glass unit 15 in the first embodiment, but is not necessary to be disposed so as to surround the whole periphery. For example, when the presentment performed using the glass unit 15 is only the presentment in which a part of the outer circumferential portion is allowed to emit light as shown in Figs. 4(A) and 4(B), the light sources 16 may be provided so as to be opposed to only a part of the whole periphery of the glass unit 15. In the first embodiment, the game machine 10 may include only one light source 16. Further, the light sources 16 may be movable, for example, may be swingable. Specifically, the light sources 16 may be swung around the optical axis. When the light sources 16 are swung, more various presentments can be performed.

(Second Embodiment)

[0035] The differences of a second embodiment from the first embodiment will be described below. In this embodiment, a light guide 20 is provided around a glass unit 15 as shown in Fig. 5. The light guide 20 is provided on the front cover 13 (see Fig. 1), and is disposed so as to extend along an outer circumferential surface 15X of the glass unit 15. A light source 16 is disposed so that an output end 16A thereof is disposed so as to be opposed to an end part 20A of the light guide 20, excitation light from the light source 16 enters from the end part 20A, and the excitation light enters the glass unit 15 from the outer circumferential surface 15X through the light guide 20.

[0036] Here, the light guide 20 needs only to be able to emit the excitation light, which has entered from the end part 20A, from a lateral surface 20X of the light guide 20. Specifically, side emitting optical fibers may be used. Examples of the side-emitting optical fibers include core-clad optical fibers with light scatterers or the like dispersed therein. Since the portion of the lateral surface 20X of the light guide 20 that is not opposed to the glass unit 15 is not required to emit the excitation light, a film that absorbs or reflects excitation light may be formed. Specifically, a film containing an ultraviolet absorber or the like may be formed.

[0037] The light emitted from the lateral surface 20X of the light guide 20 enters the inside of the glass unit 15 from the outer circumferential surface 15X side of the glass unit 15. The excitation light, which has entered the inside of the glass unit 15, is subjected to wavelength conversion by the luminescent material contained in the glass unit 15, and is emitted from the glass unit 15 as visible light.

[0038] For example, one light guide 20 is formed, and as shown in Fig. 5, may be provided along some parts of the

outer circumferential surface 15X or may be provided along the whole periphery of the outer circumferential surface 15X. In addition, the number of light guides 20 is not limited, and, for example, two or more light guides 20 may be disposed along the outer circumferential surface 15X at different positions in a circumferential direction of the glass unit 15. In this case, excitation light may enter each of the light guides from each of the light sources.

[0039] According to the configuration of the second embodiment described above, it is possible to allow the outer circumferential portion of the glass unit 15 to emit light as in the first embodiment.

(Third Embodiment)

[0040] A third embodiment of the present invention will be described below. The excitation light from the light source 16 enters the glass unit 15 from the outer circumferential surface side in the first and second embodiments, but enters from a game board side in this embodiment. Hereinafter, differences between this embodiment and the first embodiment will be described.

[0041] In this embodiment, for example, as shown in Fig. 6, light sources 16 are provided on a game board 12, and irradiate a glass unit 15 with excitation light from the game board 12 side. The light sources 16 are provided at any position without being particularly limited, but may be attached to the game board 12. For example, as shown in Fig. 6, the light sources 16 may be provided on a game area 12A. Further, the light sources 16 may be provided on an outer wall surface 12B of the game area 12A of the game board 12. In addition, the light sources 16 may be attached on various members such as a chucker, a prize-winning pocket, a windmill, and other decorative members provided on the front surface of the game board 12. Further, the light sources 16 may be provided in an outer area of the game area 12A, or may be provided on a front surface 12F of a wall part constituting the outer wall surface 12B, for example.

[0042] Also in this embodiment, only one light source 16 may be provided, but a plurality of light sources 16 are preferably provided. When the plurality of light sources 16 are provided, various presentments can be performed.

[0043] Also in this embodiment, the light source 16 may be movable. When the light source 16 is movable, various presentments can be performed using light emission of the glass unit 15. Specifically, the light source 16 may be provided so as to linearly or curvedly move on a rail, a guide, or the like provided on the game board 12, for example. In addition, the light source 16 may be disposed so as to be swingable. The light source 16 may swing around the optical axis of the light source 16, for example.

[0044] Also in this embodiment, as in the first embodiment, light source 16 irradiates at least a part of the area of the glass unit 15 with the excitation light, whereby various presentments can be performed.

[0045] Specifically, as shown in Fig. 7(A), light emitting region 15E having various shapes such a round shape, a star shape, and a square shape can be formed in the glass unit to express a starry sky, a light of a firefly, and the like. At this time, a size of the light emitting region 15E can be changed by adjustment of the irradiation intensity of the light source 16. For example, the light emitting region 15E can be formed into a desired shape in such a manner that the shape of the output end of the light source 16 is adjusted or a mask or the like is provided on the output end of the light source 16.

[0046] In this embodiment, as shown in Fig. 7, the central portion of the glass unit can be allowed to emit light, but only the outer circumferential portion of the glass unit can also be allowed to emit light as shown in Fig. 4. When the outer circumferential portion of the glass unit is allowed to emit light, the light source 16 may be disposed in the vicinity of the outer circumferential surface 15X of the game board 12.

[0047] In addition, the light emitting region 15E can move as shown in Figs. 7(B) and 7(C) by movement of the light source 16 that irradiates the glass unit with the excitation light. When the light emitting region 15E moves, expressions such as meteors, eruptions, and shredding light (light indicating a path to be shredded by a sword or the like, or a path to be hit by a fist) can be performed. Further, when the light sources 16 are appropriately combined, various presentments can also be performed as shown in Figs. 9 to 12 which will be described below.

[0048] As described above, also in this embodiment, it is possible to perform various presentments using the glass unit as in the respective embodiments describe above.

(Fourth Embodiment)

[0049] The differences of a fourth embodiment from the third embodiment will be described below. The light source includes the LED light source, the LD light source, or another light source medium in the third embodiment, but the light source constitutes a light source unit by combination with a MEMS mirror or the like and is used as a projection system capable of displaying various images in this embodiment. Specifically, for example, as shown in Fig. 8, a light source unit 30 including a MEMS (Micro Electro Mechanical Systems) mirror 31 may be used in addition to the light source 16 that emits the excitation light. The light source unit 30 is not particularly limited, as long as it is located at a position where the glass unit 15 can be irradiated with the excitation light, but may be provided on the game board 12 or on various members provided on the game board 12 as in the third embodiment such that the light source 16 may irradiate

the glass unit 15 with the excitation light from the game board 12 side. Only one light source unit 30 may be generally provided in the game machine 10, but two or more light source units may be provided.

[0050] The MEMS mirror 31 is, for example, swingable about two axes and irradiates the glass unit 15 with the light from the light source 16 by scanning. Here, the glass unit 15 is irradiated with the excitation light from the light source 16 as scanning light via the MEMS mirror 31 the drive of which is controlled. In this embodiment, the control of the drive of the MEMS mirror 31 can allow the glass unit 15 to emit light such that a desired image is displayed on a desired area. Further, since the light source unit 30 utilizing the MEMS mirror is generally small, use of the MEMS mirror can prevent the game machine from increasing in size due to the light source unit 30.

[0051] When the projection system is used as in this embodiment, various presentments can be easily performed as shown in Fig. 9. Specifically, a reel whose pattern changes can be displayed on the glass unit 15 as shown in Fig. 9(A), or various letters, logos, icons, and characters can be displayed as shown in Figs. 9(B), 9(C), and 9(D). In this embodiment, since the projection system is used, letters, logos, icons, and characters can be freely changed. Accordingly, as shown in Fig. 9(D), information on an event to be performed at a store can also be displayed.

[0052] Further, a moving image expressing complicated movements such as blood splattering or bullet-mark adding may be displayed as shown in Fig. 9(E), and various presentments can also be performed by light emission of an area of a certain size as shown in Fig. 9(F).

[0053] Further, as shown in Fig. 10, a screen 17 of a display device generally including a liquid crystal display is provided on the front surface of the game board 12 of the pachinko machine. On the screen 17, reels and images for performing other presentments are displayed. In this embodiment, as shown in Fig. 10, a quadrangle region superimposed on the screen 17 of the display device when viewed from the front may be referred to as the light emitting region 15E. Further, for example, a region superimposed on a part of the screen 17 of the display device as shown in Fig. 11 may be referred to as the light emitting region 15E. At this time, for example, bullet marks, blood splatters, meteors, eruptions, and shredding light may be expressed by the light emitting region 15E. According to the presentment shown in Figs. 10 and 11, the image displayed on the light emitting region 15E of the glass unit 15 is superimposed on the image displayed on the screen 17 of the display device, thereby a three-dimensional effect can be given to the image.

[0054] However, the light emitting region 15E does not need to be superimposed on the screen 17 of the display device, and may have a frame shape surrounding the screen 17 of the display device as shown in Fig. 12, for example.

[0055] In the fourth embodiment as described above, it is possible to perform various presentments using the projection system.

[0056] A light source unit other than the light source unit including the MEMS mirror 31 may be used, as long as it constitutes a projection system capable of displaying various images. Examples of such a light source unit may include a light source unit that irradiates the glass unit with scanning light other than the light source unit having the MEMS mirror 31. Since such a light source unit that irradiates the glass unit with scanning light is generally small, it is possible to allow the glass unit to emit light without increasing the size of the game machine, like the light source unit having the MEMS mirror.

[0057] Further, the light source unit may be a light source unit capable of irradiating the glass unit with the excitation light as beam light. The beam light irradiates all portions of the glass unit that emit light at the same timing, and no scanning shift or the like occurs as in the case of using scanning light.

[0058] Examples of the light source unit other than the light source unit having the MEMS mirror include those utilizing the DMD (Digital Micromirror Device) method with DLP (Digital Light Processing), LCOS (Liquid crystal on silicon), or the like.

[0059] In the above description, it is assumed that the glass unit emits monochromatic light when being irradiated with the specific excitation light, but the glass unit may emit light of a plurality of colors. In this case, the glass unit contains a plurality of types of luminescent materials having different maximum excitation wavelengths and maximum emission wavelengths from each other. In addition, an example of the light source to be used includes a light source that emits light according to the excitation wavelength of each luminescent material, and the wavelength of the excitation light with which the light source irradiates the glass unit may be changed according to the color to be emitted. For example, a plurality of light sources may be provided to emit excitation light different from each other. Alternatively, a light source to which an optical filter capable of varying a transmission wavelength is attached may be used.

[Light Emission Control of Glass Unit]

[0060] A specific example of light emission control of the glass unit will be described below in detail.

[0061] The light emission of the glass unit 15 may be controlled by any method, but is preferably controlled so as to be performed in conjunction with the game operation of the game machine 10. For example, when a game operation selected from any one of prize-winning, winning, reaching, losing, occurrence of probability variation, mode change due to change of probability variation, end of probability variation, and end of winning period is performed, a state of light emission of the glass unit 15 may be changed.

[0062] More specifically, when the game operation desired to the player, for example, the prize-winning, the winning, the reaching, or the occurrence of probability variation occurs, the glass unit 15 may be allowed to emit light as shown in Figs. 4, 7, and 9 to 12, or the light emitting intensity may be increased or the light emitting region 15E may be made large in a case where the glass unit 15 has already emitted light. At this time, preferably, visible light having a maximum emission wavelength of 450 nm or more is emitted, and blue, green, or red can be expressed. Further, for example, when visible light having a wavelength of 570 nm or more is used, the visible light expresses yellow or red, which is suitable as a color that arouses a player's feelings and indicates that a winning is approaching or that the winning has occurred, and that further arouses a player's emotion when a desired game operation occurs to improve amusement properties.

[0063] In addition, when the game operation undesired to the player such as the occurrence of losing, the end of probability variation, or the end of winning period occurs, the light emission operation may be ended, the light emitting intensity may be reduced, or the light emitting region 15E may be made smaller.

[0064] Further, for example, the light emitting region or the light emitting intensity when the reaching is detected may be made larger than the light emitting region or the light emitting intensity when the prize-winning is detected. Similarly, the light emitting region or the light emitting intensity when the winning is detected may be made larger than the light emitting region or the light emitting intensity when the reaching or the prize-winning is detected.

[0065] When the light emitting region or the light emitting intensity are made larger, the player is more likely to be aroused, so that the player can be expected to the winning or the reaching and amusement properties can be further enhanced.

[0066] Further, as described above, when the glass unit 15 can be irradiated with visible light of different colors by being irradiated with the excitation light of different wavelengths, the colors of light emitted by the glass unit 15 according to the game operation may be changed.

[0067] For example, the glass unit 15 may emit green or blue visible light in a normal state, and preferably emits blue visible light. More specifically, the glass unit 15 may preferably emit visible light having a maximum emission wavelength of less than 570 nm, more preferably emit visible light having a maximum emission wavelength of 530 nm or less, and still more preferably emit visible light having a maximum emission wavelength of 450 to 520 nm. The green or blue visible light calms the player down and enables the player to enjoy the game comfortably in the normal state. Note that the normal state is generally a state in which none of prize-winning, winning, reaching, and occurrence of probability variation occurs.

[0068] On the other hand, for example, when the game operation desired to the player such as prize-winning, winning, reaching, or occurrence of probability variation occurs, the glass unit 15 may preferably emit yellow or red visible light, and more preferably red visible light as described above. Specifically, the glass unit 15 may preferably emit visible light having a maximum emission wavelength of 570 nm or more, more preferably visible light having a maximum emission wavelength of 580 to 750 nm, and still more preferably visible light having a maximum emission wavelength of 590 to 690 nm.

[0069] Note that the prize-winning in the pachinko machine means that pachinko balls are inserted into the prize-winning pocket provided on the game surface of the game board and the pachinko balls are paid out or won a lottery to obtain the winning as a result of the prize-winning. In the description, the prize-winning in a slot machine means that coins are inserted, a button is appropriately pressed, and a reel starts rotating.

[0070] The winning in the pachinko machine means that various rights are acquired by prize-winning or a lottery and a predetermined prize-winning pocket such as a chucker is opened when a winning occurs, for example. The winning in the slot machine means an operation in which patterns of the reel are aligned and thus coins are ejected.

[0071] In addition, the reaching is a presentment in which the won lottery is expected to be a winning, for example, a presentment in which a winning will be achieved when one pattern of the reel is further aligned.

[0072] Further, the losing in the pachinko machine is, for example, a presentment indicating that the lottery won by the prize-winning is losing. The losing in the slot machine means that the player won the prize, but the reels are not aligned.

[0073] In addition, the probability variation indicates a state where a lottery winning probability is high, and for example, occurs when a specific winning (big winning) is won. On the other hand, the probability variation ends, for example, when a specific winning (small winning) is won or when the number of pachinko balls hit after the occurrence of the probability variation exceeds a specific count. Further, the mode change means that an operation of a presentment performed on the game machine is changed due to a change in the probability variation (for example, a start and an end of the probability variation, or a change in the winning probability).

[0074] Further, the winning period is a period in which a winning occurs in the pachinko machine and a predetermined opening pocket such as a chucker is opened.

[0075] An example of a light emission control routine of the glass unit of the present invention will be described below with reference to Fig. 13. An example of a control routine in the game machine of the fourth embodiment will be described below, but the game machines in the first to third embodiments can be controlled in the same manner. In addition, the game machine is usually provided with a control unit such as a CPU, and the following routine is performed by control

of the operation of the light source with the control unit.

[0076] As shown in Fig. 13, in this routine, first, it is determined in S11 whether the prize of pachinko balls is won in the prize-winning pocket, the process proceeds to S12 when it is determined that the prize is won, and the process waits at S11 when the prize is not won. In S12, light emission indicating that the prize is won is performed. As the light emission, the light emitting region 15E may be allowed to emit light for a short time (for example, one second or shorter), but the light emitting region 15E may be allowed to emit light so as to surround the screen 17 as shown in Fig. 12, for example. Although any light emission may be performed as the light emission in this routine, a case where the light emission shown in Fig. 12 is performed will be described below.

[0077] Next, in S13, the lottery result due to the prize-winning is read and it is detected whether the lottery result is in a reaching state. Here, when it is detected that the lottery result is not in the reaching state, a losing presentment is performed in S20. Examples of the losing presentment include maintaining a state where the glass unit 15 does not emit for several seconds. When the light emission control corresponding to the losing is completed, this routine returns to step S11. When the losing presentment is performed in the glass unit 15, the losing presentment is also performed in the screen 17 of the display device, and the presentment of the glass unit 15 is performed in conjunction with the presentment of the screen 17. In addition, examples of the losing presentment in the screen 17 include a flow of an image in which the reels are stopped in a state where the patterns are not aligned.

[0078] On the other hand, it is detected in S13 that the lottery result is in the reaching state, a light emitting operation indicating the reaching state is started in S14. Here, any operation may be performed as the light emitting operation indicating the reaching state, but the operation of emitting light in the light emitting region 15E surrounding the screen 17 of the display device shown in Fig. 12 is performed. At this time, either of the light emitting intensity or the light emitting region may be made larger than the light emission performed in S12 described above. Further, the light emission in S14 may be performed longer than the light-emitting time in S12, for example, and may be performed for 10 seconds or more, for example. The light emission may be performed continuously or intermittently. With such a reaching presentment, the player's feeling is aroused, and winning expectation is increased.

[0079] In the case of the reaching state, since the presentment is usually performed on the screen 17 of the display device according to the reaching state, the light emission of the glass unit 15 is performed in conjunction with the presentment in the screen 17.

[0080] Next, it is detected in S15 whether the lottery result is a winning. When it is detected that the lottery result is the winning, a presentment corresponding to the winning is performed in S16. Any presentment may be performed, but, for example, as shown in Fig. 12, the light emitting region 15E surrounding the screen 17 of the display device may be allowed to emit light during the winning period. At this time, for example, either of the light emitting intensity or the light emitting region may be made larger than the light emitting intensity or the light emitting region of the light emission performed in S14 described above. With such a winning presentment, the player can feel that the winning has occurred and amusement properties are further enhanced. The light emission may be performed continuously or intermittently. When step S16 ends, the routine returns to S11. When the winning occurs, since the presentment corresponding to the winning is usually performed on the screen 17 of the display device, the light emission of the glass unit 15 is performed in conjunction with the presentment in the screen 17.

[0081] On the other hand, when it is detected in S15 that the losing is detected, the process proceeds to S20, and the above-described losing presentment preferably performed in S20.

[0082] The light emission control routine described above is merely an example, and any another light emission control may be performed. For example, the light emitting state may be change depending on the type of winning or reaching state. More specifically, the light emitting state may be changed depending on whether the winning is a big winning or a small winning. In addition, the light emitting state may be changed depending on whether the reaching state is a normal reaching state or is a reaching state having a higher occurrence probability of the big winning than other reaching states. Further, the light emitting state at the time of the occurrence of the reaching or the winning may be changed depending on whether the probability variation has occurred.

[0083] Further, when the probability variation occurs or ends, the light emitting state of the glass unit may be changed to indicate that the probability variation occurs or ends using the light emission of the glass unit.

[Glass Unit]

[0084] Next, the glass unit used in the present invention will be described in detail.

[0085] The glass unit used in the present invention may be composed of a single layer or may have a multilayer structure having two or more layers. Further, in the glass unit, it is preferable that at least one layer is a transparent plate. The transparent plate may be composed of any one of inorganic glass and organic glass. The organic glass is so-called resin glass. The glass unit having a multilayer structure may include one transparent plate or may include two or more transparent plates. Further, in the glass unit, such a transparent plate may contain luminescent material and serve as a light emitting layer that emits light by an incident excitation light, or a layer other than the transparent plate

may contain a luminescent material and serve as a light emitting layer.

[0086] Further, the glass unit preferably has a multilayer structure comprising a laminate of at least one transparent plate and a resin layer, and it is more preferable that the resin layer contains a resin and a luminescent material to serve as a light emitting layer in the multilayer structure.

[0087] Further, the light emitting layer is not limited to the resin layer and the transparent plate mentioned above and may be a luminescent material coating formed by vacuum vapor deposition, sputtering, or the like of a luminescent material. The luminescent material coating may be formed, for example, on at least one surface of the transparent plate.

(Luminescent material)

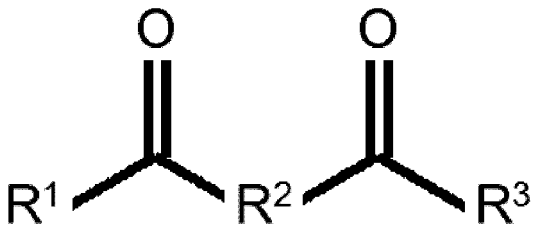
[0088] The luminescent material emits visible light by an incident excitation light, more specifically, absorbs the excitation light radiated from the aforementioned light source to emit visible light having a wavelength longer than that of the excitation light. Further, the luminescent material may be a material that emits so-called phosphorus light by irradiation with the excitation light.

[0089] Specifically, examples of the aforementioned luminescent material include a lanthanoid complex having a ligand containing a halogen atom since it can exert high luminescence. Among lanthanoid complexes, the lanthanoid complex having a ligand containing a halogen atom emits light with high light emission intensity by irradiation with light rays. Examples of the lanthanoid complex having a ligand containing a halogen atom include a lanthanoid complex having a monodentate ligand containing a halogen atom and a lanthanoid complex having a multidentate ligand containing a halogen atom such as a lanthanoid complex having a bidentate ligand containing a halogen atom, a lanthanoid complex having a tridentate ligand containing a halogen atom, a lanthanoid complex having a tetradentate ligand containing a halogen atom, a lanthanoid complex having a pentadentate ligand containing a halogen atom, and a lanthanoid complex having a hexadentate ligand containing a halogen atom.

[0090] Among these, the lanthanoid complex having a bidentate ligand containing a halogen atom or the lanthanoid complex having a tridentate ligand containing a halogen atom can emit visible light with high light emission intensity by irradiation with light at a wavelength of 300 to 410 nm. Further, the lanthanoid complex having a bidentate ligand containing a halogen atom or the lanthanoid complex having a tridentate ligand containing a halogen atom also has excellent heat resistance and can prevent deterioration of the luminescent material.

[0091] In this description, the lanthanoid includes lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, or lutetium. For obtaining still higher light emission intensity, the lanthanoid is preferably neodymium, europium, or terbium, more preferably europium or terbium, further preferably europium.

[0092] Examples of the bidentate ligand containing a halogen atom include a ligand having a structure represented by formula (1) below and a ligand having a structure represented by formula (2) below.



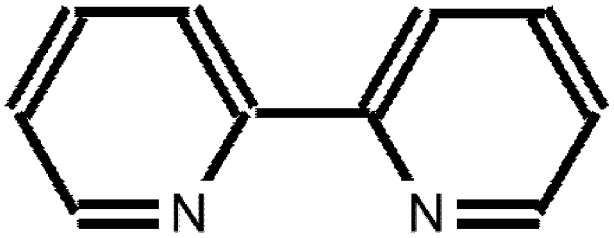
(1)

[0093] In formula (1) above, R^1 and R^3 each represent an organic group, at least one of R^1 and R^3 is an organic group containing a halogen atom, and R^2 represents a linear organic group having one or more carbon atoms. R^1 and R^3 above are each preferably a hydrocarbon group, more preferably a hydrocarbon group having 1 to 10 carbon atoms, further preferably a hydrocarbon group having 1 to 5 carbon atoms, particularly preferably a hydrocarbon group having 1 to 3 carbon atoms. The hydrogen atoms in the aforementioned hydrocarbon group may be partially replaced by atoms other than hydrogen atoms and functional groups. Examples of the hydrocarbon group having 1 to 3 carbon atoms include a methyl group, an ethyl group, and a propyl group, with no hydrogen atoms replaced, and a methyl group, an ethyl group, and a propyl group, with the hydrogen atoms partially replaced by halogen atoms. Fluorine atoms, chlorine atoms, bromine atoms, and iodine atoms can be used as the halogen atoms that partially replace the hydrogen atoms of the methyl group, the ethyl group, and the propyl group. As the hydrocarbon group having 1 to 3 carbon atoms, a methyl group, an ethyl group, and a propyl group, with the hydrogen atoms partially replaced by halogen atoms are preferable, and trifluoromethyl groups are more preferable, since they emit light with high light emission intensity.

[0094] R^2 above is preferably an alkylene group having one or more carbon atoms, more preferably an alkylene group having 1 to 5 carbon atoms, most preferably a methylene group having one carbon atom. The alkylene group having

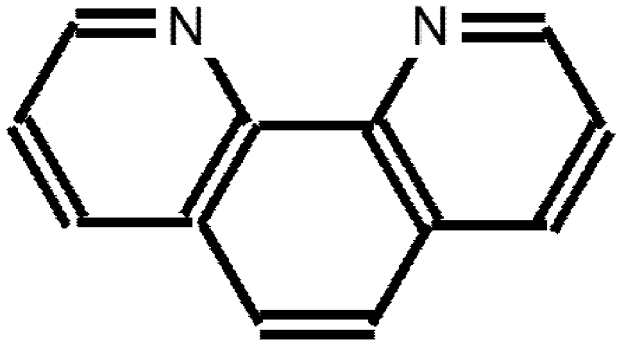
one or more carbon atoms may have hydrogen atoms partially replaced by atoms other than the hydrogen atoms and functional groups.

[0095] The lanthanoid complex having a ligand containing a halogen atom may have at least one ligand containing a halogen atom and may have a ligand containing no halogen atoms. Examples of the ligand containing no halogen atoms include a ligand that is the same as the ligand of formula (1) above except for containing no halogen atoms, and a ligand having a structure represented by formula (2) to (8) below. The ligand having a structure represented by formula (2) to (8) below may have hydrogen atoms partially or entirely replaced by - COOR, $-SO_3$, $-NO_2$, -OH, an alkyl group, $-NH_2$, and the like.



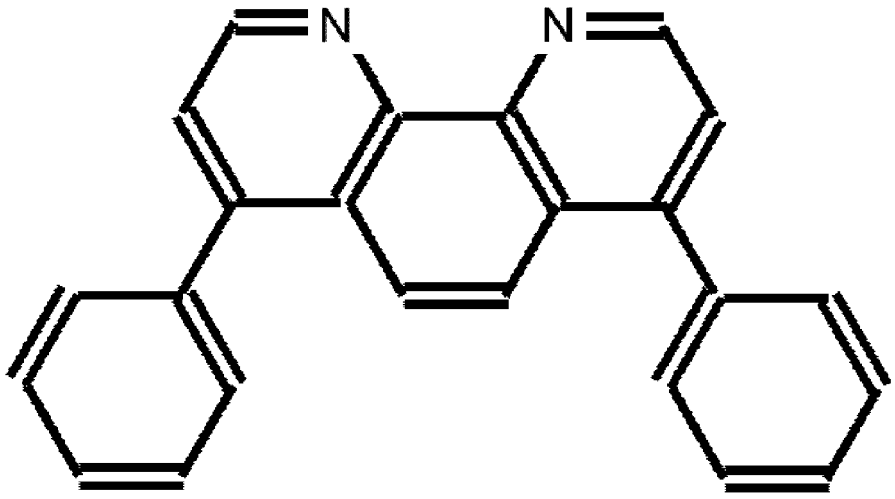
(2)

In formula (2) above, two Ns may be located at any positions in the bipyridine skeleton. For example, the two Ns are located at the 2- and 2'-positions, the 3- and 3'-positions, the 4- and 4'-positions, the 2- and 3'-positions, the 2- and 4'-positions, or the 3- and 4'-positions in the bipyridine skeleton. Among these, the two Ns are preferably located at the 2- and 2'-positions.



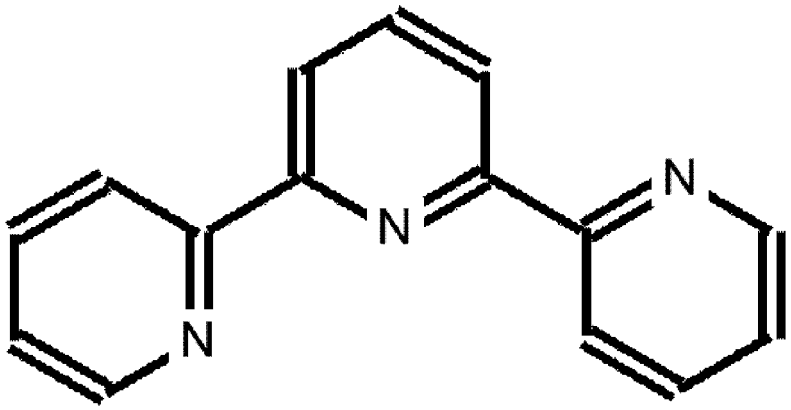
(3)

In formula (3) above, the two Ns may be located at any positions in the bipyridine skeleton. Among these, the two Ns are preferably located at the 1- and 10-positions.



(4)

In formula (4) above, the two Ns may be located at any positions in the bipyridine skeleton. Among these, the two Ns are preferably located at the 1- and 10-positions.

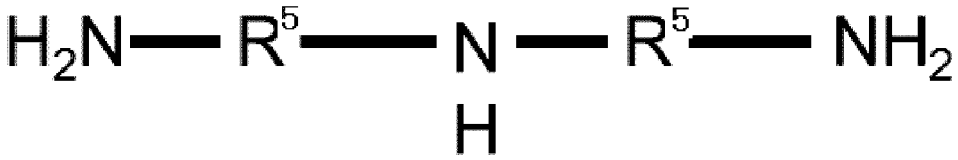


(5)

In formula (5) above, the three Ns may be located at any positions in the terpyridine skeleton.

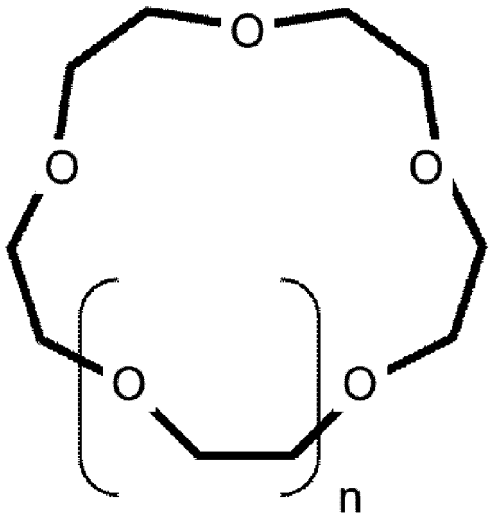
$$H_2N\text{-}R^4\text{-}NH_2 \qquad (6)$$

[0096] In formula (6) above, R^4 at the center represents a linear organic group having one or more carbon atoms.



(7)

In formula (7) above, two R^5s each represent a linear organic group having one or more carbon atoms.



(8)

[0097] In formula (8) above, n represents an integer of 1 or 2.

[0098] Examples of the lanthanoid complex having a bidentate ligand containing a halogen atom include tris(trifluoroacetylacetone)phenanthroline europium ($Eu(TFA)_3phen$), tris(trifluoroacetylacetone)diphenylphenanthroline europium ($Eu(TFA)_3dpphen$), tris(hexafluoroacetylacetone)diphenylphenanthroline europium, tris(hexafluoroacetylacetone) bis(triphenylphosphine) europium, tris(trifluoroacetylacetone)2,2'-bipyridine europium, tris(hexafluoroacetylacetone)2,2'-bipyridine europium, tris(5,5,6,6,7,7,7-heptafluoro-2,4-pentanedionate)2,2'-bipyridine europium ($[Eu(FPD)_3]bpy$), tris(trifluoroacetylacetone)3,4,7,8-tetramethyl-1,10phenanthroline europium ($[Eu(TFA)_3]tmphen$), tris(5,5,6,6,7,7,7-heptafluoro-2,4-pentanedionate)phenanthroline europium ($[Eu(FPD)_3]phen$), terpyridine trifluoroacetylacetone europium, and terpyridine hexafluoroacetylacetone europium.

[0099] Examples of the lanthanoid complex having a bidentate ligand containing a halogen atom additionally include

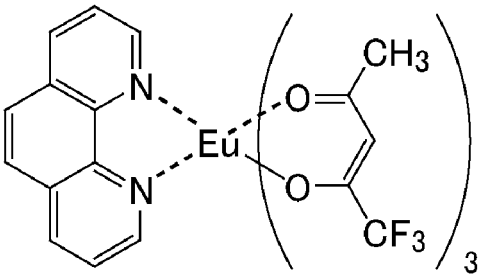
tris(trifluoroacetylacetone)phenanthroline terbium ($Tb(TFA)_3phen$), tris(trifluoroacetylacetone)diphenylphenanthroline terbium ($Tb(TFA)_3dpphen$), tris(hexafluoroacetylacetone)diphenylphenanthroline terbium, tris(hexafluoroacetylacetone)bis(triphenylphosphine) terbium, tris(trifluoroacetylacetone)2,2'-bipyridine terbium, tris(hexafluoroacetylacetone)2,2'-bipyridine terbium, tris(5,5,6,6,7,7,7-heptafluoro-2,4-pentanedionate)2,2'-bipyridine terbium ($[Tb(FPD)_3]bpy$), tris(trifluoroacetylacetone)3,4,7,8-tetramethyl-1,10phenanthroline terbium ($[Tb(TFA)_3]tmphen$), tris(5,5,6,6,7,7,7-heptafluoro-2,4-pentanedionate)phenanthroline terbium ($[Tb(FPD)_3]phen$), terpyridine trifluoroacetylacetone terbium, and terpyridine hexafluoroacetylacetone terbium.

[0100] As the halogen atom contained in the ligand of the lanthanoid complex, a fluorine atom, a chlorine atom, a bromine atom, or an iodine atom can be used. Among these, a fluorine atom is suitable for stabilizing the structure of the ligand.

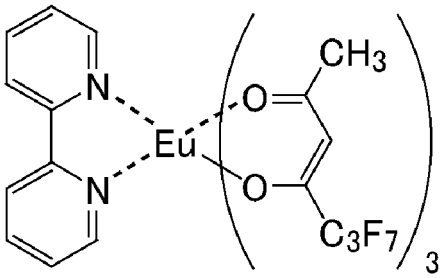
[0101] Among the lanthanoid complex having a bidentate ligand containing a halogen atom or the lanthanoid complex having a tridentate ligand containing a halogen atom, a lanthanoid complex having a bidentate ligand containing a halogen atom and having an acetylacetone skeleton is particularly suitable due to its excellent initial luminescence.

[0102] Examples of the lanthanoid complex having a bidentate ligand containing a halogen atom and having an acetylacetone skeleton include $Eu(TFA)_3phen$, $Eu(TFA)_3dpphen$, $Eu(HFA)_3phen$, $[Eu(FPD)_3]bpy$, $[Eu(TFA)_3]tmphen$, and $[Eu(FPD)_3]phen$. The structures of such a lanthanoid complex having a bidentate ligand containing a halogen atom and having an acetylacetone skeleton are shown below.

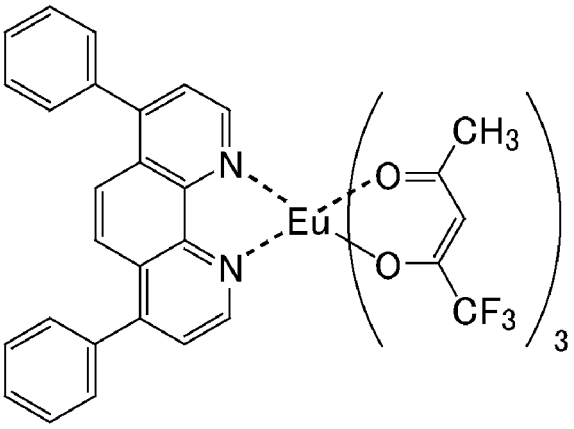
$Eu(TFA)_3phen$



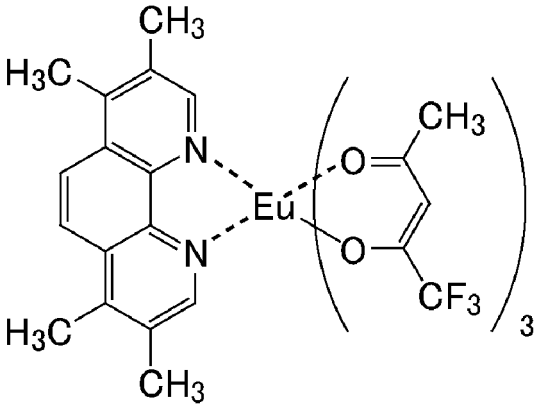
$[Eu(FPD)_3]bpy$



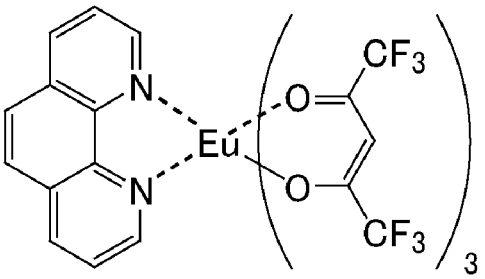
$Eu(TFA)_3dpphen$



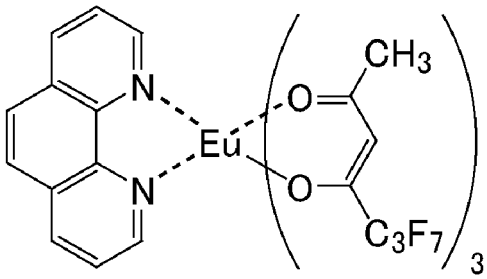
$[Eu(TFA)_3]tmphen$



Eu(HFA)$_3$phen



[Eu(FPD)$_3$]phen



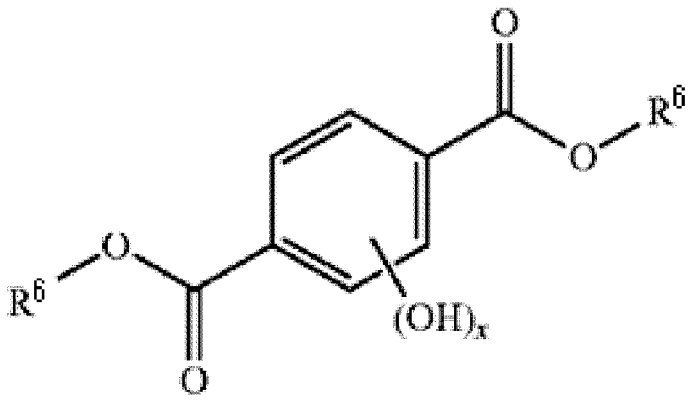
[0103] Examples of the lanthanoid complex having a bidentate ligand containing a halogen atom and having an acetylacetone skeleton additionally include Tb(TFA)$_3$phen, Tb(TFA)$_3$dpphen, Tb(HFA)$_3$phen, [Tb(FPD)$_3$]bpy, [Tb(TFA)$_3$]tmphen, and [Tb(FPD)$_3$]phen.

[0104] The lanthanoid complex having a ligand containing a halogen atom is preferably particulate. The particulate form makes it easier to finely disperse the lanthanoid complex having a ligand containing a halogen atom in the light emitting layer.

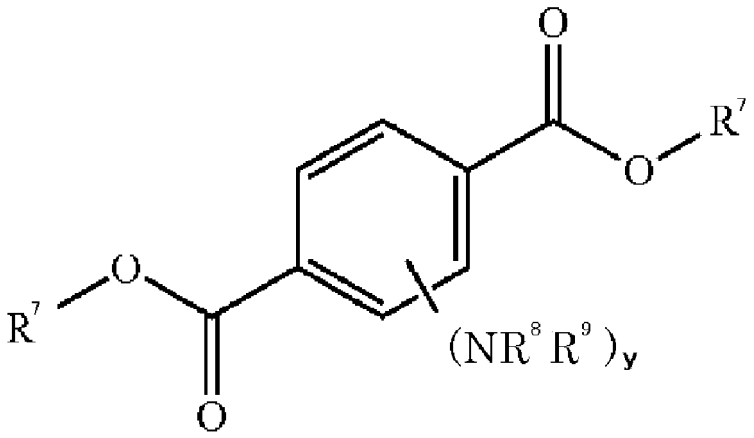
[0105] When the lanthanoid complex having a ligand containing a halogen atom is particulate, the lower limit of the average particle size of the lanthanoid complex is preferably 0.01 μm, and the upper limit thereof is preferably 10 μm. The lower limit is more preferably 0.03 μm, and the upper limit thereof is more preferably 1 μm.

[0106] As the aforementioned luminescent material, a luminescent material having a terephthalic acid ester structure can be also used. The luminescent material having a terephthalic acid ester structure emits light by irradiation with light rays.

[0107] Examples of the luminescent material having a terephthalic acid ester structure include a compound having a structure represented by formula (9) below and a compound having a structure represented by formula (10) below. One of these may be used singly, or two or more of these may be used.



(9)



(10)

[0108] In formula (9) above, R^6 represents an organic group, and x is 1, 2, 3, or 4.

[0109] For further enhancing the visible light transmission of the glass unit, x is preferably 1 or 2, more preferably the structure represented by formula (9) has a hydroxyl group at the 2- or 5-position of the benzene ring, and further preferably has hydroxyl groups at the 2- and 5-positions of the benzene ring.

[0110] The organic group of R^6 is preferably a hydrocarbon group, more preferably a hydrocarbon group having 1 to 10 carbon atoms, further preferably a hydrocarbon group having 1 to 5 carbon atoms, particularly preferably a hydrocarbon group having 1 to 3 carbon atoms. When the hydrocarbon group has 10 or less carbon atoms, the luminescent material having a terephthalic acid ester structure can be easily dispersed in the light emitting layer. The hydrocarbon group is preferably an alkyl group.

[0111] Examples of the compound having a structure represented by formula (9) above include diethyl-2,5-dihydroxyterephthalate and dimethyl-2,5-dihydroxyterephthalate. Among these, the compound having a structure represented by formula (9) above is preferably diethyl-2,5-dihydroxyl terephthalate ("diethyl 2,5-dihydroxyterephthalate" available from Sigma-Aldrich Co. LLC).

[0112] In formula (10) above, R^7 represents an organic group, R^8 and R^9 each represent a hydrogen atom or an organic group, and y is 1, 2, 3, or 4.

[0113] The organic group of R^7 is preferably a hydrocarbon group, more preferably a hydrocarbon group having 1 to 10 carbon atoms, further preferably a hydrocarbon group having 1 to 5 carbon atoms, particularly preferably a hydrocarbon group having 1 to 3 carbon atoms. When the number of carbon atoms in the hydrocarbon group is equal to or less than the upper limit, the luminescent material having a terephthalic acid ester structure can be easily dispersed in the light emitting layer. The hydrocarbon group is preferably an alkyl group.

[0114] In formula (10) above, NR^8R^9 is an amino group. R^8 and R^9 are each preferably a hydrogen atom. Of the hydrogen atoms in the benzene ring of the compound having a structure represented by formula (10) above, one hydrogen atom may be the aforementioned amino group, two hydrogen atoms may be each the aforementioned amino group, three hydrogen atoms may be each the aforementioned amino group, and four hydrogen atoms may be each the aforementioned amino group.

[0115] The compound having a structure represented by formula (10) above is preferably diethyl-2,5-diaminoterephthalate (for example, available from Sigma-Aldrich Co. LLC).

(Resin layer)

[0116] As described above, a resin layer serving as the light emitting layer is preferably provided in the glass unit. Further, the glass unit preferably has a laminated glass structure in which an interlayer film is provided between two transparent plates, and the two transparent plates are bonded together via the interlayer film.

[0117] In the laminated glass structure, the interlayer film is composed of a single layer of a resin layer, and the resin layer preferably serves as the light emitting layer. Further, two or more layers of resin layers may be provided in the interlayer film, and at least one of the plurality of resin layers may serve as the light emitting layer.

[0118] Further, the resin layer serving as the light emitting layer does not necessarily constitute the interlayer film and may be provided, for example, on the surface of any one of the transparent plates that is opposite to the surface on the interlayer film side, in the laminated glass structure. Further, when one transparent plate is provided in the glass unit, the resin layer serving as the light emitting layer may be provided on any one of the surfaces of the single layer transparent plate.

[0119] When the resin layer serving as the light emitting layer is provided on the opposite surface in the laminated glass structure or any one surface of the single layer transparent plate, a sheet-like member having the light emitting layer (resin layer) may be bonded to the surface of the single layer glass or the laminated glass structure via an adhesive, a pressure-sensitive adhesive, or the like. Thus, the light emitting layer can be provided on the glass unit by attaching such a sheet-like member onto existing glass unit by so-called post bonding.

[0120] The resin layer serving as the light emitting layer contains a resin and a luminescent material, in which the luminescent material is generally dispersed in the resin. The luminescent material may be dispersed throughout the light emitting layer. Accordingly, the glass unit emits the visible light even when any position of the glass unit is irradiated with the excitation light.

[0121] The resin used in the resin layer is preferably a thermoplastic resin. Use of the thermoplastic resin makes it easy for the resin layer to exert functions as an adhesive layer and facilitates bonding to the transparent plates or the like in the case of constituting an interlayer film, as described above.

[0122] When the resin layer contains a luminescent material, the content of the luminescent material is preferably 0.001 parts by mass or more, more preferably 0.05 parts by mass or more, further preferably 0.1 parts by mass or more, with respect to 100 parts by mass of the resin. Adjusting the content of the luminescent material to such a lower limit or more enables the glass unit to sufficiently emit light. Further, the content of the luminescent material is preferably 10 parts by mass or less, more preferably 3 parts by mass or less, further preferably 1.5 parts by mass or less. Adjusting

the content to such an upper limit or less facilitates ensuring the transparency of the glass unit.

[0123] The thickness of the resin layer is not specifically limited but is, for example, 0.1 to 2 mm, preferably 0.2 to 1 mm. Adjusting the thickness of the resin layer to such a range enables sufficient light emission brightness to be ensured without impairing the transparency of the glass unit.

[0124] Further, the thickness of the interlayer film is not specifically limited but is, for example, 0.1 to 3 mm, preferably 0.2 to 2 mm.

[0125] As described above, the resin used in the resin layer is preferably a thermoplastic resin. Further, the thermoplastic resin used in the resin layer is not specifically limited, but examples thereof include a polyvinyl acetal resin, an ethylene-vinyl acetate copolymer resin, an ionomer resin, a polyurethane resin, and a thermoplastic elastomer. Use of such a resin facilitates ensuring the adhesiveness of the resin layer to the transparent plates and is thus particularly suitable when the resin layer constitutes an interlayer film.

[0126] In the resin layer, one of such thermoplastic resins may be used singly or two or more of them may be used in combination. Among these, a polyvinyl acetal resin is particularly suitable in that excellent adhesiveness to inorganic glass is exerted when the resin layer contains a plasticizer.

[0127] When the resin layer contains a thermoplastic resin, the resin layer may further contain a plasticizer. The resin layer is made flex by containing a plasticizer, as a result of which, the glass unit is made flex. Further, the adhesiveness to the transparent plates can be enhanced, particularly when the transparent plates are inorganic glass. In the case of using a polyvinyl acetal resin as the thermoplastic resin, the plasticizer is particularly effective when contained in the layer.

[0128] Examples of the plasticizer include organic ester plasticizers such as monobasic organic acid esters and polybasic organic acid esters, and phosphoric acid plasticizers such as organic phosphoric acid plasticizers and organic phosphorous acid plasticizers. Among these, organic ester plasticizers are preferable, and triethylene glycol-di-2-ethyl hexanoate (3GO) is particularly suitable.

[0129] The content of the plasticizer is not specifically limited, but the lower limit is preferably 30 parts by mass, and the upper limit is preferably 70 parts by mass, with respect to 100 parts by mass of the thermoplastic resin. When the content of the plasticizer is 30 parts by mass or more, the glass unit is made appropriately flex, so that the handleability is made good. Further, when the content of the plasticizer is 70 parts by mass or less, separation of the plasticizer from the resin layer is prevented. The lower limit of the content of the plasticizer is more preferably 35 parts by mass, and the upper limit is more preferably 63 parts by mass.

[0130] Further, when the resin layer of the present invention contains a thermoplastic resin, the thermoplastic resin, or the thermoplastic resin and the plasticizer serve as main components, and the total amount of the thermoplastic resin and the plasticizer is generally 70 mass % or more, preferably 80 mass % or more, further preferably 90 mass % or more, with reference to the total amount of the resin layer.

[0131] The resin layer not serving as the light emitting layer is the same as described above, except that it does not contain a luminescent material. Further, the resin layer may contain additives such as antioxidants, adhesion modifiers, ultraviolet absorbers, infrared absorbers, and antistatic agents, as required.

[0132] The resin layer can be produced by a known method, but when a thermoplastic resin is used, for example, a composition obtained by kneading a material constituting the interlayer film, for example, a thermoplastic resin, a luminescent material, and a plasticizer may be molded by extrusion molding, press molding, or the like.

(Transparent plate)

[0133] As the transparent plate, those which can be used for glass unit can be used without specific limitation, and inorganic glass and organic glass can be used. The inorganic glass is not specifically limited, but examples thereof include clear glass, float plate glass, polished plate glass, figured glass, meshed plate glass, wired plate glass, and green glass.

[0134] Further, as the organic glass, those generally called resin glass are used without specific limitation, but examples thereof include transparent organic glass composed of resins such as polycarbonates, acrylic resins, acrylic copolymer resins, and polyesters.

[0135] When the glass unit has two or more transparent plates, the plurality of transparent plates may be composed of the same material as each other and may be composed of different materials. For example, when two transparent plates are included, one may be inorganic glass and the other may be organic glass. However, when a plurality of transparent plates are included, the plurality of transparent plates are preferably all inorganic glass or all organic glass.

[0136] Further, the thickness of each transparent plate is not specifically limited but is, for example, about 0.1 to 15 mm, preferably 0.5 to 5 mm. When the glass unit has a plurality of transparent plates, the thickness of each transparent plate may be the same or different.

[0137] As described above, in the glass unit, the transparent plate may serve as the light emitting layer that emits visible light. When the transparent plate serves as the light emitting layer, the transparent plate itself contains the luminescent material. At this time, the luminescent material may be dispersed in the inorganic material constituting

inorganic glass or the organic material (resin) constituting organic glass of the transparent plate. Here, the luminescent material may be dispersed throughout the transparent plate. When the transparent plate itself contains the luminescent material, the content of the luminescent material is preferably 0.001 parts by mass or more, more preferably 0.05 parts by mass or more, further preferably 0.1 parts by mass or more, with respect to 100 parts by mass of the inorganic material constituting inorganic glass or 100 parts by mass of the resin constituting organic glass. Adjusting the content of the luminescent material to such a lower limit or more enables the glass unit to sufficiently emit light. Further, the content of the luminescent material is preferably 10 parts by mass or less, more preferably 3 parts by mass or less, further preferably 1.5 parts by mass or less. Adjusting the content of the inorganic material to such an upper limit or less prevents the transparency of the glass unit from being impaired by the luminescent material.

[0138] When the transparent plate contains the luminescent material to serve as the light emitting layer, the glass unit may have the laminated glass structure as described above or the transparent plate may be composed of a single layer. In the case of having the laminated glass structure, at least one transparent plate may serve as the light emitting layer.

[0139] The glass unit transmits visible light so as to visibly recognize the game board from the outside. The visible light transmission of the glass unit is preferably 50% or more, and more preferably 70% or more. The player can easily observe the game surface by the increase of the visible light transmission. Further, the upper limit of the visible light transmission is not specifically limited and is preferably as high as possible but is practically preferably 99% or less, more preferably 95% or less. The visible light transmission can be measured, for example, according to JIS R3106 (1998).

[0140] Further, the glass unit emits visible light due to the excitation light incident from the light source, as described above. The visible light is light having a wavelength of 380 to 780 nm. Further, the glass unit may emit blue, green, red, yellow, and other light or may emit white light by mixing light of two or more colors. In the case of mixing light of two or more colors, for example, two or more light emitting layers may be provided, so that each layer irradiates the glass unit with light of different color for mixing colors, or one light emitting layer may contain two or more luminescent materials.

[0141] Further, as described above, the light emitting layer may contain two or more luminescent materials having different maximum emission wavelengths and maximum excitation wavelengths. With such a configuration, it is also possible to emit light of two or more colors by irradiating the glass unit with the excitation light according to the excitation wavelength of each of the luminescent materials. In this case, two or more light emitting layers are preferably provided, and the maximum emission wavelength and the maximum excitation wavelength of the luminescent material contained in each of the light emitting layers may be different from those of the luminescent material contained in another light emitting layers. For the light emission of two or more colors, for example, a europium complex having a ligand containing a halogen atom and a terbium complex may be used as the luminescent material.

Reference Signs List

[0142]

10:	Game machine
11:	Housing
12:	Game board
13:	Front cover
14:	Frame body
15:	Glass unit
15A, 15B:	Transparent plate
15C:	Interlayer film
15E:	Light emitting region
15X:	Outer circumferential surface
16:	Light source
17:	Screen of display device
20:	Light guide
30:	Light source unit
31:	MEMS mirror

Claims

1. A game machine comprising:

a game board; and
a glass unit disposed in front of the game board, the glass unit containing a luminescent material that emits

visible light having a wavelength of 380 to 780 nm by excitation light.

2. The game machine according to claim 1, further comprising: a light source that irradiates the glass unit with excitation light.

3. The game machine according to claim 2, wherein the light source irradiates the glass unit with the excitation light from an outer circumferential surface side of the glass unit, or irradiates the glass unit with the excitation light from the game board side.

4. The game machine according to claim 2 or 3, wherein the light source is an LED light source or an LD light source capable of irradiating the glass unit with light having an excitation wavelength, or constitutes a projection system.

5. The game machine according to any one of claims 1 to 4, wherein
the glass unit has a multilayer structure in which at least one transparent plate and a resin layer are laminated, and
the resin layer contains a resin and a luminescent material that emits the visible light by an incident excitation light.

6. The game machine according to any one of claims 1 to 5, wherein
the glass unit includes two transparent plates and an interlayer film provided between the two transparent plates, and has a glass structure in which the two transparent plates are bonded via the interlayer film, and
the interlayer film, includes one or more resin layers, and at least one of the resin layers is a light emitting layer containing a resin and a luminescent material that emits the visible light by an incident excitation light.

7. The game machine according to any one of claims 1 to 6, wherein when any game operation selected from the group consisting of prize-winning, winning, reaching, losing, occurrence of probability variation, mode change due to change of probability variation, end of probability variation, and end of winning period is performed, a state of light emission of the glass unit is changed.

8. A presentment method of a game machine including a game board and a glass unit disposed in front of the game board, the glass unit containing a luminescent material that emits visible light having a wavelength of 380 to 780 nm by excitation light, the method comprising:
irradiating the glass unit with excitation light to emit the visible light.

Fig. 1

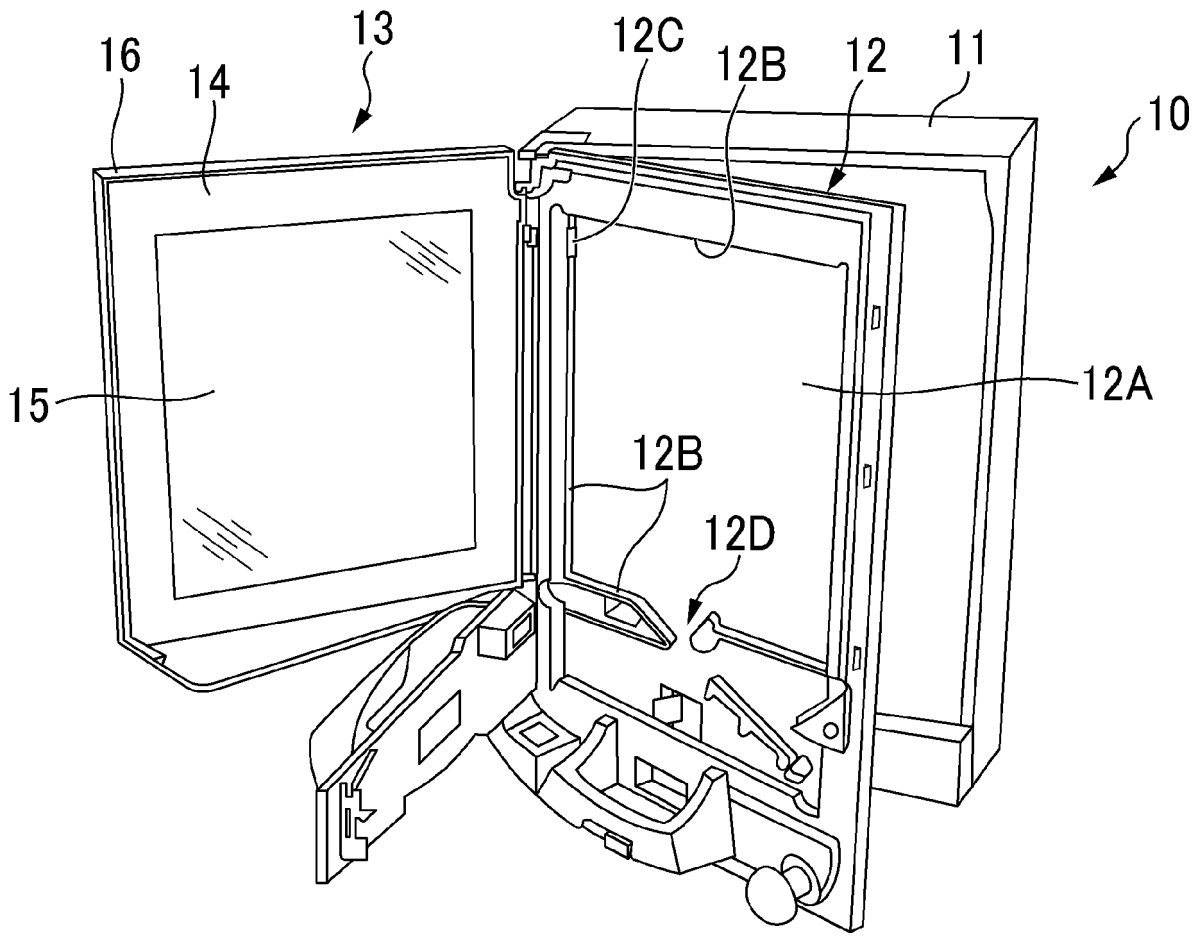


Fig. 2

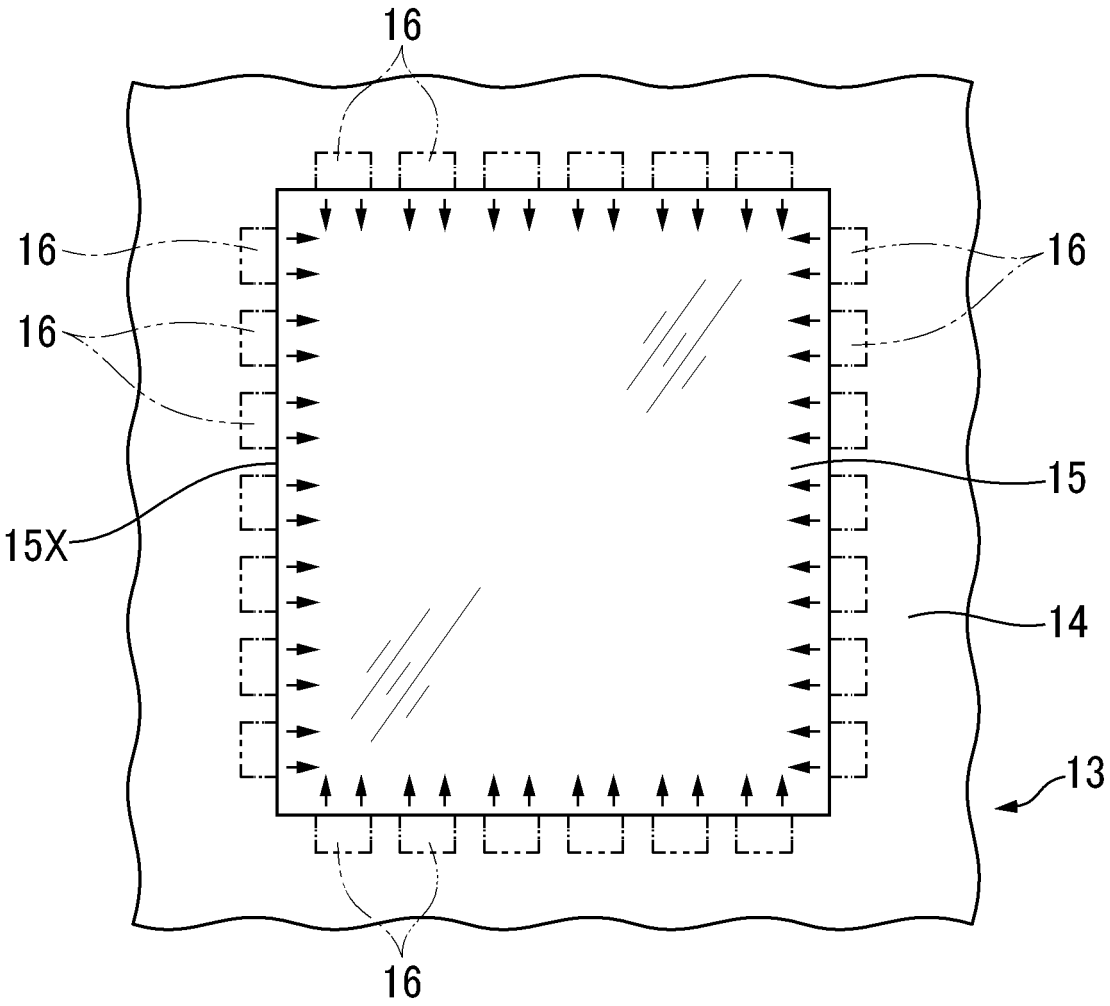


Fig. 3

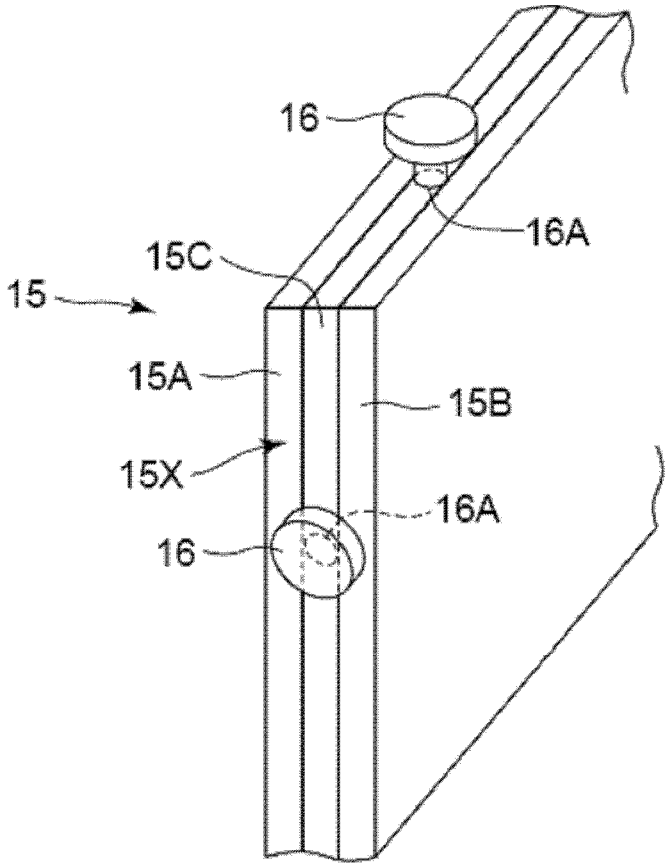


Fig. 4

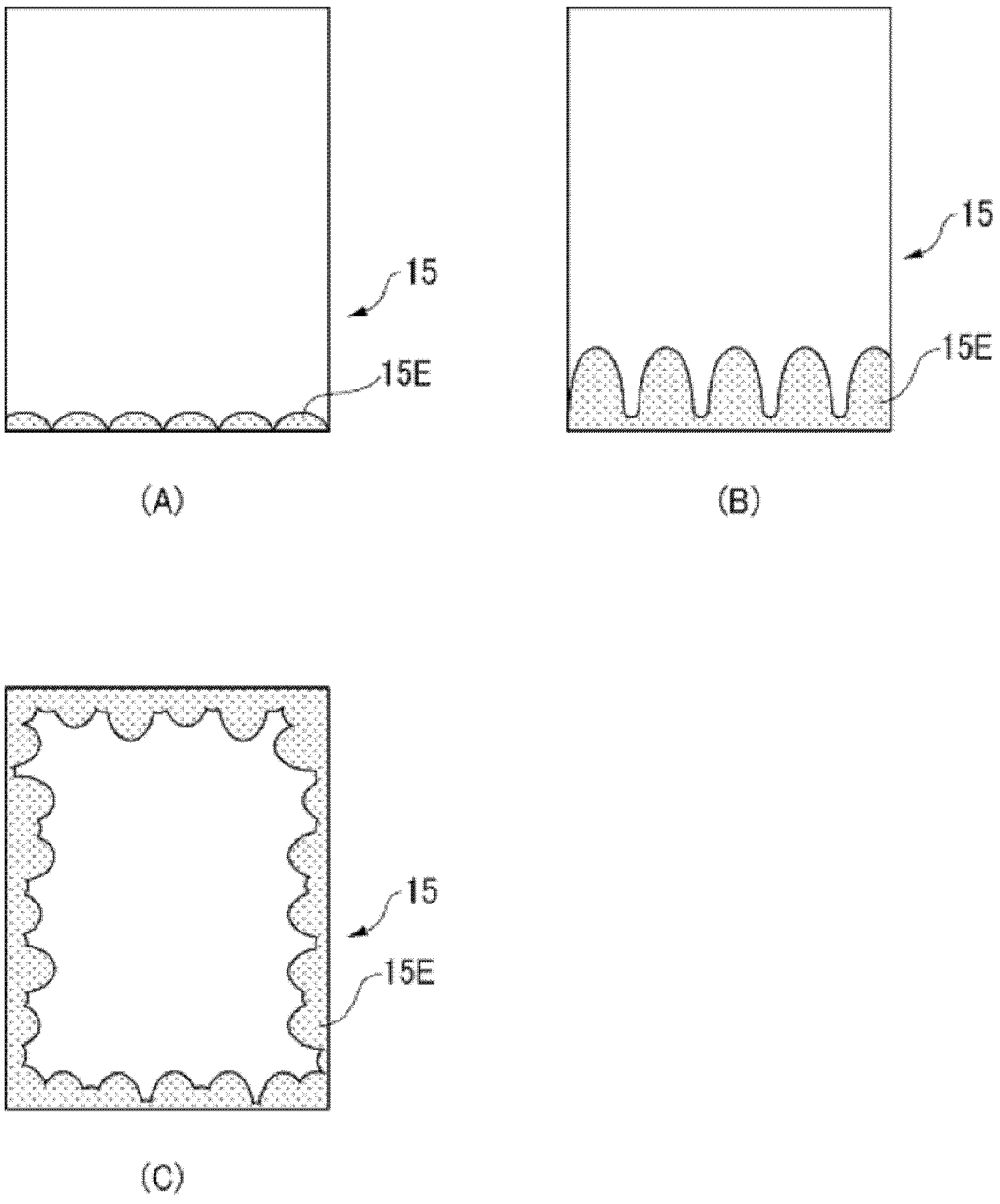


Fig. 5

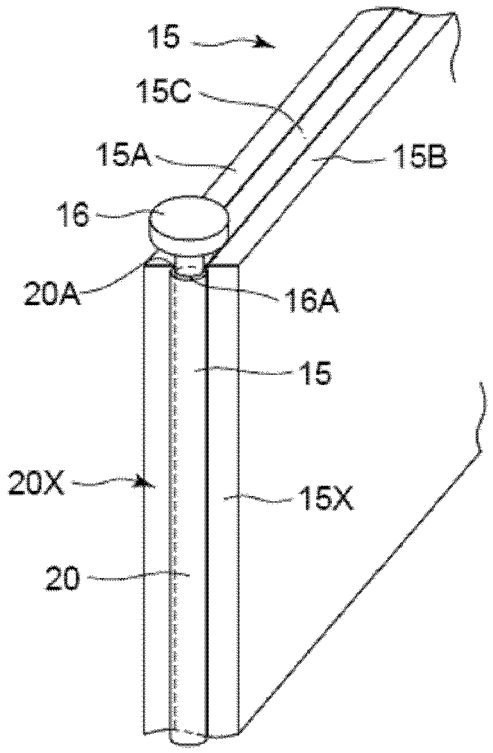


Fig. 6

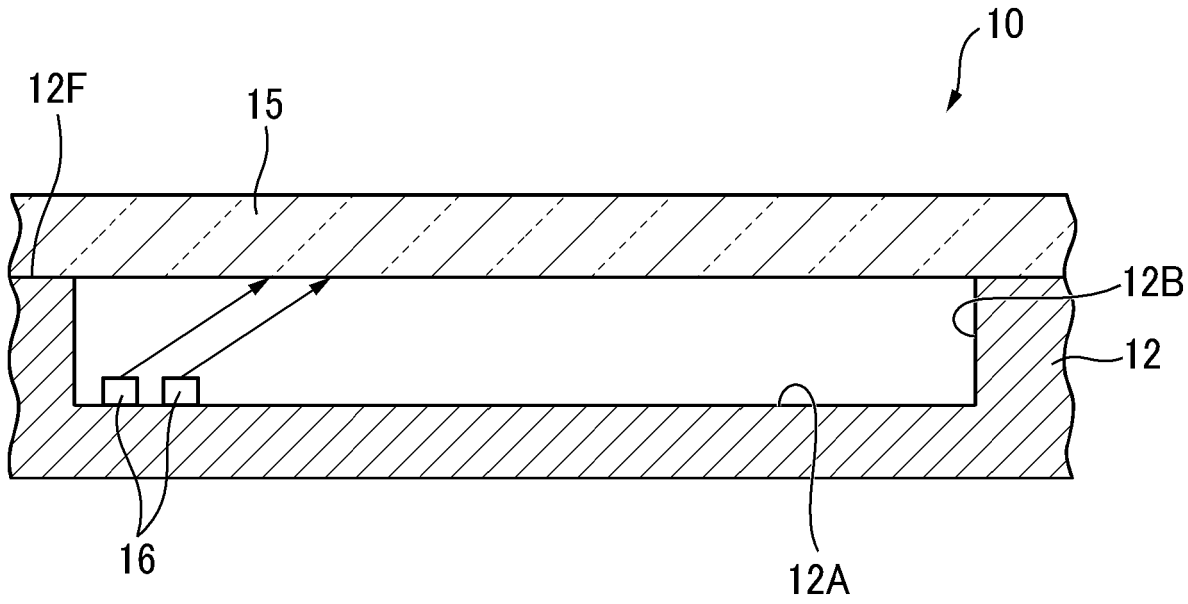
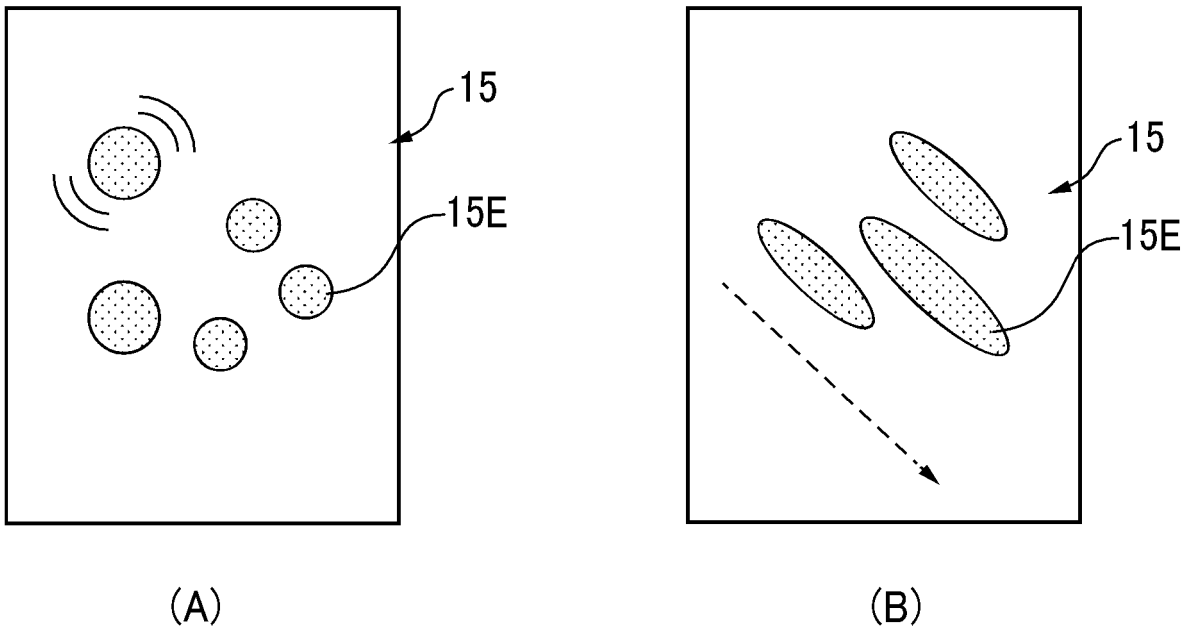


Fig. 7



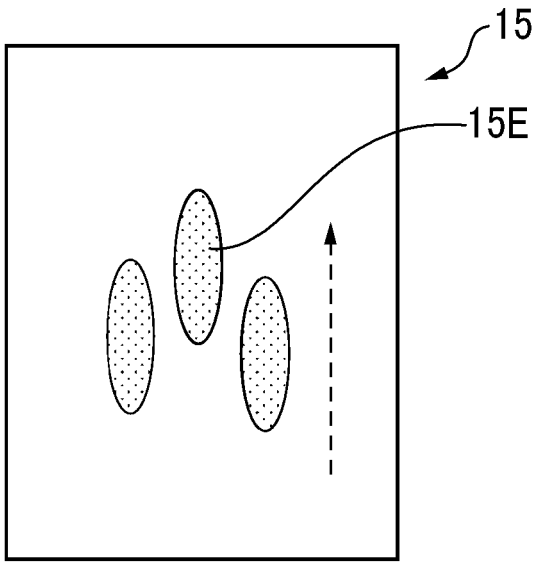


Fig. 8

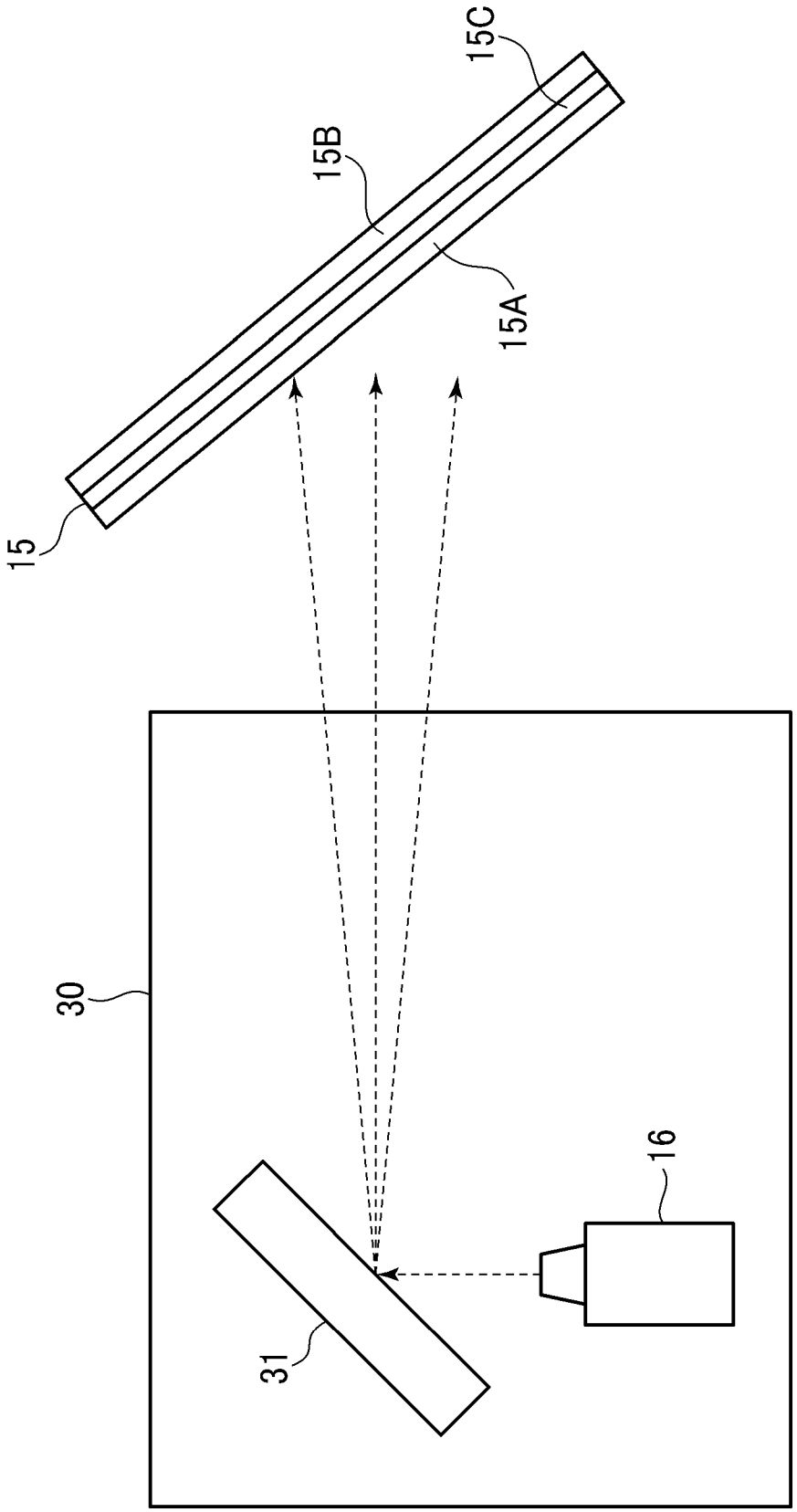


Fig. 9

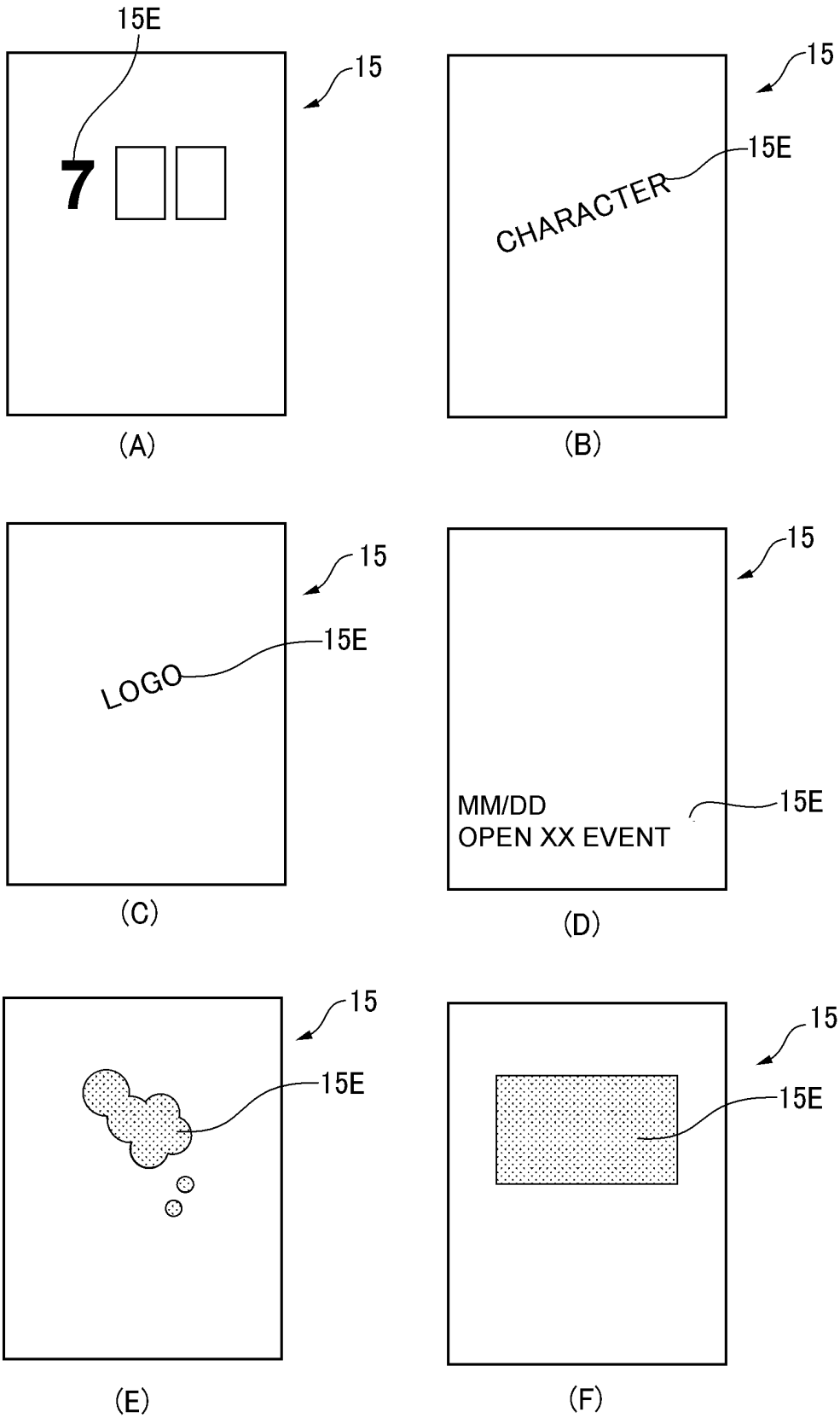

15E
15
7
(A)
15
15E
CHARACTER
(B)
15
15E
LOGO
(C)
15
MM/DD
OPEN XX EVENT
15E
(D)
15
15E
(E)
15
15E
(F)

Fig. 10

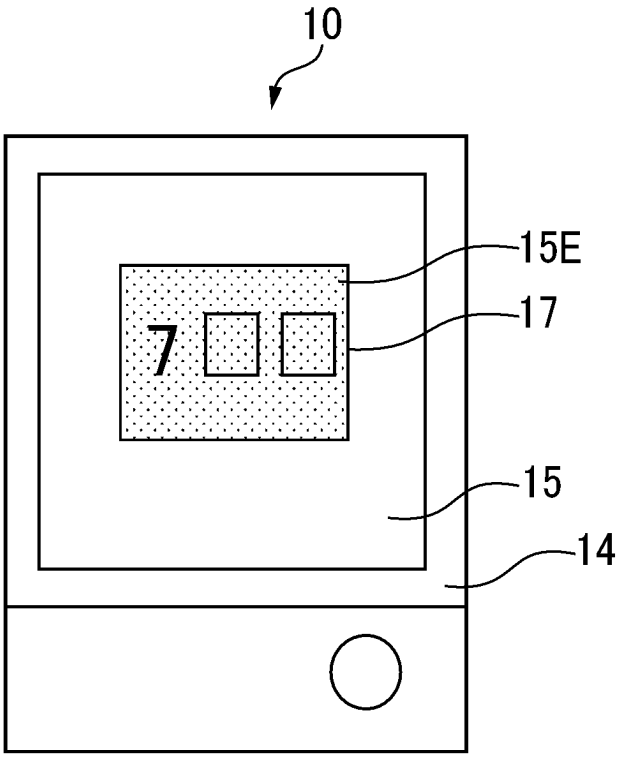


Fig. 11

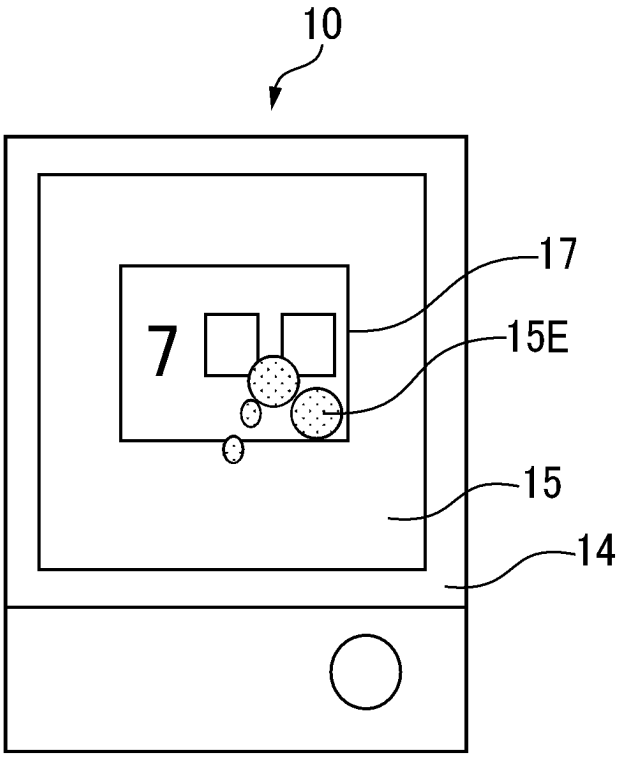


Fig. 12

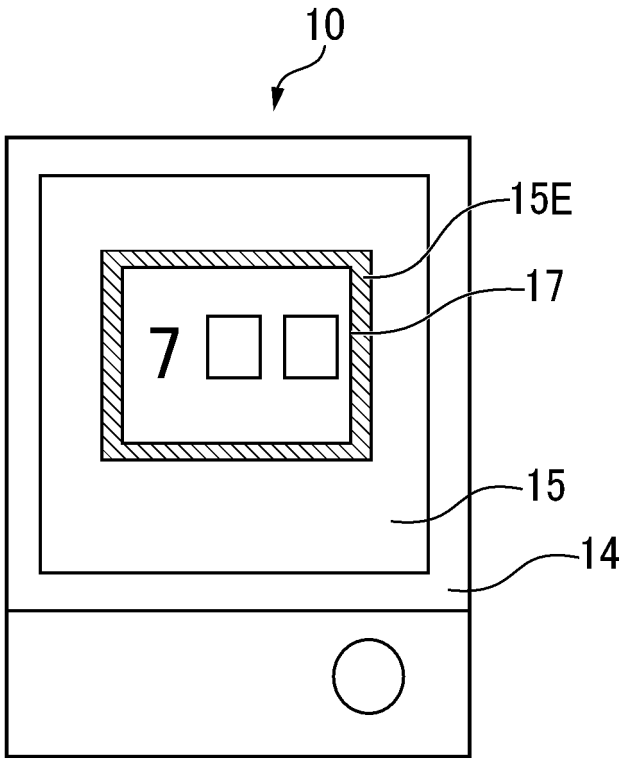
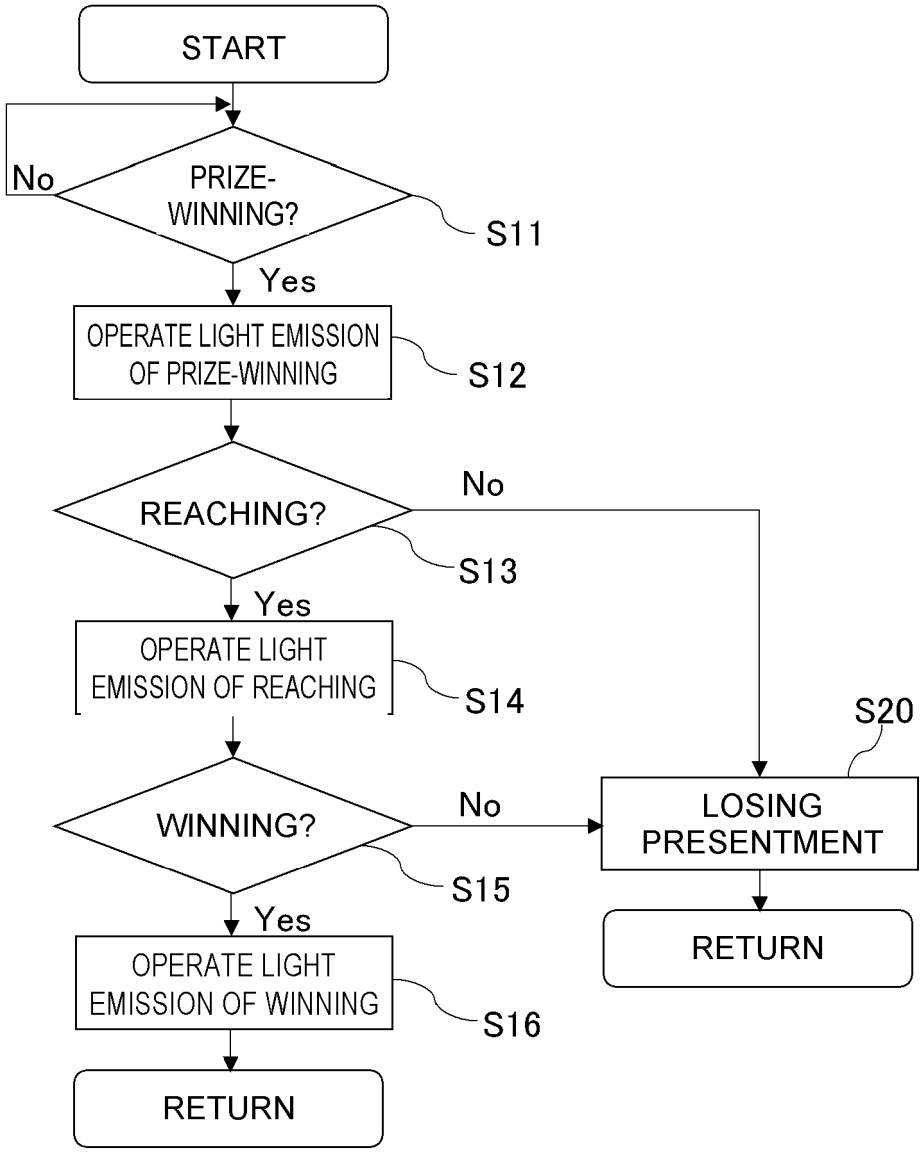


Fig. 13


START
No
PRIZE-WINNING?
S11
Yes
OPERATE LIGHT EMISSION OF PRIZE-WINNING
S12
REACHING?
No
S13
Yes
OPERATE LIGHT EMISSION OF REACHING
S14
S20
WINNING?
No
LOSING PRESENTMENT
S15
Yes
RETURN
OPERATE LIGHT EMISSION OF WINNING
S16
RETURN

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/047496

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. A63F7/02(2006.01)i

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)
Int.Cl. A63F7/02

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2019
Registered utility model specifications of Japan	1996-2019
Published registered utility model applications of Japan	1994-2019

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2007-275130 A (TAKEYA CO., LTD.) 25 October 2007, paragraphs [0219]-[0223], fig. 22 (Family: none)	1, 7-8 2-6
Y	JP 2013-111115 A (KYORAKU SANGYO KK) 10 June 2013, paragraphs [0030], [0035], [0037], fig. 2, 3, 4 (Family: none)	2-4
Y	JP 2005-58731 A (DAIMAN KK) 10 March 2005, paragraphs [0041], [0069], [0072] (Family: none)	5-6
A	US 2006/0094511 A1 (ROIREAU, Alan R. et al.) 04 May 2006, entire text, all drawings (Family: none)	1-8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 February 2019 (25.02.2019)	12 March 2019 (12.03.2019)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2017086196 A **[0005]**