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(54) **DISPLAY DEVICE FOR GAME MACHINE AND GAME MACHINE**

(57) A game machine display device of the invention includes a projector unit (21) for enlarging and projecting an image by rear projection, a screen film (22) for forming thereat the image projected by the projector unit (21), and a Fresnel lens (24) disposed between the projector unit (21) and the screen film (22). According to this structure, by disposing the Fresnel lens (24) between the projector unit (21) and the screen film (22), an image can be uniformly displayed with high illuminance over the entire game board (11)

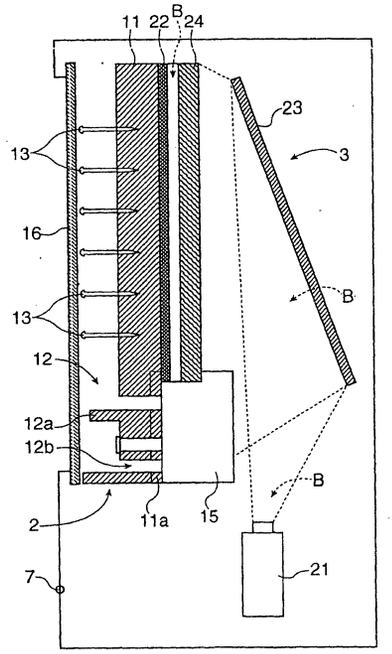


FIG. 3

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Description

Technical Field

[0001] The present invention relates to a projector mechanism for enlarging and projecting an image by rear projection, a game machine display device including an image-forming section for forming thereon the image projected by the projector mechanism, and a game machine.

Background Art

[0002] In today's pachinko machine, a display unit for displaying various images, such as animation images, in response to a prize-winning state of driven balls, is disposed at the central portion of a game board (cell plate). Here, the game board is formed by attaching a cell sheet that is printed with various designs (board face designs) to a surface of plywood, and driving a few hundred nails into the cell sheet and securing them. Therefore, the board face designs are fixed to designs on the cell sheet that has been attached at the time of manufacture, so that a game player gets tired of the board face patterns. In addition, when a game player repeatedly plays games using the same type of pachinko machine, the game player gets tired of the game features themselves. Therefore, it is necessary to appropriately change not only the type of animation displayed on the display unit, but also stories, such as animation stories, including a story concerning the prize-winning state of driven balls to a story concerning hitting the jackpot. In such a case, since an animation image displayed on the display unit and the board face designs formed on the game board need to be in conformity with each other, it is necessary to change what is displayed on the display unit and the board face designs on the game board at the same time. Therefore, ordinarily, when the game features and the board. face designs of the pachinko machine are changed, the pachinko machine itself is replaced by another type of pachinko machine.

[0003] On the other hand, one type of pachinko machine may be re-formed into another type of pachinko machine by, for example; changing the board face designs and what is displayed on the display unit. However, when this is to be done, since it is difficult to replace only the cell sheet, it is necessary to discard the whole game board and mount another game board. However, in order to discard the game board, it is necessary to separate the game board from the nail, electronic parts disposed on the game board, etc., before discarding it, thereby increasing costs of re-forming the pachinko machine caused by the costs of separating the game board from the other parts. Here, by enlarging a display area of, for example, an animation image by increasing the size of the display unit, and by changing the game features including the animation image, an ingeniously designed pachinko machine that does not cause a game player to get tired of the game may be provided. However, it is very difficult to further increase the size of the display unit due to the arrangement of the nails. In addition, the use of a large display unit is unreasonable from the viewpoint of costs. Even if the display unit is increased in size, it is still necessary to change the game board as well because of the conformity between an animation image displayed on the display unit and the designs formed on the game board. Therefore, the use of a large display unit makes it difficult to solve the aforementioned problems.

[0004] Accordingly, in order to provide a technology which can change board face designs, Japanese Unexamined Utility Model Application Publication No. 7-24381 discloses a game machine in which various images can be projected onto a front panel (1, game board) using a rear-projection-type projector (4, projector unit). The game machine is constructed so that an image can be projected onto any display area of the entire board surface of the front panel by the projector. More specifically, the game machine is constructed so that, by increasing the magnification of projection light to a randomly chosen magnification by a projection lens 5 disposed between the projector and the front panel, an image can be displayed on a light-transmissive image display section (2, display area) having a randomly chose size. Therefore, in this game machine, it is possible to display various images of a large display size without using a large expensive display unit. In addition, it is possible to change board face designs by simply changing the image to be projected by the projector, so that a pachinko machine can be relatively easily reformed into a different type.

Disclosure of Invention

[0005] The inventor et al. examined the above-described conventional pachinko machine, and found that it has the following problems. More specifically, in the pachinko machine, various images (such as board face designs) of large display sizes are displayed by enlarging projection light emitted from the projector by the projection lens. In this case, the central portion of light transmitted through the projection lens travels straight towards the eyes of a game player, whereas the outer edge portion of the light is radiated in a direction away from the eyes of the game player. Therefore, the outer edge portion of the image projected onto the front panel appears dark to the game player. In addition, in the pachinko machine, the projector and the projection lens are disposed at the back side of the front panel, so that, in order to enlarge the size of the projection light emitted from the projector to the size of the front panel, the projector (projection lens) and the front panel need to be separated by a certain distance. Therefore, the conventional pachinko machine in which the projection light emitted from the projector is directly projected onto the front panel is thick in the depth direction.

[0006] In the conventional pachinko machine, projection light emitted from a lamp of the projector is used to display various images. In this case, in the pachinko machine, a constant image is always displayed with high illuminance regardless of whether or not there is a game player. Therefore, in the pachinko machine, since the lamp continuously emits light with high illuminance (a large quantity of light), the power consumption of the lamp is large. In addition, when the lifetime of the lamp has elapsed (when, for example, the total lighting time has reached approximately 2000 hours), the lamp may burn out. In particular, since the lamp of the pachinko machine is continuously lit every day for a longer period of time, the lifetime of the lamp expires within a short period of time. Therefore, in the related pachinko machine, it is necessary to periodically replace the lamp within a short period of time. Consequently, in the conventional pachinko machine, lamps are replaced many times, and these lamps themselves are expensive, so that running costs are high.

[0007] Further, in the conventional pachinko machine, a front panel having a plurality of nails (3) implanted therein is used as an image projection screen. Therefore, dirt produced when balls are driven may adhere to the front screen and/or the front screen may get scratched when the driven balls strike the front screen. Therefore, a projected image becomes difficult to see due to the dirt and/or scratches on the front screen.

[0008] The present invention has been achieved to overcome the aforementioned problems, and its primary object is, for example, to provide a game machine display device and a game machine which can display an image having high illuminance over the entire game board. Another object of the present invention is to provide a game machine display device and a game machine which make it possible to reduce power consumption of a light source and to reduce running costs attributable to replacement of lamps. It is still another object of the present invention to provide a game machine which can be made thinner and which makes it possible to protect a game board.

[0009] A game machine display device of the present invention comprises a projector mechanism for enlarging and projecting an image by rear projection; an image-forming section for forming thereon the image projected by the projector mechanism; and a collimator lens disposed between the projector mechanism and the image-forming section.

[0010] In the game machine display device, by disposing a collimator lens between the projector mechanism and the image-forming section, for example, an image can be uniformly displayed with high illuminance over the entire game board.

[0011] It is desirable that, as the collimator lens, a Fresnel lens be opposingly disposed at the back side of the image-forming section. By virtue of this structure, the game machine can be made thinner.

[0012] It is desirable that the image-forming section comprise a screen. Consequently, the image-forming section can be formed with a relatively simple structure.

[0013] It is desirable that the game machine display device further comprise a display control section for causing the projector mechanism to project and display the image, wherein the projector mechanism comprises a light source which can emit projection light, and wherein, when a person is not detected as coming within a predetermined distance from a predetermined portion of the front side of the game machine display device within a time period equal to or greater than a predetermined time period, the display control section causes the projector mechanism to reduce the quantity of the projection light emitted from the light source. In this case, it is desirable that the light source comprise a lamp in which the luminance of the projection light is variable, and that the display control section cause the projector mechanism to reduce the quantity of the projection light by reducing the luminance of the lamp. In the case where these structures are used in, for example, a game machine, when it is not necessary to display an image with high illuminance, the quantity of light from the light source can be automatically reduced. Therefore, compared to a conventional game machine in which a constant image is always displayed with high illuminance, the power consumption of the light source (lamp) can be reduced accordingly. In addition, wearing of, for example, a filament of the light source can be restricted in correspondence with reduced lighting time with high luminance, so that the lifetime of the lamp can be increased. Therefore, it is possible to reduce the number of times lamps are replaced, so that running costs attributable to replacement of expensive lamps are sufficiently reduced.

[0014] It is desirable that the light source comprise a plurality of lamps which can emit the projection light, and that the display control section cause the projector mechanism to reduce the quantity of the projection light by turning off at least one of the plurality of lamps. By virtue of this structure, since the quantity of projection light can be reduced by only controlling an on/off operation of a power supply of each lamp, the light source can be formed with a simple structure.

[0015] It is desirable that the light source comprise a first lamp which can emit the projection light, and a second lamp which emits a smaller quantity of the projection light than the first lamp, and that the display control section cause the projector mechanism to reduce the quantity of the projection light by turning on the second lamp instead of the first lamp. By virtue of this structure, since the quantity of projection light can be reduced by only controlling an on/off operation of a power supply of each lamp, the light source can be formed with a simple structure.

[0016] It is desirable that, when the display control section causes the projection mechanism to reduce the quantity of the projection light, the display control' section change the image to a predetermined image and

cause the predetermined image to be displayed. By virtue of this structure, by changing an image to a predetermined image, such as a static image comprising, for example, a simple design, when a person is not detected within a predetermined distance from, for example, a predetermined portion of the front side of a game machine during a time period equal to or greater than a predetermined time period, it is possible to further reduce power consumption of the projector mechanism as a whole.

[0017] It is desirable that the game machine display device further comprise a person detecting sensor for outputting a sensor signal for detecting any person within the predetermined distance from the predetermined portion of the game machine display device, wherein the display control section detects the person within the predetermined distance based on the sensor signal output from the person detecting sensor. By virtue of this structure, it is possible to reliably and simply detect a person by the person detecting sensor.

[0018] A game machine of the present invention comprises any one of the above-described game machine display devices.

[0019] In the game machine, by disposing a collimator lens between the projector mechanism and the image-forming section, for example, an image can be uniformly displayed with high illuminance over the entire game board.

[0020] It is desirable that the game machine further comprise a game board formed of a light-transmissive material and having a plurality of nails secured to the front surface of the game board, wherein the image-forming section is disposed at the back surface side of the game board and forms the image projected by the projector mechanism thereon. By virtue of this structure, an image can be uniformly displayed with high illuminance over the entire game board to which nails are secured.

[0021] It is desirable that a surface of the game board have a hard coating or be laminated. By virtue of this structure, it is possible to prevent adherence of dirt to or scratching of the game board caused by driven balls contacting the game board, so that the game board can be used for a long period of time. As a result, a sharp image can be displayed over a long period of time.

[0022] It is desirable that the game board comprise an accessory protrusion and an accessory recess that are integrally formed at the front surface side. It is desirable that the game board have an integrally formed mask for covering a mechanism in order to prevent light transmission. By virtue of this structure, compared to a structure in which these are formed separately from the game board and, then, integrally formed, parts costs of the game board can be reduced, so that production costs of a pachinko machine as a whole can be reduced.

[0023] It is desirable that the game machine further comprise one or a plurality of mirrors for reflecting the projection light emitted from the projector mechanism towards the image-forming section, wherein the projector mechanism is disposed at the bottom or top portion inside the. game machine, and emits the projection light towards the one or plurality of mirrors. By virtue of this structure, a pachinko machine can be made thinner.

Brief Description of the Drawings

[0024]

Fig. 1 is a front view of a general structure of a pachinko machine 1 of an embodiment of the present invention.

Fig. 2 is a block diagram showing the structure of the pachinko machine 1.

Fig. 3 is a side sectional view of the general structure of the pachinko machine 1.

Fig. 4 is another front view of a general structure of the pachinko machine 1.

Fig. 5 is a flowchart of a save mode transition operation executed by a main control section 6 of the pachinko machine 1.

Fig. 6 is a block diagram showing a structure of a pachinko machine 1A of another embodiment of the present invention.

Fig. 7 is a front view of a slot machine 51 of another embodiment of the present invention.

Fig. 8 is a side sectional view of a general structure of the slot machine 51.

Fig. 9 is a side sectional view of a general structure of a pinball machine 81 of another embodiment of the present invention.

Fig. 10 is a side sectional view of a general structure of a pinball machine 91 of still another embodiment of the present invention.

Best Mode for Carrying Out the Invention

[0025] Hereunder, with reference to the attached drawings, a description of embodiments in which a game machine display device and a game machine of the present invention are used in and used as a pachinko machine, respectively, will be given.

[0026] First, a structure of a pachinko machine 1 will be described with reference to the relevant drawings.

[0027] As shown in Fig. 1, the pachinko machine 1 is constructed so that an image G comprising a board face design (ground, Mount Fuji, sky, etc., shown in Fig. 1) can be displayed on the entire game board 11 by rear projection. More specifically, as shown in Fig. 2, the pachinko machine 1 comprises a game section 2, an image display optical section 3, a display control section 4, an image data storage section 5, a main control section 6, and a person detecting sensor 7. As shown in Fig. 3, the game section 2 is formed of light-transmissive resin (such as polycarbonate) as a whole, and comprises the game board 11 and a game mechanism 15. The game board 11 has an access passage 12 disposed on

its surface and a plurality of nails 13, pinwheels 14, etc., (see Fig. 1) secured to its surface. The game mechanism 15 is mounted to the back surface of the game board 11 and operates the access passage 12 and recovers driven pachinko balls. Here, as shown in Figs. 1 and 3, at the game board 11, masks 11a for covering the game mechanism 15, a protrusion 12a (for example, ball collecting table or protrusion-like portion having a warped structure) and a driven pachinko ball recovery hole 12b of the access passage 12, etc., are integrally formed. The surface (at the side where the nails 13 are driven in) of the game board 11 has a hard coating (or is laminated) in order to prevent scratching and adherence of dirt caused by contact of driven pachinko balls with the surface of the game board 11. A screen film 22, which corresponds to an image-forming section in the present invention and which forms part of the image display optical section 3, is attached (mounted) to the back surface of the game board 11. As shown in Fig. 3, a transparent cover glass 16 is disposed at the front side of the game board 11.

[0028] Along with the display control section 4 and the image data storage section 5, the image display optical section 3 forms the game machine display device of the present invention. As shown in Fig. 3, the image display optical section 3 comprises a projector unit 21, the screen film 22, a mirror 23, and a Fresnel lens 24. The projector unit 21 corresponds to a projector mechanism in the present invention, is disposed towards the bottom surface inside the pachinko machine 1, and, under control of the display control section 4, for example, upwardly emits projection light B in order to project the image G comprising a board face design by rear projection. More specifically, the projector unit 21 comprises, for example, a lamp 21L (see Fig. 2); a power supply circuit 21P which is used to supply electric current to the lamp 21L and which, in accordance with a controlling operation of the display control section 4, can vary the value of the supply current; modulating means (such as a liquid crystal light valve including a liquid crystal panel, a light-incident polarizer, and a light-exiting polarizer) for modulating projection light (white light) emitted from the lamp 21L into the projection light B; and a projection lens for enlarging and projecting the projection light B. (The modulating means and the projection lens are not shown). Here, the lamp 21L and the power supply circuit 21P form a light source in the present invention.

[0029] The screen film 22 corresponds to a screen serving as the image-forming section in the present invention, and, as mentioned above, is attached to the back surface of the game board 11. The screen film 22 has, for example, the image G formed thereat by receiving and diffusing the projection light B emitted from the projector unit 21. The mirror 23 is disposed at the back surface side of the game board 11, and reflects the projection light B emitted from the projector unit 21 towards the screen film 22. Therefore, compared to a pachinko machine of a type in which projection light emitted from a projector is directly projected onto a front panel, the pachinko machine 1 is thin in the depth direction in correspondence with bending of the path of the projection light B by the mirror 23, so that the pachinko machine 1 can be made thinner. Although, in the pachinko machine 1, the structure for reflecting the projection light B using one mirror 23 is used, it is also possible to use a structure for projecting the projection light B emitted from the projector unit 21 on to the screen film 22 by reflecting the light in multiple stages using two or more mirrors.

[0030] The Fresnel lens 24 corresponds to a collimator lens in the present invention, and is disposed between the projector unit 21 and the screen film 22 (between the mirror 23 and the screen film 22 in the pachinko machine 1). The Fresnel lens 24 converts the projection light B emitted from the projector unit 21 into parallel light in order to project the parallel light onto the screen film 22. Here, the projection light B emitted from the projector unit 21 is divergent light, and is converted into parallel light by passing through the Fresnel lens 24. In the embodiments of the present invention, the term "parallel light" has a broad meaning, so that this term does not completely exclude convergent light and divergent light. More specifically, the term "parallel light" in the embodiment of the invention also means light that is slightly convergent or divergent compared to strictly parallel light.

[0031] The display control section 4 is a control section provided specifically for image display and used for causing the projector unit 21 to project, for example, the image G under control of the main control section 6; and outputs to the projection unit 21 image signals generated by executing various image processing operations on image data read out from the image data storage section 5 in accordance with a command C1 output from the main control section 6. Here, the pachinko machine 1 is formed so that it is possible to display an image G in which, for example, reels (indicated by "123" in Fig. 1) rotationally displayable in accordance with the prize-winning states of driven pachinko balls are superimposed upon a static image, such as ground, Mount Fuji, and sky, of the aforementioned board face design. The display control section 4 causes the projector unit 21 to operate in a save mode (that is, a mode in which the lamp 21L emits light at low luminance) in accordance with a command C2 output from the main control-section 6. In addition, the display control section 4 causes the projector unit 21 to operate in an ordinary mode (that is, a mode in which the lamp 21L emits light at high luminance (ordinary luminance)) in accordance with a command C3 output from the main control section 6. The image data storage section 5 is, for example, a hard disk drive, and stores data (such as image data of a board face design, image data for reel display, image data of animation including fireworks (described later), and order data for determining the order in which various images are displayed) for displaying, for example, the image G.

[0032] The main control section 6 generally controls the pachinko machine 1. In addition, the main control section 6 outputs the command C1 for displaying various images in accordance with the state of the game in the pachinko machine 1. Further, the main control section 6 outputs the commands C2 and C3 for changing the operation mode of the projector unit 21 in accordance with an output state of a sensor signal S output from the person detecting sensor 7. More specifically, when the main control section 6 monitors the output state of the sensor signal S output from the person detecting sensor 7 and when the sensor signal S is not continuously output for a time period equal to or greater than a predetermined time period, the main control section 6 executes a save mode transition operation 40 (described later), and outputs to the display control section 4 the command C2 for operating the projector unit 21 in the save mode. On the other hand, when the sensor signal S is output during the save-mode operation of the projector unit 21, the main control section 6 outputs to the display control section 4 the command C3 for operating the projector unit 21 in the ordinary mode.

[0033] As shown in Fig. 1, the person detecting sensor 7 is disposed at the front panel (front portion) of the pachinko machine 1. Here, when a pachinko player (person) comes within an area situated a predetermined distance from the front panel of the pachinko machine 1, the person detecting sensor 7 outputs the sensor signal S. On the other hand, when the pachinko player moves away from this area, the person detecting sensor 7 stops outputting the sensor signal S. In other words, when the pachinko player is sitting in the chair in front of the pachinko machine 1, the person detecting sensor 7 outputs the sensor signal S. On the other hand, when the pachinko player leaves his chair, the person detecting sensor stops outputting the sensor signal S.

[0034] Next, a description of a method of displaying various images by the pachinko machine 1 will be described with reference to the relevant drawings.

[0035] In the pachinko machine 1, when the power supply is turned on, first, the main control section 6 outputs to the display control section 4 the command C1 for displaying an initial image (for example, image G shown in Fig. 1). The output of the command C1 causes the display control section 4 to successively output to the projector unit 21 image signals, which are used for displaying the image G, generated by reading out image data from the image data storage section 5 and performing image processing by a predetermined procedure. Here, the projector unit 21 emits the projection light B for projecting the image G, based on the image signals output from the display control section 4. In this case, in the pachinko machine 1, the projection light B emitted from the projector unit 21 is reflected towards the screen film 22 by the mirror 23. The projection light B reflected by the mirror 23 is converted into parallel light as a result of passing through the Fresnel lens 24, and the parallel light is projected onto the screen film 22. Consequently, the projection light B is received by the screen film 22, and the image G is formed on the screen film 22.

[0036] Here, in the pachinko machine 1, since the game board 11 is formed of light-transmissive resin, as shown in Fig. 1, the image G formed on the screen film 22 can be seen through the game board 11 from the front side of the pachinko machine 1. In this case, since the image G is displayed over the entire screen film 22 (that is, the entire surface of the game board 11), the image G can be seen as if it were a board face design printed on the game board 11. Since the game mechanism 15, disposed at the back of the game board 11, is covered by the masks 11a of the game board 11, the game mechanism 15 cannot be seen from the front side of the pachinko machine 1. In addition, in the pachinko machine 1, since the projection light B emitted from the projector unit 21 is converted into parallel light by passing through the Fresnel lens 24, the image G can be uniformly displayed over the entire area of the screen film 22.

[0037] In the pachinko machine 1, based on whether or not there is a game player in front of the pachinko machine 1, the luminance of the lamp 21L (shown in Fig. 2) of the projector unit 21 (that is, the quantity of projection light B) is adjusted. More specifically, when, for example, a game player leaves his chair in front of the pachinko machine 1, the person detecting sensor 7 stops outputting the sensor signal S. Here, the main control section 6 executes the save mode transition operation 40 shown in Fig. 5. In the save mode transition operation 40, the main control section 6 repeatedly determines whether or not the sensor signal S is output during a predetermined period of time (for example, 30 seconds) after the output of the sensor signal S from the person detecting sensor 7 is stopped (Step 41). Here, when the output of the sensor signal S is not detected during the predetermined period of time, the main control section 6 outputs to the display control section 4 the command C2 for operating the projector unit 21 in the save mode (Step 42). On the other hand, when, in Step 41, the output of the sensor signal S during the predetermined period of time is detected (that is, when a game player has sat down in the chair at the pachinko machine 1), the main control section 6 ends the save mode transition operation 40.

[0038] Next, in accordance with the command C2 output from the main control section 6, the display control section 4, for example, reduces electrical current supplied to the lamp 21L of the projector unit 21 in order to reduce the luminance of the lamp 21L (that is, reduce the quantity of projection light B). Consequently, when a pachinko player leaves his chair and a predetermined period of time clapses, a uniform image G having low illuminance is displayed over the entire screen film 22. Here, by reducing the electrical current supplied to the lamp 21L, power consumption of the lamp 21L is reduced. By reducing the luminance of the lamp 21L, wearing of, for example, a filament of the lamp 21L can

be restricted, so that the life of the lamp 21L can be increased accordingly. In the present invention, "to reduce the quantity of projection light B" also means "reducing the quantity of projection light B to zero."

[0039] On the other hand, when a game player returns to his chair in front of the pachinko machine 1, the person detecting sensor 7 outputs the sensor signal S. This causes the main control section 6 to output to the display control section 4 the command C3 for operating the projector unit 21 in the ordinary mode. Here, in accordance with the command C3 output from the main control section 6, the display control section 4 causes the lamp 21L of the projector unit 21 to emit light with ordinary luminance. Consequently, a uniform image G having high illuminance (ordinary illuminance) is displayed over the entire screen film 22

[0040] When a game player plays pachinko and wins a prize by driving pachinko balls, the display control section 4 executes various image processing operations by a predetermined procedure in order to rotationally display downward numbers (for example, "123" shown in Fig. 1) at the center of the image G. Here, based on the image signals successively output from the display control section 4, the projector unit 21 emits the projection light B, so that numbers on the image G projected on the screen film 22 are displayed by downward scrolling. On the other hand, when predetermined conditions are satisfied, based on image data stored in the image data storage section 5, the display control section 4 stops reels at the state that numbers "777" are displays the numbers "777" at the center of the image G (see Fig. 4, which shows the state of the pachinko machine 1 when the game player has hit the jackpot). At the same time, based on image data stored in the image data storage section 5, the display control section 4 superimposes an animation image, such as an animation in which fireworks are set off, upon the board face design, comprising ground, Mount Fuji, and sky. The numbers "777" are superimposed upon the fireworks for display. Consequently, as shown in Fig. 4, an image G having the numbers "777" superimposed upon the ground, Mount Fuji, the sky, and the fireworks is displayed.

[0041] In the pachinko machine 1, only by changing the image displayed through the image display optical section 3, the game features of the pachinko machine 1 are changed without changing the game board 11. More specifically, when, instead of the board face design comprising ground, Mount Fuji, and sky, a board face design comprising sea and sky is to be displayed, image data stored in the image data storage section 5 is changed to image data of the sea and sky. If necessary, stories using, for example, animation from "a story of winning a prize" to "a story of hitting the jackpot" stored in the image data storage section 5, and image data of these stories can be changed. Consequently, the board face design (image G) comprising the sea and sky is generated by the display control section 4 in order to project the image G onto the screen film 22 through the projector unit 21. Therefore, unlike a pachinko machine comprising a game board having a cell sheet attached to plywood, the pachinko machine 1 makes it possible to change a board face design and an animation image that is displayed on a conventional display unit at the same time, so that the game features of the pachinko machine 1 can be very easily changed. In other words, the pachinko machine 1 can be easily reformed into another type of pachinko machine.

[0042] Here, in the pachinko machine 1, the surface of the game board 11 has a hard coating (or is laminated) in order to prevent scratching of and adherence of dirt to the surface of the game board 11 resulting from contact of driven pachinko balls with the surface of the game board 11. Therefore, the game board 11 can be continuously used for a long period of time. When, due to repeated use, the surface of the game board 11 gets dirty or scratched, it is possible to remove only the game board 11 from the pachinko machine 1 and replace it with a new one. Here, since the image display optical section 3 can be subsequently used while being mounted to the pachinko machine 1, it is possible to prevent wastage of valuable natural resources, and to use the pachinko machine 1 for a long period of time at a low running cost. The screen film 22 may be replaced along with the game board 11 or may be removed from the game board 11 and reused.

[0043] Accordingly, in the pachinko machine 1, the Fresnel lens 24, provided separately from the game board 11 and disposed between the projector unit 21 and the screen film 22, converts the projection light B emitted from the projector unit 21 into parallel light, so that a uniform image G having high illuminance can be displayed over the entire game board 11. In this case, a plate-shaped Fresnel lens 24 is used as a collimator lens in the present invention, so that the pachinko machine 1 can be made thinner. In addition, by removably mounting the game board 11 in the pachinko machine 1, the main structural components of the pachinko machine 1 including the image display optical section 3 can be subsequently used for a long period of time, so that natural resources can be saved. Further, by attaching the screen film 22, used for forming the image G, to the back surface of the game board 11, the image G can be displayed on the entire game board 11 even if a relatively simple structure is used. Still further, by forming the game board 11 using light-transmissive resin material and subjecting the surface of the game board 11 to hard coating (or by laminating it), scratching and staining of the game board 11 resulting from contact of driven pachinko balls with the game board 11 are prevented (that is, the game board 11 is protected), so that the game board 11 can be used for a long period of time. As a result, a sharp image G can be displayed for a long time.

[0044] When forming the game board 11, the protrusion 12a and hole 12b of the access passage 12 are integrally formed with the front surface of the game

board 11, and the masks 11a for covering the game mechanism 15 are integrally formed with the back surface of the game board 11. Therefore, compared to a structure in which these are formed separately from the game board 11 and, then, integrally formed therewith, part costs of the game board 11 can be reduced, so that production costs of the pachinko machine 1 as a whole can be reduced. In addition, by providing the mirror 23 for reflecting the projection light B emitted from the projector unit 21 towards the screen film 22, the pachinko machine 1 can be made thin.

[0045] According to the pachinko machine 1, when a pachinko player is not seated in front of the pachinko machine (that is, when there is no pachinko player' in front of the pachinko machine 1) for a period of time equal to or greater than a predetermined period of time (for example, 30 seconds), the quantity of projection light B emitted from the lamp 21L is automatically reduced. As a result, when it is not necessary to display the image G with high illuminance because the pachinko machine is not being used, the quantity of projection light B (that is, the luminance of the lamp 21L) is reduced. Therefore, compared to a conventional pachinko machine which always displays a constant image with high illuminance, power consumption of the light source can be reduced accordingly. Since the amount of time for keeping on the lamp 21L with high luminance is reduced, wearing of, for example, a filament of the lamp 21L can be restricted accordingly. Therefore, the lamp 21L has a longer lifetime. Consequently, since the number of times the lamp 21L is replaced can be reduced, running costs attributable to the replacement of a high-cost lamp can be reduced. In addition, by, for example, adjusting electric current supplied to the lamp 21L, it is possible to display the image G at any illuminance.

[0046] A pachinko machine 1A of another embodiment of the present invention will be described with reference to Fig 6. The present invention is basically applied in the same way to each pachinko machine, a slot machine 51 (described below), etc., as it is applied to the pachinko machine 1. Therefore, component parts corresponding to those of the pachinko machine 1 are given the same reference numerals, and the same descriptions thereof will be omitted. In the pachinko machine 1A, a projector unit may comprise a plurality of lamps as a light source. More specifically, as shown in Fig. 6, a projector unit 21A comprises, for example, two lamps 21LA and 21LB, and a power supply circuit 21PA for supplying electric current to both of the lamps 21LA and 21LB. In the ordinary mode, the two lamps 21LA and 21LB are turned on at the same time, whereas, in the save mode, either the lamp 21L or 21B is turned on, thereby making it possible to use a structure which reduces the quantity of projection light B. Here, the quantity of projection light B can be reduced by only controlling an on/off operation of the power supply for supplying electric current to both lamps 21LA and 21LB, so that the power supply circuit 21PA (forming the light source in the present invention along with the lamps 21LA and 21LB) for the lamps 21LA and 21LB can be formed with a simple structure. Here, it is possible to adopt a structure for reducing the quantity of projection light B, in which a projector unit 21A is constructed so that different quantities of light are emitted from the two lamps 21LA and 21LB (that is, the lamps 21LA and 21LB have different maximum luminances); only the lamp (for example, the lamp 21LA) that emits a larger quantity of projection light B is turned on in the ordinary mode; and only the lamp (for example, the lamp 211B) that emits a smaller quantity of protection light B is turned on in the save mode. Even in this structure, the quantity of projection light B can be reduced by only controlling an on/off operation of the power supply for supplying electric current to both lamps 21LA and 21LB, so that the power supply circuit 21PA for the. lamps 21LA and 21LB can be formed with simple structures.

[0047] The game machine of the present invention includes slot machines and pinball machines. For example, the slot machine 51 shown in Fig. 7 comprises, as shown in Fig. 8, screen films 53 and 54, a reel 55, and an image display optical section 56. The screen films 53 and 54 are attached to the back surfaces of respective cover glasses 52 and 52 disposed at the front surface of a machine body. Here, the image display optical section 56 comprises a projector unit 21, mirrors 61 to 63, and Fresnel lenses 64 and 65. As in the pachinko machine 1, in the slot machine 51, the projection unit 21 emits projection light B for projecting an image G based on image signals output from a display control section 4. Next, a portion of the projection light B emitted from the projector unit 21 is reflected towards the Fresnel lens 64 by the mirror 61. The other portion of the projection light B emitted from the projector unit 21 is reflected towards the Fresnel lens 65 by the mirrors 62 and 63. Here, the portions of the projection light B are converted into parallel lights by passing through the Fresnel lenses 64 and 65, and the parallel lights are projected onto the respective screen films 53 and 54. Consequently, the portions of the projection light B are received by and focused onto the screen films 53 and 54, so that, as shown in Fig. 7, prize money information (rate information) is displayed on a prize-money information display section 71, and an image of fireworks being set off is displayed on a front display section 72.

[0048] Also in this slot machine 51, the Fresnel lenses 64 and 65, disposed between the projector unit 21 and the screen film 53 and between the projector unit 21 and the screen film 54, respectively, convert the projection light B emitted from the projector unit 21 into parallel light,' so that uniform images G having high illuminance can be displayed over the entire screen films 53 and 54 at the back surfaces of the respective cover glasses 52 and 52. The structure of the slot machine 51 is not limited to this structure. In the slot machine 51, the images G are displayed only on the prize money information dis-

play section 71 and the front display section 72, so that an image G is not displayed on a reel display section 73 opposing the reel 55. In another structure, by projecting and displaying a reel image G instead of showing the reel 55, an image G can be projected and displayed on any one, any two, or all of the prize money information display section 71, the front display section 72, and the reel display section 73.

[0049] A pinball machine 81 shown in Fig. 9 comprises a game board 82, a screen film 83, and an image display optical section 84. The game board 82 has various accessories mounted thereto, is formed of light-transmissive resin, has a surface with a hard coating, and is disposed at the top surface side of a machine body. The screen film 83 is mounted to the back surface of the game board 82. Here, the image display optical section 84 comprises a projector unit 21 and a Fresnel lens 65. In the pinball machine 81, pinball is played by moving balls between the game board 82 and a transparent glass 86 disposed at the top surface of the machine body. As in a pinball machine 91 shown in Fig. 10, an image display optical section 93 including a mirror 92 may be used. Like the pachinko machine 1 and the slot machine 51, these pinball machines 81 and 91 can also provide advantages such as making it possible to display an image G including, for example, board face designs and some of the accessories uniformly and with high illuminance over the entire game board 82.

[0050] The present invention is not limited to the above-described embodiments. Although the pachinko machine 1 is constructed so that the person detecting sensor 7 is connected to the main control section 6, and so that the main control section 6 detects the presence or absence of a game player based on the sensor signal output from the person detecting sensor, the present invention is not limited thereto. For example, a structure in which the person detecting sensor 7 is connected to the display control section 4 and in which the display control section 4 detects presence or absence of a game player based the sensor signal S may be used.

[0051] In addition, it is possible to use a structure in which, when a game player is not seated in front of, for example, the pachinko machine 1 or the slot machine 51 for a period of time equal to or greater than a predetermined period of time, the quantity of projection light B is reduced, and an image G is changed to a predetermined image G and the predetermined image G is displayed. By displaying as the predetermined image G, for example, a static image comprising simple designs such as a title logo indicating the game content of the pachinko machine 1 or the slot machine 51 or a letter indicating that the pachinko machine 1 or the slot machine 51 is in the save mode, it is possible to inform a game player (or a person intending to play a game) that the pachinko machine. 1 or the slot machine 51 is in the save mode, and to reduce electric power (for example, power consumed for operating the modulating means) required when the projector unit 21 modulates the projection light B, so that power consumption of the projector unit 21 as a whole can be further reduced.

[0052] The present invention is not limited to the above-described embodiments. In the embodiment of the pachinko machine 1, the screen film 22 is attached to the back surface of the game board 11. The structure of the image-forming section in the present invention is not limited thereto. For example, it is possible to use a structure in which a rear projection screen panel formed separately from the game board 11 is disposed at the back surface side of the game board 11, or a structure in which, by making the back surface of the game board 11 or 82 rough, the projection light B is received so as to be diffused. Although, in the embodiments of the present invention, the protrusion 12a, the hole 12b, the mask 11a, etc., are integrally formed when forming the game board 11, the present invention is not limited thereto. Various accessories may be mounted to a flat game board, or a covering plate or film may be attached to the flat game board.

Industrial Applicability

[0053] As described above, a game machine display device which can, for example, display an image uniformly and with high illuminance over the entire game board by disposing a collimator lens between the projector mechanism and the image-forming section may be provided.

Claims

1. A game machine display device comprising:

a projector mechanism for enlarging and projecting an image by rear projection;
an image-forming section for forming thereon the image projected by the projector mechanism; and
a collimator lens disposed between the projector mechanism and the image-forming section.

2. A game machine display device according to Claim 1, wherein, as the collimator lens, a Fresnel lens is opposingly disposed at the back side of the image-forming section.

3. A game machine display device according to either Claim 1 or Claim 2, wherein the image-forming section comprises a screen.

4. A game machine display device according to any one of Claims 1 to 3, further comprising a display control section for causing the projector mechanism to project and display the image, wherein the projector mechanism comprises a light source which can emit projection light, and wherein, when a per-

son is not detected within a predetermined distance from a predetermined portion of the front side of the game machine display device within a time period equal to or greater than a predetermined time period, the display control section causes the projector mechanism to reduce the quantity of the projection light emitted from the light source.

5. A game machine display device according to Claim 4, wherein the light source comprises a lamp in which the luminance of the projection light is variable, and wherein the display control section causes the projector mechanism to reduce the quantity of the projection light by reducing the luminance of the lamp.

6. A game machine display device according to Claim 4, wherein the light source comprises a plurality of lamps which can emit the projection light, and wherein the display control section causes the projector mechanism to reduce the quantity of the projection light by turning off at least one of the plurality of lamps.

7. A game machine display device according to Claim 4, wherein the light source comprises a first lamp which can emit the projection light, and a second lamp which emits a smaller quantity of the projection light than the first lamp, and wherein the display control section causes the projector mechanism to reduce the quantity of the projection light by turning on the second lamp instead of the first lamp.

8. A game machine display device according to any one of Claims 4 to 7, wherein, when the display control section causes the projection mechanism to reduce the quantity of the projection light, the display control section changes the image to a predetermined image and causes the predetermined image to be displayed.

9. A game machine display device according to any one of Claims 4 to 8, further comprising a person detecting sensor for outputting a sensor signal for detecting any person within the predetermined distance from the predetermined portion of the game machine display device, wherein the display control section detects the person within the predetermined distance based on the sensor signal output from the person detecting sensor.

10. A game machine comprising the game machine display device of any one of Claims 1 to 9.

11. A game machine according to Claim 10, further comprising a game board formed of a light-transmissive material and having a plurality of nails secured to the front surface of the game board, wherein the image-forming section is disposed at the back surface side of the game board and forms the image projected by the projector mechanismthereon.

12. A game machine according to Claim 11, wherein the front surface of the game board has a hard coating or is laminated.

13. A game machine according to either Claim 11 or Claim 12, wherein the game board comprises an accessory protrusion and an accessory recess that are integrally formed at the front surface side.

14. A game machine according to any one of Claims 11 to 13, wherein the game board has an integrally formed mask for covering a mechanism in order to prevent light transmission.

15. A game machine according to any one of Claims 10 to 14, further comprising one or a plurality of mirrors for reflecting the projection light emitted from the projector mechanism towards the image-forming section, wherein the projector mechanism is disposed at the bottom or top portion inside the game machine, and emits the projection light towards the one or plurality of mirrors.

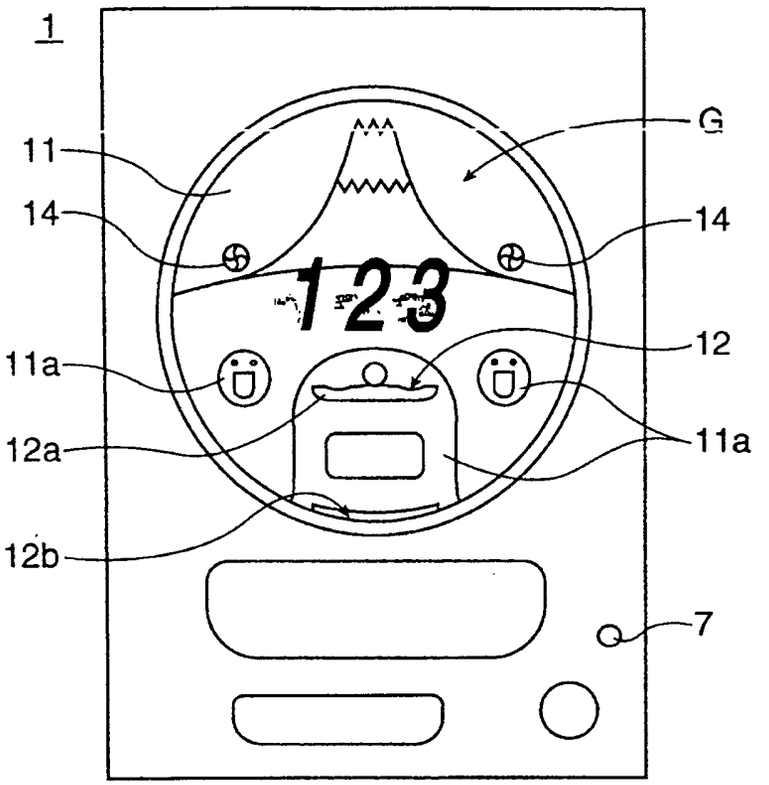

1
11
14
G
14
123
12
11a
12a
11a
12b
7

FIG. 1

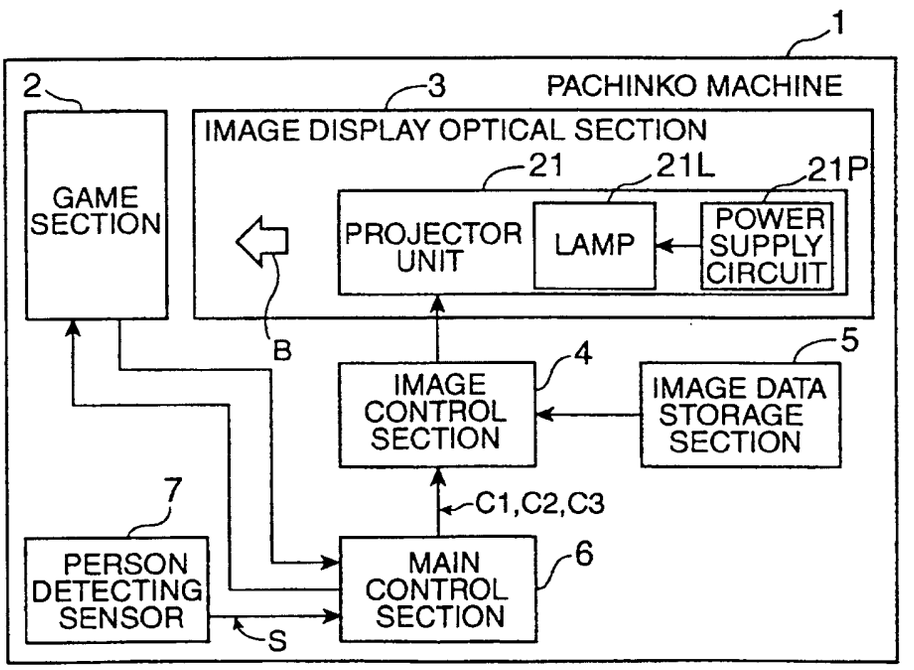

1
PACHINKO MACHINE
2
3
IMAGE DISPLAY OPTICAL SECTION
21
21L
21P
GAME SECTION
PROJECTOR UNIT
LAMP
POWER SUPPLY CIRCUIT
B
4
5
IMAGE CONTROL SECTION
IMAGE DATA STORAGE SECTION
C1,C2,C3
7
PERSON DETECTING SENSOR
MAIN CONTROL SECTION
6
S

FIG. 2

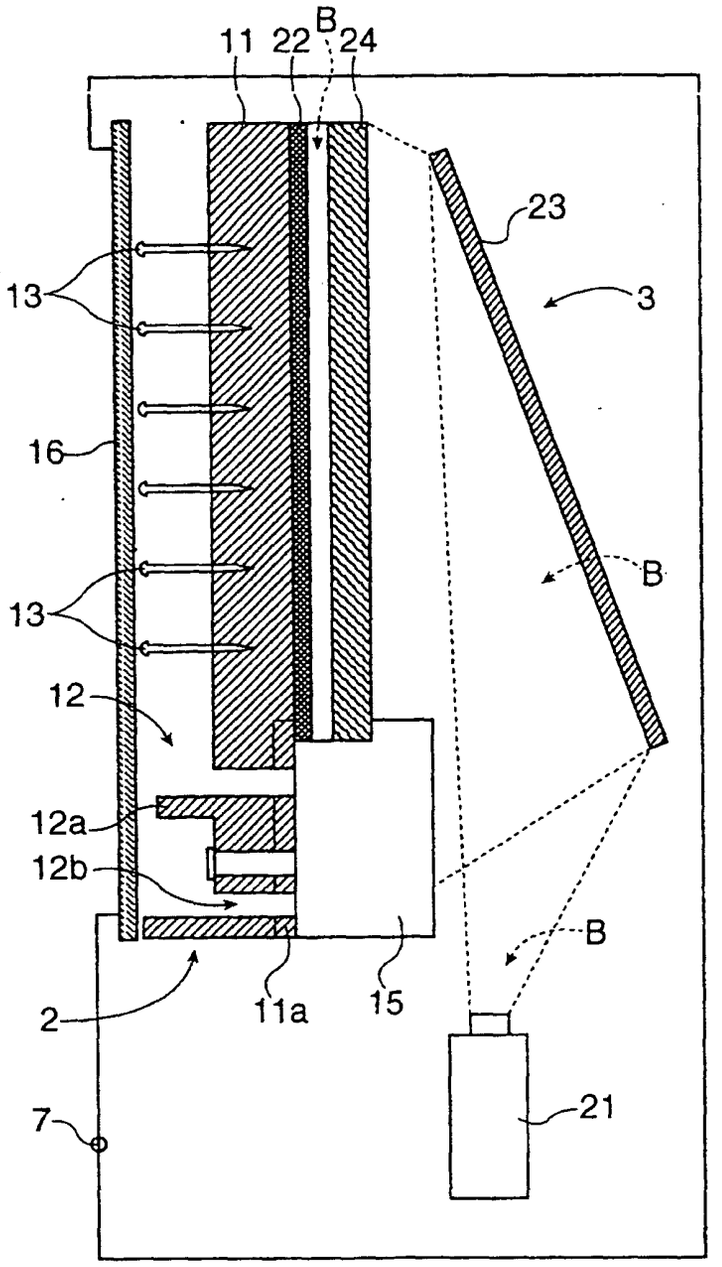


FIG. 3

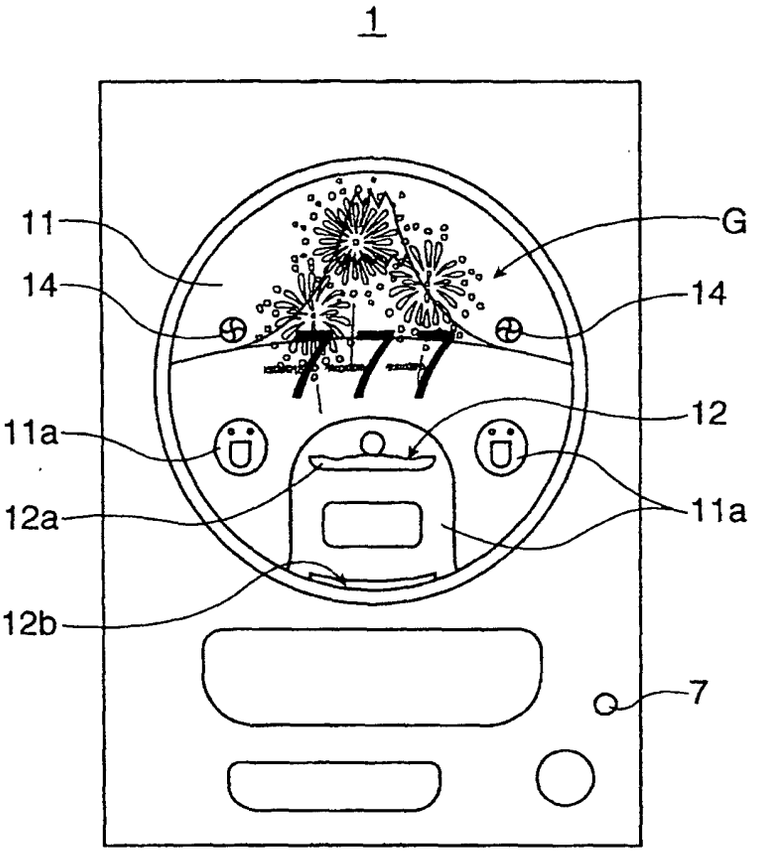


FIG. 4

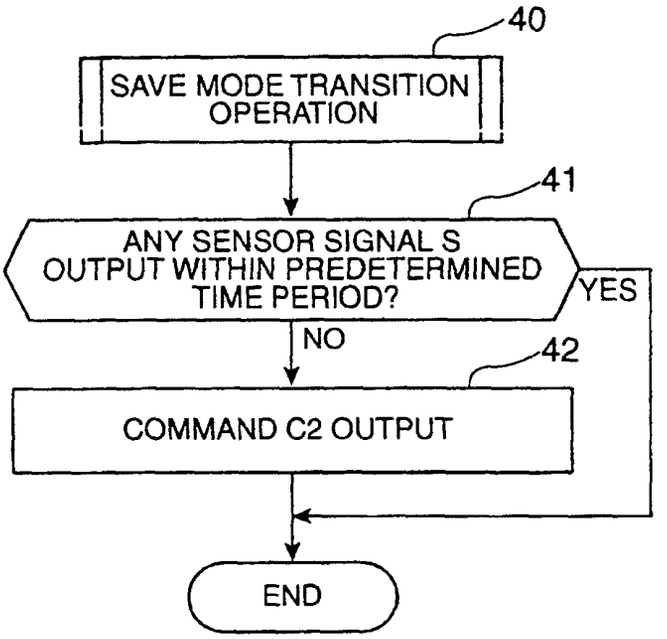

40
SAVE MODE TRANSITION OPERATION
41
ANY SENSOR SIGNAL S OUTPUT WITHIN PREDETERMINED TIME PERIOD?
YES
NO
42
COMMAND C2 OUTPUT
END

FIG. 5

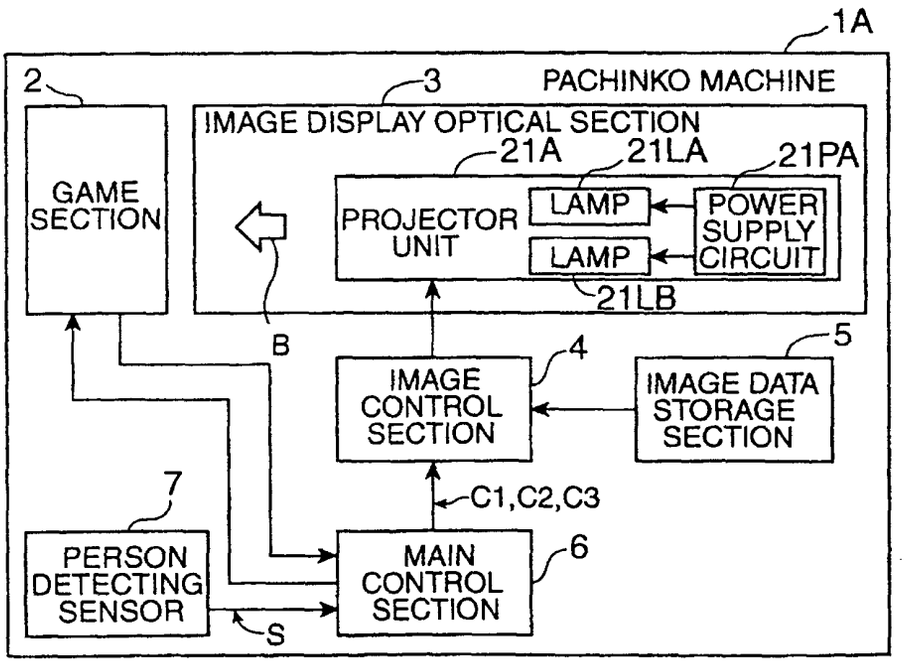

1A
PACHINKO MACHINE
2
GAME SECTION
3
IMAGE DISPLAY OPTICAL SECTION
21A
21LA
21PA
PROJECTOR UNIT
LAMP
LAMP
POWER SUPPLY CIRCUIT
21LB
B
4
IMAGE CONTROL SECTION
5
IMAGE DATA STORAGE SECTION
C1,C2,C3
7
PERSON DETECTING SENSOR
S
MAIN CONTROL SECTION
6

FIG. 6

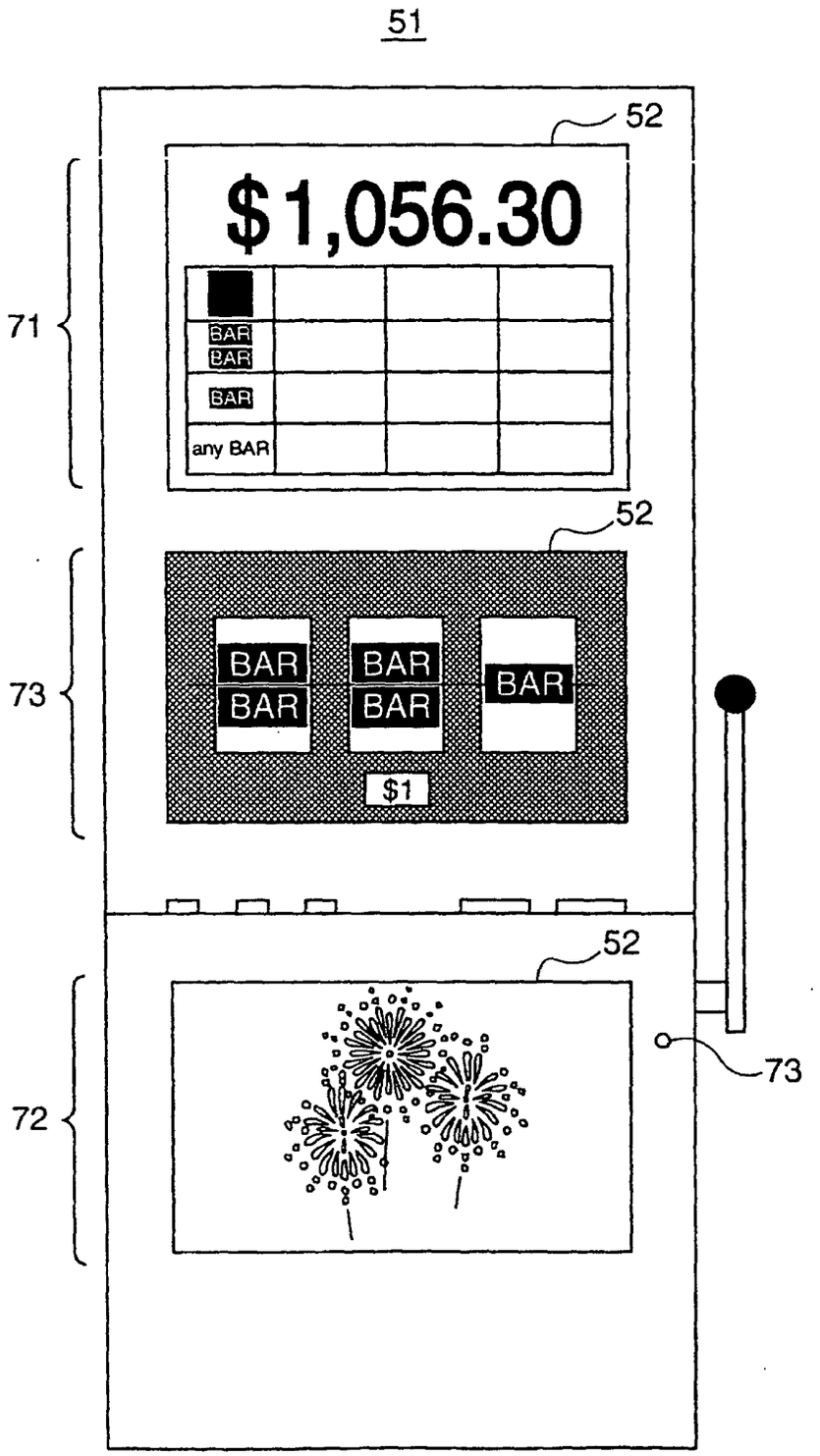

51
52
$1,056.30
BAR
BAR
BAR
any BAR
71
52
BAR
BAR
BAR
BAR
BAR
$1
73
52
72
73

FIG. 7

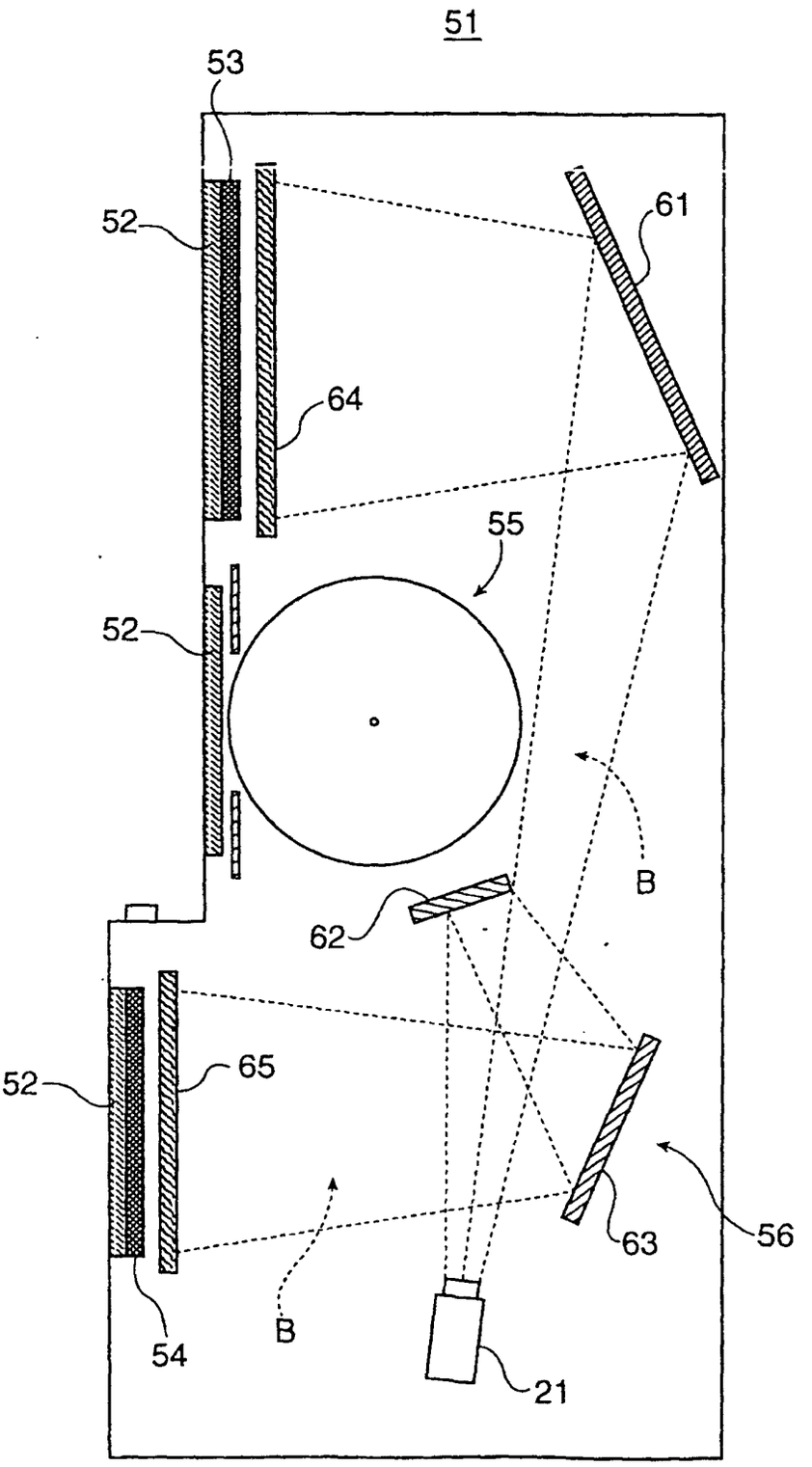


FIG. 8

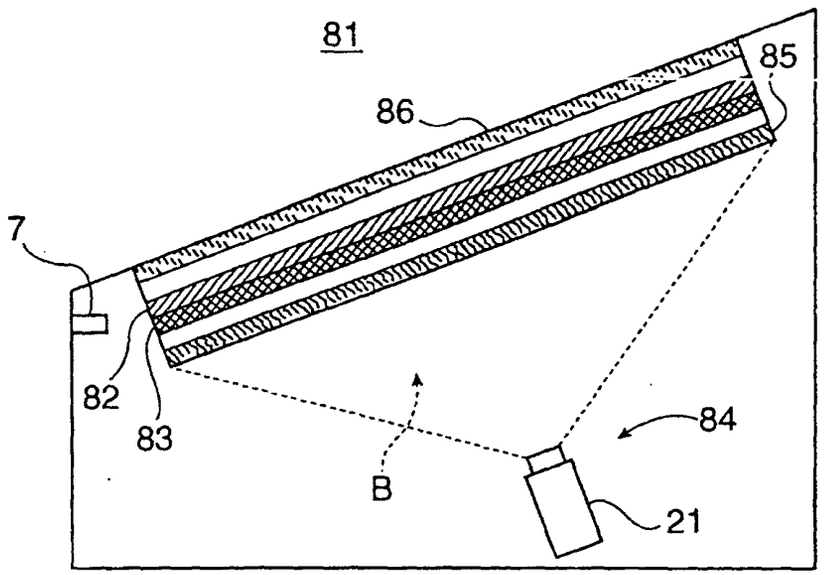


FIG. 9

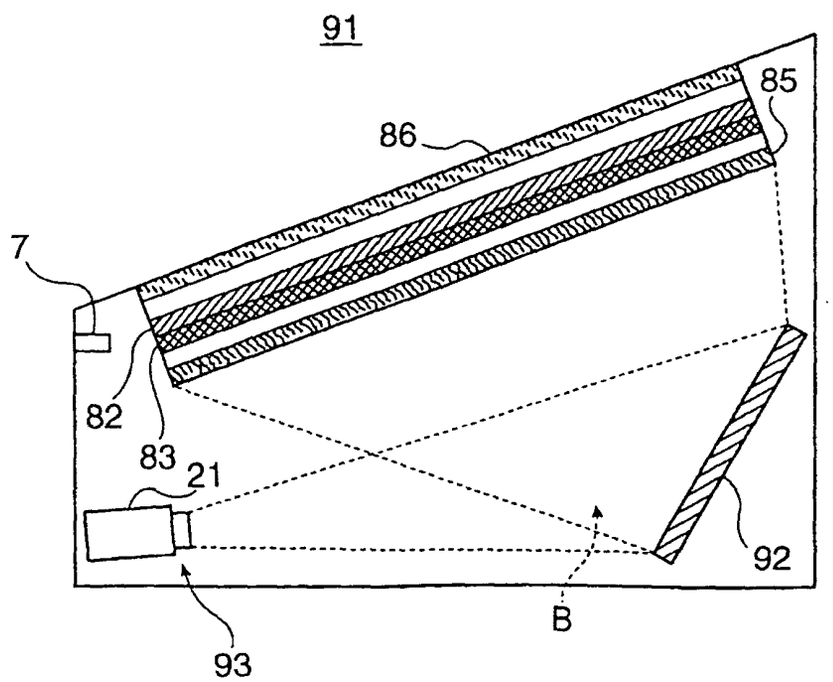


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/01039

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] A63F7/02, A63F5/04

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[7] A63F7/02, A63F5/04, G03B21/00

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

Jitsuyo Shinan Koho	1922-1996	Toroku Jitsuyo Shinan Koho	1994-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Jitsuyo Shinan Toroku Koho	1996-2003

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.
Y A	JP 6-35066 A (Kabushiki Kaisha ACE Denken), 10 February, 1994 (10.02.94), Full text; Fig. 1 (Family: none) Full text; Fig. 1 (Family: none)	1-13,15 14
Y	JP 8-196689 A (Heiwa Corp.), 06 August, 1996 (06.08.96), Par. No. [0019] (Family: none)	1,10,12,13
Y	JP 7-185074 A (Semiconductor Energy Laboratory Co., Ltd.), 25 July, 1995 (25.07.95), Claim 1; Par. No. [0021] (Family: none)	1,10,11,13

[x] 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 document 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
24 February, 2003 (24.02.03)	11 March, 2003 (11.03.03)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/01039

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 8-98929 A (Japan Aviation Electronics Industry Ltd.), 16 April, 1996 (16.04.96), Claim 1 (Family: none)	1,11,13
Y	JP 9-284685 A (Hitachi, Ltd.), 31 October, 1997 (31.10.97), Full text (Family: none)	2,3
Y	JP 2002-107672 A (Hitachi, Ltd.), 10 April, 2002 (10.04.02), Full text & CN 1346066 A & EP 1199896 A2 & KR 2002-26807 A & US 2002/63806 A1	2,3
Y	JP 2001-300016 A (Kabushiki Kaisha Sanyo Bussan), 30 October, 2001 (30.10.01), Par. No. [0043] (Family: none)	4-9

Form PCT/ISA/210 (continuation of second sheet) (July 1998)