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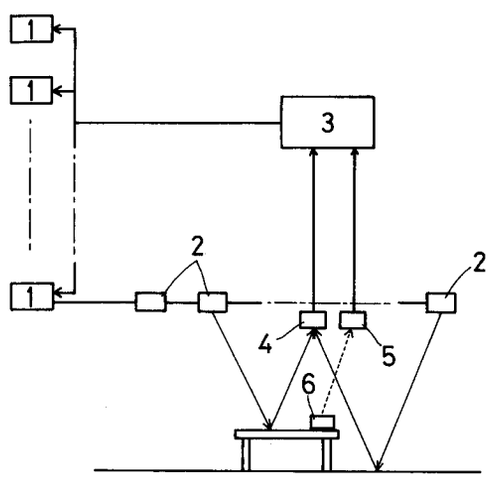
(54) Illumination dimmer system for fluorescent lamps.

(57) An illuminated location is divided up into a plurality of illumination zones for each of which a design illuminance is decided upon taking into account such factors as the use of the zone. Each illumination zone is provided with a plurality of fluorescent lamps, one or more inverters to which the lamps are connected, a photometer for receiving light reflected from objects in the zone, a controller for changing the current values of the inverters, and a setting device. The design illuminance decided is input to the controller for each illumination zone by the setting device. At prescribed time intervals, the controller reads in a change in the output of the photometer and, in dependence upon the change, alters the output current values of all inverters of this illumination zone, whereby the brightness of the illumination zone is corrected so as to be held at the originally set design illuminance.

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to an illumination dimmer system for fluorescent lamps in which an illuminated location is divided up into a plurality of illumination zones and the intensity of light is adjusted in each illumination zone upon taking into overall consideration a change in the luminous flux of the fluorescent lamps due to aging, soiling of a lamp device or wall thereof, weather, time, distance from a window and purpose for which the location is used.

Description of the Related Art

As shown in Fig. 2, the characteristic of a fluorescent lamp is such that the luminous flux thereof decreases by 20% approximately 4000 hours after start of use and then by a further 10% after an additional 10,000 hours, at which point the lamp reaches it useful service life. Moreover, a feature of such a fluorescent lamp is that power consumption during this time is substantially constant (irrespective of gradual darkening of the lamp). In addition, since contamination the lamp device reflector or wall by cigarette smoke or the like advances, ordinarily the brightness of the room declines more than the decrease in the luminous flux of the fluorescent lamp. Accordingly, at the design stage, the initial brightness is set beforehand to be considerably greater than the brightness finally required upon taking into consideration the characteristic of the decline in luminous flux as well as other factors. Subsequent dimming usually is not carried out. The result is that a considerable amount of power is consumed wastefully over a long period of time. Further, the amount of light which enters from windows varies depending upon the weather and time of day, and the influence of outdoor daylight differs depending upon distance from windows even in one and the same room. In addition, the brightness necessary at a location where one actually works differs from that necessary at a location where reception room furniture is placed. For these reasons, it is desirable that brightness be modified upon taking the above-mentioned circumstances into overall consideration. It the prior art, however, an illumination dimmer system for fluorescent lamps in which the intensity of light is adjusted upon taking the foregoing into overall consideration is not available.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an illumination dimmer system for fluorescent lamps which improves upon the above-mentioned drawbacks of the prior art.

Another object of the present invention is to provide an illumination dimmer system in which intensity of light can be adjusted upon taking into overall consideration a decrease in the luminous flux of a fluorescent lamp, soiling of the lamp device or wall thereof, weather, time and purpose of use, and in which power consumption can be reduced to a marked degree.

According to the present invention, the foregoing objects are attained by providing an illumination dimmer system for fluorescent lamps, comprising a plurality of fluorescent lamps provided for each of a plurality of demarcated illumination zones, at least one high-frequency constant-current feeder device to which the fluorescent lamps in each illumination zone are connected, a photometer provided in each illumination zone at a position at which only light reflected mainly from an illuminated object in the illumination zone impinges, a controller provided for each illumination zone for altering, at prescribed time intervals, current values of all high-frequency constant-current feeder devices of the illumination zone in conformity with a change in output from the photometer of the illumination zone, and setting means for setting and entering a design illuminance, which is different for each illumination zone, in the controllers of all illumination zones.

In a preferred embodiment, the setting means is operated by wireless remote control.

In a preferred embodiment, the controller has changeover means for switching between a maintenance mode having comparatively long time intervals at which the current value of the high-frequency constant-current feeder device is altered, and a daylight utilization mode in which the time intervals are much shorter than those of the maintenance mode.

In operation, an illuminated location is divided up into a plurality of illumination zones for each of which the design illuminance is decided upon taking into account the use of the zone as well as other factors. The design illuminance decided is set and fed into the controller of each illumination zone in advance. At prescribed time intervals, the controller reads in a change in the output of the photometer and, in dependence upon the change in value, alters the output current values of all of the high-frequency constant-current feeder devices of this illumination zone, whereby the brightness of the illumination zone is corrected so as to be held at the originally set design illuminance. As a result, a correction is applied to achieve the original design illuminance in each illumination zone upon taking into overall consideration all factors such as a decrease in the luminous flux of the fluorescent

lamps, which advances gradually over an extended period of time, a decline in illuminance caused by contamination of the reflective surface of the lamp device, and a change in illuminance ascribable to the influence of outdoor light, which depends upon the weather that changes every day, the time of day, etc.

Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram illustrating the configuration of an illumination dimmer system for fluorescent lamps in an embodiment of the present invention, and

Fig. 2 is a characteristic diagram showing a change in the luminous flux of a fluorescent lamp with the passage of time.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will now be described in detail with reference to the accompanying drawings, in which Fig. 1 is a block diagram illustrating the configuration of the illumination dimmer system for fluorescent lamps, and Fig. 2 is a characteristic diagram showing a change in the luminous flux of a fluorescent lamp with the passage of time.

A large room is divided up into four illumination zones. By way of example, the four illumination zones are a zone near windows on the east side, a zone near windows on the south side, a zone near a hall partitioned by glass, and a central zone distant from both windows and the hall. Although brightness conditions all differ from one another depending upon the time, the brightness in each individual illumination zone is substantially uniform.

Each illumination zone is provided with eight inverters 1, and nine fluorescent-lamp lighting fixtures 2 are connected to each inverter 1. The inverters 1 are high-frequency constant-current feeder devices which convert commercial power to high-frequency (e.g., 65 Hz) current and supply constant current to the fluorescent-lamp lighting fixtures 2 connected thereto. The output current values of the inverters 1 are altered and controlled at prescribed time intervals by a controller 3, which is provided for each illumination zone. Each fluorescent-lamp lighting fixture 2 is a combination of two 40-W fluorescent lamps.

One photometer 4 is provided on the ceiling of each of the four illumination zones substantially at the center, and the output signal produced by the photometer 4 is fed into the controller 3 of the particular illumination zone. The photometer 4 has a case provided with a shade in such a manner that light from the fluorescent-lamp lighting fixtures 2 will not enter the case directly. Thus it is so arranged that only light reflected from the illuminated objects in the illumination zone, such as a desk, floor and walls, will impinge upon the photometer 4. A sensor 5 which receives a signal from a remote controller is provided inside the case (or separately of the case) of the photometer 4, and the output signal of the sensor 5 is applied to setting means of the controller 3. The frequency of the signal from the remote controller differs for each of the four illumination zones. A portable transmitting unit 6 that transmits the remote control signal is equipped with channel changeover means for designating the four illumination zones, and an up/down button for entering the design illuminance.

When an up signal or down signal is fed into the controller 3 of each illumination zone via the transmitting unit 6 and sensor 5, the controller 3 raises or lowers, through prescribed increments, the current values of all of the inverters 1 of the particular illumination zone and stores the final value as the design illuminance. Thereafter, the controller 3 detects the output signal from the photometer 4 at prescribed time intervals, alters the current values of all the inverters 1 all at one and performs control in such a manner that the output signal of the photometer 4 comes into agreement with the stored design illuminance. The control time interval in a maintenance mode, which is suited to an illumination zone that receives almost no influence from outdoor daylight, is different from that of a daylight utilization mode, which is suited to an illumination zone that is influenced by outdoor daylight. The time interval is 24 hours if the maintenance mode is selected. In a case where the daylight-utilization mode is selected, the user chooses the time interval from among three stages, namely 20 minutes, 30 minutes and 40 minutes, beforehand in dependence upon the degree to which the illumination zone is influenced by outdoor daylight.

In terms of operation, the design illuminance of each illumination zone is decided upon considering the use of the zone and other factors. First, the user takes a photometer in hand in the first illumination zone, sets the channel changeover means of the transmitting unit 6 to channel 1 and then presses the up/down button. When this is done, the brightness of illumination changes. At the moment the display on the hand-held photometer indicates that the design illuminance has been attained, op-

eration is halted, whereupon the controller 3 of the first illumination zone stores the final value as the design illuminance. The design illuminance in each of the second, third and fourth illumination zones is entered in the same manner to complete the settings. Thereafter, the controller 3 of each illumination zone automatically detects the output signal from the photometer 4 at the prescribed time intervals, alters the current values of the inverters and exercises control in such a manner that the brightness of the illumination zone is maintained at the design illuminance. In a case where there is a change such as in the use of an illumination zone and it therefore becomes necessary to set the design illuminance anew, an operation identical to that described above is performed on each occasion to enter and set the new design illuminance in the controller 3 of this illumination zone.

Fig. 2 shows how the luminous flux of a fluorescent lamp changes with time. If the initial design illuminance is set to give a brightness that corresponds to the final luminous flux of the fluorescent lamp, power corresponding to the portion indicated by the shading at the upper part of Fig. 2 can be conserved while brightness is held constant over a period of time up to the end of lamp life.

It should be noted that the number of illumination zones into which a location is divided is not limited to that set forth in the foregoing embodiment; the number can be changed as necessary depending upon the size of the room and various other circumstances. Further, the number of inverters provided in each illumination zone and the number of fluorescent-lamp lighting fixtures connected to each inverter also can be changed as needed depending upon the size of the illumination zone, the rating of the inverters, etc. In the above-described embodiment, the setting means of the controller is operated by a wireless remote controller. However, it goes without saying that inputs can be made by directly manipulating the controller by hand.

The time intervals for control in the maintenance mode and daylight-utilization mode are not limited to those of the foregoing embodiment. What is essential is that a comparatively long time interval be established in the maintenance mode since only a decline in the luminous flux of the fluorescent lamps, which advances gradually over time, need be corrected in this mode, and that a comparatively short time interval that allows changes in outdoor daylight to be followed up be established in the daylight-utilization mode. The reason for providing the maintenance mode is as follows: In the daylight-utilization mode, the effects of disturbances are significant owing to the nature of this mode. For example, a photometer can react very sensitively even when a person wearing bright clothing passes near the photometer, in which case the output current values from the fluorescent-lamp lighting fixtures would be decreased. Such an unnecessary over-correction in the daylight-utilization mode can be excluded from the start by providing the maintenance mode.

As described above, the illumination dimmer system for fluorescent lamps according to the present invention performs optimum adjustment of light intensity in each of a plurality of demarcated illumination zones upon taking into overall consideration all factors such as a change in the luminous flux of the fluorescent lamps due to aging, soiling of a lamp device or wall thereof over a long period of time, weather, time, distance from windows and purpose for which the location is used. Not only can an ideal lighting environment at a constant brightness be produced but it is also possible to reduce power consumption over an extended period of time. Power consumption can be reduced significantly particularly over a period of time shortly after use of the fluorescent lamps starts. If the arrangement in which the setting means is operated by a wireless remote controller is adopted, the operation carried out when entering design illuminance is very simple. In addition, by providing the maintenance mode, it is possible to prevent unnecessary over-correction by the daylight-utilization mode in an illumination zone that is not susceptible to the effects of outdoor daylight.

As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

Claims

1. An illumination dimmer system for fluorescent lamps, comprising:

a plurality of fluorescent lamps provided for each of a plurality of demarcated illumination zones;

at least one high-frequency constant-current feeder device to which said fluorescent lamps in each illumination zone are connected;

a photometer provided in each illumination zone at a position at which only light reflected mainly from illuminated objects in the illumination zone impinges;

a controller provided for each illumination zone for altering, at prescribed time intervals, current values of all high-frequency constant-current feeder devices of the illumination zone in conformity with a change in output from said photometer of the illumination zone; and

setting means for setting and entering a

design illuminance, which is different for each illumination zone, in said controllers of all illumination zones.

2. The system according to claim 1, wherein said setting means is operated by wireless remote control.

3. The system according to claim 1 or 2, wherein said controller has changeover means for switching between a maintenance mode having comparatively long time intervals at which the current value of said high-frequency constant-current feeder device is altered, and a daylight utilization mode in which the time intervals are much shorter than those of the maintenance mode.

FIG. 1

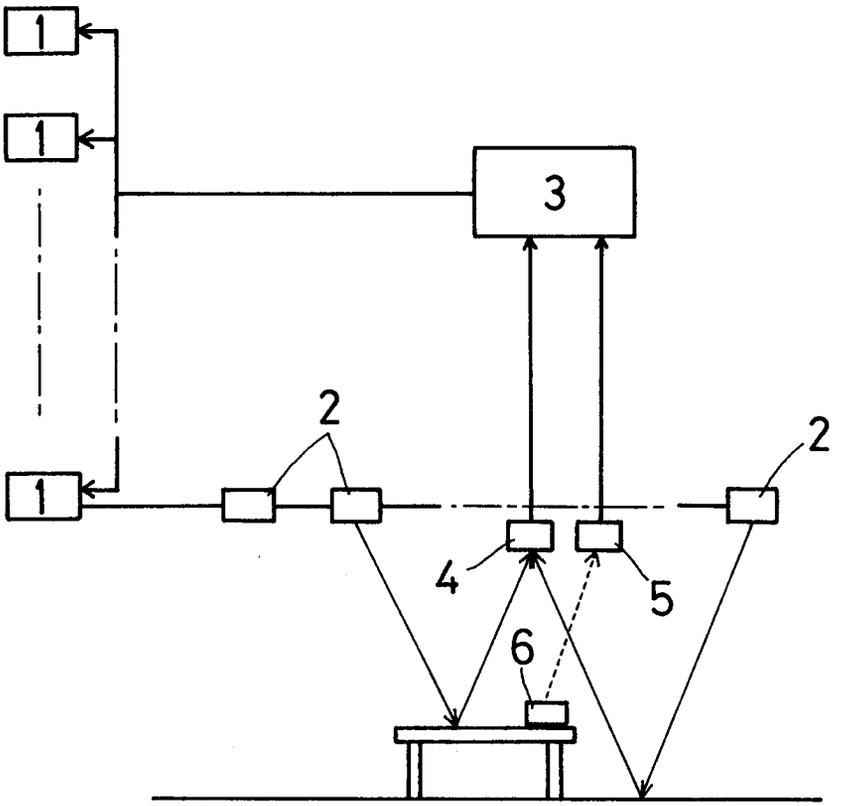
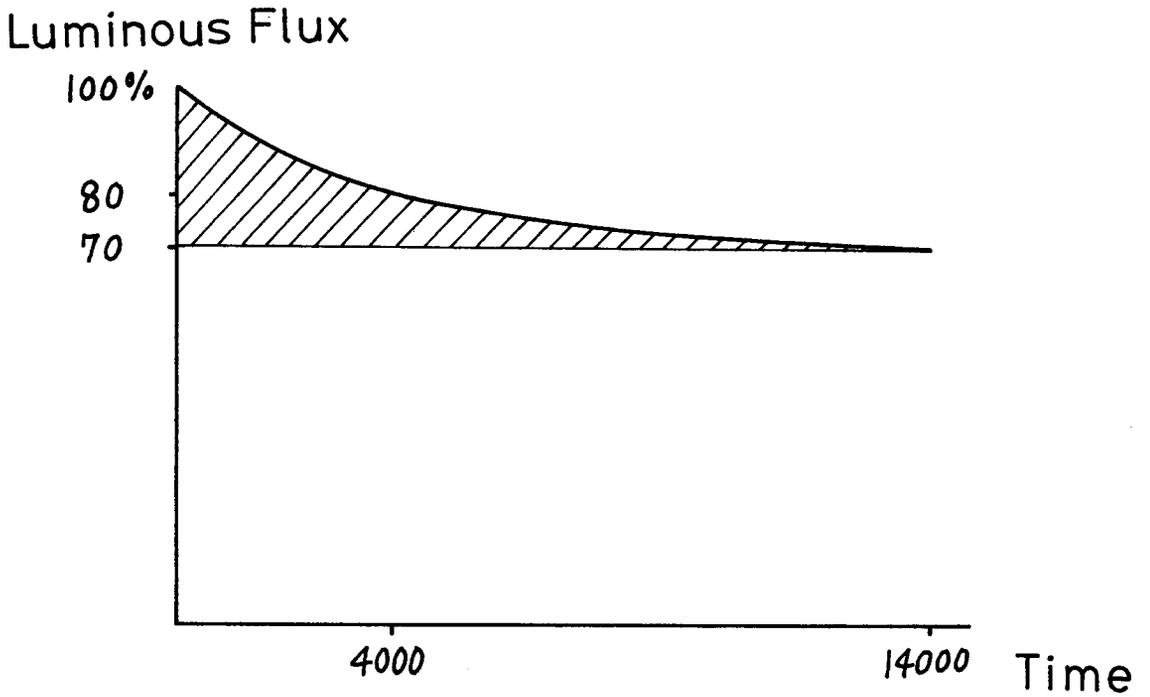


FIG. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 95 10 1639

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US-A-5 177 404 (COHEN HOWARD G ET AL) 5 January 1993 * column 4, line 30 - column 5, line 29; figure 8 *	1	H05B41/392 H05B37/02
A	EP-A-0 508 526 (PHILIPS NV) 14 October 1992 * column 5, line 22 - column 6, line 57; figure 2 *	1	
A	EP-A-0 482 680 (PHILIPS NV) 29 April 1992 * abstract; figure 2 *	1,2	
A	EP-A-0 490 329 (TRIDONIC BAUELEMENTE) 17 June 1992 * abstract; figure 1 *	1	
A	IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, vol. IA20,no. 5, October 1984 NEW YORK, pages 1198-1205, ALLING 'The integration of microcomputers and controllable output ballasts-A new dimension in lighting control'		TECHNICAL FIELDS SEARCHED (Int.Cl.6) H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 April 1995	Speiser, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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