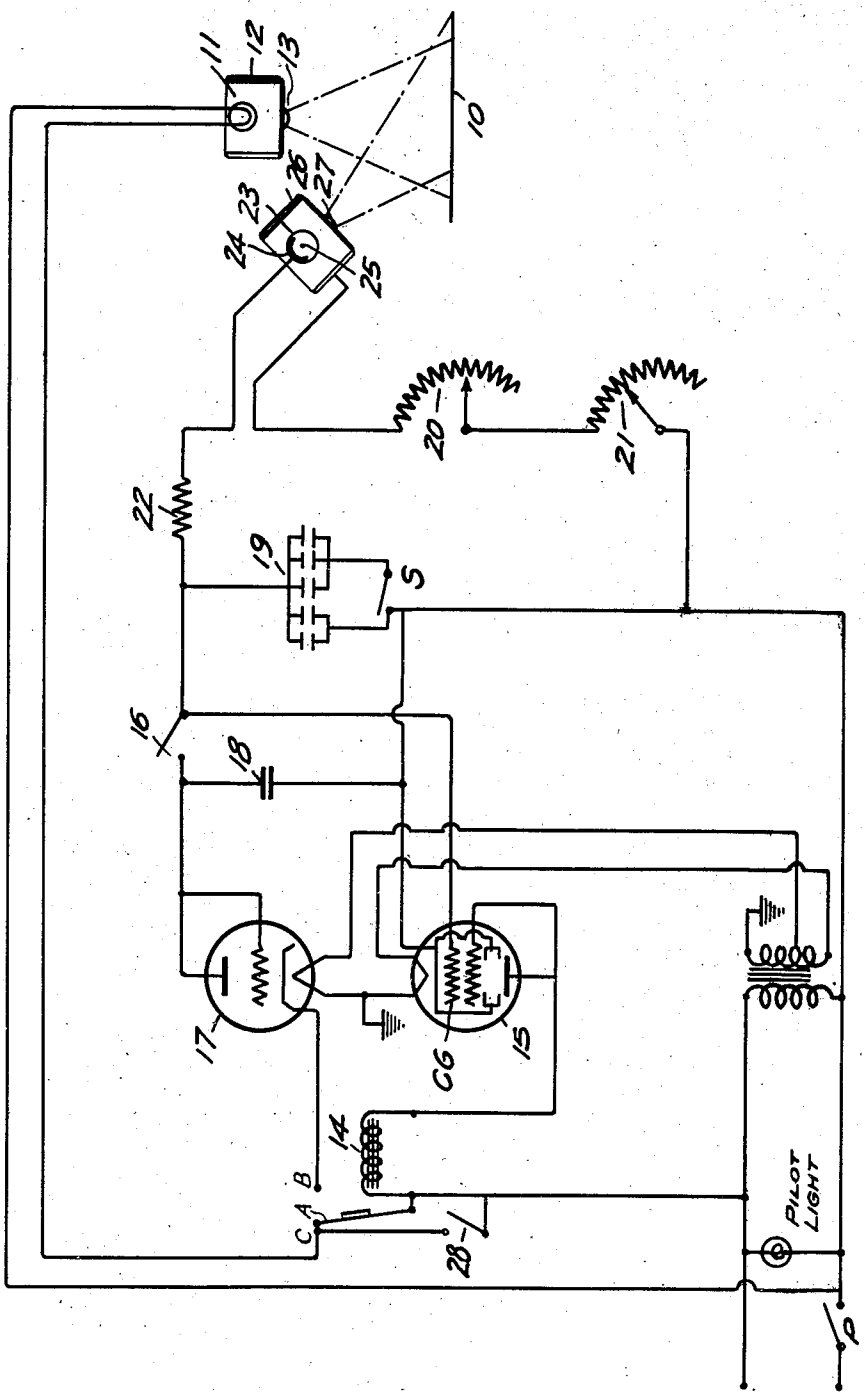
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AUTOMATIC LIGHT CONTROL

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AUTOMATIC LIGHT CONTROL

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment of any royalty thereon.

This invention relates to automatic control devices, and more particularly to devices for the automatic control of a light source.

Although I will describe and illustrate my invention as used in connection with an automatic light control for photographic equipment, it is understood that my control device may be utilized for many other different purposes.

It is an object of my invention to provide a device which will automatically control the length of time that a light source is permitted to illuminate a surface, such control being accomplished by the measurement of the intensity of the light on the illuminated surface.

It is another object of my invention to provide an automatic control device that will be responsive to light reflected from an illuminated surface during exposure to a light source.

It is still another object of my invention to provide an automatic light control means for a photographic projection printer, which will automatically cause the printing light to be cut off at the proper time to secure correct exposure of the printing paper.

The above and other objections and advantages will become readily apparent when the following specification is read in conjunction with the accompanying drawing in which the single figure is a schematic diagram of one embodiment of my invention.

In general, the time control of a light source is accomplished in my invention by causing the light which impinges upon an illuminated surface to control an electronic relay system activated by a photo-electric tube so that when the illuminated surface has received a predetermined quantity of light the illuminating source is automatically extinguished. This control is obtained by a means of a photo-electric tube which receives light from the illuminated surface during exposure to the light source. Light is received from the illuminated surface by means of a lens so placed as to produce an image of the illuminated surface or a proper portion thereof upon the cathode of the photo-tube. Referring to the drawing, it is seen that the numeral 10 refers to a surface which is to be illuminated for a certain predetermined period of time. The surface 10 may be a sheet of sensitized photo printing paper as used in the projection printing process. The surface 10 is to be illuminated by a light source 11 which is inclosed in a housing 12 having a projection lens 13 in the front portion thereof. For control of the light source 11 a relay 14 is connected in the plate circuit of an electron control tube 15 and is activated by the plate current of that tube. The relay 14 is connected such that it closes a power circuit to the light source 11 by closing of armature A and contact C when the plate current of the electron control tube 15 does not flow, and opens the light circuit when plate current of electron tube 15 does flow. Relay 15 is a two-position type which, when de-energized, has its armature A in contact with point C.

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The plate current of the electron tube 15 is controlled by the voltage on the control grid CG of that tube. A second electron tube 17 which is used as a rectifier has its output connected through a switch 16 to the control grid of the electron tube 15. Switch 16 should be of a push button type or equivalent. When the switch 16 is closed, the control grid CG of tube 15 is made strongly negative by the rectified plate current of the tube 17 and the negative charge is stored in a condenser 18. The negative swing of the control grid CG of tube 15 blocks the tube and stops the plate current of that tube causing the relay 14 to become de-energized, thereby closing the circuit for the light source 11.

Closing of the switch 16 simultaneously charges a bank of condensers 19 with the same negative charge impressed on the control grid CG of the tube 15. The closing of switch 16 also results in the opening of the rectifier cathode circuit at AB and the closing of the light circuit through the contact of relay armature A with C, thus preventing the continual charging of condensers 18 and 19. The number of condensers utilized in the condenser bank 19 is controlled by a switch S. If desired, a single capacitor may be substituted for the condenser bank 19. This charge on the condenser bank 19 holds the control grid CG of tube 15 negative until the charge in the condenser bank 19 has leaked off. Time control is obtained by the time required for the negative charge to leak from the condenser bank 19 through a series of resistances shunted across the condenser bank 19. The resistance mentioned may comprise a pair of variable resistors 20 and 21, as well as a fixed resistor 22. Also included in the series resistance is a photo tube 23 having a cathode 24 and an anode 25. The photo-electric tube 23 is inclosed in a light-tight housing 26 having a lens 27 inserted in the front portion thereof. Thus when leakage from the condenser bank 19 is sufficient for the control grid CG of the tube 15 to

swing positive, plate current again flows in tube 15 which energizes the relay 14 opening contacts B and C and, breaking the circuit to the light source 11.

Since the resistance of the photo-electric tube 23 is an inverse function of the light falling on its cathode 24 from the illuminated surface 10, a greater intensity of light on the surface 10 will lessen the resistance of the photo tube 23. The less the resistance caused by the photo tube 23, the faster the charge leaks from the condenser bank 19 and the total exposure of surface 10 by the light source 11 is thereby lessened. With a lesser intensity of illumination on the surface 10, the resistance of the photo tube 23 is greater, with the result that the charge on the condenser bank 19 leaks off more slowly and the relay 14 holds the illuminating source circuit closed a greater length of time.

Application of this operation of time control of a light source to the control of photographic exposure in a projection printer is obvious. With a denser negative the photo tube will receive less light from the surface of the paper during printing and the light will be kept lit longer. With a thinner negative, exposure will be correspondingly and automatically shortened. Adjustment of this time function of the photo cell to the printing speed of the particular paper being used, the intensity and color of the light source, developer factor and other variables is effected by adjustment of the variable resistors 20 and 21 in series with the photo tube and by varying the capacity of condenser bank 19 by the switch S. A switch 28 allows the controlled light to be turned on independently of the relay circuit. This is a convenience as for example in focusing the projection printer.

As stated before, the photo-electric tube 23 is inclosed in a light-tight housing 26, having a convex lens 27 in an opening in the front of the housing. The lens 27 is focused on the cathode 24 of the photo-electric tube. The entire photo-electric unit is so positioned as to receive light from the illuminated surface 10 to image a convenient area of that surface onto the cathode 24 of the photo tube. Since the lens 27 serves only to concentrate the light from the illuminated surface 10 onto the cathode 24, sharpness of image is immaterial. Optical correction of the lens is not necessary and lens 27 may be of a simple uncorrected form and of large aperture. To secure linearity of action, the photo tube 23 may be of the vacuum type and when used with a projection printer, such as illustrated here it should have a cathode sensitivity corresponding to the spectral sensitivity of the photographic material used.

A complete cycle of operation of the device is as follows. The power switch P closes the filament circuit of the tubes 15 and 17. As soon as these tubes warm up plate current flows in tube 15 energizing the relay 14 which breaks the controlled light circuit and closes the cathode circuit of tube 17 thereby letting it rectify the line current and charge the condenser 18. On closing the switch 16 the rectified voltage from tube 17 and the charge on condenser 18 swing the control grid CG of tube 15 strongly negative, stopping the plate current flow in tube 15, which stoppage de-energizes the relay 14. The deactivation of the relay 14 closes contacts A and B and the circuit of the light source 11. In the example illustrated this will start the exposure of the printing paper in the projection printer. When relay 14 is de-energized it also opens contacts A and B thus stopping the condenser-charging action of rectifier 17. Such stoppage prevents the duration of closure of the switch 16 from affecting the timing cycle since the charge impressed on the condenser bank 19 is always the same, initially and its discharge will be governed by resistances 20, 21, 22 and phototube 25.

As the plate current of tube 15 remains cut off, the controlled light circuit remains closed and the cathode circuit of tube 17 remains open until the charge on the condenser bank 19 leaks off through resistors 20, 21, 22 and the photo tube. When the charge on the condenser bank 19 has leaked off, the control grid of tube 15 goes positive again and plate current in tube 15 flows thus energizing the relay 14. Closing of relay 14 breaks the controlled light circuit and restores the unit to the initial stage ready for another operating cycle.

In the modification illustrated in the drawing the electric light for a projection printer is to be controlled.

The photo tube unit should be fixed in a position above the printing paper so that it will clear the projection lens 13 and the optical path of that lens to the printing paper so that the lens 27 will image a convenient area of the printing paper being exposed upon the cathode 24 of the photo tube.

The photo tube unit may be held in position by a fixed bracket and when once focused may be held in that position for all uses thereafter.

While I have described my automatic light control in use with a projection printer, it is obvious that my invention may be utilized in many other instances where an automatic light control may be desirable. The illustration given is to be considered explanatory and not limitative. Many changes and modifications may be made in my invention without departing from the scope thereof as set forth in the appended claim.

I claim:

An automatic light control having in combination a light source illuminating an object, a power line for said light source, and a control means for energizing and deenergizing said light source, said control means comprising a photo-electric device responsive to the degree of illumination of said object, a vacuum control tube having at least an anode, a cathode and a grid, a rectifier having a cathode terminal and an anode terminal, a relay in the anode circuit of said control tube, said relay including an armature, a normally-open contact in its pickup circuit and a normally-closed contact in circuit with said light source, means connecting said armature to one side of said power line, means connecting said normally-closed contact to one terminal of said light source, means connecting said other terminal of said light source to the other side of said power line, means connecting said normally-open contact of said relay to said cathode terminal of said rectifier; a first condenser connected between the anode terminal of said rectifier and said other side of the power line; a second condenser connected between said grid and cathode of the control tube, a connection between said other side of the power line and the cathode of the control tube; a push-button switch connected between the grid of the control tube and said anode terminal of said rectifier; and means connecting said photoelectric device across said second condenser; whereby upon application of power-line voltage, said control tube will con-

duct, causing the relay to operate opening the light circuit and through the action of the rectifier charge said first condenser setting up the circuit for operation, and upon depressing said switch the said second condenser charges, blocking the control tube thereby deenergizing said relay and energizing said light source, illuminating said object, the photoelectric device discharging said second condenser thereby unlocking said control tube after a predetermined time, and deenergizing said light source.

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