

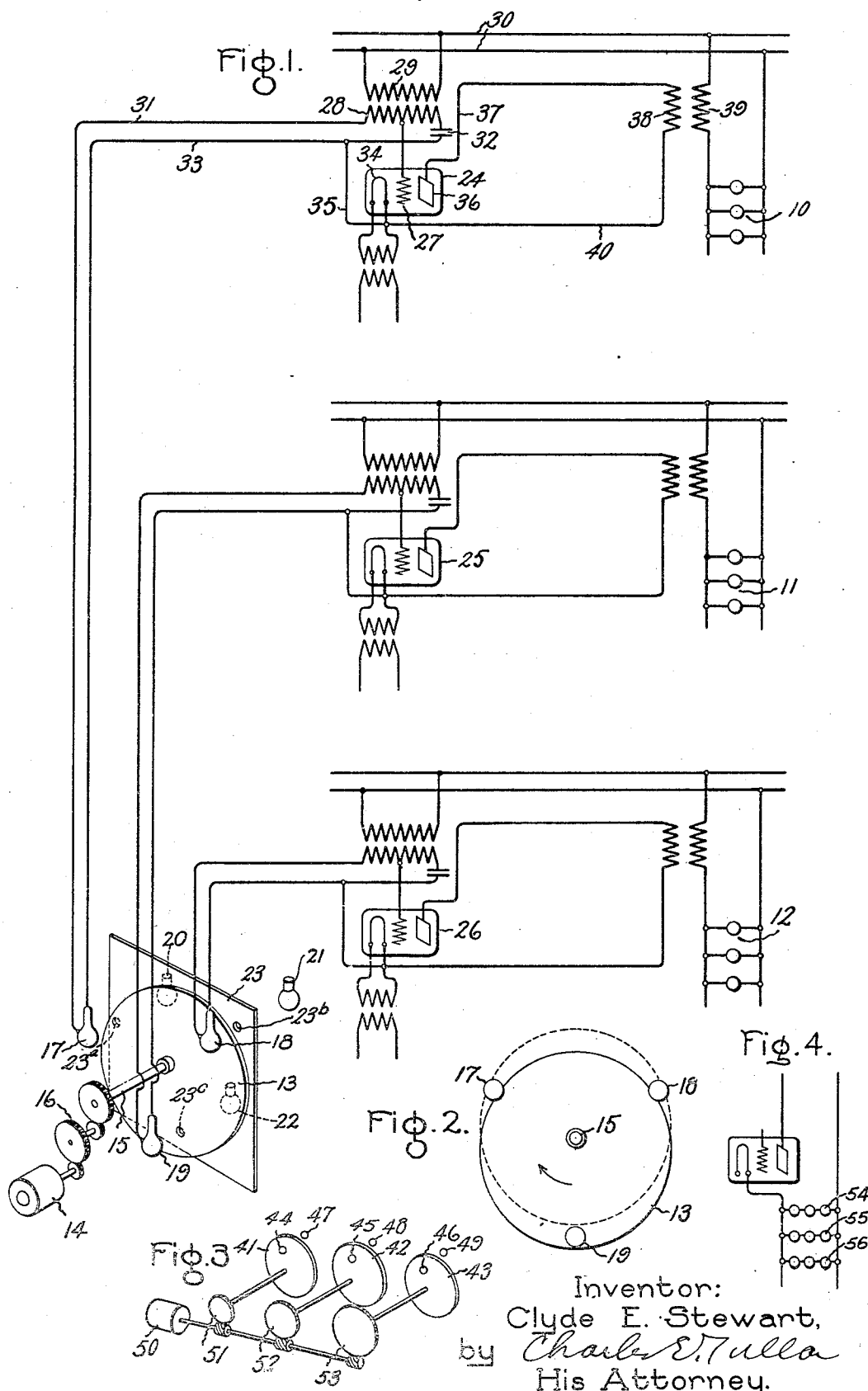
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CIRCUIT CONTROL MEANS

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CIRCUIT CONTROL MEANS

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My invention relates to control means for electrical circuits, more particularly to means for opening, closing and gradually varying the intensity of energization of electric circuits, and has for its object the provision of simple and reliable means of this character wherein a minimum of contact switching devices are employed.

Although my invention obviously has other applications, it is especially useful in the controlling of electric lights, which may be arranged in groups or banks, especially in the selective control of colored lights so as to obtain varied color combinations and, furthermore, in the control of the intensity of illumination of the lights to obtain a gradual blending of colors for desired lighting effects. An object of my invention is the simplification of such systems, particularly in the control of the relative degrees of illumination of the various colored groups.

In carrying out my invention in one form I provide light sensitive devices for controlling the individual circuits together with shielding means for gradually varying the degree of illumination of the light sensitive devices so as to control the intensity of energization of the various circuits. My invention also comprehends the utilization of electric discharge devices and reactor control devices.

For a more complete understanding of my invention reference should be had to the accompanying drawing in which Fig. 1 is a diagrammatical illustration of a light control system embodying my invention; Fig. 2 is a diagrammatical view showing details of construction; Fig. 3 is a diagrammatic illustration of a modified form of my invention; while Fig. 4 is a fragmentary view showing a modified form of connection for the load circuit.

Referring to the drawing, I have shown my invention in one form in connection with a system for selectively controlling the circuits of a plurality of groups of incandescent lamps so as to turn the lights on and off and give desired blending effects between the colors of the groups. Such a system has particular application in the artistic illumination of show windows and the like. As shown, the groups of lights 10, 11 and 12, preferably of different colors such as red, green and blue, are selectively controlled in a predetermined sequence by means of a movable shield shown as on disc 13. The shield is driven at a substantially constant speed by means of an electric motor 14 connected to its shaft 15 by suitable reducing gearing 16. It is shaped in contour to vary by predetermined degrees the in-

tensity of illumination falling on three suitable light sensitive devices such as selenium cells as shown, photoelectric cells 17, 18 and 19, which control respectively the lamp groups 10, 11 and 12. As shown, the three photoelectric cells are mounted in equally spaced relation, i. e., at 120° angles, about the shaft 15 of the shield. The photoelectric cells are also spaced equal distances from the shaft 15, on one side of the shield and at such distances from the shaft 15 that the shield gradually varies and interrupts, when it is rotated, the supply of light to the photoelectric cells from their respective light sources 20, 21 and 22. These sources of light, shown as incandescent lamps, are mounted just opposite their respective photoelectric cells on the opposite side of the shield and substantially the same distance from the shaft 15 as the photoelectric cells.

For the purpose of defining beams of light passing from the light sources to the photoelectric cells, suitable barriers or blinds are preferably provided and, as shown, a rectangular barrier 23 is mounted adjacent the shield 13 between it and the sources of light 20, 21 and 22. This barrier is, of course, stationary. It is provided with apertures 23^a, 23^b, and 23^c, which are directly between the respective photoelectric cells and their sources of light. With this arrangement, a clearly defined beam of light is passed by each aperture, which beam is controlled by the shield 13. The barrier 23 may also serve as a supporting bracket for the photoelectric cells and the lamps.

A typical shape or contour outline of the shield 13 whereby a predetermined sequence control of the groups of lights may be obtained, is indicated in Fig. 2. As shown in this figure the shield consists of a disc which is eccentrically mounted on the shaft 15. It will be observed that in the position of the disc indicated the photoelectric cell 19 is completely shielded from its light source on the opposite side of the shield whereas the photoelectric cells 17 and 18 receive equal but partially reduced illumination. It will further be observed that rotation of the disc, for example in a clockwise direction, as indicated by the arrow, gradually dims the photoelectric cell 17 over a predetermined interval and finally shuts it off, the cell 18 being at the same time increased to full illumination and the cell 19 remaining dark. Continued rotation of the disc gradually illuminates the cell 19, and gradually darkens cell 18 until after 180° rotation to the position shown in dotted lines the cell 19 is fully illuminated and the cells 17 and 18 are completely darkened. As the rotation is continued the cell 17 is first gradually illuminated and

then the cell 18 while the cell 19 is darkened as the revolution is completed. For example, assuming that the disc is rotated at such speed as to make a complete revolution in thirty seconds, the various main light changes will be made at five second intervals, that is, at each 60 degrees rotation of the disc. Thus assuming that red and blue lights are controlled respectively by the cells 17 and 18 and that green lights are controlled by the cell 19, the red and blue lights will be of equal but reduced intensity with the disc in the position shown giving a purple light, the green lamps being out. Five seconds later the blue lamps are at maximum intensity with red and green out. After ten seconds, the blue and green lamps are of equal but reduced brilliancy the red lamps being out; at fifteen seconds, the green lamps are at maximum intensity with the red and blue out, the shield then being in the dotted position indicated in Fig. 2. After twenty seconds, the green and red are of equal but reduced intensity, the blue being out; while after twenty-five seconds, the red lamps are at maximum brilliancy, the blue and green being out. It will thus be seen that with this arrangement three pure colors with a wide variety of intermediate colors and shades are produced.

It will be observed that the six main light changes or light change periods occur in such sequence with each group of lights that each group is dark for three successive change periods and of reduced, maximum and reduced brilliancy successively in the order mentioned during the remaining three periods.

In the arrangement shown the photoelectric cells control the groups of lights through the agency of electric discharge devices or Thyratrons 24, 25 and 26. Although any suitable electric discharge devices may be used, I preferably employ three-element vapor electric discharge devices or Thyratrons which are characterized by a large power output controlled by a small amount of grid energy. As well known in the art, the sealed envelope of this device contains a small quantity of an inert gas, such as mercury vapor, whereby the device becomes an arc rectifier. Its arc formation between the anode and cathode is controlled by a grid. It will be understood that at certain critical values of grid voltage when the anode is positive, the arc will start and will continue thereafter independently of the grid voltage as long as the anode is positive. Furthermore, as long as the grid voltage is more negative than the critical voltage value at which the arc starts, the arc is prevented from starting and no current will flow.

Since the connections between the photoelectric cells and the three discharge devices 24, 25 and 26 are substantially identical, these connections will be described with reference only to one discharge device, i. e., the discharge device 24. As shown the photoelectric cells are connected in the input circuits of the discharge devices in such a manner that a variation of the resistance of the photoelectric cell effects a shift in phase of the grid voltage of the discharge device to control the discharge device, substantially as described and claimed in a Patent 1,832,707 to Albert W. Hull, dated November 17, 1931. The grid 27 is connected to a midpoint of the secondary winding 28 of a transformer, the primary winding 29 of which is connected to an alternating current supply source 30. One terminal of the winding 28 is connected through a conductor 31 to the photoelectric cell 17, preferably to the cathode thereof,

while the opposite terminal of the winding 28 is connected through a condenser 32 by way of a conductor 33 to the cathode of the photoelectric cell. The cathode 34 of the discharge device is connected through a conductor 35 to a point on the conductor 33 between the condenser 32 and the photoelectric cell, while the plate or anode 36 is connected through a conductor 37 to one side of a winding 38 of a transformer having its cooperating winding 39 in series with the group of lamps 10. The output circuit of the discharge device is completed from the opposite side of the winding 38 through the conductor 40 to the cathode 34.

The group of lights 10 is connected to the supply source 30 in series with the transformer winding 39, whereby a voltage is impressed on the winding 39 and a voltage thereby induced in the winding 38, which is associated with the winding 39 on the same magnetic core. In dependence upon the degree of short circuit of the winding 38 through the electric discharge device, which thus serves as a variable resistance, this transformer serves as a reactor and it will be understood that by varying the saturation of its magnetic core by varying the current through the winding 38, the voltage drop across the winding 39 can be controlled, and consequently, the degree of illumination of the lights 10. For example, when the discharge device passes a relatively large current in response to the voltage induced in the winding 38, the core of the transformer is saturated and consequently there is only a relatively small voltage drop across the winding 39 so that the lights burn brilliantly. As the saturation of the core is decreased by a decrease in the current in the winding 38, the voltage drop across the winding 39 increases and hence the lights are dimmed.

With this connection between the photoelectric cell 17 and the discharge device 24, the photoelectric cell when darkened introduces a very high resistance in its circuit whereby the grid voltage of the device 24 is caused to lag substantially 180° behind the anode voltage and, consequently, no arc is formed. The lights 10 thus have a minimum voltage and this produces darkness. However, as the light is gradually applied to the photoelectric cell, the resistance of the cell decreases gradually and as a result the grid voltage of the discharge device 24 is gradually shifted in phase so as to decrease its lag with respect to the anode voltage, and consequently an arc will be formed in the discharge device 24 and continue throughout gradually increasing portions of the positive half of the alternating current wave whereby current pulsations of gradually increasing duration are passed by the discharge device. This gradually saturates the transformer and as a consequence gradually increases the brilliancy of the lights until finally, when the transformer is completely saturated, the lights burn at full brilliancy. The reverse of this action takes place when the illumination of the photoelectric cell is gradually decreased, the lights then being gradually changed from the bright to the darkened condition.

As previously indicated, the connections for the discharge devices 25 and 26 and their operation, is substantially the same as described in connection with the discharge device 24.

In the modified form of my invention indicated in Fig. 3, I have shown a system for the conglomerate mixing of the lights from various groups. In other words, the lights in the various

groups are selectively controlled but not in any predetermined sequence. As indicated, a plurality of discs or shields 41, 42 and 43 are provided, one for each group of lights to be controlled.

5 These discs have respectively associated with them the photoelectric cells 44, 45 and 46 and on their opposite sides the sources of light 47, 48 and 49, suitable barriers (not shown) being preferably provided to define the beams of light
10 in the manner indicated with reference to the barrier 23 in Fig. 1. The three discs are driven from a substantially constant speed motor 50 through worm gearings 51, 52 and 53 having different ratios. Thus the worm gear 51 has the
15 lowest ratio and hence give the highest driving speed for the disc 41 whereas the gears 52 and 53 have respectively higher ratios and hence give lower driving speeds for the discs 42 and 43 in the order mentioned. With this arrangement
20 it will be observed that the sequence of the control for the various photoelectric cells gradually varies due to the different driving ratios. It will be understood that the various photoelectric cells are suitably connected to control individual
25 groups of lights as indicated in Fig. 1.

As indicated in Fig. 4, I have found that satisfactory operation may also be obtained by using relatively low voltage lamps connected in series in the anode circuit of the discharge device. As
30 shown three groups 54, 55 and 56, each group containing three low voltage lamps in series, are connected in parallel directly in the anode circuit. Obviously, the number of lamps in series in each group will depend upon the voltage of each lamp
35 and the voltage of the supply source. Although the lamps receive only half wave current with this connection, no flicker was observed in a 60 cycle source.

While I have shown a particular embodiment
40 of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit
45 and scope of my invention.

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

1. In a system for controlling a plurality of lights, a plurality of separate circuits for said
50 lights, intensity control means associated with each of said circuits for varying the intensities of illumination of said lights, a plurality of light sensitive devices connected respectively to said intensity control means to control said circuits to
55 vary the intensity of illumination of said lights in accordance with the intensities of illumination of said light sensitive devices, means for supplying light to said light sensitive devices, an eccentrically mounted disc mounted for rotation between
60 said light supplying means and said light sensitive devices, and means for continuously rotating said disc, said light sensitive devices being mounted in spaced relation around the axis of rotation of said disc in such manner that the intensities of illumination of said lights are varied
65 in sequence during each revolution of said disc so that each light is out during substantially a half revolution, then gradually increased to full brilliancy and darkened during the remaining
70 half revolution.

2. In a system for controlling a plurality of

lights, a plurality of separate circuits for said lights, intensity control means associated with each of said circuits for varying the intensities of illumination of said lights, a plurality of light sensitive devices connected respectively to said
80 intensity control means to control said circuits to vary the intensity of illumination of said lights in accordance with the intensities of illumination of said light sensitive devices, means for supplying light to said devices, an eccentrically
85 mounted disc mounted for rotation between said light supplying means and said light sensitive devices, and means for continuously rotating said disc, said light sensitive devices being mounted in equally spaced relation around
90 the axis of rotation of said disc in such manner that the intensities of illumination of said lights are varied in sequence over at least six main light change periods during each revolution of said disc so that each light is dark during three
95 successive periods and of reduced, maximum and reduced brilliancy successively during the remaining three periods.

3. In a system for controlling a plurality of groups of lights, a plurality of separate circuits
100 for said groups of lights, intensity control means associated with each of said circuits for varying the intensities of illumination of said groups of lights, a disc mounted for rotation in its own plane about a predetermined axis, a plurality of light sensitive devices mounted on one side of
105 said disc in spaced relation with respect to each other and predetermined distances from the axis of rotation of said disc, electrical connections between said light sensitive devices and said intensity control means respectively whereby each of
110 said light sensitive devices controls the intensity of illumination of its light circuit in accordance with the degree of illumination of said light sensitive device, means on the side of said
115 disc opposite said light sensitive devices for supplying light to said light sensitive devices, said disc having a predetermined contour so arranged that when said disc is rotated the supply of light to said light sensitive devices is
120 gradually varied in a predetermined sequence, and means for continuously rotating said disc.

4. A system for controlling a plurality of lights comprising a plurality of circuits for said lights, a plurality of light sensitive control devices, one
125 for each circuit, intensity control means associated with each of said circuits for varying the intensity of illumination of said lights, electrical connections between said light sensitive devices and said intensity control means respectively
130 whereby each of said light sensitive devices controls the intensity of illumination of its light circuit in accordance with the degree of illumination of said light sensitive devices, means for supplying light to said light sensitive devices, a
135 plurality of discs mounted for rotation respectively between said light sensitive devices and said light supplying means for controlling the supply of light to said devices, each of said discs having a predetermined contour arranged to gradually
140 vary the supply of light to its respective light sensitive device as the disc is rotated whereby the brilliancy of the light controlled thereby is varied, and means for driving said discs at different speeds.

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