

[54] **TRIGGERING APPARATUS FOR A FLASH LAMP**

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[58] Field of Search 240/1.3; 313/201, 313/113; 315/200 A, 228, 237, 240, 241 R, 241 P, 241 S, 313, 324, 325; 340/343

[56] **References Cited**

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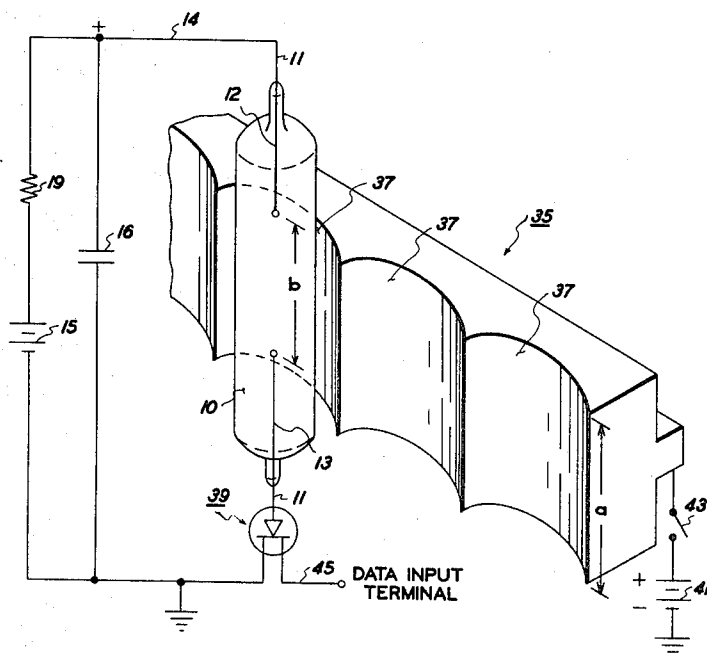
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[57] **ABSTRACT**

Apparatus for triggering a flash lamp. The flash lamp is positioned in a groove formed on a conductive member. The width of the conductive member is selected to be at least equal to the space between the lamp electrodes. In a first embodiment, a voltage of an amplitude sufficient to trigger the flash lamp is applied to the conductive member whereby the flash lamp is caused to emit radiation of a desired wave-length. In a second embodiment, a plurality of flash lamps are positioned in contact with a plurality of grooves formed on the conductive member. A voltage of an amplitude sufficient to trigger all of the flash lamps is applied to the conductive member. Selected ones of said plurality of flash lamps are triggered by applying a signal to switch means connected in the electrode circuits of the selected flash lamps.

4 Claims, 3 Drawing Figures



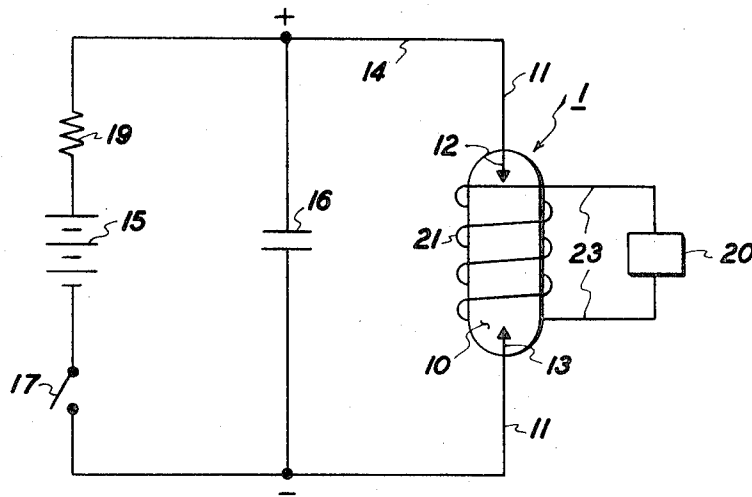


FIG. 1

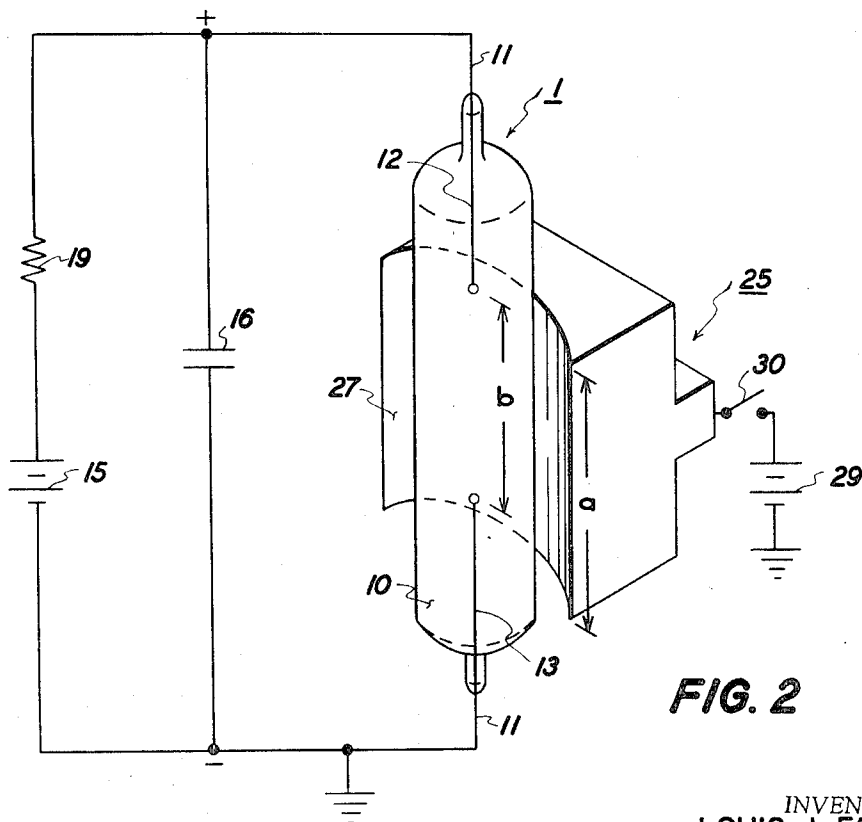


FIG. 2

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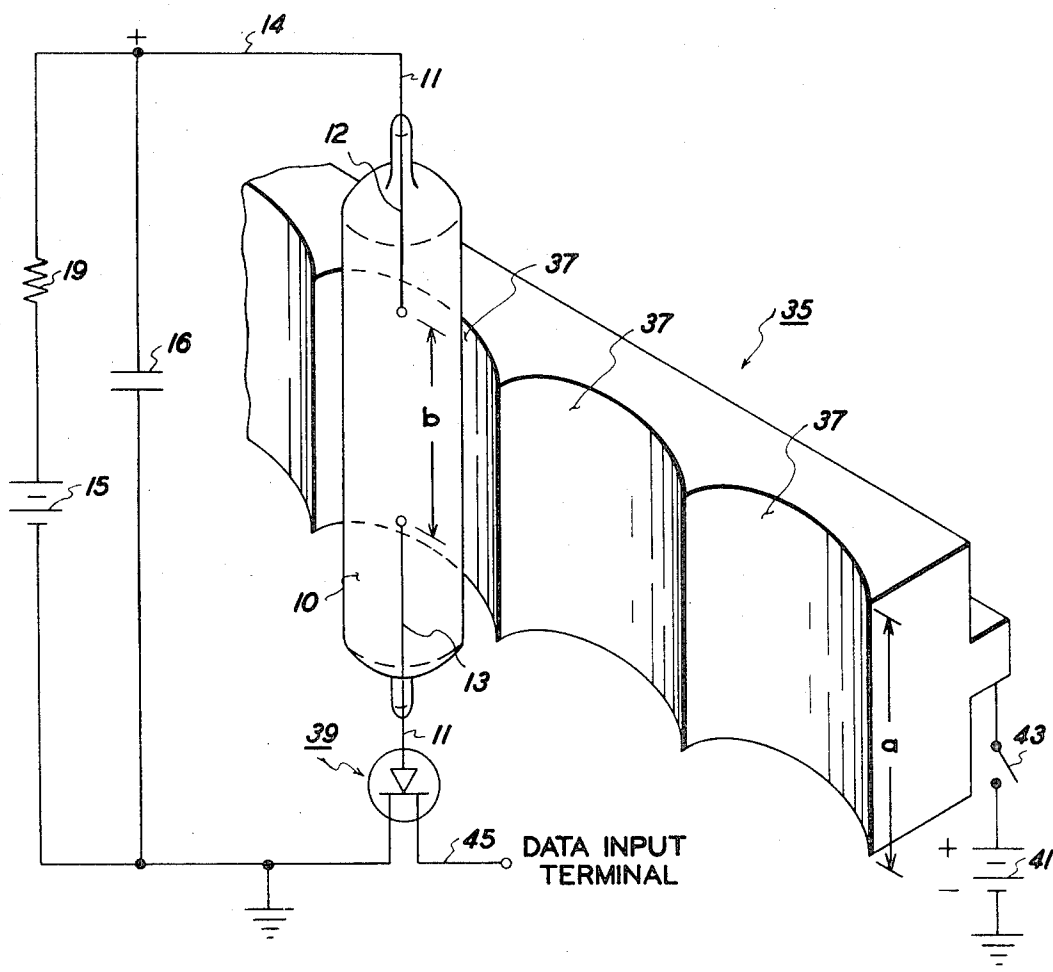


FIG. 3

TRIGGERING APPARATUS FOR A FLASH LAMP

BACKGROUND OF THE INVENTION

Flash lamps have been utilized for various purposes in the prior art, including xerography and optical character recording.

Apparatus for optically recording characters may include a plurality of flash lamps positioned within a rotating drum, the drum being rotated about the flash lamps to enable illumination of transparent characters carried upon the surface of the drum. The illumination transmitted by the transparent characters is projected onto a photosensitive recording medium.

In xerography, as described in U.S. Pat. No. 2,297,691 a fixing step is required before a permanent copy of the image to be reproduced can be obtained. In this fixing step, electroscopic toner as described in Wise's U.S. Pat. No. 2,618,522, adhering electrostatically in imagewise configuration to a recording medium, such as ordinary paper, is heated to such a degree that it melts and fuses with the fibers of the recording paper. One method for providing sufficient heat for the toner is the use of a flash fuser which generally includes a gas lamp, such as a xenon lamp, and suitable optics to direct radiant energy from the lamp onto the surfaces of recording sheets as they are conveyed past the fuser.

Conventionally, the high voltage triggering of flash lamps into a conductive state is implemented by a strand of wire wrapped around each lamp between electrodes or by a conductive strip positioned longitudinally along the side of the lamp. However, the reliability of these lamp triggering techniques is low unless the magnitude of the voltage from the triggering voltage power supply is large. The large voltage needed to trigger the flash lamp increases the power input requirements of the system with the attendant increase in cost and possibilities of lamp failure. In addition, the heat build up in the lamps due to the high voltage decreases the reliability of lamp firing.

SUMMARY OF THE INVENTION

The present invention provides novel apparatus for reducing the voltage required to trigger flash lamps and the incidence of lamp misfirings. In particular, the flash lamp is positioned in a groove formed on a conductive member. The width of the conductive member is at least equal to the space between the lamp electrodes. In a first embodiment, a voltage of an amplitude sufficient to trigger the flash lamp is applied to the conductive member, thereby triggering the lamp and causing the flash lamp to emit radiation of a desired wavelength. In a second embodiment, a plurality of flash lamps are positioned in a plurality of grooves formed on the conductive member. A voltage of an amplitude sufficient to trigger all the flash lamps is applied to the conductive member. Selected ones of said plurality of flash lamps are triggered by applying a signal to switch means connected in the electrode circuits of the selected flash lamps.

It is an object of the present invention to provide novel apparatus for triggering a flash lamp.

It is a further object of the present invention to provide novel apparatus for reducing the amplitude of the voltage required to trigger a flash lamp.

It is still a further object of the present invention to provide novel apparatus for reducing temperature build up on the envelope of a flash lamp.

It is another object of the present invention to provide novel apparatus for triggering selected ones of a plurality of flash lamps.

It is a further object of the present invention to provide novel apparatus for triggering a flash lamp, the flash lamp being positioned in contact with a groove formed on a conductive member, the width of the member being at least equal to the space between the lamp electrodes. In a first embodiment, the triggering voltage is applied to the conductive member, causing the flash lamp to emit radiation of a desired wavelength. In a second embodiment, a plurality of flash lamps are positioned in grooves formed on the conductive member and the triggering voltage is applied to the member. Selected flash lamps are triggered by applying a signal to switch means connected in the electrode circuits of the selected flash lamps.

DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention as well as other objects and features thereof, reference is made to the following description which is to be read in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic diagram of the prior art showing a flash lamp connected in operating relation to an electrical circuit with a direct current power source in combination with an auxiliary trigger circuit;

FIG. 2 is a partial schematic diagram of the novel flash lamp triggering apparatus of the first embodiment of the present invention; and

FIG. 3 is a partial schematic diagram of the novel flash lamp triggering apparatus of the second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, there is seen an envelope 10 of a material capable of being formed into a sealed container to withstand evacuation to partial vacuums and capable of transmitting desired wavelengths of radiation generated by the gaseous medium within the envelope. Lead-in wires 11 are embedded in the envelope. Each lead-in wire bears an electrode, 12 and 13, in spaced apart relationship.

The anode 12 is connected by electrical conductor 14 to the positive terminal of capacitor 16 that may be charged through a charging resistance 19 from an energy source such as battery 15 when switch 17 is closed. The other or cathode, electrode 13 is connected to the negative terminal or capacitor 16.

When the switch 17 is closed, the voltage to which capacitor 16 is charged, may, depending upon various characteristics of lamp 1, in and of itself be sufficient to effect a discharge through the gaseous medium within the envelope 10 between the anode electrode 12 and the cathode electrode 13. This initial voltage required to operate the lamp is herein called the breakdown voltage and is usually greater than later lamp operating voltages because of increased ionization and electrical conductivity of the gaseous medium within envelope 10 after the lamp has been operated for a time. A triggering circuit 23 including, for example, a radio frequency source 20 and external winding 21, provides an alternative technique for igniting lamp 1.

For example, capacitor 16 may be charged, as described hereinabove, to a voltage below the breakdown voltage for the particular conditions of flash lamp 1. The flash lamp 1 may then be triggered by means of trigger circuit 23 by transmitting an impulse from radio frequency source 20 to external winding 21 to cause partial ionization of the gaseous medium within envelope 10 making the medium conductive enough to permit the voltage stored in capacitor 16 to become discharged through the gaseous medium, from the anode 12 to cathode 13, thereby producing high intensity radiation of a wavelength dependent upon the gaseous medium utilized.

Envelope 10 may be a transparent quartz or any other material which permits transmission through the envelope of the radiation produced by the lamp. Electrodes 12 and 13 may be comprised of any suitable electrode material used in electric discharge devices. Typical electrode materials include most conductors including light metals such as aluminum or magnesium, and tungsten which may be surface treated with alkali metals and alkali-earth oxides to enhance their ability to impart charge.

Before the introduction of the gas to the envelope, the envelope is evacuated. Generally, it is found that an evacuation to about 10^{-5} torr or lower pressure is sufficient to remove enough air, water vapor and impurities to insure satisfactory lamp operation without undue deterioration of the electrodes.

Typical gases which may be utilized include xenon, argon, or krypton, and mixtures thereof, a mixture of iodine with xenon and krypton, etc. The gases may be introduced into the envelope from a side tube which may then be sealed off by a stop cock or other means.

Envelopes may take a number of shapes and may be variously placed. For example, a spherical envelope may be utilized instead of the cylindrical envelope illustrated.

Electrode spacing may be extensively varied. The closer together the electrodes, the more the radiation tends to be a point source. For larger spacings of the electrodes a combination of one or more of the following will provide satisfactory lamp operation; increasing the voltage, increasing the trigger effect (as will be described hereinafter, for a fixed electrode spacing, reduced voltage amplitudes are required for triggering in accordance with the teachings of the present invention) or increasing the temperature of the gas so as to produce more ionization of the gas to make it more conductive.

Referring now to FIG. 2, there is shown the first embodiment of the present invention with the lamp of the type disclosed herein connected in operating relation to an electrical circuit with a direct current power source in combination with the novel triggering means of the present invention. The triggering means of the present invention comprises a conductive member 25 having a curved cut-out portion, or groove, 27 thereon. The curved surface area of groove 27 is in contact with the corresponding surface area of envelope 10. The width of conductive member 25, or length of groove 27, is at least equal to the electrode spacing.

In operation, switch 30 is closed, coupling voltage source 29 to conductive member 25. This causes partial ionization of the gaseous medium within envelope 10 making the medium conductive enough to permit the voltage stored in capacitor 16 to become dis-

charged through the gaseous medium, from the anode 12 to cathode 13, thereby producing high intensity radiation of a desired wavelength.

Referring now to FIG. 3, there is shown a lamp of the type disclosed herein connected in operating relation to an electrical circuit with a direct current power source in combination with the second embodiment of the novel triggering means of the present invention. The triggering means comprises a conductive member 35 having a plurality of curved cut out portions, or grooves 37 thereon. The number of grooves 37 required is dependent, in the case of optical character recording, upon the number of columns of information to be printed. The envelope 10 of the lamps is preferably in contact with the curved surface of the grooves 37.

A switch means, such as silicon controlled rectifier (SCR) or controlled conduction device 39, is connected in series with flash lamp 1, the anode electrode of SCR 39 being connected to the cathode electrode 13 of flash lamp 1. The triggering voltage is applied to conductive member 35 by voltage source 41 via switch 43.

In operation, switch 43 is closed, coupling the triggering voltage pulse generated by source 43 to conductive member 35. It should be noted that a plurality of additional flash lamps are positioned in the remaining grooves 37 in a circuit configuration identical to the flash lamp illustrated. The additional lamps have not been illustrated to avoid confusion in the drawing. The application of this voltage pulse to conductive member 35 partially ionizes the gas, such as xenon, in all the lamps located in grooves 37. However, the control gap between the cathode and gate electrodes of SCR 39 is normally biased negatively, the SCR therefore being in the non-conductive state. Capacitor 16 is therefore prevented from discharging through the gaseous medium, from anode 12 to cathode 13. In order to trigger SCR 39 into a conductive state, a positive pulse, or gating signal, is applied to data input terminal 45 by appropriate control means (not shown). When SCR 39 is in the conductive state, capacitor 16 discharges through the circuit comprising anode 12, the gaseous medium, cathode 13, SCR 39 and ground, producing high intensity radiation.

Selected flash lamps are caused to operate by applying a gating signal to the associated SCR, enabling the associated capacitor to discharge through the gaseous medium. It is noted further that since the triggering voltage from source 43 is applied across all the flash lamps located in the grooves 37 of conductive member 35, the necessity of separate triggering voltage sources is eliminated.

Typical conductive materials which may be utilized to fabricate members 25 and 35 include brass, copper aluminum, etc. The thickness of conductive members 25 and 35, i.e., dimension *a*, as shown in FIGS. 2 and 3, should be equal to or greater than the spacing between electrodes 12 and 13, indicated by dimension *b*, in the same figure.

It is believed that intimate contact of members 25 and 35 around a portion of lamp envelope 10 enables the gas within the lamp to be ionized more easily on a volumetric basis rather than on a single point or line basis, meaning that a lower triggering voltage is required. The "wire-wrap" configuration as shown in FIG. 1, essentially a line basis, requires a greater ionizing potential.

Conductive members 25 and 35 are shaped to allow more area for greater heat conduction to the air, thereby increasing lamp life and reducing lamp misfiring by its ability to conduct heat away from each lamp. This reduces the temperatures at the junction of the lamp envelope with the surface of grooves 27 and 37, reducing lamp misfire, false fire or failure which normally results from flashing overly heated flash lamps.

Although members 25 and 35 are shown as T shaped and as having cylindrically shaped grooves, other geometric designs and shapes may be utilized. The only requirement is that conductive members 25 and 35 should be electrically conductive and that the thickness of the members utilized be at least equal to the electrode spacing.

It should be noted that in the configuration illustrated in FIG. 3, the flash lamps may be spaced closely together without the heat generated by flashing the selected flash lamps effecting to a great extent the adjacent lamps since member 35 conducts the heat away to the surrounding air rapidly.

The present invention may, for example, be utilized in the optical recording system disclosed in U.S. Pat. No. 2,843,840. In accordance with the teachings of the present invention, the flash lamp circuitry disclosed in the patent is modified so that switch means, such as SCR's, are included in the electrode circuitry of the flash lamps, as described hereinabove.

While the invention has been described with reference to its preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the true spirit and scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teaching of the invention without departing from its essential teachings.

What is claimed is:

1. Flash lamp apparatus comprising:

- a. an elongated conductive member having a plurality of grooves substantially parallel to each other on one surface thereof,
- b. a plurality of flash lamps, the envelope of each of

said flash lamps being positioned relative to each of said grooves, each flash lamp having spaced-apart electrodes within said envelope, the length of each groove being at least equal to the spacing between said electrodes,

c. means for coupling a voltage of an amplitude below the breakdown voltage across the electrodes of one or more of said flash lamps,

d. means for applying a voltage of an amplitude sufficient to trigger each of said flash lamps to said conductive member, and

e. switch means coupled to the electrodes of each of said flash lamps, said switch means being initially biased in a non-conductive state, and means coupled to said switch means for receiving a gating signal, said gating signal causing said switch means to assume a conductive state, thereby causing said flash lamps to emit radiation.

2. The apparatus as defined in claim 1 wherein said gating signal is applied to selected ones of said switch means whereby selected ones of said plurality of flash lamps are caused to emit radiation.

3. A lamp array for illuminating discrete preselected regions upon a surface to be exposed comprising a plurality of lamps each having an envelope containing an ionizable gas;

a pair of electrodes extending into the interior of the lamp and having leads for connecting each lamp to an external driving circuit;

said lamps being arranged in spaced parallel fashion at regular intervals along an imaginary straight line; an elongated bar of conductive material positioned along one side of said array immediately adjacent all of the lamps in the array;

said conductive bar being adapted to trigger the ignition of those preselected lamps in the array whose energizing circuits have been activated.

4. The lamp array of claim 3 wherein said surface is provided with a plurality of arcuate-shaped grooves each being adapted to receive and position the envelope portion of an associated lamp.

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