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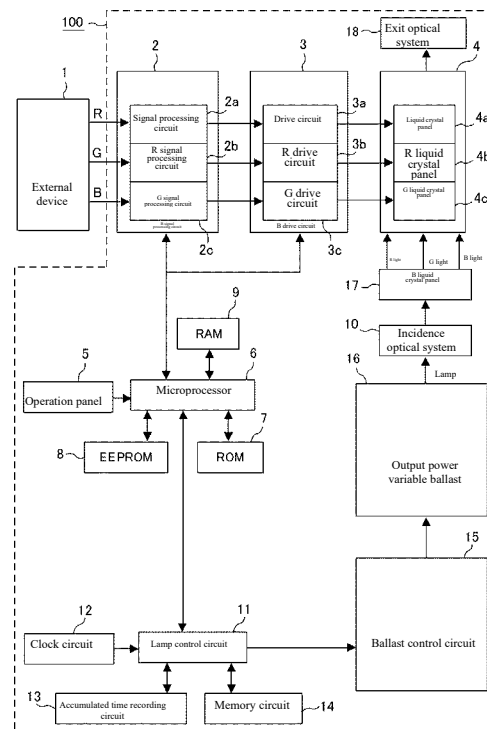
(54)[Title of invention] Projection type display device

(57) [Summary]

[Problem] To obtain an inexpensive projection type display device which hardly suffers from luminance deterioration due to aging in long-term use from the beginning to the end of use of a lamp used in the projection type display device, and further which can display an image with constant brightness for a long period of time without causing loss of white or black gradation of the image.

[Means for solving] The accumulated lighting time, which is the accumulated value of the lighting time from the start of use of the lamp, is recorded, and the brightness of the lamp is controlled based on the pre-stored light emission characteristic data from the start of use of the lamp to its end and the information on the accumulated lighting time, thereby correcting the luminance deterioration due to the change over time.

[Selected Drawing] FIG. 1



[Scope of Patent Claims]

[Claim 1]

A projection type display device characterized by comprising: an illumination means for emitting illumination light; an illumination lighting means for lighting the illumination means and variably controlling the amount of light emitted; a memory means for storing light emission characteristic data due to changes over time of the illumination means; a clock means for measuring the lighting time of the illumination means; an accumulated time recording means for recording the accumulated value of the measured time of the clock means; and a control means for controlling the illumination means based on information from the memory means and the accumulated time recording means.

[Claim 2]

The projection type display device according to Claim 1, characterized in that the projection type display device comprises an illumination identification means for identifying the type of the illumination means and/or an illumination condition discrimination means for discriminating the illumination conditions, wherein the memory means stores light emission characteristic data corresponding to the type of the illumination means and/or the illumination conditions based on information from the illumination identification means and/or the illumination condition discrimination means.

[Claim 3]

A projection type display device according to any one of Claim 1 or Claim 2, characterized in that it comprises power detection means for detecting the power of the lighting means, and power comparison means for comparing the power detection data of the power detection means with the light emission characteristic data of the storage means, wherein the control means controls the lighting means based on the power comparison data of the power comparison means.

[Claim 4]

A projection type display device according to any one of Claims 1 to 3, characterized in that it comprises brightness detection means for detecting the brightness of the lighting means, and brightness comparison means for comparing the brightness detection data of the brightness detection means with the light emission characteristic data of the storage means, wherein the control means controls the lighting means based on the brightness comparison data of the brightness comparison means.

[Detailed Description of the Invention]

[Technical field]

[0001]

The present invention relates to liquid crystal projectors, projectors equipped with switching devices with small mirrors, and other projection type display device that project and display images by lighting means.

[Prior Art]

[0002]

In conventional projection type display devices, the luminescence amount of the lamp is detected, and the drive voltage is controlled to increase when the initial luminescence amount and lifetime luminescence amount are lower than the intermediate value due to the rated voltage of the lamp described above. (See, for example, Patent Literature 1.)

[0003]

In addition, in other conventional projection type display devices, the accumulated lighting time of the lamp is measured, light emission spectrum distribution characteristic data corresponding to the accumulated lighting time is read from a memory, and the signal amplitudes of red, green and blue are variably controlled based on the light emission spectrum distribution characteristic data read from the memory, thereby performing color balance correction corresponding to the accumulated lighting time. (See, for example, Patent Literature 2.)

[0004]

In addition, in other conventional projection type display devices, in addition to the main bright control unit that adjusts the brightness of the projection light, a brightness control section that automatically adjusts the brightness of the lamp of the projection light is provided. (See, for example, Patent Literature 3.)

[0005]

[Patent Literature 1] Japanese Unexamined Patent Application Publication No. 2000-131760 Publication (pages 2-3, FIG. 1)

[Patent Literature 2] Japanese Unexamined Patent Application Publication No. 2002-010177 Publication (pages 3-14, FIG. 1)

[Patent Literature 3] Japanese Unexamined Patent Application Publication No. 2001-142145 Publication (pages 2-3, FIG. 1)

[Disclosure of invention]

[Problem to be Solved by the Invention]

[0006]

In the conventional projection type display device disclosed in Patent Literature 1, the first power supply and the second power supply, which are two power sources with different power supply capabilities for supplying power to the lamp, are provided, and the first power supply and the second power supply are used to compensate for the brightness deterioration associated with the lighting time of the lamp by turning off the first power supply and the second power supply when the detection data at the light output monitor reaches the threshold light output, in relation to the threshold light output derived from the initial light output of the lamp and the life-time light output of the lamp. Because of this, the amount of light emitted by the lamp could only be controlled at two values, and there was a problem that the brightness change during power switch was large and the quality was significantly damaged. Furthermore, it is necessary to provide two power sources with different power supply capacities to supply power to the lamp, which not only increases the cost but also increases the size of the device.

[0007]

In addition, with the conventional projection type display device disclosed in Patent Literature 2, based on information on changes in emission spectrum distribution characteristics that accompany changes over time from when an instruction to turn on the lamp is issued, stored in a memory, the amplification rate of the red, green, and blue (hereinafter referred to as R, G, and B) signals is controlled in response to changes in emission spectrum distribution that accompany changes over time from when an instruction to turn on the lamp is issued, thereby varying the video signal amplitude of each of R, G, and B, and correcting changes in color balance that accompany changes over time. In this way, this method merely corrects the color balance during the so-called aging period in which the lamp stabilizes after being instructed to light, and does not address the deterioration in brightness that occurs when the lamp is turned on for a long period of time. In addition, since color balance correction is performed by controlling the amplification rate for the signals of R, G, and B colors, there was also a problem that the gradation expressions that are usually 8 bit or 10 bits change over time as a result. In addition, if the emission spectrum distribution characteristics change significantly in the lamp over time, the dynamic range on the circuit side cannot be supported, and there was a problem that at least one of the signals in each of the R, G, and B colors could collapse.

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[0008]

In addition, while it is stated that the brightness of the light source is automatically adjusted in the conventional projection type display device disclosed in Patent Literature 3, there is no mention of specific control methods or specific circuit configurations, etc. in the brightness control section in the specification.

[0009]

This invention is made to solve the above-mentioned problems, and the purpose of which is to obtain a projection type display device that can display images with a constant brightness over a long period of time without causing a white or black gradation of the image, with little brightness deterioration due to changes over time, in the long-term use from the beginning to the end of use of the lamp.

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[Means for solving the problem]

[0010]

In the projection type display device according to the present invention, it includes lighting means that emits illumination light, lighting means that illuminates said lighting means and controls the amount of light emitted, memory means that stores light emission characteristic data due to changes over time of said lighting means, time measuring means that measures the lighting time of said lighting means, cumulative time recording means that records the cumulative value of the measurement time of said time measuring means, and control means that controls said lighting means based on information from said memory means and said cumulative time recording means.

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[Effects of the invention]

[0011]

The invention records the cumulative lighting time, which is the cumulative value of the lighting time from the beginning of use of the lamp, and controls the brightness of the lamp by means of the light emission characteristic data from the beginning of use to the end of use and the cumulative lighting time information stored in advance. In the long-term use from the beginning of use to the end of use of the lamp, the brightness deterioration due to changes over time can be corrected reliably, in an inexpensive manner, and without any image quality deterioration.

[Best form for implementing the invention]

[0012]

One embodiment of the present invention will be described based on the drawings. It should be noted that, in each drawing, the same sign represents the same or equivalent.
Embodiment 1.

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[0013]

FIG. 1 is a block diagram illustrating a schematic of a projection type display device 100 in Embodiment 1 of the present invention. The projection type display device 100 in FIG. 1 is a liquid crystal projector that generates an image corresponding to an input video signal and displays the image by projecting towards a screen, etc.

[0014]

In FIG. 1, the image signals of R, G, B components or composites output from external device 1, such as a computer or DVD player, are input to the projection type display device 100. First, the processing operation when R, G, and B signals are input as video signals is described. In the R signal processing circuit 2a, G signal processing circuit 2b, and B signal processing circuit 2c provided in the video signal processing circuit 2, each of the input R, G, and B signals is sent to the R drive circuit 3a, G drive circuit 3b, and B drive circuit 3c, each of the R, G, and B signal processing circuits in the drive circuit 3, after the video signal processing, such as amplitude adjustment, black level adjustment, and gamma adjustment, is performed by control from the microprocessor 6. In the drive circuit 3, the R, G, and B signals are amplified to the amplitude level required for the liquid crystal panel 4 after the signal processing required to display the image in the liquid crystal panel 4 is performed by the control from the microprocessor 6. The R, G, and B drive signals from the drive circuit 3 are sent to R liquid crystal panels 4a, 4b, and 4c corresponding to R, G, and B, and images corresponding to R, G, and B, respectively, are formed on each panel.

[0015]

On the other hand, each operation information input by a user from the operation panel 5 is detected by the microprocessor 6. In microprocessor 6, programming, etc. stored in ROM 7 and numerical data, etc. stored in EEPROM 8 are read as appropriate by means of various external memory electrically connected ROM 7, EEPROM 8, and RAM 9, and each operation information is processed as appropriate using the working area of RAM 9. Of each operation information, the light indicator information, which is the setting information for the light brightness of the lamp 10 that is being lit and turned off, which is input by the user, is also sent through the microprocessor 6.

[0016]

Next, the flow until the light emitting lamp 10, such as a high-pressure mercury lamp, is lit and the brightness is controlled is explained by receiving the lighting indication information from the microprocessor 6. The lamp 10 of the embodiment constitutes the illumination means of the present invention. Upon receiving the lighting indication information from the microprocessor 6, the lamp control circuit 11 instructs the clock circuit 12 to measure the lighting time of the lamp 10 after indicating the lighting of the lamp 10. The timed lighting time is recorded in the cumulative time recording circuit 13 that records the cumulative lighting time, which is the cumulative measurement time of the clock circuit 12 consisting of nonvolatile memory, for example, EEPROM or flash memory, that is, the accumulated time recording circuit of the lamp 10 from the beginning of use. The cumulative lighting time is the sum of the lighting time from the beginning of use of lamp 10.

[0017]

For example, memory circuit 14, which is composed of a non-volatile memory such as an EEPROM or flash memory stores, as table values, data on the light emission characteristics of lamp 10 due to changes over time, that is, data on the light emission characteristics due to changes over a long period of time from the beginning to the end of use of lamp 10 (hereinafter referred to as long-term light emission characteristics) and/or calculation data (hereinafter referred to as calculation data) obtained by performing calculations on the light emission characteristic data. The lamp control circuit 11 obtains brightness control information to control the brightness of the lamp 10 based on the light emission characteristic data and/or calculation data and the cumulative lighting time recorded in the accumulated time recording circuit 13. This brightness control information is sent to the ballast control circuit 15.

[0018]

Ballast control circuit 15 controls output power variable ballast 16, which turns on the lamp 10 and variably controls the amount of light emitted based on the brightness control information. The output power variable ballast 16 of the embodiment constitutes the lighting means of the present invention. The output power variable ballast 16 controls the brightness of the lamp 10 by varying the output power. The lamp 10 is also lit and off by varying the output power of the output power variable ballast 16 based on control by the lamp control circuit 11 and the ballast control circuit 15. The light emission characteristic data shown here is data showing the light emission characteristics of lamp 10, which is the illumination means, due to long-term changes over time from the beginning of use to the end of use, and data showing the stable light emission state after lamp 10 starts to light up

[0019]

In this way, based on the control by the lamp control circuit 11 and the ballast control circuit 15, the lamp 10 is lit, turned off, and brightness are controlled for a long period of time from the beginning of use to the end of use to compensate for the brightness deterioration due to changes over time.

[0020]

A brief overview of the operation in the optical system will now be described. Light in the visible light region illuminated from lamp 10 is incident on incident optical system 17 as substantially parallel light (hereinafter described as parallel light). In the incident optical system 17, the distribution of light is treated to be uniform, then spectroscopy is performed on each of the R, G, and B light and illuminated on the R liquid crystal panel 4a, G liquid crystal panel 4b, and B liquid crystal panel 4c, which are each of the R, G, and B liquid crystal panels. In the R liquid crystal panel 4a, G liquid crystal panel 4b, B liquid crystal panel 4c, each illumination light of R, G, B is irradiated from the incident optical system 17, thereby combining each image of R, G, B displayed on the R liquid crystal panel 4a, G liquid crystal panel 4b, B liquid crystal panel 4c and each illumination light of R, G, B is incident on the exit optics 18 as each optical image of R, G, B. In exit optics 18, each optical image of R, G, and B is combined and then extended to a screen, etc.

[0021]

The operation of the optical system is then described in FIG. 2. FIG. 2 is a structural diagram illustrating the arrangement of components of the optical system structure, lamp 10, liquid crystal panel 4, incident optical system 17, and exit optical system 18. In FIG. 2, light in the visible light region emitted from the discharge tube 20 of the lamp 10 is reflected and collected such that the reflective surface is parallel light in front of the wide mouth opening by a concave-shaped reflector 21 having a spherical, parabolic or elliptical surface. After the parallel light is incident on the first lens array 22 and separated into a plurality of luminous fluxes, it is incident on the second lens array 23 to form a plurality of secondary light sources. The plurality of secondary light sources are superimposed by superimposed lens 24 to illuminate first dichroic mirror 25 disposed at a 45 degree angle to incident light as a bundle of light having a uniform illumination distribution.

[0022]

In the first dichroic mirror 25, only R light is transmitted and G, B light is reflected. The reflected G, B light is irradiated to a second dichroic mirror 26 disposed parallel to the first dichroic mirror 25 on the optical path. The second dichroic mirror 26 transmits only B light and G light reflects. Of the light of each of R, G, and B thus spectroscopy, the light of G is illuminated to the G liquid crystal panel 4b through the G field lens 27. The light of R is also reflected by the R mirror 28 arranged parallel to the first dichroic mirror 25 in the optical path and then illuminated to the R liquid crystal panel 4a through the R field lens 29. The light of B is transmitted through the condenser lens 30 disposed perpendicular to the incident light, then totally reflected by the first B mirror 31 disposed parallel to the first dichroic mirror 25 on the optical path, and then transmitted through the relay lens 32 disposed perpendicular to the incident light, then totally reflected by the second B mirror 33 disposed perpendicular to the first B mirror 31, then illuminated through the B field lens 34 to the B liquid crystal panel 4c. Here, the condenser lens 30 and relay lens 32 are provided for correction of the illumination state due to the long distance from the light source to the B liquid crystal panel 4c.

[0023]

In this way, the respective light of R, G, and B irradiated to the R liquid crystal panel 4a, G liquid crystal panel 4b, and B liquid crystal panel 4c, respectively, is superimposed with the respective images of R, G, and B displayed in the R liquid crystal panel 4a, G liquid crystal panel 4b, and B liquid crystal panel 4c, respectively, and is incident to dichroic prism 35 as respective image light of R, G, and B with image elements from the respective directions of R, G, and B.

[0024]

A dichroic coat reflecting only R light is provided at interface 35a of dichroic prism 35, and a dichroic coat reflecting only B light is provided at interface 35b. The image light of each of R, G, and B is synthesized with dichroic prism 35 and projected through projection lens 36 onto the screen not shown in the drawings.

[0025]

Here, the portion corresponding to the above-described incident optical system 17 extends from the portion including the first lens array 22 to the portion including the R, G, and B field lenses 27, 29, 34, and the portion corresponding to the above-described exit optical system 18 refers to the portion consisting of dichroic prism 35 and projection lens 36.

[0026]

In the projection display device 100 configured in this manner, the lighting time of the lamp 10 is timed by the clock circuit 12 and accumulated and recorded in the accumulated time recording circuit 13, and by comparing this with the long-term light emission characteristic data and/or calculated data of the lamp 10 stored in advance as table values in the memory circuit 14, it is possible to correct the brightness of the lamp 10 according to the accumulated lighting time. As a result, brightness degradation due to the long-term emission characteristics of the lamp 10 can be reliably corrected in an inexpensive manner without the accompanying degradation of image quality. FIG. 3 shows a simple example of brightness correction of lamp 10 according to the cumulative lighting time. The brightness/power (%) of the vertical axis in FIG. 3 is the value of the brightness (%) of the lamp 10 and the output power (%) of the output power variable ballast 16 on the same axis, and the lamp brightness reduction curve and overall brightness curve in FIG. 3 show the change in brightness over time on the horizontal axis as a percentage of the initial brightness when turned on at the specified standard power (hereinafter referred to as "standard mode"), which is set to 100%. The ballast power curve also shows the output power required to keep the overall brightness constant (90% in this case) over time on the horizontal axis, expressed as a percentage of the power in standard mode, taken as 100%. FIG. 3 shows that by varying the output power of the output power variable ballast 16 according to the brightness due to the long-term emission characteristics of the lamp 10, the total brightness, which is the corrected brightness of the lamp 10, is kept constant.

[0027]

Here, the long-term emission characteristics exhibit different characteristics depending on the type of lamp 10, such as high-pressure mercury lamps used as lamp light sources of about 100 W to 400 W, metal halide lamps, and xenon lamps of about 1 KW used for large equipment, but exhibit almost the same characteristics for the same type of lamp 10. FIG. 4 shows one example of a long-term emission characteristic in, for example, a high-pressure mercury lamp. The Lm Maintenance of the vertical axis in FIG. 4 shows the initial brightness of the lamp 10 shown in the vertical axis in FIG. 3 as 100% of the initial brightness of the standard mode. The solid line in FIG. 4 is a characteristic of the standard mode, and the dashed line is a characteristic when the power is reduced by a certain amount and the power consumption is suppressed (hereinafter referred to as "eco mode"). If the lighting conditions (hereinafter referred to as "mode") are changed as in the standard mode and the eco mode, the characteristics are different, but if the same type of lamp 10 is lit in the same mode, the characteristics are almost identical. In addition, when the mode is changed for the same type of lamp 10, such as in the standard mode and the eco mode, there is a clear correlation between the standard mode and the eco mode.

[0028]

In general, the long-term emission characteristics (hereinafter referred to as reference emission characteristics) when a particular type of lamp 10 is lit in the same mode are approximately the same characteristics. That is, if the lamp 10 type is different, the reference emission characteristics for each lamp 10 will be different, but if the lamp type is the same, it will be almost the same reference emission characteristics. However, even with lamps of the same type 10, some variation in emission characteristics and so-called brightness variation occur due to the manufacturing time, so-called lot difference, etc., but compared to the difference between lamps of the same type 10, it can be said that these characteristics are almost identical.

[0029]

Therefore, at least one of the microprocessor 6, the lamp control circuit 11, and the ballast control circuit 15 is provided with lighting identification means that identifies the type of lamp 10, and by reading light emission characteristics data corresponding to the type of lamp 10 from the memory circuit 14 based on information from the lighting identification means, it is possible to control corresponding to the type of lamp 10.

[0030]

For example, as a table value stored in the memory circuit 14, the luminescence characteristic data for the plurality of types of lamps 10 are stored as respective power correction tables A, B, and C as shown in FIG. 5, and by identifying the type of lamp 10 by means of lighting identification means, and switching the power correction tables A, B, and C depending on the type of lamp 10, optimal control can be achieved for the various types of lamps 10. In addition, as a table value in this case, it is acceptable to numerically store long-term luminescence characteristic data of lamp 10 as electronic data, and it is acceptable to store numerically calculated power characteristic data of lamp 10 that is actually controlled by output power variable ballast 16 having inverse characteristics of long-term luminescence characteristic data as electronic data.

[0031]

On the other hand, the long-term emission characteristics (hereinafter referred to as dependent emission characteristics) when changing the type and mode of lamp 10 are derived from the results of calculation performed on the reference light emission characteristics for a particular type of lamp 10 using parameters obtained from the characteristic differences due to the type of lamp 10 and the differences in modes.

[0032]

Thus, at least one of the microprocessor 6, the lamp control circuit 11, and the ballast control circuit 15 is provided with lighting identification means identifying the type of lamp 10 and/or a lighting condition determination means to determine the mode, and by setting a parameter based on the information from the lighting identification means and/or the lighting condition determination means, and the lamp 10 is controlled using calculation data obtained as a result of performing a calculation using the parameters on a table corresponding to the reference light emission characteristics for a specific type of lamp 10 read from the memory circuit 14, thereby making it possible to control the lamp 10 according to the type and mode of the lamp 10. At the same time, it is possible to store less luminescent characteristic data as table values, and it can be handled with small memory. Of course, the data corresponding to each type and mode of lamp 10 (which may be actual measurement data or data obtained as a result of calculations using the above parameters) may be stored as table values in memory circuit 14, but in this case a large memory would be required.

[0033]

The above calculation is performed according to the type and mode of the lamp 10. Specific types of lamp 10 include high-pressure mercury lamps and metal halide lamps used as lamp light sources of about 100 W to 400 W, and xenon lamps of about 1 kW used in large equipment. Specific modes may be reflected in the correction function corresponding to the function of the projection type display device 100, for example, when projecting brightly at all times, when it is okay to project a little darker and energy saving is emphasized, or when multiple projection type display devices 100 are used in combination to form a so-called multi-screen, where brightness variations due to differences in environmental temperature, differences in lighting time, power variations, etc. must be corrected between each projection type display device 100.

[0034]

FIG. 6 shows a simple example of correction corresponding to the function of the projection type display device 100. In FIG. 6, ballast power A, ballast power C is the output power characteristic of the normal mode, the eco mode without correction. Ballast power B is an example in which the initial brightness of lighting is secured when lighting at the specified standard power only at the beginning of installation, and after that, in order to keep the failure rate of lamp 10 low, the failure rate increases according to the cumulative lighting time, and the load applied to lamp 10 is reduced over time, that is, according to the failure rate, so as to reduce the failure rate. For example, it is possible to control the lamp 10 in a projection type display device 100 under a power company's plant management system such that it must be displayed in a bright environment for installation work and system confirmation work at the beginning of installation, but for management purposes after installation, it must be displayed for a long period of time without failure in a dark environment.

[0035]

Furthermore, by enabling the table value of the light-emitting characteristic data stored in the memory circuit 14 to be rewritten directly from the outside by a computer, etc., it is possible to easily respond to cases such as when there is a significant difference between the table value and the light-emitting characteristic data due to actual changes over time, when a new type of lamp 10 is developed, or when various types of lamps 10 must be supported even when there is only a small memory, etc.

[0036]

Also, while the example of lamp control circuit 11 being separately configured from microprocessor 6 is described here, it is acceptable to incorporate functions of the lamp control circuit block portion consisting of lamp control circuit 11, clock circuit 12, accumulated time recording circuit 13, memory circuit 14 into the microprocessor block portion consisting of microprocessor 6, ROM7, EEPROM8, RAM9. As a specific example, the function of the lamp control circuit 11 and the clock circuit 12 may be incorporated into the microprocessor 6 and configured to store cumulative lighting time data recorded in the accumulated time recording circuit 13 and long-term luminescent characteristic data recorded as table values in the memory circuit 14 in the EEPROM 8. In this case, the microprocessor 6 performs various control while using the area of RAM 9 by a program stored in ROM 7. However, since the cumulative lighting time of lamp 10 is also managed, the lighting time is measured by the clock circuit 12 incorporated into the microprocessor 6 from after the lamp 10 is turned on until the lamp is turned off. Also, by recording the time measurement results at each set time and/or when the lights are turned off, it is possible to maintain the recorded state without resetting the cumulative lighting time even after the main power is turned off. Furthermore, at the next lighting time, the cumulative lighting time of lamp 10 can be managed until the end of use of lamp 10 by adding it to the previous cumulative lighting time and recording it.

[0037]

In addition, the function of the ballast control circuit 13 may be incorporated into the microprocessor block. Such a configuration increases the operational load of the microprocessor 6, but can reduce the number of parts and configure simpler and cheaper circuits.

[0038]

Also, in this case, the brightness of lamp 10 was controlled by utilizing the table value of long-term emission characteristic data stored in memory circuit 14. What is stored as a table value of long-term emission characteristic data in this case is when lamp 10 is lit and a stable emission state is reached. However, lamp 10 also has light emission characteristics that change over time during a short period of time from when it is turned on until it is turned off (hereinafter referred to as short-time light emission characteristics). In addition, this short emission characteristic exhibits different characteristics depending on the type of lamp 10, similar to the long-term emission characteristic, but exhibits almost the same characteristics for the same type of lamp 10.

[0039]

Therefore, by storing the short emission characteristics as a table value of the light emission characteristic data in the memory circuit 14, using the same table value of the light emission characteristic data showing the long-term light emission characteristics, and controlling the brightness of the lamp 10, brightness can be corrected for the long-term light emission characteristics and short-term light emission characteristics of the lamp 10 when the projection type display device 100 is lit.

[0040]

Embodiment 2.

FIG. 7 is a block diagram illustrating a schematic of a projection type display device 100 in Embodiment 2 of the present invention. In the projection type display device 100 of embodiment 2, a lamp power detection circuit 20 is provided to detect the power applied to the lamp 10, and a power value is detected when the lamp 10, which is the power detection data, is actually lit. The lamp power detection circuit 20 of the embodiment constitutes the power detection means of the present invention. A power comparison means is provided in the lamp control circuit 11 for comparing the actual power value, which is the power value at the time of the detected actual lighting, with the scheduled power value, which is the power value corresponding to the cumulative lighting time set based on the long-term light-emitting characteristic data and/or the calculation data of the lamp 10 stored in the memory circuit 14. The lamp 10 is controlled based on the power comparison data that is the difference between the planned power value and the actual power value obtained by comparing the power value in the lamp control circuit 11.

[0041]

In this way, by detecting the difference between the planned power value and the actual power value of the lamp 10, anomalies, lifespan, etc. of the lamp can be detected. That is, by feeding the output power from the output power variable ballast 16 to the lamp control circuit 11, anomalies of the lamp can be detected.

[0042]

Here are some specific examples of detection. The long-term tube voltage change characteristic over time (hereinafter referred to as the long-term tube voltage characteristic) of the lamp 10 from the beginning to the end of use varies depending on the type of lamp 10, but lamps 10 of the same type show approximately the same characteristic. Therefore, if the actual power value from the lamp power detection circuit 20 is greater than a certain limit with respect to the planned power value at the lamp control circuit 11, it indicates that an abnormally large amount of current is flowing. In addition, conversely, if the actual power value is less than a certain limit for the planned power value, it indicates that the current is flowing abnormally low. In such cases, the lamp 10 is likely to be abnormal.

[0043]

Furthermore, by storing long-term tube voltage characteristic data for each lamp type as a table value, for example, in memory circuit 14, and using long-term tube voltage characteristic data in addition to power comparison data to detect anomalies, anomalies can be detected for each lamp type with higher accuracy. In addition, as shown in FIG. 8, a tube voltage detection circuit 21 is provided for detecting the tube voltage of lamp 10, and in addition to detecting the power value at the time of actual lamp lighting of lamp 10 by lamp power detection circuit 20, by detecting the actual tube voltage value by tube voltage detection circuit 21, anomaly detection of lamp 10 can be performed in a more accurate state.

[0044]

In addition, a correlation between the scheduled power value and the actual power value can be obtained by recording the actual power value over time as data, for example, in the accumulated time recording circuit 13 and comparing the scheduled power value and the actual power value as a change over the cumulative lighting time. For example, if the gap between the scheduled power value and the actual power value gradually occurs over a long period of time, it is the life of the lamp 10, and if the gap between the scheduled power value and the actual power value occurs during a short period of time, it is possible to make a determination easily at the lamp control circuit 11 that the gap is an abnormality of the lamp 10.

[0045]

Embodiment 3.

FIG. 9 is a block diagram illustrating a schematic of a projection type display device 100 in Embodiment 3 of the present invention. In the aforementioned Embodiment 2, a method for detecting anomalies in lamp 10 is described by comprising lamp power detection circuit 20, but in the aforementioned Embodiment 3, a method for detecting anomalies in lamp 10 is described by changing to lamp power detection circuit 20 and comprising lamp brightness detection circuit 22 to detect brightness of lamp 10. It should be noted that the lamp brightness detection circuit 22 of the embodiment constitutes a brightness detection means of the present invention.

[0046]

In the projection type display device 100 of Embodiment 3, a lamp brightness detection circuit 22 is provided to detect a brightness value when the lamp 10, which is the brightness detection data, is actually lit. A brightness comparison means is provided in the lamp control circuit 11 for comparing the actual brightness value, which is the brightness value at the time of the detected actual lighting, with the expected brightness value, which is the brightness value according to the cumulative lighting time set based on the long-term light emission characteristic data and/or calculation data of the lamp 10 stored in the memory circuit 14. The lamp 10 is controlled based on the brightness comparison data that is the difference between the planned brightness value and the actual brightness value obtained by comparing the brightness value in the lamp control circuit 11.

[0047]

In this way, by detecting the difference between the planned brightness value and the actual brightness value of the lamp 10, anomalies, lifespan, etc. of the lamp can be detected. That is, by measuring a brightness value at a particular location of light irradiated from the lamp 10 and feedback to the lamp control circuit 11, an abnormality of the lamp can be detected.

[0048]

Here are some specific examples of detection. If the brightness control of the lamp 10 is functioning normally with respect to the expected brightness value at the lamp control circuit 11, it should indicate a nearly constant brightness value regardless of the cumulative lighting time. If the actual brightness value from the lamp brightness detection circuit 22 is greater than a certain limit, it indicates that there is an abnormally high current flow. In addition, conversely, if the actual brightness value is less than a certain limit for the planned brightness value, it indicates that the current is flowing abnormally low. In such cases, the lamp 10 is likely to be abnormal.

[0049]

Furthermore, by storing long-term tube voltage characteristic data for each lamp type as a table value, for example, in memory circuit 14, and comparing brightness comparison data with long-term tube voltage characteristic data, anomaly detection for each lamp type can be performed with higher accuracy.

[0050]

In addition, a tube voltage detection circuit 21 shown in the above embodiment 2 is provided, and in addition to detecting the brightness value when the lamp 10 is actually lit by the lamp brightness detection circuit 22, by detecting the actual tube voltage value by the tube voltage detection circuit 21, anomaly detection of the lamp 10 can be performed in a more accurate state.

[0051]

Furthermore, by recording the actual brightness value over time as data, for example, in the accumulated time recording circuit 13, and comparing the scheduled brightness value with the actual brightness value as a change through the cumulative lighting time, a correlation between the scheduled brightness value and the actual brightness value can be obtained. For example, if the planned brightness value and the actual brightness value gradually over a long period of time occur, the life of the lamp 10, and if the difference between the scheduled brightness value and the actual brightness value occurs during a short period of time, it can be easily determined at the lamp control circuit 11 that the lamp is abnormal.

[Brief Description of the Drawings]

[0052]

[FIG. 1] A block diagram showing a schematic of a projection display device in Embodiment 1 of the present invention

[FIG. 2] A structural diagram of an optical system in Embodiment 1 of the present invention.

[FIG. 3] A power control characteristic diagram of the cumulative time of Embodiment 1 of the present invention.

[Fig. 4] A characteristic diagram showing an example of the brightness reduction of the lamp.

[FIG. 5] An ROM table in Embodiment 1 of the present invention.

[FIG. 6] A power control characteristic diagram of the cumulative time of Embodiment 1 of the present invention.

[FIG. 7] A block diagram showing a schematic of a projection display device in Embodiment 2 of the present invention

[FIG. 8] A block diagram showing a schematic of a projection display device in Embodiment 2 of the present invention

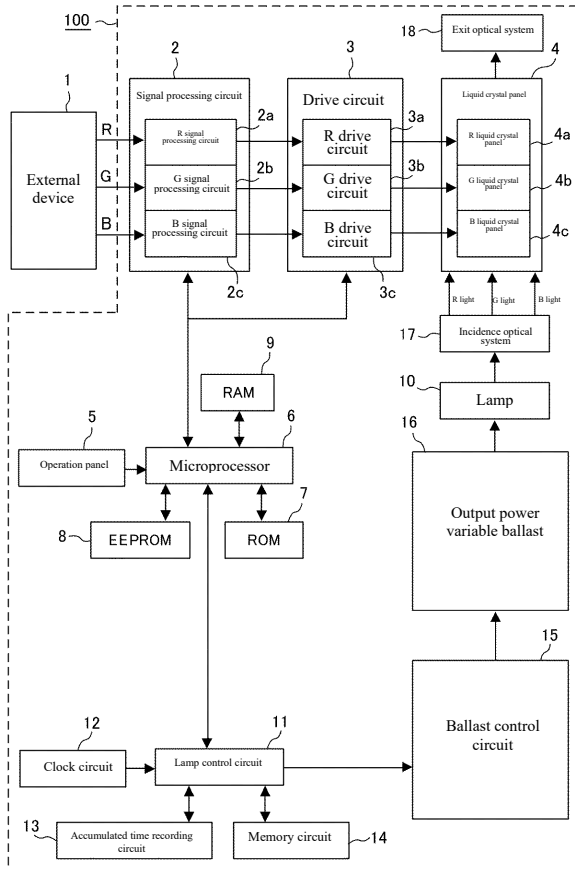
[FIG. 9] A block diagram showing a schematic of a projection display device in Embodiment 3 of the present invention

[Explanation of References]

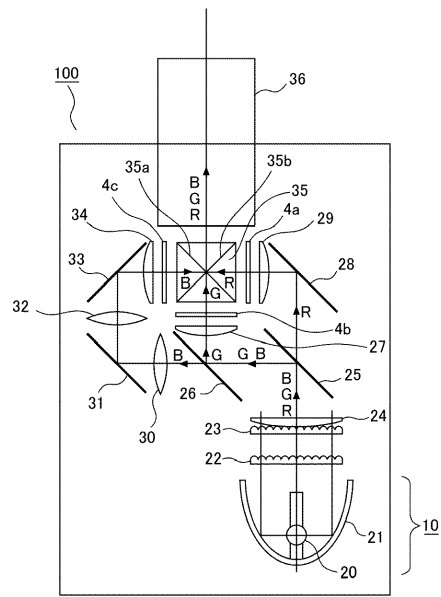
[0053]

1 external device, 2 signal processing circuit, 2a R signal processing circuit, 2b G signal processing circuit, 2c B signal processing circuit, 3 drive circuit, 3a R drive circuit, 3b G drive circuit, 3c B drive circuit, 4 liquid crystal panel, 4a R liquid crystal panel, 4b G liquid crystal panel, 4c B liquid crystal panel, 5 operation panel, 6 microprocessor, 7 ROM, 8 EEPROM, 9 RAM, 10 lamp, 11 lamp control circuit, 12 clock circuit, 13 accumulated time recording circuit, 14 memory circuit, 15 ballast control circuit, 16 output power variable ballast, 17 input optical system, 18 output optical system, 20 lamp power detection circuit, 22 lamp brightness detection circuit, 100 projection type display device

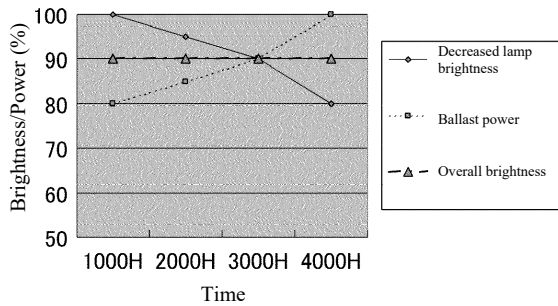
[FIG. 1]



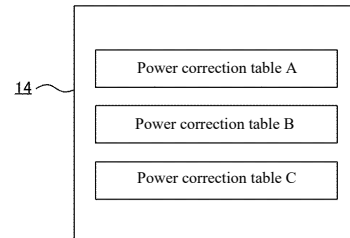
[FIG. 2]



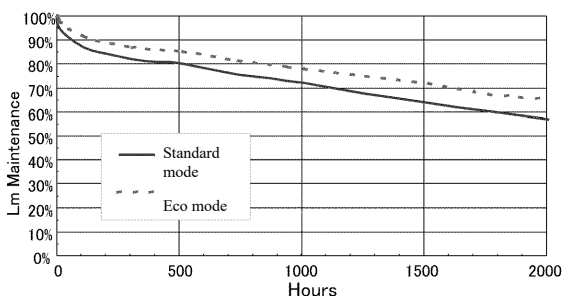
[FIG. 3]



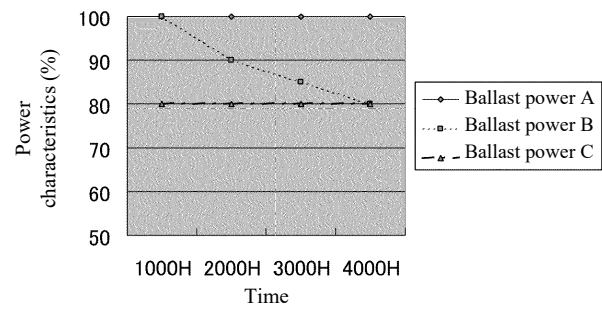
[FIG. 5]



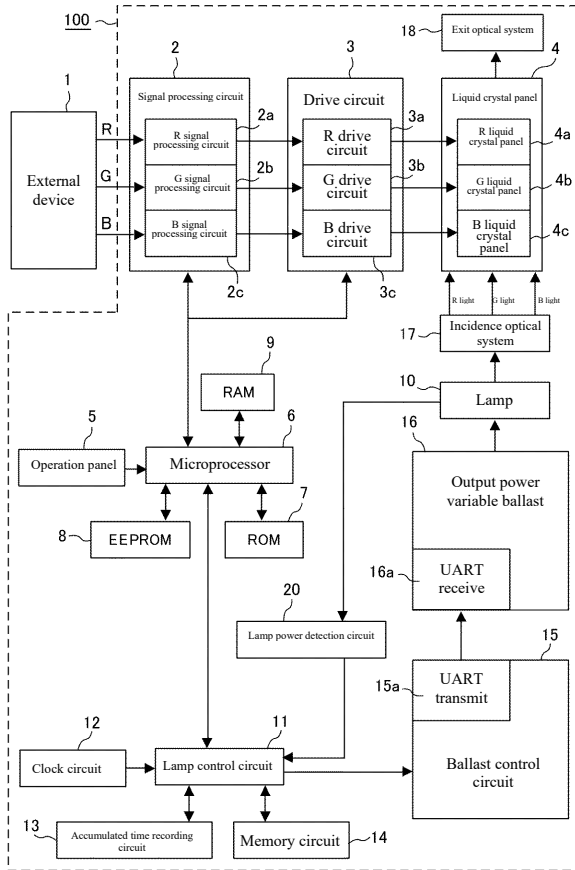
[FIG. 4]



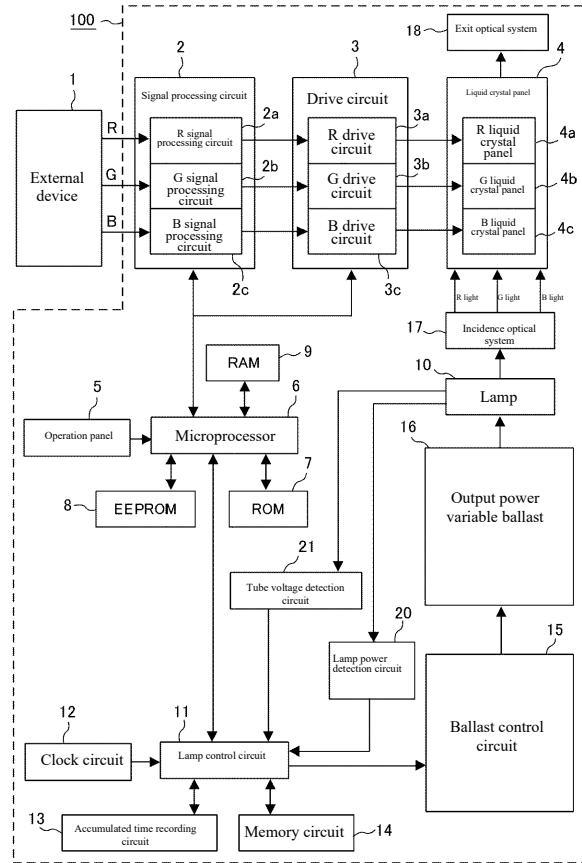
[FIG. 6]



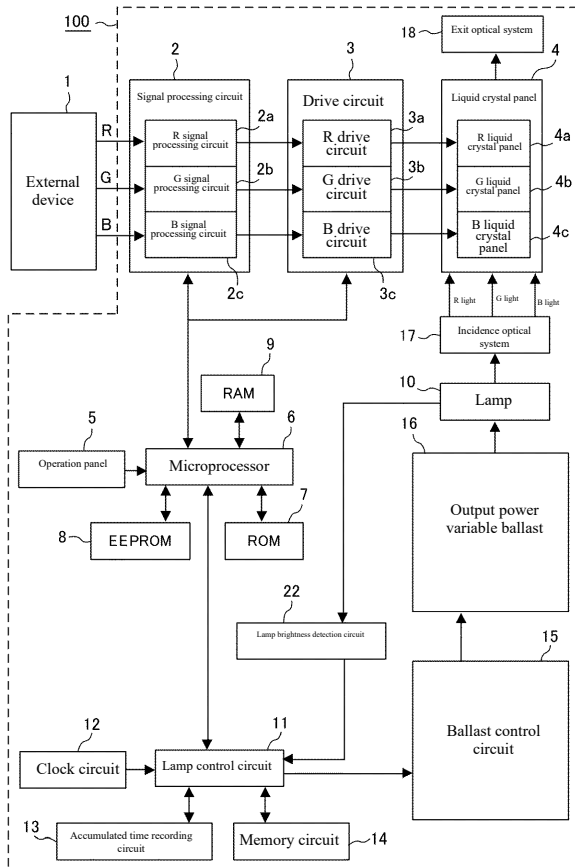
[FIG. 7]



[FIG. 8]



[FIG. 9]



Continuation from the front page

F term (reference) 2H088 EA14 EA15 EA18 HA13 HA24 HA28 MA04
 2H091 FA05X FA26X FA26Z FA41Z FD22 GA11 LA18 MA07
 2K103 AA01 AA05 AA11 AB01 AB04 BA14 BA15 CA54 CA72