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Pearlman et al.

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[54] **MICROCOMPUTER-CONTROLLED LIGHT SWITCH**

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[73] Assignee: **Lightolier Incorporated,** Jersey City, N.J.

[21] Appl. No.: **724,015**

[22] Filed: **Apr. 17, 1985**

[51] **Int. Cl.**[4] **H05B 37/02**

[52] **U.S. Cl.** **315/307;** 315/292; 315/293; 315/362

[58] **Field of Search** 315/307, 292, 293, 362

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,668,467	6/1972	Isaac	315/292
3,706,914	12/1972	Van Buren	315/316
3,766,431	10/1973	Isaacs	315/292
3,805,096	4/1974	Hamilton	315/292
3,968,401	7/1976	Bryant	315/293
4,240,011	12/1980	Dinges	315/292
4,241,295	12/1980	Williams	315/294
4,287,468	9/1981	Sherman	315/DIG. 4
4,289,972	9/1981	Wern	315/362
4,359,670	11/1982	Hosaka et al.	315/307

Primary Examiner—Harold Dixon

Attorney, Agent, or Firm—Chernoff, Vilhauer, McClung & Stenzel

[57] **ABSTRACT**

A light level controller includes a microcomputer controlled light switch which responds to a manual tap or a longer manual depression of the switch in order to initiate various control modes for a light source. Preset levels of light intensity may be stored in the microcomputer's memory and an automatic fade mode may be initiated to cause the level of light intensity to fade from a current level to a preset level at a pre-established rate. The controller may respond to the momentary depression of the switch to initiate the automatic fade mode or if tapped while a fade is in progress it may cause the light source to make an abrupt transition to either full on or full off, depending on whether a higher or lower level of light intensity is desired. A depression of the switch for a period longer than a tap will cause the level of light intensity to continue to change until the switch is released, and simultaneously this level will be stored in memory.

21 Claims, 8 Drawing Figures

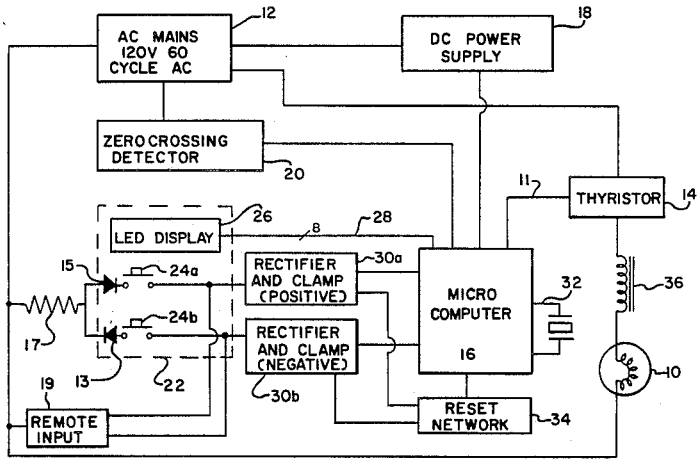


FIG.1

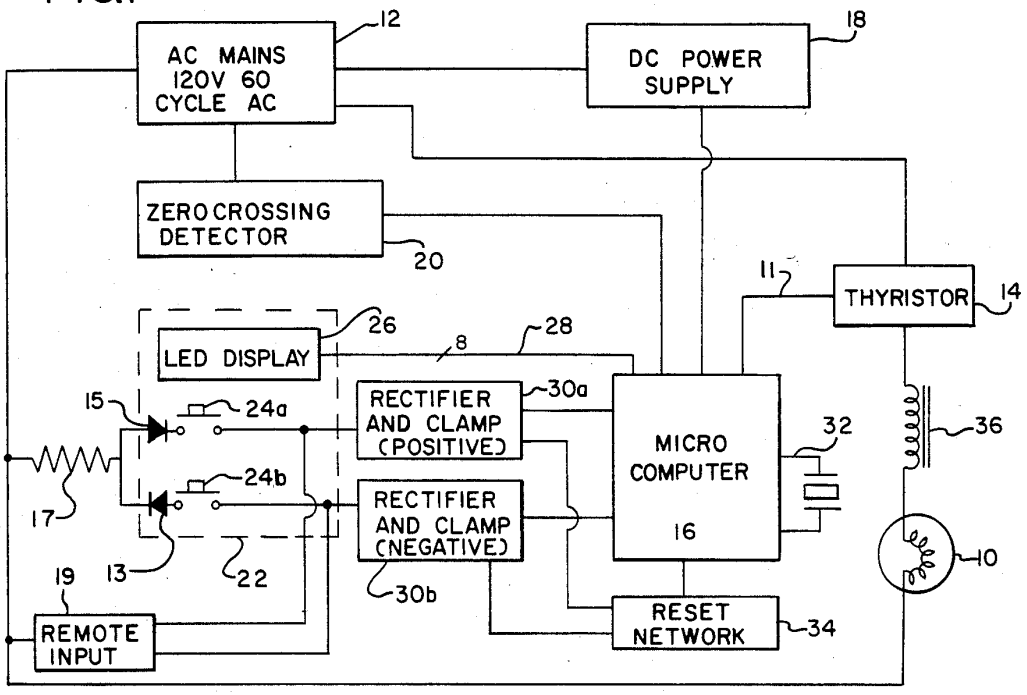


FIG.5

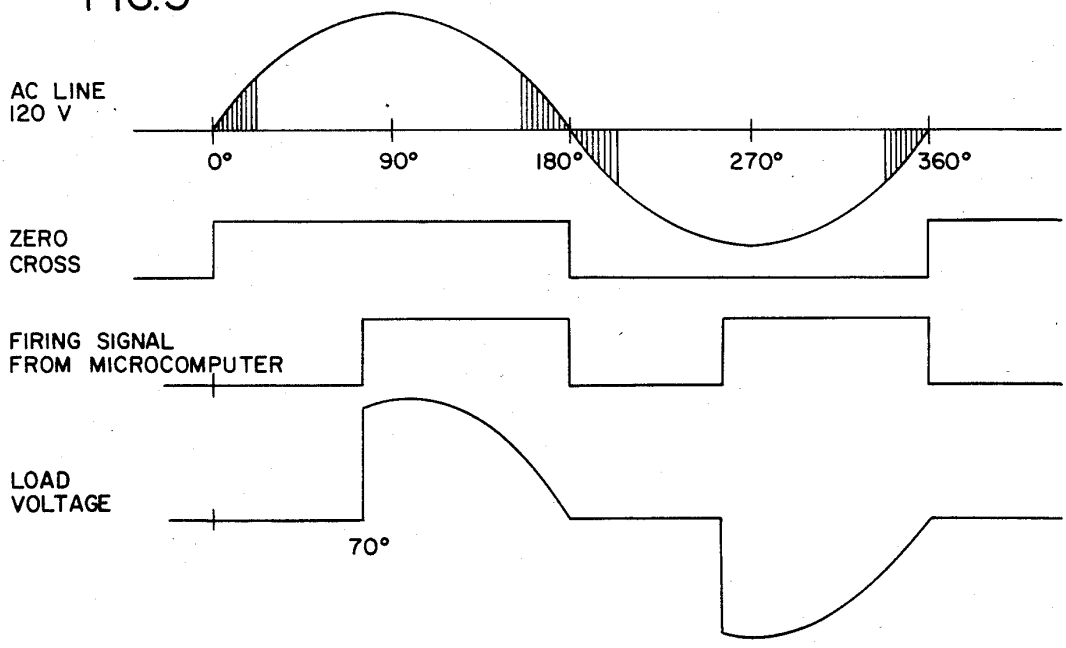


FIG. 2

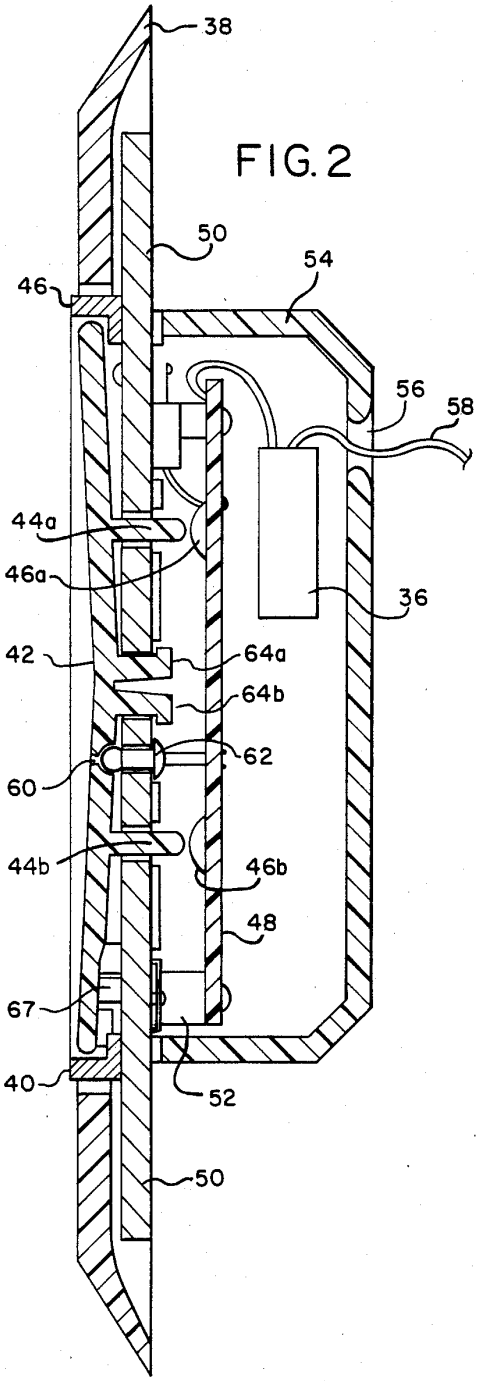


FIG. 3

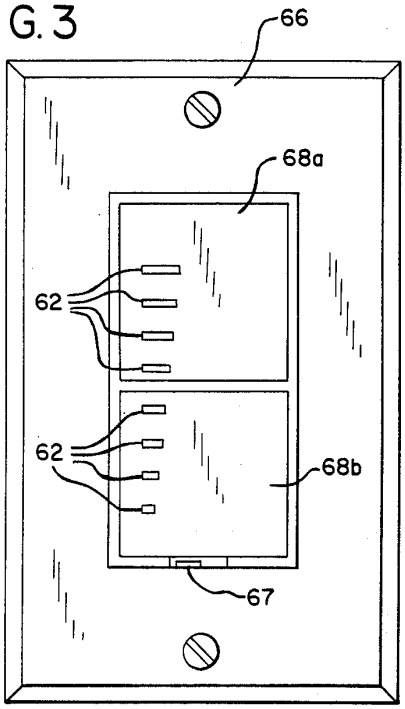
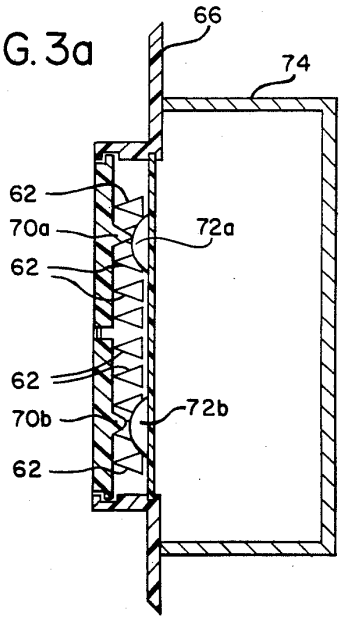
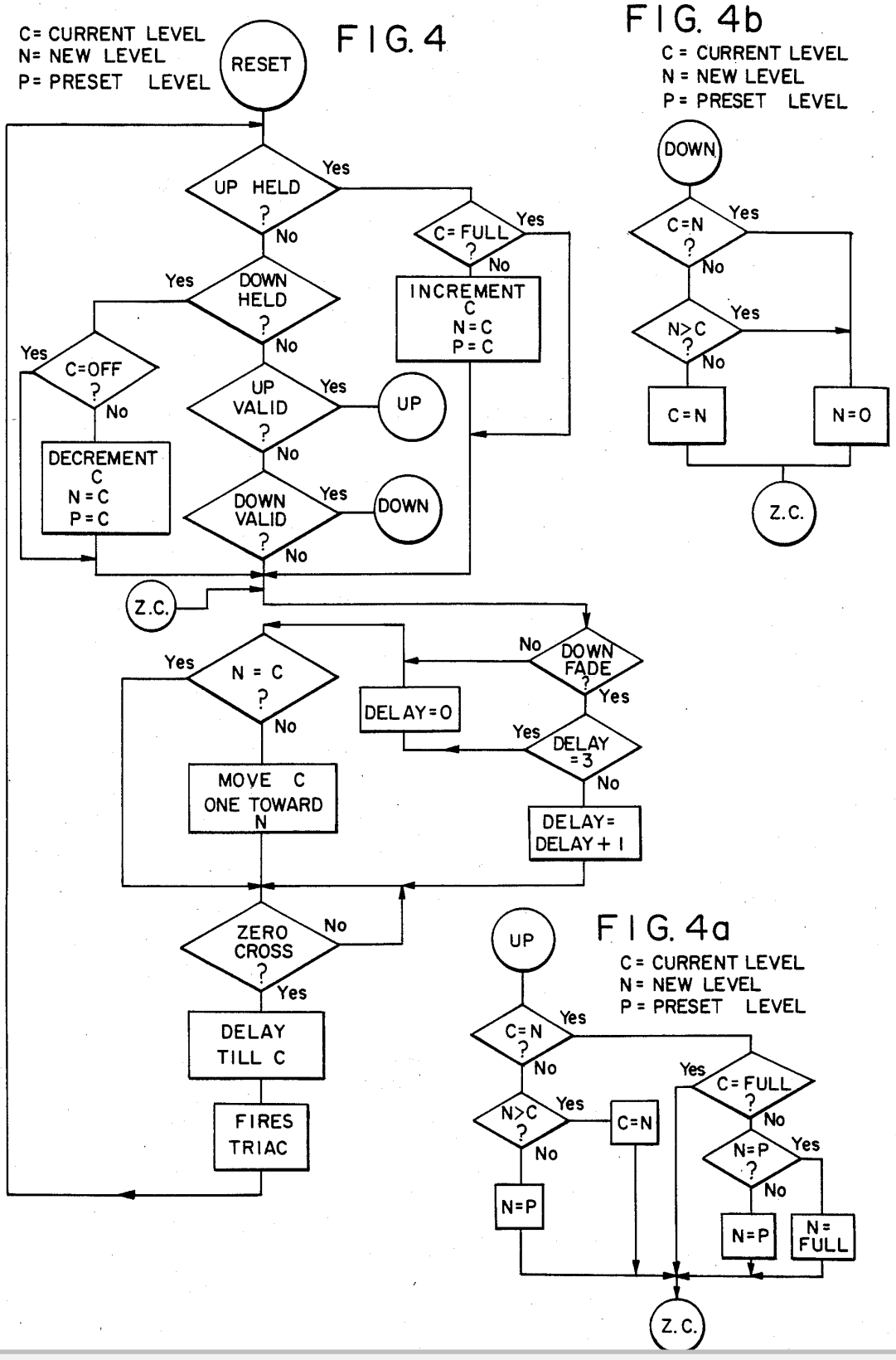


FIG. 3a





MICROCOMPUTER-CONTROLLED LIGHT SWITCH

BACKGROUND OF THE INVENTION

The present invention relates to a manually operated switch such as a wall-mounted light switch for controlling the level of light intensity from a light fixture and more particularly to a light level controller actuated by the switch which includes a microcomputer for initiating control programs to regulate the level of light intensity.

Wall-mounted light switches which include a dimmer have become increasingly popular especially for residential applications where it is desired to precisely control the level of light intensity in a particular room. Such light switches usually include a variable resistor which is manually manipulated to control the voltage input to the light, where the variable resistor is connected in series with the household AC power line. A desirable feature in such switches would be the ability to return to predetermined levels of light intensity from conditions of either full power on or full power off. At present, however, such switches have no such memory and formerly established light intensity levels may be reestablished only by manual operation and guesswork.

There are in existence, however, touch actuated dimmer controls which cycle through a dim to a bright cycle and back again, and include a memory function such that removing the hand from the switch will stop the cycle and store the level of light intensity at that point in memory. A subsequent touch will turn the light off and yet a further touch will return the light to its previous intensity level based upon the value of the intensity level stored in memory. While an improvement over the manually-operated variable-resistor type of dimmer, this dimmer may require the user to manually cycle through a complete cycle of dim light to bright light to arrive at a desired intensity level. This latter switch is known as a DECORA ® touch dimmer and is manufactured by Leviton Manufacturing Company, Inc. of Littleneck, N.Y. The DECORA ® touch dimmer, however, lacks the versatility needed for certain aesthetic effects such as an automatic gradual fade from one light level to another. Moreover, it cannot change the direction, that is, either the increasing (up) or the decreasing (down), of light intensity from one direction to another without completing a full cycle from dim to bright and back again. Also, the touch dimmer has no "remote" capability that would enable one to use its features from a remote location such as a hallway or another room. Full function remotes are common with ordinary two-position light switches, but have not been available for dimmers because of the complexity of the circuitry.

Yet another touch-type light control is shown in Hamilton, U.S. Pat. No. 3,805,096, and in Hosaka, et al., U.S. Pat. No. 4,359,670. These devices are responsive to the duration of touch for initiating various control functions but include no provision for automatically fading light from one level to another.

Automatic fading has in the past been available only in theatrical lighting systems employing very complicated switching inputs such as keyboard commands or elaborate banks of switches. Examples of such systems are shown in Williams, U.S. Pat. No. 4,241,295; Dinges, et al., U.S. Pat. No. 4,240,011; Van Buren, U.S. Pat. No. 3,706,914; and Isaacs, U.S. Pat. Nos. 3,766,431 and 3,668,467.

SUMMARY OF THE INVENTION

The present invention provides a highly versatile microcomputer-controlled light level intensity switch which is operated by a pair of non-latching switches which provide inputs to the microcomputer. The non-latching switches may be arranged as upper and lower switches on a rocker panel or independent pair of panels which are normally biased to remain in a neutral position. The switches are each connected in series with the AC mains power line so that when either switch is depressed a signal in the form of a series of sequential pulses is provided to the microcomputer.

When the switch is depressed in either the up or down direction, the microcomputer first determines whether the depression of the switch is momentary, that is, a brief tap, or whether it is being held down for a period of more than transitory duration. When the switch is held, the microcomputer advances the level of light intensity in the direction indicated by the switch, that is, either towards bright or towards dim. When the switch is subsequently released the microcomputer stores that current level of light intensity as a "preset" level in its memory. If the switch is first tapped in either direction with the light intensity at some static level the microcomputer will cause the level of light intensity to automatically advance or "fade" towards a predetermined level, either "full on," "off," or "preset." The fade may occur at a rate which can be programmed in the microcomputer. If desired, the speed of the fade may vary depending upon whether the fade is from dim to bright or vice versa. For example, it is possible to program all downward fades to occur more gradually than all upward fades. If the switch is tapped again while the light intensity is fading towards the preset level, the microcomputer will halt the fade and cause the light intensity level to abruptly shift to the preset level. If the "up" switch is tapped with light at the preset level, the light intensity will fade to full maximum. If it is tapped in the downward position when the light intensity level is at the preset position the light intensity will fade towards zero. Thus, the microcomputer interprets the character of the command, that is, a hold or a tap, determines the current control mode, and initiates a light intensity control function accordingly. The three types of programs are preset, automatic fade, and abrupt transition.

The non-latching switches provide a pulse input, which is derived from the AC power source, to the light switch through a clamp and half-wave rectifying network. Thus, the input to the microcomputer is a series of square wave pulses. The microcomputer has an internal program which counts the number of a sequential series of pulses to determine if the switch is being tapped or held and executes a control program mode accordingly.

The microcomputer is connected to a source of light such as an incandescent light bulb of between 40 and 2,000 watts by means of a thyristor solid state switch. The thyristor controls power to the incandescent light source by turning on at a predetermined phase angle relative to the phase of the AC line source. For this purpose the thyristor is responsive to a timed firing signal generated by the microcomputer according to the program in operation. The firing signal is synchronized with the incoming power supply line by a zero

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