

Description

This is an invention in the lighting art. More particularly, it involves a fluorescent lamp controller by which a fluorescent lamp may be controlled in accordance with the amount of ambient light incident, or falling upon, at least a part of the area in which the fluorescent lamp is located. The invention also involves a sensing circuit for generating a signal representative of ambient light intensity, suitable for use in such a fluorescent lamp controller.

One of the objects of this invention is the conservation of energy. In liquid crystal displays backlighting is used to provide contrast between the ambient light incident upon the display and the display itself. This invention controls the amount of light from fluorescent lamps used as such backlighting in accordance with the amount of ambient light incident on the display. It conserves energy by reducing the luminescence of a backlighting fluorescent lamp as the incident ambient light decreases.

It is a feature of the invention that it enables the control of the amount of fluorescent light used as backlighting for a liquid crystal display in an efficient manner.

In accordance with an aspect of the invention, there is provided a sensing circuit. The sensing circuit is connected to a ballast means for the fluorescent lamp which ballast means include a light control circuit for controlling the luminescence of the fluorescent lamp. The sensing circuit includes a light sensor, a first and a second stage amplifier and two terminals and produces a signal representative of the light impinging upon the light sensor. The sensing circuit is operable from power derived from the ballast means via the terminals and controls the light control circuit so that the luminescence emanating from the fluorescent lamp is increased in accordance with increases in the light striking the light sensor.

European Patent Application EP-A-0416697, which was only published after the priority date of the present application, discloses a light sensing circuit for controlling the light output of fluorescent lamps operated on a dimmable ballast. Contrary to the light sensing circuit incorporated in a fluorescent lamp controller according to the present invention, however, that light sensing circuit is configured to increase the light output of the fluorescent lamps when the amount of light that strikes the light sensor decreases.

Other objects, features and advantages of the invention will be apparent from the following description and appended claims when considered in conjunction with the accompanying drawing in which,

Figure 1 is a block diagram of a fluorescent lamp controller provided in accordance with this invention;

Figure 2 is the schematic of a light sensing circuit

included in the fluorescent lamp controller of Figure 1; and

Figure 3 is a family of curves plotting controlled light output of fluorescent lamps against light incident upon a light sensor by which the fluorescent lamp controller of this invention may be operated.

Except for light sensing circuit 2 each of the elements shown in Figure 1 correspond to those of a ballast means disclosed in European Patent Application Serial No. 399.613. As a consequence, it is to be understood that the ballast means including the following elements of European Patent Application Serial No. 399.613 namely, input rectifier circuit 32, preconditioner circuit 28, DC-AC converter circuit 24, output circuit 20, fluorescent lamps 11 and 12, voltage supply 40, control circuit 36, signal applying circuit 112 and dimming interface circuit 110 correspond respectively to input rectifier circuit 13, preconditioner circuit 15, DC-AC converter circuit 17, output circuit 19, fluorescent lamps 21 and 23, voltage supply 25, control circuit 27, signal applying circuit 29 and dimming interface circuit 30 of this application. The operation of the ballast means is described in European Patent Application Serial No. 399.613. The light output of fluorescent lamps 21 and 23 is controllable by means of the voltage present between terminal 113 and terminal 114 of dimming interface circuit 30.

The improvement disclosed herein involves the provision of a light sensing circuit connected to terminals 113 and 114 of dimming interface circuit 30. A representative circuit for light sensing means 2 is shown in Figure 2. Light sensing circuit 2 receives its power for operation from the ballast means shown in Figure 1 from terminals 113 and 114. Light sensing circuit 2 comprises a light sensor LS connected between line 114 and one end of a capacitor C. The other end of capacitor C is connected to terminal 113. The one end of capacitor C is also connected to the base of NPN transistor Q_1 , which acts as a first stage amplifier. The emitter of transistor Q_1 is connected to line 114. The base of transistor Q_1 is also connected to one end of a variable resistor R whose other end is connected to line 113. The collector of transistor Q_1 is connected to one end of a resistor R_c , whose other end is connected to line 113. The one end of resistor R_c is also connected to the base of PNP transistor Q_2 . Transistor Q_2 serves as the second stage amplifier of the disclosed control circuit. It acts as a current sink. The emitter of this transistor is connected to line 113 while its collector is connected to line 114. A zener diode is also connected across lines 113 and 114 to protect against overvoltages being applied across those lines.

In controlling the backlighting of a liquid crystal display, light sensor LS is placed in a position where it can only sense light incident on the display, or at least a part thereof. It should be so located that the

backlighting does not strike it. In response to the light striking light sensor LS it controls the operation of transistor Q₁ in accordance with the bias established by variable resistor R. Transistor Q₁ in turn, in conjunction with biasing resistor R_c controls the operation of transistor Q₂. In operation, the less incident light that strikes light sensor LS the more current transistor Q₁ conducts. As a result transistor Q₂ sinks more current between terminals 113 and 114. This causes interface circuit 30 to lower the luminescence of lamps 21 and 23. As incident light at the display increases light sensor LS causes transistor Q₁ to conduct less current accordingly. This causes transistor Q₂ to sink less current between lines 113 and 114 and consequently, interface circuit 30 operates to cause lamps 21 and 23 to increase their luminescence.

Figure 3 shows the controlled light output of fluorescent lamps 0, expressed in lumen as a function of the incident light on the light sensor I, also expressed in lumen. A curve in solid line is the presently desired method of operating such liquid crystal display backlighting lamps. A threshold of light is provided even without light incident on light sensor LS. This remains somewhat constant for an increase in incident light and then increases in accordance with the slope of the solid line curve until it reaches a maximum, whereupon the controlled lamp light output remains constant again regardless of increased light incident on the display. The upper dotted line shows a similar method of controlling the lamp light output except it starts at a higher threshold and has a less steep slope from that higher threshold to the maximum light output. The lower dotted curve starts at a lower threshold but increases continuously until it gets to the maximum lamp output.

It should be apparent that various modification of the above will be evident to those skilled in the art and the arrangement described herein is for illustrative purposes and is not to be considered restrictive.

Claims

1. Fluorescent lamp controller for operating at least one fluorescent lamp (21,23) comprising
 - a light sensing circuit (2) for generating a signal representative of ambient light intensity, including
 - a light sensor (LS),
 - a first stage amplifier (Q₁) coupled to the sensor,
 - a second stage amplifier (Q₂) connected to an output of the first stage amplifier, and
 - two terminals (113, 114) connected to the second stage amplifier,
 - ballast means including a light control circuit (30), connected to the light sensing circuit

cuit by means of the terminals, for increasing the light output of the fluorescent lamp as the signal indicates an increase in ambient light intensity, the signal being present between the terminals and the sensing circuit receiving power from the ballast means via the terminals.

2. Fluorescent lamp controller as claimed in claim 1, wherein said first stage amplifier comprises an NPN transistor (Q₁).
3. Fluorescent lamp controller as claimed in claim 1 or 2, wherein said second stage amplifier comprises a PNP transistor (Q₂).
4. Fluorescent lamp controller as claimed in claim 1, 2 or 3, wherein the light sensing circuit comprises means (R) for keeping the light output of the fluorescent lamp substantially constant as the ambient light intensity is lower than a threshold level.
5. Light sensing circuit (2) for generating a signal representative of ambient light intensity, including
 - a light sensor (LS),
 - a first stage amplifier (Q₁) coupled to the sensor,
 - a second stage amplifier (Q₂) connected to an output of the first stage amplifier, and
 - two terminals (113, 114), connected to the second stage amplifier, for connection to a ballast means for operating at least one fluorescent lamp, said ballast means including a light control circuit (30) and increasing the light output of the fluorescent lamp as the signal indicates an increase in ambient light intensity during operation, the signal being present between the terminals and the light sensing circuit receiving power from the ballast means via the terminals, when said light sensing circuit is connected to said ballast means.
6. Light sensing circuit as claimed in claim 5, wherein the first stage amplifier comprises an NPN transistor (Q₁).
7. Light sensing circuit as claimed in claim 5 or 6, wherein said second stage amplifier comprises a PNP transistor (Q₂).
8. Light sensing circuit as claimed in claim 5, 6 or 7, comprising means (R) for keeping the light output of the fluorescent lamp substantially constant as the ambient light intensity is lower than a threshold level.



backlighting does not strike it. In response to the light striking light sensor LS it controls the operation of transistor Q_1 in accordance with the bias established by variable resistor R . Transistor Q_1 in turn, in conjunction with biasing resistor R_c , controls the operation of transistor Q_2 . In operation, the less incident light that strikes light sensor LS the more current transistor Q_1 conducts. As a result transistor Q_2 sinks more current between terminals 113 and 114. This causes interface circuit 30 to lower the luminescence of lamps 21 and 23. As incident light at the display increases light sensor LS causes transistor Q_1 to conduct less current accordingly. This causes transistor Q_2 to sink less current between lines 113 and 114 and consequently, interface circuit 30 operates to cause lamps 21 and 23 to increase their luminescence.

Figure 3 shows the controlled light output of fluorescent lamps 0, expressed in lumen as a function of the incident light on the light sensor I , also expressed in lumen. A curve in solid line is the presently desired method of operating such liquid crystal display backlighting lamps. A threshold of light is provided even without light incident on light sensor LS. This remains somewhat constant for an increase in incident light and then increases in accordance with the slope of the solid line curve until it reaches a maximum, whereupon the controlled lamp light output remains constant again regardless of increased light incident on the display. The upper dotted line shows a similar method of controlling the lamp light output except it starts at a higher threshold and has a less steep slope from that higher threshold to the maximum light output. The lower dotted curve starts at a lower threshold but increases continuously until it gets to the maximum lamp output.

It should be apparent that various modification of the above will be evident to those skilled in the art and the arrangement described herein is for illustrative purposes and is not to be considered restrictive.

Claims

1. Fluorescent lamp controller for operating at least one fluorescent lamp (21,23) comprising
 - a light sensing circuit (2) for generating a signal representative of ambient light intensity, including
 - a light sensor (LS),
 - a first stage amplifier (Q_1) coupled to the sensor,
 - a second stage amplifier (Q_2) connected to an output of the first stage amplifier, and
 - two terminals (113, 114) connected to the second stage amplifier,
 - ballast means including a light control circuit (30), connected to the light sensing circuit

by means of the terminals, for increasing the light output of the fluorescent lamp as the signal indicates an increase in ambient light intensity, the signal being present between the terminals and the sensing circuit receiving power from the ballast means via the terminals.

2. Fluorescent lamp controller as claimed in claim 1, wherein said first stage amplifier comprises an NPN transistor (Q_1).
3. Fluorescent lamp controller as claimed in claim 1 or 2, wherein said second stage amplifier comprises a PNP transistor (Q_2).
4. Fluorescent lamp controller as claimed in claim 1, 2 or 3, wherein the light sensing circuit comprises means (R) for keeping the light output of the fluorescent lamp substantially constant as the ambient light intensity is lower than a threshold level.
5. Light sensing circuit (2) for generating a signal representative of ambient light intensity, including
 - a light sensor (LS),
 - a first stage amplifier (Q_1) coupled to the sensor,
 - a second stage amplifier (Q_2) connected to an output of the first stage amplifier, and
 - two terminals (113, 114), connected to the second stage amplifier, for connection to a ballast means for operating at least one fluorescent lamp, said ballast means including a light control circuit (30) and increasing the light output of the fluorescent lamp as the signal indicates an increase in ambient light intensity during operation, the signal being present between the terminals and the light sensing circuit receiving power from the ballast means via the terminals, when said light sensing circuit is connected to said ballast means.
6. Light sensing circuit as claimed in claim 5, wherein the first stage amplifier comprises an NPN transistor (Q_1).
7. Light sensing circuit as claimed in claim 5 or 6, wherein said second stage amplifier comprises a PNP transistor (Q_2).
8. Light sensing circuit as claimed in claim 5, 6 or 7, comprising means (R) for keeping the light output of the fluorescent lamp substantially constant as the ambient light intensity is lower than a threshold level.



Patentansprüche

1. Leuchtstofflampenregler zum Betreiben wenigstens einer Leuchtstofflampe (21, 23) mit folgenden Elementen:

- einer Lichtsensorschaltung (2) zum Erzeugen eines Signals zur Darstellung des Umgebungslichtstärke, mit
 - einem Lichtsensor (LS),
 - einem Erststufenverstärker (Q₁), der mit dem Sensor gekoppelt ist,
 - einem Zweistufenverstärker (Q₂), der mit einem Ausgang des Erststufenverstärkers verbunden ist, und
 - zwei Klemmen (113, 114) in Verbindung mit dem Zweistufenverstärker,
- einem Vorschaltgerät mit einer Lichtregelschaltung (30), die mit der Lichtsensorschaltung über die Klemmen verbunden ist, um den Lichtausgang der Leuchtstofflampe zu erhöhen, wenn das Signal eine Erhöhung der Umgebungslichtstärke angibt, wobei das Signal zwischen den Klemmen und der Sensorschaltung vorhanden ist, die Leistung aus dem Vorschaltgerät über die Klemmen empfängt.

2. Leuchtstofflampenregler nach Anspruch 1, worin der Erststufenverstärker einen npn-Transistor (Q₁) enthält.

3. Leuchtstofflampenregler nach Anspruch 1, oder 2, worin der Zweistufenverstärker einen pnp-Transistor (Q₂) enthält.

4. Leuchtstofflampenregler nach Anspruch 1, 2 oder 3, worin die Lichtsensorschaltung Mittel (R) zum wesentlichen Konstanthalten des Lichtausgangs der Leuchtstofflampe enthält, wenn die Umgebungslichtstärke einen Schwellenpegel unterschreitet.

5. Lichtsensorschaltung (2) zum Erzeugen eines Signals zur Darstellung der Umgebungslichtstärke, mit folgenden Elementen

- einem Lichtsensor (LS),
- einem Erststufenverstärker (Q₁), der mit dem Sensor gekoppelt ist,
- einem Zweistufenverstärker (Q₂), der mit einem Ausgang des Erststufenverstärkers verbunden ist, und
- zwei Klemmen (113, 114) in Verbindung mit dem Zweistufenverstärker zum Verbinden eines Vorschaltgeräts zum Betreiben wenigstens einer Leuchtstofflampe, wobei das Vorschaltgerät eine Lichtregelschaltung (30) enthält, und den Lichtausgang der Leuchtstofflampe erhöht, wenn das Signal

einen Anstieg in der Umgebungslichtstärke im Betrieb anzeigt, wobei das Signal zwischen den Klemmen und der Lichtsensorschaltung vorhanden ist, die Leistung aus dem Vorschaltgerät über die Klemmen empfängt, wenn die Lichtsensorschaltung mit dem Vorschaltgerät verbunden ist.

6. Lichtsensorschaltung nach Anspruch 5, worin der Erststufenverstärker einen npn-Transistor (Q₁) enthält.

7. Lichtsensorschaltung nach Anspruch 5 oder 6, worin der Zweistufenverstärker einen pnp-Transistor (Q₂) enthält.

8. Lichtsensorschaltung nach Anspruch 5, 6 oder 7, mit Mitteln (R) zum wesentlichen Konstanthalten des Lichtausgangs der Leuchtstofflampe, wenn die Umgebungslichtstärke einen Schwellenpegel unterschreitet.

Revendications

1. Dispositif de commande d'une lampe fluorescente conçu pour faire fonctionner au moins une lampe fluorescente (21, 23) comportant

- un circuit détecteur de lumière (2) conçu pour engendrer un signal représentant l'intensité de lumière ambiante, incorporant
 - un détecteur de lumière (LS),
 - un premier amplificateur (Q₁) couplé au détecteur,
 - un deuxième amplificateur (Q₂) relié à une sortie du premier amplificateur, et
 - deux bornes (113, 114) reliées au deuxième amplificateur,
- des moyens de ballast incorporant un circuit de commande de lumière (30) relié au circuit détecteur de lumière au moyen des bornes et conçus pour augmenter le flux lumineux de la lampe fluorescente lorsque le signal indique un accroissement d'intensité de lumière ambiante, le signal étant présent entre les bornes et le circuit détecteur recevant de la puissance des moyens de ballast par l'intermédiaire des bornes.

2. Dispositif de commande d'une lampe fluorescente selon la revendication 1, dans lequel ledit premier amplificateur comporte un transistor NPN (Q₁).

3. Dispositif de commande d'une lampe fluorescente selon la revendication 1 ou 2, dans lequel ledit deuxième amplificateur comporte un transistor PNP (Q₂).



4. Dispositif de commande d'une lampe fluorescente selon la revendication 1, 2 ou 3, dans lequel le circuit détecteur de lumière comporte des moyens (R) pour maintenir le flux lumineux de la lampe fluorescente sensiblement constant lorsque que l'intensité de lumière ambiante est inférieure à un niveau de seuil. 5
5. Circuit détecteur de lumière (2) conçu pour engendrer un signal représentant l'intensité de lumière ambiante, incorporant 10
- un détecteur de lumière (LS),
 - un premier amplificateur (Q_1) couplé au détecteur,
 - un deuxième amplificateur (Q_2) relié à une 15
- sortie du premier amplificateur, et
- deux bornes (113, 114) reliées au deuxième amplificateur pour réaliser une connexion à 20
- des moyens de ballast pour faire fonctionner au moins une lampe fluorescente, lesdits moyens de ballast incorporant un circuit de commande de lumière (30) et augmentant le flux lumineux de la lampe fluorescente lorsque le signal indique un accroissement d'intensité de lumière ambiante pendant le fonctionnement, le signal étant présent entre les bornes et le circuit 25
- détecteur de lumière recevant de la puissance des moyens de ballast par l'intermédiaire des bornes lorsque ledit circuit détecteur de lumière est relié auxdits moyens de ballast. 30
6. Circuit détecteur de lumière selon la revendication 5, dans lequel le premier amplificateur 35
- comporte un transistor NPN (Q_1).
7. Circuit détecteur de lumière selon la revendication 5 ou 6, dans lequel ledit deuxième amplificateur comporte un transistor PNP (Q_2). 40
8. Circuit détecteur de lumière selon la revendication 5, 6 ou 7, comportant des moyens (R) pour maintenir le flux lumineux de la lampe fluorescente sensiblement constant lorsque l'intensité 45
- de lumière ambiante est inférieure à un niveau de seuil.

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