

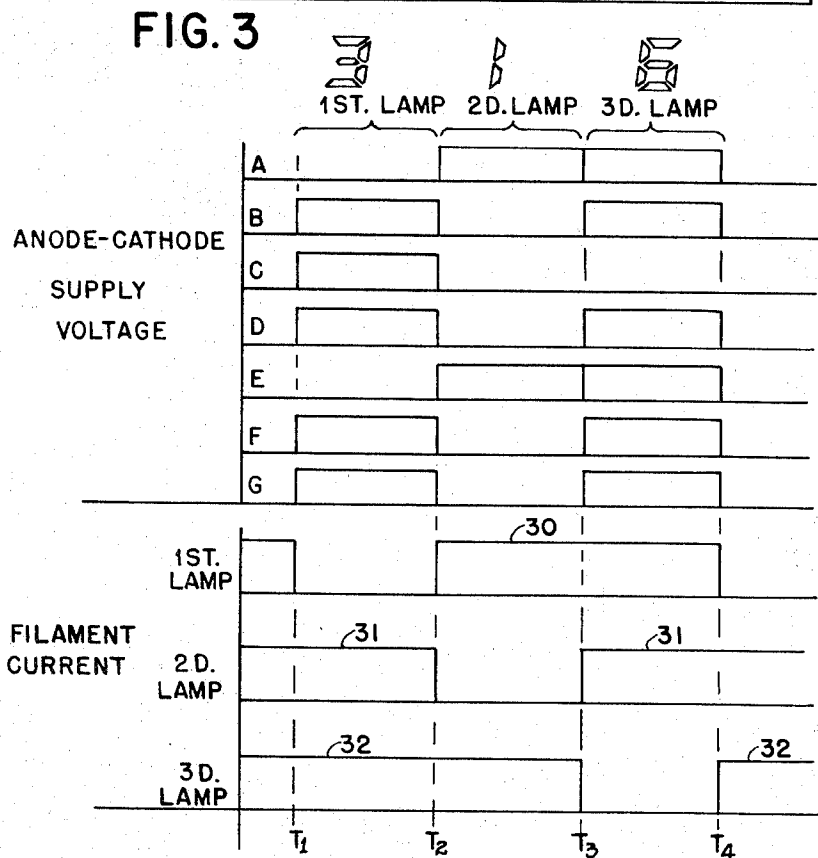
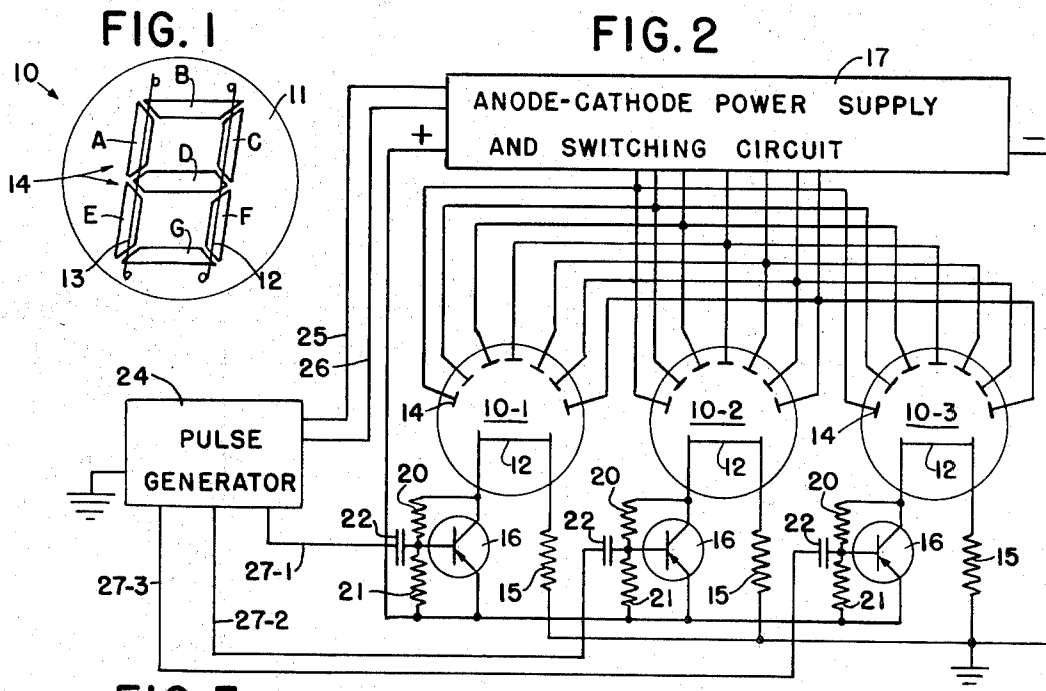
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C. E. ATKINS

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TIME-SHARING INDICATOR LAMP CONTROL CIRCUIT

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CARL E. ATKINS
INVENTOR

BY *Eyre, Mann & Lucas*
ATTORNEYS

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TIME-SHARING INDICATOR LAMP CONTROL CIRCUIT

Carl E. Atkins, Montclair, N.J., assignor to Wagner
Electric Corporation, a corporation of Delaware
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6 Claims

ABSTRACT OF THE DISCLOSURE

A control circuit is described for controlling the symbols displayed by a plurality of indicators each having a cathode and a plurality of phosphor-coated anodes. The control circuit is particularly adapted to control the showing of indicia when similar anodes in all the digit devices are connected to a common supply conductor. During the showing of any symbol, the electron-emitting filament is temporarily disconnected from its power supply by a series transistor. This type of control circuit is particularly adapted to the showing of digital information provided by a computer circuit.

The present invention relates to a control circuit for showing indicia. While this type of indicator may be adapted for letters, numerals, and other symbols, the present description will be directed to the showing of digits from zero to nine, inclusive. The invention has particular reference to a control circuit which uses the strobing or time-sharing principle. This form of operation results in the saving of many electrical circuit components and simplifying the design of the circuit which supplies the digit information.

Many types of digit displaying devices have been developed and used in connection with the output of computer circuits and other calculating devices. One such device is a lamp having seven segments, each connected as an anode and each coated with a phosphorescent substance which generates light when bombarded by electrons. The device herein described is a diode and employs one or more electron-emitting filaments. There are on control grids of any kind within the evacuated lamp envelope.

One of the features of the present invention is the use of a control circuit which cuts off the filament current during the time the lamp is used as an indicator. At other times the voltage drop through a resistor connected in series with a filament increases the voltage at the filament to a value which is substantially equal to the voltage of the active anodes. While this condition exists there is no potential from anodes to cathode, and no light is generated.

For a better understanding of the present invention, together with other details and features thereof, reference is made to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a front view of one of the lamps employed as a digit indicator;

FIG. 2 is a schematic diagram of connections showing how three lamps are connected together and to a control circuit for indicating digits; and

FIG. 3 is a graph showing the voltage variations as applied to the three lamps to indicate an array of three numbers (3-1-6) and the filament currents supplied to each of the three lamps during the showing of information.

Referring now to FIG. 1, the digit-including lamp 10 includes a glass envelope 11 having two filaments 12 and 13 and seven anodes 14 indicated by letters A to G, inclusive. Each of the anodes is coated on its view-

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ing face with phosphorescent material and each of the seven anodes is secured to a lead-in conductor which in turn is connected to a base pin for connection to an external circuit. This type of digit indicator has been described in a co-pending patent application, Ser. No. 751,168, filed Aug. 8, 1968.

FIG. 2 shows the circuit employed for energizing three lamps 10-1, 10-2 and 10-3. In this symbolic representation the seven anodes 14 are shown grouped around a single filament 12. Each filament is connected in series with a resistor 15, the collector-emitter electrodes of a transistor 16, and a filament power supply. In FIG. 2, the filament power supply is included within the combined power supply and switching circuit 17. Each transistor 16 has its emitter and collector electrodes connected to the terminals of a voltage divider which includes resistors 20 and 21, the base electrodes of each transistor being connected to the junction of resistors 20 and 21 and through capacitor 22 to pulse generator 24. Under normal circumstances, with no voltage pulse applied to the base, the transistor 16 conducts and current is passed through the filament 12 and through resistor 15. The current supply to the filaments and the voltage supplied to the anodes are given values which do not produce any light at the phosphorescent surfaces as long as the filament carries current. For example, the anode voltage might be 40 volts, with a filament current of 40 milliamperes and a resistance 15 of 1,000 ohms. When the filament current is on, the 40 milliamperes creates a voltage drop of 40 volts when passing through resistor 15 and this drop raises the potential of filament 12 to about 40 volts. Since the anodes are normally supplied with only 40 volts, there is substantially no electric field within the envelope and the electrons have little or no energy with which to produce light.

A pulse generator 24 is connected to the combined power supply and switching circuit 17 by conductors 25 and 26 in order to keep the pulses produced by the generator 24 and the switching operations in synchronism. The output of the pulse generator is carried by three conductors 27-1, 27-2 and 27-3, each of these conductors being connected to one of the capacitors 22 which are in series with the base electrodes of transistors 16. The operation includes a synchronous clock within circuit 17 which first applies a series of anodes pulses to selected anode segments in all the tubes. During this same time, the pulse generator applies a positive pulse over conductor 27-1 to the first transistor 16 making it nonconductive and cutting off the filament current in lamp 10-1. The pulse duration is of the order of one millisecond and, because of the thermal inertia of the filament, the electron emission continues at about the same rate as when maximum filament current is flowing.

With no filament current there is no potential drop across resistor 15 and the filament is reduced to ground potential, thereby creating a potential of 40 volts between the selected anodes and the filament. This potential is sufficient to accelerate the electrons emitted from the filament toward the phosphorescent anodes 14 causing the anodes to give off light and show a desired symbol. In order to show a symbol on the second lamp 10-2, a similar procedure sends a voltage pulse over conductor 27-2 to cut off the filament current in the second lamp and thereby energize the phosphor on a desired array of anodes. The third lamp 10-3 is activated in a similar manner. During each activation period the anodes in all the lamps 14 are supplied with voltages to form the digit desired.

FIG. 3 indicates the operation of the circuit when the number 316 is displayed. During the first time interval, from t_1 to t_2 , five anodes B, C, D, F, and G in all the

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lamps are connected to a positive supply voltage by the switching circuit 17 and the filament current 30 in the first lamp is cut off. This results in the figure 3 in the first lamp. During this first time interval, the filament current in lamps 2 and 3 are on and there is no light produced by their anodes. During the second time interval, from t_2 to t_3 , the filament current 31 in the second lamp is cut off and anode segments A and E are supplied with positive voltage. This shows a 1 in the second lamp while the first and third lamps are dark. During the third time interval, from t_3 to t_4 , the filament current 32 in the third lamp is cut off and anode segments A, B, D, E, F, and G, are supplied with a positive voltage in all the tubes. This action shows a 6 in the third lamp while the other lamps are dark. This sequential operation is then repeated at a rapid rate to show the digits 316 in what appears to the eye as a steady illuminated symbol representation.

It should be noted that the sequential lighting of a number of lamps in the manner described above does not reduce the light output as much as might be expected. When phosphorescent material is activated by a pulse of electrons, after a very short time the phosphor shows fatigue, i.e., a reduction in light output. The repeated pulse activation of the phosphors largely cancels out the effect of fatigue and produces far more than the normally expected light output.

The advantages of the present invention, as well as certain changes and modifications to the disclosed embodiment thereof, will be readily apparent to those skilled in the art. It is the applicant's intention to cover all those changes and modifications which could be made to the embodiment of the invention herein chosen for the purposes of the disclosure without departing from the spirit and scope of the invention.

What is claimed is:

1. A control circuit for repetitively energizing a plurality of indicator lamps in sequence, said lamps each comprising an electron-emissive cathode filament and a plurality of phosphorescent anodes, said control circuit comprising:

- (1) first circuit means operative to
 - (a) sequentially and repetitively apply a predetermined potential to the anodes in each lamp which are to be energized to form a predetermined symbol,
 - (b) provide electrical power to render said lamp filament electron-emissive, and
 - (c) provide electrical power to create an electron-

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accelerating potential between the lamp filament and the selected anodes of each lamp; and

- (2) second circuit means electrically connected to said first circuit means and operative to reduce the potential of the filament of each lamp in synchronization with the application of said predetermined potential to the anodes of each lamp by said first circuit means.
2. A control circuit according to claim 1 wherein said second circuit means includes:
 - (1) a normally-conductive switching circuit and a resistance connected in series with the filament of each lamp; and
 - (2) a pulse generator to provide pulses to said switching circuit associated with each lamp to render each switching circuit sequentially and repetitively non-conductive.
3. A control circuit according to claim 2 wherein said switching circuit comprises:
 - (1) a transistor having its collector connected to the first terminal of the lamp filament, its emitter connected to the high terminal of a source of potential, and its base capacitively coupled to said pulse generator; and
 - (2) a voltage-dividing network comprising first and second resistances connected in series across the collector and emitter of said transistor, the base being connected to the junction of said first and second resistances.
4. The control circuit according to claim 2 wherein said resistance is connected between the second terminal of the lamp filament and ground.
5. A control circuit according to claim 1 wherein said first circuit means simultaneously energizes identical combinations of anodes in each lamp and said second circuit means causes an electron-accelerating potential between the filament and the combination of anodes of only one lamp.
6. A control circuit according to claim 1 in combination with a plurality of indicator lamps, each lamp comprising an electron-emissive filament and seven phosphor-coated anodes arranged in a figure-eight configuration for forming the digits from 0 to 9, inclusive.

No references cited.

RALPH D. BLAKESLEE, Primary Examiner

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