

ENERGY SAVING FLUORESCENT LIGHTING SYSTEM

FIELD OF THE INVENTION

This invention relates to reducing the energy consumption of magnetically ballasted fluorescent lamps by enabling them to operate at variable levels of light intensity.

BACKGROUND

Fluorescent lighting is widely used for the general lighting of common areas like corridors, walkways and staircases; however, often times they remain at full illumination during times when a lesser or zero amount of light intensity is actually required.

While variable intensity electronically ballasted fluorescent lights are known, they are initially very expensive to purchase and the electrical savings from dimming them are generally insufficient to recover the initial investment. At the same time, there is a very large percentage of magnetically ballasted fluorescent light in use due to the low cost of such systems. However , there are no low cost commercially available systems for dimming magnetically ballasted lights. In most cases, such fluorescent lights are simply switched on at dusk and left at on at full power until they are turned off at dawn. Such operation is wasteful of substantial amounts of energy because they do not take into account the low, or even zero, human traffic in such common areas, such as in the very late night or very early morning hours. Consequently, such unnecessary lighting is both wasteful of energy and results in substantially unnecessary costs of building operations.

Accordingly, it is an object of the present invention to substantially reduce such wasted energy and unnecessary costs by providing a dimmable magnetically ballasted system which may be

operated at variable intensity light levels as may be actually required or desired at different times.

SUMMARY OF THE INVENTION

In accordance with an aspect of the invention, there is provided an energy saving circuit for use with a fluorescent lamp, the fluorescent lamp having a sealed magnetic ballast and a pair of electrodes, the energy saving circuit comprising:

- (a) a power source connected to the fluorescent lamp,
- (b) a pair of control switches, a main ballast and a control ballast connected between said power source and said lamp such that in use, by switching on the first switch and switching off the second switch, current is supplied only through the main ballast so as to provide a maximum line current to the fluorescent lamp resulting in full illumination, and

by switching on the second switch and switching off the first switch, current is supplied through both the control ballast and main ballast so as to provide a minimum line current to the fluorescent lamp resulting in reduced illumination.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic diagram of the fluorescent lighting circuit in connection with a microcontroller/microprocessor, auxiliary components and the alternating current (A.C.) voltage source;

Figures 2a to 2b illustrate the functions of a typical PIR (Passive Infra-Red) processing circuit.

Figure 3 illustrates the voltage/current waveforms experienced by the fluorescent lamp when the alternating current (A.C.) voltage is applied to the fluorescent lamp.

Detailed Description

Figure 1 illustrates a variable intensity lighting system 10 including a standard magnetically ballasted fluorescent lamp 12 powered by an energy-saving circuit according to the present invention. For example, lamp 12 may be a commercially available 40-watt T12 fluorescent lamp having an internally sealed magnetic ballast and a pair of electrodes or filaments 14, 16.

Lamp 12 is powered by a variable voltage source 18 which, for example, may be a conventional 120 or 240 volt AC source. In the present invention, AC power is supplied to filaments 14, 16 of the lamp through the energy-saving circuit which includes a pair of control switches 20, 22 and inductances 24, 26. Inductance 24 acts as a main ballast and inductance 26 acts as a control ballast 26 for varying the intensity of the lamp. That is, it will be apparent that when switch 20 is off and switch 22 is on, current flows from power source 120 to the lamp through both of main ballast 24 and control ballast 26, whereas, when the order of switching is reversed, only main ballast 24 is in the circuit. Thus, when switch 20 is on, the current to the lamp is at the maximum. Conversely, when switch 22 is on and switch 20 is off, the current to the lamp is decreased or dimmed, thereby saving substantial amount of energy during such times as full illumination is not required.

While it will be apparent that numerous types of switches may be used in the present invention, it has been found that triac switches are substantially preferred, and it will also be understood that three or more inductances, together with additional switches, may be used to produce light intensities of the lamp at three or more levels thereby enabling a standard magnetically ballasted fluorescent lamp to operate at multiple levels of light intensity as may be desired.

While control switches 20 and 22 may be controlled manually, or automatically by any number of different types of control systems, it has been found that the use of a microcontroller is preferred for a number of reasons as will become more fully apparent. Accordingly, a microcontroller 30 is illustrated in Figure 1 as supplying on/off voltage to operate triacs 20, 22.

The microcontroller 30 uses the alternating current (A.C.) voltage zero crossing as a stable time-base for embedding a lighting schedule. As each A.C. cycle has a definitive period (20 ms for 50Hz A.C. supply), accurate timings can be embedded onto the microcontroller. For instance, the microcontroller 30 can be programmed to switch the fluorescent lamp to operate at full-illumination for the first four hours of operation. It could then be programmed to operate at half-illumination for the next six hours. During this six hours, it would rely on the PIR detector output to switch back to full-illumination momentarily until the passer-by has moved away. Finally, for the last hours into dawn, the microcontroller 30 can switch back to full-illumination permanently. Controls inputs 130, 132 provide the signals for controlling the switches 20, 22.

Figure 2a illustrates a typical PIR signal processing circuit making use of an amplifier stage 136 followed by a comparator stage 138. A pyroelectric detector 134 is installed before the amplifier stage 136. This often entails the use of a quad operational amplifier 136. Two operational amplifiers are normally used for the amplification stage with two more used for the comparator stage 136. The comparator stage 136 is implemented using external discrete components and appropriate alternating current (A.C.) voltage biasing that might drift with time.

Figure 2b illustrates a PIR signal processing circuit used in the present invention. The PIR signal processing circuit makes use of an amplifier stage 142 followed by a microcontroller 144. A

pyroelectric detector 140 is installed before the amplifier stage 142. By using microcontrollers 144 that incorporate input pins (such as those from Microchip Technology eg PIC16F609 etc) that has the feature known as Interrupt-On-Change, it is possible to eliminate the comparator stage using operational amplifiers. In addition, this new approach makes use of the built-in hysteresis of the input pin, thereby preventing false PIR detections from changing ambient temperature.

Figure 3 illustrates the voltage waveforms experienced by the fluorescent lamp when the alternating current (AC) voltage is applied to the fluorescent lamp. The current waveforms are produced by the alternating current (AC) voltage. As shown, the approximately 90° phase lagging waveform of the entire circuit is halved when the second switch 22 is switched on, first switch 20 is off (half-illumination) and when second switch 22 is switched off, first switch 20 is switched on (full-illumination).

It is submitted that by programming the microcontroller / microprocessor such that by controlling the switches 20, 22, half or full illumination can be resulted giving rise to the possibility of more cost-effective use of electricity for general illumination.

Although exemplary embodiments of the present invention have been shown and described, it will be apparent to those skilled in the art that a number of changes, modifications, or alternations to the invention as described herein may be made, none of which depart from the spirit of the present invention. All such changes, modifications and alterations should therefore be seen as within the scope of the present invention.

Claims:

1. An energy saving circuit for use with a fluorescent lamp, the fluorescent lamp having a sealed magnetic ballast and a pair of electrodes, the energy saving circuit comprising:
 - (a) a power source connected to the fluorescent lamp,
 - (c) a pair of control switches, a main ballast and a control ballast connected between said power source and said lamp such that in use, by switching on the first switch [20] and switching off the second [22] switch, current is supplied only through the main ballast [24] so as to provide a maximum line current to the fluorescent lamp resulting in full illumination, and by switching on the second switch [22] and switching off the first [20] switch, current is supplied through both the control ballast [24] and main ballast [26] so as to provide a minimum line current to the fluorescent lamp resulting in reduced illumination.
2. The energy-saving circuit according to claim 1, wherein the switching on / off of the switches are controlled by the microcontroller / microprocessor.
3. The energy-saving circuit according to claim 2, wherein the microcontroller further includes an alternating current (A.C.) voltage zero crossing operating as a lighting schedule.
4. The energy-saving circuit according to claims 2 or 3, wherein the microcontroller / microprocessor is further electrically connected to a PIR signal processing circuit.
5. The energy-saving circuit according to claim 4, wherein the PIR signal processing circuit comprises an amplifier stage and a pyroelectric detector.