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(71) Applicant
Frank Joseph Prineppi
1108 Avocado Isle, Fort Lauderdale, FL 33315,
United States of America

(72) Inventors
Frank Joseph Prineppi
Chan Ngor Chi

(74) Agent and/or Address for Service
Edward Evans & Co
Chancery House, 53-64 Chancery Lane, London,
WC2A 1SD, United Kingdom

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INT CL[5] H05B 37/00 37/02 39/00 39/02 39/04 39/06
39/08 39/09 41/44
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(54) Lamp controller giving flickering flame effect

(57) The controller generates a cyclically varying lamp drive current corresponding to the combination of a first, smoothly fluctuating, signal of a relatively low frequency and a second, sharply fluctuating, signal of a high frequency relative to the first signal thereby to produce a flickering flame effect. The first signal may be produced by a low frequency sinusoidal oscillator 2 having a period of 20 to 40 seconds. The second signal may be produced by a generator 3 as a noise signal having a bandwidth of 0 to 16 Hz. The drive signal may be produced as the weighted sum of these signals and an intensity control signal. The signals may alternatively be produced by digital signal processors. The drive signal may be provided as a pulse width modulation signal (Fig. 8).

A decoration set may incorporate a plurality of independently operating controllers (Fig. 10). Lamps for use in the system may have a frosted glass diffuser (8), (Fig. 9), shapes like a candle flame and enclosing an upper filament (19) energised by the controller and a lower filament (21) operating at below full brightness on a constant amplitude drive current. Alternatively, an axial filament (33), (Figs 11 to 13), energised by the controller may be partially surrounded at its base end by a V-shaped, transversely extending filament (27) energised by the constant amplitude currents.

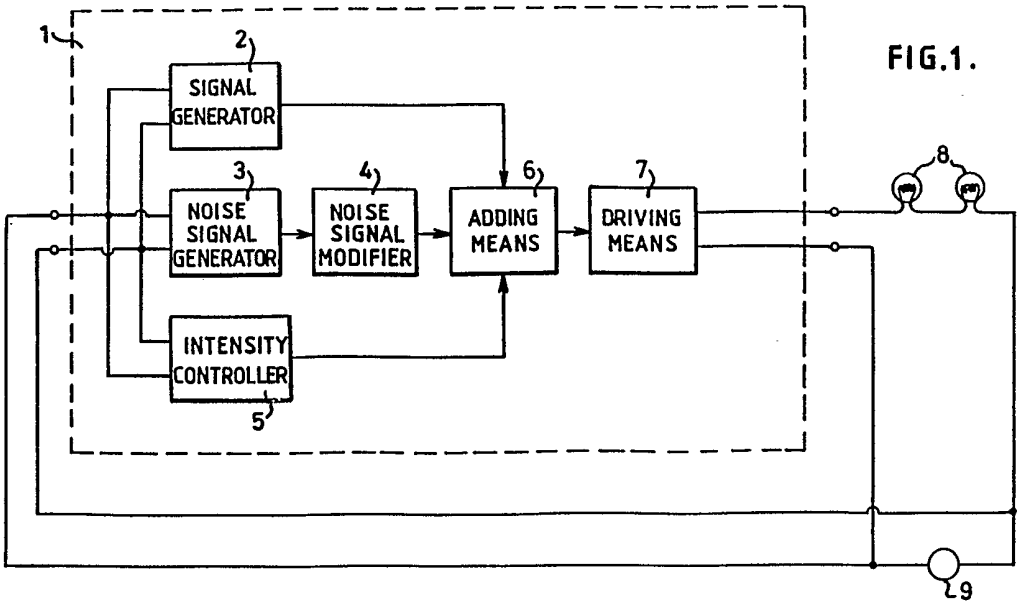

FIG.1.

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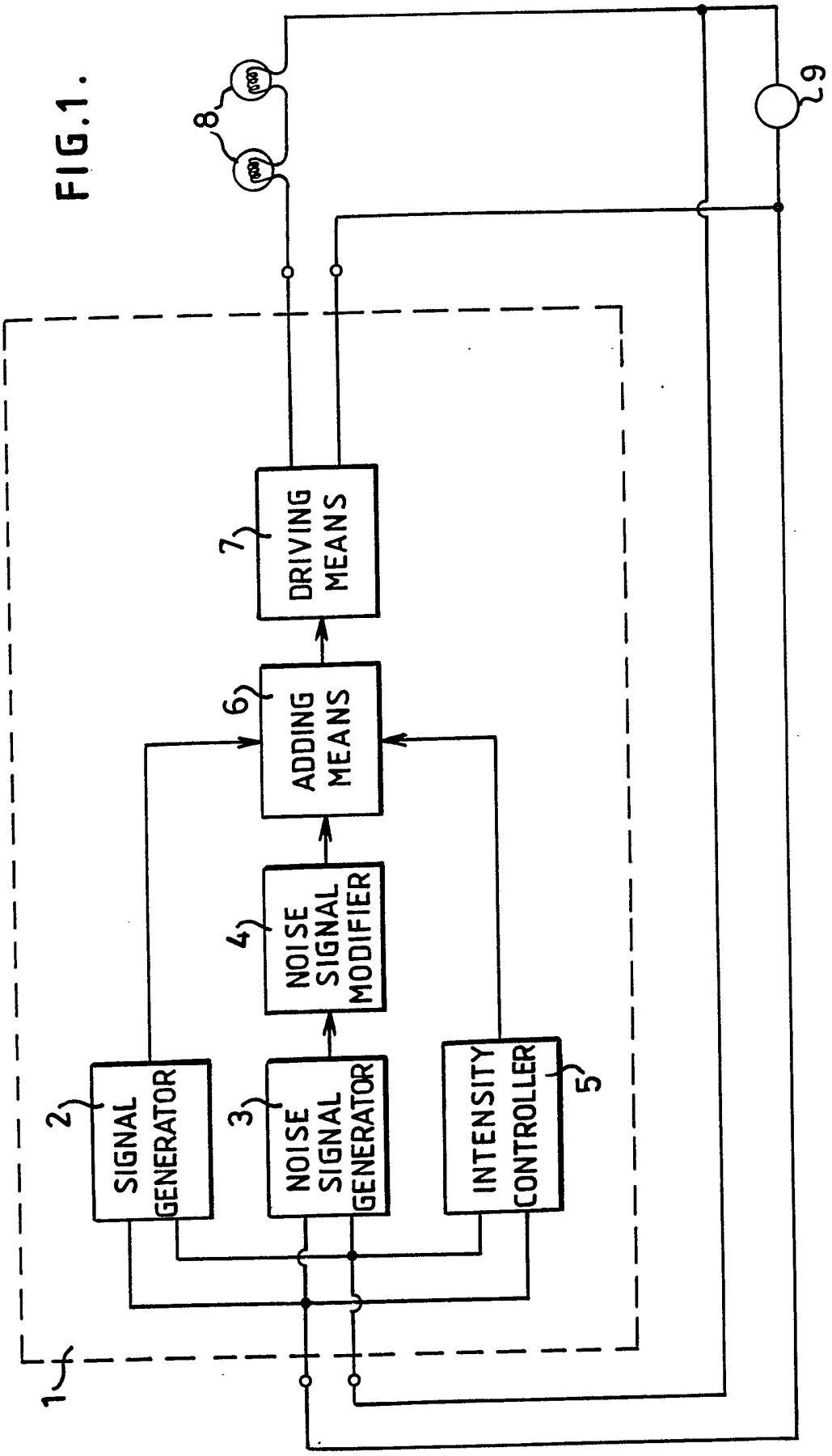
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG.1.


1
2
SIGNAL GENERATOR
3
NOISE SIGNAL GENERATOR
4
NOISE SIGNAL MODIFIER
5
INTENSITY CONTROLLER
6
ADDING MEANS
7
DRIVING MEANS
8
9

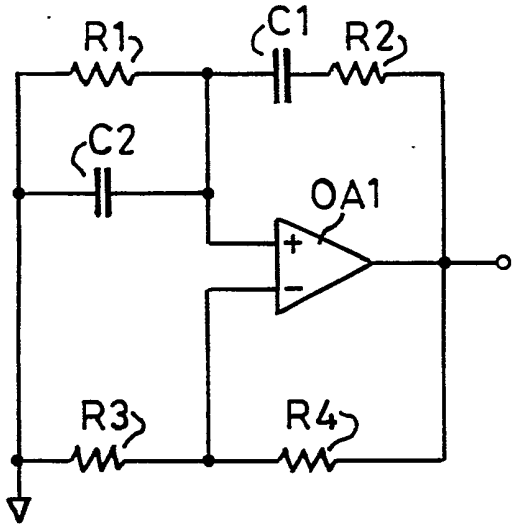


FIG. 2.

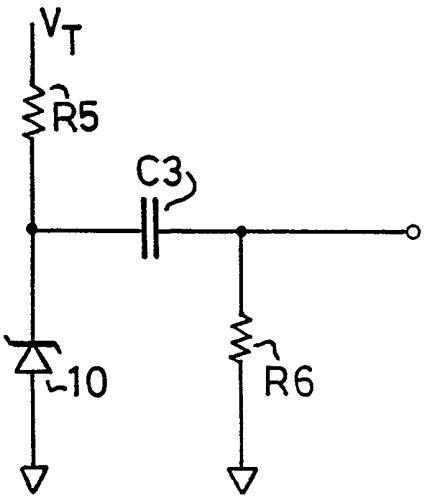


FIG. 3.

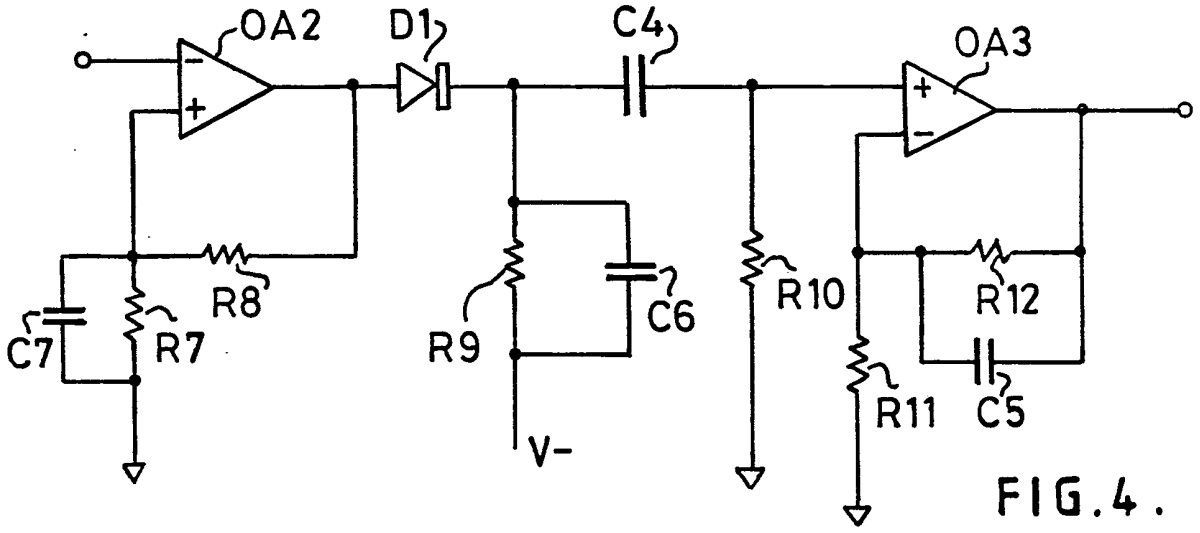


FIG. 4.

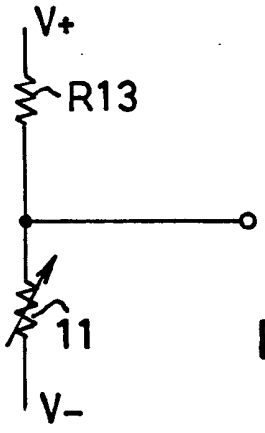


FIG. 5.

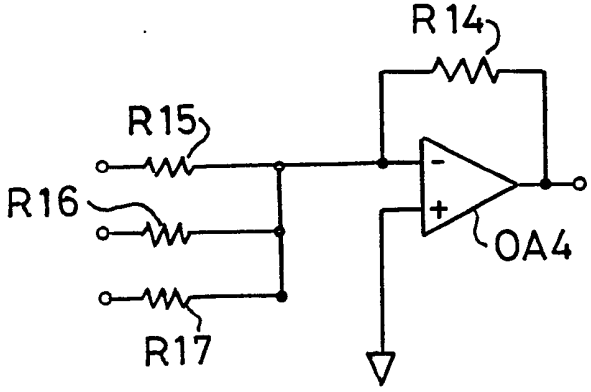


FIG.6.

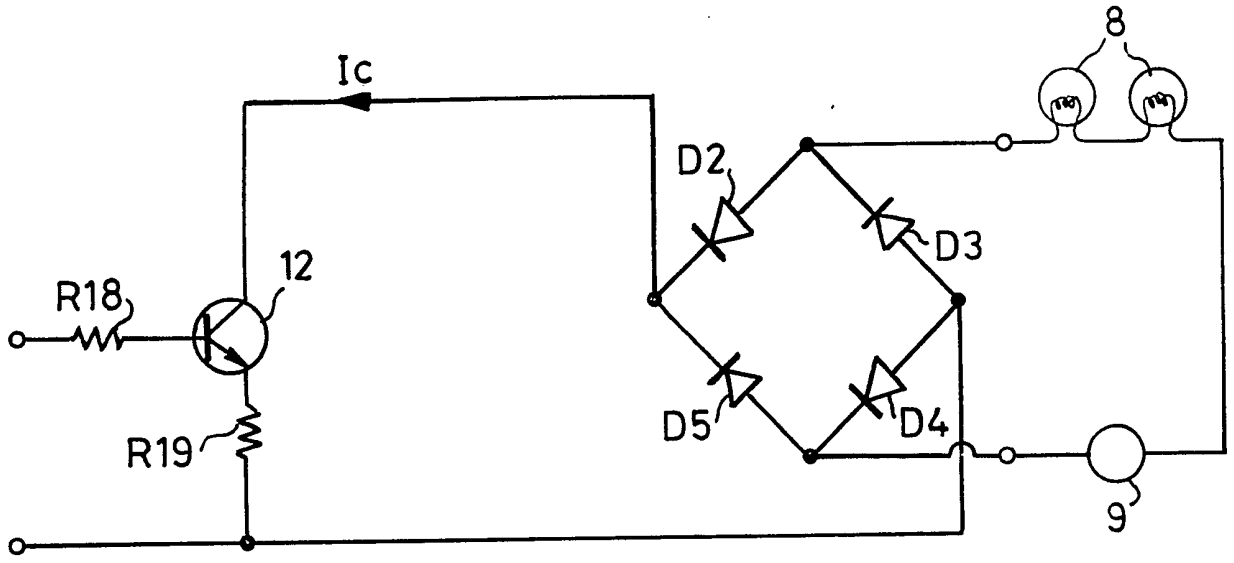


FIG.7.

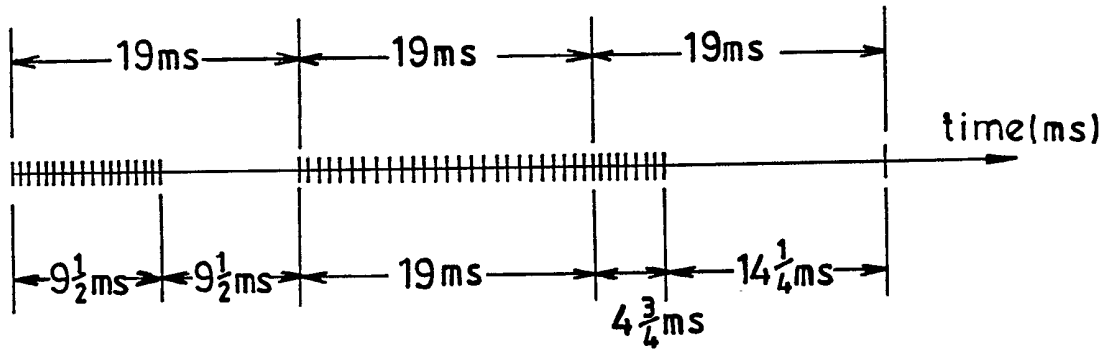


FIG.8.

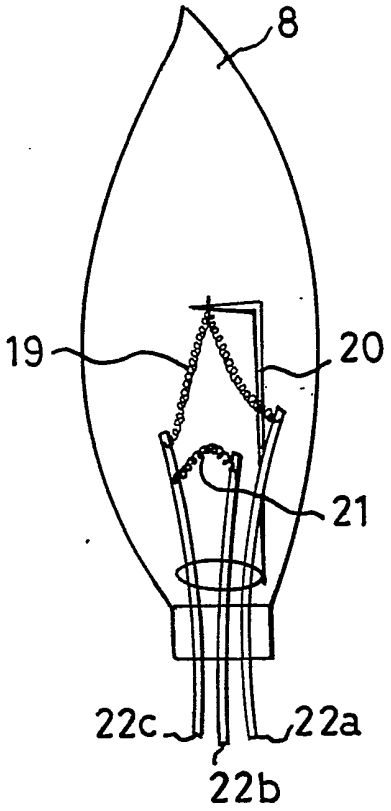


FIG.9.

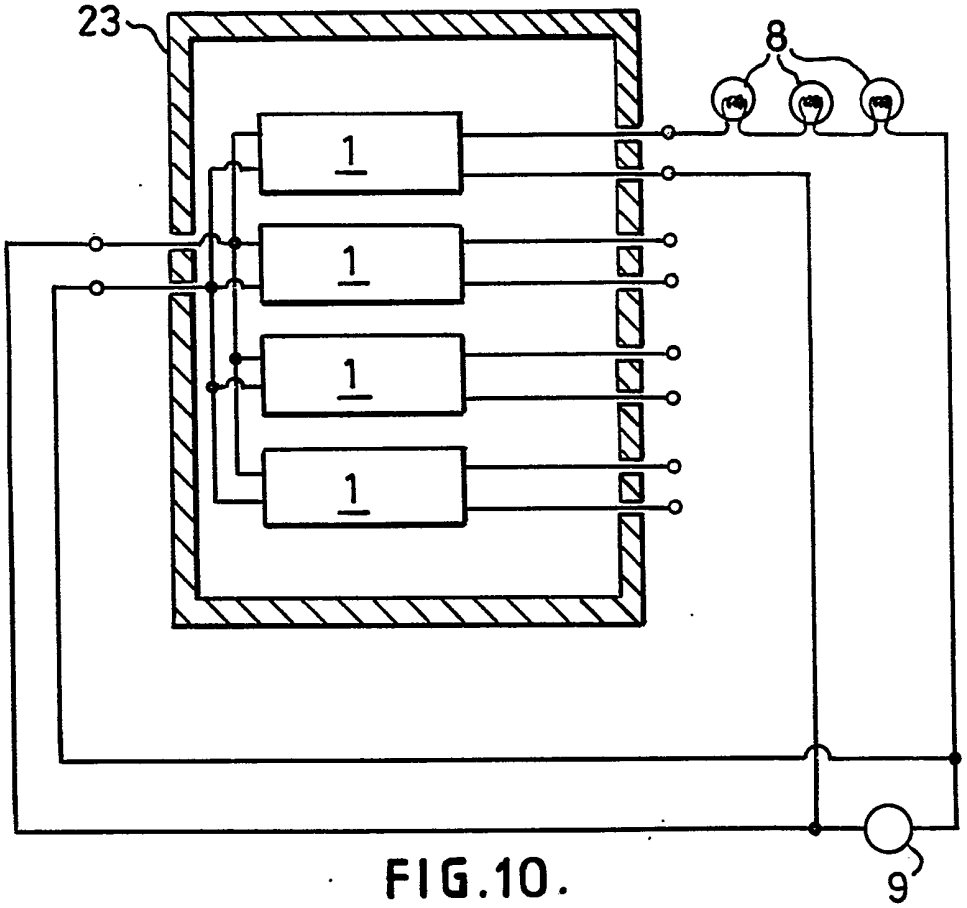


FIG.10.

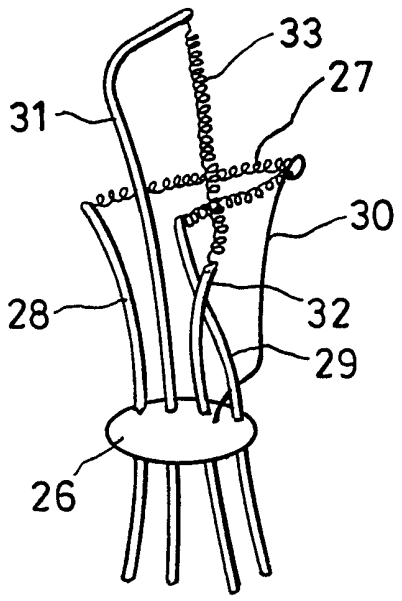


FIG.11.

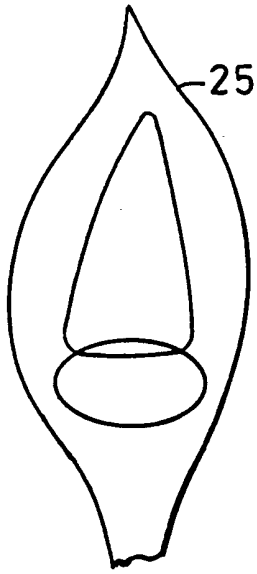


FIG.12.

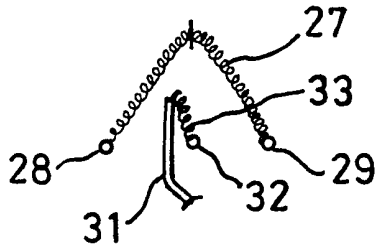


FIG.13.

IMPROVEMENTS IN OR RELATING TO ELECTRIC LIGHT SYSTEMS

This invention relates to improvements in or relating to electric light systems and, in particular, electric light systems intended to mimic the visual effect of a candle flame. Such electric light systems can conveniently be used in an electric decoration set to be put on to or around a Christmas tree. The invention also relates to improvements in electric lamps and to electric light systems incorporating such electric lamps.

Conventionally, Christmas trees have been decorated by balls, stars or the like, which may be made of plastics or glass. With the general utilization of electricity, electric decoration sets were designed. Such electric decoration sets included one or more electric lamps to be switched on or off manually or even electronically. Such electric lamps may be encased in a coloured plastics figure or a three-dimensional geometrical mold, so as to enhance the aesthetic feeling of the decoration sets. A further improvement of the above decoration sets utilizes circuit arrangements which allow strings of electrical lamps to be divided into several groups, each group being switched on and off collectively but at a different frequency from other groups so as to give a somewhat flickering effect.

A yet further improvement over the aforesaid prior art provides for some gas between an anode and a cathode, all encased within a housing. The presence of a high tension potential between the anode and cathode ionizes the gas molecules and an electric discharge is produced which appears to flicker at random, rather like a candle flame.

The last illustrated electric candle, though being an improvement over other mentioned decoration sets, suffers from a number of disadvantages which hinder it from being used more generally. To allow such an electric candle to work realistically, the electric lamp must be specially designed. Conventional electric lamps using tungsten heating wires cannot be used. Such specially

designed electric lamps are relatively expensive to manufacture and this adds to the cost of the lamps and, if used as such, the decoration sets.

Another shortcoming associated with the aforesaid electric candle is that it does not give a vivid flickering effect. The observer only notices "jumping" of the candle flame but not an effect mimicking a naturally burning flickering candle.

It is therefore an object of the present invention to provide both an improved electric light system and an improved electric decoration set in which the aforesaid shortcomings are obviated.

The present invention stems from the realization that tungsten wire lamps can produce a vivid and realistic flickering effect.

According to a first aspect of the invention, there is provided an electric light system comprising means for generating a cyclically variable drive current to power one or more electric lamps, the power of the drive current varying during each cycle in a manner corresponding to the combination of a first, smoothly fluctuating, signal of a relatively low frequency and a second, sharply fluctuating, signal of a high frequency relative to the first signal, such that the variation of the drive current during each cycle produces a corresponding variation in the intensity of light emitted by the or each lamp to thereby produce a flickering effect similar to a flickering flame.

The electric light system may conveniently include means for generating a drive signal having a profile analogous to the combination of a first, smoothly fluctuating, signal of a relatively low frequency and a second, sharply fluctuating signal of a high frequency relative to the first signal, and a driving means for providing a drive current to power said one or more lamps, the magnitude of the drive current fluctuating proportionally to the drive signal.

Conveniently, the means for generating a drive signal comprises a signal generator for generating said first signal, a noise signal generator for generating said second signal and an adding means for receiving said first and second signals and generating in response thereto the drive signal.

Advantageously, the drive signal generated by the adding means is a weighted sum of the first and second signals.

Preferably, the said second signal generated by the noise signal generator is first received by a noise signal modifier whereby the second signal is modified so as to select the degree of fluctuation, before passing to the adding means.

Conveniently, there is provided an intensity controller for generating a third signal through adjustment of the magnitude of which the average intensity of the electric light system is varied.

The first signal is advantageously with a period between 20 to 40 seconds and preferably around 30 seconds. The first signal may be a sinusoidal wave form.

The second signal is conveniently of a bandwidth of 0 to 16 Hertz. The second signal may advantageously randomly fluctuate.

Advantageously, the invention is carried out by using one or more programmable devices, and when such a device or devices are used, the drive signal may be in a binary format which is converted to an analog signal by means of a digital to analog converter, or in pulse Width Modulation format.

When using one or more programmable devices to work the present invention, it may be convenient to so program a programmable device which controls the drive currents powering two or more sets of electric lamps within the system, such that each set is driven by a drive current different to the other set or sets, thus enabling each set to exhibit a different flickering effect.

According to a second aspect of the present invention, there is provided an electric decoration system comprising an electric light system according to the first aspect of the present invention and one or more electric lamps, each of the electric lamps having a first tungsten wire powered by the said electric light systems and a second tungsten wire powered by a non-fluctuating electric current source operated at below full brightness. The term "non-fluctuating" in this context does not necessarily means "constant" e.g. as in a fixed direct current, but can mean simply "not visibly fluctuating" e.g. flickering at a rate greater than is perceptible to the human eye, such as a 50Hz or 60Hz current.

The said first tungsten wire may conveniently be disposed in an upward pointing position and above the said second tungsten wire.

To enhance the flickering effect, the or each electric lamp may advantageously be made of frosted glass so as to diffuse the light emitted by the tungsten wires.

According to a third aspect of the present invention, there is provided an electric decoration set comprising one or more electric light systems according to the first aspect of the present invention, or one or more electric decoration systems according to the second aspect of the present invention, a plurality of electric lamps connected by electrical connecting wires and electric power supply means.

According to a fourth aspect of the present invention there is provided an electric lamp suitable for use in the aspects of the invention defined above, which electric lamp comprises a translucent envelope in which are disposed two lamp filaments, the first lamp filament being disposed generally transversely of the envelope and the second lamp filament being disposed generally axially of the envelope and the first lamp filament at least partially surrounding the second lamp filament, the arrangement being such that, in use, when a non-fluctuating electric current is

supplied to the first lamp filament and a fluctuating electric current is supplied to the second lamp filament, light from the first lamp filament is emitted approximately uniformly transversely of the envelope and a flickering light is emitted from the second lamp filament, thereby to produce a flicking effect similar to a flickering flame.

According to a fifth aspect of the present invention there is provided an electric decoration system as defined with respect to the second aspect of the invention and including one or more electric lamps as defined with respect to the fourth aspect of the invention.

The invention will now be described, by way of example only, with reference to the accompanying drawings wherein:-

Fig. 1 is a schematic block diagram of an embodiment of the present invention, to which a number of electric lamps are shown connected:

Fig. 2 shows a circuit arrangement which can be used in the present invention as the first signal generator;

Fig.3. shows a circuit arrangement which can be used in the present invention as the noise signal generator;

Fig.4. shows a circuit arrangement which can be used in the present invention as the noise signal modifier:

Fig.5. shows a circuit arrangement which can be used in the present invention as the adding means;

Fig.7. shows a circuit arrangement which can be used in the present invention as the driving means, to which a number of electric lamps are shown connected;

Fig.8. shows the respective on and off duration of the drive current during a representative time scale where the

drive signal is in pulse Width Modulation format;

Fig.9. shows an electric lamp which can be used in the present invention;

Fig.10 shows a schematic block diagram of a decoration set comprising four electric light systems in accordance with the present invention, to one of the electric light systems a number of electric lamps are shown connected;

Fig.11. is a diagrammatic representation of the filament arrangement of an embodiment of an electric lamp according to the present invention;

Fig.12. is a diagrammatic representation of the effect in use of the electric lamp of Fig. 11; and

Fig.13. is a diagrammatic plan view of the filament arrangement of Fig.11.

Referring first to Fig.1 which shows a schematic block diagram of an electric light system 1 in accordance with the present invention, there are provided a signal generator 2, a noise signal generator 3, a noise signal modifier 4, an intensity controller 5, an adding means 6, a driving means 7, and a number of tungsten electric lamps 8 to which the electric light system 1 is connected. Both the electric light system 1 and the tungsten electric lamps 8 are connected to an electric power supply means 9.

The signal generator 2 generates a first signal having a relatively long but smoothly fluctuating profile to be fed to the adding means 6. The period of the signal generated by the signal generator 2 should be short enough to enable a normal observer to notice a brightening and dimming effect but not so short as to reveal the existence of the cycle. A period within the range of 20 to 40 seconds gives a satisfactory result. A preferred period is around 30 seconds. Among the numerous forms of smoothly fluctuating profiles that can be produced and employed, it is found

that sinusoidal wave forms are best suited for working the present invention.

The signal generator 2 can be constructed of a Wien bridge oscillator, the circuit arrangement of which is shown in Fig. 2, comprising an operational amplifier OA1, resistors R1, R2, R3 and R4 and capacitors C1 and C2.

The noise signal generator 3 generates a second signal (called the noise signal) having a profile which is sharply irregular relative to the signal generated by the signal generator 2. Fig. 3 shows a circuit arrangement, comprising resistors R5 and R6, a capacitor C3 and a Zener diode 10, which can be used as the noise signal generator 3 in the present invention. Such a circuit arrangement makes use of the inherent noise generating effect of a non-linear device, such as a diode or Zener diode, biassed in its non-linear region of conductivity. Preferably, the noise signal is of a bandwidth of 0 to 16 Hz.

The noise signal generated by the noise signal generator 3 is fed to a noise signal modifier 4. The noise signal modifier 4 limits the bandwidth of the noise signal before passing it to the adding means 6. Such can be achieved by means of a peak follower with filters, a circuit arrangement of which being shown in Fig. 4, comprising operational amplifiers OA2 and OA3, resistors R7, R8, R9, R10, R11 and R12, capacitors C4, C5, C6 and C7 and a diode D1.

The intensity controller 5 generates a third signal to be fed to the adding means 6. The intensity controller 5 can be constructed of a resistor network, such as the one as shown in Fig. 5, comprising a resistor R13 and a variable resistor 11. In such an arrangement, the signal generated by the intensity controller 5 is in the form of an electric voltage level. Some other reference voltage generators, such as zeners, voltage regulators and voltage supervisors can also be used to achieve the same result. By adjusting the variable resistor 11, the average brightness of the electric light system 1 is controlled.

The adding means 6 receives the signals from the signal generator 2, the noise signal modifier 4 and the intensity controller 5 respectively and produces in response thereto a resultant drive signal, being a weighted sum of the above-mentioned signals. The adding means 6 can be constructed by using mixer amplifiers or operational amplifiers. Figure 6 shows a circuit arrangement which can be used in the present invention as the adding means 6, comprising an operational amplifier OA4 and resistors R14, R15, R16 and R17. The respective resistances of resistors R15, R16 and R17 are so selected as to obtain the desired combination of the signals received from the signal generator 2, the noise signal modifer 4 and the intensity controller 5.

The resultant drive signal from the adding means 6 is fed to the driving means 7. Fig. 7 shows a circuit arrangement, which can be used as the driving means 7, comprising resistors R18 and R19, a transistor 12 and diodes D2, D3, D4 and D5, the diodes D2, D3, D4 and D5 being arranged to form a bridge. To the output end of the driving means 7 are connected tungsten electric lamps 8.

During the positive half cycle, the electric current Ic flows through the tungsten electric lamps 8, diode D2, transistor 12, resistor R19 and diode D4. During the negative half cycle, the electric current Ic flows through diode D5, transistor 12, resistor R19, diode D3 and tungsten electric lamps 8. In both situations, the magnitude of the electric current Ic, hence the brightness of the tungsten electric lamps 8, is proportional to the drive signal.

The present invention can also be worked by using micro-controllers or similar programmable devices. In this case, a programmable device is programmed to generate output signals in a binary format at a point of time, corresponding to the magnitude of a signal which is analogous to the combination of a first signal having a relatively long but smoothly fluctuating profile and a second signal having a profile which is sharply irregular relative to the first signal, at that particular point of time.

An alternative to the above arrangement is to program a

first programmable device so that the programmable device generates a first signal in a binary format having a relatively long but smoothly fluctuating profile. Such can be achieved by doing a table look up for some pre-selected functions or by computing from sets of function description parameters. A second programmable device is also programmed to provide a second signal, whose profile is sharply irregular relative to the first signal. This can be achieved by, for example, looking up a stored random number sequence such as the maximal sequence or by computing the random numbers using random number generating algorithms. An instruction of "ADD" or some similar instructions may be used for performing the funcation carried out by the adding means 6. The signal for controlling the average brightness of the electric light system 1 is also in binary format, the value of which being adjustable.

The resultant digital signal from the adding means 6 is then converted into an analog signal using a digital to analog converter so that the signal passed to the driving means is in analog format.

Alternatively, the resultant drive signal is in pulse Width Modulation format so that the electric current driving the electric lamps 8 is turned on and off alternatively for a very short period of time depending on the magnitude of the resultant drive signal. Fig. 8 shows the respective on and off duration of the drive current during a representative time scale where the drive signal is in pulse Width Modulation format. Assuming that the largest possible value of the resultant drive signal is 15 in decimal format and that time is divided into segments each of 19 milliseconds (ms). A resultant value of 7.5 will turn the drive current on for the first 9.5 ms and off for the remaining 9.5 ms. A resultant value of 15 will turn the drive current on for the entire time segment of 19ms. A resultant value of 3 3/4 will turn the drive current on for the first 4 3/4 ms and off for the remaining 14 1/4 ms in the time segment.

Because of the short interval of each time segment and the fact that the tungsten wires in the electric lamps 8 do not stop

glowing immediately upon turning off of the drive current, a normal observer will notice a flickering effect instead of repeated on and off of the electric lamps 8.

To enhance the realistic flickering effect, the electric lamp 8 is constructed so that it contains an upper tungsten wire 19 supported by a wire support 20 and a lower tungsten wire 21. The upper tungsten wire 19 is connected to and powered by the electric light system 1 via connecting wires 22a and 22c. The brightness of the upper tungsten wire 19 therefore depends on the variation of the drive current produced by the electric light system 1. The lower tungsten wire 21 is connected to and powered by a non-fluctuating electric current source via connecting wires 22b and 22c. The lower tungsten wire 21 is operated at below full brightness, such as at about 80% brightness.

To further improve the effect, the electric lamp 8 is made of frosted glass to diffuse the light emitted by the upper tungsten wire 19 and lower tungsten wire 21, so that the variation in brightness of the upper tungsten wire 19 is perceived by an observer as movement of a candle flame. This effect can be further enhanced by shaping the electric lamp 8 into a candle flame.

Referring now to Figs. 11 to 13 of the accompanying drawings there is shown diagrammatically an improved electric lamp 24 suitable for use in the electric decoration set of the present invention. A translucent glass envelope 25 having a frosted effect surface (not shown) contains a support plate 26 for supporting the electric filament system of the lamp. The electric filament system comprises a first electric filament 27 connected to and supported by electrical connector wires 28, 29 and further supported by support wire 30. The electric filament is arranged generally transversely of the envelope 25 and is arranged to surround, at least partially, electrical connector wires 31, 32 supporting a second electric filament 33. Said second electric filament 33 is arranged generally axially of the glass envelope 25. Preferably the first electric filament is located at a proximal end of the envelope 25 and the second electric filament 33 extends from a

position adjacent or within the area circumscribed by the first electric filament 27 towards a distal end of the envelope 25 (as shown in Fig. 11). Preferably the first electric filament 27 is given a generally V-shaped configuration in plan as shown in Fig. 13. When the said electric filaments 27, 33 are arranged as shown in Figs. 11 and 13 and a non-fluctuating electric current is applied to filament 27 and a fluctuating electric current is applied to filament 33 the filament 27 radiates a constant and generally uniform light transversely of the envelope 25 and the filament 27 produces a flickering light thereby to produce a relatively realistic flickering flame effect.

The electric lamp of Figs. 11 to 13 may be incorporated into the electric decoration set described hereinbefore and preferably replaces the electric lamp described hereinbefore with reference to Fig. 9.

Two or more electric light systems 1 according to the present invention may be housed together to form a decoration set. each electric light system 1 being independently controllable. Fig. 10 shows a schematic diagram of an arrangement wherein four electric light systems 1 are housed in a container 23.

It is also possible to program a programmable device so that it can control two or more electric light systems 1 simultaneously, while each individual electric light system 1 can exhibit a different flickering effect.

It will be readily apparent to all persons skilled in the relevant art that other circuit arrangements or properly programmed devices can be utilized for achieving a similar effect without departing from the spirit of the invention. It should also be understood that the number of electric light systems 1 housed in the container 23 or the number of electric lamps 8 connected to an electric light system 1 can be varied as desired.

CLAIMS

1. An electric light system comprising means for generating a cyclically variable drive current to power one or more electric lamps, the power of the drive current varying during each cycle in a manner corresponding to the combination of a first, smoothly fluctuating, signal of a relatively low frequency and a second, sharply fluctuating, signal of a high frequency relative to the first signal such that variation of the drive current during each cycle produces a corresponding variation in the intensity of light emitted by the or each lamp thereby to produce a flickering effect similar to a flickering flame.

2. An electric light system as claimed in Claim 1, comprising:

means for generating a drive signal having a profile analogous to the combination of a first, smoothly fluctuating, signal of a relatively low frequency and a second, sharply fluctuating, signal of a high frequency relative to the first signal; and

a driving means for providing a drive current to power said one or more lamps, the magnitude of the drive current fluctuating proportionally to the drive signal.

3. An electric light system as claimed in Claim 2, wherein the means for generating a drive signal comprises:

a signal generator for generating the first signal;

a noise signal generator for generating the second signal; and

an adding means for receiving the first and second signals and generating in response thereto the drive signal.

4. An electric light system as claimed in Claim 3, wherein the drive signal generated by the adding means is a weighted sum of the first and second signals.

5. An electric light system as claimed in Claim 3 or 4, wherein the second signal is first received by a noise signal modifier whereby the band width of the second signal is modified so as to select the degree of fluctuations, before being passed to the adding means.

6. An electric light system as claimed in Claim 5, wherein the noise signal modifier acts to limit the band width of the second signal.

7. An electric light system as claimed in any one of the preceding claims, wherein an intensity controller is provided for generating a third signal through adjustment of which the average intensity of the electric light system is varied.

8. An electric light system as claimed in any one of the preceding Claims, wherein the period of the first signal is between 20 to 40 seconds.

9. An electric light system as claimed in any one of Claims 1 to 6, wherein the period of the first signal is approximately 30 seconds.

10. An electric light system as claimed in any one of the preceding Claims, wherein the first signal is in a sinusoidal wave form.

11. An electric light system as claimed in any one of the preceding Claims, wherein the second signal fluctuates randomly.

12. An electric light system as claimed in any one of the preceding Claims, wherein the second signal is of a bandwidth of 0 to 16Hz.

13. An electric light system as claimed in any one of the preceding Claims, wherein one or more programmable devices are utilized.

14. An electric light system as claimed in Claim 13, wherein

the drive signal is in a binary format convertable to an analog signal by means of a digital to analog converter.

15. An electric light system as claimed in Claim 13, wherein the drive signal is in Pulse Width Modulation format.

16. An electric light system as claimed in Claims 13, 14 or 15, for powering two or more sets of electric lamps within the electric light system, wherein each set is driven by a drive current different from the other set or sets.

17. An electric light system substantially as hereinbefore described with reference to any of Figs. 1 to 10 of the accompanying drawings.

18. An electric decoration system comprising an electric light system according to any one of Claims 1 to 17, and one or more electric lamps, the or each said electric lamp having a first tungsten wire powered by the said electric light system and a second tungsten wire powered by an electric current source which does not visibly fluctuate and which is operated at below full brightness.

19. An electric decoration system as claimed in Claim 18, wherein said first tungsten wire of the or each said electric lamp is disposed in an upward pointing position and above said second tungsten wire.

20. An electric decoration set as claimed in Claim 18, in which said second tungsten wire is disposed generally transversely of the or each lamp and the said first tungsten wire is disposed generally axially of the or each lamp, and said second tungsten wire at least partially surrounds said first tungsten wire, the arrangement being such that, in use, said second tungsten wire emits constant light approximately uniformly transversely of the or each lamp and said first tungsten wire emits a flickering light, thereby to produce a flickering effect similar to a flickering flame.

21. An electric decoration system as claimed in Claim 20, wherein said second tungsten wire is given a generally V-shaped configuration in plan.

22. An electric decoration system as claimed in Claim 20 or 21, wherein said second tungsten wire is located at a proximal end of the or each lamp and said first tungsten wire extends from a position adjacent or within the area circumscribed by said second tungsten wire towards a distal end of the lamp.

23. An electric decoration system as claimed in any one of Claims 17 to 22, wherein the or each said electric lamp is made of frosted glass so as to diffuse the light emitted by the or each said electric lamp.

24. An electric decoration system, substantially as hereinbefore described, with reference to any one of Figs. 1 to 13 of the accompanying drawings.

25. An electric decoration system suitable for use in the aspects of the invention defined above, which electric lamp comprises a translucent envelope in which are disposed two lamp filaments, the first lamp filament being disposed generally transversely of the envelope and the second lamp filament being disposed generally axially of the envelope and the first lamp filament at least partially surrounding the second lamp filament the arrangement being such that, in use, when a non-fluctuating electric current is supplied to the first lamp filament and a fluctuating electric current is supplied to the second lamp filament, light from the first lamp filament is emitted approximately uniformly transversely of the envelope and a flickering light is emitted from the second lamp filament, thereby to produce a flicking effect similar to a flickering flame.

26. An electric lamp as claimed in Claim 25, wherein the first electric filament is located at a proximal end of the envelope and the second electric filament extends from a position adjacent or within the area circumscribed by the first electric

filament towards a distal end of the envelope .

27. An electric lamp as claimed in Claims 25 or 26, wherein the first electric filament is given a generally V-shaped configuration in plan.

28. An electric lamp as claimed in any one of Claims 25 to 27, wherein the translucent envelope is made of frosted glass so as to diffuse the light emitted from the lamp.

29. An electric lamp, substantially as hereinbefore described with reference to Figs. 11 to 13 of the accompanying drawings.

30. An electric decoration systems including one or more electric lamps according to any one of Claims 25 to 29.

31. An electric decoration set comprising:

one ore more electric light systems acording to any one of Claims 1 to 17, or comprising one or more electric decoration systems according to any one of Claims 18 to 24 ;

a plurality of electric lamps;

electrical connecting wires connecting said plurality of electric lamps; and

electric power supply means.

32. An electric decoration set, substantially as hereinbefore described, with reference to any one of Figs. 1 to 10 of the accompanying drawings.

33. The features hereinbefore disclosed, or their equivalents, in any novel selection.

[:ents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9121223.3

Relevant Technical fields

(i) UK Cl (Edition K) H2H LL1,LL4; A6M M15A

(ii) Int Cl (Edition 5) H05B 37/00,37/02,39/00,39/02, 39/04,39/06,39/08,39/09,41/44

Search Examiner

M J BILLING

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES - WPI

Date of Search

15.01.92

Documents considered relevant following a search in respect of claims 1 TO 23

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 1083450 A (KAYATT) - eg see figures 3,4	18,20 at least
Y	US 4593232 A (MEEDWARDS) - eg see figures 1,6	7,16,18, 19,20 at least
X Y	US 4510556 A (JOHNSON) - eg see figures 1,3	1,2,6,18 3,5,6,7, 13,14, 19,20
X Y	US 4417182 A (WEBBER) - eg see figure 1; column 3 lines 15-19	1,2,11, 16,21 3,5,6,7, 13,14,18 19,20
Y	US 4064414 A (FBW) - eg see figure 1	7,11,13, 14 at least
X Y	US 3789211 A (GLASS) - eg see column 5 lines 33-40	1,2 3,5,6,7, 11,13,14, 16,18,19, 20

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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(i) UK Cl (Edition) Contd. from page 1

(ii) Int Cl (Edition)

Search Examiner

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	US 3506876 A (ANTONICH) - eg see figure 1, column 2 lines 13-47	3,5,6,11, at least
X Y	US 3500126 A (FORD) - eg see figure 1; column 3 line 11 - column 4 line 52	1,2 3,5,6,7, 11,13,14, 16,18,19, 20

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Category	Identity of document and relevant passages	Relevant to claim(s)

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