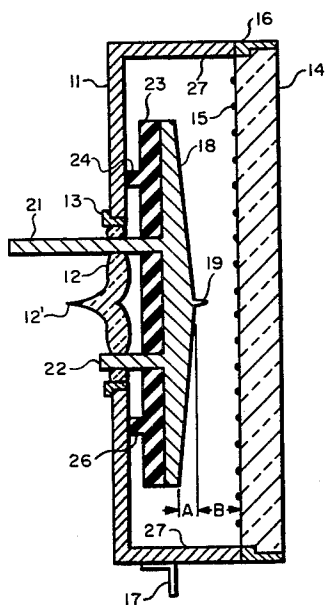
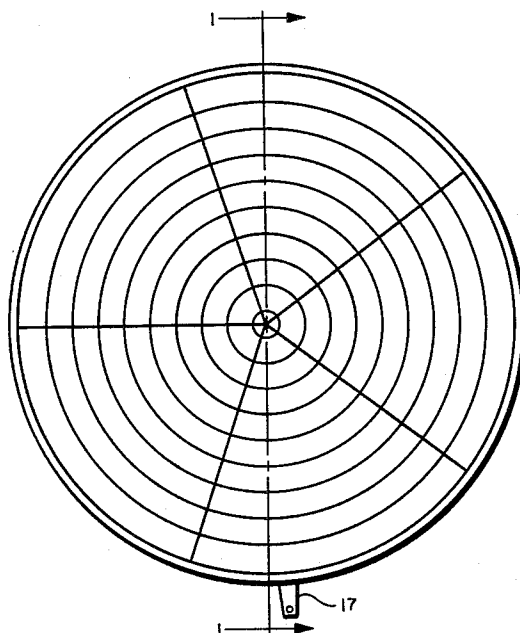
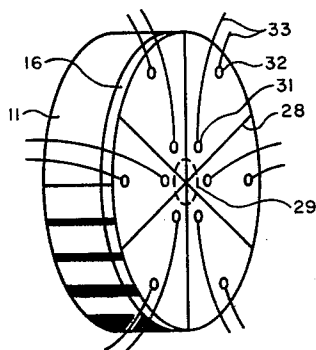


N. L. DU BOIS

GLOW LAMP AND PHOTSENSITIVE ASSEMBLY

Filed June 19, 1962



INVENTOR.
NORMAN L. DUBOIS

NORMAN L. DUBOIS

1

3,198,981

GLOW LAMP AND PHOTSENSITIVE ASSEMBLY
Norman L. Du Bois, Thornwood, N.Y., assignor to
General Precision, Inc., a corporation of Delaware
Filed June 19, 1962, Ser. No. 293,660
11 Claims. (Cl. 315-84.5)

This invention relates to electrical discharge devices for producing ionization and light by collision, commonly termed glow lamps, and to such lamps combined with photosensitive devices.

In applications of glow lamps as circuit control elements, in which the light output which constitutes a function of the input current is utilized, the manner of light production by the glow lamp becomes important. In these applications it is desired that a selected relation be secured between the quantity of light emitted and the lamp current applied. Additionally, it is some times required that the directions in which the light of the glow lamp are transmitted be controlled. These lamp characteristics are not obtainable in existing glow lamps, most of which are designed to give illumination rather than to act as circuit control elements.

Circuits employing glow lamps as circuit control elements and requiring quantitative relations between light emitted and lamp current are described in patent application No. 839,388, filed September 11, 1959, entitled Multiplying Circuit now Patent No. 3,070,306.

In some applications of a glow lamp as a circuit control element the lamp is required to transmit its light equally to a plurality of receiving elements, and to maintain the equality over a range of lamp current. It is therefore necessary to provide symmetry of the lamp design relative to selected locations for light-receiving elements.

Such a combination of glow lamp with a plurality of light-sensitive elements, in which a single input signal variation produces a plurality of exactly equal output signal variations may be termed a signal manifolding device. It has the advantage over earlier manifolding devices that, one of the energy transmission links being a beam of light, the output has no measurable reaction upon the input.

One embodiment of the lamp of this invention provides a metal cathode in the form of a flat cone. The anode comprises a disc placed perpendicular to the cone axis and near the cone nose. This disc is made of transparent material and bears a design, symmetrical about the cone axis, of conductive material imprinted on the inner face of the disc and electrically connected to form the lamp anode. The transparent plate is sealed to a cylindrical case which is gas filled which encloses the cone.

In operation, when the metallized transparent surface constitutes the anode and sufficient voltage is applied between the anode and cathode a glow discharge commences, seeming to envelop part of the cathode surface and occupying a circular area centered at the cone nose. The area of this glow-enveloped surface is a function of the lamp current.

One object of this invention is to provide a glow lamp design suitable for use as a circuit element.

Another object of this invention is to provide a glow lamp design in which the cathode glow changes symmetrically in area as cathode current is changed.

2

Still another object of this invention is to provide a signal manifolding device including a glow lamp having symmetrical light output pattern and a plurality of light sensitive elements equally illuminated by the glow lamp and having equal electrical outputs.

A further understanding of this invention may be secured from the detailed description and associated drawings, in which:

FIGURE 1 is a side view of an embodiment of the lamp of the invention cross-sectioned on the line 1-1, FIGURE 2.

FIGURE 2 is a front view of the lamp of the invention.

FIGURE 3 is an oblique view of the lamp of the invention combined with a photoconductive cell assembly.

Referring now to FIGURE 1, a metal case 11 is composed of a circular head and a peripheral rim to form a shallow box having the form of a short cylinder. An opening in the circular head is filled by a glass terminal header 12 sealed to the metal box head by means of a suitable metal ring 13. The glass terminal header 12 is provided with a tubulation for exhausting the lamp housing and filling it with gas, the tubulation then being sealed off, as indicated by the tip 12'.

The front of the case 11 is closed by a circular transparent glass disc 14 sealed to the metal rim by the use of a suitable metal ring 16. The glass disc 14 is provided on its inner surface with a close conductive web, net, or grid, 15, to serve as the lamp anode. This grid may have any configuration which provides a substantially even electrical distribution over the area of the glass surface. A preferred form is illustrated in FIGURE 2, in which a number of concentric metallic rings are joined by five equidistant radial metallic ribs. These ribs extend to and around the edges of the glass disc, so that they make electrical contact with the conductive ring 16, FIGURE 1, and through it are electrically connected to the metal case 11. The case 11 is provided with an electrical terminal lug 17.

A conical cathode element 18 is made of any metal such as nickel customarily used in glow lamps suitable for emitting electrons upon being bombarded with positive ions, the process being termed secondary emission. As an example, the cone may have a nose angle of about 176° and a face area of about one square inch. The height, A, of the cone at the center may be about 1/2 inch. The cone is preferably provided at its apex with a small, sharp point or projection 19, about .010 inch long. The distance, B, between the apex of the cone and the conductive elements on the inner surface of the glass disc 14 may be about 1/16 inch. The cone is provided with three or more anchor pins, such as pins 21 and 22, one of which, pin 21, projects outside the lamp case to serve as a connection pin. All of the pins pass into or through the glass header 12 and are sealed into it. The cone 18 is separated and insulated from the circular head of the box 11 by an insulating spacer 23 in the form of a disc provided with three or more feet, such as feet 24 and 26, equidistantly spaced circumferentially.

The lamp is filled, before sealing, with argon or other similar inert gas at a few millimeters of mercury pressure.

In the operation of this lamp, it is connected across a source of direct potential, with the positive conductor connected to the anode grid 15 and the negative conduc-

tor connected to the cathode cone 18. A ballast resistor may be inserted in series with the lamp to prevent runaway. As the potential is increased across the lamp, it breaks down and conducts, the potential dropping somewhat until the lamp is operating at that part of its characteristic in which its dynamic resistance is positive. Break-down occurs first at the point where the potential gradient is greatest, at the projection 19, or in its absence, at the cone apex. The discharge produces a cathode glow covering a circular area including and symmetrically surrounding the cone apex, and having an area approximately proportional to the lamp current.

In the bombardment of the cathode 18 by positive gas ions, particles of metal are torn off and tend to settle out in the coldest part of the lamp volume. Since the interior cylindrical wall of the metal enclosure, such as the wall 27, is as cold as any part of the lamp, the particles tend to become deposited there. The action tends to prevent the particles from depositing on the warmer inside face of the glass disc 14 and thereby blackening and obscuring it.

In place of the metal grid shown in FIGURE 2, the glass disc 14 may be made of conductive glass, so that its inner surface is used as the anode yet is completely transparent.

Another way of making the anode is to "half-silver" the inner glass surface by depositing a thin uniform coat of some metal thereon. The coat should be so thin as not to reduce the transparency greatly but thick enough to conduct lamp currents.

The lamp can be combined with a special photoconductive cell assembly to make a combination in which the glow lamp illuminations of the cells are all precisely equal, thus making use of the designed symmetry of the glow around the cone apex. This combination has many uses, one being that described in the Multiplying Circuit previously referred to.

One form of this combination is shown in FIGURE 3, in which the lamp includes the case 11 and the coated glass, serving as the anode, sealed to the case by means of ring 16. The glass itself is nonconductive. In this combination, the outer surface of the glass carries a thin deposited film of cadmium selenide or other photoconductive material. This film is electrically separated into six pie-shaped sectors by six radial insulating spacers 28. All of the sectors are of exactly the same size and shape and are symmetrical about the center of the glass disc. A small opaque disc is applied to the inner surface of the glass disc 14 at its center, as indicated by the dashed circle 29. Each section is provided with two indium buttons, such as buttons 31 and 32, deposited on it for the purpose of making electrical contact with the film of cadmium selenide, and each indium button has a conductor secured to it, such as conductors 33.

In the operation of this combination, when potential is applied between anode and cathode of the lamp a circular cathode glow envelops part of the cathode cone 18, FIGURE 1, symmetrically about its apex. When this glow has a radius larger than the radius of the opaque disc 29, FIGURE 3, the six sectors are equally irradiated by the light of the glow because of the geometrical symmetry of the design. Therefore, each one of the sectors, acting as a photoconductive cell, is increased in conductivity by the same amount as each other sector. Thus, external circuits connected to the sector conductors, such as conductors 33, are equally affected.

When the glow is less in radius than the radius of the opaque disc 29, the photoconductive cells receive little, if any, irradiation. Thus, when the lamp current is low and the glow area is small, making it likely that the lamp may have entered or be about to enter its unstable negative-resistance mode of operation, the photoconductive cells are prevented from operation.

What is claimed is:

1. A glow lamp comprising, a gas-tight envelope having a transparent end face, a filling gas at low pressure

within said envelope, means rendering the inner surface of said transparent face conductive, a conical conductive cathode disposed within said envelope, said conical cathode facing said transparent face, and means applying direct potential between said inner conductive surface and said conical conductive cathode.

2. A glow lamp comprising, a gas-tight envelope having a transparent end face, a filling gas at low pressure within said envelope, means rendering the inner surface of said transparent face conductive, a flat, conical conductive cathode disposed within said envelope, the apex of said conical cathode facing said transparent face with the cone axis normal to the transparent face, and means applying direct potential between said inner surface constituting an anode and said conical conductive cathode.

3. A glow lamp in accordance with claim 2 in which the included angle of the cone of said conical cathode is greater than 170° .

4. A glow lamp comprising, a gas-tight cylindrical envelope one end of which is transparent, the inner surface of said transparent end being conductive and being provided with an external terminal, a filling gas at low pressure within said envelope, a conical conductive cathode disposed within said envelope with a terminal therefor emerging from the envelope, the apex of said conical cathode facing said transparent end with the cone axis normal thereto, and a sharp projection positioned at the apex of said conical cathode extending toward said conductive end surface, the included angle of said conical cathode having a range including 180° within which the voltage gradient between said cathode and said conductive end surface is maximum at all currents including zero current at said sharp tip and within which at all lamp currents the cathode glow has a periphery surrounding said sharp tip and circularly symmetrical thereto.

5. A glow lamp in accordance with claim 4 in which said inner surface of the transparent end has a metallic grid applied thereto.

6. A glow lamp in accordance with claim 4 in which said inner surface of the transparent end is composed of conductive glass.

7. A glow lamp in accordance with claim 4 in which said inner surface of the transparent end is provided with a half-silvered inner surface.

8. A glow lamp in accordance with claim 4 in which the cylindrical walls of said gas-tight cylindrical envelope are composed of metal and remain cooler in operation than said transparent end.

9. A glow lamp comprising, a gas-tight cylindrical envelope one end of which is transparent and the cylindrical walls of which are composed of metal, said transparent end having an opaque disc positioned at the center of the inner surface thereof, the inner surface of said transparent end being conductive and having an external terminal connected thereto, and a conical conductive cathode disposed within said envelope with a terminal therefor emerging from the envelope, the apex of said conical cathode facing said transparent end with the cone axis normal thereto.

10. The combination of a glow lamp and a plurality of photosensitive cells comprising, a glow lamp having a gas-tight envelope having a transparent end face, a filling gas therein, means rendering the inner surface of said transparent side conductive, a conical conductive cathode disposed within said envelope with the apex of said cathode facing the inner surface of said transparent face, means for applying an input signal between said conductive inner surface and said cathode, a plurality of identical photosensitive cells concentrically disposed at equal radii around the center of the outer surface of said transparent face, and means for deriving electrical output signals from each of said photosensitive cells.

11. The combination of a glow lamp and a plurality

5

of photosensitive cells comprising, a glow lamp having a gas-tight envelope having a transparent end face, a filling gas therein, means rendering the inner surface of said transparent face conductive, a conical conductive cathode disposed within said envelope with the apex of said cathode facing the inner surface of said transparent face, means for applying an input signal between said conductive inner surface and said cathode, a photosensitive coating on the outer surface of said transparent face, insulating means radially dividing said photosensi-

5

10

6

tive coating into a plurality of equal sectors, and means for deriving electrical output signals from each of said equal sectors.

References Cited by the Examiner**UNITED STATES PATENTS**

3,070,306 12/62 Du Bois ----- 235—179

GEORGE N. WESTBY, *Primary Examiner*.