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

(11) **EP 2 728 972 B2**

(12) **NEW EUROPEAN PATENT SPECIFICATION**
After opposition procedure

(45) Date of publication and mention of the opposition decision:
30.10.2024 Bulletin 2024/44

(45) Mention of the grant of the patent:
26.08.2015 Bulletin 2015/35

(21) Application number: **12190767.9**

(22) Date of filing: **31.10.2012**

(51) International Patent Classification (IPC):
H05B 37/02 *(2006.01)* ***H05B 33/08*** *(2020.01)*

(52) Cooperative Patent Classification (CPC):
H05B 45/20; H05B 47/10; H05B 47/185;
H05B 47/165

(54) **Controlling operation of light sources**

Steuerung des Betriebs von Lichtquellen

Commande du fonctionnement de sources de lumière

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

(43) Date of publication of application:
07.05.2014 Bulletin 2014/19

(73) Proprietor: **Helvar Oy Ab**
02150 Espoo (FI)

(72) Inventor: **Lamminpää, Kimmo**
FI-03600 KARKKILA (FI)

(74) Representative: **Papula Oy**
P.O. Box 981
00101 Helsinki (FI)

(56) References cited:
EP-A2- 2 219 418 **US-A1- 2002 071 279**

EP 2 728 972 B2

Description

FIELD OF THE INVENTION

[0001] The invention relates to control of two or more light sources. In particular, the invention relates to an apparatus and to a computer program for controlling operation of two or more light sources, such as two or more light emitting diodes (LEDs), two or more fluorescent lamps, two or more high-intensity discharge (HID) lamps, two or more incandescent lamps, etc.

BACKGROUND OF THE INVENTION

[0002] Figure 1 schematically illustrates an exemplifying conceptual switching arrangement 100 known in the art. The switching arrangement 100 comprises a switch unit 110, a controller 120 and a light source 140. The switch unit 110 comprises a user-operable push button or a corresponding arrangement configured to provide an input control signal to the controller 120 in response to the push button being pushed, the input control signal having a duration essentially corresponding to the duration of the push button being pushed. Consequently, the controller 120 is configured to control the light source 140 in dependence of the duration of the input control signal such that a short input control signal results in switching the light source 140 on or off, whereas a long input control signal results in changing the light intensity provided by the light source 140, thereby providing a dimming functionality.

[0003] In particular, a short input control signal received during the off state of the light source 140 results in switching the light source 140 on, while a short drive signal received during the on state results in switching the light source 140 off. Moreover, if the most recent input control signal was a short input control signal switching the light source 140 on or a long input control signal for decreasing the light intensity provided by the light source 140, a long input control signal results in increasing the light intensity provided by the light source 140. In contrast, if the most recent input control signal was a long input control signal for increasing the light intensity, a long input control signal results in decreasing the light intensity provided by the light source 140. Furthermore, a long input control signal received when the light source 140 is in the off state may result in switching the light source 140 on.

[0004] While the exemplifying arrangement 100 as described above enables the control of the on/off state of the light element 140 and the intensity of light provided by the light element 140 by a single switch operated by a single push-button, it would be desirable to also enable different and/or more versatile adjustment of characteristics of light provided by the light element 140 in order to enable better adaptation to variations in ambient light conditions and different usages of a space the light element 140 is employed to illuminate. Known solutions for providing further or alternative functions typically require further components to be introduced to the arrangement 100 and/or a significant modification of the arrangement 100, resulting in an arrangement that is typically more complex to construct and more expensive to manufacture.

[0005] A prior art document EP 2 219 418 A2 discloses a LED illumination device, with determination means that determines light amounts of the light-emitting diodes of the illumination light source, corresponding to an operation input received at operation input receiving means, so that a color temperature and a light amount of the illumination light increase and decrease in conjunction with each other. The light color and the illumination intensity of the illumination light can be adjusted with the characteristic proximate to an incandescent lamp. A prior art document WO 2011/107280 A2 discloses an operating device for a light-emitting diode that comprises an interface connection for capturing probe signals or potentiometer control signals. An internal voltage source feeds the inlet connection. The probe signals are produced by a probe that short-circuits or disconnects both connections of the interface during the actuation thereof.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide an approach that enables different and/or more versatile control of one or more light sources on basis of input control signals having user-controllable duration. Another object of the present invention is to enable different and/or more versatile approach for controlling operation of one or more light sources on basis of input control signals having user-controllable duration that does not introduce a significant change to the existing approach employed for controlling one or more light sources, e.g. the light source 140 of the arrangement 100.

[0007] The objects of the invention are reached by apparatuses and a computer program as defined by the respective independent claims.

[0008] According to a first aspect of the invention, an apparatus for controlling operation of a first light source of a first color and a second light source of a second color is provided. The apparatus comprises an input portion configured to receive an input control signal having a user-controllable duration and a control portion configured to switch, in response to a single input control signal having the overall duration not exceeding a first predetermined threshold, the first and second light sources on or off, wherein the control portion is further configured to change characteristics of light provided by the first and second light sources in response to the duration of an input control signal exceeding a second predetermined threshold that is no smaller than the first predetermined threshold, the change in characteristics being dependent on duration of the input control signal and the change comprising adjustment of the ratio between the light intensities of the first light source and the second light

source. The change further comprises adjustment of the combined light intensity of the first light source and the second light source such that the ratio between the light intensity of the first light source and the second light source remains essentially constant. The adjustment of combined light intensity is continued until termination of the input control signal or until reaching a maximum or a minimum combined light intensity of the first and the second light sources. The change comprises adjustment of the ratio between the light intensities of the first light source and the second light source in accordance with a first predetermined rule in response to the input control signal continuing after a predetermined period of time after reaching said maximum combined light intensity of the first and the second light sources has elapsed.

[0009] According to a second aspect of the invention, a second apparatus for controlling operation of a first light source of a first color and a second light source of a second color is provided. The second apparatus comprises at least one processor and at least one memory including computer program code for one or more programs. The at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus, at least, to

- receive an input control signal having a user-controllable duration,
- switch, in response to a single input control signal having the overall duration not exceeding a first predetermined threshold, the first and second light sources on or off, and
- change characteristics of light provided by the first and second light sources in response to the duration of an input control signal exceeding a second predetermined threshold that is no smaller than the first predetermined threshold.

The change in characteristics is dependent on duration of the input control signal and the change comprising adjustment of the ratio between the light intensities of the first light source and the second light source. The change further comprises adjustment of the combined light intensity of the first light source and the second light source such that the ratio between the light intensity of the first light source and the second light source remains essentially constant. The adjustment of combined light intensity is continued until termination of the input control signal or until reaching a maximum or a minimum combined light intensity of the first and the second light sources. The change comprises adjustment of the ratio between the light intensities of the first light source and the second light source in accordance with a first predetermined rule in response to the input control signal continuing after a predetermined period of time after reaching said maximum combined light intensity of the first and the second light sources has elapsed.

[0010] According to a third aspect of the invention, a computer program for controlling operation of a first light source of a first color and a second light source of a second color is provided. The computer program comprises one or more sequences of one or more instructions which, when executed by one or more processors, cause an apparatus, at least, to

- receive an input control signal having a user-controllable duration,
- switch, in response to a single input control signal having the overall duration not exceeding a first predetermined threshold, the first and second light sources on or off, and
- change characteristics of light provided by the first and second light sources in response to the duration of an input control signal exceeding a second predetermined threshold that is no smaller than the first predetermined threshold.

The change in characteristics is dependent on duration of the input control signal and the change comprises adjustment of the ratio between the light intensities of the first light source and the second light source. The change further comprises adjustment of the combined light intensity of the first light source and the second light source such that the ratio between the light intensity of the first light source and the second light source remains essentially constant. The adjustment of combined light intensity is continued until termination of the input control signal or until reaching a maximum or a minimum combined light intensity of the first and the second light sources. The change comprises adjustment of the ratio between the light intensities of the first light source and the second light source in accordance with a first predetermined rule in response to the input control signal continuing after a predetermined period of time after reaching said maximum combined light intensity of the first and the second light sources has elapsed.

[0011] The computer program may be embodied on a volatile or a non-volatile computer-readable record medium, for example as a computer program product comprising at least one computer readable non-transitory medium having program code stored thereon, the program code, which when executed by an apparatus, causes the apparatus at least to perform the operations described hereinbefore for the computer program in accordance with the third aspect of the invention.

[0012] The exemplifying embodiments of the invention presented in this patent application are not to be interpreted to pose limitations to the applicability of the appended claims. The verb "to comprise" and its derivatives are used in this patent application as an open limitation that does not exclude the existence of also unrecited features. The features described hereinafter are mutually freely combinable unless explicitly stated otherwise.

[0013] The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation,

together with additional objects and advantages thereof, will be best understood from the following detailed description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Figure 1 schematically illustrates an exemplifying arrangement known in the art.

Figure 2 schematically illustrates an exemplifying arrangement in accordance with an embodiment of the invention.

Figure 3 schematically illustrates a controller in accordance with an embodiment of the invention.

Figure 4a provides an example illustrating a relationship between input control signals and the changes in the overall light intensity and in the color temperature by an example.

Figure 4b provides an example illustrating a relationship between input control signals and the changes in the overall light intensity and in the color temperature by an example.

Figure 5 schematically illustrates an exemplifying arrangement in accordance with an embodiment of the invention.

Figure 6 schematically illustrates an exemplifying arrangement in accordance with an embodiment of the invention.

Figure 7 schematically illustrates an exemplifying arrangement in accordance with an embodiment of the invention.

Figure 8 schematically illustrates an apparatus in accordance with an embodiment of the invention.

DETAILED DESCRIPTION

[0015] Figure 2 schematically illustrates an exemplifying conceptual arrangement 200 comprising a switch unit 210, a controller 220 and two or more light sources 240. For clarity and brevity of description, the one or more light sources 240 are depicted as comprising a first light source 240a and a second light source 240b, although the two or more light sources 240 may comprise further light sources. The two or more light sources 240 may be arranged into one or more light elements, such that each light element comprises one or more of the two or more light sources 240.

[0016] The arrangement 200 presents a logical architecture, and the elements thereof may be provided as units or portions of a single apparatus or units or portions of one or more apparatuses. In other words, the switch unit 210 and the controller 220 are logical entities which may be implemented in one or more apparatuses, with the two or more light sources 240 being connectable to the apparatus of the one or more apparatuses comprising the controller 220 or a portion thereof. Examples in this regard are described in the following.

[0017] As an example, all elements may be implemented in a single apparatus, the single apparatus hence comprising the switch unit 210, the controller 220 and an arrangement for connecting the two or more light sources 240 thereto. Such an apparatus may be referred to e.g. as a switch apparatus, as a control apparatus, as a switch control apparatus, as a driver apparatus, etc.

[0018] As another example, the switch unit 210 may be implemented in a first apparatus and the controller 220 may be implemented in a second apparatus together with an arrangement for connecting the two or more light sources 240 thereto. In such an arrangement the second apparatus may be referred to e.g. as a control apparatus, as a switch control apparatus, as a driver apparatus, etc.

[0019] As a further example, the switch unit 210 may be implemented in a first apparatus, a first portion of the controller 220 may be implemented in a second apparatus, and a second portion of the controller 220 may be implemented in a third apparatus together with an arrangement for connecting the two or more light sources 240 thereto. In such an arrangement the second apparatus may be referred to as a control apparatus, as a switch control apparatus, etc. whereas the third apparatus may be referred to e.g. as a driver apparatus.

[0020] Regardless of a manner of arranging the aforementioned elements into one or more apparatuses, the controller 220 or parts thereof may be embodied as hardware, as software or as a combination of hardware and software. In particular, the hardware may comprise e.g. an electric circuit including a number of discrete components, one or more integrated circuits, one or more microcontrollers, one or more processors, etc. whereas the software may comprise e.g. computer readable instructions arranged into a program code executable by a microcontroller or by a processor.

[0021] The switch unit 210 may be similar to the control unit 110 of the arrangement 100 referred to hereinbefore. The switch unit 210 may comprise a push button 212, which is a user operable button that is arranged to cause an input control signal being provided to or issued at the controller 220. In particular, the switch unit 210 is configured to provide, upon pressing the push button 212, an input control signal to the controller 220, the input control signal having a duration matching or essentially matching the duration of the push button 212 being pushed. In other words, the switch unit 210 is configured to provide a control signal having a user-controllable duration. Such a push button arrangement may be implemented for example by using the push button 212 as an actuator clos-

ing a switch of an electric circuit, which is configured to provide an input control signal exhibiting predetermined voltage and/or predetermined electric current upon push of the button.

[0022] The switch unit 210 is coupled to the controller 220 either directly or via one or more intervening components or elements. As an example, the switch unit 210 may be in a wired connection to the controller 220, hence enabling direct provision of the input control signal thereto as an electric signal, for example as an electric signal exhibiting predetermined characteristics with respect to voltage and/or electric current. Wired connection between the switch unit 210 and the controller 220 may involve a wired connection between separate apparatuses hosting the switch unit 210 and the controller 220 or a wired connection within a single apparatus hosting the switch unit 210 and the controller 220.

[0023] On the other hand, the connection between the switch unit 210 and the controller 220 may be a wireless one. In such an approach the switch unit 210 may comprise e.g. an infrared (IR) transmitter configured to provide an IR signal descriptive of the input control signal and to transmit the IR signal to the controller 220 provided with an IR receiver configured to receive the IR signal and to convert the IR signal back to the input control signal into a format suitable for subsequent processing in the controller 220. Alternatively, the wireless transmission may make use of Radio Frequency (RF) transmitter and a RF receiver with the RF transmitter arranged in the switch unit 210 and the RF receiver arranged in the controller 220. Instead of IR or RF, wireless connectivity of other type known in the art may be employed. Such an approach based on wireless connection between the switch unit 210 and the controller 220 enables e.g. implementing the switch unit 210 in a remote controller.

[0024] The controller 220 is coupled to the two or more light sources 240 either directly or via one or more intervening components or elements. Figure 3 schematically illustrates an exemplifying structure of the controller 220. The controller 220 comprises an input portion 222 for receiving in input control signal and a control portion for controlling operation of the two or more light sources 240. The input portion 222 is configured to receive an input control signal, wherein the input control has a user-controllable duration. The input control signal may originate, for example, from the switch unit 210. In particular, the input control signal may be received directly from the switch unit 210 or the input control signal may be received via an intermediate element that may result in buffering of the input control signal for a short duration. While for practical purposes any buffering should be kept to a minimum in order to ensure timely response to an input control signal originating from the (user-operated) switch unit 210, even a very short buffering may result in a temporal difference between the starting and ending times of the input control signal as issued at the switch unit 210 and those of the input control signal as received in the controller 220. Consequently, the termination of the input control signal at the controller 220 may be temporally different from the termination of respective input control signal at the switch unit 210.

[0025] The input portion 222 may be further configured to process the input control signal before passing it to the control portion 224. An example of such processing is conversion of an input control signal received over a wireless connection into a format suitable for subsequent processing by a control portion 224.

[0026] The control portion 224 may be configured to control operation of the two or more light sources 240 by issuing one or more output control signals or commands or by otherwise controlling operating parameters of the two or more light sources 240 to switch a light source 240a, 240b of the two or more light sources 240 on or off and/or to change, i.e. increase or decrease, the light intensity provided by a light source 240a, 240b of the two or more light sources 240. In particular, the control portion 224 may be configured to control operation of the two or more light sources 240 by issuing one or more output control signals or commands, each configured to cause a change of a predetermined amount in light intensity of the first light source 240a and/or in the light intensity of the second light source 240b. The operations of the controller 220 and the input portion 222 and the control portion 224 comprised therein are described in more detail hereinafter.

[0027] Herein, the term light intensity is employed to refer to any applicable measure of intensity of light provided by a light source. As example, the light intensity may be a measure of luminous intensity, measured in lumens per steradian (lm/sr) or in candela (cd). As further examples, the light intensity may be a measure of illuminance or luminous emittance, measured in lumens per square meter (lm/m^2) or lux (lx), or a measure of luminance, measured in candela per square meter (cd/m^2). As a yet further example, the light intensity provided by a light source may be directly proportional to electric current and/or voltage used to drive the light source and, consequently, the electric current and/or the voltage may hence serve as the measure of the light intensity. For example for a LED light source the light intensity may be directly a measure of the prevailing electric current supplied thereto. As a further example, at given electric current and/or given voltage the duty cycle or the duty ratio of a pulse-width modulation (PWM) signal controlling the light intensity of a light source may be directly proportional to the prevailing light intensity such that 100 % duty cycle implies maximum light intensity of the light source at the given electric current and/or given voltage, e.g. 60 % duty cycle implies 60 % of the maximum light intensity of the light source at the given electric current and/or given voltage, e.g. 40 % duty cycle implies 40 % of the maximum light intensity of the light source at the given electric current and/or given voltage etc. The measures of light intensity discussed herein serve as a non-limiting set of examples and hence other applicable measures of light intensity may be employed without departing from the

scope of the present invention.

[0028] The two or more light sources 240 may be connected or coupled to the controller 220, and the two or more light sources 240 may be coupled to the controller 220 either directly or via an intermediate element. The first light source 240a of the two or more light sources 240 is capable of providing light at a first color and the second light source 240b of the two or more light sources 240 is capable of providing light at a second color. The first color and the second color may be distinctly different predetermined colors. Alternatively, the first color and the second color may be similar or essentially similar colors at different predetermined color temperatures, e.g. white at different predetermined color temperatures. In other words, the first light source 240a may be a light source of the first color or a first color temperature and the second light source 240b may be a light source of the second color or a second color temperature, where the first color or the first color temperature is different from the second color or the second color temperature. As a further alternative, the first color and the second color may be similar or essentially similar colors at similar or essentially similar color temperature.

[0029] As a particular example, the first light source 240a may be capable of providing white light at the color temperature B_1 and the second light source 240b may be capable of providing white light at the color temperature B_2, where $B_1 < B_2$. The first and second light sources 240a, 240b may be controlled to provide a color temperature in the range from B_1 to B_2: when the combined light intensity of the first and second light sources 240a, 240b relies solely on the first light source 240a, the resulting color temperature is B_1 whereas when relying solely on the second light source 240b the resulting color temperature is B_2. If, for example, the first light source 240a contributes 60 % of the combined light intensity and the second light source 240b contributes 40 % of the combined light intensity - in other words if the ratio between the light intensity provided by the first light source 240a and the light intensity provided by the second light source 204b is 60/40 = 1.5 - the resulting color temperature is $0.6 \times B_1 + 0.4 \times B_2$. Hence, such an exemplifying arrangement of the first and second light sources 240a, 240b enables provision of a desired color temperature by adjusting the relative light intensity of the first and second light sources 240a, 240b accordingly.

[0030] The above example of providing a desired color temperature by using two light sources capable of providing light at fixed predetermined color temperatures different from each other generalizes into an arrangement comprising further light sources in addition to the first and second light sources 240a, 240b, i.e. into two or more light sources 240, each capable of providing light at a color temperature different from that of the other light sources, where the combined color temperature is a weighted sum of the color temperatures of the two or more light sources 240, the weighting factors being indicative of the fraction of the combined light intensity contributed by the respective light source. Along similar lines, the above example generalizes into an arrangement into two or more light sources 240, each capable of providing light at a color different from that of the other light sources, where the combined color is a weighted sum of the colors of the two or more light sources 240, the weighting factors being indicative of the fraction of the combined light intensity contributed by the respective light source.

[0031] Returning to the controller 220, the input portion 222 may be configured to determine, upon and/or during reception of the input control signal, the duration of the input control signal t_{in}. In particular, the input portion 222 may be configured to determine the duration t_{in} as the duration of a period during which the input control signal fulfills predetermined characteristics. As an example, the predetermined characteristics may comprise a requirement that the input control signal exceeds or is less than a predetermined voltage level. As another example, the predetermined characteristics may, additionally or alternatively, comprise a requirement that the input control signal exhibits electric current exceeding or being less than a predetermined current level. The input portion 222 may be further configured to provide the determined duration of the input control signal to the control portion 224.

[0032] The input portion 222 may be configured to monitor the input control signal and, in particular, the duration of the input control signal t_{in} during reception of the input control signal. Monitoring may involve the input portion 222, or the controller 220 in general, keeping up and updating information regarding the accumulated duration of an input control signal that is still continuing and making this information available to the control portion 224 for controlling the operation of the first and the second light sources 240a, 240b e.g. via determination of one or more corresponding output control signals. Monitoring may further comprise detecting an end of the input control signal and providing an indication thereof to the control portion 224 to be used for additional information that may be made use of in control of the first and second light sources 240a, 240b.

[0033] The input portion 222 may be configured to monitor reception of a sequence of input control signals on basis of a monitoring period. A pair of consecutive input control signals may be considered to belong to the same sequence if they are separated by a temporal interval that is smaller than a predetermined margin t_m. In particular, the predetermined margin t_m may define the maximum time between an end of a first input control signal of a pair of consecutive input control signals and a beginning of a second input control signal of the pair of consecutive input control signals that are considered to belong to the same sequence. Monitoring sequences of input control signal enables control of the first and the second light sources 240a, 240b on basis of a sequence of input control signals in addition to or instead of controlling the first and second light sources 240a, 240b on basis of duration of the input control signal(s).

[0034] The control portion 224 may be configured to

determine whether the determined duration of the input control signal t_{in} fails to exceed a first predetermined threshold Th_{L1} and/or whether the determined duration of the input control signal exceeds a second predetermined threshold Th_{L2}. The first predetermined threshold Th_{L1} is set to a value indicative of an upper limit of the duration of an input control signal that is considered as a short input control signal, while the second predetermined threshold Th_{L2} is set to a value indicative of a lower limit of the duration of an input control signal t_{in} that is considered as a long input control signal, thereby enabling control of the first and the second light sources 240a, 240b, e.g. by determination and composition of one or more output control signals or by otherwise controlling parameters that control operation of the first and the second light sources 240a, 240b, in dependence of duration and sequence of the input control signal(s), e.g. in dependence of a single input control signal being classified as a short one or as a long one. Preferably, the first predetermined threshold Th_{L1} and the second predetermined threshold Th_{L2} are set to an equal value in order to guarantee classification of each input control signal either as short or long. However, it is possible to employ a second predetermined threshold Th_{L2} having a value higher than the first predetermined threshold Th_{L1} to ensure clearer distinction between short and long inputs. However, this approach results in an input control signals having the duration falling between Th_{L1} and Th_{L2} to be classified neither as short nor long input control signal, which may require special processing of input control signals of such an intermediate duration.

[0035] The control portion 224 is configured to control, in response to a single input control signal having the overall duration t_{in} not exceeding the first predetermined threshold Th_{L1}, switching the two or more light elements 240 on or off. Controlling may comprise the control portion 224 controlling switching the first light source 240a and the second light source 240b - together with possible further light sources of the two or more light sources 240 - on if the first and the second light sources 240a, 240b are currently off. Controlling may further comprise the control portion 224 controlling switching the first light source 240a and the second light source 240b - together with possible further light sources of the two or more light sources 240 - off if the first and second light sources 240a, 240b are currently on. Controlling operation of the first and second light sources 240a, 240b in this regard cannot commence until an input control signal has been received in full due to the overall duration of the input control signal t_{in} not being known before termination of the input control signal.

[0036] The control portion 224 may be configured to store information indicative of the prevailing ratio between the light intensities of the first light source 240a and the second light source 240b and/or information indicative of the prevailing combined light intensity provided by the first and the second light sources 240a, 240b in a memory upon switching off the two or more light sources 240. Such a memory may be provided in the controller 220 or the memory may be otherwise accessible by the controller 220. As an example, such information may comprise information indicative of the light intensity of the first light source 240a and the light intensity of the second light source 240b upon switching the two or more light sources 240 off. As another example, such information may comprise information indicative of either the light intensity of the first light source 240a or the light intensity of the second light source 240b together with the prevailing ratio between the two upon switching off the two or more light sources 240. Such information enables e.g. switching the first and the second light sources 240a, 240b on at ratio of light intensities and/or at the combined light intensity employed upon switching off the first and the second light sources 240a, 240b.

[0037] The control portion 224 may be configured to acquire the information indicative of the desired ratio between the light intensities of the first light source 240a and the second light source 240b from the memory upon switching on the two or more light sources 240 and to switch on the first light source 240a and the second light source 240b such that the desired ratio between the light intensities is provided. This may involve switching the first light source 240a and the second light source 240b on at the respective light intensities read from the memory. Alternatively, this may involve switching the first light source 240a and the second light source 240b on at different light intensities from the ones read from the memory while still keeping the desired ratio between the light intensities of the first and second light sources 240a, 240b, thereby enabling provision of a desired, possibly predetermined, combined light intensity of the first and the second light sources 240a, 240b at the desired ratio therebetween upon switching on the two or more light sources 240.

[0038] The control portion 224 is further configured to change, in response to the duration of the input control signal t_{in} exceeding the second predetermined threshold Th_{L2}, characteristics of light provided by the first and the second light sources 240a, 240b. The change in characteristics of the light is dependent on the duration of the input control signal, the change comprising adjusting the ratio between the light intensity of the first light source 240a and the light intensity of the second light source 240b. In other words, the change comprises adjustment of the relative light intensities of the first and second light sources 240a, 240b. As described hereinbefore, the second predetermined threshold Th_{L2} has a value that is no smaller than the first predetermined threshold Th_{L1}. In case the second predetermined threshold Th_{L2} has a value larger than the first predetermined threshold Th_{L1}, the control portion 224 may be configured to ignore an input control signal having a duration falling between the first and second predetermined thresholds.

[0039] As an example, the first and second predetermined thresholds Th_{L1} and Th_{L2} may be set e.g. to a value in the range 300 to 450 milliseconds, for example

to 350 milliseconds. As another example, the first predetermined threshold Th_{L1} may be set to a value in the range 200 to 300 milliseconds, for example to 250 milliseconds while the second predetermined threshold Th_{L2} may be set to a value in the range 300 to 450 milliseconds, for example to 350 milliseconds. However, these values are provided as examples only and any values of the first and second predetermined thresholds such that $Th_{L1} \leq Th_{L2}$ are applicable within scope of the present invention. The predetermined margin t_m may be set e.g. to a value in the range 100 to 300 milliseconds, for example to 200 milliseconds.

[0040] The control portion 224 may be configured to adjust the ratio between the light intensities of the first and second light elements 240a, 240b by increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching a maximum light intensity of the first light source 240a or a minimum light intensity of the second light source 240b, whichever occurs first. A maximum light intensity in this context refers to a selected maximum intensity of the respective light source 240a, 240b, which may be the maximum light intensity the respective light source 240a, 240b is capable of providing, referred to herein as an absolute maximum light intensity of the respective light source 240a, 240b. Alternatively, the selected maximum light intensity may be a predetermined selected light intensity that is lower than the absolute maximum light intensity of the respective light source 240a, 240b. Similarly, a minimum light intensity in this context refers to a selected minimum light intensity of the respective light source 240a, 240b, which is typically zero, e.g. the respective light source 240a, 240b essentially switched off or, alternatively, the minimum light intensity may be a predetermined selected non-zero light intensity.

[0041] Along similar lines, the control portion 224 may be configured to adjust the ratio between the light intensities of the first and second light elements 240a, 240b by decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching a minimum light intensity of the first light source 240a or a maximum light intensity of the second light source 240b, whichever occurs first. As in the previous example, the selected maximum light intensity may be the absolute maximum intensity of the respective light source or a predetermined selected light intensity that is lower than the absolute maximum intensity and the selected minimum light intensity may be zero or a predetermined selected non-zero light intensity.

[0042] In context of increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b, the adjustment of the ratio upon reaching one or both of the maximum intensity of the first light source 240a and the minimum light intensity of the second light source 240b may be handled at least in two different ways. As a first example, the adjustment of the ratio may be terminated in response to the termination of the input control signal or in response to reaching one of the maximum light intensity of the first light source 240a and the minimum light intensity of the second light source 240b, as already described hereinbefore. As a second example, the adjustment of the ratio may continue until termination of the input control signal or until both the maximum light intensity of the first light source 240a and the minimum light intensity of the second light source 240b have been reached. This may involve keeping, upon reaching the maximum light intensity of the first light source 240a, the light intensity of the first light source 240a at its maximum and continuing to adjust (to decrease) the light intensity of the second light source 240b until reaching its minimum and/or keeping, upon reaching the minimum light intensity of the second light source 240b, the light intensity of the second light source 240b at its minimum and continuing to adjust (to increase) the light intensity of the first light source 240a until reaching its maximum. Similar considerations are valid when reaching the minimum light intensity of the first light source 240a and/or the maximum light intensity of the second light source 240b in context of decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b.

[0043] The control portion 224 may be configured to adjust the ratio by increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b in case the most recent adjustment of the ratio caused decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b. Conversely, the control portion 224 may be configured to adjust the ratio by decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b in case the most recent adjustment of the ratio caused increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b. In this context the most recent adjustment of ratio refers to the most recent adjustment of ratio caused by the most recent input control signal and, in particular, caused by the most recent input control signal that has already terminated, i.e. the most recent preceding input control signal but not by the 'current' input control signal that is still continuing.

[0044] Increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b may comprise increasing the light intensity of the first light source 240a without changing the light intensity of the second light source 240b. As a consequence, the combined light intensity of the first and second light sources 240a, 240b is also increased. As a variation of this technique, increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b may comprise decreasing the light intensity of the second light source 240b without changing the light intensity of the first light source 240a, resulting in decreasing the combined light intensity

of the first and second light sources 240a, 240b.

[0045] Similarly, decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b may comprise decreasing the light intensity of the first light source 240a without changing the light intensity of the second light source 240b with the consequence of decreasing the combined light intensity of the first and second light sources 240a, 240b. A related technique comprises decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b by increasing the light intensity of the second light source 240b without changing the light intensity of the first light source 240a, thereby resulting in increasing the combined light intensity of the first and second light sources 240a, 240b.

[0046] As a further option, increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b may comprise increasing the light intensity of the first light source 240a by a first amount and decreasing the light intensity of the second light source 240b by a second amount, with the first amount being larger than or equal to the second amount. In particular, the first amount may be equal to the first amount, thereby resulting in adjustment of ratio to be carried out such that the combined light intensity of the first light source 240a and the second light source 240b remains constant or essentially constant. Similarly, decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b may comprise decreasing the light intensity of the first light source 240a by the first amount and increasing the light intensity of the second light source 240b by the second amount, with the preferred case of the first and second amounts being equal resulting in adjustment of ratio to be carried out such that the combined light intensity of the first light source 240a and the second light source 240b remains constant or essentially constant.

[0047] As an example, the adjustment of the ratio may further comprise, after reaching one or both of the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, termination of the adjustment of ratio regardless of the status of the input control signal. The adjustment of ratio may likewise comprise, after reaching one or both of the (selected) minimum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240b, termination of the adjustment of ratio regardless of the status of the input control signal.

[0048] As a first alternative example, the adjustment of the ratio may comprise, after reaching one or both of the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching the (selected) minimum light intensity of the first light source 240a or the (selected) maximum light intensity of the second light source 240, whichever occurs first. Alternatively, this adjustment of the ratio may be continued until termination of the input control signal or until reaching both the (selected) minimum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240, whichever occurs first. Similarly, the adjustment of the ratio may comprise, after reaching one or both of the (selected) minimum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240b, increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching the (selected) maximum light intensity of the first light source 240a or the (selected) minimum light intensity of the second light source 240b, whichever occurs first. Alternatively, this adjustment of the ratio may be continued until termination of the input control signal or until reaching both the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, whichever occurs first.

[0049] As a second alternative example, the adjustment of the ratio may comprise, after reaching one or both of the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, setting the light intensity of the first light source 240a to the (selected) minimum light intensity thereof and the light intensity of the second light source 240b to the (selected) maximum light intensity thereof and, subsequently, increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching the (selected) maximum light intensity of the first light source 240a or the (selected) minimum light intensity of the second light source 240b, whichever occurs first. Alternatively, this adjustment of the ratio may be continued until termination of the input control signal or until reaching both the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, whichever occurs first. Similarly, the adjustment of the ratio may comprise, after reaching one or both of the (selected) minimum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240b, setting the light intensity of the first light source 240a to the (selected) maximum light intensity thereof and the light intensity of the second light source 240b to the (selected) minimum light intensity thereof and, subsequently, decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching the (selected) maximum light intensity of the first light source 240a or the (selected) minimum light intensity of the second light source 240b, whichever occurs first. Alternatively, this adjustment of the ratio may

be continued until termination of the input control signal or until reaching both the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, whichever occurs first.

[0050] In the first and second alternative examples for operation in response to reaching the (selected) maximum and/or the (selected) minimum light intensity of the first or the second light source 240a, 240b described hereinbefore, the adjustment of ratio may further comprise waiting for a predetermined period of time t_w, which may be referred to as a waiting time, before further adjusting the ratio between the light intensities of the first and the second light sources 240a, 240b. Such a waiting time serves to facilitate setting a ratio of light intensities that involves operating the first and/or second light source 240a, 240b at or close to its (selected) maximum or minimum light intensity. The waiting *time* t_w may be set e.g. into a value in the range 0.5 to 1.5 seconds, for example to one second.

[0051] Instead of only providing adjustment of ratio between light intensities of the first and second light sources 240a, 240b, the control portion 224 may be further configured to enable adjustment of the combined light intensity of the first and second light sources 240a, 240b. In other words, the change in characteristics of the light in response to the duration of the input control signal t_{in} exceeding the second predetermined threshold Th_{L2} may further comprise adjusting the combined light intensity of the first light source 240a and the second light source 240b. This adjustment is preferably carried out such that the ratio between the light intensities of the first light source 240a and the second light source 240b remains constant or essentially constant.

[0052] In particular, the control portion 224 may be configured to perform the adjustment of ratio and the adjustment of combined light intensity in a sequential manner in response to a single input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2}. Such sequential adjustment of characteristics of light may comprise first adjusting the combined light intensity without changing the ratio, followed by adjustment of the ratio in dependence of the duration of the input control signal and in dependence of the current light intensities of the first and/or second light sources 240a, 240b.

[0053] In this regard, the control portion 224 may be configured to change, in response to the duration of the input control signal t_{in} exceeding the second predetermined threshold Th_{L2}, characteristics of light provided by the first and second light sources 240a, 240b by adjusting the combined light intensity of the first light source 240a and the second light source 240b such that the ratio of the light intensities is kept unchanged or essentially unchanged. The control portion 224 may be configured to continue the adjustment of combined light intensity until termination of the input control signal, until reaching a (selected) maximum combined light intensity of the first and the second light sources 240a, 240b, or until reaching a (selected) minimum combined light intensity of the first and the second light sources 240a, 240b, whichever occurs first. The control portion 224 may be further configured to change characteristics of light by adjusting the ratio between the light intensities of the first light source 240a and the second light source 240b in accordance with a first predetermined rule in response to the input control signal continuing after a predetermined period of time t_{CT} has elapsed since reaching the (selected) maximum combined light intensity of the first and the second light sources 240a, 240b. In other words, if t_X denotes the moment of time of reaching the (selected) maximum combined light intensity of the first and the second light sources 240a, 240b, the adjustment of ratio is initiated at $t_x + t_{CT}$ denoting the predetermined period of time t_{CT} having passed after reaching the (selected) maximum combined light intensity.

[0054] The adjustment of the combined light intensity of the first and second light sources 240a, 240b may comprise increasing the combined light intensity in case the most recent preceding input control signal resulted in decreasing the combined light intensity and/or the adjustment of the combined light intensity of the first and second light sources 240a, 240b may comprise decreasing the combined light intensity in case the most recent preceding input control signal resulted in increasing the combined light intensity.

[0055] The (selected) maximum combined intensity referred to above may be the light intensity where at least one of the first and the second light sources 240a, 240b has reached its (selected) maximum light intensity, as described hereinbefore. While such an approach makes the available maximum combined light intensity dependent on the current ratio of intensities, at the same time it enables making full use of the capabilities of the first and the second light sources 240a, 240b in order to provide a maximal light intensity at the current ratio of light intensities.

[0056] As another example, the (selected) maximum combined light intensity may be limited in accordance with the prevailing light intensities of the first and the second light sources 240a, 240b such that if the first light source 240a is operating at x % of its (selected) maximum light intensity and the second light source 240b is operating at y % of its (selected) maximum light intensity, the combined value of x + y is not allowed to exceed 100 %. In other words, the (maximum) combined light intensity may be defined by the fractions of the respective (selected) maximum light intensities of the first and the second light sources 240a, 240b such that at the (selected) maximum combined light intensity the sum of the fractions is 100 %. While such an approach may not make full use of the capabilities of the first and second light sources 240a, 240b, at the same time it makes the available maximum combined light intensity independent of the ratio between the light intensities of the first and the second light sources 240a, 240b provided that the (selected)

maximum light intensities of the first and the second light sources 240a, 240b are equal or essentially equal.

[0057] While the above example of basing the (selected) combined maximum light intensity of fractions of the (selected) individual light intensities of the first and the second light sources 240a, 240b provides a straightforward approach for controlling the (selected) combined maximum light intensity at the prevailing ratio of light intensities, it may result in e.g. making the perceived (selected) combined maximum light intensity dependent on the prevailing ratio of light intensities in case the (selected) maximum light intensities of the first and second light sources 240a, 240b are not equal. In an alternative exemplifying approach the (selected) combined maximum light intensity is set to a minimum of the (selected) maximum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240b. Consequently, the combined light intensity is limited such that the sum of the light intensities of the first and the second light sources 240a, 240b is not allowed to exceed the smaller of the (selected) maximum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240b. In this approach the (selected) combined maximum intensity is independent of the prevailing ratio of light intensities also in case the (selected) maximum light intensities of the first and the second light sources 240a, 240b are different.

[0058] The (selected) minimum combined light intensity is preferably the light intensity where either of the first and the second light sources 240a, 240b has reached its (selected) minimum light intensity. Alternatively, the (selected) minimum combined light intensity may be the light intensity where both light sources 240a, 240b have reached their respective (selected) minimum intensities. However, this alternative approach may result in a change in the ratio between the light intensities before reaching the (selected) minimum light intensities of the both light sources 240a, 240b.

[0059] Alternatively, the sequential adjustment of characteristics of light in response to a single input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2} may comprise first adjusting the ratio between the light intensities followed by adjustment of the combined light intensity without changing the ratio, where the adjustment(s) are carried out in dependence of the duration of the input control signal and in dependence of the current light intensities of the first and/or second light sources 240a, 240b.

[0060] In this regard, the control portion 224 may be configured to change, in response to the duration of the input control signal t_{in} exceeding the second predetermined threshold Th_{L2}, characteristics of light provided by the first and second light sources 240a, 240b by adjusting the ratio between the light intensities of the first light source 240a and the second light source 240b. The control portion 224 may be configured to continue the adjustment of the ratio until termination of the input control signal, until reaching the (selected) maximum light intensity of the first light source 240a or the (selected) minimum light intensity of the second light source 240b or until reaching the (selected) minimum light intensity of the first light source 240a or the (selected) maximum light intensity of the second light source 240b, whichever occurs first. Alternatively, this adjustment of the ratio may be continued until termination of the input control signal, until reaching the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b or until reaching the (selected) minimum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240b, whichever occurs first.

[0061] The control portion 224 may be further configured to change characteristics of light by adjusting the combined light intensity of the first light source 240a and the second light source 240b such that the ratio of the light intensities is kept unchanged or essentially unchanged in accordance with a second predetermined rule in response to the input control signal continuing after a predetermined period of time t_{CT} has elapsed since reaching said (selected) maximum light intensity of the first light source 240a and/or said (selected) minimum light intensity of the second light source 240b. Along the lines described hereinbefore, if t_y denotes the moment of time of reaching said (selected) maximum light intensity of the first light source 240a and/or said (selected) minimum light intensity of the second light source 240b, the adjustment of the combined light intensity is initiated at $t_Y + t_{CT}$ denoting the predetermined period of time t_{CT} having passed after reaching said (selected) maximum light intensity of the first light source 240a and/or said (selected) minimum light intensity of the second light source 240b.

[0062] The adjustment of ratio may comprise adjusting the ratio by increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b in case the most recent preceding input control signal resulted in decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b. Conversely, the adjustment of ratio may comprise, additionally or alternatively, adjusting the ratio by decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b in case the most recent preceding input control signal resulted in increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b.

[0063] The predetermined period t_{CT} may be for example in the range 1 to 5 seconds, for example 3 seconds. However, these values are provided as non-limiting examples only and the predetermined period may have values outside the exemplifying range without departing from the scope of the present invention. A short value for the predetermined period t_{CT}, e.g. 1 second or even less, may be beneficial in case also the adjustment of ratio is

made available to all users to avoid unnecessarily long delay between changing from adjusting the combined light intensity (to the (selected) maximum value) to the adjustment of ratio. On the other hand, a long value for the predetermined period t_{CT}, e.g. 5 seconds or more, may be beneficial in case the adjustment of ratio is intended only for maintenance personnel to decrease the risk of a casual user accidentally activating the ratio adjustment function.

[0064] The first predetermined rule for adjusting the ratio between light intensities of the first and second light sources 240a, 240b referred to hereinbefore may comprise adjusting the ratio by increasing the light intensity of the first light source 240b in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching one or both of the (selected) maximum light intensity of the first light source 240b and the (selected) minimum light intensity of the second light source 240b.

[0065] The first predetermined rule for adjusting the ratio between light intensities of the first and second light sources 240a, 240b may comprise adjusting the ratio by increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b in case the most recent preceding input control signal that caused adjustment of the ratio resulted in increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b. Conversely, the first predetermined rule may comprise adjusting the ratio by decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b in case the most recent preceding input control signal that caused adjustment of the ratio resulted in decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b. In other words, the first predetermined rule may comprise continuing the adjustment of ratio between light intensities of the first and second light sources 240a, 240b in the same direction with the most recent adjustment of ratio.

[0066] Alternatively, the first predetermined rule may comprise always starting the adjustment of ratio in a predetermined direction, i.e. by increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b or by decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b. As a further alternative, the first predetermined rule may comprise starting the adjustment of ratio in a direction opposite to that of the adjustment of ratio caused by the most recent preceding input control signal.

[0067] The first predetermined rule for adjusting the ratio between light intensities of the first and second light sources 240a, 240b may further comprise, after reaching one or both of the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, decreasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching the (selected) minimum light intensity of the first light source 240a or the (selected) maximum light intensity of the second light source 240b, whichever occurs first. Alternatively, this adjustment of the ratio may be continued until termination of the input control signal or until reaching both the (selected) minimum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240b, whichever occurs first. Conversely, the first predetermined rule may further comprise, after reaching one or both of the (selected) minimum light intensity of the first light source 240a and the (selected) maximum light intensity of the second light source 240b, increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching the (selected) maximum light intensity of the first light source 240a or the (selected) minimum light intensity of the second light source 240b, whichever occurs first. Alternatively, this adjustment of the ratio may be continued until termination of the input control signal or until reaching both the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, whichever occurs first.

[0068] Alternatively, the first predetermined rule for adjusting the ratio between light intensities of the first and second light sources 240a, 240b may further comprise, after reaching one or both of the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, setting the light intensity of the first light source 240a to the (selected) minimum light intensity thereof and the light intensity of the second light source 240b to the (selected) maximum light intensity thereof and increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching the (selected) maximum light intensity of the first light source 240a or the (selected) minimum light intensity of the second light source 240b, whichever occurs first. Alternatively, this adjustment of the ratio may be continued until termination of the input control signal or until reaching both the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, whichever occurs first.

[0069] Regardless of the approach applied in response to reaching the (selected) maximum and/or the (selected) minimum of the first and/or the second light source 240a, 240b, the first predetermined rule may further comprise applying the waiting time t_w described hereinbefore before further adjusting the ratio between the light intensities of the first and the second light sources 240a, 240b.

[0070] The second predetermined rule for adjusting the combined light intensity of the first and the second light sources 240a, 240b referred to hereinbefore may

comprise adjusting the combined light intensity by increasing or decreasing the light intensity of the first and second light sources 240a, 240b such that the ratio between the light intensities remains constant or essentially constant until termination of the input control signal, until reaching the (selected) maximum combined light intensity of the first light source 240a and the second light source 240b or until reaching the (selected) minimum combined light intensity of the first light source 240b and the second light source 240b, whichever occurs first.

[0071] The second predetermined rule for adjusting the combined light intensity may comprise increasing the combined light intensity in case the most recent preceding input control signal that resulted in adjustment of the combined light intensity resulted in increasing the combined light intensity. Conversely, the second predetermined rule for adjusting the combined light intensity may comprise decreasing the combined light intensity in case the most recent preceding input control signal that resulted in adjustment of the combined light intensity resulted in decreasing the combined light intensity. In other words, the second predetermined rule may comprise continuing the adjustment of the combined light intensity of the first and the second light sources 240a, 240b in the same direction with the most recent adjustment the combined light intensity thereof. Alternatively, the second predetermined rule may comprise always starting the adjustment of the combined light intensity in a predetermined direction, i.e. by increasing the combined light intensity or by decreasing the combined light intensity. As a further alternative, the second predetermined rule may comprise starting the adjustment of the combined light intensity in a direction opposite to that of the adjustment of the combined light intensity caused by the most recent preceding input control signal.

[0072] The second predetermined rule for adjusting the combined light intensity of the first and the second light sources 240a, 240b may further comprise, after reaching the (selected) maximum combined light intensity of the first light source 240a and the second light source 240b, decreasing the light intensities of the first light source 240a and the second light source 240b such that the ratio therebetween is kept unchanged or essentially unchanged until termination of the input control signal or until reaching the (selected) minimum combined light intensity of the first light source 240a and the second light source 240b, whichever occurs first. Conversely, additionally or alternatively, the second predetermined rule may further comprise, after reaching the (selected) minimum combined light intensity of the first light source 240a and the second light source 240b, increasing the light intensities of the first light source 240a and the second light source 240b such that the ratio therebetween is kept unchanged or essentially unchanged until termination of the input control signal or until reaching the (selected) maximum combined light intensity of the first light source 240a and the second light source 240b, whichever occurs first.

[0073] Along the lines described in context of the first predetermined rule, the second predetermine rule may further comprise applying the waiting time t_w described hereinbefore after reaching the (selected) maximum combined light intensity and/or the (selected) minimum combined light intensity of the first and the second light sources 240a, 240b before further adjusting the combined light intensity.

[0074] Instead of applying sequential adjustment of the ratio between the light intensities of the first and second light sources 240a, 240b and the combined light intensity of the first and the second light sources 240a, 240b in response to a single input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2}, the control portion 224 may be configured to alternately adjust the ratio of light intensities and the combined light intensity in response to a single input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2}.

[0075] In particular, the control portion 224 may be configured to adjust, in response to a single input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2} and until termination of the input control signal, the ratio between the light intensities of the first light source 240a and the second light source 240b in accordance with the first predetermined rule in case the most recent preceding input control signal has resulted in adjustment of the combined light intensity of the first light source 240a and the second light source 240b. Conversely, the control portion 224 may be configured to adjust, in response to a single input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2} and until termination of the input control signal, the combined light intensity of the first light source 240a and the second light source 240b such that the ratio of the light intensities is kept unchanged or essentially unchanged in accordance with the second predetermined rule in case the most recent preceding input control signal has resulted in adjustment of the ratio between the light intensities of the first light source 240a and the second light source 240b. This may be considered as an approach for adjusting either the ratio between the light intensities or the combined light intensity in accordance with the current state of the controller 220, where the state is changed in response to each input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2}.

[0076] As an alternative exemplifying approach for adjusting either the ratio between the light intensities or the combined light intensity in accordance with the current state of the controller 220 in response to an input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2}, the control portion may be configured to adjust the ratio between the light intensities in a first state and adjusting the combined light intensity in a second state.

[0077] In particular, in the first state the control portion 224 may be configured to, for example, to adjust ratio

between the light intensities of the first light source 240a and the second light source 240b by increasing the light intensity of the first light source 240a in relation to the light intensity of the second light source 240b until termination of the input control signal or until reaching the (selected) maximum light intensity of the first light source 240a or the (selected) minimum light intensity of the second light source 240b, whichever occurs first. Alternatively, this adjustment of the ratio may be continued until termination of the input control signal or until reaching the (selected) maximum light intensity of the first light source 240a and the (selected) minimum light intensity of the second light source 240b, whichever occurs first. In the second state the control portion 224 may be configured to adjust, i.e. to increase or to decrease, the combined light intensity of the first light source 240a and the second light source 240b such that the ratio of the light intensities is kept unchanged or essentially unchanged until termination of the input control signal or until reaching the (selected) maximum combined light intensity of the first and the second light sources 240a, 240b or until reaching the (selected) minimum combined light intensity of the first and the second light sources 240a, 240b.

[0078] The control portion 224 may be configured to change the state of the controller 220 from the first state to the second state or from the second state to the first state in response to a predetermined number of control signals, each having the overall duration not exceeding the first predetermined threshold Th_{L1}. As a non-limiting example, the predetermined number of such 'short' input control signals initiating the change between the first and second states may be for example two. In particular, the control portion 224 may be configured to trigger the change between the first and second states in response to receiving a sequence of a predetermined number of 'short' control signals, where individual input control signal is separated from the adjacent 'short' input control signal by a temporal interval that is smaller than the predetermined margin t_m, as described hereinbefore. Additionally, the control portion 224 may be configured to change state of the controller 220 from the first state to the second state in response to each input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2}, i.e. in response to a 'long' input control signal resulting in change of the ratio or in change of the combined light intensity.

[0079] The control portion 224 may be configured to cause change in light intensity of a light element 240a, 240b by controlling the respective light source to increase or decrease its light intensity by a predetermined amount. Consequently, in order to result in desired change of light intensity, a number of consecutive changes by the predetermined amount may be required. In particular, the control portion 224 may be configured to repeatedly control a light source to increase or decrease its light intensity by the predetermined amount at predetermined intervals as long as the input control signal continues, thereby resulting in step-wise change of the ratio between intensities of the first and the second light sources 240a, 240, or a step-wise change in the combined light intensity of the first and the second light sources 240a, 240b.

[0080] Alternatively, instead of repeatedly controlling a series of consecutive changes of the predetermined amount at predetermined intervals, the control portion 224 may be configured to control initiation of step-wise increase or decrease of light intensity of the respective light source 240a, 240b by the predetermined amount at the predetermined intervals. The control portion 224 may be further configured to control termination of the step-wise increase or decrease of light intensity of the respective light source 240a, 240b in response the termination of the input control signal.

[0081] As a variation of the approach involving the control portion 224 causing the change in light intensity of the first and the second light sources 240a, 240b in steps, the control portion 224 may be configured to adjust the ratio between the light intensities of the first and the second light sources 240a, 240b by changing between a plurality of predetermined ratios in accordance with a predetermined pattern during a period the input control signal fulfilling the criterion or criteria for adjusting the ratio. In particular, such a predetermined pattern may comprise, in context of an example involving five different predetermined ratios from R_1 to R_5, adjusting the ratio from the ratio R_i to the ratio R_{i+1} with the adjustment from the ratio R_5 to the ratio R_1. As another example, the predetermined rule may comprise adjusting the ratio from the ratio R_i to the ratio R_{i+1} with the adjustment after reaching the ratio R_5 involving adjusting the ratio from the ratio R_i to the ratio R_{i-1} until reaching the ratio R_1. The adjustment may comprise adjusting from the current ratio to the next predetermined ratio according to the predetermined pattern after a predetermined interval since the most recent adjustment or since the initiation of the adjustment (initiated by the currently on-going input control signal), thereby providing a change from one predetermined ratio to another according to the predetermined pattern at predetermined intervals while the input control signal continues. The plurality of predetermined ratios R_i and/or the predetermined pattern may be arranged, for example, to provide a sequence of ratios where the ratio monotonously changes from one predominantly relying on the first light source 240a towards one predominantly relying on the second light source 240b and/or vice versa. As another example, the plurality of predetermined ratios R_i and/or the predetermined pattern may be arranged to provide an essentially random change from one ratio to another, e.g. from one lighting scene to another without providing a monotonous or smooth change in contribution by either one of the first and the second light sources 240a, 240b. Instead of using a set of five predetermined ratios as in the example described hereinbefore, any number of predetermined ratios, e.g. any number in the range from 2 to 20 may be employed, depending on the requirements of the usage scenario.

[0082] The predetermined amount for increasing or de-

creasing the light intensity of a light source 240a, 240b may be a predetermined fixed amount. As a non-limiting example, the predetermined amount may be fixed e.g. to a predetermined fraction of a maximum light intensity provided by the respective light source 240a, 240b, e.g. to 5 % of the respective (absolute or selected) maximum light intensity. Selecting a smaller value for the predetermined amount results in more accurate and hence smoother - but typically slower - adaptation of characteristics of lighting, whereas selecting a larger value results in faster - but typically coarser - adaptation.

[0083] As another example, the predetermined amount may depend on the current light intensity provided by the respective light source 240a, 240b, e.g. in such a way that a smaller step size, e.g. in the range 1 to 3 % of the respective (absolute or selected) maximum light intensity, is applied if the current light intensity of the respective light source 240a, 240b is close to the (absolute or selected) minimum light intensity of the respective light source 240a, 240b (e.g. if the current light intensity is in the range 0 to 10 % of the (absolute or selected) maximum light intensity of the respective light source 240a, 240b) or close to the (absolute or selected) maximum light intensity of the respective light source 240a, 240b (e.g. if the current light intensity is in the range 90 to 100 % of the maximum light intensity of the respective light source 240a, 240b). In contrast, a larger step size is used in the mid-range of light intensities, e.g. if the current light intensity is in the range 10 to 90 % of the (absolute or selected) maximum light intensity of the respective light source 240a, 240b. Such an adaptation of the step size results in slower adaptation of characteristics of lighting close to the ends of the available light intensity range(s).

[0084] Instead of employing a predetermined fraction or percentage of the (absolute or selected) maximum light intensity of a light source 240a, 240b to determine the predetermined amount, the predetermined amount may be fixed absolute amount that is not directly related to the respective (absolute or selected) maximum light intensity. However, typically, the fixed absolute amount is small in relation to the respective (absolute or selected) maximum light intensity, for example, in the order of one tenth of the respective (absolute or selected) maximum light intensity or smaller in order to provide a step size enabling smooth change in light intensity of the respective light source.

[0085] The predetermined interval is preferably a fixed interval in order to provide constant and continuous response to an input control signal. The temporal length of the predetermined interval is a parameter whose value may be selected to provide desired speed of adjustment in view of the respective predetermined amount described hereinbefore. As a non-limiting example, the predetermined interval may be a value in the range from 0.01 to 0.3 seconds, e.g. 0.1 seconds. Moreover, the predetermined amount and the predetermined interval may be selected such that adjustment of the ratio between light intensities of the first and the second light sources 240a, 240b and/or the adjustment of the combined light intensity of the first and the second light sources 240a, 240b is carried out, if resulting from a single input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2}, during a desired period of time. Such a desired period of time may be e.g. in the range from 1 to 5 seconds, e.g. two seconds.

[0086] In the following, an exemplifying scenario regarding the change in light intensities of the first and the second light sources 240a, 240b is provided in order to further illustrate some concepts described in more detail hereinbefore. In particular, this exemplifying scenario involves usage of a first light source 240a capable of providing white light at color temperature 3200 K and a second light source 240b capable of providing with light at color temperature of approximately 7000 K. Moreover, a single input control signal having duration t_{in} exceeding the second predetermined threshold Th_{L2} is assumed to result in the adjustment of ratio and the adjustment of combined light intensity in a sequential manner by first adjusting the combined light intensity of the first and the second light sources 240a, 240b without changing the ratio, followed by adjustment of the ratio of light intensities of the first and the second light sources 240a, 240b without changing the combined light intensity in dependence of the duration of the input control signal and in dependence of the current light intensities of the first and/or second light sources 240a, 240b.

[0087] In this regard, Figure 4a provides an example illustrating the relationship between the input control signal, the change in the combined light intensity and the color temperature. Note that in this example the color temperature reflects the ratio between the light intensities of the first and the second light sources 240a, 240b. The upper diagram of Figure 4a shows as the bold line the status of the switch controlled by the push-button 212 as a function of time and, consequently, indicates input control signals received by the controller 220. The lower diagram of Figure 4a illustrates as the bold solid line the (relative) combined light intensity as a function of time and as the bold dashed line the color temperature as a function of time.

[0088] A first input control signal commencing at time t_1 in response to the push-button 212 being pushed is a short one, hence causing the controller 220 to control switching the one or more light elements 240 on after termination of the first input control signal at a maximum combined light intensity at color temperature of approximately 4500 K. A second input control signal commencing at time t_2 is a long one, causing the controller 220 to control decreasing the combined light intensity starting *at* $t_2 + Th_{L2}$ until termination of the second input control signal, resulting in the combined light intensity being brought to approximately 55 % of the maximum combined light intensity without affecting the color temperature.

[0089] A third input control signal commencing at time t_3 is a long one, and it first causes the controller 220 to

control increasing the combined light intensity starting at $t_3 + Th_{L2}$ until the maximum combined light intensity has been reached at time t_4. The third input control signal still continues at time $t_5 = t_4 + t_{CT}$, hence exceeding the predetermined period t_{CT} after reaching the maximum combined light intensity at time t_4 and causing the controller 220 to change the ratio between light intensities of the first and the second light sources 240a, 240b and hence to change the color temperature. Consequently, starting from time t_5 the ratio is adjusted first to provide higher color temperatures, followed by adjustment of the ratio to provide lower color temperatures after reaching the maximum color temperature approximately at 7000 K, further followed by adjustment of the ratio to provide higher color temperatures after reaching the minimum color temperature at approximately 3200 K. The maximum color temperature is reached when the first light source 240a provides a zero light intensity with the second light source 240b providing the (selected) maximum light intensity, while the minimum color temperature is reached when the first light source 240a provides its (selected) maximum light intensity with the second light source 240b providing a zero light intensity. The adjustment of the ratio is terminated in response to termination of the third input control signal, resulting in the color temperature of approximately 5200 K.

[0090] A fourth input control signal commencing at time t_6 is a long one, causing the controller 220 to control decreasing the combined light intensity starting at $t_6 + Th_{L2}$ until termination of the fourth input control signal, resulting in the combined light intensity being brought to approximately 35 % of the maximum overall light intensity without affecting the ratio between the light intensities and hence the color temperature. Finally, a fifth input control signal commencing at time t_7 is a short one, causing the controller 220 to control switching the one or more light elements 240 off after termination of the fifth input control signal.

[0091] The example provided in context of Figure 4a assumed the adjustment of the ratio to continue in another direction after a desired waiting time t_w in response to reaching a (selected) maximum or a (selected) minimum light intensity of a light source 240a, 240b. In contrast, Figure 4b provides an example illustrating the relationship between the input control signal, the change in the combined light intensity and the ratio between the light intensities (reflected in the color temperature) in accordance with a second exemplifying scenario assuming the adjustment of the ratio to the other extreme in response to reaching a (selected) maximum or a (selected) minimum light intensity of a light source 240a, 240b.

[0092] As in Figure 4a, also in Figure 4b the upper diagram shows as the bold line the status of the switch controlled by the push-button 212 as a function of time and the lower diagram illustrates as the bold solid line the (relative) combined light intensity as a function of time and as the bold dashed line the ratio of light intensities and hence the color temperature as a function of time. The durations and timing of the input control signals of the example of Figure 4b are identical to those of the example of Figure 4a.

[0093] In the example illustrated in Figure 4b the responses to the first and second input control signals are the same as described hereinbefore in context of the example illustrated in Figure 4a. Also the response to the third input control signal is the same described for the example of Figure 4a until time t_5. Due to the third input control signal still continuing at time $t_5 = t_4 + t_{CT}$, hence exceeding the predetermined period t_{CT} after reaching the (selected) maximum combined light intensity at time t_4, the controller 220 controls adjusting the ratio between the light intensities and hence changing the color temperature. Consequently, starting from time t_5 the ratio is adjusted first to provide higher color temperatures, followed by continuing the adjustment of the ratio towards higher color temperatures from the minimum color temperature approximately at 3200 K after reaching the maximum color temperature approximately at 7000 K. The adjustment of ratio and hence the adjustment of the color temperature is terminated in response to termination of the third input control signal, resulting in the color temperature of approximately 3700 K. The responses to the fourth and fifth control signals are identical to those described in context of the example of Figure 4a, while the ratio of light intensities of the first and the second light sources 240a, 240b and hence the resulting color temperature after the third input control signal is different from that of the first exemplifying scenario of Figure 4.

[0094] The controller 220 may, optionally, further comprise a driver portion 226, as schematically illustrated in Figure 5. The driver portion 226 is configured to drive operation of the two or more light sources 240, e.g. the first light source 240a and the second light source 240b in accordance with control provided by the controller 220. The control may be carried out by the controller 220 issuing control signal(s) or commands, as described hereinbefore. In particular, the driver portion 226 may be configured to switch the first light source 240a and/or the second light source 240b on or off and to change the light intensity provided by the first light source 240a and/or by the second light source 240b in accordance with the control provided by the controller 220. The driver portion 226 may be further configured to drive or control further functions of the two or more light elements 240.

[0095] The driver portion 226 may be configured to switch the first and the second light sources 240 on or off and/or to change light intensity of the first or the second light source 240a, 240b by changing the operating parameters of the respective light sources 240. This may involve initiating or discontinuing provision of the operating power to the two or more light sources 240 in order to switch the respective light sources on or off. Moreover, this may involve changing a signal providing operating power to the first or the second light source 240a, 240b, e.g. by changing the characteristics of the voltage and/or electric current provided to the respective light source

240a, 240b in order to result in a desired change in its light intensity. Such change of characteristics may comprise e.g. changing the voltage level or the current level provided to the first and/or the second light sources 240a, 240b and/or changing the duty cycle or the duty ratio of a PWM signal controlling the light intensity of the first and/or the second light source 240a, 240b.

[0096] The driver portion 226 may be configured to provide to the control portion 224 an indication of the (selected) maximum light intensity of a light source 240a, 240b or the (selected) minimum light intensity of a light source 240a, 240b having been reached to facilitate controlling the change of characteristics. Moreover, the driver portion 226 may be further configured to provide to the control portion 224 indication(s) of the current light intensities of the first and the second light sources 240a, 240b to facilitate monitoring of the prevailing combined light intensity and/or the ratio of the light intensities. Conversely, the control portion 224 may be configured to receive such indication(s) from the driver portion 226.

[0097] Instead of providing the controller 220 with the driver portion 226, the function(s) and/or the operation(s) of the driver portion 226 may be provided as a driver 230 forming a logical and functional entity separate from the controller 220, as schematically illustrated in Figure 6. In particular, the driver 230, performing the operations and/or functions described hereinbefore for the driver portion 226 may be provided in an apparatus separate from the apparatus acting as or hosting the controller 220.

[0098] In such an arrangement involving a dedicated driver 230, the driver 230 may be provided with a single input for receiving control information, e.g. output control signals or commands, from the controller 220 addressed for the first light source 240a or the second light source 240b. The control signals or commands may comprise information identifying the respective light source 240a, 240b to enable the driver 230 to address the output control signal or the command to the intended light source 240a, 240b of the two or more light sources 240. Alternatively, the driver 230 may be provided with a dedicated input for each light source 240a, 240b for receiving control, e.g. output control signals or commands, from the controller 220 addressed to the respective light source 240a, 240b. In case of dedicated inputs it may not be necessary to include the information identifying the respective light element in the control signals or commands received at the driver 230.

[0099] Instead of a single driver 230, the controller 220 may control operation of the two or more light sources 240 via two or more drivers. In particular, the two or more drivers may comprise a first driver 230a for driving operation of the first light source 240a and a second driver 230b for driving operation of the second light source 240b, as schematically illustrated in Figure 7. The first driver 230a and the second driver 230b may be hence considered to represent two or more drivers, each configured to control operation of the respective light source 240a, 240b connectable thereto independently of the other drivers (but in control of the controller 220).

[0100] In general, the driving portion 226 or the driver 230, if present, provides a driver function or a driver apparatus in accordance with the characteristics and requirements of the light source 240a, 240b it is configured to drive.

[0101] As an example, the driver may comprise a LED driver and the light sources connectable thereto may comprise one or more LED light sources. As another example, the driver may comprise an electrical ballast and the light sources connectable thereto may comprise one or more fluorescent lamps. As a further example, the driver may comprise a driver for a HID lamp while the light sources connectable thereto may comprise one or more HID lamps.

[0102] The operations, procedures and/or functions assigned to the structural units of the controller 220, e.g. to the input portion 222, to the control portion 224 and to the possible driver portion 226, may be divided between these portions in a different manner. Moreover, the controller 220 may comprise further portions or units that may be configured to perform some of the operations, procedures and/or functions assigned to the input portion 222, to the control portion 224 and/or to the possible driver portion 226 in the description hereinbefore. On the other hand, the operations, procedures and/or functions assigned to the input portion 222, to the control portion 224 and to the possible driver portion 226 may be assigned to a single portion or to a single processing unit within the controller 220.

[0103] In particular, the controller 220 may be provided as a control apparatus for controlling operation of a first light source 240a of a first color and a second light source 240b of a second color, the control apparatus comprising means for receiving an input control signal having a user-controllable duration, means for switching, in response to a single input control signal having the overall duration t_{in} not exceeding a first predetermined threshold Th_{L1}, the first light source 240a and the second light source 240b on or off, and means for changing the characteristics of light provided by the first and second light sources 240a, 240b, in response to the duration of the input control signal t_{in} exceeding a second predetermined threshold Th_{L2} that is no smaller than the first predetermined threshold, the change in characteristics being dependent on duration of the input control signal and the change comprising adjustment of the ratio between the light intensities of the first light source and the second light source.

[0104] As a non-limiting example, Figure 8 schematically illustrates an exemplifying apparatus 800 that may be employed for embodying the present invention. The apparatus 800 comprises a processor 810 and a memory 820, the processor 810 being configured to read from and write to the memory 820. The apparatus 800 may further comprise a communication interface 830, such as a network card or a network adapter enabling wireless or wired communication with one or more another appa-

ratuses. The apparatus 800 may further comprise a user interface 840 for providing data, commands and/or other input to the processor 810 and/or for receiving data or other output from the processor 810, the user interface 840 comprising for example one or more of a display, one or more keys, a keyboard, a mouse or a respective pointing device, a touchscreen, etc. The apparatus 800 may comprise further components not illustrated in the example of Figure 8.

[0105] Although the processor 810 is presented in the example of Figure 8 as a single component, the processor 810 may be implemented as one or more separate components. Although the memory 820 is illustrated as single component, the memory 820 may be implemented as one or more separate components, some or all of which may be integrated/removable and/or may provide permanent/semi-permanent/ dynamic/cached storage.

[0106] The apparatus 800 may be embodied as a special-purpose or as a general purpose device with a sufficient processing capacity. Alternatively, the apparatus 800 may be embodied as an apparatus dedicated for operating as the controller 220 described hereinbefore.

[0107] The memory 820 may store a computer program 850 comprising computer-executable instructions that control the operation of the apparatus 800 when loaded into the processor 810 and executed by the processor 810. As an example, the computer program 850 may include one or more sequences of one or more instructions. The computer program 850 may be provided as a computer program code. The processor 810 is able to load and execute the computer program 850 by reading the one or more sequences of one or more instructions included therein from the memory 820. The one or more sequences of one or more instructions may be configured to, when executed by one or more processors, cause an apparatus, for example the apparatus 800, to implement the operations, procedures and/or functions described hereinbefore in context of the controller 220.

[0108] Hence, the apparatus 800 may comprise at least one processor 810 and at least one memory 820 including computer program code for one or more programs, the at least one memory 820 and the computer program code configured to, with the at least one processor 810, cause the apparatus 800 to perform the operations, procedures and/or functions described hereinbefore in context of the controller 220.

[0109] The computer program 850 may be provided independently of the apparatus, and the computer program 850 may be provided at the apparatus 800 via any suitable delivery mechanism. As an example, the delivery mechanism may comprise at least one computer readable non-transitory medium having program code stored thereon, the program code which when executed by an apparatus cause the apparatus at least implement processing to carry out the operations, procedures and/or functions described hereinbefore in context of the controller 220. The delivery mechanism may be for example a computer readable storage medium, a computer program product, a memory device a record medium such as a CD-ROM, a DVD, a corresponding optical media, an article of manufacture that tangibly embodies the computer program 850, etc. As a further example, the delivery mechanism may be a signal configured to reliably transfer the computer program 850.

[0110] Reference to a processor should not be understood to encompass only programmable processors, but also dedicated circuits such as field-programmable gate arrays (FPGA), application specific circuits (ASIC), signal processors, etc.

Claims

1. An apparatus for controlling operation of a first light source (240a) of a first color and a second light source (240b) of a second color, the apparatus comprising

an input portion (222) configured to receive an input control signal having a user-controllable duration,

characterized in that the apparatus comprises a control portion (224) configured to

switch, in response to a single input control signal having the overall duration not exceeding a first predetermined threshold, the first (240a) and second (240b) light sources on or off, and

change characteristics of light provided by the first (240a) and second (240b) light sources in response to the duration of the input control signal exceeding a second predetermined threshold that is no smaller than the first predetermined threshold, the change in characteristics being dependent on duration of the input control signal and the change comprising adjustment of the ratio between the light intensities of the first light source (240a) and the second light source (240b), and the change further comprising adjustment of the combined light intensity of the first light source (240a) and the second light source (240b) such that the ratio between the light intensity of the first light source (240a) and the second light source (240b) remains essentially constant;

wherein said adjustment of the combined light intensity occurs first in response to said input control signal when the duration of the input control signal exceeds said second predetermined threshold, so that the control portion is configured to continue the adjustment of combined light intensity until termination of the input control signal or until reaching a maximum or a minimum combined light intensity of the first (240a) and the second (240b) light sources and perform the adjustment of the ratio between the light intensities thereafter.

2. An apparatus according to claim 1, wherein the change comprises adjustment of the ratio between the light intensities of the first light source (240a) and the second light source (240b) in accordance with a first predetermined rule in response to the input control signal continuing after a predetermined period of time after reaching said maximum combined light intensity of the first (240a) and the second (240b) light sources has elapsed.

3. An apparatus according to claim 2, wherein the first predetermined rule comprises adjusting the ratio by increasing the light intensity of the first light source (240a) in relation to the light intensity of the second light source (240b) until termination of the input control signal or until reaching the maximum light intensity of the first light source (240a) and/or the minimum light intensity of the second light source (240b).

4. An apparatus according to claim 3, wherein the adjustment of ratio further comprises, after reaching the maximum light intensity of the first light source (240a) and/or the minimum light intensity of the second light source (240b), one of the following:

decreasing the light intensity of the first light source (240a) in relation to the light intensity of the second light source (240b) until termination of the input control signal or until reaching a minimum light intensity of the first light source (240a) and/or a maximum light intensity of the second light source (240b), and
setting the light intensity of the first light source (240a) to the minimum light intensity thereof and the light intensity of the second light source (240b) to the maximum light intensity thereof and increasing the light intensity of the first light source (240a) in relation to the light intensity of the second light source (240b) until termination of the input control signal or until reaching the maximum light intensity of the first light source (240a) and/or the minimum light intensity of the second light source (240b).

5. An apparatus according to claim 4, wherein the adjustment of ratio further comprises, after reaching the maximum light intensity of the first light source (240a) and/or the minimum light intensity of the second light source (240b), waiting for a second predetermined period of time before further adjusting the ratio between the light intensities of the first (240a) and the second (240b) light sources.

6. An apparatus according to any preceding claim, wherein the adjustment of the ratio between the light intensities of the first light source (240a) and the second light source (240b) is carried out such that the combined light intensity of the first light source (240a) and the second light source (240b) remains essentially constant.

7. An apparatus according to any preceding claim, wherein the change in light intensity of the first light source (240a) and/or the second light source (240b) is provided as one or more changes of a predetermined amount, each change increasing or decreasing the light intensity of the respective light source by the predetermined amount.

8. An apparatus according to any preceding claim, wherein the apparatus is configured to issue one or more control signals to cause a desired change in light intensity of the first light source (240a) and/or the second light source (240b).

9. An apparatus according to claim 1, comprising:
at least one processor (810) and at least one memory (820) including computer program code for one or more programs, the at least one memory (820) and the computer program code configured to, with the at least one processor (810), cause the apparatus to implement at least said input portion (222) and said control portion (224).

10. A computer program for controlling operation of a first light source (240a) of a first color and a second light source (240b) of a second color, the computer program including one or more sequences of one or more instructions which, when executed by one or more processors, cause an apparatus to at least perform the following:

receive an input control signal having a user-controllable duration,
characterized in that the computer program, when executed by the one or more processors, causes the apparatus to
switch, in response to a single input control signal having the overall duration not exceeding a first predetermined threshold, the first (240a) and second (240b) light sources on or off, and
change characteristics of light provided by the first (240a) and second (240b) light sources in response to the duration of the input control signal exceeding a second predetermined threshold that is no smaller than the first predetermined threshold, the change in characteristics being dependent on duration of the input control signal and the change comprising adjustment of the ratio between the light intensities of the first light source (240a) and the second light source (240b), and the change further comprising adjustment of the combined light intensity of the first light source (240a) and the second light source (240b) such that the ratio between the light intensity of the first light source (240a) and

the second light source (240b) remains essentially constant
wherein said adjustment of the combined light intensity occurs first in response to said input control signal and the adjustment of combined light intensity is continued until termination of the input control signal or until reaching a maximum or a minimum combined light intensity of the first (240a) and the second (240b) light sources and the adjustment of the ratio between the light intensities is performed thereafter.

Patentansprüche

1. Vorrichtung zum Steuern/Regeln vom Betrieb einer ersten Lichtquelle (240a) einer ersten Farbe und einer zweiten Lichtquelle (240b) einer zweiten Farbe, wobei die Vorrichtung

einen Eingabeabschnitt (222) aufweist, der konfiguriert ist, um ein Eingabesteuersignal mit einer vom Benutzer steuerbaren Dauer zu empfangen,
dadurch gekennzeichnet, dass die Vorrichtung einen Steuerabschnitt (224) aufweist, welcher konfiguriert ist zum:

Ein- oder Ausschalten der ersten (240a) und der zweiten (240b) Lichtquelle, in Antwort auf ein einzelnes Eingabesteuersignal, dessen Gesamtdauer einen ersten vorbestimmten Schwellenwert nicht überschreitet, und
Ändern von Charakteristiken des Lichts, das von der ersten (240a) und zweiten (240b) Lichtquelle geliefert wird, in Antwort darauf, dass die Dauer des Eingabesteuersignals einen zweiten vorbestimmten Schwellenwert überschreitet, der nicht kleiner als der erste vorbestimmte Schwellenwert ist, wobei die Änderung in den Charakteristiken von der Dauer des Eingabesteuersignals abhängig ist, und die Änderung eine Einstellung des Verhältnisses zwischen den Lichtintensitäten der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) aufweist, und wobei die Änderung ferner aufweist: Einstellung der kombinierten Lichtintensität der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) derart, dass das Verhältnis zwischen der Lichtintensität der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) im Wesentlichen konstant bleibt;
wobei die Einstellung der kombinierten Lichtintensität zunächst in Antwort auf das Eingangssteuersignal erfolgt, wenn die Dauer des Eingabesteuersignals den zweiten vorbestimmten Schwellenwert überschreitet, so dass der Steuerabschnitt konfiguriert ist, die Einstellung der kombinierten Lichtintensität fortzusetzen, bis das Eingabesteuersignal endet oder bis eine maximale oder eine minimale kombinierte Lichtintensität der ersten (240a) und der zweiten (240b) Lichtquelle erreicht ist, und danach die Einstellung des Verhältnisses zwischen den Lichtintensitäten auszuführen.

2. Vorrichtung nach Anspruch 1, wobei die Änderung aufweist: Einstellen des Verhältnisses zwischen den Lichtintensitäten der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) gemäß einer ersten vorbestimmten Regel in Antwort darauf, dass das Eingabesteuersignal nach einer vorbestimmten Zeitdauer fortdauert, nachdem das Erreichen der maximalen kombinierten Lichtintensität der ersten (240a) und der zweiten (240b) Lichtquelle abgelaufen ist.

3. Vorrichtung nach Anspruch 2, wobei die erste vorbestimmte Regel aufweist: Einstellen des Verhältnisses durch Erhöhen der Lichtintensität der ersten Lichtquelle (240a) in Bezug auf die Lichtintensität der zweiten Lichtquelle (240b), bis das Eingabesteuersignal endet oder bis die maximale Lichtintensität der ersten Lichtquelle (240a) und/oder die minimale Lichtintensität der zweiten Lichtquelle (240b) erreicht ist.

4. Vorrichtung nach Anspruch 3, wobei die Einstellung des Verhältnisses, nach Erreichen der maximalen Lichtintensität der ersten Lichtquelle (240a) und/oder der minimalen Lichtintensität der zweiten Lichtquelle (240b), ferner eines vom Folgenden aufweist:

Verringern der Lichtintensität der ersten Lichtquelle (240a) in Bezug auf die Lichtintensität der zweiten Lichtquelle (240b), bis das Eingabesteuersignal endet oder bis eine minimale Lichtintensität der ersten Lichtquelle (240a) und/oder eine maximale Lichtintensität der zweiten Lichtquelle (240b) erreicht ist, und
Setzen der Lichtintensität der ersten Lichtquelle (240a) auf ihre minimale Lichtintensität und der Lichtintensität der zweiten Lichtquelle (240b) auf ihre maximale Lichtintensität, und Erhöhen der Lichtintensität der ersten Lichtquelle (240a) in Bezug auf die Lichtintensität der zweiten Lichtquelle (240b), bis das Eingabesteuersignal endet oder bis die maximale Lichtintensität der ersten Lichtquelle (240a) und/oder die minimale Lichtintensität der zweiten Lichtquelle (240b) er-

reicht ist.

5. Vorrichtung nach Anspruch 4, wobei die Einstellung des Verhältnisses, nach Erreichen der maximalen Lichtintensität der ersten Lichtquelle (240a) und/oder der minimalen Lichtintensität der zweiten Lichtquelle (240b), ferner aufweist: Abwarten einer zweiten vorbestimmten Zeitdauer vor einer weiteren Einstellung des Verhältnisses zwischen den Lichtintensitäten der ersten (240a) und der zweiten (240b) Lichtquelle.

6. Vorrichtung nach einem vorhergehenden Anspruch, wobei die Einstellung des Verhältnisses zwischen den Lichtintensitäten der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) derart erfolgt, dass die kombinierte Lichtintensität der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) im Wesentlichen konstant bleibt.

7. Vorrichtung nach einem vorhergehenden Anspruch, wobei die Änderung in der Lichtintensität der ersten Lichtquelle (240a) und/oder der zweiten Lichtquelle (240b) als eine oder mehrere Änderungen eines vorbestimmten Betrags bereitgestellt wird, wobei jede Änderung die Lichtintensität der entsprechenden Lichtquelle um den vorbestimmten Betrag erhöht oder verringert.

8. Vorrichtung nach einem vorhergehenden Anspruch, wobei die Vorrichtung konfiguriert ist, um ein oder mehrere Steuersignale auszugeben, um eine gewünschte Änderung in der Lichtintensität der ersten Lichtquelle (240a) und/oder der zweiten Lichtquelle (240b) zu bewirken.

9. Vorrichtung nach Anspruch 1, welche aufweist: zumindest einen Prozessor (810) und zumindest einen Speicher (820), der einen Computerprogramm-Code für ein oder mehrere Programme enthält, wobei der zumindest eine Speicher (820) und der Computerprogramm-Code konfiguriert sind, um mit dem zumindest einen Prozessor (810) zu bewirken, dass die Vorrichtung zumindest den Eingabeabschnitt (222) und den Steuerabschnitt (224) implementiert.

10. Computerprogramm zum Steuern/Regeln vom Betrieb einer ersten Lichtquelle (240a) einer ersten Farbe und einer zweiten Lichtquelle (240b) einer zweiten Farbe, wobei das Computerprogramm eine oder mehrere Sequenzen von einer oder mehreren Instruktionen enthält, die, wenn sie von einem oder mehreren Prozessoren ausgeführt werden, bewirken, dass eine Vorrichtung zumindest das Folgende durchführt:

Empfangen eines Eingabesteuersignals mit einer vom Benutzer steuerbaren Dauer,

dadurch gekennzeichnet, dass das Computerprogramm, wenn es von dem einen oder mehreren Prozessoren ausgeführt wird, bewirkt, dass die Vorrichtung:

die erste (240a) und die zweite (240b) Lichtquelle, in Antwort auf ein einzelnes Eingabesteuersignal, dessen Gesamtdauer einen ersten vorbestimmten Schwellenwert nicht überschreitet, ein- oder ausschaltet, und
Charakteristiken des Lichts ändert, das von der ersten (240a) und zweiten (240b) Lichtquelle geliefert wird, in Antwort darauf, dass die Dauer des Eingabesteuersignals einen zweiten vorbestimmten Schwellenwert überschreitet, der nicht kleiner als der erste vorbestimmte Schwellenwert ist, wobei die Änderung in den Charakteristiken von der Dauer des Eingabesteuersignals abhängig ist, und die Änderung eine Einstellung des Verhältnisses zwischen den Lichtintensitäten der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) aufweist, und die Änderung ferner aufweist: Einstellung der kombinierten Lichtintensität der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) derart, dass das Verhältnis zwischen der Lichtintensität der ersten Lichtquelle (240a) und der zweiten Lichtquelle (240b) im Wesentlichen konstant bleibt,
wobei die Einstellung der kombinierten Lichtintensität zuerst in Antwort auf das Eingabesteuersignal erfolgt und die Einstellung der kombinierten Lichtintensität fortgesetzt wird, bis das Eingabesteuersignal endet oder bis eine maximale oder eine minimale kombinierte Lichtintensität der ersten (240a) und der zweiten (240b) Lichtquelle erreicht ist, und die Einstellung des Verhältnisses zwischen den Lichtintensitäten danach ausgeführt wird.

Revendications

1. Appareil pour commander le fonctionnement d'une première source de lumière (240a) d'une première couleur et d'une seconde source de lumière (240b) d'une seconde couleur, l'appareil comprenant

une partie d'entrée (222) configurée pour recevoir un signal de commande d'entrée ayant une durée pouvant être commandée par l'utilisateur, **caractérisé en ce que** l'appareil comprend une partie de commande (224) configurée pour allumer ou éteindre, en réponse à un seul signal

de commande d'entrée ayant la durée totale ne dépassant pas un premier seuil prédéterminé, les première (240a) et seconde (240b) sources de lumière, et

changer des caractéristiques de lumière fournie par les première (240a) et seconde (240b) sources de lumière en réponse à la durée du signal de commande d'entrée dépassant un second seuil prédéterminé qui n'est pas inférieur au premier seuil déterminé, le changement de caractéristiques dépendant de la durée du signal de commande d'entrée et le changement comprenant l'ajustement du rapport entre les intensités de lumière de la première source de lumière (240a) et de la seconde source de lumière (240b), et le changement comprenant en outre l'ajustement de l'intensité de lumière combinée de la première source de lumière (240a) et de la seconde source de lumière (240b) de sorte que le rapport entre l'intensité de lumière de la première source de lumière (240a) et de la seconde source de lumière (240b) reste essentiellement constant;

dans lequel ledit ajustement de l'intensité de lumière combinée intervient d'abord en réponse au signal de commande d'entrée lorsque la durée du signal de commande d'entrée dépasse ledit second seuil prédéterminé de sorte que la partie de commande est configurée pour continuer l'ajustement de l'intensité de lumière combinée jusqu'à la terminaison du signal de commande d'entrée ou jusqu'à atteindre une intensité de lumière combinée maximale ou minimale de la première (240a) et de la seconde (240b) source de lumière, et effectuer ensuite l'ajustement du rapport entre les intensités de lumière.

2. Appareil selon la revendication 1, dans lequel le changement comprend l'ajustement du rapport entre les intensités de lumière de la première source de lumière (240a) et de la seconde source de lumière (240b) conformément à une première règle prédéterminée en réponse au signal de commande d'entrée continuant après qu'une période de temps prédéterminée après avoir atteint ladite intensité de lumière combinée maximale de la première (240a) et de la seconde (240b) source de lumière s'est écoulée.

3. Appareil selon la revendication 2, dans lequel la première règle prédéterminée comprend l'ajustement du rapport en augmentant l'intensité de lumière de la première source de lumière (240a) par rapport à l'intensité de lumière de la seconde source de lumière (240b) jusqu'à la terminaison du signal de commande d'entrée ou jusqu'à atteindre l'intensité de lumière maximale de la première source de lumière (240a) et/ou l'intensité de lumière minimale de la seconde source de lumière (240b).

4. Appareil selon la revendication 3, dans lequel l'ajustement du rapport comprend en outre, après avoir atteint l'intensité de lumière maximale de la première source de lumière (240a) et/ou l'intensité de lumière minimale de la seconde source de lumière (240b), un de ce qui suit :

la diminution de l'intensité de lumière de la première source de lumière (240a) par rapport à l'intensité de lumière de la seconde source de lumière (240b) jusqu'à la terminaison du signal de commande d'entrée ou jusqu'à atteindre une intensité de lumière minimale de la première source de lumière (240a) et/ou une intensité de lumière maximale de la seconde source de lumière (240b), et

le réglage de l'intensité de lumière de la première source de lumière (240a) à l'intensité de lumière minimale de celle-ci et de l'intensité de lumière de la seconde source de lumière (240b) à l'intensité de lumière maximale de celle-ci et l'augmentation de l'intensité de lumière de la première source de lumière (240a) par rapport à l'intensité de lumière de la seconde source de lumière (240b) jusqu'à la terminaison du signal de commande d'entrée ou jusqu'à atteindre l'intensité de lumière maximale de la première source de lumière (240a) et/ou l'intensité de lumière minimale de la seconde source de lumière (240b).

5. Appareil selon la revendication 4, dans lequel l'ajustement du rapport comprend en outre, après avoir atteint l'intensité de lumière maximale de la première source de lumière (240a) et/ou l'intensité de lumière minimale de la seconde source de lumière (240b), l'attente d'une seconde période de temps prédéterminée avant d'ajuster en outre le rapport entre les intensités de lumière de la première (240a) et de la seconde (240b) source de lumière.

6. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'ajustement du rapport entre les intensités de lumière de la première source de lumière (240a) et de la seconde source de lumière (240b) est effectué de sorte que l'intensité de lumière combinée de la première source de lumière (240a) et de la seconde source de lumière (240b) reste essentiellement constant.

7. Appareil selon l'une quelconque des revendications précédentes, dans lequel le changement de l'intensité de lumière de la première source de lumière (240a) et/ou de la seconde source de lumière (240b) est fourni comme un ou plusieurs changements d'une quantité prédéterminée, chaque changement

augmentant ou diminuant l'intensité de lumière de la source de lumière respective de la quantité prédéterminée.

8. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'appareil est configuré pour émettre un ou plusieurs signaux de commande pour provoquer un changement souhaité de l'intensité de lumière de la première source de lumière (240a) et/ou de la seconde source de lumière (240b).

9. Appareil selon la revendication 1, comprenant :
au moins un processeur (810) et au moins une mémoire (820) incluant un code de programme informatique pour un ou plusieurs programmes, la au moins une mémoire (820) et le code de programme informatique configurés pour, avec le au moins un processeur (810), amener l'appareil à mettre en oeuvre au moins ladite partie d'entrée (222) et ladite partie de commande (224).

10. Programme informatique pour commander le fonctionnement d'une première source de lumière (240a) d'une première couleur et d'une seconde source de lumière (240b) d'une seconde couleur, le programme informatique incluant une ou plusieurs séquences d'une ou plusieurs instructions qui, lorsqu'elles sont exécutées par un ou plusieurs processeurs, amènent un appareil à effectuer au moins ce qui suit :

la réception d'un signal de commande d'entrée ayant une durée pouvant être commandée par l'utilisateur,
caractérisé en ce que le programme informatique, lorsqu'il est exécuté par les un ou plusieurs processeurs, amène l'appareil à
allumer ou éteindre, en réponse à un seul signal de commande d'entrée ayant la durée totale ne dépassant pas un premier seuil prédéterminé, les première (240a) et seconde (240b) sources de lumière, et
changer des caractéristiques de lumière fournie par les première (240a) et seconde (240b) sources de lumière en réponse à la durée du signal de commande d'entrée dépassant un second seuil prédéterminé qui n'est pas inférieur au premier seuil déterminé, le changement de caractéristiques dépendant de la durée du signal de commande d'entrée et le changement comprenant l'ajustement du rapport entre les intensités de lumière de la première source de lumière (240a) et de la seconde source de lumière (240b), et le changement comprenant en outre l'ajustement de l'intensité de lumière combinée de la première source de lumière (240a) et de la seconde source de lumière (240b) de sorte que le rapport entre l'intensité de lumière de la première source de lumière (240a) et de la seconde source de lumière (240b) reste essentiellement constant,
dans lequel l'ajustement de l'intensité de lumière combinée est effectué d'abord en réponse au signal de commande d'entrée et l'ajustement de l'intensité de lumière combinée est continué jusqu'à la terminaison du signal de commande d'entrée ou jusqu'à atteindre une intensité de lumière combinée maximale ou minimale de la première (240a) et de la seconde (240b) source de lumière, et l'ajustement du rapport entre les intensités de lumière est effectué ensuite.

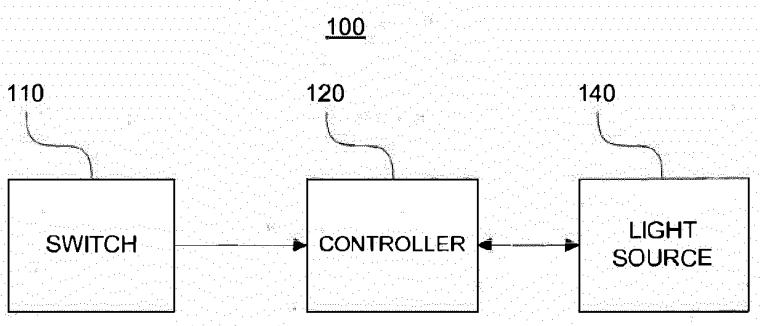

Figure 1

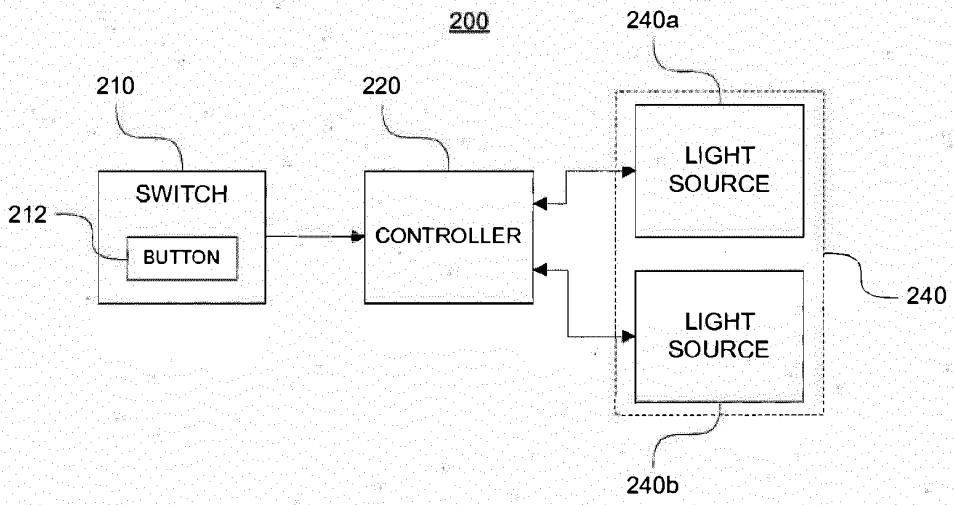

Figure 2

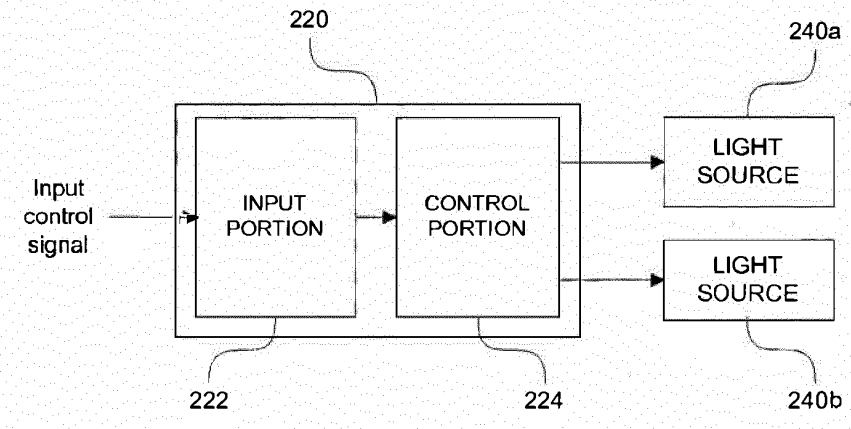

Figure 3

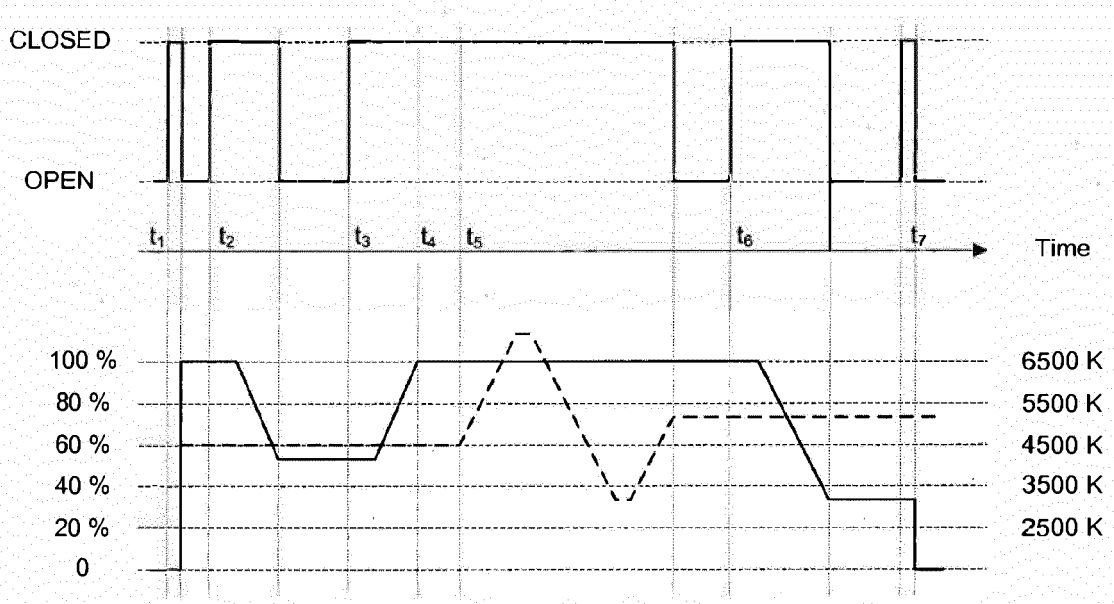

Figure 4a

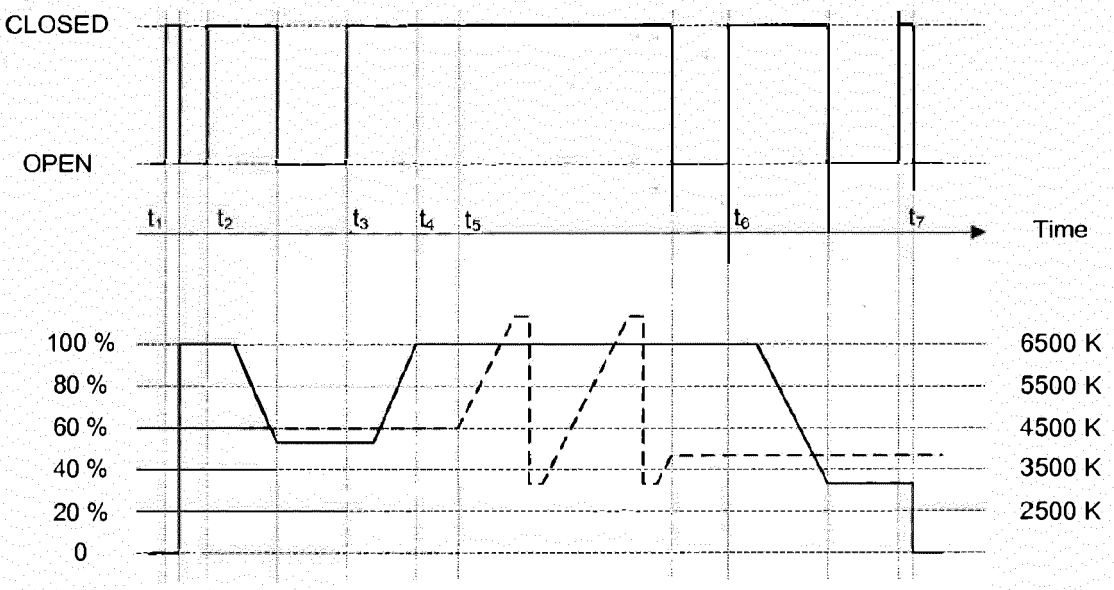

Figure 4b

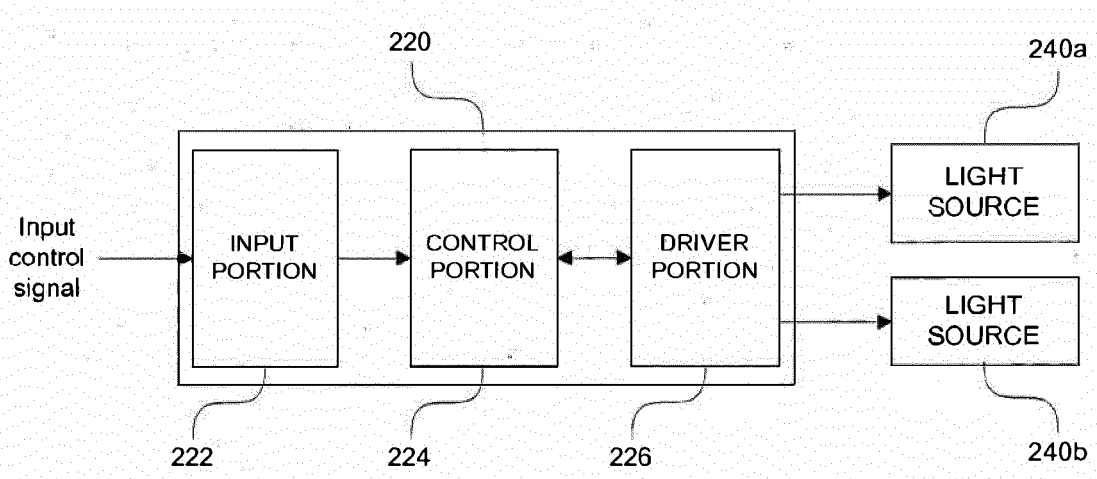

Figure 5

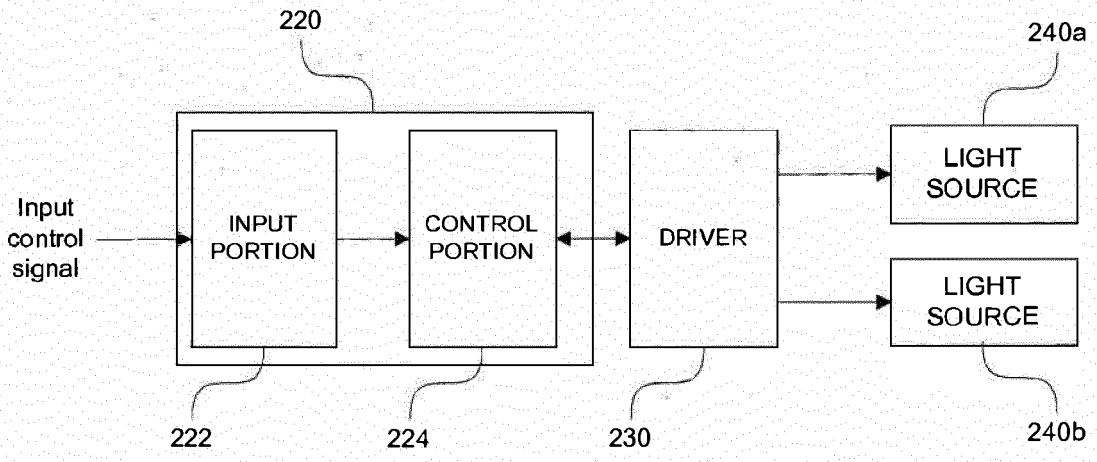

Figure 6

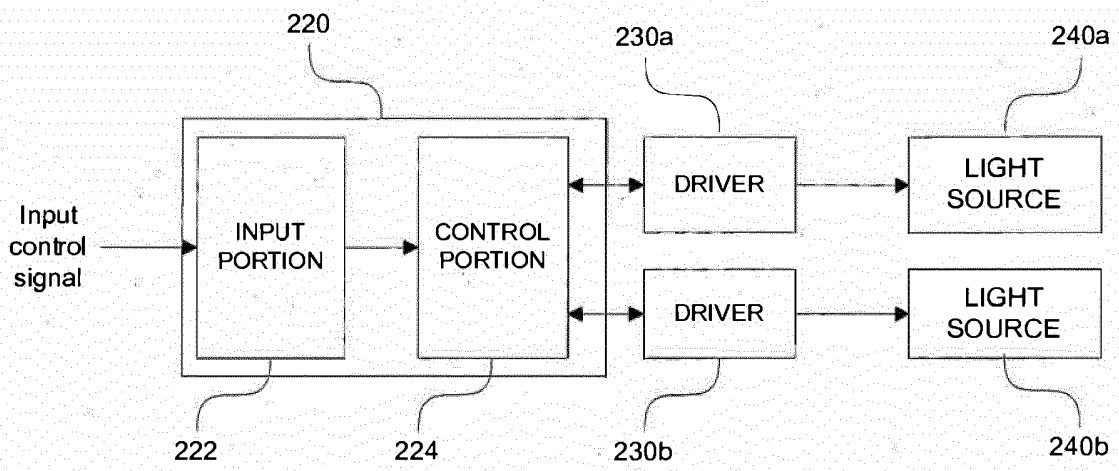

Figure 7

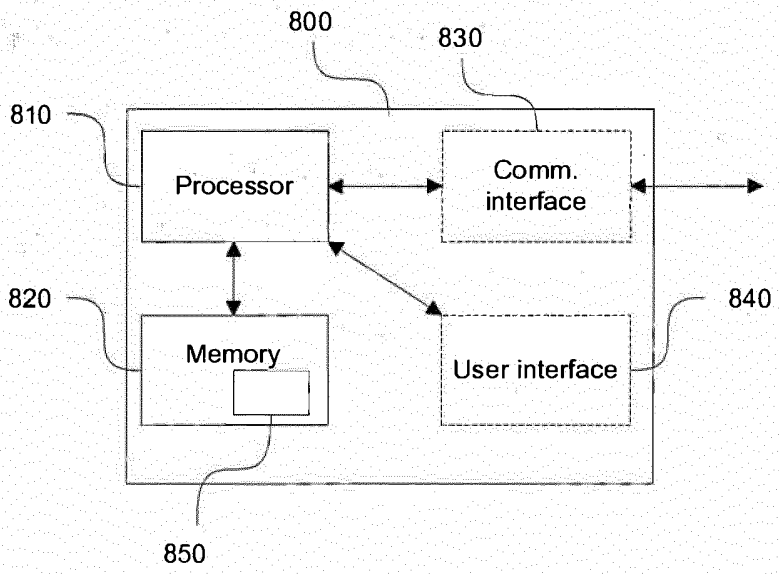

Figure 8

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- EP 2219418 A2 **[0005]**
- WO 2011107280 A2 **[0005]**