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Li Donnici

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[54] **MULTIPLE LAMP UNIT FOR PROTECTION**

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[52] **U.S. Cl.** **315/89;** 240/37.1; 315/93; 315/136; 315/313; 353/85; 353/119

[51] **Int. Cl.**[2] **H05B 37/04;** H05B 39/10

[58] **Field of Search** 315/88, 89, 93, 136, 313; 240/37.1; 352/198; 353/85, 87, 119

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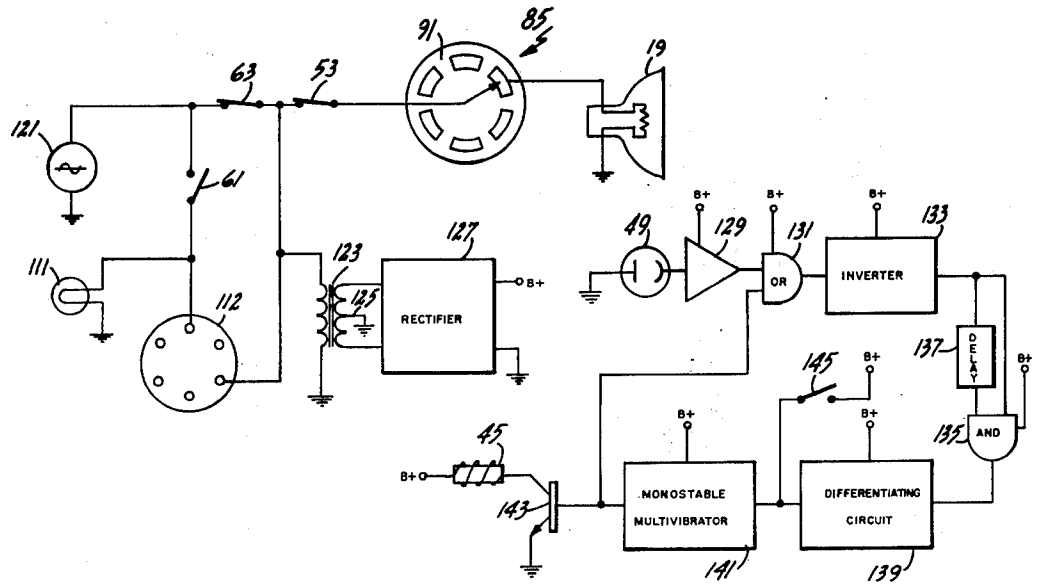
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Primary Examiner—James W. Lawrence
Assistant Examiner—E. R. La Roche

[57] **ABSTRACT**

A multiple lamp unit suitable for use with a photographic film projector which includes a plurality of lamps mounted on a turntable which transports the lamps successively into a working position. The turntable is incremented by means of an escapement which stops it as each successive lamp is brought into the working position. A photocell senses when the lamp in the working position burns out and causes the escapement to increment the turntable. The energy for rotating the turntable is provided by a torsion spring which is wound by the operator as he replaces burned out lamps and then unwinds to supply the rotational energy to increment the turntable.

10 Claims, 7 Drawing Figures



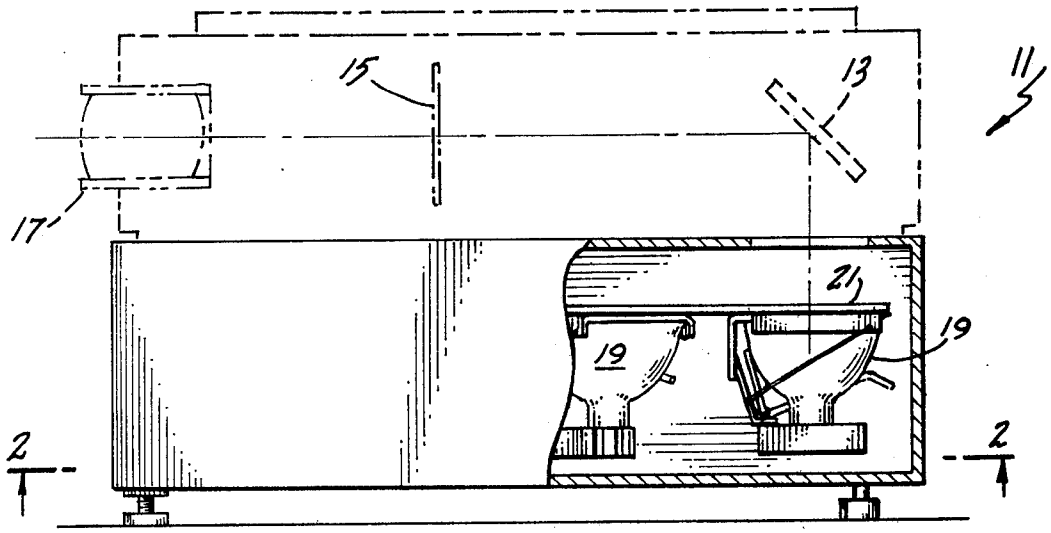

15
13
11
17
21
19
19
2
2

Fig. 1

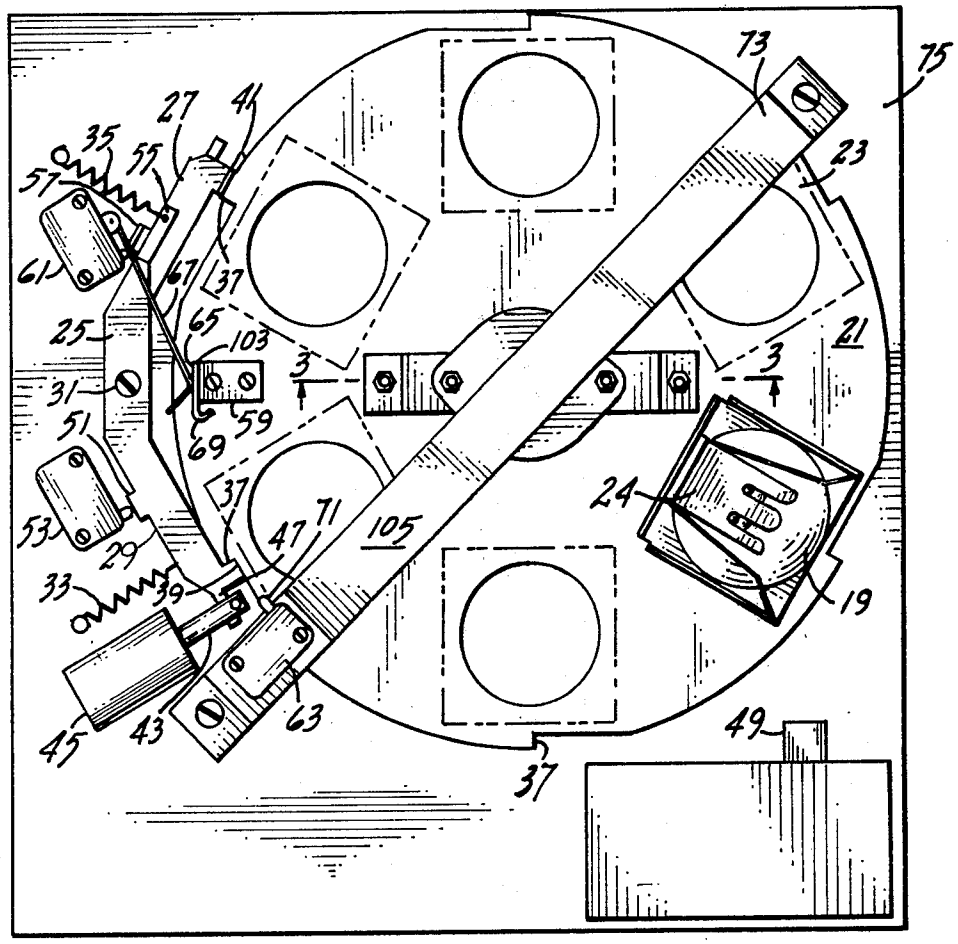

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63
49
37

Fig. 2

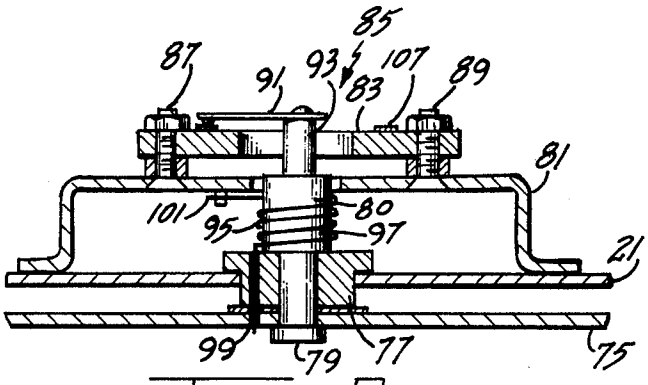


Fig. 3

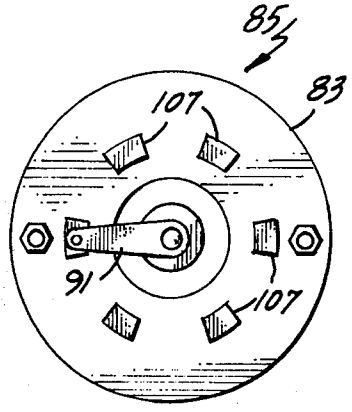


Fig. 4

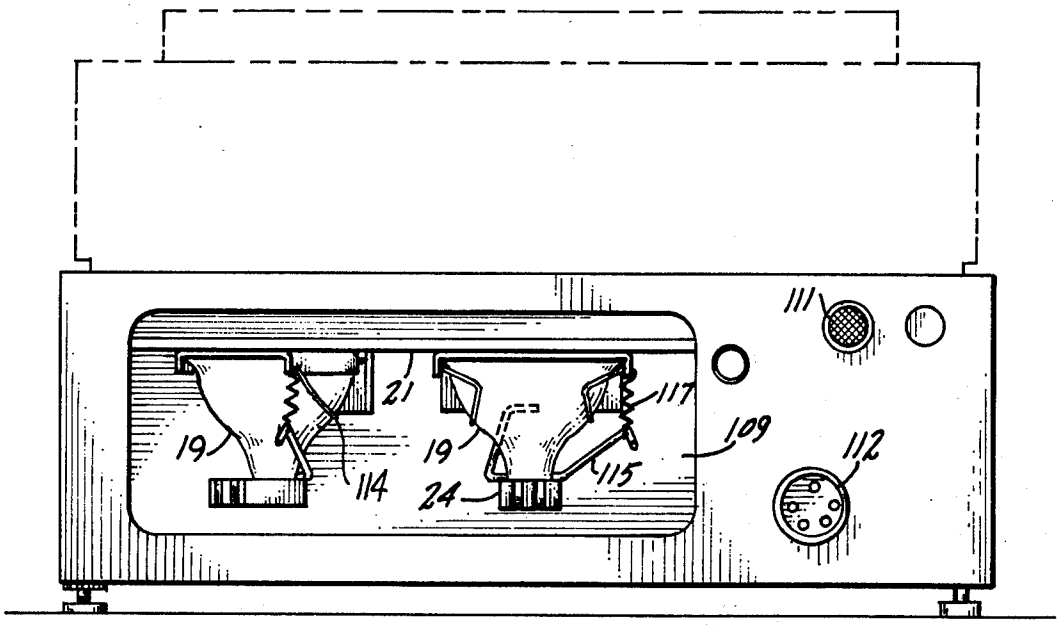


Fig. 5

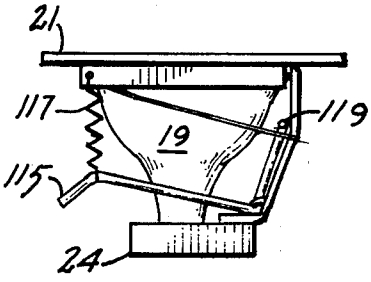


Fig. 6

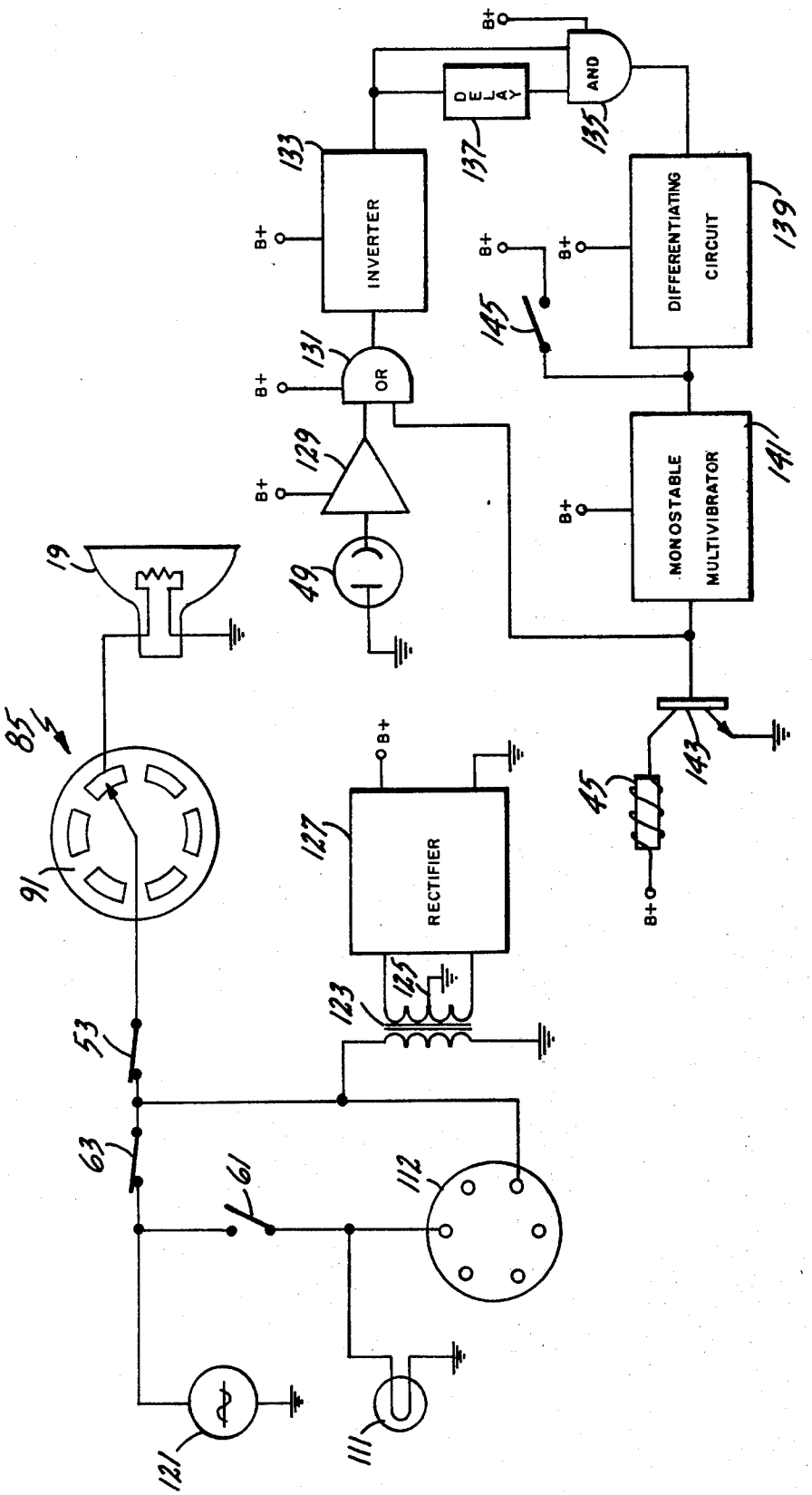

B+
AND
DELAY
135
137
133
INVERTER
139
DIFFERENTIATING CIRCUIT
145
131
OR
129
49
19
85
91
MONOSTABLE MULTIVIBRATOR
141
143
45
127
RECTIFIER
123
125
53
63
61
112
121
111

FIG - 7

MULTIPLE LAMP UNIT FOR PROTECTION

BACKGROUND OF THE INVENTION

This invention relates generally to multiple lamp mechanisms for photographic projectors and more particularly to multiply lamp mechanisms for photographic projectors in which the mechanism automatically indexes to a next lamp when the lamp in use burns out.

Because of their convenience and versatility photographic slide projectors have achieved widespread acceptance in commercial ambients where they are often the preferred medium for visual or audio-visual displays or presentations. Such projectors generally include a high intensity lamp which directs light through a slide and a lens for projection on a screen.

Perhaps the most significant weak point of presently available projectors is the lamp system. If the lamp fails during a presentation, for instance at a business or sales meeting, the prededings are interrupted for a ssubstantial time while the operator removes the burned-out lamp, replaces it with a new one and then repositions the projector and refocuses the image on the screen. The problem is even more severe in displays in which the images projected by a plurality of projectors (in some cases as many as 70 are focused on a single screen in a coordinated manner. In this case when a lamp fails, a very noticeable "hole" is left in the display which destroys the intended visual effect.

Since in presently available projectors access to the lamp is only from the bottom, the projector must be moved to replace the lamp. The repositioning and refocusing of the image in such a case is not a trival matter but requires a good deal of painstaking effort. The average life time of a popular high-intensity lamp is about 35 hours. In order to guard against lamp failures at inopportune times, it is the custom to change lamps after 28 to 30 hours. While this practice does eliminate most of the embarrassing lamp failures it has many disadvantages. It wastes an average of 5 to 7 hours of life per lamp and, since these lamps cost about 10 dollars each, the amount of money involved is significant, especially for multiple projector installations. Furthermore, since some lamps fail before 28 hours the problem is not solved completely. This practice also does nothing to solve the problem of having to recoordinate the images projected by the projectors of a multiple unit display.

It has been suggested to provide a projector having a plurality of lamps which automatically indexes to a fresh lamp when one burns out. This attempt was abondoned, however, both because it did nothing to address the problem of having to move the projector to replace the bulbs and because the indexing mechanism and the provisions for loading the bulbs were completely impractical.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a projector in which the failure of a lamp does not disable the unit.

It is a further object of the invention to provide a practical automatically indexing multiple lamp projector.

It is a further object of the invention to provide an automatically indexing multiple lamp mechanism for use with a projector in which the lamps can be changed without moving the projector.

In accordance with these and other objects of the invention applicant provides a multiple lamp unit suitable for use with a photographic film projector which comprises means for individually and successively transporting a plurality of lamps into a working position and escapement means for stopping the transporting means when each successive lamp is brought into the working position. The action of the escapement means is controlled by means which sense when the lamp in the working position burns out and which actuate the escapement means to increment the transporting means for bringing the next lamp into the working position. The energy for moving the transporting means is furnished by energy storage means which supplies energy to the transporting means to move it in a first direction to bring the successive lamps into the working position and which receives and stores energy from the transporting means when it is manually moved in a second direction during the replacement of the burnt out bulbs by an operator.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the preferred embodiment of the multi-lamp projector according to the invention.

FIG. 2 is a bottom view of the lamp mounting and incrementing assembly of the projector according to the invention.

FIG. 3 is a sectional view of the lamp mounting and incrementing assembly of FIG. 2.

FIG. 4 is a bottom view of the wafer switch of the lamp mounting and incrementing assembly of FIG. 2.

FIG. 5 is a back view of the projector of FIG. 1.

FIG. 6 shows the lamp mounting socket of the projector of FIG. 1.

FIG. 7 is a schematic diagram of the electrical portion of the projector according to the invention.

DETAILED DESCRIPTION

Referring to FIG. 1 of the drawings a slide projector 11 may include a mirror 13 for directing light through a slide 15 positioned between the mirror 13 and a lens or lens system 17. The lens 17 projects and focuses the light passing through the slide 15 onto a screen for viewing. The light passing through the slide 15 in the projector 11 according to the invention, is derived from one of a plurality of lamps 19 mounted below the mirror 13 on a turntable 21.

As seen in FIG. 2 of the drawing the illustrated embodiment of the invention, six lamps 19 are positioned equidistantly about the periphery of the turntable 21 on the underside thereof with only the lamp 19 positioned in the working location 23, directly below the mirror 13, being energized. Apertures are provided in the turntable 21 at each lamp position to allow the light generated by the lamp 19 to pass therethrough. When the lamp 19 burns out the turntable 21 automatically indexes in the counter clockwise direction as viewed in FIG. 2 by the distance between adjacent lamps 19 to bring the next lamp 19 into the working position 23. Thus the full life of each lamp 19 is used and, since only a few seconds is required for the indexing operation, no serious interruption occurs when a lamp 19 burns out. When the sixth lamp 19 is in the working position a "last lamp" signal is generated which indicates that it is time to replace the 5 burned out lamps 19. The lamps 19 are mounted face up in the socket 24 which are affixed to the underside of the turntable 21.

The periphery of the turntable 21 is formed into a 6 tooth ratchet which cooperates with the double escapement mechanism 25 for allowing the turntable 21 to index in the counterclockwise direction by one lamp position when the lamp 19 in the working position 23 burns out. The escapement mechanism 25 includes a pair of identical levers 27 and 29 which are mounted on a common pivot 31 and biased into engagement with the periphery of the turntable 21 by the springs 33 and 35, respectively. Lever 29 normally engages a ratchet tooth 37 on the peripery of the turntable 21 by means of the lug 39 for holding the turntable 21 against rotational movement while the lug 41 on the lever 27 is normally positioned at a point immediately beyond the next following tooth 37 on the periphery of the turntable 21. The armature 43 of the solenoid 45 is coupled to the extention 47 of the lever 29.

When the laamp 19 in the working position 23 burns out, the photocell 49 senses the decrease in light level and causes the actuation of the solenoid 45 which pulls in the armature 43 and pivots the lever 29 against bias in the clockwise direction. The movement of the lever 29 both causes the lug 51 thereon to actuate the lamp switch 53 and thereby turn off power to the lamps 19 and disengages the lug 39 thereon form the ratchet tooth 37 thereby allowing the turntable to rotate in the counterclockwise direction. The lug 41 of lever 27 is held in contact with the periphery of the turntable 21 by the spring 33 and stops the turntable 21 when it engages the next tooth 37. The solenoid 45 is deactuated after 2 to 5 seconds and allows the spring 35 to return the lever 29 into engagement with the periphery of the turntable 21. The deactivation of the solenoid 45 also causes the lug 51 on the lever 29 to move out of engagement with the switch 53 thereby restoring power to the lamp 19 being brought into the working position 23.

The spring 35 is chosen to be stronger than the spring 33 so that when the lever 29 is released by the solenoid 45, the portion 55 of the lever 29 engages the lug 57 of lever 27 and rotates the lever 27 in the counterclockwise direction as seen in FIG. 2 thereby disengaging the lug 41 of lever 27 from the tooth 37. The turntable 21 then rotates a further small distance until the lug 39 of lever 29 engages a tooth 37 stopping the turntable 21 with the next lamp 19 in the working position 23. With a new lamp 19 in the working position 23 normal operation of the projector 11 is restored without the necessity of any repositioning or refocusing.

The removal of power from the lamps 19 during most of the indexing operation further increases average lamp life since the lamp filament is most brittle and sensitive to shock when power is applied.

The member 59 is affixed to and rotates with the turntable 21 for actuating switches 61 and 63. In the positon illustrated in FIG. 2 of the drawings the sixth (and last) lamp 19 on the turntable 21 is in the working position 23. In this position the portion 65 of the member 59 depresses the actuating lever 67 of the switch 61 thereby generating an indication that the last lamp 19 is in use. As will be explained in connection to FIG. 6, the actuation of the switch 61 may turn on a last lamp indicator lamp and/or be coupled to remote point through a connector.

When the sixth lamp 19 burns out the turntable 21 indexes again in the manner described above and causes the portion 69 of the member 59 to strike the actuating member 71 of the switch 63 thereby turning off all power to the projector 11 and optionally generating a "lamps burned out" signal. The switch 63 is fixedly mounted on the bridge member 73 which is in turn affixed to the underside of the top plate 75 of the lamp mechanism housing portion of the projector 11 according to the invention.

FIG. 3 is a sectional view taken through the center of the mounting structure of the turntable 21. The turntable 21 is rotatably mounted on the bearing 77 which is affixed to the top plate 75 by the bolt 79 which extends through the bearing 77 and secures the stepped shaft 80 to the top thereof. A second bridge member 81 is fixedly mounted on the turntable 21 for rotation therewith and carries the rotatable portion 83 of the wafer switch 85 secured to it by the bolts 87 and 89. The stationary wiper 91 of the wafer switch 85 is affixed to the upper portion 93 of the stepped shaft 80. The energy for rotating the turntable 21 when the solenoid 45 (FIG. 2) is actuated is stored in the torsion spring 95 which is wound about the lower portion 97 of the stepped shaft 80. One end 99 of the torsion spring 95 is secured in place by passing through a hole in the bearing 77. The other end 101 is affixed to the bridge member 81 and thus to the turntable 21. It is an important feature of the present invention that when the operator rotates the turntable 21 as he replaces the burned out lamps 19, he also provides the energy of indexing the turntable 21 by winding up the spring 95. When all the lamps 19 are replaced and the turntable 21 is positioned so that the first lamp 19 is in the working position 23 the spring 95 is fully wound and stores ample energy for indexing the turntable 21 through the five succeeding lamp positions. Returning to FIG. 2 of the drawings the portion 103 of the member 59 strikes the portion 105 of the bridge member 73 when the turntable is fully wound with the first lamp 19 in the working position 23. This prevents overtightening of the spring 95 and gives an indication to the operator that the turntable 21 has been rotated to the proper position.

Referring now to FIG. 4 of the drawings the portion 83 of the wafer switch 85 which rotates with the turntable 21 includes six conductive pads 107 arranged circumferentially about the face of the rotatable portion 83. These pads 107 are electrically connected to the lamps 19 and cooperate with the stationery wiper 91 to supply electric power to the lamp 19 in the working position 23.

As seen in FIG. 5 of the drawings access to the lamps 19 may be had from the rear of the projector 11 according to the invention through the door 109. When it is time to replace the burnt out lamps 19, the operator can reach and replace them from the door 109 without moving the projector 11. Also in the rear of the projector 11 there is provided a "last lamp burning" indicator light 111 and a terminal for coupling such indications as "last lamp burning" to a remote point such as a central monitoring board for a multiple unit display.

The lamp mounting mechansim can best be seen in FIGS. 5 and 6 of the drawings. The lamp 19 is held in position in the socket 24 by means of a wire frame 114 and may be ejected by pivoting the ejecting member 115 downwardly against the bias of the spring 117. This causes the rear portion 119 of its ejecting member 115

to eject the lamp **19** from the socket **24** for easy removal.

Referring now to FIG. **7** of the drawings the A-C power for operating the lamp mechanism is obtained from a source **121** which may be either a direct connection to the line power or a connection to the circuitry of the projector portion of the unit **11.** The latter choice is preferred. One side of the source **121** is grounded while the other side is connected to the normally closed OFF switch **63** and the normally open last lamp switch **61.** The other side of the last lamp switch **61** is connected to one side of the last lamp indicating light **111** and to one terminal of the connector **112.** The other side of the OFF switch **63** is connected through the normally closed lamp switch **53** to the stationary wiper **91** and rotatable portion **83** of the wafer switch **85** and thence to the lamp **19** in the working position **23.** The other side of the OFF switch **63** is also connected to the primary winding of the transformer **123** and to a second terminal of the connector **112.**

The secondary winding of the transformer **123** has a centertap **125** connected to ground and two ends which are connected to the rectifier **127.** The rectifier **127** rectifies the A-C voltage present at its input to produce a DC B^+ voltage at its input. The b^+ voltage is in turn connected to the logic circuitry which controls the operation of the solenoid **45** when the lamp **19** in the working position **23** burns out.

The photocell **49** senses the light produced by the lamp **19** in the working position **23** and is connected between ground and is connected between ground and an input to the amplifier **129.** The output of the amplifier **129** is connected to one input the OR gate **131** whose output is connected to the inverter **133.** The output of the inverter **133** is connected to an input of the AND gate **135** and to a delay circuit **137.** The output of the delay circuit **137** is connected to the other input of the AND gate **135.** The output of the AND gate **135** is connected to the differentiating circuit **139** whose output is connected to the monostable multivibrator **141.** The output of the multivibrator **141** is connected to the base of the transistor **143** and to the other input of the OR gate **131.** The emitter of the transistor **143** is connected to ground while the collector is connected to the solenoid **45.** The other end of the solenoid **45** is connected to B^+.

When the lamp **19** in the working position burns out the output of the photocell **49** drops. This drop is amplified by the amplifier **129** and coupled through the OR gate **131** to the inverter **133** so that the output of the inverter **133** goes high. This sets one input of the AND gate **135** high immediately and sets the other input high after a delay determined by the delay circuit **137.** The delay circuit **137** is conventional and may for instance include an R-C circuit connected to a threshold sensitive device. The delay time may be varied by varying the value of R or C or the level of the threshold and for the present application is preferably on the order of from two to five seconds.

When both inputs of the AND gate **135** go high its output is set high which causes the differentiating circuit **139** to generate a pulse. This pulse causes the monostable multivibrator **141** to switch to its unstable state in which its output to the transistor **143** is high thereby turning the transistor **143** on. This in turn energizes the solenoid **45** which pulls in the armature **43** thereby releasing the turntable **21** (FIG. **2**) to index under bias and opening the lamp switch **53.** In this manner power is removed from the lamp **19** during the major portion of the indexing operation. When the output of the multivibrator **141** goes high it also acts through the OR gate **131** to cause the output of the inverter **133** to drop thereby removing the inputs to the AND gate **135** and to the delay circuit **137.** When the monostable multivibrator **141** returns to its stable state (preferably after an unstable period of 2 to 5 seconds) the transistor **143** is turned off and the solenoid **45** is de-energized. This allows the spring **35** (FIG. **2**) to return the lever **28** into engagement with the periphery of the turntable **21** and disengages the lever **27** from the tooth **37** thereby allowing the turntable **21** to rotate another small amount until the tooth **37** engages the lug **39** on the lever **29.** During this portion of the indexing, power may be applied to the lamp **19** being brought into the working position **23** since the disengaging of the solenoid **45** allows the lever **29** to move out of engagement with the lamp switch **53** thereby allowing it to close.

If, as is occasionally the case, the lamp **19** brought into the working position **23** is defective and does not light, the output of the photocell **49** remains low after the output of the monostable multivibrator **141** returns to the stable state the AND gate **135** is again actuated and another indexing operation is initiated.

The delay circuit **137** prevents spurious indexing signals from being generated by the AND gate **135** both when the multivibrator **141** returns to the stabe state and when the projector **11** is being used in a fade out mode. In this mode the power to the lamps is decreased gradually over a few seconds rather than being switched off abruptly. Thus the image projected also fades gradually. At some point during the fading of the lamp **19** the output of the photocell **49** drops to a level such that the output of the inverter **133** goes high. The provision of the delay circuit **137** insures that the output of the AND gate **135** doesn't go high until B^+ voltage has dropped to a level insufficient to actuate the solenoid **45.**

As explained above in relation to FIG. **2** when the sixth lamp **19** is in the operating position, the switch **61** is closed thereby actuating the indicator light **111** and generating an input on a terminal of the connector **112.** When the turntable **21** indexes after the sixth lamp **19** burns out the switch **63** is opened thereby removing all power to the circuitry of FIG. **7.**

A manually actuable switch **145** may be provided for manually causing the incrementing of the lamps **19.**

It should be recognized that the above description of the preferred embodiment of the invention is for purposes of illustration only and that changes or modifications could be made without departing from the spirit and scope of applicant's invention. For instance the turntable **21** could be replaced by a linearly movable lamp carrier and the torsion spring **95** by a coil spring. Furthermore, while the multiple lamp mechanism has been described as part of a slide projector, it could equally well be sold as a separate unit for attachment to a projector, or be used with units other than slide projectors. The photocell **49** could be replaced by other means for detecting lamp burn outs, such as a resistor in series with the conductor carrying current to the lamp **19** in the working position. The voltage across this resistor would be an indicator of whether the lamp was operating properly. Furthermore, in a rather more

expensive embodiment the torsion spring arrangement described in relation to FIG. 3 could be replaced by a motor drive for the turntable 21. The illustrated embodiment is preferred however.

What is claimed is:

1. In a projector for projecting visual images recorded on film a multiple lamp unit for supporting and energizing a lamp in a working position and for automatically transporting a fresh lamp into said working position after the lamp in said working position burns out comprising:

a plurality of lamps

a support member movably mounted for supporting said plurality of lamps and for serially moving said lamps through said working position;

motive means for moving said support member in a first direction;

electrically powered escapement means for holding said member with one of said lamps in said working position and for selectively incrementing said support member in two stages first through a major portion of the distance between adjacent lamps and then through the remaining minor portion of said distance to bring said successive lamps into said working position, said escapement means requiring for operation at least a predetermined minimum level of electrical power supplied thereto;

means for energizing said lamp in said working position;

common means for supplying electrical power both to the lamp in said working position and to said escapement means;

means sensitive to the failure of the lamp in said working position for initiating the action of said escapement means to increment said support member including first delay means for preventing the actuation of said escapement means during a gradual reduction in the level of electrical power supplied by said common means when the projector is operating in a fade out mode until said level is below that necessary to operate said escapement means and second delay means for preventing the incrementing of said support member through said remaining minor portion until a predetermined time after the incrementing through said major portion; and

means for removing power from said lamps during at least said major portion of the incrementing of said lamps.

2. The multiple lamp unit of claim 1 wherein said support member includes a rotably mounted turntable, said lamps being mounted on said turntable at equal distances form the center thereof, said escapement means including:

first and second pawls;

a common pivot for said pawls;

a plurality of ratchet teetn in the periphery of said turntable equal in number to said plurality of lamps, said turntable being normally held with a lamp in said wording position by the engagement of the first pawl with one of said rachet teeth;

solenoid means actuated in response to said means sensitive to the failure of a lamp for temporarily disengaging said first pawl from said turntable for allowing said turntable to rotate, said second pawl being biased toward said turntable for engaging one of said ratchet teeth after the disengagement of said first pawl for stopping the rotation of said turntable before the next lamp is brought into said working position;

means for biasing said first pawl into engagement with said turntable; and

means integral with said first pawl for disengaging said second pawl from said turntable when said solenoid means is deactuated to allow said first pawl to return under bias into engagement with said turntable.

3. The multiple lamp unit of claim 1 wherein said means for removing power includes a switch actuated by said escapement means during the incrementing of said lamps.

4. The combination of claim 1 further including a projector having a lens attached to the multiple lamp unit and means for giving access to said lamps for replacing burned out ones thereof, said access means being positioned on the side of said unit opposite said lens.

5. The multiple lamp unit of claim 1 wherein said support member includes a rotatably mounted turntable said lamps being mounted about said turntable equidistantly form the center thereof.

6. The multiple lamp unit of claim 5 wherein said turntable includes a plurality of ratchet teeth in the periphery for cooperating with said escapement means each of said lamps being positioned in a uniform predetermined relationship with a different one of said teeth.

7. The multiple lamp unit of claim 5 wherein said motive means includes a torsion spring coupled to said turntable for rotating said turntable in said first direction, the rotation of said turntable in the opposite direction during the replacement of the burned out ones of said bulbs acting to store energy in said torsion spring.

8. The multiple lamp unit of claim 1 further including means for indicating when the last of said plurality of lamps is in said working position.

9. The multiple lamp unit of claim 8 further including means for removing electrical power from the unit after the last of said plurality of lamps burns out.

10. The multiple lamp unit claim 9 wherein said means for indicating and said means for removing electrical power each includes a switch and a common member carried by said support member, said common member actuating said switch included in said means for indicating when said last lamp is in said working position and actuating said switch included in said means for removing power when said support member is incremented after said last lamp burns out.

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