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GLOW INDICATOR FOR SIGNALING SYSTEMS

Original Filed May 9, 1934

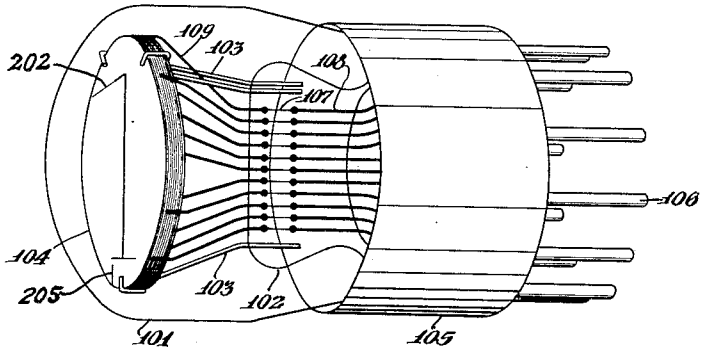

Fig. 1

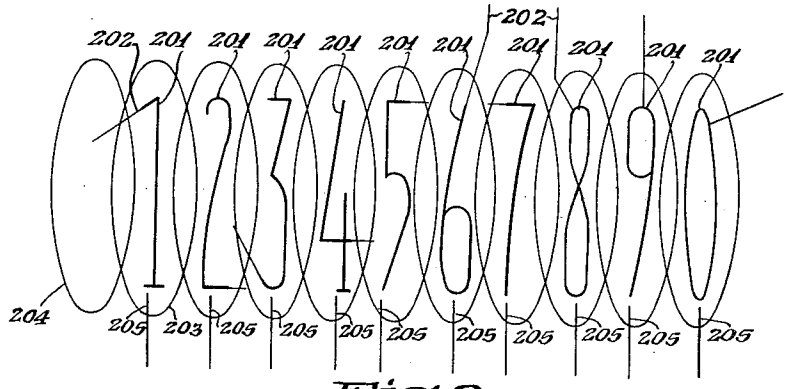

Fig. 2

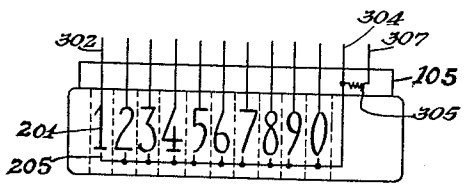

Fig. 3

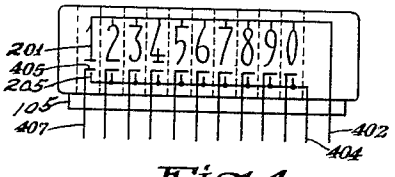

Fig. 4

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GLOW INDICATOR FOR SIGNALING SYSTEMS

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Original application May 9, 1934, Serial No. 724,687. Divided and this application December 31, 1938, Serial No. 248,754

4 Claims. (Cl. 177—327)

This invention is a division of my application Serial No. 724,687, filed May 9, 1934, United States Patent No. 2,142,106, issuing January 3, 1939, and relates to a signaling device and more specifically to glow discharge indicators for selectively signaling numerals, letters or other characters or symbols.

One object of the present invention is to provide a signaling device which is capable of selectively displaying one of a plurality of characters in substantially the same space.

Another object is to provide a signaling device comprising a relatively small compact unit in which the clarity of any selected character displayed is not lessened by the restricted size of the unit or by the presence of other characters which are not displayed.

A further object is to provide a plurality of selectively displayed characters in a compact unit said characters being capable selectively of emitting light or of furnishing no substantial impediment to the passage of light therethrough.

Other objects will appear in the following description taken in conjunction with the accompanying drawing in which:

Figure 1 illustrates one embodiment of the glow discharge indicator.

Figure 2 shows certain parts of the indicator of Figure 1 in exploded fashion.

Figure 3 is a diagrammatic representation of the internal circuit connections of the discharge indicator of Figure 1.

Figure 4 is a diagrammatic representation of the internal circuit connections of an alternative embodiment of the glow discharge indicator.

In the well-known space discharge devices or glow lamps, a pair of metallic electrodes are sealed within a glass bulb filled with neon, mercury, sodium or other suitable gases or vapors at a definite very low pressure. When a unidirectional (direct current) potential is applied to the electrodes and gradually increased, the glow discharge will set in a certain definite potential called an "igniting potential." The luminous glow discharge is produced by negative electrons and positive gas ions and takes place within a certain small distance from the exposed surface of the cathode or negative electrode, which appears to be surrounded or coated with a thin film of light. This film of light follows the contours of the cathode surface in all details.

When the potential is further increased, the glow discharge becomes somewhat brighter. When the potential is gradually reduced, the glow discharge is maintained down to a potential considerably below the igniting potential, until at a certain definite minimum potential the discharge ceases.

If an intermediate potential somewhere between the igniting and minimum potentials is applied to the electrodes, there will be no glow discharge, but if the potential is momentarily raised to or above the igniting potential and thereafter reduced to the intermediate potential, the discharge will be started by the igniting potential and thereafter be maintained by the intermediate potential until the potential is reduced to or below the minimum potential. This characteristic of the glow lamp makes it possible to control the starting and stopping of the glow discharge by means of brief momentary impulses of high and low potentials, with the lamp normally connected to an intermediate potential.

Thus, the glow lamp may be lighted by the application of an igniting impulse and thereafter remains lit, until the potential is reduced momentarily below the minimum potential. This feature offers a means to control glow lamps without external holding relays or other means for keeping the lamp circuit closed when it is desired to have the lamp glow.

The fact that the exposed parts of the cathode of a glow lamp are entirely surrounded by a thin film of luminous discharge may be utilized to display any desired character by means of properly shaped cathodes. A cathode consisting of a wire or metallic coating shaped in the form of the numeral 1 will, when ignited, produce a luminous outline of the numeral 1, and similarly any other desired character may be formed.

In the present invention these two characteristics of the glow lamps are utilized as follows: In Figure 1 the glass bulb **101** is filled with a suitable gas, such as neon, at the required pressure. The glass foot **102** has fused into it a number of supports **103**, which hold the disk assembly **104** near the forward part of the bulb. The disk assembly **104** consists of preferably eleven very thin disks of glass or any other suitable light transmitting insulating material, stacked one behind the other with a small separation between adjacent disks. In the interstices between the disks the electrodes are arranged in the shape of fine metal wires, the cathodes being shaped in any suitable form such as the ten numerals 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0, while the anodes are short pieces of wire **205** near the lower part of each cathode. The anodes do not glow, and those parts of the cathode wires which are not desired

to glow are covered by a suitable insulation, such as enamel.

The bulb is mounted in a base 105 provided with external terminals 106. The connections from the terminals to the electrodes are made by means of connecting wires 108 and 109, and are carried through the glass foot 102 in a well-known manner by means of short connectors 107 made of metal having the same coefficient of expansion as glass.

Figure 2 shows the disk assembly 104 in an exploded view to illustrate the ten cathodes 201 and ten anodes 205. Each of the ten glass disks 203 has the wires 201 and 205 forming the electrodes cemented to its surface in a suitable manner. The lead out wires, such as 202, which are not desired to glow, are covered with suitable insulation.

These ten disks with an additional front cover disk 204 are then stacked one upon the other, the wire electrodes serving to separate the disks from each other so as to permit access of the gas filling to the electrodes. After the disks are assembled, the interstices between them may be sealed in a suitable manner around the periphery to prevent interference from one electrode to another. A small aperture may be left at one point of the periphery by for instance omitting the sealing material at that point to provide communication with the main gas chamber formed by the glass bulb 101.

When the bulb 101 is subsequently exhausted and then filled with gas at the proper pressure, the exhausting and filling process extends through this communicating aperture to the ten gas chambers formed by the eleven glass disks 203 and 204. The communicating aperture may be filled with a suitable sealing material which permits the air and gas to permeate during the exhausting and filling operation. After these operations are completed and the bulb 101 is sealed off, the sealing material in the communicating aperture may be rendered impervious to the gas by suitable procedures, such as heating by means of electronic bombardment, for the purpose of completely sealing the ten gas chambers from each other and from the main gas chamber formed by the bulb 101.

The entire disk assembly is very thin. If, for example, each glass disk is 0.008 inch thick and the electrode wires or metallic coatings have a diameter of 0.002 inch, the assembly 104 is altogether only 0.108 inch thick. As a result, the rearmost cathode 0, when glowing, will be easily discernible through the ten disks in front, and the other nine cathodes in the shape of the numerals 1 to 9 will not obscure the glow surrounding the cathode 0 to a noticeable degree, inasmuch as the cathodes are only 0.002 inch in diameter while the glow discharge appearing on both sides of the glowing cathode is approximately $\frac{1}{16}$ inch wide.

Viewed from the front of the bulb, therefore, any one of the ten cathodes, when glowing, will appear in approximately the same place. In this manner, any one of the ten numerals may be displayed by causing the corresponding cathode to glow.

Figure 3 shows the connections inside the bulb, the member 201 being the ten cathodes, connected to ten terminals 302, the ten anodes 205 being connected to terminal 304. A resistance 305 for applying intermediate potentials to all the cathodes as described in my Patent 2,142,106, page 2, lines 51 to 54, right hand column in connection with Figure 4, may also be mounted in the base 105 and connected to terminals 304 and 307.

It will be obvious from the foregoing description of the characteristics of the glow lamp that if a potential between the minimum and igniting potentials is applied between the common anode and all ten cathodes, any one of the ten numerals may be displayed by the momentary application of the igniting potential to the corresponding cathode. This initiates the glow discharge at the selected cathode which is then maintained by the intermediate potential after the igniting potential is removed while all other cathodes will remain dark, since the discharge of these cathodes had not been initiated by the application of the igniting potential. To extinguish the glowing cathode, the potential of this cathode, or of all cathodes, is momentarily reduced to a value below the minimum potential or to zero. Thereafter, any other cathode may be caused to glow by momentarily applying to it the igniting potential.

Thus the described glow lamp may be used to display any one of the ten numerals at will, and it will be obvious that, instead of ten numerals, letters or any other desired characters may be displayed by giving the cathodes the required shape, and that the construction is not limited to ten characters, but permits the use of a larger or smaller number of different characters.

Means for initiating the specific signal desired by the application of the igniting potential between the common anode and the selected cathode, and means for reducing the potential below the minimum potential or to zero in order to extinguish the signal, as well as means for selecting the desired signal are described in my above-mentioned Patent No. 2,142,106 of which this application is a division.

In the well-known grid glow lamp, a third electrode, the so-called grid, is interposed between the cathode and anode. When a negative bias potential is applied to this grid, the result is an increase of the potential required for igniting the discharge. When the grid bias is gradually reduced, the discharge sets in at a certain definite value. Thereafter, the grid bias may be increased again without affecting the discharge, since the negative grid attracts a space charge of positive ions from the glow discharge, which effectively neutralizes the grid. This principle may also be used for the present invention. Figure 4 shows the internal circuit of a glow lamp indicator using this principle. The mechanical construction is substantially the same as illustrated in Figures 1 and 2. Electrically, however, all cathodes 201 are connected to a common terminal 402, while the anodes 205 are connected to a terminal 404 extending through the base of the tube 105. Ten grids 405 are interposed between the cathodes and anodes and connected individually to ten terminals 407. The ten grids 405 are normally connected to a negative grid bias potential. A potential below the igniting value for the given negative grid bias is impressed upon terminals 402 and 404, and will not start the discharge as long as the negative grid bias is maintained. To start the discharge at any one of the cathodes, its corresponding grid bias is lowered to a point where the discharge will set in. Thereafter, the grid bias may be returned to its normal value without affecting the discharge that has set in. In the actual construction of the glow lamp in-

dicator, the grids may take the form of a short piece of wire interposed between the cathodes and anodes.

Means for initiating and controlling the specific signal in this form of my invention are also described in my application above mentioned.

Since my invention is thus capable of various embodiments which include a plurality of symbols arranged in a compact unit, each symbol being arranged selectively to emit light, the visibility of which is not destroyed by the presence of the other unselected symbols, I prefer to be limited not by the specific disclosure herein, but only by the appended claims.

I claim:

1. In a glow lamp luminous indicator for selectively displaying a plurality of configurations each comprising a positive electrode; a negative electrode; transparent insulating members spaced between said electrodes; means for producing a gaseous discharge in said indicator for producing a glow at said negative electrode; means whereby when said discharge occurs, the outline of a predetermined one of said configurations glows; said configurations being sufficiently thinner than the glow produced thereabout and so arranged one behind the other that there is substantially no interference with the visibility, from a common point external of said indicator of the glowing outline of the selected configurations.

2. A glow discharge tube having a plurality of transparent insulating members, said members being arranged one behind the other with a small separation between adjacent members, each member having electrode material coated thereon and of a predetermined polarity; electrode means of opposite polarity for said plurality of electrodes; and lead-in means for applying a potential between said electrode material and said electrode means in such a direction that when the discharge occurs at one of said electrode materials, the outline of said electrode material glows said glow being of a thickness greater than the thickness of the electrode material so that the non-glowing electrodes offer substantially no visibility interference with the glowing electrode, whereby said discharge configuration is visible through said transparent insulating members at a common point exterior to said tube.

3. In a glow lamp luminous indicator for selectively displaying a plurality of configurations, said configurations being in the form of relatively thin wire; transparent insulating members spaced between said wires; means for selectively causing the wire of one of said configurations to glow to display the outline of the configurations; the wire for each configuration being arranged behind each other and in such a manner that any one of them is visible from a single point external of said tube said glow being of a thickness greater than the thickness of the wire so that the non-glowing wires offer substantially no visibility interference with the glowing wire, whereby said discharge configuration is visible through said transparent insulating members at a common point exterior to said tube.

4. In a luminous indicator, a transparent envelope containing a rarefied gas, a plurality of cathodes within the envelope, said cathodes consisting of conducting material in the form of thin lines configurated in the shape of predetermined characters arranged in parallel relation one behind the other, transparent insulating members spaced between said cathodes, anode means within said envelope, said cathodes and anode means having external terminals whereby a voltage may be selectively applied to a desired one of said cathodes and to said anode means to cause said desired cathode to be outlined with a luminous gaseous discharge glow visible through other cathodes in front thereof said glow being of a thickness greater than the thickness of the conducting material so that the non-glowing conducting material offers substantially no visibility interference with the glowing conducting material, whereby said discharge configuration is visible through said transparent insulating members at a common point exterior to said tube.

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