

Aug. 26, 1930.

H. C. SINGLETON
SYSTEM OF ILLUMINATION

1,774,457

Filed March 18, 1927

Fig. 1.

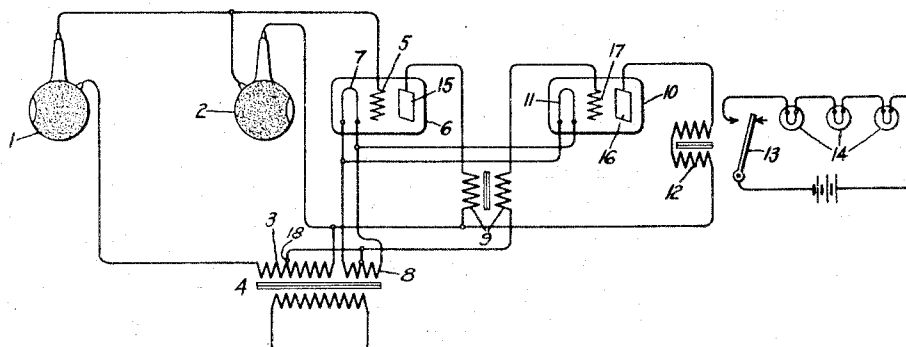


Fig. 2.

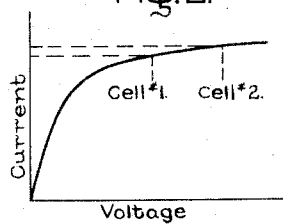
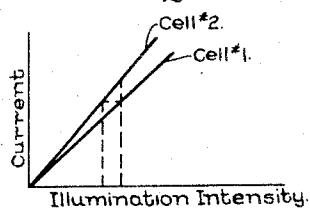


Fig. 3.



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UNITED STATES PATENT OFFICE

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SYSTEM OF ILLUMINATION

Application filed March 18, 1927. Serial No. 176,563.

The present invention relates to a system of illumination, and more particularly to an arrangement for illuminating sign-boards located along public highways.

It is one of the objects of my invention to provide a system of illumination in which the lamps for illuminating a sign shall be energized only when the sign is no longer visible by daylight and only when a vehicle displaying light approaches or passes the sign.

It is a further object of my invention to provide a circuit arrangement employing an alternating current source of supply for controlling the output of a pair of reversely connected photoelectric cells.

In carrying the invention into effect, a lamp or series of lamps are placed adjacent the sign-board. The energization of these lamps is controlled by means of a pair of light sensitive cells, one of which is placed adjacent the highway and pointed in a direction so as to be affected by the headlights of oncoming vehicles. The latter cell may be placed at any convenient point with respect to the sign-board. The second light sensitive cell is employed to balance the effect of daylight on the first cell and thereby prevent the energization of the lamps during daylight hours. It may be placed in any suitable position where it will be subjected to the action of daylight, but unaffected by the lights of passing vehicles. By the use of two light sensitive cells in this manner the sign-board is illuminated only after dark and only when automobiles or other vehicles provided with illumination and traveling in one direction pass or approach the cell which is adjacent the highway.

The novel features which are characteristic of my invention are pointed out with particularity in the appended claims. My invention itself, however, will best be understood from reference to the following specification taken in connection with the accompanying drawing in which Fig. 1 shows diagrammatically a circuit organization employing a source of alternating current whereby my invention may be carried into effect, while Figs. 2 and 3 show respectively characteristic curves of the photoelectric cells,

and curves showing the relation between the intensity of illumination and current in the two cells.

Referring more particularly to the drawing, I have indicated at 1 and 2 a pair of vacuum type photoelectric cells connected to the secondary winding 3 of a transformer 4, and reversely connected to the grid or control element 5 of an electron discharge device or tube 6. The cathode 7 of tube 6 is supplied with current through a secondary winding 8 of transformer 4, the mid-point of winding 8 being connected to a tap 18 at one side of the central point of winding 3.

The output circuit of tube 6 includes the primary winding of a transformer 9, the secondary winding of which is connected to the control electrode or grid of an amplifier tube 10. The cathode 11 of amplifier 10 is connected in parallel with the cathode 7, while the output circuit of the amplifier includes a time delay relay 12 adapted to actuate a switch 13 and close a circuit for a series of lamps 14 arranged adjacent a sign-board, not shown. Cells 1 and 2 are both subjected to the action of daylight. Cell 1, however, is alone affected by the lights of passing vehicles, cell 2 being positioned so as to be unaffected by such lights.

It will be evident that the photo-electric cells 1 and 2 together with the coil 3 constitute an electrical bridge, the path between the grid 5 and the filament 7 being effectively connected to opposite points thereof. When current is induced in coil 3 such that the right-hand end is positive, this current will pass through the photo-electric cells 1 and 2 in series. However, the voltage drop V_1 between the negative end of the coil and the tap 18 transmits a negative charge to the grid 5, while the voltage drop V_2 between the tap 18 and the right-hand or positive end of the coil produces a positive charge on the grid. Inasmuch as the filament 7 is not connected to the mid-point of coil 3 but to the left thereof, the voltage V_2 preponderates over the voltage V_1 hence giving to the grid a net positive charge so that when the cells are activated during daylight a pulsating current will flow in the output circuit of tube 6 and

through the primary winding of the transformer 9. The cells 1 and 2 thus carry equal amounts of circulatory current which traverses the entire coil 3 due to their series relation but pass unequal amounts of charging current flowing to the grid 5 due to the unsymmetrical position of the tap 18 in the grid circuit. Both photoelectric cells are operated on the flat portions of their characteristic curve as indicated in Fig. 2, and as a result fairly wide fluctuations in the voltages applied to the cells produce very little change in the current through the cells.

With the connections shown, a positive potential will be simultaneously applied to the anode or plate members 15 and 16 of tubes 6 and 10, respectively. When current flows in the output circuit of tube 6, however, the secondary of transformer 9 is so connected that a negative potential is supplied to the grid 17 of tube 10. If grid 5 is positive, as during daylight, full anode current flows through the primary winding of transformer 9. The maximum negative potential is, therefore, simultaneously applied to the grid or control element 17 of tube 10, and as a result current does not flow through relay 12, and lamps 14 are not illuminated. After daylight, the photoelectric cell 1 is alone subjected to the action of light from passing vehicles. Cell 2 remains dark and, therefore, offers a very high resistance to the passage of current. When light is directed onto cell 1, at this time, electrons flow from the cathode to the anode member of the light sensitive cell and to grid 5, thereby tending to produce a negative charge on the grid. The pulsating current which now flows in the output circuit of tube 6, together with the negative potential which is applied to grid 17 of tube 10, are greatly reduced in value. As a result, current flows in the output circuit of tube 10, and switch 13 is actuated, thereby closing a circuit for the lamps 14.

In the operation of the circuit described, it will be noted that during one half of the alternating cycle, when the anodes of tubes 6 and 10 are positive with respect to their associated filaments, the photoelectric cells 1 and 2 will have the proper polarities applied to their electrodes. During the succeeding half cycle of the alternating current wave, the anodes of tubes 6 and 10 are both negative, and the tubes do not conduct any current. The grids of tubes 6 and 10 are, therefore, biased properly during the half wave when the anodes 15 and 16 are positive, and it is, of course, immaterial what potential is applied to the grid elements of the tubes during the succeeding or negative half of the alternating current wave, since at this latter time the tubes 6 and 10 are both non-conducting.

The relay 12 included in the output circuit of the amplifier 10 is so designed that the circuit for lamps 14 remains closed for a definite

time interval after light from a passing vehicle has been directed onto the light sensitive cell 1, or until the vehicle has had time to pass the sign-board.

What I claim as new, and desire to secure by Letters Patent of the United States, is:

1. A system of illumination comprising an electric lamp and an electron discharge device having input and output circuits, means responsive to the flow of current in the output circuit for controlling a circuit for said lamp, a pair of light sensitive cells connected in said input circuit, and means whereby one of said cells operates to prevent the flow of current through the output circuit when substantially equal amounts of light are directed onto both cells, said electron discharge device and light sensitive cells being energized by alternating current.

2. A system of illumination comprising a lamp, a circuit therefor, means controlling said circuit, said means including a light sensitive cell and means for balancing the effect of said cell, an electron discharge device comprising an anode, cathode and control electrode, a connection from said cell to the control electrode, and means whereby an alternating potential may be simultaneously supplied to said cell and balancing means and to the cathode and anode of said discharge device, the potentials applied to said cell and balancing means being unequal.

3. A system of illumination comprising a lamp, a circuit therefor, means controlling said circuit, said means including a circuit comprising a pair of reversely connected light sensitive cells, an electric discharge device including an anode, cathode and control electrode, a connection from said second-mentioned circuit to said control electrode, a second electron discharge device comprising an anode, cathode and control electrode, means in the output circuit of said first-mentioned discharge device for controlling the potential of the control electrode of said second device, means in the output circuit of the second electron discharge device for controlling the first-mentioned circuit, and means whereby an alternating potential may be simultaneously applied to said first-mentioned circuit and to said electron discharge devices.

4. In combination, a circuit including a light sensitive cell and balancing means therefor, an electron discharge device comprising an anode, cathode and control electrode, a connection from said cell to said control electrode, a source of alternating current, connections from said source to said cathode, anode and circuit, said connections including means whereby unequal potentials may be applied to said cell and balancing means.

5. In combination, a circuit including a pair of reversely connected light sensitive

cells, an electron discharge device comprising an anode, cathode and control electrode, a connection between said cells and the control electrode of said discharge device, a source of alternating current and connections from said source to said anode, cathode and light sensitive cells, said connections including means whereby unequal electromotive forces may be applied to said light sensitive cells.

6. In combination, a pair of reversely connected light sensitive cells, means whereby light may be directed onto said cells, a pair of electron discharge devices each comprising a cathode, anode and control electrode, a connection from said light sensitive cells to the control electrode of one of said devices whereby variations in the current through the cells may produce corresponding variations in the potential of said control electrode, means in the output circuit of said one device for controlling the potential of the control electrode of the other discharge device, a source of alternating current and connections from said source to the light sensitive cells and to the cathodes and anodes of the discharge devices.

7. In combination, a pair of light sensitive cells energized by a source of alternating current and containing a cathode and an anode, means whereby light may be directed onto said cells, a plurality of electron discharge devices each having a cathode, anode and control electrode, the anodes of said devices being so connected to the source of alternating current that they simultaneously have the same polarity, a connection from the anode of one cell and from the cathode of the other cell to the control electrode of one of said discharge devices, and means in the output circuit of said one discharge device for controlling the potential applied to the control electrode of the second discharge device.

8. In combination, a pair of light sensitive cells, each containing a cathode and an anode, a winding adapted to be energized from an alternating current source for supplying the cells with energy, a plurality of electron discharge devices each having a cathode, anode and control electrode, a connection from one end of said winding to each of the anodes of said devices, a connection from the cathode of one cell and from the anode of the other cell to the control electrode of one of said devices, and a connection from said winding to each of the cathodes of the electron discharge devices and to the control electrode of said other discharge device.

In witness whereof, I have hereunto set my hand this 16th day of March, 1927.

HAROLD C. SINGLETON.