

Jan. 28, 1969

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PHOTOELECTRIC LIGHTING CONTROL DEVICE UTILIZING TRANSLUCENT
FILM WITH REFLECTIVE AREAS

3,424,914

Filed April 20, 1966

Sheet 1 of 2

FIG. 1

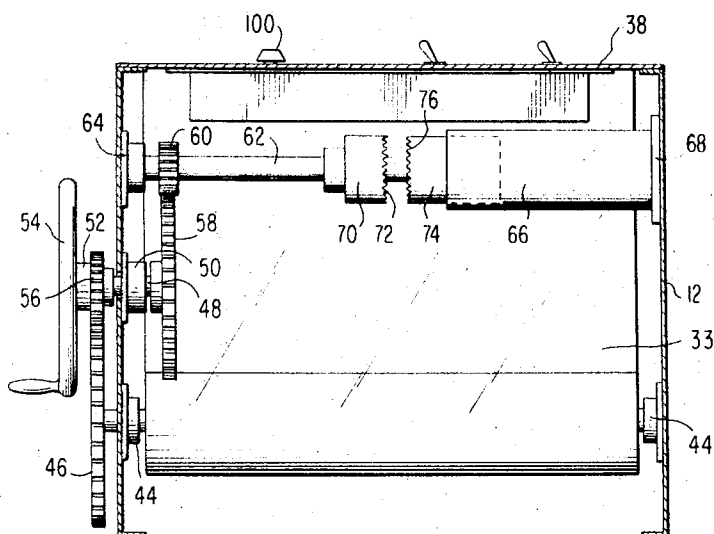
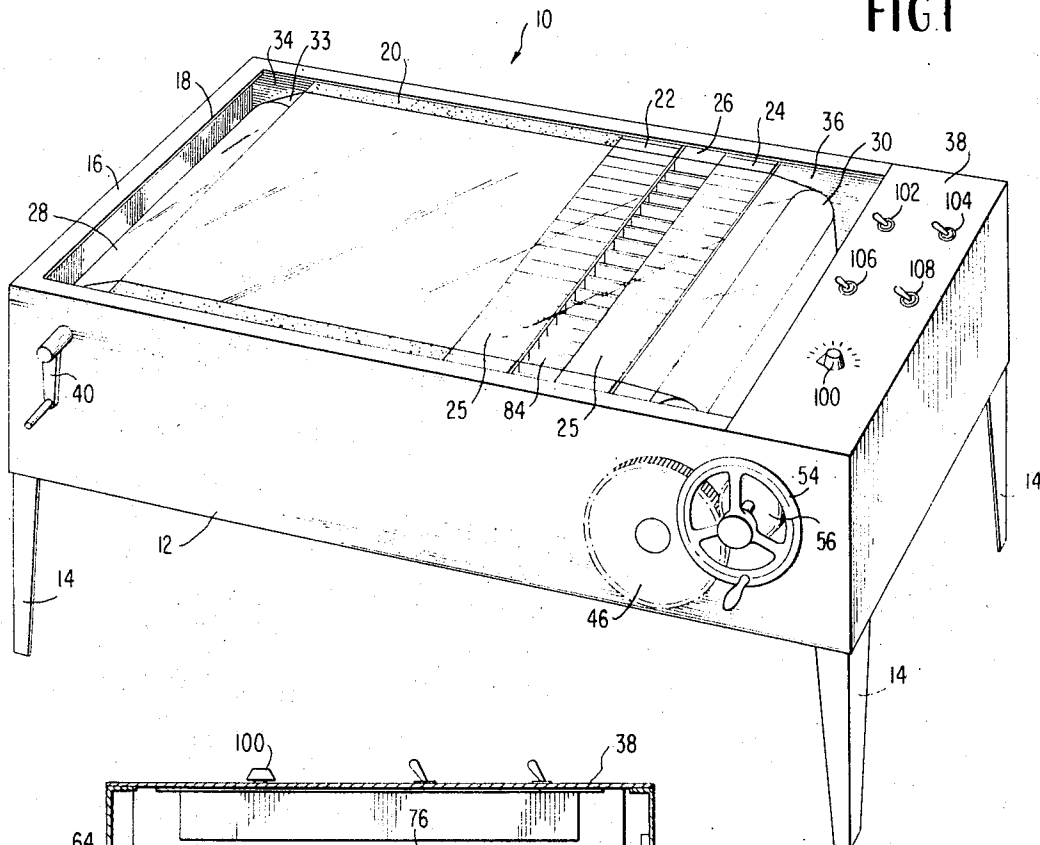


FIG. 2

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Sheet 2 of 2

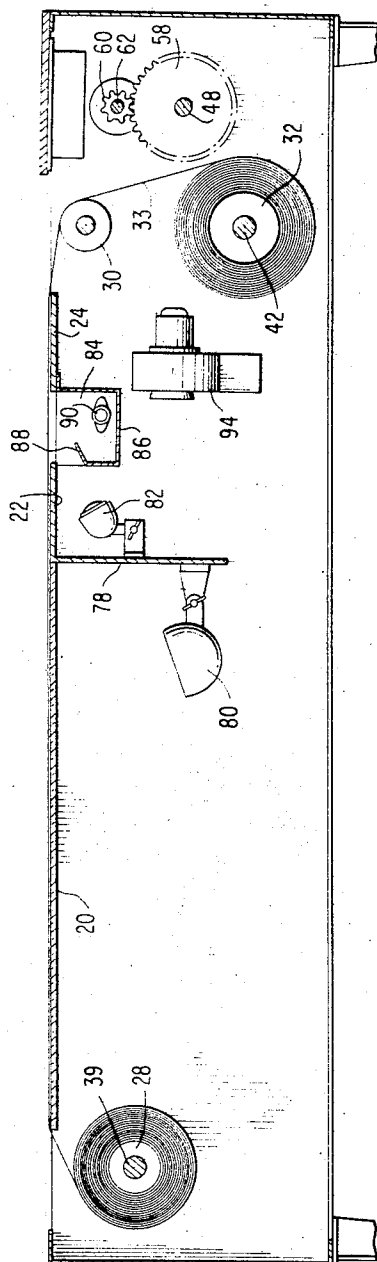


FIG. 3

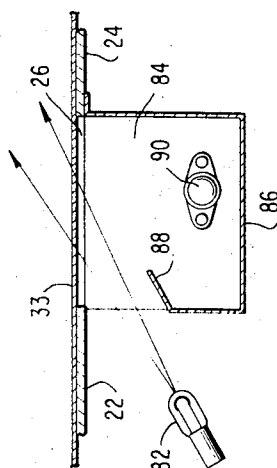


FIG. 4A

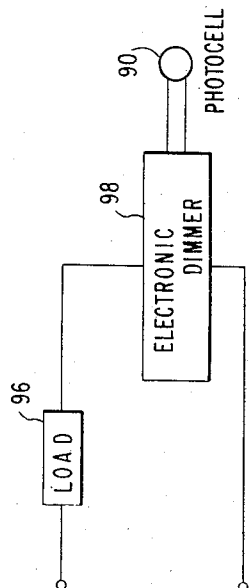


FIG 5

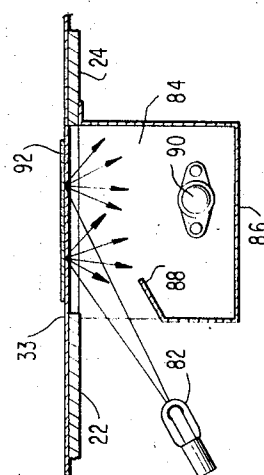


FIG. 4 B

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PHOTOELECTRIC LIGHTING CONTROL DEVICE UTILIZING TRANSLUCENT FILM WITH RE- FLECTIVE AREAS

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8 Claims

Int. Cl. G01n 21/30

The present invention is directed to a compact, low-cost control system for lighting displays of the type usually found in theaters. The control system may also be used to control any electrical device including sound effects, musical instruments, water pumps, electrically operated mechanical devices, latches, valves, motors or the like. The system could be used to control a musical fountain in which the musical tones, water pressure, light colors and intensities would all be controlled by the various control channels of the system. The system is useful in any application where the artist composes with and plays back a composition on a number of electrical circuits. Such a device is capable of being preset in an infinite number of arrangements and the present program may be operated intermittently or continuously at any desired speed.

Lighting control systems for use in theaters or in conjunction with various other displays have in the past been extremely complicated and expensive and only the larger more profitable theaters could afford any type of automatic lighting control system. In recent years, the lighting control systems have become even more sophisticated and expensive as evidenced by the computer-type record and read-out systems which are currently in operation in several theaters throughout the country. The American theater in recent years has experienced an amazing revival of the small drama group, both on the amateur and professional level. Such a revival is welcome and necessary in order to stimulate the cultural growth of the American public. Numerous cities are expending large sums of money on community theater centers or cultural centers which will need a vast pool of talent to draw upon in order to make adequate use of the facilities. To provide the existing large theater groups with a steady supply of talent, the small drama groups must be encouraged and given every opportunity to perform under conditions which approximate those found in the larger theaters. The cost of lighting control systems for these small drama groups is prohibitive and the need for a small, compact, inexpensive lighting control system which will provide automatic lighting control comparable to that found in the larger, more expensive lighting control systems, is evident.

In the past, researchers have rejected the idea of developing analog recording devices to control lighting arrangements because of their lack of sophistication and because of a tendency to keep a less perfect record of exact intensity readings than the digital recording devices. The present invention, which utilizes an analog recording arrangement shows that the disadvantages which may be theoretically inherent to analog devices are not meaningful in practice and in fact certain significant advantages which have not been previously explored readily stand out. The most obvious of these is simplicity.

The lighting control device of the present invention is unique in that it proves to be esthetically useful to the artist as well as practical for the electrician. The controlling information is recorded directly onto an acetate film or the like by an operator using graphic techniques familiar to him as an artist. It is possible to see at a glance the relationship between the markings made upon the tape thereby enabling the mind to interpret and recognize the varying widths or intensities of these markings much

more rapidly than the mind could keep track of digital information. The controlling information may be recorded onto the film simultaneously with the performance of the play by the actors in the case of theater lighting. The lighting design specialist on the stage can quickly determine which lights are too dim or too bright and convey this information to the operator of the lighting control device who then simply adds to or takes away from a reflective material on the film. The electronic circuits react at the same time the markings on the film are changed, thereby allowing the operator to determine instantaneously what he is doing so that he may make immediate adjustments.

The lighting control device of the present invention not only provides a means for recording the controlling information readily onto a film, but also provides a simple versatile and accurate means for indexing the film at the proper times and at the proper speeds to achieve the desired lighting effects. A play is not a precise series of movements, but the timing varies depending upon the particular actors, the particular performance and the particular audience involved. Therefore, a rigidly programmed lighting control system would place an undue burden upon the actors by forcing them to keep up with a lighting control system rather than having the lighting control system follow the movements of the actors. By use of a manual hand wheel with reduction gearing connected in the drive train between the hand wheel and the take-up roll for the film, the film may be advanced at any time by the operator and at any desired speed. Thus, where the tape is programmed to fade a particular light from full on to completely off between two cue stops, the fading may be accomplished rapidly or over a prolonged period of time depending upon the speed at which the operator advances the film. Automatic brake means are also provided to prevent the operator from moving the film past a particular cue stop. This feature enables the operator to devote his full time and attention to the movement of the actors on the stage.

The lighting control device of the present invention also contemplates the use of a variable speed motor for indexing the tape from cue stop to cue stop. The control of the variable speed motor may be accomplished by means of a separate channel on the tape and a separate photocell motor will run either fast or slow to change from one cue stop to another at a desired rate. In such a system, the operator would only have to initiate the operation of the motor when it is desired to advance the tape from one cue stop to the next. The present invention is also capable of controlling any number of lights independently of each other and yet is capable of a controlled proportional fade-out of all of the lights simultaneously irrespective of their setting at the beginning of the fade-out.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings which disclose, by way of example, the principle of the invention and the best mode which has been contemplated of applying that principle.

In the drawings:

FIGURE 1 is a perspective view of the lighting control device of the present invention;

FIGURE 2 is an end elevational view of the device as viewed from the right end in FIGURE 1 with the end panel removed;

FIGURE 3 is a side elevational view of the device as viewed in FIGURE 1 with the side panel, the hand wheels, cranks and gearing removed therefrom;

FIGURE 4a is a partial sectional view showing a photocell arrangement and the path of the control light when the film is unmarked;

FIGURE 4b is a partial sectional view similar to FIG-

URE 4a but showing the path of the light when the film is coated with reflective material; and

FIGURE 5 is a schematic showing of the electrical circuitry associated with each photocell arrangement.

The lighting control device is comprised of a frame having a top surface thereon and having elongated aperture means located in said surface, translucent film means adapted to be rendered light reflective and adapted to be moved across said surface over said aperture means, means for moving said film means, photocell means mounted on said frame adjacent to and beneath said surface at the aperture means, light source means located beneath said surface adjacent said aperture means and adapted to direct light upwardly through said aperture means to said translucent film means, baffle means substantially surrounding said photocell means to shield said photocell means from stray light as light from said source passes through said aperture means to said film means but permitting light from said source to be reflected from said film means when said tape means has been rendered reflective with a reflective material onto said photocell means, lighting means to be controlled, and dimmer means connected to said lighting means and controlled by said photocell means to automatically dim and brighten said lighting means at the desired rate according to the programmed film means.

Turning now to FIGURE 1, the lighting control device designated generally as 10, is comprised of a rectangular cabinet 12 supported above the floor by means of a plurality of legs 14. The top surface 16 of the housing 12 is formed with a rectangular cutout 18 extending over substantially the entire top surface. A relatively large portion of the opening 18 is covered by a rectangular frosted glass plate 20 which is spaced from both ends of the opening 18. Adjacent the glass plate 20 are a pair of opaque tape support plates 22 and 24 which are spaced from each other to define an aperture 26. A plurality of channel defining lines 25 are placed on the surface of the plates.

Journalled in the housing 12 are three roller members 28, 30 and 32. A transparent acetate film 33 is wound upon the supply roll 28 and extends upwardly through an aperture 34 between the end of the cutout opening 18 and the glass plate 20. The tape 32 extends over the surface of the glass plate 20, the opaque plates 22 and 24 and the aperture 26. Another aperture 36 is formed between the opaque plate 24 and the control panel 38. The film 33 passes over the idler roller 30 and is wound up on the take-up roller 32. The shaft 39 of the feed roller 28 is connected to a crank 40 exteriorly of the housing 12. If desired, a one-way coupling may be placed between the crank 40 and the shaft 39 so as to prevent the rotation of the crank 40 when the film is being wound up upon the take-up roller 32. The crank 40 is provided for rewinding the film onto the supply roll 28.

The shaft 42 of the take-up roller 32 is journaled in bearings 44 mounted on the housing 12. The shaft 42 extends through an opening in the housing 12 and has a gear 46 mounted thereon externally of the housing. A shaft 48 is journaled in a bearing 50 mounted on the frame 12 and extends through an aperture in the housing. The outer end of the shaft 48 has a hand wheel 54 mounted thereon. The hand wheel is formed with a hub 52 which as a gear 56 formed thereon which meshes with the gear 46. Inwardly of the housing 12, the shaft 48 has a gear 58 secured thereto which is adapted to mesh with the gear 60 secured to the shaft 62, journaled above end in bearing 64 within the housing 12. The opposite end of the shaft 62 is journaled for rotation within the solenoid housing 66 which is secured to the housing 12 by means of a bracket 68. Secured to the shaft 62 for rotation therewith is a hub member 17 having a plurality of axially directed teeth 72 about the circumference thereof. A second hub member 74 is mounted for axial sliding movement upon the shaft 62 and is also provided with a plurality of axially directed teeth 76 about the circumference thereof which

are adapted to mesh with the teeth 72. The slidable hub 74 is journaled for reciprocating motion within the solenoid housing 66 and is prevented from rotational movement. A solenoid (not shown) is mounted within the housing 66 and the armature thereof is secured to the slidable hub member 74 to shift the teeth 76 into and out of engagement with the teeth 72. A spring member (not shown) may be provided for shifting the slidable hub member 74 in one direction while the solenoid supplies the motor force for shifting the hub in the opposite direction. When the teeth 76 are in mesh with the teeth 72 the shaft 62 will be prevented from rotating and hence the shaft 48 and the hand wheel 54 will be prevented from turning.

Turning now to FIGURE 3, we see a divider panel 78 extending transversely of the housing 12. The panel 78 provides a support for the light sources 80 and 82. The light source 80 is mounted beneath the frosted glass plate 20 and provides a source of illumination for the marked tape member which passes over the upper surface of the glass plate. The light source 82 is shown more or less schematically in FIGURE 3 and may in practice consist of a battery of spotlights mounted along the length of the panel or may be a single elongated bulb such as a fluorescent tube. In either case it is necessary to provide a light source which is fairly even along the entire length of the aperture 26 between the two work support plates 22 and 24.

Secured to and depending from the support plates 22 and 24 are a plurality of vertically disposed parallel baffle members 84. The space between each of the vertical members 84 is provided with a U-shaped housing member 86 which has a portion 88 adjacent the light source being bent inwardly. The members 84 and 86 cooperate to define a plurality of box-like members which are adapted to receive a photocell 90 which may be mounted near the bottom of the box-like member. In the arrangement shown, the photocell is mounted on the vertically disposed baffle plate 84 but depending upon the particular photocell used it might be more convenient to mount the photocell on another wall of the baffle member. However, the photocell should be near the bottom of the box defined by the members 84 and 86 so that the photocell will be unaffected by any stray light or by directly reflected light from the shiny undersurface of the film. The inwardly bent portion 88 prevents light from reflecting downwardly from the upper plate member 22 to the photocell 90.

As seen in FIGURE 4a, when the film passes over the aperture 26 and is free from any markings, the light from the source 82 will pass completely through the translucent film. In actual practice there would be a small amount of light reflected from the shiny surface of the film but such light would be at an angle insufficient to activate the photocell 90. However, when the film 33 is rendered opaque with the reflective coating 92, as seen in FIGURE 4b, the light from the source 82 will be reflected diffusely downwardly to the photocell 90 to activate the photocell. The material 92 may be a white material which may be painted on. An example of one material which might be used is an acrylic polymer latex emulsion which artists commonly use. This material has a good consistency allowing the material to be painted on with ease or wiped off clean. It dries rapidly so that it gives no problem with offsetting as it is rolled. Days after it has dried it can be easily scraped off with a stylus if the cues need to be altered. This particular material never peels, cracks or discolors. Other materials which could be used would be a white adhesive tape which could be cut to the desired size to give the desired area coverage. It is also possible to design the device for markings with colors or perhaps fluorescent paint which would be energized by a black light source.

Also mounted within the housing 12 is a fan member

94 which may or may not be needed depending upon the amount of heat generated by the various light sources.

The circuitry for use in the lighting system is extremely simple and is shown in FIGURE 5. The electronic dimmer 98 may be any of the standard electronic dimmers with the terminals of the photocell connected in the electronic dimmer in lieu of the adjustable resistance therein. The load indicated at 96 could be the spotlight or any other combination of lights up to the capacity of the dimmer. There are presently on the market several inexpensive electronic dimmers which will handle a load up to 600 watts.

The light source 82 which provides the light for energizing the various photocells 90 may be controlled by a master fade switch 100 to enable the lighting means 96 controlled by each of the photocells 90 to be faded simultaneously at the same rate regardless of their present level due to the markings on the film. The control panel 38 is also provided with a plurality of control switches. The switch 102 may be connected to control the worklight 80, the switch 104 may be connected to act as a system switch for controlling the whole operation, a switch 106 may be connected to control the blower or fan 94 and the switch 108 may be connected to control the electric brake member.

In operation, a roll of transparent or translucent film is placed in the housing at the left end as viewed in FIGURE 1. The tape is drawn across the upper surface of the frosted glass plate over the work plates and the aperture, about the idler roller 30 and is fastened to the take-up roller 32. The system control switch 104 is turned to the "on" position and the master fader 100 is set for the maximum intensity for the light source 82. The fan switch 106 and the worklight switch 102 may be turned on if necessary. With no markings on the tape whatsoever all of the light bulbs to be controlled will be completely "off" and if we are dealing with a theater the entire stage would be in darkness. Each light is controlled by a single channel on the tape as indicated by the lines 25 on the support plates 22 and 24. The lines 25 are aligned with the vertically disposed baffle plates 84 so that each photocell 90 controls a single channel or light means. When it is desired to bring a particular light up, the operator merely covers a portion of the tape over a particular photocell box. Depending upon the amount of the area covered by the material 92 or the density of the material, the intensity of the light will be varied accordingly. If the area of the tape over a photocell box is completely covered with the white reflective material the light will be brought up to its full "on" intensity. Likewise, if only half the area over a particular photocell box is covered by the white reflective material the light will operate at 50% intensity. Cue stops may be marked along the edge of the acetate film and the spacing may not be necessarily uniform inasmuch as a long extended sequence of lighting changes may be required during a single movement between stops. On the other hand, the distance between cue stops may be very short if only a quick change such as "on" to "off" is required. The distance from the aperture where the white reflective material is applied to the tape and the take-up roll upon which the tape is wound is sufficiently great so as to enable the material to dry if it is a paint. The various channels cause the lights to fade up or down during movement of one aperture width of the tape. If the film moves an aperture's width for each cue, then all channels will fade proportionately up or down from one set of ratings to the next at each cue. In lighting the stage, all lights may fade rapidly except one or one or more can come up faster or a light can brighten before it dims.

One of the channels between the lines 25 may be utilized to control the solenoid operated brake member. If it is desired to use the brake member for automatically stopping the movement of the film at the proper time, the switch 108 is turned to the "on" position. The circuit to

the solenoid, however, will still remain open and the spring will maintain the brake teeth 72 and 76 separated. When the photocell of the brake control channel is energized due to the presence of white reflective material on the film, a relay will be operated to complete the circuit to the solenoid, thereby shifting the brake teeth 76 into engagement with the teeth 72 to immobilize the handle 54. In this way the operator may devote his full attention to the movements on stage and vary the rotation of the handcrank 54 accordingly and the movement of the film will be automatically braked at the predetermined instant. When it is desired to move the film to the next cue stop, it is only necessary to flip the switch 108 to the "off" position until the film marking has moved past the aperture 26 at which time the switch 108 may be closed again to automatically stop the movement of the film at the next cue stop.

One of the channels may also be painted with the white reflective material in a manner suitable to control a motor which in turn would be connected to drive the take-up roller 32 in lieu of the handcrank 54. By varying the amounts of reflective material the photocell could control the speed of the motor. Whether the take-up roll 32 is motor driven or hand driven, the supply roll could still be actuated by means of the handcrank 40 to rewind the film at the end of a particular performance.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings such as the use of separate pieces of film which could be placed in any desired sequence over the aperture. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A lighting control device comprising a frame having a top surface thereon, aperture means located in said surface, translucent film means adapted to be provided on the upper surface thereof with a reflective material, means for moving said film means over said aperture means, photocell means mounted on said frame adjacent to and beneath said surface at the aperture means, light source means located beneath said surface adjacent said aperture means and adapted to direct light upwardly through said aperture means and said translucent film means, baffle means substantially surrounding said photocell means to shield said photocell means from stray light as light from said source passes through said aperture means and film means but permitting light from said source to be reflected from said film means when said film means has been rendered reflective onto said photocell means, said photocell means adapted to be connected to an electronic dimmer in a lighting circuit to automatically dim and brighten lights in said lighting circuit at the desired rate according to the programmed film means.

2. A lighting control device according to claim 1 wherein said means for moving said tape means comprises a supply roll and a take-up roll journaled in said frame and upon which said tape means is wound, crank means connected to each of said rolls, gear reduction means interposed between said crank means for said supply roll and said take-up roll.

3. A lighting control device according to claim 1 wherein a plurality of photocell means are located along the length of said aperture means to provide the control for each of a plurality of lighting means and dimmer means.

4. A lighting control device according to claim 3 wherein each of said photocell means is mounted on said baffle means, said baffle means comprising a plurality of box-like structures arranged side by side along the length of said aperture means.

5. A lighting control device according to claim 4 wherein each of said box-like structures is provided with an open top adjacent said aperture means and the upper edge of the side of the box adjacent said light source is

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bent inwardly to allow the light from said light source to pass upwardly through said aperture means, said photocell means mounted adjacent the bottom of said box-like structure.

6. A lighting control device according to claim 1 5 further comprising brake means for said moving means and means for controlling said brake means comprising additional photocell means located beneath said film means adjacent said first mentioned photocell means and controllable by markings upon the film to automatically operate said brake means.

7. A lighting control device according to claim 1 further comprising fan means located on said frame beneath the top surface thereof.

8. A lighting control device according to claim 1 15 wherein a portion of said top surface is translucent and

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further comprising additional light source means mounted upon said frame beneath said translucent surface to illuminate said tape means.

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