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(54) Abstract Title
Flicker light string suitable for unlimited series-connection

(57) A flicker light string suitable for unlimited series-connection includes a driver 12 and a plurality of series-connected lamps 11. The driver has an input end 121 connected to an independent-external power supply and a trigger circuit inside it. The trigger circuit (fig 2) has an output end (128) connected to the series-connected lamps and a trigger end 123 being reserved for connection to an external cord for acquiring an outcoming oscillatory signal to control the continuity and interruption of the trigger circuit, so that the light string can flicker with the outcoming signal. Multiple units of the flicker light string can be serially connected to form an unlimitedly extended flicker light string, and all the connected light strings can flicker synchronously without the risk of being overloaded or overheated.

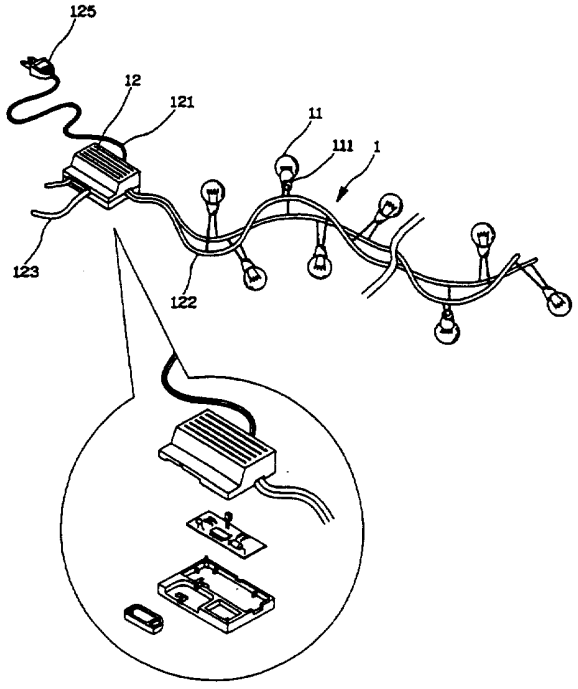

FIG. 1

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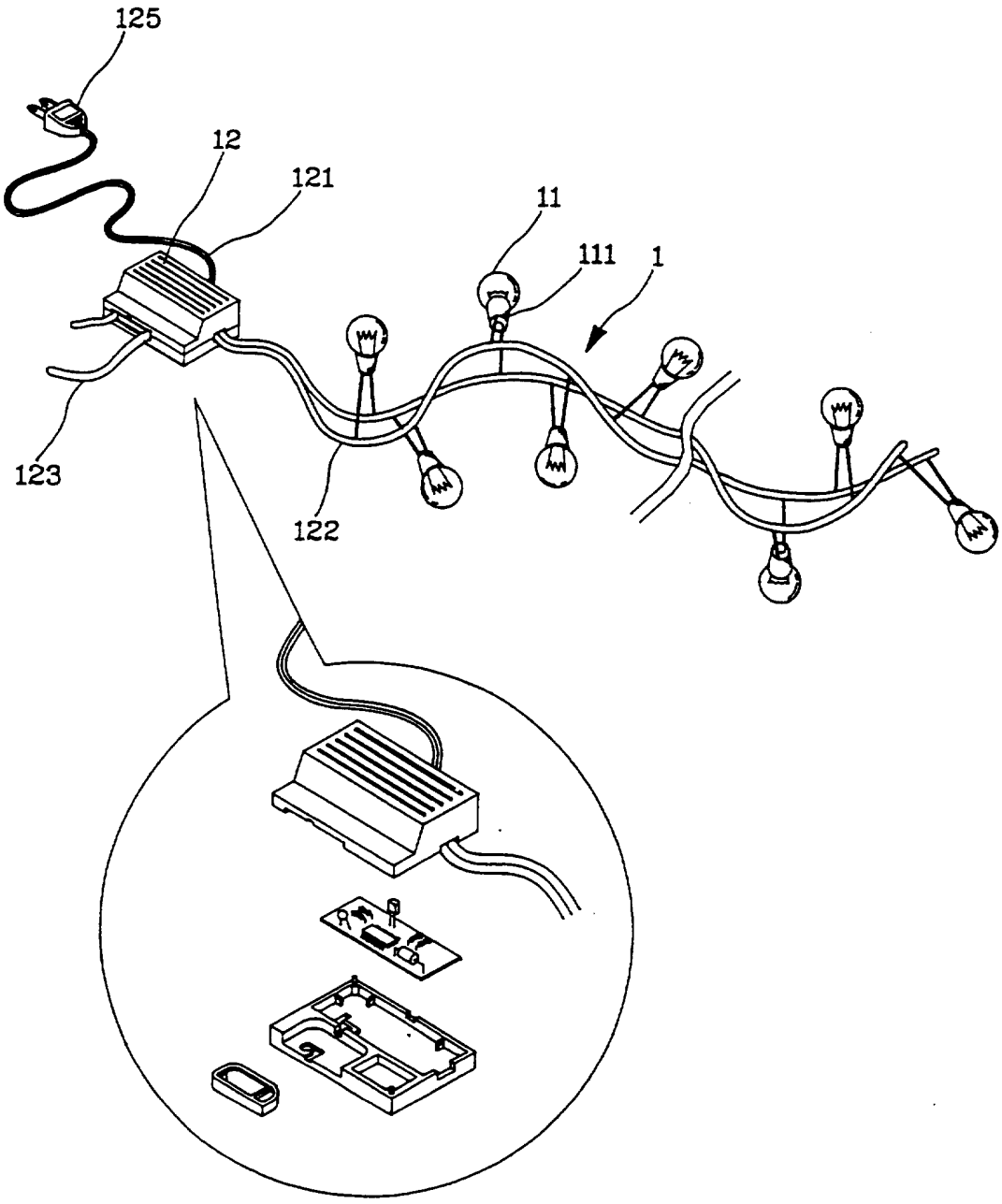


FIG. 1

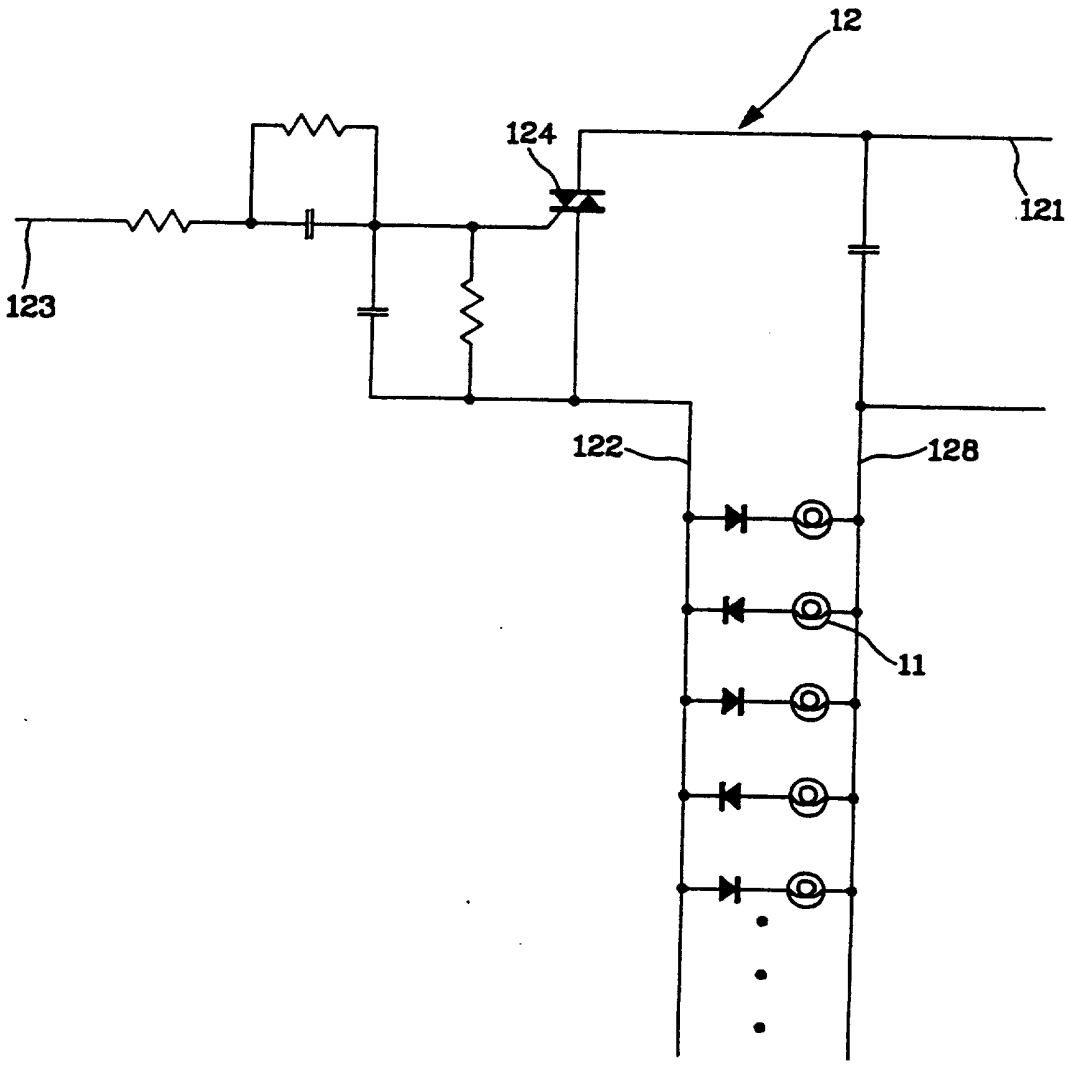


FIG. 2

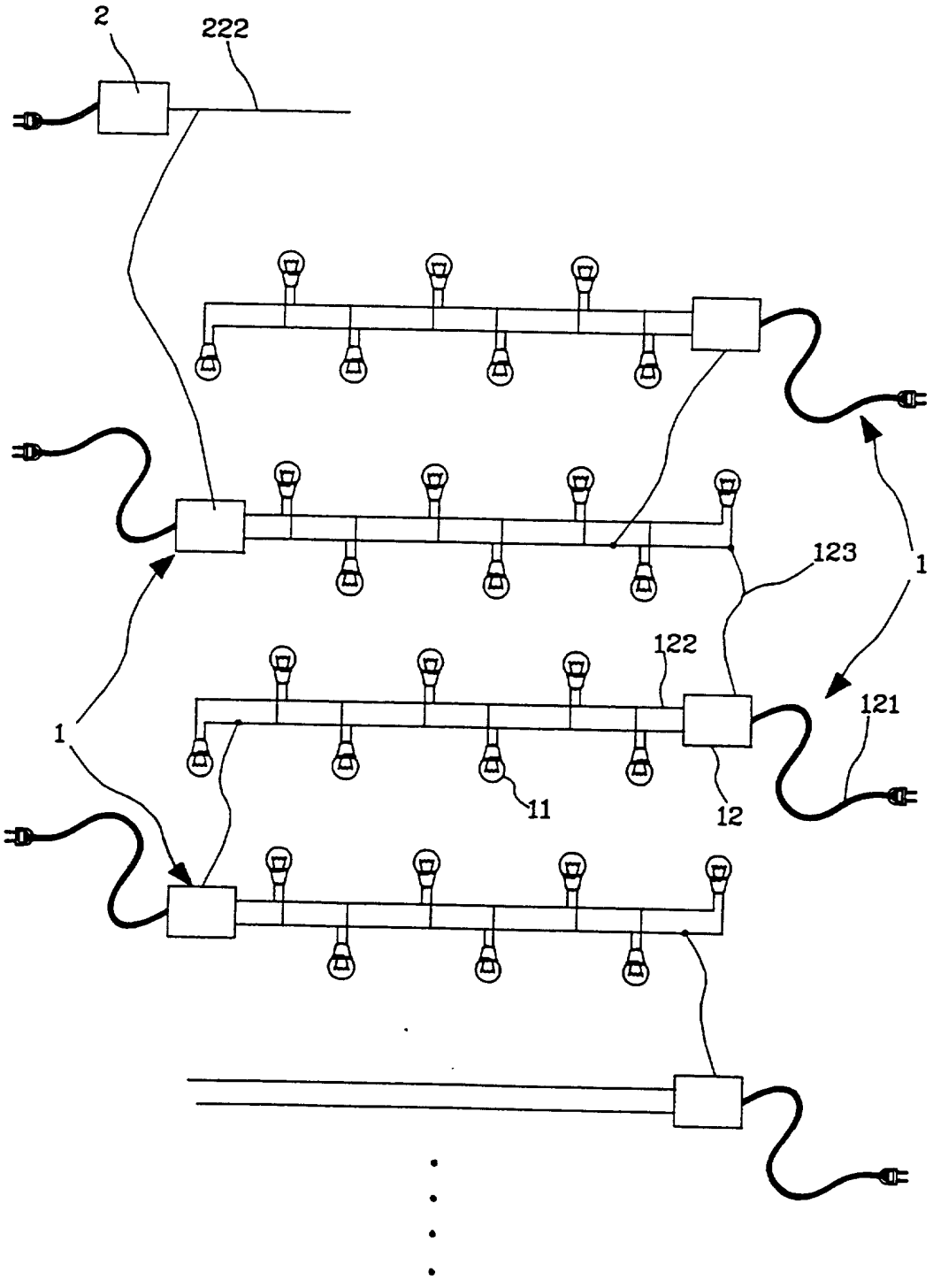


FIG. 3

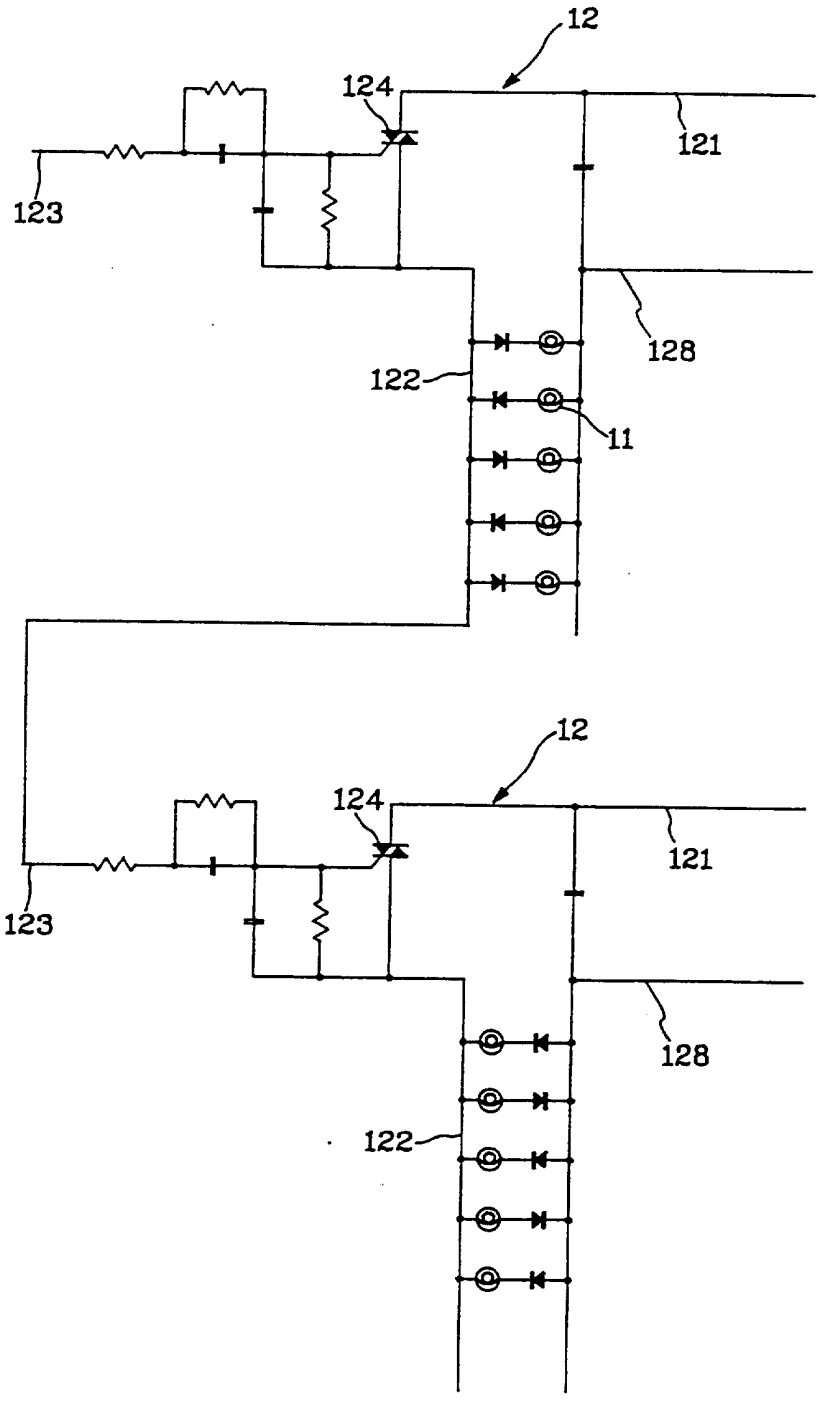


FIG. 4

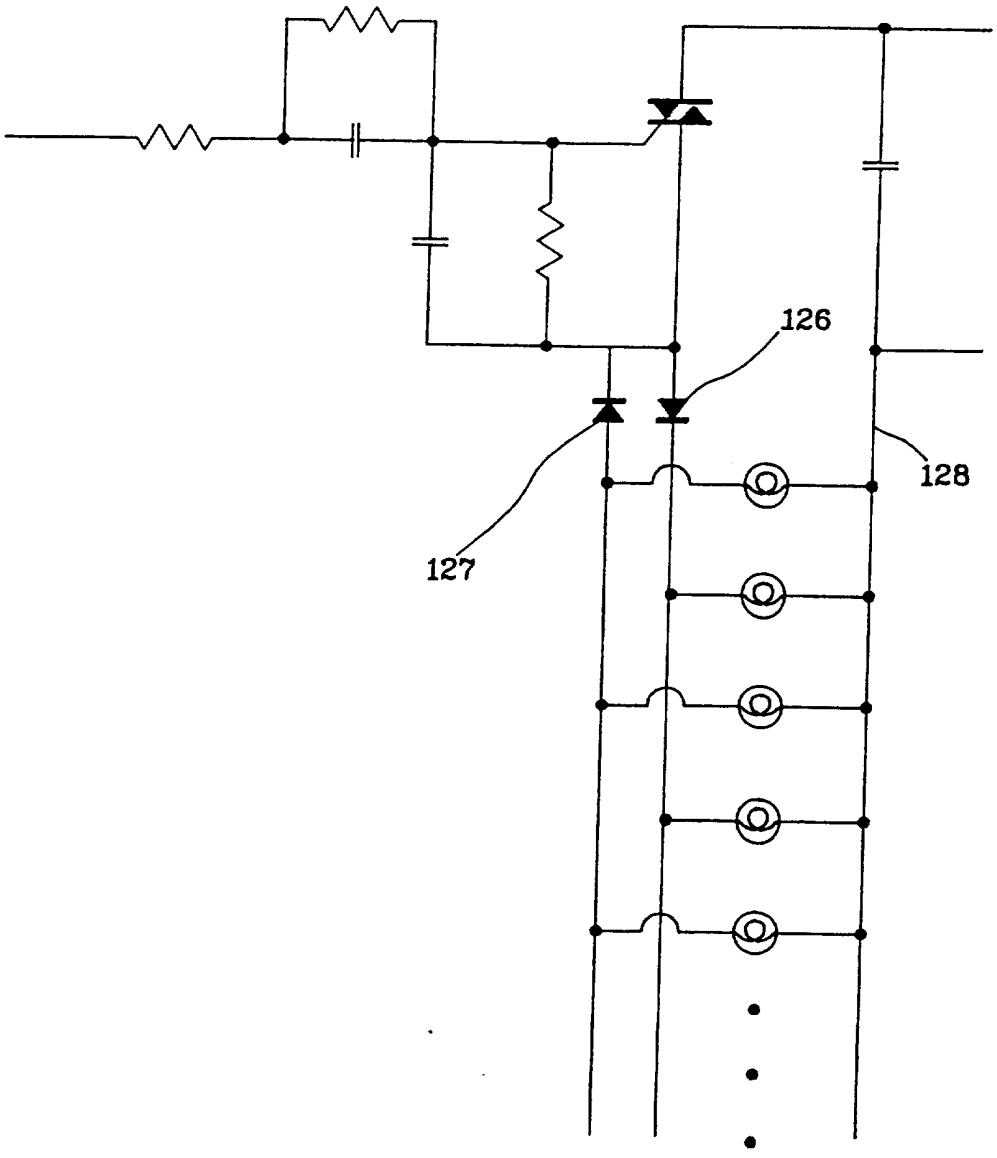


FIG. 5

Fig. 6

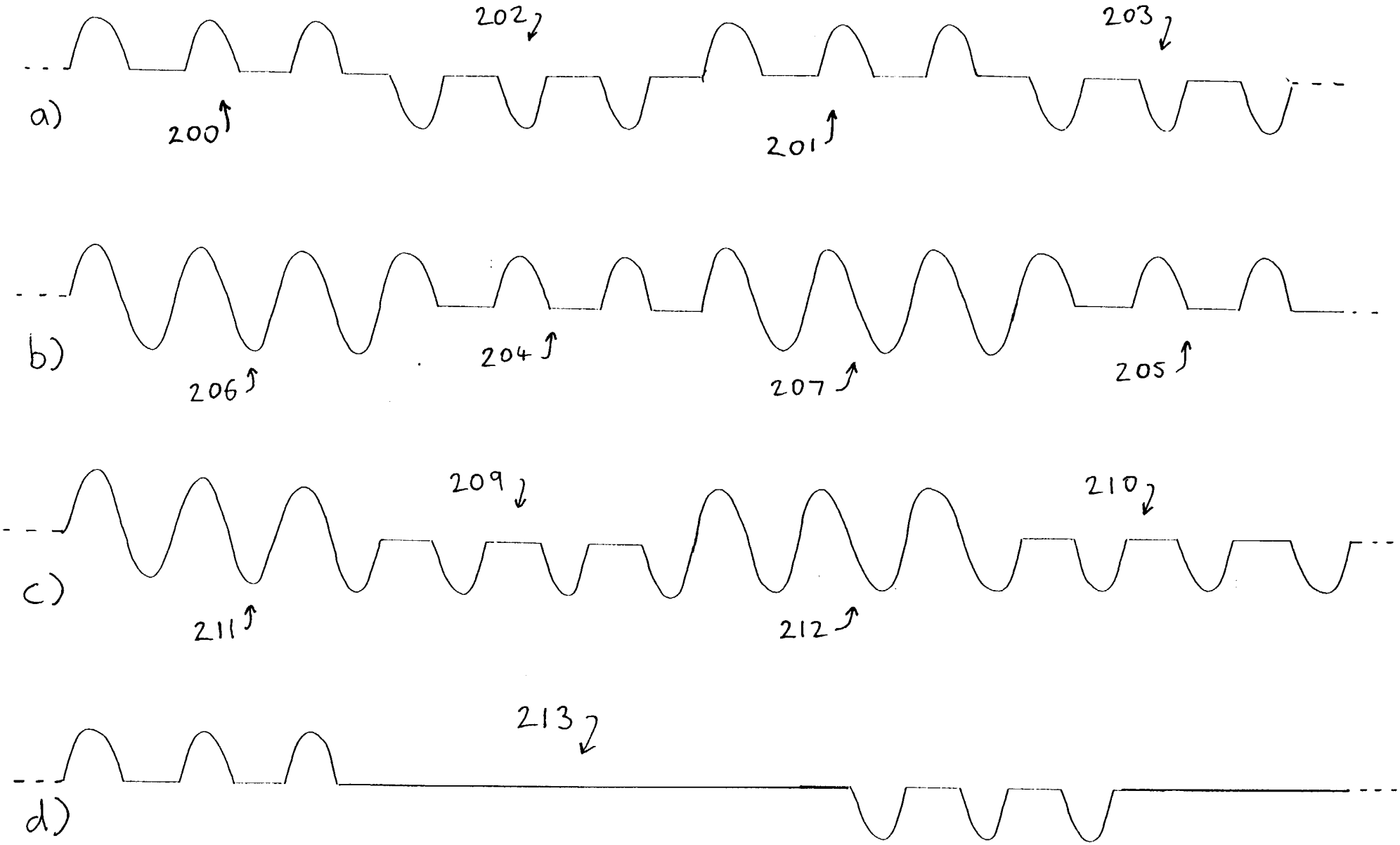
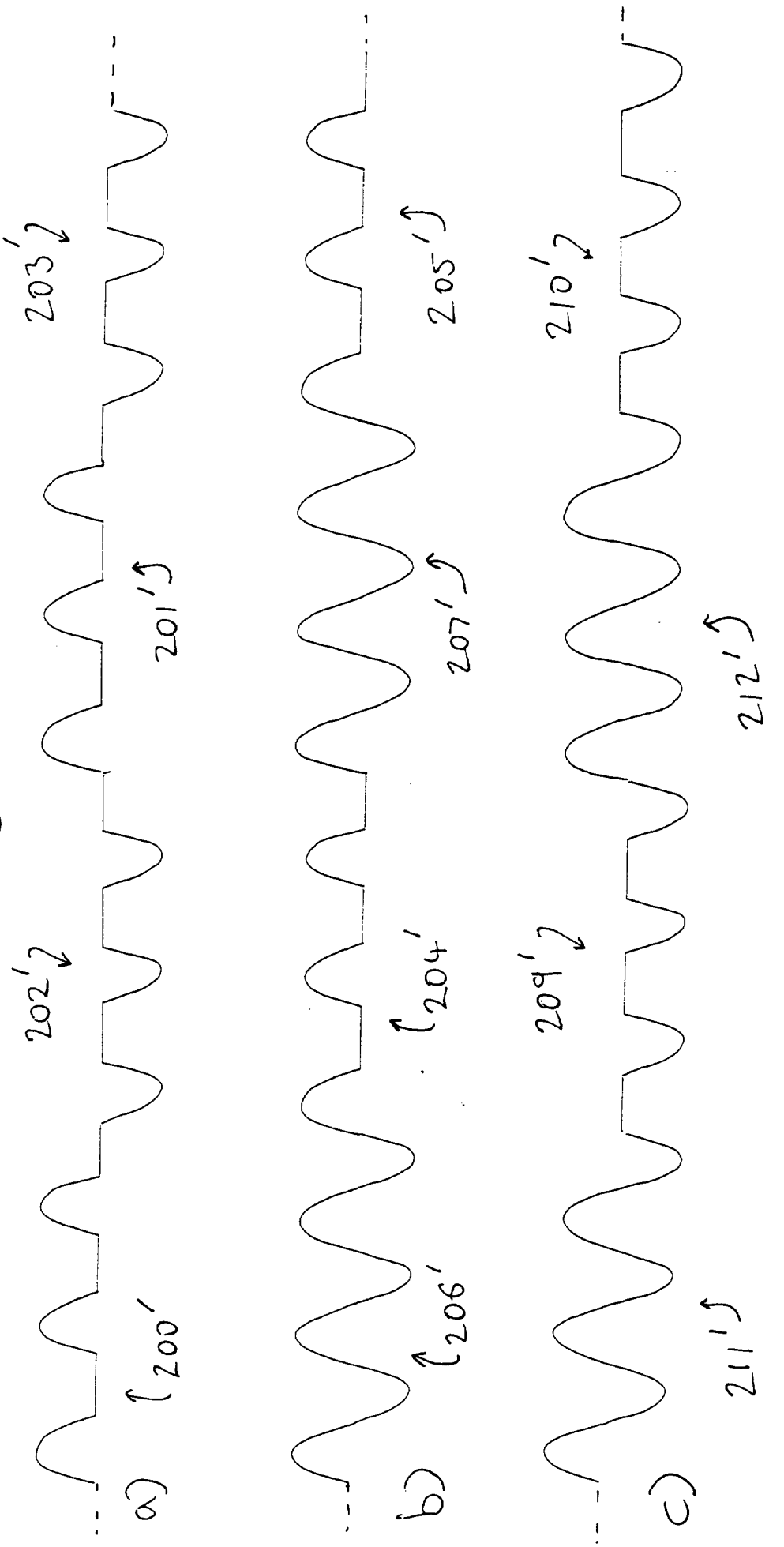


Fig. 7



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FLICKER LIGHT STRING UNIT

The present invention relates to a flicker light string unit.

Conventional flicker light strings are frequently used as a decoration in festivities, commercial advertisements, and many special occasions. Such conventional light string each can have only limited numbers of lamps because of the limited amperage of wires for the light string. To extend the length of the light string by connecting too many lamps to the wire of the light string shall cause the wire to be overloaded and overheated and even cause the lamp's to be burned out. To solve this problem, it is a common practice to use multiple separate light strings to complete the decoration. The drawback of this solution is that not all the light strings can flicker synchronously. To overcome this problem, some of the manufacturers/customers ignore the wire load and arbitrarily extend the light strings to use the same at the risk of public safety while others use larger wires and increase the output of controllers for the light strings. The larger wires and high output controllers shall significantly increase the manufacturing cost of the light strings. For example, the price for an electronic device of 500A is much higher than that for an device of 5A. And, even with these dangerous and costly means, the light strings still have limitation in their length and cannot be unlimitedly extended. In addition, it is difficult and inconvenient in the repair, maintenance, and installation of such extended light strings.

It is therefore tried by the inventor to develop a flicker light string suitable for series-connection to eliminate the drawbacks existed in the conventional flicker light strings.

In accordance with a first aspect of the present invention there is provided a flicker light string unit comprising a driver and a plurality of lamps; said driver comprising an input end for connection to a power supply,

and a trigger circuit comprising an output end connected in parallel to the plurality of lamps and a trigger end for receiving an oscillatory signal, wherein the trigger circuit is adapted to control the lamps in accordance with the oscillatory signal such that the lamps flicker.

A plurality of light string units according to the first aspect of the present invention can be connected without limit to extend the string length without the risk of overload.

In a preferable embodiment, a plurality of light string units according to the first aspect of the present invention are connected together to form a light string, wherein the trigger end of a first one of said drivers is connected in use to a main driver which provides the oscillatory signal, and the trigger ends of the other drivers are each connected to the output end of a respective driver.

The trigger ends of the other drivers may be connected in series with the output end of the first one of said drivers. In addition, or as an alternative, the trigger end of one or more of the other drivers may be connected in parallel with the output end of the first one of said drivers. As a further alternative, or in addition, the trigger end of one or more of the other drivers may be connected in parallel with the main driver.

The plurality of connected light string units may be powered from a single power supply. Preferably however each input end is connected in use to a respective power supply.

Typically the light string or light string unit further comprises a main driver which provides the oscillatory signal, which typically comprises a pulse train.

Preferably the or each trigger circuit comprises a TRIAC which typically is connected to the power supply and the output end of the driver, wherein the switching of the TRIAC is controlled by the oscillatory signal.

The light string unit according to the first aspect of the present invention is suitable for series connection wherein an output end of the driver of the light string can be changed as desired to adapt to either a two-wire or a three-wire light string. Where the driver is adapted to a three-wire light string, the or each output end typically comprises a three-wire output, wherein two of the three outputs comprise a pair of diodes connected in anti-parallel.

In accordance with a second aspect of the present invention there is provided a method of constructing a light string comprising a plurality of light string units according to the first aspect of the present invention, the method comprising connecting the trigger end of a first one of the drivers to the main driver, and connecting the trigger ends of the other drivers to the output end of a respective driver.

The flicker light string according to the present invention each mainly includes a plurality of series-connected lamps and a driver. The flicker light string so formed has an independent external power supply connected to an input end of the controller. The driver has a trigger circuit inside it. An output end of the circuit is connected to the series-connected lamps and a trigger end thereof is reserved for acquiring outcoming oscillatory signals for controlling the continuity and interruption of the trigger circuit, whereby the light string can flicker with the outcoming signals. By this way, multiple flicker light strings of the present invention can be serially connected as required without limitation in the length of the connected light strings. All the serially connected flicker light strings can flicker synchronously without the risk of overload and overheat.

The detailed structure of and the technical means adopted by the present invention, and the features, functions and operation thereof can be best understood by referring to the following detailed description of the

preferred embodiment and the accompanying drawings, wherein:-

Figure 1 is a perspective view showing an example of the present invention;

Figure 2 is a circuit diagram of an example of one unit of the present invention;

Figure 3 shows the manner in which multiple units according to an example of the present invention are serially connected without limitation in a total length of the connected strings;

Figure 4 is a circuit diagram showing the series-connection of more than one unit according to an example of the present invention;

Figure 5 is a circuit diagram of an example of the present invention wherein the driver is changed from a two-wire to a three-wire output end;

Figure 6 shows four example voltage waveforms of the oscillatory signal on the main driver output end; and

Figure 7 shows four corresponding example voltage waveforms of the signal on the TRIAC output end.

Please refer to Figures 1 and 2. The present invention relates to a flicker light string 1 mainly including a plurality of series-connected lamps 11 and a sub-driver 12.

Each lamp 11 is fixedly connected to a lampholder 111 having a diode. The lampholder 111 is then connected to two wires.

The sub-driver 12 has a trigger circuit inside it. The trigger circuit is mainly formed from a single TRIAC transistor 124 and other resistances and capacitances. An power input end 121 of the sub-driver is provided with a plug 125 for connecting with an external power source. An output end 122 of the sub-driver 12 is connected to one end of the series-connected lamps 11 while the other end of the lamps 11 are connected to a common ground end 128. A trigger end 123 of the circuit is reserved for connection to an external wire for acquiring an outcoming oscillatory

signal to control the continuity and interruption of the trigger circuit. The trigger end 123 is reserved by providing a copper piercing means on the sub-driver 12, so that the sub-driver 12 can be directly assembled to a conductor containing the oscillatory signal.

With the above arrangements,each flicker light string of the present invention has an independent external power supply and a trigger end 123 to acquire an outcoming oscillatory signal, causing the lamps 11 on the string to flash with the outcoming signal synchronously.

Please refer to Figures 3 and 4 for the series-connection of multiple flicker light strings 1. To do so, first connect the trigger end 123 of a first flash light string 1 to a main driver 2 containing an oscillatory signal. Use the copper piercing means to pierce through an signal cord which extends from an output end 222 of the main controller 2 and contains the oscillatory signal. Lead the signal cord into the trigger circuit of the sub-driver 12 so that the TRIAC transistor 124 thereof is electrically connected at the same time the outcoming oscillatory signal is received, causing the lamps 11 on the light string 1 to flicker synchronously. Since the oscillatory signal from the main controller 2 is led into the light string 1 simply to trigger the lamps 11 without increasing the load of the string 1, and since every subsequent light strings 1 either serially connected to the first light string 1 or parallelly connected to the main driver 2 all have their own independent external power supply, each of the light strings 1 has a load current that is used by the light string 1 itself instead of a total current used by all the series-connected light strings 1. Thus, no overload will occur in any of the individual light string 1 no matter how many units of the light string 1 are serially or parallelly connected.

The signal on lines 121 comes from the electricity company (120 volts AC at 50-60 Hz or 220 volts AC at 50-60 Hz). The six power leads 121 shown in Figure 3 may each be

connected to a single power supply or to separate power supplies, depending on the number of light string units to be connected (i.e. depending on the load). The signal of trigger end 123 comes from sub-driver 122 or main driver 2 to output end 222. The voltage signal from main driver output end 222 is a variable waveform pulse train of the type illustrated in Figure 6. In a first alternative (Figure 6a), the variable waveform train comprises a series of positive waveform pulses 200-201 alternating with a series of negative waveform pulses 202,203. In a second alternative (Figure 6b) the variable waveform train comprises a series of positive waveform pulses 204,205 alternating with a series of AC pulses 206,207. In a third alternative (Figure 6c), the variable waveform train comprises a series of negative waveform pulses 209,210 alternating with a series of AC pulses 211,212. The pulses 200-212 may also be separated by a gap of 0.5-3 seconds 213 in which all lamps are turned off, as illustrated in Figure 6d.

The voltage signal on TRIAC output end 122 is illustrated in Figure 7. Figures 7a-7c show the voltage on output end 122 when the oscillating signal on trigger end 123 is of the form shown in Figures 6a-6c. Corresponding pulses are given corresponding reference numerals - i.e. pulse 200' corresponding with pulse 200.

The oscillatory signals illustrated in Figures 6 and 7 are typically at the power supply frequency (e.g. 50-60Hz). Conveniently the main driver 2 receives a common power supply signal which is also received on the power input ends 121 of the sub-drivers 1. The main driver 2 rectifies the power supply signal to generate the signals of Figure 6. Therefore the signal of Figure 6 is at the same frequency, and in phase with the power supply signal on power input ends 121.

The lamps 11 flicker synchronously due to the AC power source (AC signal).

Turn on/turn off action depends on main driver 2 output end 222.

The diodes discriminate between a positive voltage waveform and a negative waveform that can make the lamps 11 turn light on.

The trigger end 123 is reserved by providing a copper piercing means on the sub-driver 12, so that the sub-driver 12 can be directly assembled to a conductor containing the oscillatory signal. This oscillatory signal can come from main driver 2 output 222 (i.e. line end) (two wires, one end is line, and the other end is neutral). The oscillatory signal also can come from sub-driver 12 output end 122 (i.e. line end), 128 neutral end.

The trigger end 123 can probe the oscillatory signal of main driver/sub-driver (the line end). Line end 121 and 222/122 line end are different. Only main driver 2 can turn on/turn off all the strings.

In electricity theory, AC power source frequency is 50-60Hz. In Figure 4, two trigger ends 123 receive a different outcoming oscillatory signal. Two trigger timings are different (between 1.5μs (TRIAC) delay time). Two trigger waveforms are the same. The human eyes can not discriminate this difference (delay time), so that we call the same signal.

The common outcoming oscillatory signal come from main driver 2, so that all the connected light strings can flicker synchronously.

Please refer to Figure 5 now. In the event a three-wire output end is required in the present invention, it can be achieved by a series-parallel connection of two diodes 126 and 127 to a signal cord at the output end 122. With this simple change, the present invention can be more widely used either as a two-wire or as a three-wire light string 1 without the confusion of unmatched specification to prevent required wire connection.

From the above description, it can be seen that unlimited units of the flicker light string 1 of the

present invention can be serially connected without any technical difficulty while all the connected flicker light strings can be lighted synchronously. In addition, following advantages are found in the present invention:

1. The light strings of the present invention are uniform in their specification and are therefore suitable for mass production. Since different units of the flicker light string can still flicker synchronously, it is not necessary to manufacture light strings in different or special specifications. The light strings in uniform specification may largely reduce the manufacturing cost and allow consumers to purchase and use them depending on their actual need.

2. The products of such light strings are safer in use and cheaper in price. The simplified specification of the light string also largely reduces the cost for electronic devices thereof and further ensures high safety of the light strings in use.

3. Unlimited numbers of light strings can be serially connected for them to flicker at the same time. Theoretically, since each light string has its own independent power supply, its operation is independent of the total power consumption of the whole connected light strings and of the gauge of wires. Thus, unlimited numbers of such light strings can be serially connected. It is surely a revolutionary invention in the industrial field.

4. It is very convenient to install the light strings. Every light strings other than the main light string can use the power of a lamp at any position after the driver of a preceding light string as its control signal. The light strings can be easily connected to form different patterns and the assembly and installation thereof is convenient.

5. The repair and maintenance of the light strings is simple and convenient. A consumer needs only to replace a complete set of failed light string with a new one without the help of any professional electrician. The

maintenance costs to be undertaken by the manufacturers and the consumers are both reduced.

In brief, the flicker light string according to the present invention has simple structure which not only allows mass production to reduce the manufacturing cost but also ensures safety in use and lower maintenance cost. That is, the flicker light string of the present invention provides new and special functions and significantly increases the economical benefit of the flicker light strings.

CLAIMS

1. A flicker light string unit comprising a driver and a plurality of lamps; said driver comprising an input end for connection to a power supply, and a trigger circuit comprising an output end connected in parallel to the plurality of lamps and a trigger end for receiving an oscillatory signal, wherein the trigger circuit is adapted to control the lamps in accordance with the oscillatory signal such that the lamps flicker.

2. A flicker light string comprising a plurality of light string units according to claim 1, wherein the trigger end of a first one of said drivers is connected in use to a main driver which provides the oscillatory signal, and the trigger ends of the other drivers are each connected to the output end of a respective driver.

3. A flicker light string according to claim 2 wherein the trigger ends of the other drivers are connected in series with the output end of the first one of said drivers.

4. A flicker light string according to claim 2 or 3 wherein the trigger end of one or more of the other drivers is connected in parallel with the output end of the first one of said drivers.

5. A flicker light string according to any of claims 2 to 4 wherein the trigger end of one or more of the other drivers is connected in parallel with the main driver.

6. A flicker light string according to any of claims 2 or 5 wherein each input end is connected in use to a respective power supply.

7. A flicker light string or flicker light string unit according to any of the preceding claims further comprising a main driver which provides the oscillating signal.

8. A flicker light string or flicker light string unit according to claim 7 wherein the oscillating signal comprises a pulse train.

9. A flicker light string or flicker light string unit according to any one of the preceding claims wherein the or each trigger circuit comprises a TRIAC.

10. A flicker light string or flicker light string unit according to claim 9 wherein the TRIAC is connected to the power supply and the output end of the driver, and wherein the switching of the TRIAC is controlled by the oscillating signal.

11. A flicker light string or flicker light string unit according to any of the preceding claims wherein the or each output end comprises a two-wire output.

12. A flicker light string or flicker light string unit according to any of the preceding claims wherein the or each output end comprises a three-wire output, and wherein two of the three outputs comprise a pair of diodes connected in anti-parallel.

13. A flicker light string suitable for unlimited series-connection, comprising a driver and a plurality of series-connected lamps, said driver having an input end connected to an independent external power supply and having a trigger circuit thereinside, said trigger circuit having an output end connected to said series-connected lamps and a trigger end being reserved for connection to an external cord for acquiring an outcoming oscillatory signal to control the continuity and interruption of said trigger circuit, causing said light string to flicker with said outcoming signal, whereby multiple units of said flicker light string are allowed to be serially connected to form an unlimitedly extended flash light string.

14. A flicker light string suitable for unlimited series-connection as claimed in claim 13, wherein said trigger circuit of said controller comprises a single triac and other resistances and capacitances, and said output end of said trigger circuit being a two-wire output end.

15. A flicker light string suitable for unlimited series-connection as claimed in claim 14, wherein said output end of said trigger circuit of said driver has diodes parallel-

connected to a signal cord extended therefrom to form a three-wire output end.

16. A flicker light string or flicker light string unit substantially as hereinbefore described with reference to the accompanying drawings.

17. A method of constructing a flicker light string according to claim 2, the method comprising connecting the trigger end of the first one of said drivers to the main driver, and connecting the trigger ends of the other drivers to the output end of a respective driver.

18. A method of constructing a flicker light string substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

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Application No: GB 9707127.8 **Examiner:** C.A.Clarke
Claims searched: 1-18 **Date of search:** 25 June 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F4R (RFG, RS); H2H (HLL4)

Int Cl (Ed.6): F21P 1/02; A47G 33/16; H05B 39/09

Other: ONLINE: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WO 80/01746A WEINER see whole document	1 and 9 at least

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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