APPARATUS FOR FLASHING GASEOUS DISCHARGE LAMPS

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Fig.1.

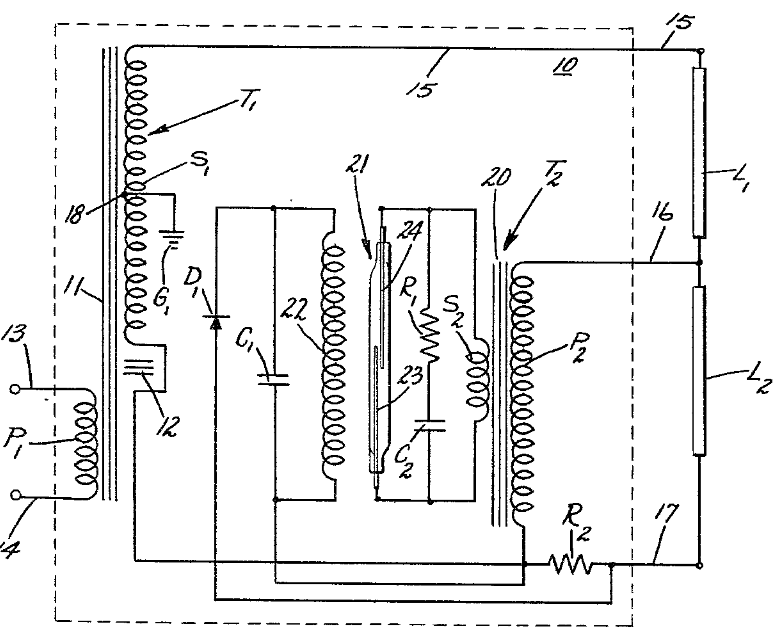
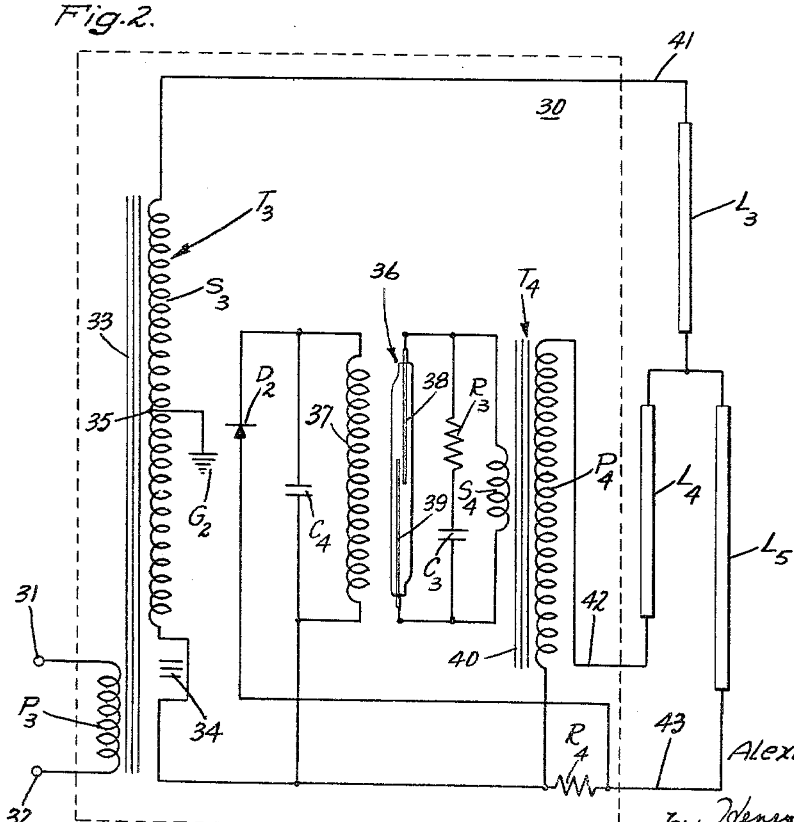


Fig.2.



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APPARATUS FOR FLASHING GASEOUS DISCHARGE LAMPS

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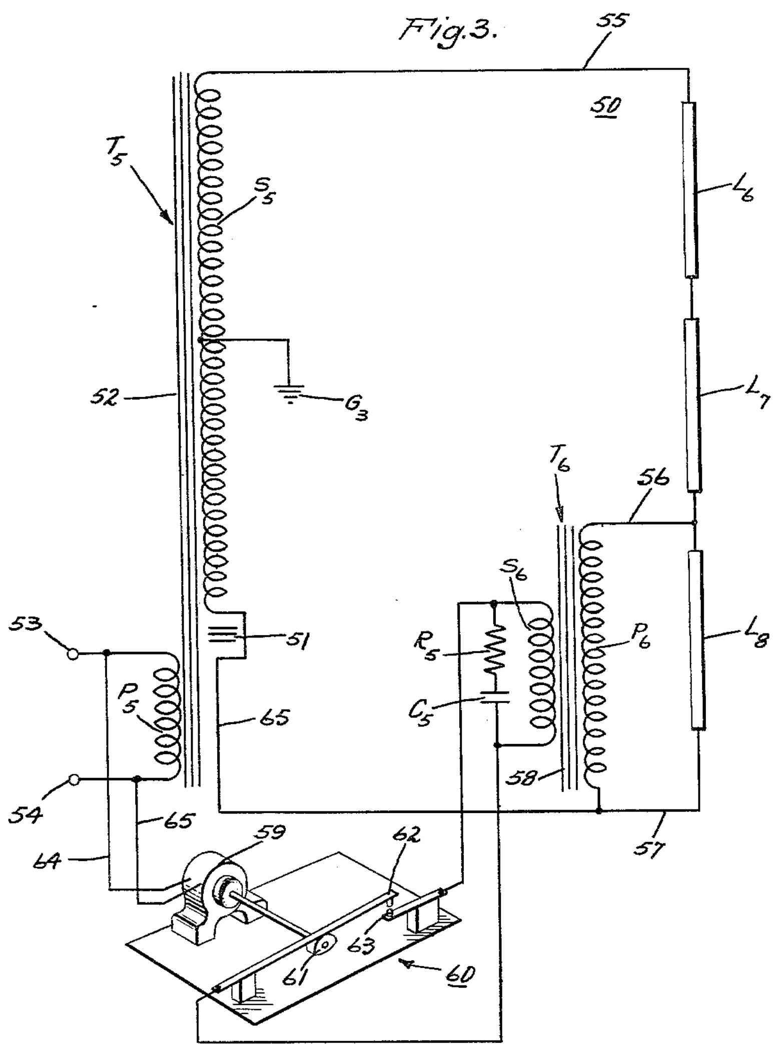
Fig. 3.



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United States Patent Office

3,240,992
Patented Mar. 15, 1966

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3,240,992

APPARATUS FOR FLASHING GASEOUS DISCHARGE LAMPS

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Filed Apr. 11, 1963, Ser. No. 272,269
11 Claims. (Cl. 315—254)

The invention relates generally to electrical apparatus for flashing gaseous discharge lamps. More particularly, it relates to such apparatus wherein two or more gaseous discharge lamps are started and operated by the apparatus and at least one of the gaseous electric discharge lamps is flashed on and off in conjunction with one or more lamps operated at a steady output level.

Where luminous gaseous discharge lamps, such as neon tubes or fluorescent lamps, are used in signs or display systems, it is frequently desirable to flash one or more of the lamps on and off to attract attention to the sign or display system. In a commonly used apparatus, the gaseous discharge lamp is flashed on and off by alternately energizing and deenergizing the primary circuit of the ballast transformer employed to provide the starting and operating potentials for the lamp. A disadvantage of such a conventional flashing arrangement is that separate ballast transformers are required for the lamp or lamps that are to be flashed and for the lamps that are to be continuously operated at a normal light output level. From an economic standpoint, it is desirable where possible to operate the flashing and nonflashing lamps from a single ballast transformer.

The need for separate ballast transformers may, of course, be eliminated by placing the switching device in the secondary circuit of the transformer. One of the principal difficulties with such an arrangement arises out of the high secondary voltages involved which will vary depending upon particular neon tube applications and will range from 2,000 to 15,000 volts. At 15,000 volts open switching is not feasible because high voltage arcing presents a fire hazard. Although various switching arrangements have been proposed for the use in secondary circuits to minimize the effects of high voltage arcing, reliability and service life have not been entirely satisfactory since the switching elements employed are subjected to relatively high voltage.

In applications where the sign or display system is used at a location that is not readily accessible, it is usually desirable to locate the components of the flashing apparatus that require some periodic maintenance, such as the switching device, at a location where the component can be conveniently serviced. Where the component is a switching device connected in the secondary circuit of the ballast transformer, it is usually not desirable and generally not practicable to run long high voltage cables to place the component at a convenient location for servicing. For this reason and more particularly to improve the reliability and service life of the apparatus, it is desirable that the switching devices used in the flashing apparatus have relatively low volt-ampere ratings.

Accordingly, a general object of the present invention is to provide an improved apparatus for flashing one or more gaseous electric discharge lamps.

A more specific object of the present invention is to provide an improved apparatus for flashing one or more gaseous discharge lamps wherein the switching device utilized has a relatively low volt-ampere rating.

It is a further object of the present invention to provide an improved apparatus for flashing at least one gaseous discharge lamp in conjunction with one or more gaseous discharge lamps that are operated at normal light output level, all of the gaseous discharge lamps being operated from a single ballast transformer.

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Another object of the present invention is to provide an improved apparatus for operating and flashing gaseous discharge lamps wherein the switching element associated with the secondary circuit of a ballast transformer can be readily wired at locations remote from ballast transformer to facilitate servicing.

A further object of the invention is to provide an improved apparatus for operating flashing and non-flashing lamps from a single ballast transformer that will provide satisfactory and reliable service over extended periods of time.

In accordance with one form of the invention, I have provided an improved arrangement in which a flasher transformer having a relatively low volt-ampere rating is employed in conjuction with a ballast transformer to isolate a switching means from the high secondary voltage of the ballast transformer. The secondary winding of the flasher transformer is preferably loosely coupled with the primary to limit the secondary current. The primary winding of the flasher transformer is connected in circuit with the gaseous discharge lamp or lamps to be flashed. The switching element of the switching means is connected in the secondary circuit of the flasher transformer in order to alternately open and close the secondary circuit of the flasher transformer thereby to change the flasher transformer from a high impedance to a low impedance condition. The change of the flasher transformer from the high impedance to the low impedance condition of the secondary causes one or more of the gaseous discharge lamps to flash on and off.

According to one aspect of the invention, where the lamp is to be flashed in conjunction with one or more non-flashing lamps operated from a single ballast transformer, the primary winding of the flasher transformer is connected across the lamp to be flashed. Where a pair of lamps having different starting voltage requirements are to be flashed alternately, the primary winding of the flasher transformer may be connected in series circuit with the lamp having a lower impedance. In this arrangement the flashing gaseous discharge lamps are connected in parallel circuit branches which are connected in series circuit relation with the non-flashing lamp or lamps.

The improved arrangement makes it possible to use a switching element as a component of the switching means that is characterized by a relatively low volt-ampere rating. Thus, the reliability and service life of the switching means is significantly increased as compared with conventional systems employing switching elements subjected to the secondary voltage of the ballast transformers. Also, because of the low volt-ampere ratings of the switching elements that may be used in the improved arrangement, switching devices such as reed switches, thermal switches, clock motor driven rotary switches and other types of switching devices, can be employed to open and close the secondary circuit of the flasher transformer.

The subject matter which I regard as my invention is set forth in the appended claims. The invention itself, however, together with further objects and advantages thereof may be better understood by referring to the following description taken in connection with the accompanying drawings in which:

FIGURE 1 is a schematic circuit diagram of an apparatus embodying one form of the invention in which one gaseous discharge lamp is flashed on and off and another gaseous discharge lamp is operated at a normal output level;

FIGURE 2 is a schematic circuit diagram of an apparatus embodying the invention wherein one gaseous discharge lamp is operated at a normal output level and a pair of gaseous discharge lamps are alternately flashed on and off; and

FIGURE 3 is a schematic illustration of another embodiment of the invention utilizing a motor-driven rotary switch to perform the switching function in the improved flashing arrangement.

In FIGURE 1 I have illustrated an apparatus **10** for operating gaseous discharge lamps L_1 at a normal light output level and for flashing a gaseous discharge lamp L_2. The gaseous discharge lamps L_1, L_2 used in the illustrated embodiment of the invention were neon tubes. As used herein, a neon tube generally denotes a luminous gaseous discharge lamp comprised of a sealed glass tube with an electrode at each end and filled with a gas vapor or a mixture thereof, which may include neon, argon, helium, xenon, krypton or mercury vapor.

When a specific starting potential is applied across the lamps L_1 and L_2, they will ignite and will glow in a color determined by the color of the tube and the particular gas or vapor or combinations thereof contained in the lamps L_1 and L_2. The requisite starting and operating potentials for lamps L_1 and L_2 are provided by a ballast transformer T_1. As is shown schematically in FIGURE 1, the transformer T_1 includes a primary winding P_1 and a high leakage reactance secondary winding S_1 inductively coupled with the primary winding P_1 on a magnetic core **11**. A magnetic shunt **12** provides a path for leakage flux.

Although magnetic shunts were used to provide the desired leakage reactance, it will be understood, of course, that various other arrangements for providing flux leakage paths or shunts between the primary winding P_1 and the secondary winding S_1 may be employed. Depending upon the design of the particular ballast transformer, either air leakage paths, inserted shunts, or shunts integrally formed on the magnetic core **11** may be employed.

The primary winding P_1 of the transformer T_1 has a pair of leads or terminals **13, 14** for connection to a suitable alternating current supply. Lamps L_1 and L_2 are connected in circuit with the apparatus **10** by means of the leads or terminals **15, 16** and **17**. The center tap **18** of the high leakage reactance secondary winding S_1 of the transformer T_1 is connected in circuit with a ground G_1 to reduce the secondary voltage to ground.

In accordance with the improved arrangement of the invention, a flasher transformer T_2 has a primary winding P_2 that is connected in circuit across the flashing gaseous discharge lamp L_2 and inductively coupled with a secondary winding S_2 on a magnetic core **20**. In the embodiment of the invention shown in FIGURE 1, I have employed a reed switch **21** and a coil **22**. The flashing circuit arrangement is more fully described and claimed in an application (3D–2502) of Gordon M. Bell filed concurrently with the present application and assigned to the same assignee as the present application.

The reed switch **21** includes a pair of switching contacts **23, 24**. When the apparatus **10** is initially energized, the reed switch **21** is normally in the open condition as shown. When the voltage across the coil **22** reaches a predetermined level as determined by the charge on capacitor C_1, the switching contacts **23, 24** are closed to short the secondary circuit of the flasher transformer T_2. The switching contacts **23, 24** are again opened when voltage across the coil **22** falls off as capacitor C_1 discharges.

Resistor R_1 and capacitor C_2 are connected across the switching contacts **23, 24** to prevent the switching contacts **23, 24** from arcing. It will be noted that the capacitor C_1 is charged with a D.C. voltage through a diode D_1 which is connected in circuit with a voltage dropping resistor R_2. The rate at which the gaseous discharge lamp L_2 is flashed on and off is determined by the frequency at which the capacitor C_2 is charged to the voltage level required for coil **22** to close the switching contacts **23, 24** and is discharged to cause the contacts **23, 24** to open.

The apparatus **10** operates from the power supplied to the ballast transformer T_1. When input terminals **13, 14** of the primary winding P_1 are energized from a suitable alternating current source, the open circuit voltage is

initially applied across gaseous dicharge lamps L_1 and L_2 since during the initial starting condition the secondary circuit of the transformer T_2 is open, and the transformer T_2 presents a high impedance. Consequently, the open circuit voltage is applied across leads **15** and **17** to ignite gaseous discharge lamps L_1 and L_2, and current flows through the lamps L_1 and L_2 and the dropping resistor R_2. A unidirectional charging current is supplied to capacitor C_1. When the capacitor C_1 charges to a predetermined level and discharges through the coil **22** to provide the pull-in ampere-turns, the switching contacts **23, 24** close. The reactor or transformer T_2 now presents a low impedance thereby causing the secondary of the ballast transformer T_1 to shunt gaseous discharge lamp L_2, therby extinguishing lamp L_2. When lamp L_2 does not support any current flow, there is no current flow through the dropping resistor R_2. As capacitor C_1 discharges through coil **22**, the coil current falls off. When the coil current reaches a certain level, the switching contacts **23, 24** are opened, and the reactor or transformer T_2 reverts to its high impedance condition. Thus, lamp L_2 is again flashed on, and current flows through the dropping resistor R_2 to start another charging cycle on the capacitor C_1. The flashing cycle repeats itself at a frequency which is determined by the rate at which the capacitor C_1 is charged and discharged to close and open switching contacts **23** and **24**.

Referring now to FIGURE 2, I have illustrated therein a schematic circuit diagram of an apparatus **30** for operating a gaseous discharge lamp L_3 at its normal luminous output level and for flashing a pair of gaseous discharge lamps L_4 and L_5. In the embodiment of the invention reduced to practice, as will be hereinafter more fully described, gaseous discharge lamp L_3 was a white neon tube, gaseous discharge lamp L_4 was a green tube having a lower operating voltage than the lamp L_5, and gaseous discharge lamp L_5 was a red neon tube, the green and red neon tubes being alternately flashed on and off.

As in the other embodiments of the invention, the starting and operating potentials for the gaseous discharge lamps L_3, L_4 and L_5 were provided by a high leakage reactance type of ballast transformer T_3. Transformer T_3 includes a primary winding P_3 having terminals or leads **31, 32** adapted for connection to an alternating current supply and a secondary winding S_3 inductively coupled therewith on a magnetic core **33**. A path for leakage flux was provided by magnetic shunts **34** interposed between the primary winding P_3 and the secondary winding S_3. In order to reduce the secondary voltage to ground, the center tap **35** of the secondary winding S_3 was connected to a ground G_2.

It will be noted that in this embodiment of the invention the primary winding P_4 of the flasher transformer T_4 is connected in series circuit relation with a flashing gaseous discharge lamp L_4, which has the lower impedance. The switching means used to open and close the secondary circuit of the flasher transformer T_4 is essentially similar to the one used in the other illustrated embodiments of the invention. It includes a reed switch **36** having a coil **37** and a pair of switching contacts **38, 39**, a serially connected resistor R_3 and capacitor C_3 which prevent contacts **38, 39** from arcing, a capacitor C_4, a diode D_2 and a resistor R_4. The resistor R_4 is a voltage dropping impedance element across which a voltage is developed when current flows through the gaseous discharge lamp L_5. The diode D_2 rectifies the voltage across the resistor R_4 so that capacitor C_4 is charged with a unidirectional current.

Preferably, secondary winding S_4 of the flasher transformer T_4 is loosely coupled with the primary winding P_4 on a magnetic core **40**. With a loosely coupled secondary winding S_4, it is possible to limit the current flowing through the reed switch **21** during the interval the switching contacts **23, 24** are closed and further reduce the volt-ampere rating of the switching device. For example, in the embodiment of the invention actually reduced to practice, the reed switch **21** used has a rating of 15 volt-amperes.

As is shown in FIGURE 2, lead **41** connects lamp L_3 in circuit with the secondary winding S_3. Lead **42** joins lamp L_4 in series circuit relation with the primary winding P_4 in one parallel circuit branch while lead **43** joins lamp L_5 in the other parallel circuit branch. In this circuit configuration, lamp L3 is operated at a steady light output level, and lamps L_4 and L_5 are alternately flashed off and on.

When apparatus **30** is energized, the open circuit voltage of the ballast transformer T_3 is initially applied across gaseous discharge lamps L_3 and the parallel combination of L_4 and L_5. The two lamps L_3 and L_5 are ignited thereby causing a current to flow through the lamps L_3, L_5 and the dropping resistor R_4. The parallel circuit branch containing the gaseous discharge lamp L_4 and the primary winding P_4 presents a high impedance to current flow since the secondary winding S_4 is essentially an open circuit. Since current flows through the resistor R_4, the charging cycle of the capacitor C_4 now commences. When the charge on capacitor C_4 reaches a predetermined level, the reed switch **36** is activated, and the switching contacts **38, 39** close to cause the secondary circuit of transformer T_4 to be shorted. Consequently, flasher transformer T_4 is in the low impedance condition, and lamp L_4 is ignited and conducts current. The voltage across lamp L_5 is now insufficient to sustain the electric discharge and it flashes off.

When gaseous discharge lamp L_4 conducts, it will be noted that the main load current in the secondary circuit of the ballast transformer T_3 shunts the resistor R_4, the extinguished lamp L_5 being in effect an open circuit. Thus, during the interval that the gaseous discharge lamp L_4 conducts, no charging current is supplied to capacitor C_4, and it now discharges through the coil **37**. When the voltage across coil **37** drops below a certain level, the switching contacts **38, 39** are again opened to restore the flasher transformer T_4 to its high impedance condition, and another flashing cycle commences, the green and red lamp, L_4 and L_5, being alternately flashed on and off while the white lamp L_3 operates at its normal and steady light output level.

The apparatus **30** is illustrated in FIGURE 2 was constructed for alternately flashing the red and green gaseous discharge lamps L_4 and L_5 at a flashing rate of one cycle per second. The following specifications of the circuit components used are given by way of a more specific exemplification of the invention and not by limitation thereof:

Transformer T_3	7,500 volt, .030 ampere, 225 volt-amperes.
Primary winding P_3	457 turns of .0339 inch in diameter wire.
Secondary winding S_3	33,000 turns of .0031 inch in diameter wire.
Transformer T_4	Rated at 27 volt-amperes.
Primary winding P_4	13,000 turns of .0028 inch in diameter wire.
Secondary winding S_4	400 turns of .021 inch in diameter wire.
Resistor R_3	27 ohms, 1 watt.
Capacitor C_3	0.47 microfarad, 500 volts D.C.
Reed switch	GE reed switch rated at 15 volt-amperes.
Capacitor C_4	50 microfarads, 50 volts D.C.
Diode D_2	1N1162.
Resistor R_4	2,000 ohms, 2 watt.
Coil **37**	25,000 turns of .002 inch in diameter wire.

An important advantage of the apparatus **30** shown in FIGURE 2 is that gaseous discharge lamps L_4 and L_5 can be alternately flashed on and off and one or more other lamps can be operated continuously from one ballast transformer with a switching element having a volt-ampere rating as low as 15 volt-amperes. This volt-ampere rating insures that the apparatus will provide a long and dependable service. For example, after 60 million flashing cycles, the apparatus **30** employing the specific circuit components described above was operating satisfactorily, and the reed switch **36** did not require any servicing.

Turning now to FIGURE 3, I have shown therein a schematic circuit diagram of an apparatus **50** for operating a pair of gaseous discharge lamps L_6 and L_7 at normal light output and for flashing a third gaseous discharge lamp L_8. The starting and operating potentials for these lamps are supplied by a high leakage reactance type of ballast transformer T_5 having magnetic shunts **51**, a primary winding P_5, and a high leakage reactance secondary winding S_5 inductively coupled with the primary winding P_5 on a magnetic core **52**. The input terminals or leads **53, 54** of transformer T_5 are provided for connection to a suitable alternating current supply. Gaseous discharge lamps L_6, L_7 and L_8 are serially connected across leads **55, 56** and **57**, gaseous discharge lamp L_8 being connected across the primary winding P_6 of the flasher transformer T_6. As in the other illustrated embodiments of the invention, a secondary winding S_6 of flasher transformer T_6 is inductively coupled with a primary winding P_6 on a magnetic core **58**.

The switching means used in the embodiment of the invention to drive the flasher transformer T_6 between a low impedance and a high impedance condition included a small synchronous clock motor **59** driving a rotary switch **60**. The rotary switch **60** was comprised of a cam **61** and switching contacts **62, 63**. Switching contact **63** is stationary while the other switching contact **62** is actuated by the pressure of the cam **61** as it rotates. The motor **59** is energized by the connections **64, 65** which are shown connected in circuit with input leads **53, 54** of the primary winding P_5. It will be understood, of course, that the motor **59** may be directly connected to the alternating current at any convenient location, if desired.

With the apparatus **50** energized by connecting the input leads **53, 54** to an alternating current supply, the flashing rate of the gaseous discharge lamp L_8 is controlled by the rotational speed of the motor **59** which drives the rotary switch **60**. In general, the operation of apparatus **50** is similar to the apparatus **10** shown in FIGURE 1 except that the ballast transformer T_5 must provide a sufficient starting and operating potential for three serially connected gaseous discharge lamps L_6, L_7 and L_8.

When the switching contacts **62, 63** are in the open position as shown, the flasher transformer T_6 is in its high impedance condition, and gaseous discharge lamp L_8 is flashed on. When the cam **61** rotates to a position in which the switching contacts **62, 63** are actuated to a closed position, the secondary circuit of the flasher transformer T_6 is shorted, and it is now in its low impedance condition thereby causing lamp L_8 to flash off. The flashing rate can be readily changed by providing a motor having a different speed or by providing a variable speed motor or by a different number of tubes on the cam.

From the foregoing description it will be apparent that because of the low switching voltages which are made possible by the improved arrangement, the flashing apparatus can readily employ various other types of switching arrangements. Although reed switches and a motor driven rotary switch are shown in the illustrated embodiments of the invention, it will be apparent that other switching arrangements can be used as for example, thermal switches, semiconductor switching circuits, and other switching arrangements that are rendered practicable because of the low switching voltages.

Although the gaseous discharge lamps are shown in the illustrated embodiments of the invention, as straight elongated tubes, it will be understood that the lamps may be formed in any desired shape or configuration. For example, the lamps may take the form of words where the lamps are used in a sign to convey a desired advertising message.

While particular embodiments of the invention have been described herein for illustrative purposes, it will be apparent that these particular embodiments may be changed or varied without departing from the spirit and scope of the invention. It is to be understood, therefore, that I intend by the appended claims to cover all such modifications that fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An apparatus for flashing a gaseous discharge lamp from an alternating current source, said apparatus comprising: a high leakage reactance transformer for connection with the alternating current source to provide the starting and operating potential for said lamp, said transformer having a secondary winding for connection in circuit with the gaseous discharge lamp, a flasher transformer having a primary winding for connection in parallel with the gaseous discharge lamp, a secondary winding inductively coupled with the primary winding of said flasher transformer, and a switching means including a switching element connected across said secondary winding of said flasher transformer to alternately open and close the secondary circuit thereof to flash said gaseous discharge lamp on and off.

2. The apparatus set forth in claim 1 wherein the secondary winding of said flasher transformer is loosely coupled with the primary winding to limit the current flow through said switching element.

3. An apparatus for starting and operating gaseous discharge lamps from an alternating current source and for flashing at least one of the gaseous discharge lamps, said apparatus comprising: a high leakage reactance transformer for supplying the starting and operating potential for said gaseous discharge lamps, said high leakage reactance transformer having a primary winding for connection in circuit with the alternating current source and a secondary winding coupled thereto for connection in circuit with said lamps, a flasher transformer having a primary winding and a secondary winding inductively coupled therewith, said primary winding of said flasher transformer being arranged for connection in circuit with one of said gaseous discharge lamps, a switching means including a switching element, circuit means connecting said switching element in circuit with said secondary winding of the flasher transformer to open and close the secondary circuit thereof during operation to thereby cause at least one of said gaseous discharge lamps to be flashed on and off.

4. The apparatus set forth in claim 3 wherein the secondary winding of said flasher transformer is loosely coupled with the primary winding to limit the current flow through said switching element.

5. An apparatus for starting and operating a plurality of gaseous discharge lamps from an alternating current source and for flashing at least one of said gaseous discharge lamps, said apparatus comprising: a ballast transformer having a primary winding for connection to the alternating current source and having a high leakage reactance secondary winding inductively coupled with said primary winding, circuit means including leads for connecting at least said high leakage reactance secondary winding in circuit with said gaseous discharge lamps to supply the starting and operating potential thereto, a flasher transformer having a primary winding and a secondary winding inductively coupled therewith, circuit means for connecting the primary winding of said flasher transformer in circuit with the gaseous discharge lamp to be flashed on and off during operation, and a switching means including a switching element connected in circuit with the secondary winding of said flasher transformer to cause said secondary circuit of said flasher transformer to be alternately opened and closed thereby to present a high and low impedance in circuit with said gaseous discharge lamp to be flashed on and off.

6. The apparatus set forth in claim 5 wherein the secondary winding of said flasher transformer is loosely coupled with the primary winding to limit the current flow through said switching element.

7. An apparatus for operating from an alternating current source a first gaseous discharge lamp at a normal light output level and for flashing a second gaseous discharge lamp, said apparatus comprising: a ballast transformer having a primary winding for connection to the alternating current source and having a high leakage reactance secondary winding coupled to said primary winding, circuit means for connecting the first and second gaseous discharge lamp in series across at least the secondary winding of said ballast transformer, a flasher transformer having a primary winding and a secondary winding inductively coupled therewith, means for connecting the primary winding of said flasher transformer in circuit across the second gaseous discharge lamp, and a switching means including a switching element operable between a low impedance and a high impedance condition, said switching means being connected in circuit with the secondary winding of said flasher transformer to short the secondary circuit and to open the secondary circuit thereof during operation thereby to cause the second gaseous discharge lamp to flash on and off.

8. An apparatus for operating a gaseous discharge lamp at a steady light output level and for alternately flashing a pair of gaseous discharge lamps, one of said pair of gaseous discharge lamps having a lower starting voltage than the other, said apparatus comprising: a ballast transformer having a primary winding for connection to the alternating current source and having a high leakage reactance secondary winding inductively coupled with said primary winding, circuit means for connecting one of said pair of gaseous discharge lamps to be flashed in a first parallel circuit branch and the other of said lamps in a second parallel circuit branch and for connecting said parallel circuit branches in a series circuit with the gaseous discharge lamp to be operated at a steady light output level, means connecting said series circuit across said secondary winding, a flasher transformer having a primary winding and a secondary winding inductively coupled therewith, said primary winding being adapted for connection in the parallel circuit branch with the gaseous discharge lamp having the lower starting voltage and in series circuit relation therewith, and a switching means including a switching element operable between an open and closed condition at a predetermined frequency, said switching element being connected in circuit with the secondary winding of the flasher transformer to open and short the secondary circuit thereof, and said switching element when switched from the open to the closed position causing one of said pair of gaseous discharge lamps to flash on and the other of said lamps to flash off.

9. An apparatus for flashing at least one gaseous discharge lamp and for operating at least one gaseous discharge lamp at a steady light output level, said apparatus comprising: a ballast transformer having a primary winding and a high leakage reactance secondary winding inductively coupled therewith, circuit means connecting said ballast transformer in circuit with said lamps for supplying the starting and operating potentials thereto, a flasher transformer having a primary winding and a loosely coupled secondary winding, circuit means for connecting the primary winding of said flasher transformer in circuit across one of said lamps, and switching means including a switching element switchable from an open to a closed condition at a predetermined frequency, said switching

element being connected across the secondary winding to short and open the secondary circuit of said flashing transformer thereby to cause the gaseous discharge lamps connected across the primary winding of said flasher transformer to be flashed on and off.

10. The apparatus set forth in claim **9** wherein the switching means is comprised of a motor and a rotary switch operatively connected as said switching element, said rotary switch being driven by said motor at a predetermined frequency to short and open the secondary circuit of said low leakage reactance transformer.

11. An apparatus for operating at least one lamp at a steady light output level and for alternately flashing a pair of gaseous discharge lamps on and off, one of said flashing lamps having a lower impedance than the other of said pair of flashing lamps, said apparatus comprising: a ballast transformer having a primary winding for connection to an alternating current source and a high leakage reactance secondary winding inductively coupled therewith, circuit means for connecting at least said high leakage reactance secondary winding in circuit with the gaseous discharge lamps for supplying the starting and operating potential thereto and for connecting one of the pair of flashing lamps in a first circuit branch and for connecting the other of the pair of flashing lamps in a second circuit branch connected in parallel with the first circuit branch and in series circuit relation with the lamp operated at a steady output level, a reactive device having a first winding and a second winding inductively coupled therewith on a magnetic core, circuit means for connecting said first winding in series circuit with the flashing lamp in said first circuit branch, and a switching means including a switching element connected in circuit with the second winding of said reactive device, said switching element when closed actuating said reactive device from a high impedance to a low impedance condition to flash on the gaseous discharge lamp in the first circuit branch and to flash off the gaseous discharge lamp in the second circuit branch, and said switching element when opened actuating said reactive device from the low impedance condition to the high impedance condition to flash off the gaseous discharge lamp in the first circuit branch and to flash on the gaseous discharge lamp in the second circuit branch.

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