April 5, 1938. V. A. LEACH 2,113,273

FLASHING SIGNAL

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Fig. 1.

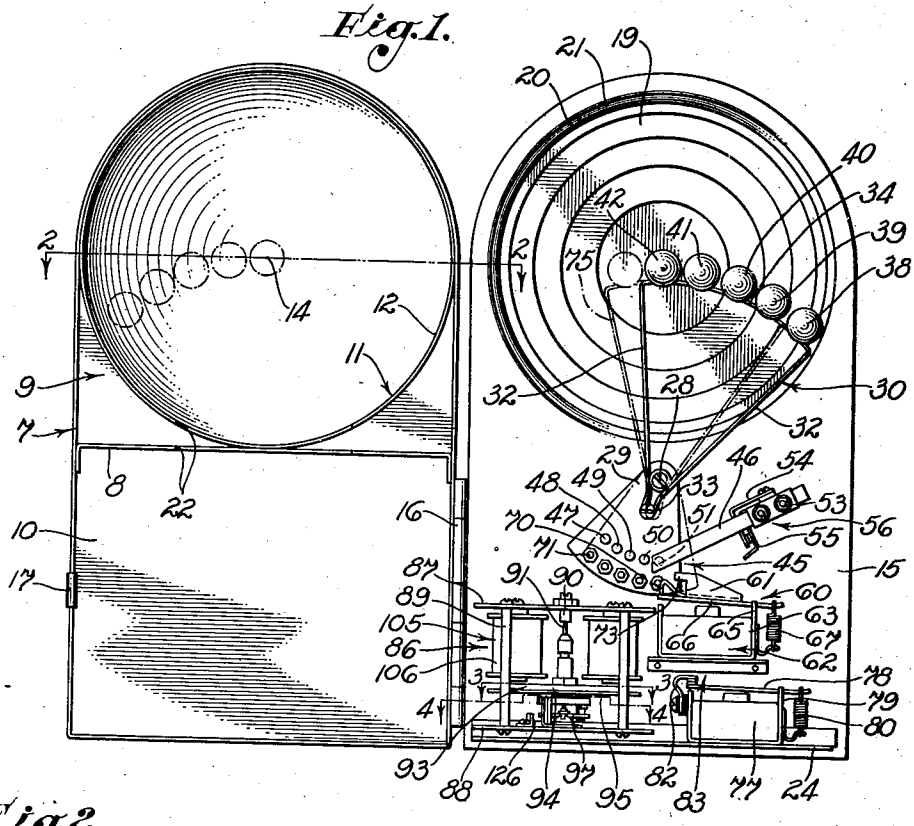


Fig. 2.

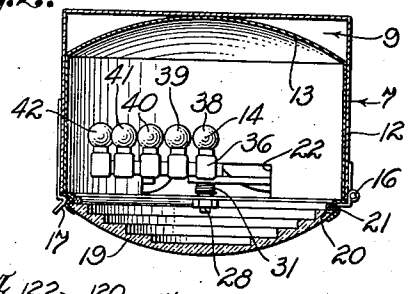


Fig. 3.

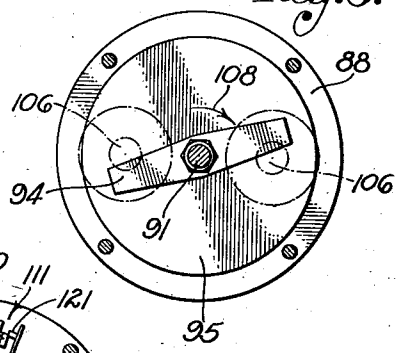
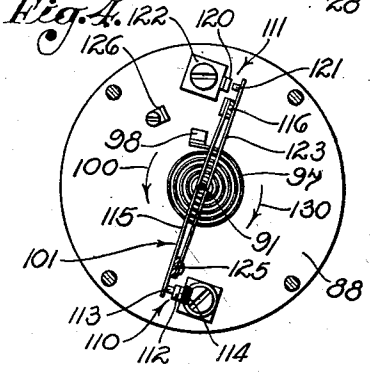


Fig. 4.



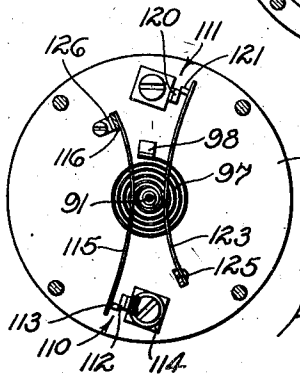


Fig. 5.

INVENTOR:
Val A. Leach,
BY
Fred A. Lamin
ATTORNEY.

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Fig. 6.

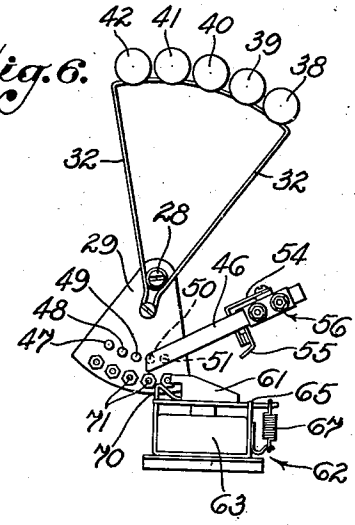

Fig. 7.

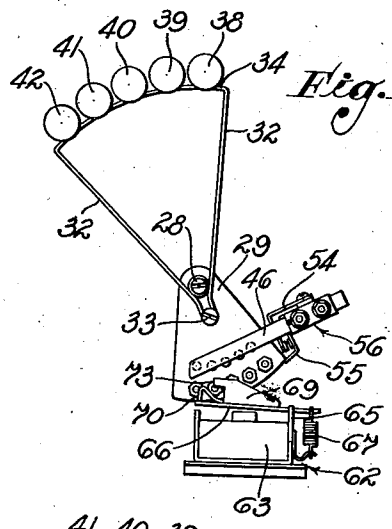

Fig. 8.

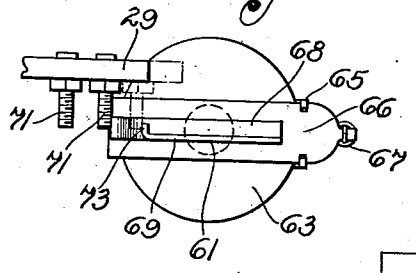

Fig. 9.

INVENTOR:
Val A. Leach,
BY
Fred W. Lamir
ATTORNEY.

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UNITED STATES PATENT OFFICE

2,113,273

FLASHING SIGNAL

Val A. Leach, Los Angeles, Calif.

Application November 10, 1933, Serial No. 697,434

9 Claims. (Cl. 177—329)

My invention relates to a flashing signal system, and more particularly to a flasher system such as is employed to produce a flashing warning on highways, buoys, ships, etc. Many of the existing flash-type signals are defective in that the signal fails to function if the light source burns out.

It is an object of the present invention to provide an improved flasher structure in which a plurality of light sources are utilized, these sources being successively connected in circuit as they burn out.

Another object of the invention is to provide a flasher system in which an intermittently operated switch controls the periodic energization of one light source, and in which a mechanism is provided for bringing another light source into circuit, this mechanism operating in a time interval which is less than the interval between energizations. By this structure the system will shift connections between flashes so that there is no prolonged dark period between flashes as the electrical connections are changed. This completely eliminates any dark period during which the signal is incapable of performing its warning function.

It is a further object of the invention to provide a novel impulse means for operating a flasher signal or other device requiring an intermittent supply of current.

Further objects of the invention lie in the provision of novel circuit elements interconnecting the impulse means and the sequence switch which brings the lamps successively into circuit.

It is a further object of the present invention to provide a plurality of lamps which are successively movable through the focal point of a reflector system, and to control this movement in a step-by-step fashion, the lamps being shifted to bring a new lamp into the focus of the reflector at such time as the previous lamp burns out.

It is a further object of the invention to provide a novel flasher system which includes a plurality of lamps which are successively connected in circuit with an intermittently operated switch, and which system automatically ceases to flash when the last lamp comes into circuit, this last lamp giving a steady light indicating the condition which exists in the system.

A further object of the invention lies in the provision of a limit switch for stopping the impulse means when the last lamp is brought into the circuit.

Other objects of the invention lie in the provision of a novel switch means associated with the impulse means, this switch preferably including one or more movable and stationary contacts arranged in a novel manner to effect a wiping action between the contacts.

Another object of the invention is to provide a flasher system, the operating parts of which are mounted in a novel manner so as to be readily accessible for purpose of inspection or repair.

In the drawings I have illustrated a preferred embodiment of the invention for the purpose of definiteness, though it should be distinctly understood that the concepts of the invention may take various forms without departing from the spirit of the invention.

Referring to these drawings,

Fig. 1 is a face view of the flasher system with the door swung open to expose the operating mechanism.

Fig. 2 is a sectional view of the reflector and light source taken on the line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1.

Fig. 5 is a sectional view similar to Fig. 4 illustrating the oscillating member in an extreme rearward position.

Fig. 6 illustrates the lamp structure in an intermediate position.

Fig. 7 illustrates this lamp structure in its extreme advanced position.

Fig. 8 is a top view of the escapement shown in Fig. 1.

Fig. 9 is a wiring diagram of the preferred embodiment.

Referring particularly to Fig. 1, I have shown the invention as utilized in conjunction with a container 7 divided by a partition 8 to form a reflector compartment 9 and a control compartment 10. A suitable reflector means 11 is mounted in the reflector compartment 9. As shown this reflector means includes a cylindrical reflector 12 to the rear of which a parabolical mirror 13 is secured. The focal point of this mirror is indicated by the numeral 14.

A cover 15 is preferably hinged to the container 7 by a hinge 16 so that when this cover is in closed position it extends across the control compartment 10, as best shown in Fig. 2. A spring clip 17 functions to hold this cover 15 in closed position.

In the preferred embodiment, I prefer to extend the cover 15 forward to carry a lens or bull's-eye 19 retained in an annular channel 20 of the cover

15 by a suitable ring or other clamping means 21 so that when the cover is swung into an open position, as shown in Fig. 1, the lens is carried therewith. It is preferable to form a tight joint between the cover 15 and the container 7 when the cover is in closed position. This may be done by a suitable gasket means, not shown, or the cover 15 may include a forward extending flange which telescopes with the container 7 when the cover is in closed position. Portions of the reflector 12 and the partition 8 are cut away to form an opening 22 through which the lamp supporting structure may extend.

Carried by the cover 15 is a shelf 24, the operating mechanism being secured either to this shelf or to the cover 15 so that when the cover is opened this mechanism is completely exposed for inspection, repair, replacement, etc. If desired, the entire cover and its associated mechanism can be replaced by simply removing the pin of the hinge 16. In other instances repairs can be readily made without detaching the cover 15.

Pivoted to the cover 15 as by a pin 28 carried thereby is a sector plate 29 to which is secured a lamp support 30 extending upward through the opening 22, a spring 31 resiliently forcing the sector plate 29 and the lamp support 30 toward its extreme position indicated in Fig. 7. This lamp support 30 is preferably in the form of a pair of arms 32 extending upward on opposite sides of the pin 28 and suitably secured to the sector plate 29 as by a screw 33 or other suitable means. A cross-arm 34 extends across the upper ends of the arms 32 and is bent to form a segment of a circle formed about the axis of the pin 28. Suitably secured to and electrically connected with the cross-arm 34 are a plurality of sockets indicated, for instance, by the numeral 36, Fig. 2, each socket opening toward the reflector 12 when the cover 15 is closed. These sockets are so spaced with respect to each other and with respect to the pivotal axis formed by the pin 28 that the horizontal axis of these sockets will successively intersect the focal point 14 as the sector plate 29 and lamp supports 30 are moved step-by-step in a manner to be hereinafter described. Each socket 36 carries a light source in the form of a light bulb, these bulbs being respectively designated by the numerals 38 to 42, inclusive. Each of these bulbs includes a filament, these filaments being so positioned as to be successively positioned at or near the focal point 14 when the lamp support 30 is moved step-by-step. Only one of the lamps is flashed at a time, this lamp being the one which is positioned closest to the focal point 14 at any instant of time.

A sequence switch is provided for successively energizing these lamps, this switch being indicated in general by the numeral 45 and including in detail a master contact 46 which successively engages lamp contacts 47 to 51, inclusive. These lamp contacts are respectively connected to the live central terminals of each of the sockets 36, being thereby respectively connected to the lamps 38 to 42, as best shown in Fig. 9. These wires are preferably positioned along and secured to the arms 32 so as to impede the reflected light to a minimum degree.

The master contact 46 is preferably mounted in a base 53 formed of insulating material. This base also carries spring contacts 54 and 55 which are normally in contact with each other, the later spring contact carrying an extension which is engageable by the sector plate 29 to separate these spring contacts when this sector plate is in its extreme position shown in Fig. 7. The spring contacts 54 and 55 thus define a limit switch, indicated in general by the numeral 56, which opens when the sector plate is in an extreme position.

In the prefered embodiment, however, I prefer to pivotally mount the lamp support as shown so that the lamp contacts 47 to 51 move relative to the master contact 46. In accomplishing this movement in a step-by-step manner I provide an advancing means indicated in general by the numeral 60 and including an escapement 61 operated by an operating means 62 in the form of a relay providing a winding 63. This winding surrounds a central post of a magnet frame 65, there being an armature 66 pivoted at one end of the frame. A tension spring 67 tends to move the armature 66 upward, but when the winding 63 is energized, this armature is drawn downward so as to bridge across the relay frame, this downward position being shown in Fig. 6.

The escapement 61 is of novel construction, as best shown in Figs. 1 and 8. Referring to these figures, a base plate 68 is secured to the armature 66 and provides an upward extending wall 69. The forward end of the plate 68 slopes upward and is then bent downward, as best shown in Fig. 1, to provide a main stop 70 which is engageable with one of a plurality of pins 71 when the armature is in its raised position, as shown in Fig. 1. These stops are suitably secured to the sector plate 29 and correspond in number to the lamps utilized. They are spaced from each other an angular distance equal to the angular spacing of the lamps so that when any of the pins 71 are in engagement with the main stop 70, one of the lamps will be positioned at the focal point 14. The upward extending wall 69 is positioned in front of the pins 71, but the forward end of this wall is bent inward towards the pins to define an auxiliary stop 73, best shown in Fig. 8, this stop being above the path of travel of the pins 71 when the armature is in raised position.

In the operation of this escapement it will be clear that one of the pins 71 will be in engagement with the main stop 70 when the armature is in raised position. When it is desired to bring a new bulb into the circuit, the winding 63 is energized, thus moving the armature 66 and escapement 61 into the position shown in Fig. 6. This moves the main stop 70 below the pin which it previously engages so that this pin and the associated sector plate 29 move into an intermediate position under the action of the spring 31 to bring the pin into engagement with the auxiliary stop 73, as best shown in Fig. 6. This permits the sector plate 29 and the lamp support 30 to move through an angular distance which is a fraction of the angular distance between lamps. This movement of the sector plate is sufficiently large, however, to bring the next contact 50 beneath the master contact 46 so that the electric impulse delivered to the lighting circuit is transferred to the next lamp associated with this contact 50. When the winding 63 is de-energized the spring 67 moves the escapement 61 into its upper position, thus permitting the next pin 71 to come into engagement with the main stop 70, the previous pin now moving beneath the auxiliary stop 73 due to the raising of this stop. The sector plate 29 and the lamp support 30 will then be moved into its dotted line position indicated by the numeral 75 of Fig. 1. In actual operation the winding 63 is energized only momentarily and the time interval required to shift from one pin 71 to another is preferably less than the time in-

terval between successive energizations of the lamps.

Each time the winding 63 is momentarily energized the mechanism will move to bring a new lamp into the focal point. When the last lamp comes into the focal point, the mechanism will assume a position as shown in Fig. 7, the limit switch 56 being opened at this time, and the last pin 71 being in engagement with the main stop 70. As will be hereinafter described, the engagement between this last pin and the main stop 70 closes an auxiliary circuit, permitting current to flow continuously through the last bulb 38.

A suitable control means is provided for momentarily energizing the winding 63 when one of the lamps burns out. Included in this control means is a control relay 77 including an armature 78 preferably pivoted to a relay frame 79. The relay 77 includes two windings so that energization of either winding will attract the armature 78. If desired, this relay may be of a floating type, these windings being simultaneously energized at successive instants of time so as to maintain the armature in neutral position. Energization of either winding alone, will, however, upset the balance and cause the armature 78 to close a circuit supplying current to the winding 63. In the preferred embodiment, however, I prefer to bias the armature 78 by a spring 80, and to so position the windings that energization of either winding will attract the armature 78. So also, the forward end of this armature carries a movable contact which is normally held in engagement with a stationary contact 82 by the spring 80, these contacts providing a control switch 83. In this form the two windings are indicated respectively in Fig. 9 by the numerals 84 and 85. One of these windings is connected in series with the lamp circuit and the other is connected to a holding circuit so that when these windings are alternately energized the armature 78 will always be retained in its lower position, thus separating the contacts thereof. If, however, the lamps should burn out, the system will become magnetically unbalanced and the spring will move the armature to close the contact, thus actuating the operating means 62. The magnetic flux generated by either of the windings 84 or 85 may be large enough to attract the armature 78. However, this is not always necessary, for the function of the auxiliary winding 85 connected to the holding circuit is merely to hold the armature down, once it has been moved downward by the magnetic flux set up by the winding 84. A smaller amount of flux is needed to hold the armature down than is required to move this armature into a downward position. Thus, the flux set up by the winding 85 need not be sufficiently great to actually move the armature 78.

An impulse means in the form of an intermittently operated main switch means 86 is used for periodically connecting a potential supply source to the remainder of the circuit, thereby flashing the lamp which is positioned at the focal point. This main switch means is of novel construction regardless of the particular mode in which it is connected to the remaining elements of the circuit, and also finds utility in other combinations.

As best shown in Fig. 1, this switch means includes upper and lower plates 87 and 88 spaced apart by spacing members 89 to form a frame structure suitably secured to the shelf 24 of the cover 15. This frame structure carries upper and lower jeweled bearings 90 in which a shaft 91 is pivoted. This shaft carries an oscillating member 93 which includes a bar-shaped armature 94 and a disc 95. A hair-spring 97 is secured to the pivot shaft 91, the outer end being held in a support 98 secured to the lower plate 88. This hair-spring tends to turn the oscillating member in a direction indicated by the arrow 100 of Fig. 4, this tendency toward counter-clockwise rotation being overcome by a resilient contact means 101 to be hereinafter described. In Figs. 3 and 4 the oscillating member is shown in its neutral position which it assumes when the system is de-energized.

The oscillating member 93 is caused to oscillate by electric impulses momentarily delivered to an actuating means 105 which is preferably in the form of a pair of electromagnets 106. As best shown in Fig. 3, the cores of these electromagnets 106 are spaced from each other on a line which is angularly disposed with respect to the axis of the armature 94. Momentary energization of the pair of windings 106, or either of them, will thus tend to set up a momentary torque tending to rotate the armature 94 in a clockwise direction, as indicated by the numeral 108 of Fig. 3. The system is so designed that only a momentary impulse is delivered to the actuating means 105, this impulse being timed to swing the oscillating member 93 through successively larger angular paths until an equilibrium condition is reached, at which time the energy supplied to the actuating means 105 is just sufficient to overcome the frictional forces. The system thus requires only a minute amount of energy. In addition, the switch means 86 is self-starting, a very important feature of the present design. It will, of course, be understood that the period of oscillation of the member 93 can be controlled by changing the weight of this member. Thus, if slower oscillation is desired, it is only necessary to add weight members to the oscillating member 93.

The intermittent energization of the actuating means 105, and the intermittent supply of current to the lamp circuits, are controlled by the contact means 101. In the preferred embodiment, this contact means, best shown in Figs. 4 and 5, includes a set of main contacts 110 and a set of auxiliary contacts 111, though the latter may sometimes be dispensed with, as will be hereinafter described. The set of main contacts includes a stationary contact 112 and a movable contact 113, the former being suitably secured to the lower plate 88 of the frame as by a bracket 114. The movable contact 113 is of much smaller size than the stationary contact 112 in the preferred embodiment. This movable contact is carried on an arm 115 preferably of resilient construction and extends to the left of the pivot shaft 91 as viewed in Fig. 4. The rear end of this arm 115 is attached to the oscillating member 93 by means of a bracket 116 extending downwardly from the disc 95.

The auxiliary set of contacts 111 is preferably formed by a stationary contact 120 and a movable contact 121, the former being considerably larger than the latter and being secured to the lower plate 88 of the frame as by a bracket 122. The movable contact 121 is carried on an arm 123 which is preferably of resilient construction and which extends on the opposite side of the pivot shaft 91 from the arm 115. The end of this resilient arm 123 is carried by the oscillating mem-

ber 93 through the medium of a bracket 125 extending downward from the disc 95.

The spring arms 115 and 123 are, among other things, utilized in absorbing the recoil energy of the oscillating member 93. Thus, a counter-clockwise movement of the oscillating member, as indicated by the arrow 100 of Fig. 4, will cause the brackets 116 and 125 to be shifted toward or into the position shown in Fig. 5. Due to the fact that the arm 115 is secured to the oscillating member at a point which is disaligned from a line connecting the stationary and movable contacts 112 and 113 when these contacts are slightly separated, the distance between the bracket 116 and the stationary contact 112 will decrease during this counter-clockwise movement of the oscillating member. In view of the fact that the arm 115 is of constant length, this recoil movement of the oscillating member will cause the movable contact 113 to move outward along the stationary contact 112 toward or into its position shown in Fig. 5, thus effecting a very desirable wiping action which keeps these contacts clean at all times. It will also be noted that during this recoil movement of the oscillating member the spring arm 115 is flexed toward or into its position shown in Fig. 5. This flexing serves to momentarily store some of the recoil energy of the oscillating member, returning this energy thereto at a later instant of time when the oscillating member starts to turn in a forward direction. In addition, this flexing action is very desirable in that the forward end of the arm 115 which carries the contact 113 is always parallel to the contact face of the stationary contact 112. This insures surface-to-surface contact between the movable and stationary contacts 112 and 113 as distinguished from a line contact which would take place if this forward end of the arm 115 were not maintained substantially parallel to the contact surface of the contact 112. A stop 126 extends upward from the lower plate 88 in the path of travel of the bracket 116, and engages this bracket to prevent any excessive recoil movement such as might move the movable contact 113 off the stationary contact 112. Similarly, the movable contact 121 of the auxiliary set of contacts 111 will move outward across the stationary contact 120 with substantially the same wiping action.

I have further found that a very minute pitting inevitably occurs upon either the moving or the stationary contacts of the sets 110 and 111, corresponding points or domes being formed on the other contact. I have further found that by reversing the connections of the potential source, this pitting and building up can be made to shift from one contact to the other. In the preferred embodiment I prefer to so connect the source that any pitting which takes place will occur on the moving contacts 113 and 121, while the points or domes are formed on the stationary contacts 112 and 120. Thus, as these movable contacts slide outward on either of the respective stationary contacts, there will be no tendency to gouge the outer portions of these stationary contacts due to points formed on the movable contact. Further, pitting and point formation take place only during the breaking of the circuit so that points or domes are formed on the stationary contacts only at those portions which are first engaged by the movable contacts. As these movable contacts slide outward, they leave this zone and slide onto an entirely flat surface, thus removing all possibility of any material voltage drop due to current passing through points formed on the contact surfaces. The pitting takes place on the contact connected to the positive terminal of the source, while the points are formed on the contact connected to the negative terminal. Thus I prefer to connect the source as shown in Fig. 9.

As best shown in Fig. 4, when the oscillating member 93 is in a neutral position I prefer to have the main set of contacts 110 closed. At this time the auxiliary set of contacts 111 may be either open or closed, the system being so designed that the auxiliary set of contacts 111 closes just before, just after, or simultaneously with the main set of contacts 110. In the preferred embodiment the auxiliary contacts 111 close an instant after the main set of contacts 110, assuming that the oscillating member is moving counter-clockwise as indicated by the arrow 100 on its recoil movement. In this form of the invention the auxiliary set of contacts 111 will be slightly open when the oscillating member is in neutral position, as shown in Fig. 4.

Any forward movement of the oscillating member 93 will cause the bracket 116 to engage the arm 123 and the bracket 125 to engage the arm 115, thus respectively moving the contacts 121 and 113 from the vicinity of the stationary contacts 120 and 112. During this forward movement in a direction indicated by the arrow 130 of Fig. 4, the arms 115 and 123 will maintain their relative positions shown in Fig. 4. If desired, this forward movement may be limited by engagement between the stop 126 and the bracket 125.

The preferred method of electrically connecting the elements hereinbefore described is disclosed in Fig. 9 in which the numeral 135 indicates the potential source in the form of a series of dry cells or suitable storage battery. A conductor 136 connects the positive terminal of the source 135 to the winding 84, the other terminal of this winding being connected by a conductor 137 to the master contact 46 of the sequence switch 45. The current then flows through the corresponding conductor to the corresponding lamp and returns to the cross-arm 34 which is grounded as indicated by the numeral 139. This lamp circuit is completed from ground through the contact means 101, returning to the negative terminal of the battery through a conductor 140 connected to the stationary contact 114. Two paths of current-flow through this contact means 101 are provided. One path includes the hair-spring 97 which is grounded as indicated by the numeral 141 so that the current may flow from ground through this hair-spring to the pivot shaft 91 and thence to the disc 95, reaching the contact arm 115 through the bracket 116, and thus being carried through the main set of contacts 112 to the conductor 140. On the other hand, if the auxiliary set of contacts 111 is closed, this current may flow from ground through a conductor 142 connected to the stationary contact 120 and thence through the arm 123, the bracket 125, the disc 95, the bracket 116, the arm 115, the stationary set of contacts 112 to the conductor 140. In either instance it will be clear that the lamp circuit is only energized when the main set of contacts 112 is closed, these contacts being closed during the recoil movement of the oscillating member 93.

So also, it will be clear that energy is delivered to the actuating means 105 including the pair of electromagnets 106 only during the time that

the main set of contacts 112 is closed. The current in this instance flows from the positive side of the battery 135 through the conductor 136, and through a conductor means 145 including the limit switch 56, thence through the electromagnets 106 in series and to ground, the current returning through the contact means 101 by either of the paths previously mentioned.

I have found that the hair-spring 97 must necessarily be small so that if the current required by the lamps and the actuating means 105 were continuously passed through this hair-spring, there would be danger of this spring overheating to such a degree that the temper would be impaired. To prevent any possibility of such action, the auxiliary set of contacts 111 is utilized, it being clear from Fig. 9 that this set of contacts is in parallel with the hair-spring 97. Thus, in the form shown, the lamp current passes through the hair-spring 97 only for a very short instant of time until the auxiliary set of contacts 111 closes, after which the current is bypassed through these auxiliary contacts and is not required to pass through the hair-spring 97. In this connection it will be clear that the oscillating member 93 is not at ground potential due to the fact that it rotates in jeweled bearings.

In other instances, however, it is possible to dispense with the auxiliary set of contacts 111 by forming the hair-spring 97 of sufficient size to carry this current or by utilizing smaller lamps. In other instances it is possible to have the auxiliary set of contacts 111 closed before the main set of contacts 112 closes. In this way it is possible to entirely eliminate any current-flow through the hair-spring 97, though the system will not then be self-starting.

It will be clear that the winding 84 of the control means is thus intermittently energized, the current flowing through the lamp circuit also flowing through the winding 84 which is connected in series therewith. The magnetic flux set up by this winding is sufficient to draw the armature 78 downward, thus opening the contact switches 83. During the time that the lamp circuit and the winding 84 are not energized, it is necessary to pass a current through the winding 85 sufficient to maintain the contact switch 83 open. In the preferred embodiment the windings 84 and 85 are successively energized to accomplish this result. In effecting energization of the winding 85 current may flow through the conductor 136, the conductor means 145, and the limit switch 56, thence through the actuating means 105. The current may then return to the negative terminal of the source through a conductor 150 connected to the armature 78 and to one terminal of the winding 85, the other terminal of this winding being connected by a conductor 151 to the source and also being connected by a conductor 152 to the last pin 71 for a purpose to be hereinafter described. The amount of current flowing through the conductor 150, the winding 85, and the conductor 151 is very minute so that the winding 85 ordinarily includes a large number of turns so that the requisite flux can be set up. It will be noted, however, that the contact means 101 is connected in short-circuiting relation with the circuit including the conductor 150, the winding 85, and the conductor 151. Thus current flows through the winding 85 only during the time that the main set of contacts 112 is open, for when this set of contacts closes, substantially no current flows through the winding 85 due to the fact that the resistance of the path through the main set of contacts 112 is much lower than the resistance of the path including the winding 85. In this way the windings 84 and 85 are successively energized. The magnetic action set up by either of these windings does not, however, become zero immediately upon the de-energization thereof. Instead, there is a slight overlapping in the magnetic action as set up respectively by the windings 84 and 85 so that the contact switch 83 is maintained open so long as these windings are successively energized.

However, any action which tends to prevent this successive energization of the windings 84 and 85 will cause an unbalanced condition allowing the contact switch 83 to close. Thus, if the particular lamp electrically connected in the lamp circuit by the selector switch 45 burns out, the current through the winding 84 will drop and the spring 80 will close the contact switch 83. A circuit will then be completed through the conductor 136, the conductor means 145, the limit switch 56, the current reaching the winding 63 of the advancing means through a conductor 155. This current returns through a conductor 166 connected to the contact switch 83 and flows to the negative terminal of the battery through the conductor 150 and through the contact means 101, as previously described. The closing of the main set of contacts 112 during the time that the control switch 83 is closed will thus draw the armature 66 and its associated escapement 61 into the position shown in Fig. 6. This will instantaneously shift the sector plate 29 into its position shown in Fig. 6, thus connecting a new lamp in circuit with the source. The current flowing through this new lamp will also flow through the winding 84 and thus again open the control switch 83, the current through this new lamp being broken when the main set of contacts 112 separates. It will thus be clear that in the system herein shown there will be no dark period during the time that the mechanism is shifting from one lamp to another. Instead, the flashes will continue at the usual time-interval as determined by the period of oscillation of the oscillating member 93.

Should successive lamps burn out, the sector plate 29 and the lamp support 30 will be moved step-by-step until thrown into the position shown in Fig. 7, at which time the last lamp is adjacent the focal point 14. At this time the limit switch 56 opens, thus de-energizing the actuating means 105 including the pair of windings 106 so that the oscillating member will coast to a standstill.

A new circuit is completed at the instant that the last pin 71 comes into contact with the main stop 70 of the escapement, these elements forming a supplemental switch means. At this time current may flow from the source 135 through the conductor 136, the winding 84, the conductor 137, the master contact 46 of the selector switch, and the lamp contact 47, this current then returning through an auxiliary circuit by flowing through the lamp 38 and through the ground 139 to the armature 66 which is grounded as indicated by the numeral 160, the current flowing through the stop 70, the pin 71, the conductors 152 and 151 to the negative terminal of the source 135. Thus, a continuous current flows through the last lamp 38 and through the auxiliary circuit connected in parallel with the switch means 86, indicating to the inspector that all of the lamps have burned out and that replacement is necessary.

In general, then, it will be clear that if the source 135 is connected to the circuit when the contact means 101 is in the position shown, two circuits will be completed. One of these circuits is the lamp circuit, including the winding 84 and one of the lamps, as previously described. Energization of this circuit, of course, opens the control switch 83. A second or actuating circuit is completed through the limit switch 56, the actuating means 105, and the contact means 101. The system is made self-starting by the momentary current passed through the hair-spring 97. This hair-spring thus carries sufficient current for the first small impulse exerted to advance the oscillating member 93. It will be clear, however, that as soon as the set of contacts 112 separates, both the lamp and the actuating circuits are broken.

On the recoil movement of the oscillating member 93, the set of switch contacts 112 will first be closed to establish the lamp and actuating circuits previously mentioned, the current flowing through the hair-spring 97 for a very short interval of time until the recoil movement has closed the set of switch contacts 111, at which time the hair-spring 97 is by-passed so that substantially no current will thereafter flow therethrough during the recoil movement of the oscillating member 93. However, during this recoil movement the lamp circuit will be energized as will also the actuating circuit. The result is that the magnetic force exerted by the actuating means tends to stop this recoil movement and reverse the oscillating member 93, current flowing through the actuating circuit until the set of switch elements 112 is opened. It will also be clear that the hair-spring 97 may conduct current flowing through the lamp and actuating circuits for the short interval of time between the separation of the set of switch elements 111 and 112. As previously mentioned, separation of the set of switch contacts 112 will energize the holding circuit including the winding 85.

It will thus be clear that in the preferred embodiment the windings 84 and 85 are successively energized and that the actuating circuit and the lamp circuit are energized only during the time that the contacts 112 are closed.

The self-starting feature of the invention is an important one, as well as the provision of a dual-winding balanced relay. So also, the feature wherein the oscillating means is moved through successive impulses applied to the actuating means 105 is a novel one and permits operation of the system with a minimum of current-flow. In actual tests one set of dry batteries has been found to operate the structure for a period of eight to ten months or more.

So also, the lamp shifting feature herein illustrated forms an important detail of the present invention.

I claim as my invention:

1. In a flasher, the combination of: a container providing a control compartment and a reflector compartment; a cover hinged to said container for closing both compartments; a lens carried by said cover and positioned to extend in front of said reflector compartment when said cover is closed; a lamp means in said reflector compartment and supported by said cover, a switch means in said control compartment; and means supported by said cover in said control compartment for intermittently closing said switch means to intermittently energize said lamp means.

2. In combination in a flasher system; a plurality of lamps; a lamp circuit; means for successively connecting said lamps in said lamp circuit and including a sequence switch providing a master contact connected to said lamp circuit and a plurality of successively arranged lamp contacts and means respectively connecting each of said lamp contacts to one of said lamps whereby movement resulting in successive contact between said master contact and said lamp contacts brings said lamps successively into said lamp circuit; a drive means for said sequence switch and providing an escapement controlling the movement thereof, movement of said escapement to one extreme position advancing said sequence switch to a given position for contacting another of said lamp contacts, subsequent movement of said escapement to another extreme position causing no movement of said sequence switch sufficient to disengage said master contact and said other of said lamp contacts; operating means for moving said escapement from one extreme position to the other and for returning the same to said one extreme position; control means for actuating said operating means, said control means including a relay means electrically connected to said lamp circuit to be responsive to the current flowing through said master contact and including means operated by said relay means for actuating said operating means; a flasher switch connected to said lamp circuit to intermittently energize the same; and means for preventing operation of said control means during normal periods of deenergization of said lamp circuit by operation of said flasher switch.

3. In combination in a flasher system: a plurality of lamps; a potential source; a relay providing an armature biased to move from a given position and providing main and auxiliary windings each acting when energized to hold said armature in said given position; switch means; actuating means for intermittently closing said switch means and including a winding; circuit means connected to said switch means, said potential source, said windings and one of said lamps for alternately energizing said main and auxiliary windings when said switch means opens and closes, said circuit means including a lamp circuit connecting said main winding and said one of said lamps in series circuit with said switch means and said potential source whereby burning out of said one of said lamp means prevents energization of said main winding in time to hold said armature in said given position whereby said biased armature moves into another position, said circuit means also including a circuit connecting said winding of said actuating means in series with said switch means and said potential source whereby said winding is intermittently energized when said switch means closes; and means responsive to movement of said armature from said given position to said other position for energizing another of said lamps.

4. In combination in a flasher system: a plurality of lamps; a lamp circuit including a potential source; sequence switch means for successively connecting said lamps in said lamp circuit when moved step-by-step; advancing means for moving said sequence switch means step-by-step; a control means including a control switch and a pair of windings for individually operating said control switch, one of said windings being connected in series with said lamp circuit so as to be energized by the current flowing to said sequence switch means; circuit

means connecting said potential source to said advancing means through said control switch; means for intermittently closing said lamp circuit and alternately energizing said windings and including a main switch means in said lamp circuit and electrically connected to the other of said windings and including actuating means for said main switch means, said actuating means providing a winding; and circuit means connecting said winding of said actuating means in circuit with said potential source and said main switch means.

5. In combination in a flasher system: a series of lamps; a lamp circuit including one of said lamps; means for connecting another of said lamps to said lamp circuit upon burn-out of a preceding lamp; a switch means connected in said lamp circuit; means for intermittently closing said switch means; and means for eliminating said switch means from said lamp circuit when the last of said series of lamps is connected to said lamp circuit by said first-named means; and means for continuously energizing said last one of said lamps after said switch means has been eliminated to indicate that the last lamp of said series of lamps is in said lamp circuit.

6. In combination in a flasher system: a plurality of lamps; a lamp circuit including a potential source and one of said lamps; a switch means in said lamp circuit; a sequence switch movable to successively connect said lamp circuit to said lamps through said switch means; electrically energizable actuating means constructed and arranged to periodically close said switch means; advancing means for moving said sequence switch step-by-step; control means including a control switch for energizing said advancing means, means for closing said control switch when said lamp circuit is broken by burn-out of said lamp connected to said lamp circuit, and means preventing the closing of said control switch by the normal periodic flashing of said lamp connected to said lamp circuit; and means including a limit switch operated by movement of said sequence switch to a predetermined position to de-energize said actuating means.

7. In a flasher, the combination of: a container having walls forming a reflector compartment and a control compartment communicating through a restricted opening; a lamp support mounted in said control compartment and having a movable portion extending through said restricted opening and into said reflector compartment; a plurality of lamps mounted on said movable portion within said reflector compartment; advancing means in said control compartment for moving said movable portion step-by-step to successively shift said lamps into an operating position; a lamp circuit including an intermittent switch in said control compartment for intermittently energizing said operating lamp; control means in said control compartment for actuating said advancing means to move said movable portion one step and including means for preventing actuation of said advancing means during normal flashing of said operating lamp; and means for de-energizing said intermittent switch when said movable portion has moved to a predetermined position.

8. In combination in a flasher system: a plurality of lamps; a lamp circuit; sequence switch means in said lamp circuit for successively connecting said lamps in said lamp circuit; an electric operating means controlling said sequence switch means; a control switch for said operating means and electrically connected thereto; a dual winding relay for controlling said control switch, one of the windings of said relay being electrically connected to said lamp circuit; and means including an intermittent switch means connected in said lamp circuit, and means electrically connecting said intermittent switch means to the other of said windings in a manner to alternately supply current to said lamp circuit and to said other of said windings, said relay holding said control switch in a given position until said dual windings become unbalanced by change in current conditions in one winding relative to the other.

9. In combination in a flasher system: a lamp circuit; means for intermittently energizing said lamp circuit including a switch means and means for periodically closing said switch means; a plurality of lamps; sequence means for successively connecting said lamps to said lamp circuit, said means including a sequence switch: quick-acting advancing means for actuating said sequence means when the lamp connected to said lamp circuit burns out to connect a succeeding lamp to said lamp circuit before said switch means is again closed and without interrupting the periodic closings thereof; and means for preventing actuation of said advancing means by the periodic energization and de-energization of said lamp circuit by said switch means.

VAL A. LEACH.