

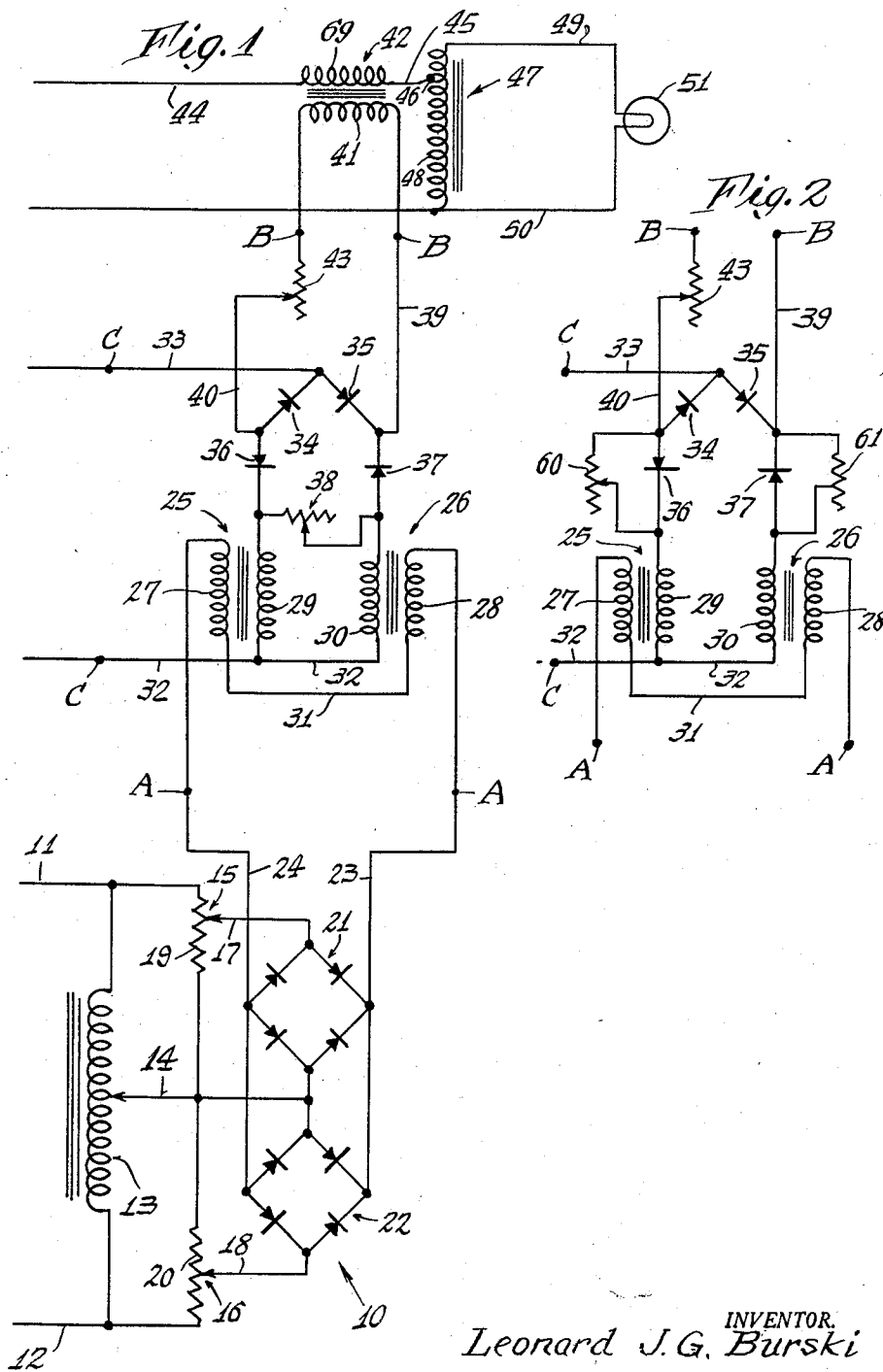
May 5, 1959

L. J. G. BURSKI
LIGHTING CONTROL

2,885,598

Filed Aug. 1, 1956

2 Sheets-Sheet 1



INVENTOR,
Leonard J. G. Burski
BY
Johnson and Kline
ATTORNEYS

May 5, 1959

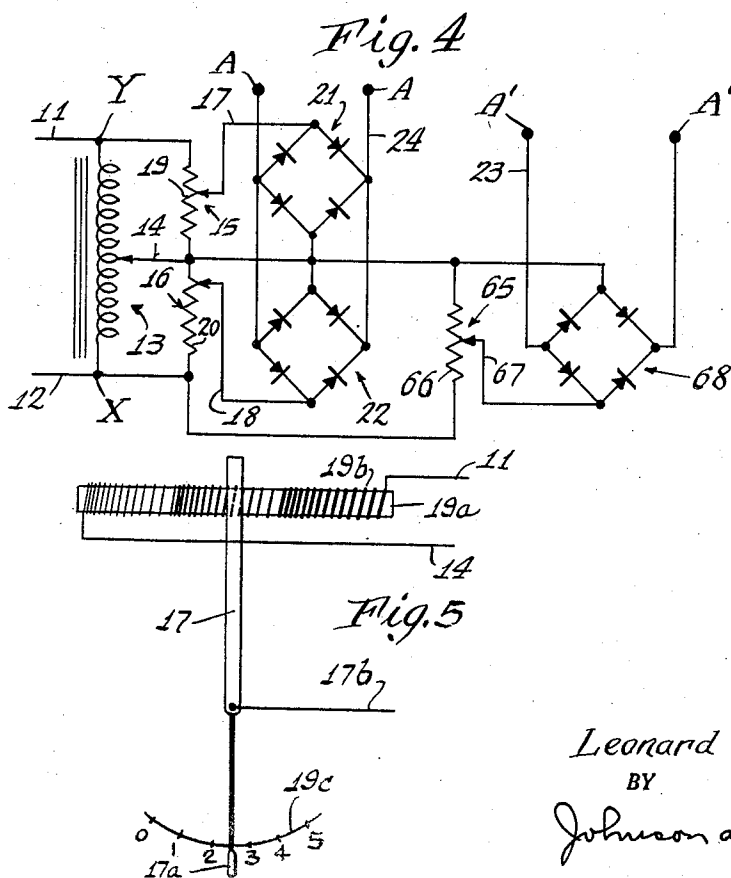
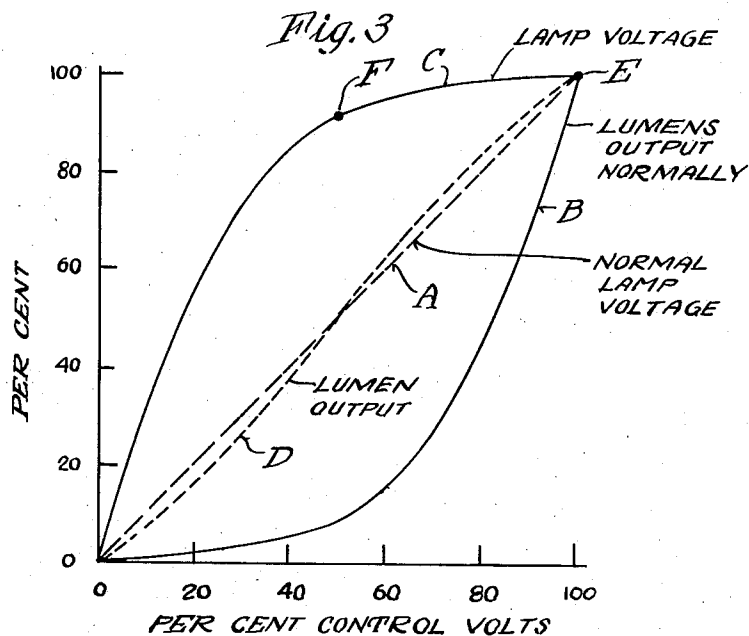
L. J. G. BURSKI

2,885,598

LIGHTING CONTROL

Filed Aug. 1, 1956

2 Sheets-Sheet 2



INVENTOR.
Leonard J. G. Burski
BY
Johnson and Kline
ATTORNEYS

1

2,885,598

LIGHTING CONTROL

Leonard J. G. Burski, Bristol, Conn., assignor to The Superior Electric Co., Bristol, Conn., a corporation of Connecticut

Application August 1, 1956, Serial No. 601,507

5 Claims. (Cl. 315—320)

The present invention relates to a lighting control for a lamp load in which the intensity or output of the lamp load may be varied.

The present application is an improvement of my co-pending application, Serial No. 586,953, filed May 24, 1956.

In said prior application there is disclosed a control system for a lamp load which is usable in the lighting of theatres and other places of entertainment. There is provided at least two manually settable controls, each determining the degree of illumination desired for each scene, and an autotransformer for shifting the control of the lamp load from one control to the other. The settable controls are generally referred to as presets and the autotransformer as a fader since it enables the fading of the lamp load from one preset value to another. The circuit is such that the voltage across the lamp load during the transition from one preset to the other varies on a substantially straight line from the value of one preset to that of the other. In addition the voltage across the lamp load is varied by each preset control along a substantially linear curve. This provides a desirable relationship between the preset control elements, the fader and the lamp voltage, as the brilliancy as sensed by the human eye is substantially proportional to the voltage across the lamps. However, it has been found that the voltage across the lamp load is not linearly related to the luminous energy or lumen output of the lamps as determined, for example, by a light meter. This is particularly disadvantageous when one preset is utilized to control a lamp load having one color light, while the second preset is utilized to control a lamp load having a different color light since, when changing from the first lamp load to the second, the first color dims and then the second color rises in intensity rather than a gradual change in color from one to the other without any decrease in the amount of illumination.

It is an object of the present invention to provide for the shifting from one lamp load to another in which the total lumen output varies substantially linearly during the shifting from the setting of one lamp load to that of the other.

Another object of the present invention is to provide for the voltage across a lamp load to vary along a non-linear or logarithmic curve when it is being varied by the fader.

A further object of the present invention is to provide an output voltage of a preset variable along a logarithmic curve and to translate this variable voltage into a substantially linear voltage across a lamp load.

Another object of the invention is to provide an amplifying and translating unit in which an input signal voltage can vary along one curve and the output voltage of the unit can vary along a different curve and in which the curve on which the output voltage varies may be altered.

A feature of the invention resides in having a saturable

2

reactor having a control winding and having a load winding in series between a lamp load and a source of A.C. for varying the voltage across a lamp load. The control winding is connected to the output of an amplifier or translating unit which includes two saturable reactors, one way valve or rectifying means and control windings, the latter being connected to the output of the presets and fading controls. In order to carry out the above objects the translating unit is constructed such that it translates an input voltage variable along a logarithmic curve into an output voltage variable along a linear curve and it translates an input voltage variable along a linear curve into an output voltage variable along a logarithmic curve. The first input voltage is varied by manipulation of a preset control while the latter input voltage is varied by the fader.

There is provided in the translating unit two adjustable means, the first for setting the desired lamp voltage for the full or 100% setting of the preset control, while the second adjustable means is utilized to set the desired lamp voltage at a particular setting of the input volts, as for example 50% of full preset voltage. By utilization of such construction, substantially any desired curve may be selected along which the output voltage of the translating unit may be varied which may differ from the curve on which the input voltage varies. The voltage across the lamps generally varies along substantially the same curve as the output of the translating unit. In a specific embodiment of the present invention the output curve selected is logarithmic as compared to linear input curve, in order that the lumen output of the lamp load will be substantially proportional to the linear input curve. Accordingly, when fading from a preset controlling a white lamp load to a preset controlling a colored lamp load, for example red, the illuminated area will be changed from white to light light pink, to light pink, to pink and then to red, with no substantial decrease in the total lumen output when both presets are set at the same value. Also when the presets are set for different values of lumen output, the total amount of lumens on the area will vary linearly from the value determined by one preset to the value determined by the other.

Other features and advantages will hereinafter appear.

Referring to the drawing:

Figure 1 is a schematic diagram of a lighting control system according to the present invention.

Fig. 2 is a modification of an amplifying and translating unit thereof.

Fig. 3 is a graph showing the various curves.

Fig. 4 is a schematic diagram of the fading and preset controls when it is desired to control two lamp loads.

Fig. 5 is a view of a variable resistor utilized in the preset.

Referring to the drawing, particularly Figure 1, there is shown a control circuit 10 having leads 11 and 12, connectible to a source of A.C. which may be on the order of 18 volts. A fader 13, which is preferably an autotransformer, is positioned across the leads 11 and 12 and has a movable tap 14. There is also provided two preset controls 15 and 16. Each preset 15 and 16 has a variable resistor, 19 and 20, and a tap 17 and 18 respectively. Additionally, each preset is provided with a full wave rectifying bridge, 21 and 22. Leads 23 and 24 are connected to the output of the bridges and constitute the output of the presets and fading means. This arrangement is shown and claimed in my previously mentioned co-pending application. However, the present embodiment differs in that the resistors 19 and 20 are wound to produce a voltage variable along a logarithmic curve rather than a linear curve upon movement of the taps 17 and 18 along a linear scale. While this may be ac-

complished by having a somewhat conical shaped core, in the present embodiment shown in Fig. 5, a cylindrical core 19a is utilized and has a resistance wire 19b wound thereon. The wire 19b has segments of different resistances per unit length and each segment is wound to have the spacing between the turns decrease. A scale 19c graduated with equal increments from 0-5 is provided and the tap 17 has a manually operable insulated protuding element 17a for adjusting the tap 17 and giving a visible indication of the setting of the tap. A wire 17b connects the tap to the bridge 21. The preset is constructed so that at the 5 index mark the 100% control volts are available and at 0 index mark 0% are available. Additional movement of the tap between the 4 and 5 index mark produces a greater change in output volts than movement between the 0 and 1 index marks. Thus a curve plotted with output volts on an ordinate axis against a percent setting on the abscissa axis for the element 17 in the specific embodiment illustrated herein would closely approximate a parabolic type or power function curve having an exponent greater than one.

While the output voltage controlled by the preset varies along a substantially logarithmic curve, when the fader is utilized to shift from one preset to the other, the output voltage will vary along a linear curve for the reasons given in my copending application.

The output leads 23 and 24 of the presets and fader are connected to an amplifying and translating unit. Thus unit includes a pair of saturable reactors 25 and 26 having control windings 27 and 28 and load windings 29 and 30 respectively. As shown the control windings 27 and 28 are connected to the output leads 23 and 24 and are connected in series by a lead 31. A lead 32 connects one end of the load windings 29 and 30 in parallel. One side of a source of A.C. which may be 18 volts is connected as at C to the lead 32. Another lead 33 is connected to the other side of the A.C. source as at C and to a junction of two electric one way valves 34 and 35, which may be selenium rectifiers. Two more valves 36 and 37 are provided, the former connected to the valve 34 and to the other end of the winding 29, while the valve 37 is connected between the valve 35 and the other end of the winding 30. The polarity of the valves are as indicated in the schematic diagram. An adjustable resistance 38 is connected between the other two ends of the windings 29 and 30. The output of the amplifier circuit is through leads 39 and 40 which are connected to a control winding 41 of a saturable reactor 42. An adjustable resistance 43 is positioned in the lead 40.

The saturable reactor 42 is utilized to control the voltage across a lamp load 51 and has a load winding 69. One end of the load winding 69 is connected to a lead 44 which is connectible to a source of A.C., preferably standard voltage such as 120 volts. The other end of the winding 69 is connected by a lead 45 to a fixed tap 46 of an autotransformer 47. The winding 48 of the autotransformer has its ends connected to leads 49 and 50 which are in turn connectible to the lamp load 51. The lead 50 is connected to the other side of the 120 volt source.

In the adjusting of the lighting control system when it is desired to have lumens output linear when fading from one preset to the other, the resistor 43 is initially adjusted so that at 100% of the control volts, from either one of the presets 15 or 16, the voltage across the lamp load 51 will be 100%. Next, the control voltage is adjusted to a certain percentage of its maximum value, as for example 50%, and the resistor 38 is adjusted until the desired voltage is across the lamp load 51. Then, resistor 43 is again adjusted at 100% of control volts so that the voltage across the lamps is 100%. This requires a certain amount of balancing between the two resistors in order to obtain the desired values

at the two settings of the preset. Though in the specific embodiment a logarithmic curve is described, substantially any curve between the control volts from the preset and fader and the lamp voltage may be obtained simply by adjustment of these two resistors. For example, both a curve having a slope changing from zero to infinity or a curve having a slope varying from infinity to zero may be obtained.

Referring to Fig. 3, there is shown a graph with the control volts, that is, the voltage across the leads 23 and 24 on the abscissa axis with the axis graduated into percentages of the maximum control voltage while the ordinate axis is simply graduated in percent. The curve A shows the usual relationship between the lamp voltage and the control volts which may exist, for example, in my previously mentioned copending application. The curve B denotes the usual curve between the lumen output and the control volts as may exist in my copending application. The curve C is the relationship existing between the control volts and the lamp voltage when it is desired to have the lumen output linear when changing from one preset to the other. This curve is substantially similar to a power function curve having an exponent less than one. The curve D denotes the relationship between the lumen output and the control volts. The curve D closely approximates a straight line, as shown, and in order to obtain the curves C and D, the resistors 43 and 38 are adjusted to give a value of lamp voltage of 100% indicated by the point E at 100% control volts, and to give a value of lamp voltage indicated by the point F for 50% of the control voltage in the manner previously stated.

Referring to Fig. 1, it will be appreciated that the resistor 38 provides a bypass around the one-way valves 36 and 37. Thus, if the line 32 is taken as being instantaneously positive, current will flow through the elements 32, winding 30, valve 37, line 39, winding 41, resistor 43, line 40, valve 34 and out line 33. In addition, a portion of the current as regulated by the setting of the resistor 38 flows through the winding 29, resistor 38, valve 37, etc. When the line 33 is instantaneously positive, current can flow through the elements 33, 35, 39, 41, 43, 40, 36, 29 and 32. In addition, a portion of the current as regulated by the resistor 38, can flow through the winding 30.

It will be appreciated that, in both instances the portions of the current through the windings 29 and 30 as determined by the resistor 38, is opposite to the current flowing when the instantaneous value changes. In other words when line 32 is positive, current flows in one direction through winding 30 and when line 32 is negative, the portion of current determined by the resistor 38 flows in the other direction through the winding 30. Consequently, the net sum of the direct current through each load winding 29 and 30 of the saturable reactors 25 and 26 is the difference between or algebraic sum of these two currents. Since the total direct current in all the windings of each saturable reactor 25 and 26 determines the current in the winding 41, it will be appreciated that as the current in the windings 29 or 30 is decreased by reason of the adjustment of the resistor 38, a larger control current or voltage from the preset is needed to maintain the same value of current through the control winding 41. Stated differently, if the control current from the presets stays constant and the resistance of resistor 38 is decreased, the load current through the winding 41 will decrease since the sum of the control current and the load current is less. Conversely, if the resistor 38 is increased, the load current will increase up to the point where the resistor 38 has infinite resistance. Though the above discussion has been related to current it will be obvious to those skilled in the art that as the current flowing through the winding 41 increases, a proportionately larger voltage is also present.

The above discussion has used only one variable, name-

5

ly the voltage across the lines 23 and 24. This voltage may be determined by either the preset 15 when the resistor 19 has line voltage across it, by the preset 16 when the resistor 20 has line voltage across it, or during the transition from one preset to another by utilizing the autotransformer or fader 13.

Referring to Fig. 2 there is shown a modification of the instant invention. In this embodiment in which like reference numerals indicate the same elements as in the prior embodiment, the circuit is adapted to be in the circuit of Figure 1 with the points AA of Fig. 2 and AA of Figure 1, BB of Fig. 2 and BB of Figure 1, and CC of Fig. 2 and CC of Figure 1 connected together. In this embodiment, rather than have a single adjustable resistor 38, there are provided two resistors 60 and 61. The resistor 60 allows a regulated portion of the current to bypass the one way valve or rectifier 37 while the resistor 61 permits the same to occur with relation to the valve or rectifier 36. Preferably, both these resistors are adjustable and also identical in order to have the same value of bypass current flow through each winding 29 and 30 and also they may be mounted on the same control shaft (not shown) to permit adjusting both equally at the same time.

Shown in Fig. 4 is a schematic diagram of a fading and preset circuit when it is desired to fade from one lamp load to a second lamp load. Like reference numerals are given the same elements as in Figure 1. This circuit is designed to have the points AA connected to the points AA of Figure 1. Connected to the points A'A' is circuit identical to the one connected to the points AA. Thus it would have the amplifying, or translating unit, a saturable reactor and a lamp load. The two lamp loads may be of different color in order to fade from one color of lamp load to the other without having a dip in the amount of total lumens illuminating the area. In Fig. 4, a second preset 65 is provided and is connected in parallel to the preset 16. This preset 65 is constructed identically to the presets 15 and 16 and has a resistor 66, a tap 67 and a bridge rectifier 68.

With the above arrangement of elements and the lamp load controlled by the preset 15 emitting for example white light and the lamp load controlled by the preset 65 emitting for example red light, the preset 16 is set to zero output voltage. The tap 14 is positioned at the point X on the autotransformer 13 and is moved to the point Y. At the position X, there is only white light while at the position Y there is only red light. At any intermediate position between X and Y the control voltage to the translating unit will be the sum of the percentage of full line voltage times the setting of one preset plus the percentage of full line voltage times the setting of the other preset and thus will be linear. However, the translating unit will cause the lamp voltage to vary along the curve C (Fig. 3) with the lumen output varying along the substantially linear curve D. Moreover if desired just to have pink light at the point Y, the preset 16 can be set to a value greater than zero so that both lamp loads will be energized. Though reference has been made to two lamp loads, while referring to this embodiment, the term lamp load as used throughout this specification is to be understood as referring to one or more lamp loads, except where the context in which it is used, definitely limits it to a single lamp load. A lamp load, while shown in the drawing as having only one bulb preferably has a plurality thereof.

There has thus been disclosed a lightening control system in which fading from one preset to another, the lumen output of a lamp load (which may be two individual lamp loads) varies linearly from the value set by one preset to the value set by the other. In addition, in order to provide for the voltage across the lamp to vary linearly with respect to the setting of each preset, the preset output voltage varies along a substantially

6

logarithmic curve and then is translated into a substantially linear curve of voltage on the control winding of a saturable reactor utilized to vary the voltage across the lamp. Furthermore an amplifying and translating unit is provided which by means of two variable resistors enables it to have an output voltage which varies along a curve which differs from the curve on which its input signal voltage varies.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. A lighting control system comprising a lamp load for producing a lumen output which varies along a logarithmic curve when energized by a voltage which varies along a linear curve; controlling means connected between the lamp load and a source of A.C. and responsive to the value of a signal for controlling the energization of the lamp load, said controlling means varying the electrical energization of the lamp load along a logarithmic curve as the signal varies along a linear curve; terminals connectible to a source of electrical energy; and control means connected to the terminals and the controlling means for producing the signal for the controlling means, including two adjustable means with each producing a signal of adjustable value from the source of electrical energy, and shifting means connected between the terminals and both adjustable means for shifting the energization from the source of electrical energy from one adjustable means to the other and transferring the value of the signal from that of the one adjustable means to that of the other along a linear curve whereby the lumen output of the lamp load during the shifting varies substantially linearly from the value determined by one adjustable means to that determined by the other adjustable means.

2. A lighting control system comprising a lamp load; controlling means connected between the lamp load and a source of A.C. and responsive to the value of a signal for controlling the energization of the lamp load, said controlling means varying the voltage across the lamp load along a logarithmic curve when the signal voltage varies along a linear curve; terminals connectible to a source of electrical energy; and control means connected to the terminals and the controlling means for producing the signal for the controlling means, including two adjustable means with each producing a signal of adjustable voltage value from the source of electrical energy, and shifting means connected between the terminals and both adjustable means for shifting the energization from the source of electrical energy from one adjustable means to the other and transferring the voltage value of the signal from that of the one adjustable means to that of the other along a linear curve whereby the voltage across the lamp load during the shifting varies substantially logarithmically from the value determined by one adjustable means to that determined by the other adjustable means.

3. A lighting control system comprising a lamp load for producing a lumen output which varies along a logarithmic curve when energized by a voltage which varies along a linear curve and in which the lumen output varies along a linear curve when energized by a voltage which varies along a logarithmic curve; controlling means connected between the lamp load and a source of A.C. and responsive to the value of a signal for controlling the energization of the lamp load, said controlling means varying the electrical energization of the lamp load along a logarithmic curve when the signal varies along a linear curve; terminals connectible to a source of electrical energy; and control means connected to the terminals and the controlling means for producing the signal for the controlling means, including two adjustable means with each having a manually operable member for pro-

7

ducing a signal of adjustable value along a logarithmic curve from the source of electrical energy upon movement of the manually operable member, and shifting means connected between the terminals and the adjustable means for shifting the energization from the source of electrical energy from one adjustable means to the other and transferring the value of the signal from that of the one adjustable means to that of the other along a linear curve whereby the lumen output of the lamp load during the shifting varies substantially linearly from the value determined by one adjustable means to that determined by the other adjustable means and the lumen output varies substantially logarithmically as the value of the signal is adjusted along a logarithmic curve by movement of the manually operable member.

4. A lighting control system for illuminating an area comprising two circuits; each circuit being substantially identical and having a lamp load for producing a lumen output on the area which varies along a logarithmic curve when energized by a voltage which varies along a linear curve, controlling means connected between the lamp load and a source of A.C. and responsive to the value of a signal for controlling the energization of the lamp load, said controlling means varying the electrical energization of the lamp load along a logarithmic curve when the value of the signal varies along a linear curve, terminals connectible to a source of electrical energy and control means connected to the terminals and the controlling means for producing the signal for the controlling means, including an adjustable means for producing a signal of adjustable value from the source of electrical energy; and shifting means connected between the terminals and the adjustable means for shifting the energization by the source of electrical energy from one adjustable means to the other and shifting the value of the signal from that determined by the one adjustable means for its controlling means to zero and to that determined by the other adjustable means for its controlling means

8

from zero with values of the signal being shifted along linear curves, whereby the total lumen output of the lamp loads on the area varies substantially linearly during the transition from the value set by one adjustable means for its lamp load to the value set by the other adjustable means for its lamp load.

5. A lighting control system for illuminating an area comprising two circuits; each circuit being substantially identical and having a lamp load for producing a lumen output on the area, controlling means connected between the lamp load and a source of A.C. and responsive to the value of a signal for controlling the voltage across the lamp load, said controlling means varying the voltage across the lamp load along a logarithmic curve when the value of the signal voltage varies along a linear curve, terminals connectible to a source of electrical energy and control means connected to the terminals and the controlling means for producing the signal for the controlling means including an adjustable means for producing a signal of adjustable value from the source of electrical energy; and shifting means connected between the terminals and the adjustable means for shifting the energization by the source of electrical energy from one adjustable means to the other and shifting the value of the signal from that determined by the one adjustable means for its controlling means to zero and to that determined by the other adjustable means from zero with the values of the signal being shifted along linear curves, whereby the voltage across each lamp load on the area varies substantially logarithmically during the transition.

References Cited in the file of this patent

UNITED STATES PATENTS

1,926,423	Barclay	Sept. 12, 1933
2,236,195	McKesson	Mar. 25, 1941
2,458,277	Lark	Jan. 4, 1949
2,462,371	Engle	Feb. 22, 1949