

[54] STOVE WARNING DEVICE

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[51] Int. Cl. H05b 3/68

[58] Field of Search 340/227 R, 228 R, 213 R; 126/39 J; 431/13; 219/453, 487, 506, 269; 307/116, 117; 317/133.5; 73/359, 362 SC, 362.5, 339; 328/6; 337/332

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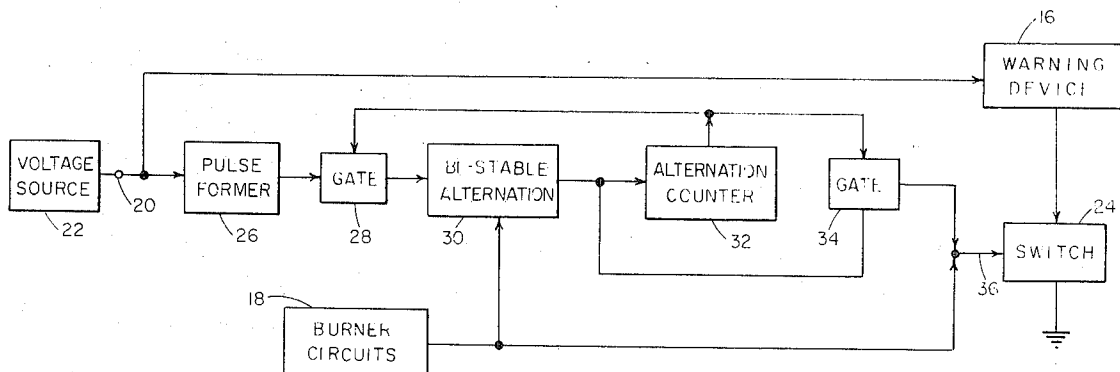
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[57] ABSTRACT

Apparatus for operating a warning device such as a lamp to indicate that the burners on an electric stove are hot. A switch for the warning device is connected to a first control circuit that sets the switch in a mode completing a continuous energizing path for the device, and to a second control circuit that causes an intermittent completion of the energizing path. The control circuits operate sequentially to produce a first warning signal when one or more of the burners are on, and a different warning signal for a predetermined period of time after the burners have been turned off. Intermittent operation is achieved on a preferred embodiment by connecting various stages of a binary counter in the second control circuit.

14 Claims, 8 Drawing Figures



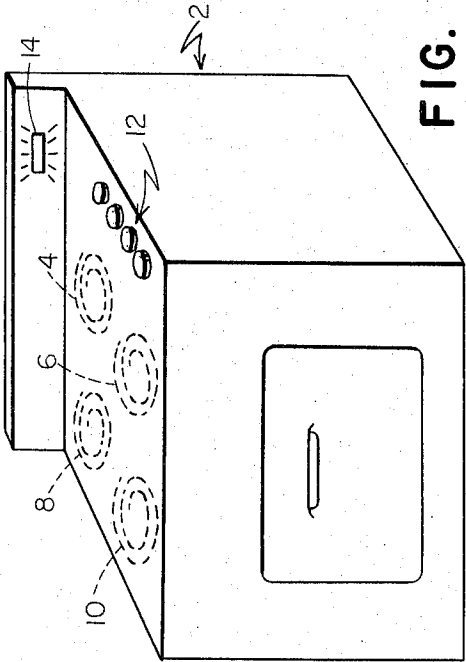


FIG. 1

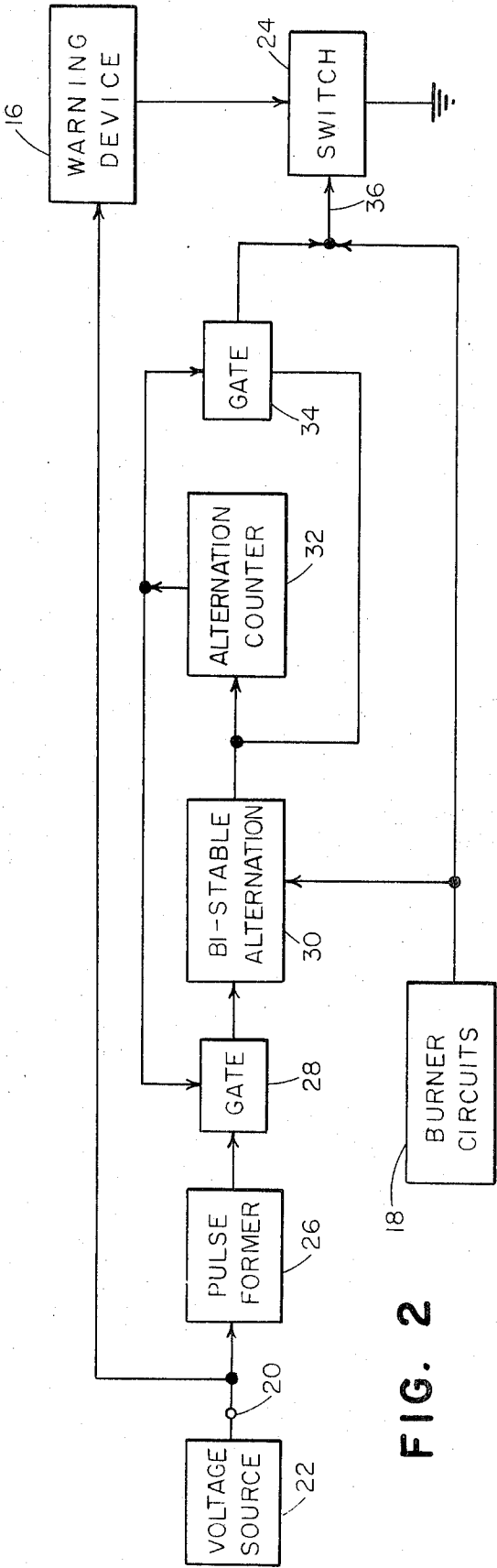


FIG. 2

FIG. 3

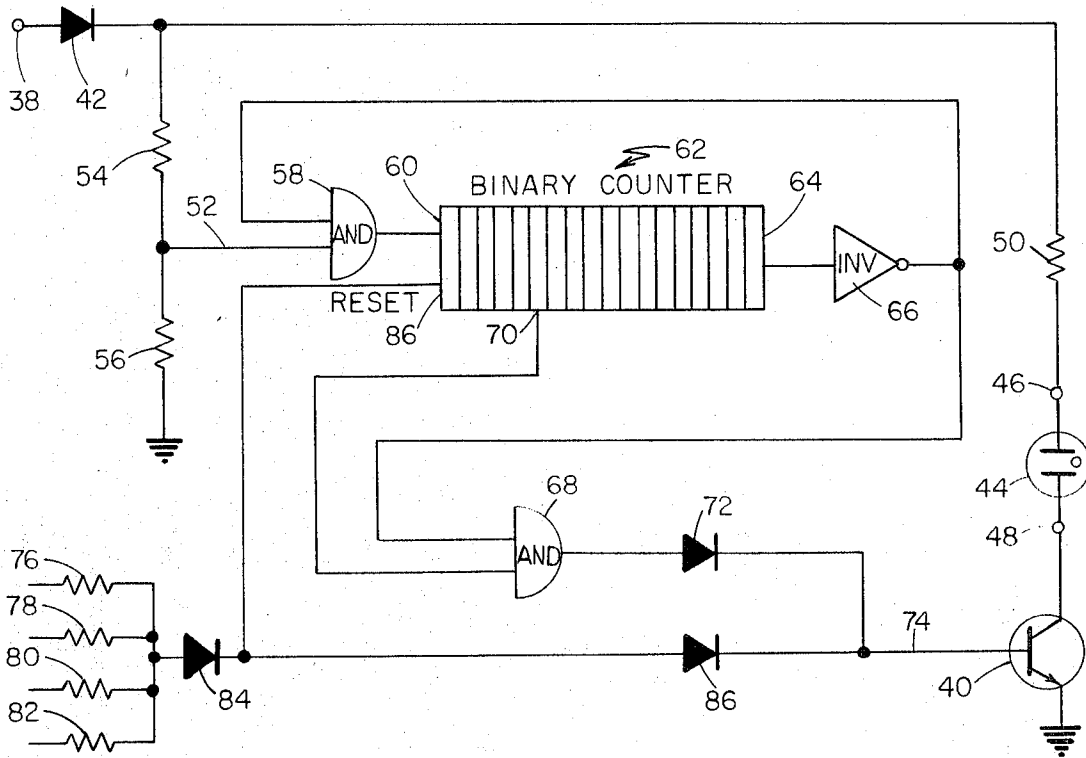


FIG. 4A

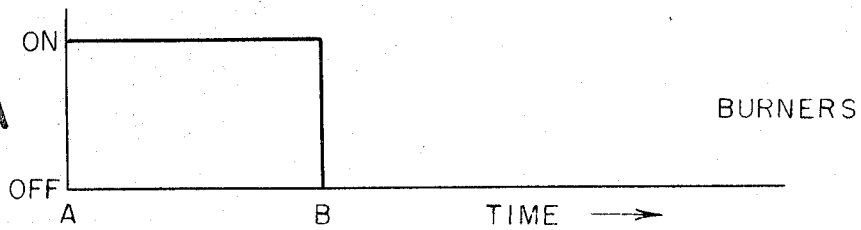


FIG. 4B

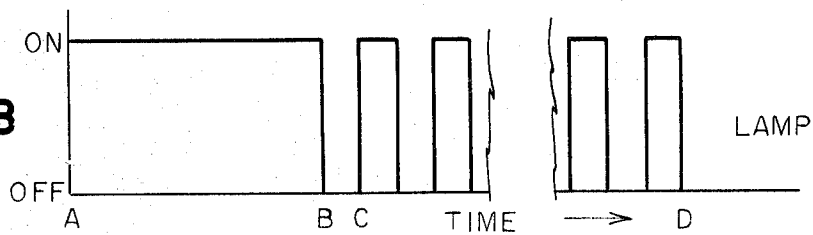


FIG. 5

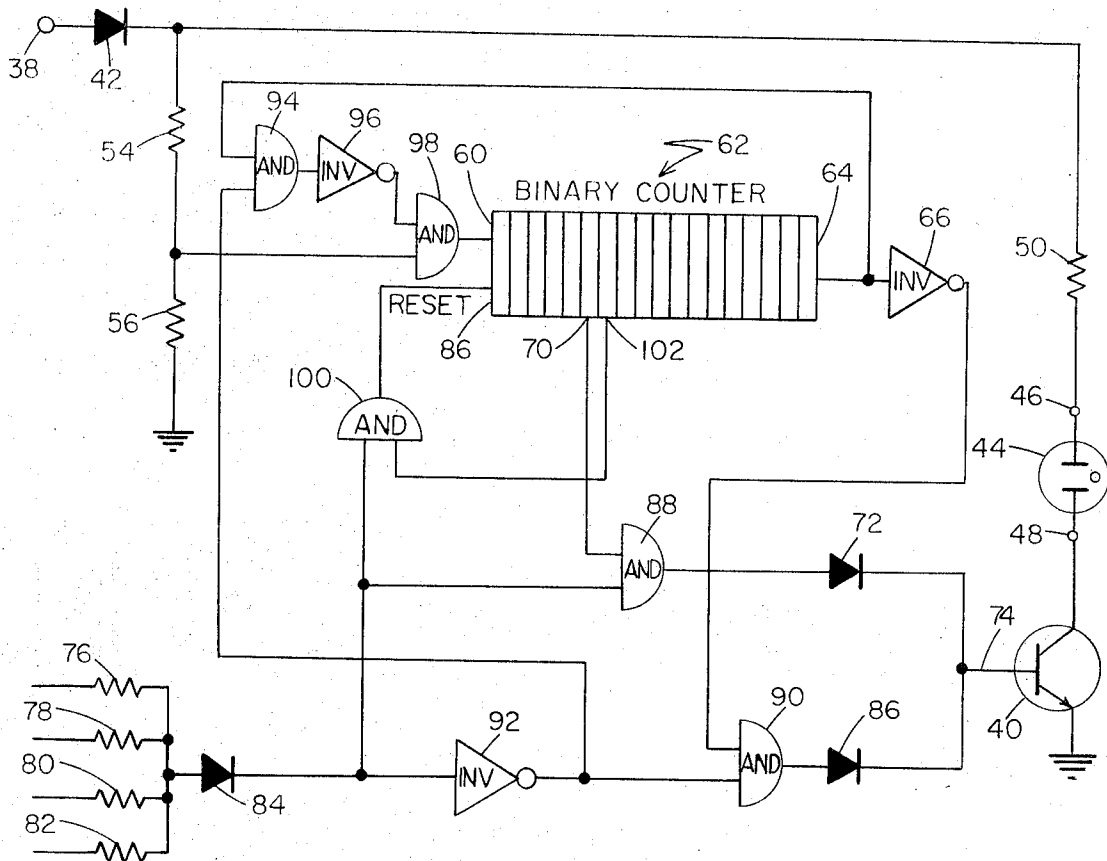


FIG. 6A

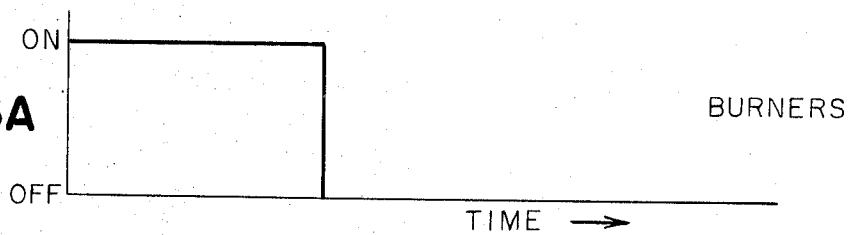
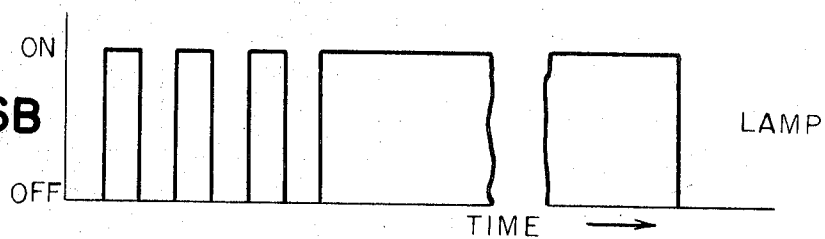


FIG. 6B



STOVE WARNING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to apparatus for operating a warning device to indicate operation of an electric stove, and more particularly to apparatus for operating a warning device in a given manner when the stove is energized and in a different manner for a period of time after the stove has been de-energized.

The burner coils of electric stoves can become hot enough to inflict very serious burns if they are touched. At their highest temperatures the coils generally glow brightly, but the glowing is not so evident at lower temperature settings and may give little or no indication that the coils are hot. The problem is particularly acute in the case of stoves now becoming popular that feature a smooth glass top hiding the burners. With these stoves there is no visible sign that the glass top is hot even for the highest settings. It is therefore desirable that some means be provided to indicate when the burners are in use.

The dangerous situation continues after the electric flow through the coils has been turned off, as the burners will remain hot for a period of time and cool off only gradually. Some sort of warning device during this period is consequently also important. If, however, the same warning mechanism is provided for both the period when the burners are energized and the subsequent period when they are de-energized but still hot, a person using the stove may attempt to cook on one of the burners when it is actually turned off and in the process of cooling.

SUMMARY OF THE INVENTION

Apparatus is provided according to the present invention to operate a warning device for an electric stove in a manner that gives an adequate and intelligent warning in view of the above-stated considerations. The invention broadly comprehends an energizing circuit for the warning device that includes a switch means that governs the operation of the warning device. A first control signal is applied to the switch means by means communicating with the burner circuits when at least one of the burner circuits is energized, while means are provided for applying a second control signal to the switch means following de-energization of all the burner circuits. Timing means terminate the application of the second control signal to the switch means a predetermined period of time after all the burner circuits are de-energized, the said predetermined time period preferably being approximately equal to the time required by the electric burners to cool.

In the preferred embodiment, first circuit means are adapted when connected to the burner circuits to continuously set the switch means in a mode completing a path for energizing the warning device. Second circuit means include means alternatable between states respectively setting and not setting the switch means in a mode completing a warning device energizing path. The embodiment includes means for applying a control signal from one of the circuit means to the switch means when at least one of the burner circuits is energized, and for applying a control signal from the other circuit means to the switch means following de-energization of all the burner circuits. Application of a

control signal from the last circuit means to operate is terminated a predetermined period of time after all the burner circuits are de-energized. With this embodiment the hazardous condition existing when the burners are operated is distinguished from the condition when the burners are still hot but in the process of cooling off, by a continuous operation of the warning device during one period and an intermittent operation thereof during the other period. In a more particular embodiment of this feature the apparatus includes a binary counter, the alternatable means comprising one stage of the counter, and the control signal is terminated by means that includes an actuator comprising a higher order stage of the binary counter.

In one particular embodiment of the invention, the warning device is continuously operated when the burner circuits are energized, and periodically energized and de-energized for a predetermined period of time following de-energization of all the burner circuits by bi-stable means in controlling communication with the switch means. Means are included for alternating the bi-stable means, an actuator being provided to initiate operation of the alternating means in response to de-energization of the burner circuits. According to one feature of this embodiment, the alternating means comprises a binary counter in combination with and controlled by a substantially constant frequency pulse source, the frequency of the pulse source being a whole number power of two multiple of the alternation rate, and the bi-stable means comprises a stage of the binary counter.

In another aspect of the invention employing a binary counter with a plurality of stages and circuit means connectable to the burner circuits and in controlling communication with the switch means, the circuit means are adapted continuously to set the switch means in a mode completing an energizing path for the warning device when at least one of the burner circuits is energized. The circuit means is connected to reset the binary counter to an initial count when at least one of the burner circuits is energized. The switch means is also controlled by logic circuitry that has an input from a first stage of the binary counter, the logic circuitry being adapted to set the switch means in a mode completing the warning device energizing path when the said first counter stage is in a non-reset state. A second, higher order stage of the counter is connected to terminate counter operation when the second stage is in a non-reset state. The circuit means is connected to inhibit counting by the binary counter when at least one of the burner circuits is energized. The binary counter and logic circuitry may be provided in the form of an integrated circuit, and the invention preferably includes means for converting normal house voltage to a series of pulses suitable for application to the counter.

Other objects, features, and advantages will occur to one skilled in the art from the following description of particular embodiments of the invention taken together with the attached drawings thereof, in which:

FIG. 1 is a perspective view of an electric stove with a warning device that may suitably be operated by the apparatus of this invention;

FIG. 2 is a block diagram of one embodiment of the invention;

FIG. 3 is a circuit diagram of an embodiment incorporating the features of FIG. 2;

FIGS. 4A and 4B are graphs respectively showing the operation plotted against time of the stove burners, and the operation of a warning device controlled by the circuit of FIG. 3;

FIG. 5 is a circuit diagram of another embodiment of the invention; and

FIGS. 6A and 6B are graphs respectively showing the operation plotted against time of the stove burners, and the operation of a warning device controlled by the circuit of FIG. 5.

DETAILED DESCRIPTION OF PARTICULAR EMBODIMENTS

The present invention is suitable for operating a warning device used with an electric stove 2 such as the one shown in FIG. 1, which has a smooth glass top 3 overlying and hiding from view a plurality of burner coils 4, 6, 8, and 10 (shown by dashed lines), and a set of controls 12 for operating individual electrical circuits associated with each of the coils. A warning device such as a neon lamp 14 is provided to warn that the area of at least one of the burners is too hot to touch. As the burners remain hot for a period of time after their controls 12 have been turned off, the apparatus described herein gives a warning that spans the full dangerous period by energizing the warning lamp 14 both when one or more of the burners are on, and also for a period of time after they have been turned off. Two different modes for operating the lamp are provided to distinguish the two conditions. Other warning devices such as buzzers could also be used, but a visual indication is most desirable.

Referring now to FIG. 2, apparatus is shown in block diagram form for operating a warning device 16 in response to heating of electric stove burners 18. An energizing circuit for the warning device 16 includes a terminal 20 connectable to a suitable voltage source 22 such as the house electrical system, and a controlled switch 24 connected to complete or interrupt an energizing path for the warning device 16. While a single switch and warning device are shown, a plurality of such elements may be provided, one for each of the warning device operating modes comprehended by my invention. In the preferred embodiment, however, only one of each element is used. A pulse forming circuit 26 is connected to voltage source 22 and applies a series of pulses to a gate 28. The output of gate 28 is connected to a bi-stable alternator 30, the output of which is in turn fed to a device 32 that counts the number of alternations by alternator 30, and to another gate 34. An output from alternation counter 32 is applied back to each of gates 28 and 34. The output of gate 34 is connected over lead 36 to the control for switch means 24. A signal indicating operation of burners 18 is also applied to the control for switch means 24 via lead 36, and in addition is applied to a reset input for bi-stable alternator 30.

When one or more of the burners 18 are operated, a reset signal is continually applied to the bi-stable alternator 30, inhibiting it from producing an output. The burner signal is also applied directly over lead 36 to switch means 24, causing it to complete a continuous energizing path for the warning device 16 between the voltage source and ground. The warning device 16 remains energized for as long as one of the burners 18 is on. When all of the burners 18 are turned off, the said signal to switch means 24 disappears. At the same time,

the reset signal is removed from bi-stable alternator 30, which begins to alternate between the production of an active output and no output each time a pulse is applied from pulse former 26 via gate 28. Active alternator outputs are passed through gate 34, over lead 36, to set switch means 24 in a mode completing the energizing path for warning device 16. When there is no output from bi-stable alternator 30 the switch means 24 is set in a mode preventing completion of the energizing path. The warning device 16 is thus alternately turned on and off after the burners 18 have been de-energized. After a predetermined number of alternations, as determined by alternation counter 32, blocking signals are applied to gates 28 and 34 to prevent the passage of any future pulses to bi-stable alternator 30 and to prevent any output from the alternator 30 from reaching switch means 24. The warning device 16 remains inactive until one of the burners 18 is again turned on, setting switch means 24 in a mode again completing the energizing path and resetting bi-stable alternator 30.

A circuit is shown in FIG. 3 that embodies the features illustrated in FIG. 2. House voltage is applied between a terminal 38 and the grounded emitter of a switching transistor 40. A diode 42 rectifies the signal at terminal 38. A neon lamp 44 serving as the warning device is connected to terminals 46 and 48 in an energizing path that extends from terminal 38, through diode 42 and transistor 40, to ground, the energizing path also including a current limiting resistor 50.

Lead 52 is connected between a pair of voltage dividing resistors 54 and 56 as an input to AND gate 58, the output of which is connected to the first stage 60 of a binary counter 62. An output from the last counter stage 64 is connected through an inverter 66 as a second input to AND gate 58 and to an input of an AND gate 68. The output from an intermediate counter stage 70 is connected to another input of AND gate 68, the output of which is applied to the base of transistor 40 through diode 72 and lead 74. Each of the burner circuits 76, 78, 80, and 82 is connected through diode 84 directly to a reset control 86 for the binary counter 62, and to the base of transistor 40 through diode 84, diode 86, and lead 74.

When one or more of the burner circuits 76, 78, 80, and 82 are energized, binary counter 62 is continuously reset and inhibited from counting. At the same time, a signal is applied from the burner circuits to the base of transistor 40 over the circuit described above, elevating the voltage at the transistor base to drive the collector-emitter circuit of the transistor 40 into a conducting mode to complete the energizing path for lamp 44, which stays on for as long as at least one of the burner circuits remains energized.

The condition existing at the moment all the burner circuits become de-energized is as follows: binary counter 62 is reset to a count of zero, there is no output from counter stage 64, and inverter 66 is producing a positive output to AND gates 58 and 68. Shortly thereafter, binary counter 62 begins to count under the influence of pulses arriving at stage 60 from AND gate 58. In this embodiment the initial stages of the binary counter through stage 70 function as the bi-stable alternator 30 of FIG. 2, while the remaining stages provide the alternation counter 32. Counter stage 70 alternates between producing a positive input and no input to AND gate 68 at a rate determined by the frequency of the pulses applied to the counter 62 and by the order

of stage 70 within the counter. The voltage level at the base of transistor 40 is respectively raised and lowered each time counter stage 70 produces a positive output or a zero output, flashing lamp 44 on and off. When stage 70 has operated a sufficient number of times to cause a change of state of stage 64, that stage produces a positive output and the output of inverter 66 goes to zero, preventing the passage of any further signals through AND gates 58 and 68. The binary counter 62 is thus prevented from operating until the end of another reset cycle, following re-energization of the burner circuits.

When normal 60 hz. house voltage is used, 60 pulses per second are applied to the first binary counter stage 60, causing it to turn on 30 times per second and to turn off 30 times per second. The lamp 44 can be made to go through an on-off flash cycle approximately once each second by selecting the sixth stage of the binary counter 62 for intermediate stage 70. Flashing of the lamp 44 will terminate in approximately 35 minutes, by which time the burner coils are generally cool enough to touch, by selecting stage 64 to be the last stage of an 18-stage counter.

FIGS. 4A and 4B illustrate the operation of the warning device when one or more of the burners are turned on at a time A and turned off at a time B. Referring to FIG. 4B, the lamp 44 is continuously energized during the time A-B under the influence of a signal applied to the base of transistor 40 from the burner circuits. After time B, the binary counter 62 begins to operate and the lamp goes off until stage 70 makes an initial change of state at time C and delivers a signal through AND gate 68, diode 72, and lead 74 to the base of transistor 40. Thereafter the lamp 44 flashes on and off until time D, when stage 64 changes state and discontinues operation of the counter 62.

Another embodiment of the invention that operates a warning device in a manner opposite to that described above, i.e., intermittently when the stove burners are energized and continuously for a predetermined period of time after the burners are de-energized, is shown in FIG. 5. Several of the circuit components are the same as in FIG. 3, and the numerals employed in that figure are retained for the common elements.

In the embodiment of FIG. 5 the burner circuits 78-82 and the intermediate binary counter stage 70 control an AND gate 88, the output of which provides a first switching signal for transistor 40. A second switching signal is derived from a circuit comprising an AND gate 90, an inverter 92 connected between the burner circuits 76-82 and an input to AND gate 90, and the inverter 66 connected between the output terminal of binary counter stage 64 and a second input to AND gate 90. Binary counter stage 64 is also connected through a series circuit including AND gate 94, inverter 96, and AND gate 98 to the first binary counter stage 60. The output of inverter 92 provides a second input to AND gate 94, while the pulse forming circuit is connected by lead 52 as a second input to AND gate 98. A resetting circuit for binary counter 62 comprises AND gate 100 controlling the binary counter reset 86, and having a first input from burner circuits 76-82 and a second input from the binary counter stage 102 that is one order higher than stage 70.

Initially, the binary counter 62 is left at the count of stage 64 from the previous operation, thereby provid-

ing a gating signal to AND gate 94 and a blocking signal to AND gate 90 from stage 64. The other input to AND gate 94 is also positive, producing a positive output signal that is processed by inverter 96 to block AND gate 98 from passing pulses to the binary counter 62.

When one or more of the burner circuits 76-82 is energized, the blocking signal is removed from AND gate 98 and the binary counter 62 begins to operate. A gating signal is provided for transistor 40 when counter stage 70 turns on, thereby completing the energizing circuit to switch lamp 44 on. The lamp is subsequently switched off when counter stage 102 turns on and stage 70 turns off. At the same time the reset circuit is completed to reset the binary counter 62 to zero and repeat the above cycle. The lamp 44 continues to flash on and off for as long as at least one of the burner circuits 76-82 is energized. It will be noted that the binary counter 62 is reset each time the count reaches the level of stage 102, thereby precluding an operation of the last stage 64.

When all the burner circuits 76-82 are turned off, their input to AND gate 100 is also terminated, locking out the reset circuit. An enabling signal appears at AND gate 94 from inverter 92, but operating pulses are still transmitted to the binary counter 62 from lead 52 because the other input to AND gate 94 remains off. AND gate 90 commences to produce a positive output, gating transistor 40 to continuously energize lamp 44. The reset circuit being locked out, no restraint is imposed on binary counter 62 and it continues to count for the desired period of time until stage 64 turns on. That occurrence removes the output from AND gate 90, turning lamp 44 off, and further completes a positive set of inputs for AND gate 94 to disable AND gate 98 and prevent any further pulses from reaching binary counter 62. The circuit remains in this state until a burner circuit is again energized, thereby removing the restraint imposed by AND gate 94 and permitting renewed operation of binary counter 62.

While particular embodiments of the invention have been shown and described, modifications thereof will be apparent to those skilled in the art. For example, other sequences for operating the warning device in a first mode when one of the burner circuits is active and in a second mode for a predetermined period of time after the burner circuits have been turned off may be envisioned. Therefore, it is not intended that the invention be limited to the disclosed embodiments or to the details thereof, and departures may be made therefrom within the spirit and scope of the invention as defined in the claims.

What is claimed is:

1. Apparatus for operating a warning device for use with a stove having one or more electric burner circuits, comprising:

an energizing circuit for said warning device, including a switch means governing the operation of said warning device,

a first control circuit for said switch means, said control circuit having means to receive a signal indicating operation of at least one of the burner circuits, and means to set said switch means in a mode completing an energizing path for the warning device during receipt of said burner operation signal, and

a second control circuit for said switch means, including bi-stable means alternatable in response to

discontinued operation of said burner circuits between first and second states respectively setting and not setting the switch means in a mode completing an energizing path for the warning device, means to alternate said bi-stable means, and means to terminate operation of said bi-stable means after a predetermined number of alternations.

2. Apparatus as claimed in claim 1, wherein said bi-stable means comprises a stage of a binary counter.

3. Apparatus for operating an electrical warning device for use with a stove having one or more burner circuits, comprising:

an energizing circuit for said warning device, including a switch means governing the operation of said warning device,

circuit means connectable to said burner circuits and in controlling communication with said switch means, said circuit means adapted when so connected to continuously set said switch means in a mode completing an energizing path for said warning device when at least one of the burner circuits is energized,

bi-stable means in controlling communication with said switch means, alternatable between first and second states respectively setting and not setting said switch means in a mode completing an energizing path for said warning device,

means for alternating said bi-stable means between said first and second states at a predetermined rate of alternation,

an actuator adapted to initiate operation of said alternating means in response to de-energization of all the burner circuits, and

means to terminate alternating operation of said bi-stable means a predetermined period of time after such operation is initiated.

4. Apparatus as claimed in claim 3 wherein said alternating means comprises a binary counter in combination with and controlled by a substantially constant frequency pulse source, the frequency of said pulse source being a whole number power of two multiple of said predetermined alternation rate, and said bi-stable means comprises a stage of said binary counter.

5. Apparatus for operating an electrical warning device for use with a stove having one or more electric burner circuits, comprising:

an energizing circuit for said warning device, said circuit including a switch means governing the operation of said warning device,

circuit means connectable to said burner circuits and in controlling communication with said switch means, said circuit means adapted when so connected to continuously set said switch means in a mode completing an energizing path for said warning device when at least one of the burner circuits is energized,

a binary counter having a plurality of stages, said circuit means being connected to reset said counter to an initial count when at least one of the burner circuits is energized,

logic circuitry in controlling communication with said switch means and having an input from a first stage of said counter, said logic circuitry adapted to set said switch means in a mode completing an energizing path for said warning device when said first counter stage is in a non-reset state, and

a second, higher order stage of said counter connected to terminate counter operation when said second stage is in a non-reset state.

6. Apparatus according to claim 5, wherein said binary counter and logic circuitry are in the form of an integrated circuit.

7. Apparatus according to claim 5, wherein said circuit means is connected to inhibit counting by said binary counter when at least one of the burner circuits is energized.

8. Apparatus according to claim 5, useful for operating an electrical warning light by continuously energizing the light when one of the burner circuits is energized, and for flashing the light for a predetermined period of time following de-energization of all the burner circuits.

9. Apparatus according to claim 5, and further including means connected as an input to the counter for converting normal house voltage to a series of pulses suitable for application to said counter.

10. Apparatus for operating a warning device for use with a stove having one or more electric burner circuits, comprising:

an energizing circuit for said warning device, said circuit including a switch means governing the operation of said warning device,

first circuit means connectable to said burner circuits and in controlling communication with said switch means, adapted when so connected to continuously set said switch means in a mode completing an energizing path for said warning device,

second circuit means in controlling communication with said switch means, including means alternatable between states respectively setting and not setting said switch means in a mode completing an energizing path for said warning device,

means for applying a control signal from one of said circuit means to said switch means when at least one of said burner circuits is energized, and for applying a control signal from the other of said circuit means to said switch means following de-energization of all of said burner circuits, and

means for terminating the application of a control signal from the last mentioned circuit means to said switch means a predetermined period of time after all of said burner circuits are de-energized.

11. Apparatus as claimed in claim 10, wherein said alternatable means comprises a stage of a binary counter.

12. Apparatus as claimed in claim 11, wherein said means for terminating the application of a control signal includes an actuating means comprising a stage of said binary counter of higher order than said alternatable means stage.

13. Apparatus for operating a warning device for use with a stove having one or more electric burner circuits, comprising:

an energizing circuit for said warning device, said circuit including a switch means governing the operation of said warning device,

means communicating with said burner circuits for applying a first control signal to said switch means when at least one of said burner circuits is energized,

means for applying a second control signal to said switch means following de-energization of all of said burner circuits,

9

and timing means for terminating the application of said second control signal to said switch means a predetermined period of time after all of said burner circuits are de-energized.

14. Apparatus as claimed in claim 13, wherein said 5

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predetermined period of time after which application of the second control signal to the switch means is terminated is approximately equal to the time required by the electric burners to cool.

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