APPARATUS CONTROLLING THE BRIGHTNESS OF LAMPS

Filed Oct. 23, 1967 2 Sheets-Sheet 1

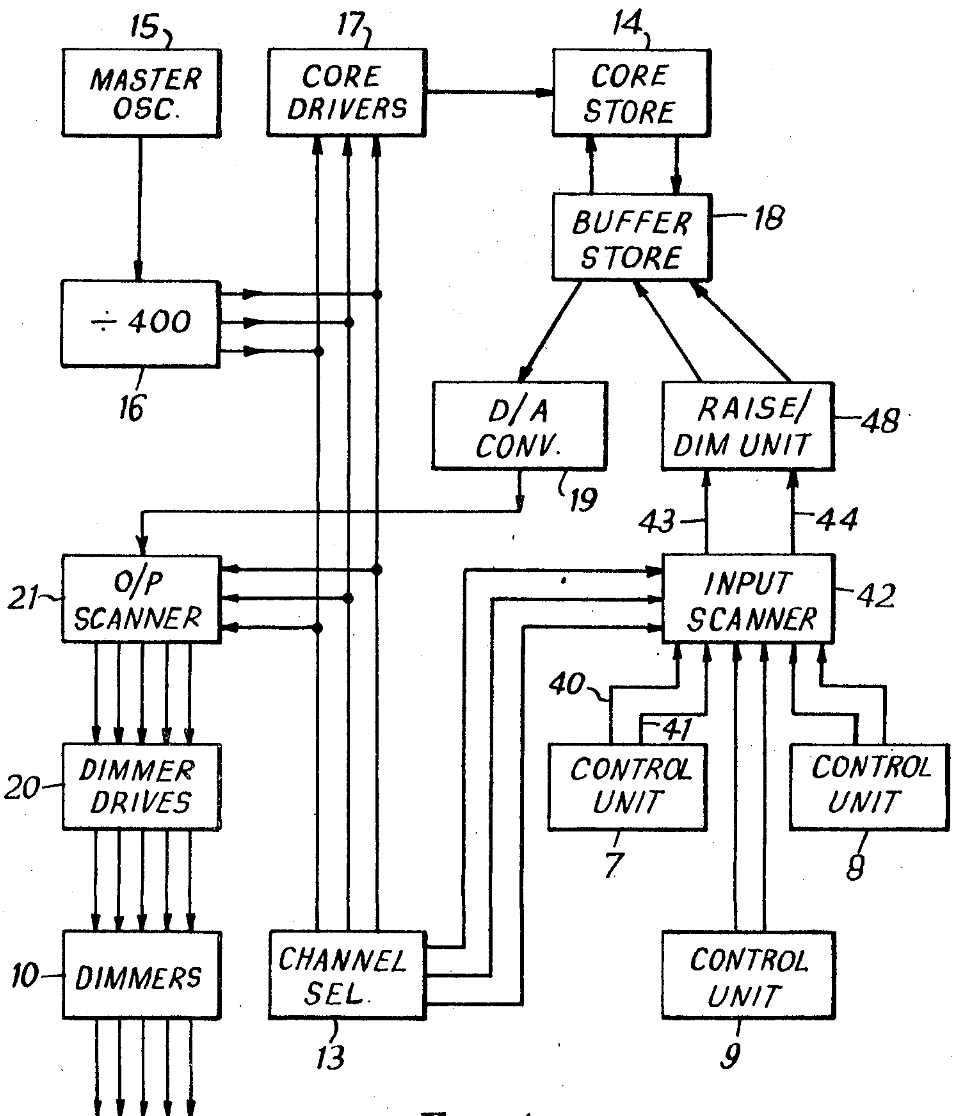

Fig. 1.

ANTHONY LEONARD ISAACS
INVENTOR

BY Lawrence Burns
ATTORNEY

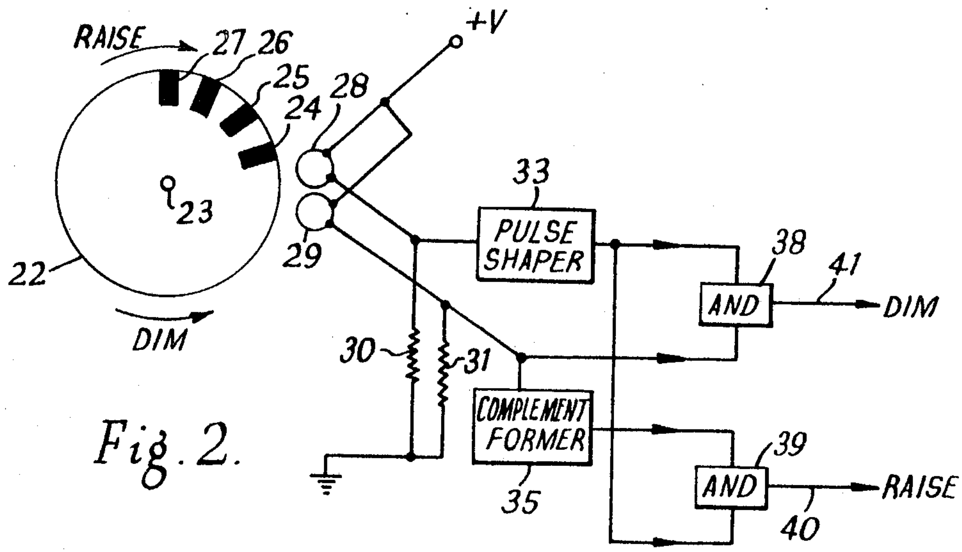

Fig. 2.

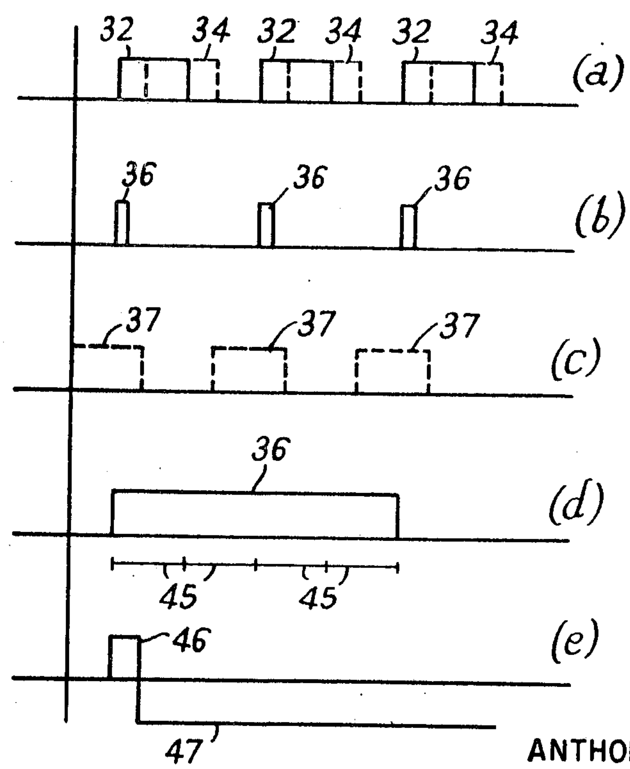

Fig. 3

ANTHONY LEONARD ISAACS
INVENTOR
BY Laurence Burns,
ATTORNEY

United States Patent Office

3,514,670

Patented May 26, 1970

1

3,514,670

APPARATUS CONTROLLING THE BRIGHTNESS OF LAMPS

Anthony Leonard Isaacs, London, England, assignor to Thorn Electronic Limited, London, England

Filed Oct. 23, 1967, Ser. No. 677,275
Claims priority, application Great Britain, Oct. 21, 1966, 47,343/66
Int. Cl. H05b *37/02*
U.S. Cl. 315—292 7 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for changing lamp brightness, in which a contact has voltage applied to it intermittently by a rotating member, and electronic apparatus, in a circuit including the contact and the lamp, responsive to the frequency with which voltage is applied to the contact so that it changes the brightness of the lamp at a rate dependent on said frequency. The rotating member contains magnets which actuate contacts in reed switches. The circuitry is arranged so that it will either dim or raise the brightness, depending on which of two reed switches is closed first.

The present invention relates to apparatus for controlling the brightness of lamps, particularly but not exclusively lamps used in stage and studio lighting.

According to the present invention there is provided apparatus for changing lamp brightness comprising a contact, control means for intermittently applying a voltage to the contact including a member mounted for manual rotation about a shaft to pass adjacent to the contact and apply a signal thereto, the apparatus also comprising brightness-setting means, electrically coupled to the contact for changing the brightness of a lamp at a rate dependent on the frequency with which the signal is applied to the contact.

A pair of contacts may be provided, one contact being that mentioned in the preceding paragraph, and the other being for connection to a voltage source. The contacts may then be opened or closed as the member passes adjacent during rotation. For example, the member could be a cam closing the pair of contacts during rotation, or, if the contacts are those of a reed switch, the member could be a wheel with one or more magnets mounted in its periphery.

A thumb-wheel, hand-wheel or lever may be fixed to the shaft and used to rotate the member.

In stage lighting system, for example, it is advantageous to rotate a thumb wheel in one direction to increase, that is raise, brightness and in the other direction to decrease, that is dim, brightness. Thus it is useful if raise and dim outputs are wire encoded, and appear on one of two wires depending on which way the thumb wheel is rotated.

According to another aspect of the invention therefore there is provided apparatus for sensing the direction of rotation of a member, comprising a member mounted for rotation about a shaft to pass adjacent to first and second contacts and apply a voltage thereto, first direction-indicating means for providing an output signal if a voltage is applied to the first contact before the second, and second direction-indicating means for providing an output signal if a voltage is applied to the second contact before the first.

Preferably two reed switches adjacent to one another are provided, these switches being actuated one after the other as the wheel carrying the magnets is rotated. In this way two related trains of pulses appear, the phase of one being retarded in relation to the other and hence indicating the direction of rotation of the wheel, that is whether the lamp is to be made more or less bright. The leading edges of one pulse train, or short pulses derived therefrom may be passed to two "AND" gates, one having another input from the other pulse train, and the other "AND" gate having another input which is the complement of the other pulse train. One of the "AND" gates will then be opened when the lamp brightness is to be increased, and the other "AND" gate will be opened when the lamp is to be dimmed. If the "AND" gate outputs are connected to "raise" and "dim" wires pulses from these gates will be wire encoded.

2

Where the control means are rotated by a lever, outputs on "raise" and "dim" wires may be provided by means responsive to lever position, for example changeover switches or reed switches. Then moving the lever in one direction in a "raise" sector of movement increases brightness and in the other direction in a "dim" sector of movement decreases brightness.

Several lamps or groups of lamps may be selectively controlled by apparatus according to the invention. For example each group of lamps may be allocated a channel in a time-divided system and several sets of apparatus according to the invention may be selectively allocated to each channel. Pulses representative of the speed of opening of a number of pairs of contacts, for example the short pulses which pass through the above mentioned "AND" gates, are made long enough to last for one complete cycle of channels and are passed to a matrix of AND gates, one gate for each set of apparatus. The matrixed "AND" gates are connected to a scanning pulse source by way of a selector which is set so that selected gates, corresponding to the selected channels receive enabling input. Thus pulses derived from the short pulses appear in the selected channels only. Over a number of cycles of channels, pulses will appear on raise or dim wires from the matrix in the selected channels every cycle or less depending on the speed of rotation of the said member. The raise and dim wires are connected to means for changing the brightness of the groups of lamps which are scanned in accordance with the time-divided channels.

In order to ensure one-for one correspondence between the short pulses and the pulses in the selected channels, a two-state register is provided for each set of apparatus which is triggered into a first state by the leading edge of each first short pulse, and triggered into its second state at the end of the period of the channel selected for that set of apparatus. When in its first state the two-state register is applied as an enabling signal to the matrixed AND gates.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a block diagram of a stage lighting system,

FIG. 2 is a schematic diagram of apparatus according to the invention, used in the system of FIG. 1 as a control unit, and

FIG. 3 shows pulse waveforms useful in explaining the invention.

In the stage lighting system of FIG. 1 a bank **10** of dimmers controls groups of lamps (not shown). The intensity of light from any group can be changed by rotating a thumb-wheel control of any of ten control units, three of which **7**, **8** and **9** are shown. If a thumb wheel is rotated in one direction the brightness of a group of lamps selected by a channel selector **13** is continuously increased, at a rate depending on the speed of rotation of the thumb wheel. Rotation in the other direction decreases the brightness of the lamps in the group.

Each group of lamps is allocated a channel and eight cores in a core store **14**. One of the cores registers a one-bit "On Off" signal, and the other seven register a seven bit brightness count giving the required brightness for the group of lamps. The channels are time divided and for this purpose a 40 kc./s. master oscillator **15** supplies pulses to a divider circuit **16**, having two cascaded divide-by-ten stages and two cascaded divide-by-two stages. The first divide-by-ten stage gives a units output, the second divide-by-ten stage gives a tens output, and the two divide-by-two stages gives a four state hundreds output. The channels are numbered from one to four hundred and have a duration of twenty-five microseconds. The outputs from the divider circuit are passed to core drivers **17**, which at the beginning of each twenty-five micro-second channel period, using the conventional half current pulses applied to X and Y axis wires of the matrix of the store **14**, select the eight cores allocated to one of the channels and transfer their contents to a buffer store **18**. The contents of the buffer store is then converted to an analogue voltage by a digital to analogue converter **19**. The resultant voltage is passed to a selected dimmer drive unit **20**, by an output scanner **21** comprising a sampling matrix of AND gates controlled by the outputs of the divider circuit **16** feeding four hundred reservoir capacitors. The sampling matrix, timed from the main divider waveforms, decommutates the 400-channel time sequential signal from the digital-to analogue convertor **19** into four hundred parallel signals on the four hundred reservoir capacitors. These signals, one per lighting channel, are shaped in the dimmer drive units **20** into signals controlling the four hundred dimmers, one per lighting channel.

At the end of each twenty-five micro-second period the contents of the buffer store are read back into the core store, and the contents of the next eight cores corresponding to the next channel are read into the buffer store.

The ten control units are used to enter the desired brightness counts into the store **14** and to change them as necessary. One of these control units will now be described with reference to FIG. 2. A wheel **22** and a shaft **23** are rotated by means of a thumb wheel, hand wheel or lever attached to the shaft. As the wheel rotates magnets **24, 25, 26** and **27** set in its periphery pass adjacent to two reed switches **28** and **29**, closing the switches intermittently. In practice magnets would be evenly distributed throughout the whole periphery of the wheel **22**. One contact of each reed switch is connected to a voltage source V, and the other contacts of the switches are connected through resistors **30** and **31** respectively to earth. Thus, if the wheel **22** is rotated clockwise, pulses **32** (see FIG. 3(*a*)) appear at the input to a pulse-shaper circuit **33** and pulses **34** appear the input to a complement-forming circuit **35**. The pulse-shaper circuit **33** provides short pulses **36**, coincident with the leading edges of the pulses **32**, and the complement-forming circuit provides the pulses **37** which are complementary to the pulses **34**. The pulses **34** and **36** are passed to an AND gate **38**, and the pulses **36** and **37** are passed to an AND gate **39**. Hence for clockwise rotation of the wheel **22** the AND gate **39** opens and passes the pulses **36** to a Raise output wire **40**. If the wheel **22** is rotated in a counter clockwise direction the leading edge of the pulses **34** appear before the pulses **32**, the pulses **36** and **34** are coincident and the AND gate **38** allows the pulses **36** to reach a Dim output wire **41**.

The wires **40** and **41** are connected to an input scanner **42** which is used to time the pulses **36** so that pulses derived therefrom appear only in channels selected using the channel selector **13**. The channel selector panel has ten "10's" buttons marked 0, 10, 20 . . . 80 and 90 and four "100's" buttons marked 0, 100, 200 and 300 respectively. There are two registers or stores in the channel selector **13**, a ten-state "10's" register (states 0, 10, 20, . . . 80 and 90) and a four-state "100's" register (states 0, 100, 200 and 300). If the "200" button is depressed and released the "100's" register is set to its "200" state, lightning a signal lamp within or near the "200" button and extinguishing all other "100's" signal lamps.

This condition is sustained until another "100's" button is operated. If now the "70" button is depressed and released the "10's" register is set to its "70" state, lighting a signal lamp within or near the "70" button and extinguishing all other "10's" signal lamps. The control units **0** to **9** now operate on channels **270** to **279** respectively of the 400 channels available, controlling the lamps in lighting channels **270** to **279**. If the "10's" button "0" is now depressed the "10's" register is set to its state "0," "10's" button "0" is illuminated instead of button "70" and the control units **0** to **9** operate on channels **200** to **209** respectively. If "100's" button "0" is next depressed the "100's" register is set to "0," "100's" button "0" is illuminated instead of the "200" button and the control units **0** to **9** operate on channels **0** to **9** respectively.

With the channel selector set to **270**, the "100's" and "10's" registers in the channel selector are compared in an "AND" gate matrix with the corresponding counters of the divider circuit **16** to produce an output pulse when the divider circuit is in states **270** to **279**.

Each output wire of the control units is connected to an AND-gate matrix together with the "units" output of the main divider and the output of the channel selector. The pulses **36** are made longer than one cycle of channels so that with the "200" and "70" buttons illuminated pulses appear in a raise output wire **43** or a dim output wire **44** of the input scanner **42** from the control unit **0** when the divider is in the state "270" from the control unit **1** when the divider is in the state **271** etc., and from the control unit **9** when the divider is in the state **279**.

Each control unit also has an associated two state register (not shown) to ensure one to one correspondence between pulses in the channels and pulses from the control units. FIG. 3(*d*) shows one of the pulses **36** to an enlarged time scale, and shows this pulse spanning a number of complete cycles **45** of channels. The two state register is triggered into one state **46** at the beginning of each pulse **36** (FIG. 3(*e*)) and triggered into its other state **47** at the end of the period of the channel selected for the associated control unit. The two-state register is connected to provide an enabling pulse to that AND gate in the input scanner connected to the associated control unit. Pulses **36** do not therefore appear on wires **43** or **44** during the last three cycles **45** spanned by the illustrated pulse **36** FIG. 3(*d*).

The pulses **36** may be made 12.5 ms. in duration, for example, to ensure spanning one cycle of channels. With this pulse width the wire encoding system can operate at reed-switch pulse rates up to 20 pulses per second when the 12.5 ms. pulse occupies one quarter cycle of the reed-switch output waveform.

When the brightness count of a group of lamps, represented by the states of the eight cores allocated to that group has been read into the buffer store **18**, a raise/dim unit **48** raises or lowers the count at one unit per pulse received along the wires **43** or **44**. Thus for example if the thumb wheel of the control unit **7** were rotated in a clockwise direction and if the control unit **7** were coupled to channel **277**, the count stored by the cores allocated to that channel would be raised.

The "brightness count" for any selected channel may thus be "wound up and down" by the thumb-wheel, or hand-wheel, or raised and lowered by "ratchet and pawl" action of the lever in the appropriate sector of its travel. There is no one-to-one relationship between control shaft position and lamp brightness because the shaft may be disengaged from a given control channel and re-engaged in a different relative attitude.

Many other embodiments of the invention will be apparent. For example the rotating member could be a wiper connected to a voltage source, and making contact with one of two separately connected contacts, before the other in one direction of rotation, and vice-versa in the other direction. As has been mentioned the rotating member may be a cam, or toothed wheel which comes into contact with a moving contact of a pair of contacts pushing the moving contact against a stationary contact.

I claim:

1. Apparatus for changing lamp brightness comprising a contact,
control means for intermittently applying a voltage to the contact,
said control means comprising a control member for co-operation with the contact and a shaft mounting said control member for manual rotation and brightness-setting means electrically coupled between the contact and the lamp to change the brightness of the lamp at a rate dependent on the frequency with which the voltage is applied to the contact.

2. Apparatus as claimed in claim **1** including a further contact connected to a voltage source, said control member comprising means to engage and disengage said further contact with said first contact.

3. Apparatus as claimed in claim **2** wherein said first contact and said further contact form the contacts of a magnetically-operable reed switch, and said control member is a wheel having magnets mounted around its periphery.

4. Apparatus for changing lamp brightness as claimed in claim **1** having a second contact to which a voltage is intermittently applied by the rotation of the control member, the second contact being spaced from the first contact around the shaft, a first direction-indicating means coupled between the first and second contacts on the one hand and the brightness-setting means on the other hand to change the brightness in one sense if a voltage is applied to the first contact before the second, and a second direction-indicating means coupled between the first and second contacts on the one hand and the brightness-setting means on the other hand to change the brightness in the opposite sense if a voltage is applied to the second contact before the first.

5. Apparatus as claimed in claim **4** in which the first and second contacts are each one of a pair of contacts of a separate reed switch and the member is a wheel carrying magnets around its periphery which actuate the switches one after the other as the wheel rotates, thereby generating two trains of pulses one of which is displaced in phase relative to the other in a direction determined by the sense of rotation, and in which the first direction-indicating means is an "AND" gate receiving one pulse train and the leading edges of the other pulse train and the second direction-indicating means comprises a second "AND" gate and means for generating the complement of the said one pulse train, said complement being applied to the second "AND" gate together with the leading edges of the other pulse train.

6. A system for controlling the brightness of several groups of lamps comprising a number of sets of apparatus as claimed in claim **5** with their first direction-indicating means each connected to a different one of a first matrix of "AND" gates and their second direction-indicating means each connected to a different one of a second matrix of "AND" gates, the two matrices being connected to a scanning pulse source by way of a selector which is set so that only selected gates, corresponding to selected ones of a plurality of time-divided channels for individual control of the several groups of lamps, receive enabling inputs, the outputs of the direction-indicating means being shaped to give pulses of a length covering one complete cycle of channels so that a pulse is passed to a brightness-setting means associated with a group of lamps when an enabling input is received by a selected gate, the brightness-setting means being scanned by the scanning pulse source.

7. A system as claimed in claim **6** including a two-state register for each set of apparatus, the register being triggered into a first state by the leading edge of each first output pulse from the direction indicating means and triggered into its second state at the end of the period of the channel selected for that set of apparatus, the output of the register in its first state being applied as an enabling signal to the matrices of "AND" gates.

References Cited

UNITED STATES PATENTS

2,994,804	8/1961	Skirpan	315—297 X
3,004,193	10/1961	Bentham et al.	315—316 X
3,221,214	11/1965	Wolff et al.	315—292
3,358,237	12/1967	Houle	307—218 X

JOHN W. HUCKERT, Primary Examiner

R. F. POLISSACK, Assistant Examiner

U.S. Cl. X.R.

315—294, 297, 299, 316, 317, 318, 319