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OTHER REFERENCES

Transistor H. T. Generator, By D. L. Johnston, published in Wireless World, October 1954, page 518 copy in Group 250 class 331/111.

IBM Technical Disclosure Bulletin, Inverter Power Supply, by L. B. Brummel Vol. 2, No. 2, August 1959 page 66 copy in Group 250 331/111.

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[54] **RANDOM FLASHING CIRCUIT INCLUDING A VOLTAGE STEP-UP CONVERTER**
6 Claims, 3 Drawing Figs.

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71, 72, 183, 204, 205, 206, 200, 238, 241, 232,
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143; 340/105

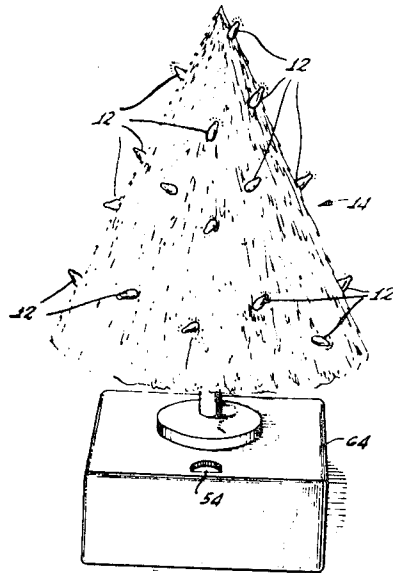
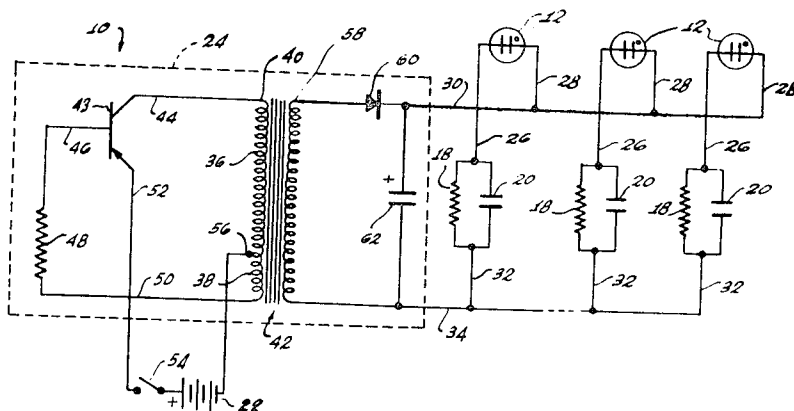
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References Cited

UNITED STATES PATENTS

2,717,336	9/1955	Craddock	315/241 X
3,368,107	2/1968	Skirvin	331/112 X
3,389,298	6/1968	Skirvin	315/206

ABSTRACT: An electrical circuit for periodically and essentially randomly flashing a plurality of gas discharge tubes, particularly for decorative effect. A plurality of gas discharge tubes are connected with associated resistor and capacitor combinations in a relaxation oscillator configuration. A sufficiently high voltage to operate the parallel relaxation oscillators is derived from a low-voltage source and a DC to DC voltage step-up converter. The converter comprises a transistor oscillator of the Hartly type with the main frequency determining coil and the feedback coil being the primary winding of a step-up transformer. The oscillator is powered by the low-voltage DC source and the stepped-up AC voltage appearing at the secondary of the transformer is rectified and filtered to supply the sufficiently high voltage to operate the plurality of flashing circuits.



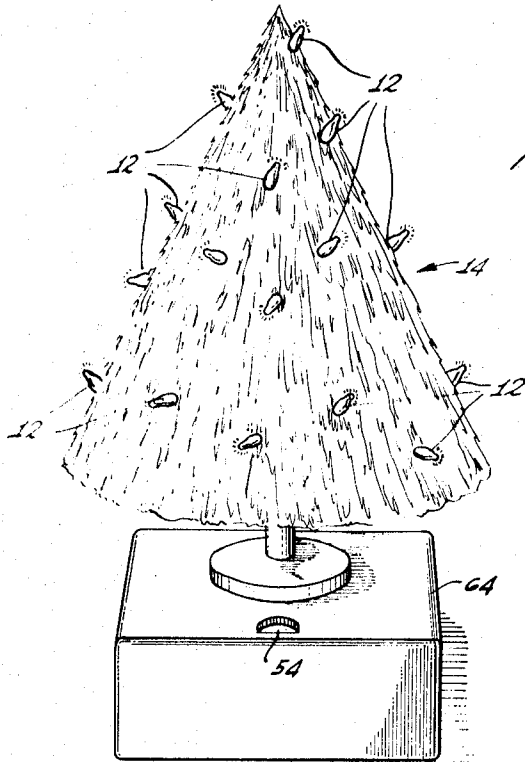


Fig. 1

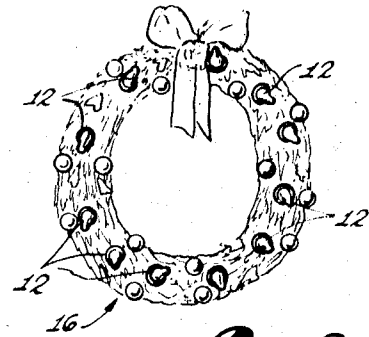


Fig. 2

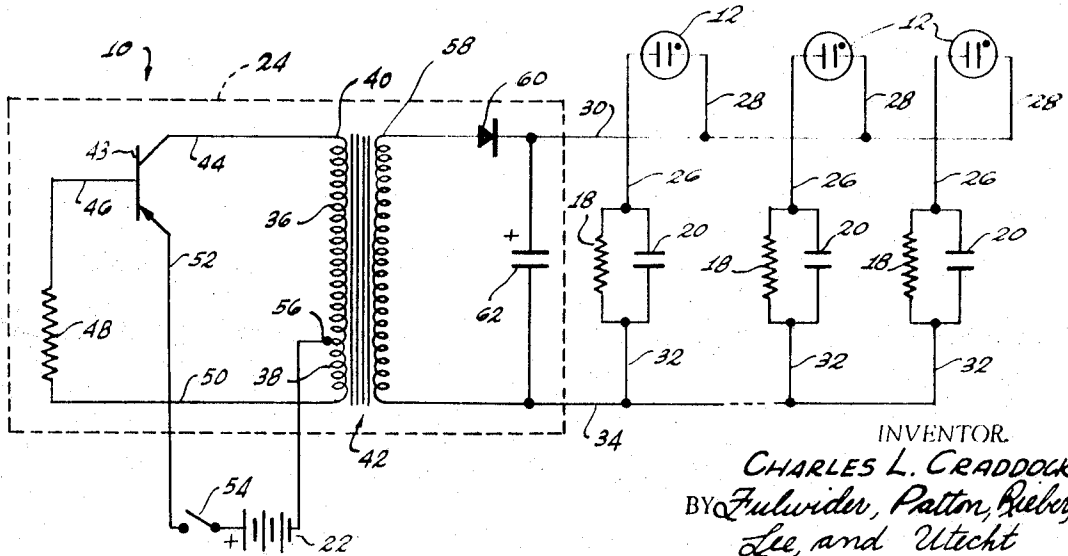


Fig. 3

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RANDOM FLASHING CIRCUIT INCLUDING A VOLTAGE STEP-UP CONVERTER

BACKGROUND OF THE INVENTION

The present invention relates generally to electrical light flashing circuits and more particularly to a circuit for essentially randomly flashing a plurality of small gas discharge tubes primarily for decorative effect.

In designing the decorations used in homes or business establishments during holiday seasons, it is often desired to employ a number of flashing or blinking lights for their aesthetic effect on particular decorative articles. Also, it is particularly desirable, again for the enhanced aesthetic effect, that the individual lights flash on and off at different times to produce the visual effect of randomness in the flashing of the lights.

While a considerably number of miniature bulbs and electrical configurations are possible to achieve the random flashing effect of a number of small bulbs, the most practical bulb to employ for such purposes, both from an aesthetic and economic viewpoint, is the common miniature neon glow tube. Such glow tubes are inexpensive and have a practically unlimited life. In addition, the character of the neon gas in the glow tubes is such that when the tube is lighted, it glows with a characteristic reddish color which enhances its aesthetic effect.

The electrical characteristics of the neon glow tube can also be used to advantage in flashing circuits by connecting the glow tubes in the familiar relaxation oscillator configuration with the period of oscillation set to the desired flash rate for the tube. This eliminates the need for a plurality of relatively expensive relays and switches which might be required if filament-type miniature bulbs were used.

Unfortunately, however, the neon glow tube requires a relatively high voltage for its operation compared to other miniature bulbs and, although suitably high voltages can be obtained from common household electrical outlets, the nature of the decorations on which the tubes are to be used is such that battery operation is much more desirable. Batteries with a sufficiently high-output potential are available, but these batteries were formerly used primarily to power battery-operated radios using vacuum tubes and, since solid-state devices have virtually replaced vacuum tubes in such applications, the demand for small, high-voltage batteries has decreased to the point where such batteries cannot be quickly and easily obtained in local stores. The decreased demand for such high-voltage batteries has also made them relatively expensive compared to the low-voltage types which are readily available. As the decorative articles on which the blinking or flashing lights are to be used are normally only for limited, seasonal use, the use of expensive and difficult to obtain high-voltage batteries makes the decorative articles practically unsuitable for mass markets.

SUMMARY OF THE INVENTION

To solve the above problems in inexpensively utilizing neon glow tubes in random flashing configurations, particularly in decorative applications, the present invention provides an electrical circuit in which a plurality of gas discharge tubes are operated in essentially a random flashing fashion with power for operating the circuit derived from a readily available, low-voltage DC source.

Generally, a plurality of gas discharge tubes, which are in the preferred embodiment neon glow tubes, are electrically connected with associated resistors and capacitors and a relaxation oscillator configuration with each of the relaxation oscillator assemblies having a different period of oscillation. The relatively high-voltage direct current needed to operate the neon glow tube relaxation oscillator assemblies is derived from a low-voltage source through a direct current to direct current voltage step-up converter.

The step-up converter comprises a transistor oscillator of the Hartly type with the main oscillator coil and feedback coil being the primary winding of a step-up transformer. The oscillator is driven from the low-voltage source. The stepped-up AC voltage derived from the oscillations in the primary winding of the transformer appears in the secondary winding and is rectified and filtered to provide the relatively high-voltage DC source needed to operate the neon glow tube relaxation oscillators.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a decoration in the form of a small Christmas tree with a plurality of neon glow tubes in place on the tree;

FIG. 2 is a perspective view of a decorative wreath also having a plurality of neon glow tubes in place on the wreath; and

FIG. 3 is a schematic diagram of the circuit for producing a random flashing of a plurality of neon glow tubes from a low-voltage source with additional glow tube assemblies being indicated by dashed lines.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, the preferred embodiment of the flashing circuit shown in FIG. 3 is employed to provide a plurality of essentially random flashing neon glow tubes on a decorative article such as the Christmas tree 14 or Christmas wreath 16 shown in FIGS. 1 and 2, respectively. The flash rates of all the neon glow tubes 12 are all different and the combined effect is one of random flashing or "twinkling" which enhances the decorative qualities of the tree 14 or wreath 16. It should be noted, however, that the flashing circuit 10 can be used for many applications other than the seasonal decorative articles illustrated.

In general, the flashing circuit 10 has a plurality of neon glow tubes 12 individually connected to an associated resistor 18 and a capacitor 20 in a basic relaxation oscillator circuit. All of the glow tube relaxation oscillator assemblies are connected in parallel and, while FIG. 3 shows only three oscillator circuits, it will be appreciated that a suitable number of oscillators can be provided for a particular decorative article. The high voltage required to operate the oscillators is derived from a relatively low-voltage source such as a battery 22 which powers a direct current to direct current voltage step-up converter 24. The converter 24 steps up the low voltage from the battery 22 to a level sufficient to operate the glow tube relaxation oscillators.

The particular relaxation oscillator configuration used makes use of the characteristic of the gas discharge tubes in general, and the glow tubes 12 in particular, of remaining in an "off" or nonconducting condition until the voltage across the tube is increased to a predetermined firing potential where the gas in the tube ionizes or glows and the tube conducts. The tube 12 will then remain in the conducting condition until the voltage across the tube is lowered to a predetermined extinguishing potential where the tube becomes nonconducting again.

In the relaxation oscillator circuits employed, individual glow tubes 12 are connected in series by a lead 26 to an R.C. network with a resistor 18 and a capacitor 20 connected in parallel. The other side of the glow tube 12 is connected through a lead 28 to a power lead 30 from the converter 24. The other side of the parallel R.C. circuit 18, 20 is connected through a lead 32 to another power lead 34 from the converter 24.

When the high-voltage supply from power leads 20, 34 is initially applied to an individual relaxation oscillator circuit, the capacitor 20 is uncharged and essentially the full voltage from the supply is applied across the glow tube 12 firing it. In the conducting condition, the glow tube offers a relatively low impedance and the capacitor 20 charges quickly toward the supply voltage and the voltage across the glow tube quickly decreases to the extinguishing potential where the tube

becomes nonconducting again. In the nonconducting state, little current flows through the tube 12 and because the capacitor 20 is charged to the supply voltage potential less the extinguishing potential of the tube 12, the voltage across the tube is well below the firing potential. The capacitor 20 then discharges at a relatively slower rate through the resistor 18 and the voltage across the glow tube 12 correspondingly increases until the firing potential is again reached when the tube again becomes conducting. Thus, it can be seen that the glow tube 12 "flashes" at a rate which is determined by the values of the resistor 18 and the capacitor 20. In order to create the appearance of "randomness" in the flashing of the plurality of glow tubes 12, different values of the resistor 18 and the capacitor 20 are chosen for each relaxation oscillator, thus giving individual flashing periods for each glow tube 12. By way of example, the following ranges of voltages and component values have been found to give variable flash rates which produce the desirable aesthetic effects:

Voltage from Converter 24	90—100v.
Glow lamps 12	NE-2 Neon or Equivalent
Resistor 18	2.2 Megohms
Capacitor 20	0.22 to 0.27 mfd.

The high voltage supplied to power leads 30 and 34 which operates the plurality of relaxation oscillators is derived from a relatively low-voltage battery 22 and a DC to DC voltage step-up converter 24. The converter 24 is, in general, a Hartly-type oscillator powered by the low-voltage battery 22. The oscillator has a main oscillator coil 36 and a feedback coil 38 which are also a tapped primary winding of a step-up transformer 42. A transistor 43 has a collector lead 44 connected to the main oscillator coil 36 and a base lead 46 connected through an adjusting resistor 48 to a feedback lead 50 to the lower end of the feedback coil 38. An emitter lead 52 from the transistor 35 is connected through a switch 54 to the positive terminal of the battery 22 and the negative terminal of the battery is connected to a tap 56 between the main oscillator coil 36 and the feedback coil 38.

The main frequency determining parameters are believed to be the inductance of the main oscillator coil 36 and the capacitance between individual coils. The amplitude of the oscillations and to a lesser degree the frequency of oscillations can be adjusted by varying the value of the adjusting resistor 48 in the base and feedback leads 46, 50 of the oscillator.

The oscillations in the primary winding 40 of the transformer 42 produce a stepped-up AC voltage in a secondary winding 58 and the stepped-up voltage is, in turn, rectified and filtered by means of a diode 60 and an electrolytic capacitor 62. In this regard, it is to be noted that the voltage appearing across the power leads 30 and 34 from the converter can be varied by suitable adjustment of the resistor 48 and the oscillator. Also, while many combinations of component values can be used in the converter 24, very satisfactory results can be obtained by using the following component values:

Transistor 35	(Med. Power PNP)	2N1303	
Transformer 42	(Miniature transformer)	TRIAD TY202X	60
	Primary-Secondary turns ratio	1:200	
	Primary Winding Feedback ratio	50:1	
Resistor 48	(Variable, adjusted to give 90 to 100 volts across power leads 30, 34 for particular transistor	Typical Value 3,300 Ohms	65
	35 used)		
Diode 60 (200 volt PIV at 10MA)	1N91		70
Electrolytic Capacitor 62	10 mfd. at 150 WVDC		
Switch 54	Single-Pole Single-Throw		
Battery 22	1.5 volts		

The preferred embodiment of the flashing circuit 10 thus described provides a plurality of randomly flashing neon tubes 75

12 which can be efficiently and inexpensively operated using readily available and inexpensive 1.5 volt batteries of a type commonly employed in flashlights. The battery 22, as well as all of the other circuit components except the glow tubes 12, can be conveniently assembled in a central location, such as a base 64, for the Christmas tree 14 shown in FIG. 1. The switch 54 can then be mounted so as to be externally accessible. Similar housings can be employed for other decorative articles, depending upon their physical shape.

Thus, utilization of the electrical circuit of the present invention allows use of the decorative and aesthetically enhancing effects of the inexpensive neon glow tubes with an inexpensive, low-voltage battery and relatively inexpensive electrical components, compared to the initial cost and replacement cost of high-voltage batteries.

It will be understood that while a particular preferred embodiment of the invention has been described and illustrated, modifications of design and construction can be made without departing from the spirit and scope of the invention. Hence, the invention is no to be limited except as defined in the appended claims.

1. A random flashing circuit, comprising:

a plurality of flashing assemblies connected in parallel, having a plurality of flashing rates, each of said assemblies having a gas discharge tube connected in series with a resistor and a capacitor connected in parallel said assemblies being operative when a direct current voltage applied across them is at least 70 volts;

A direct current voltage source having a voltage equal to or less than 3 volts;

a voltage step-up converter, the step-up ratio of said converter being sufficient to raise the voltage of said source to at least 70 volts to operate said flashing assemblies, said converter including a step-up transformer having a primary winding and a secondary winding, said primary winding having a tap, an oscillator including a transistor having a base, a collector and an emitter, said collector being connected to one end of said primary winding, said base being connected through an adjusting resistor to the other end of said primary winding and said emitter being connected through said voltage source to said tap; and

a rectifier and filter connected to said secondary winding of said transformer to develop the direct current voltage of at least 70 volts applied across said flashing assemblies.

2. A random flashing circuit comprising:

a plurality of relaxation oscillator assemblies connected in parallel, each of said assemblies having a neon glow tube connected in series with a resistor and a capacitor connected in parallel, a plurality of periods of oscillations for said relaxation oscillators being provided by a plurality of values for said capacitor, said relaxation oscillators being operative when a direct current voltage applied across them is at least 70 volts;

a battery having a voltage of approximately 1 1/2 volts;

a step-up transformer having a primary winding and a secondary winding, said primary winding having a tap;

a transistor having a base, a collector and an emitter, said collector being connected to one end of said primary winding, said base being connected through an adjusting resistor to the other end of said primary winding, and said emitter being connected through said battery to said tap, the relationship between said tap and adjusting resistor being such as to sustain oscillation in said primary winding; and

a rectifier and a filter connected between said secondary winding of said transformer and said plurality of relaxation oscillators connected in parallel.

3. The random flashing circuit of claim 2, wherein: the primary to secondary turns ratio of said transformer is approximately 1 to 200.

4. The random flashing circuit of claim 2, wherein: said primary winding is tapped so as to produce a feedback turns ratio of approximately 50 to one with said collector

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of said transistor being connected to the end of said primary winding having the greater number of turns to said tap.

5. The random flashing circuit of claim 2, wherein:
the primary to secondary turns ratio of said transformer is approximately 1 to 200; and
said primary winding is tapped so as to produce a feedback turns ratio of approximately 50 to 1 with said collector of said transistor being connected to the end of said primary winding having the greater number of turns to said tap.
6. A random flashing circuit comprising:
a plurality of flashing assemblies connected in parallel, having a plurality of flashing rates, each of said assemblies having a gas discharge tube connected in series with a resistor and a capacitor connected in parallel, said assemblies being operative when a direct current voltage applied across them is at least 70 volts;

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a direct current voltage source having a voltage of approximately 1½ volts;
a voltage step-up converter, the step-up ratio of said converter being sufficient to raise the voltage of said source to at least 70 volts to operate said flashing assemblies, said converter including a step-up transformer having a primary winding and a secondary winding, said primary winding having a tap, an oscillator including a transistor having a base, a collector and an emitter, said collector being connected to one end of said primary winding, said base being connected through an adjusting resistor to the other end of said primary winding and said emitter being connected through said voltage source to said tap; and
a rectifier and filter connected to said secondary winding of said transformer to develop the direct current voltage of at least 70 volts applied across said flashing assemblies.

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