

[54] **METHOD AND APPARATUS FOR FORMING SPATIAL LIGHT PATTERNS**

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[58] Field of Search.....315/209, 227, 238, 315/240, 241; 340/373, 378; 350/144; 240/6.42, 6.4 R, 6.44, 2 R, 2 AD, 10 F

[56] **References Cited**

UNITED STATES PATENTS

2,108,802	2/1938	Dorsey	240/6.42 X
2,496,601	2/1950	Schamblin	343/721 X
2,726,483	12/1955	Hughes et al.....	240/6.42 X
3,113,241	12/1963	Yanushka	315/209 R X
3,465,207	9/1969	Meridan, Jr.	317/33

OTHER PUBLICATIONS

Electronics World - Oct. 1965 - p. 68 - "Battery-

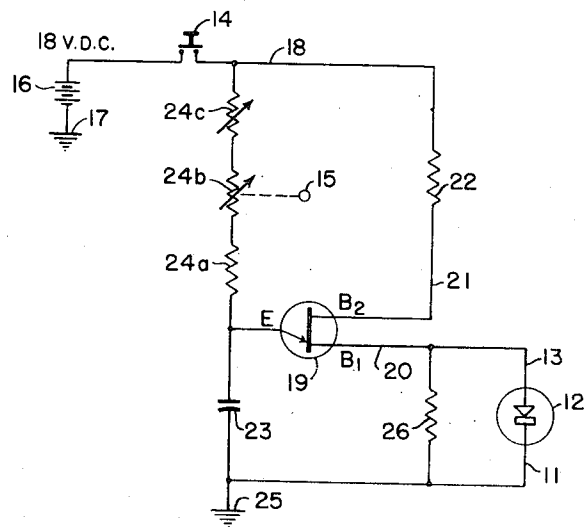
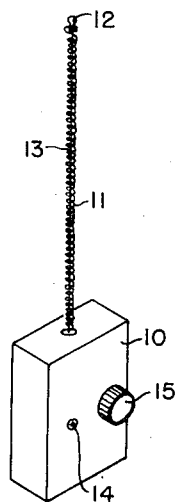
Operated Fluorescent Lamp"- by Mapham/G.E.Co.

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Attorney—Milmore & Cypher

[57] **ABSTRACT**

Spatial light patterns, such as one or several stationary or moving dots or lines are formed in a darkened environment by repeatedly moving a pulsing light emitter which is intensely bright, yet yields little or no illumination to surrounding objects; such as a light-emitting diode or neon light, through a fixed or random path. The light emitter is periodically connected to a source of electric potential by an electronic oscillator, which energizes the light emitter and lights it during parts of the periods between successive energizations. Preferably the frequency of the light pulses and the duration of these pulses can be varied, either manually or in response to an externally controlled electrical signal generated by sound, heat, mechanical motion, pressure, light or other means.

5 Claims, 5 Drawing Figures



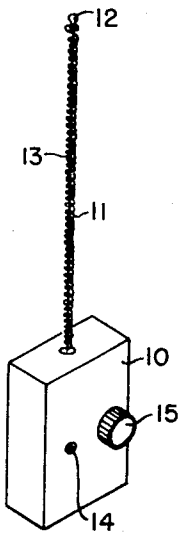


FIG. 1

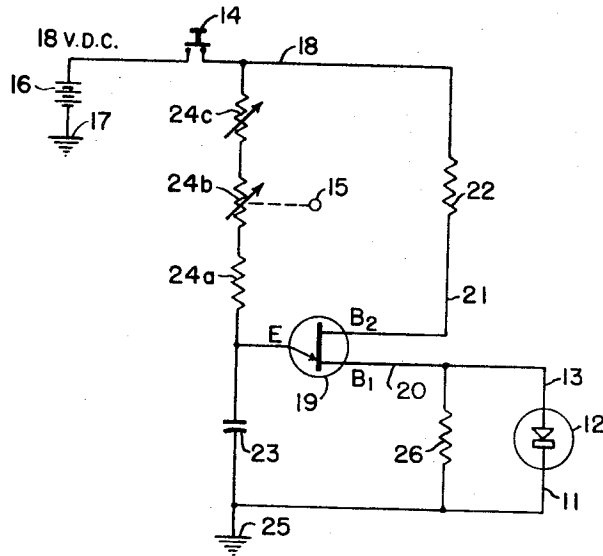


FIG. 2

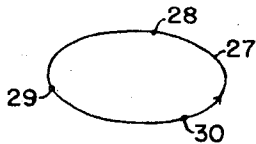


FIG. 3

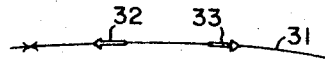


FIG. 4

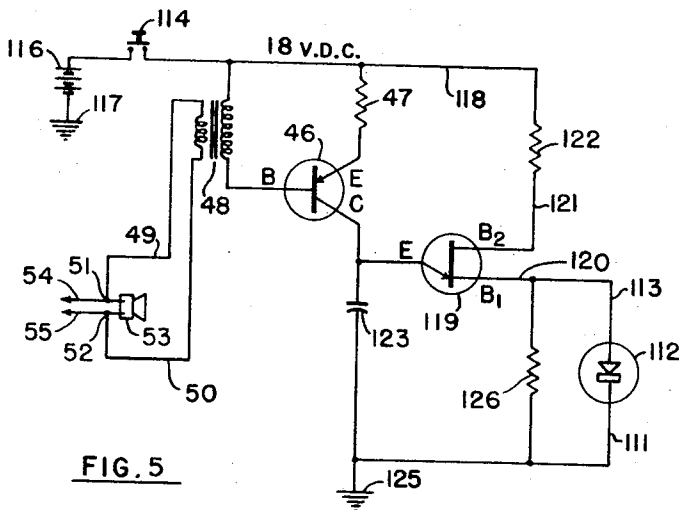


FIG. 5

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METHOD AND APPARATUS FOR FORMING SPATIAL LIGHT PATTERNS

The invention relates to a process and a device for forming spatial light patterns in a darkened environment. It is applied principally as an amusement device, to give aesthetic pleasure to an observer, and may be manually operated or mechanically attached to another object, such as a frame in a shop window or an external display.

Display devices, such as stroboscopic lights and movable illuminating lights that are turned on and off are known. In these devices, however, the lamp illuminates a moving or a stationary, light-reflective object, such as a rotating or reciprocating machine part. In contrast, the present invention is concerned with a process and device wherein essentially only the periodically lighted source of light itself is seen.

Further, known display devices employing lamps with switching elements were not suitable for creating in space the illusion of various light patterns. In contrast, the present invention makes it possible to create in a darkened environment various geometric light patterns. These geometric light patterns may appear to remain stationary or an illusion may be created in which the entire geometric pattern appears to shift or revolve about an axis.

It is the principal object to provide a process and device for forming in a darkened environment spatial light patterns wherein essentially only a periodically lighted light emitter is seen, the light emitter being lighted for durations that are parts of the periods between successive energizations of the light emitter.

A further object is to facilitate use of the device by making the lengths of the said periods variable, either by control by an operator or in response to some other condition.

A specific object is to provide a hand-operated device for the purpose stated in the first object having a container which is graspable by the hand for movements and a light emitter carried by a member such as a rod which projects from the container. Ancillary thereto, it is an object to provide a device in which said projecting member is flexible and resilient, whereby the light emitter can swing relatively to the container.

In summary, according to the invention a light emitter which is periodically energized from a source of electrical potential by means including an electronic oscillator so as to light the emitter for durations which are parts of the periods between successive energizations, is moved through a path in a darkened environment. Depending upon the length of the period between energizations and the speed at which the light emitter is moved, there will appear one or several locations in space which are illuminated, and which appear to a viewer to have fixed positions in space or which appear to drift in one direction or the other along the said path. These illuminated locations may appear as dots or as lines, depending upon the flashing rate, upon the speed of movement of the light emitter, and upon the duration that the light emitter is lighted in each period.

Varying light patterns can be generated by altering the speed of movement along the path, by varying duration of the "on" time, by altering the path — even following random paths instead of repetitively following the same path — and varying the flashing rate, (which is inversely proportional to the lengths of the periods between energizations).

Since altering the flashing rate and flash duration is in most applications desirable for attaining different spatial patterns, the electronic oscillator for periodically energizing the light emitter is preferably provided with means for varying the flashing rate and flashing duration.

By mounting the light emitter on an elongated member which is fixed to and projects from a supporting element, such as a container housing the oscillator and other parts, the length of the path can be controlled by simply giving a rocking motion to the element, as by turning the wrist of the hand supporting the element or rocking the element mechanically. Further, by forming the projecting member of flexible, preferably resilient material, the light emitter can be made to swing relatively to the supporting element, thereby facilitating still longer paths for the light emitter.

The invention will be further described with reference to the accompanying drawings which show certain preferred embodiments by way of illustration, wherein:

FIG. 1 is an isometric of a hand-operated device;

FIG. 2 is a circuit diagram of the device of FIG. 1;

FIG. 3 is an isometric of an orbital path and showing one possible spatial effect produced by the device;

FIG. 4 is an elevation of a substantially linear path and showing another possible spatial effect;

FIG. 5 is a circuit diagram of a second embodiment.

Referring to FIGS. 1 and 2, the mechanical parts of the device include a container 10 having fixed thereto a projecting member 11, such as a resilient, coiled spring, extending upwards and carrying at its end a light emitter 12 which is connected to the energizing circuit within the container. In this embodiment only a single insulated wire 13 is used, the member 11 being grounded to the case and serving as the second circuit element. The light emitter in this embodiment is a small device, such as a light-emitting diode; a specific example is a diffused gallium arsenide phosphide diode, which emits a point source of light of ruby color having a luminous intensity so low as not to illuminate nearby light-reflective objects. A lamp having a rated brightness of 750 foot candles is produced at 20 milliamperes with about 5 milliamperes being used in the described example. In this embodiment, the case 10 is small and is suitable to be grasped and moved manually. It includes, further, a normally open, spring-urged on-off push button switch 14 and a rotatable knob 15 for adjustment of the flashing rate.

An alternate form of the invention replacing the bendable reed or spring with the light at the distal free end, is to replace members 11 and 13 with a flexible fiber optic tube and to mount the light emitting diode in the case 10 at the base of the fiber optic tube. The light is then observed as emanating from the free end of the tube.

All parts of the circuit shown in FIG. 2 except the light emitter and parts of its connecting circuits are located within the case 10. This circuit includes a source of electrical potential, such as an 18-volt dry cell battery 16 having one terminal grounded at 17 to the case and the other terminal connected via the switch 14 to a power circuit 18. The electronic oscillator includes a unijunction transistor 19 which has its first base B₁ connected via a circuit 20 and the wire 13 to the light-emitting diode 12; its second base B₂ connected by a circuit 21 and a first resistor 22 to the power circuit 18; and its emitter E connected to the junction of a capaci-

tor 23 and a second resistor which, in this embodiment, is made variable and contains sections 24a, 24b and 24c, the capacitor and resistor being serially connected between the circuit 18 and ground at 25, i.e., across the source of potential. The light emitter has a third resistor 26 in shunt therewith and has its second terminal connected, via the spring 11, to ground. In this embodiment, the section 24a is fixed, section 24b is a variable resistor the value of which is controlled by the knob 15, and section 24c is a trimming resistor.

Without in any way restricting the invention, it may be stated that the following components are suitable: Resistors have resistances of 220 ohms for 22, 1 K ohms for 24a, 100K for 24b, 10K for 24c, and 470 ohms for 26 when used with the diffused gallium arsenide phosphide diode, type MV50TM; and the unijunction transistor 19 may be of type 2N4891.

It is evident that other types of electronic oscillators or electronic switches may be used for the unijunction transistor 19, to switch the light emitter on and off at variable pulse rates and durations such as flip flops.

The components are in most instances selected to permit the flashing rate to be varied from about 5 to 500 times per second.

OPERATION

The device is used in a darkened environment (either total darkness or subdued light) by holding the case 10 in one hand, pressing the switch 14 and moving the case to cause the light emitter to follow a desired regular or random path.

One possible path 27, orbital in shape, is shown in FIG. 3. By adjusting the resistor 24b by means of the knob 15, it is possible to cause only one dot of light 28 to appear, either always in the same location or apparently drifting forwards or backwards along the path 27. By increasing the flashing rate and/or slowing the speed of movement of the light emitter along the path, additional dots of light such as 29 and 30, are made to appear, again, always at the same locations or apparently drifting forwards or backwards. Any number of such dots, for example a dozen or more may be made to appear.

A distinctive phenomenon of the circuit heretofore described is the illusion of seeing the light as a line with defined ends. This illusion is created by lengthening the "on" time of the moving light electronically by making the electrical pulse to the light of longer duration. When the amount of resistance in resistor 24 is reduced to below a certain value (1,000 - 2,000 ohm) the pulse length from the unijunction oscillator becomes variable as well as the pulse rate and instead of short pulses longer segments of continuous current get through to the light emitting diode. Whereas the dot producing pulse has a duration of about 0.0001 seconds, decreasing R 24 past a certain point begins to elongate the pulse until it is on the order of tenths of a second and lines begin to appear along the path.

Another visual illusion that may be seen in the present circuit is that of an "arrow with a head." This effect is the result of the waveform which is electronically produced in which the initial amplitude is greater and therefore the light output at that instant is greater. This effect, of course, is only observed when the light source is moving relatively rapidly as the duration of the pulse is only about 0.0001 seconds with the duration of the greater amplitude being in the order of about 0.000001

seconds. The difference in the relative pulse amplitude causes the bright head on a relatively dim tail.

FIG. 4 shows an example of a path 31, forming a single line along which the light emitter is moved back and forth, this path being usually slightly convex upwardly, as shown. This view shows two lines 32 and 33 with what appears to be arrow-heads at their ends. Of course, shorter illuminated locations even dots, can be attained also by following this path.

SECOND EMBODIMENT

FIG. 6 shows an embodiment in which the flashing rate is controlled by an external signal, shown in this exemplary embodiment to be the audio level of an acoustic device. This device may, save for the presence of an electrical cord, include a hand-held supporting element in the form of a case as described for the first embodiment, in which the parts 11-14, 16-23 and 25-26, increased by 100, denote like parts. However, a mechanically-operated supporting element is not shown.

The resistor 24 is replaced by a junction transistor 46, one of type p-n-p being shown for illustration, connected to impose a variable resistance between the circuit 118 and the junction of the capacitor 123 and the emitter E of the unijunction transistor 119. While various connections are possible, it is preferred to connect the emitter E of the transistor 46 through a resistor 47 to the wire 118 and the collector to the capacitor 123 and the first-mentioned emitter. The emitter E thereby functions as the control part of the transistor. The base B of transistor 46 is connected to the output of an impedance matching device, such as the secondary of a transformer 48, the other side of which is connected to the wire 118. The input of the transformer 48 is connected by electrical wires 49 and 50, such as an electrical cord, to terminals 51 and 52, which are adapted to be connected to an acoustic device, such as an audio speaker 53 powered from a line 54, 55.

By way of specific example, when the speaker 53 has an impedance of 8 ohms and the transistor 46 is a PNP transistor type 2N3906 connected as shown, the transformer 46 may be a subminiature audio transformer having input and out impedances of 8 and 2,000 ohms, respectively, and the resistor 47 may have a value of 10 ohms.

The transistor 46 performs the function of the section 24 b of the first embodiment, controllably conducting a variable current there through by varying the resistance in response to the audio level (volume) of the speaker 53, to vary the flashing rate. Thus, as the audio level changes, the potential between the base and emitter of the transistor 46 is varied, permitting a current to flow at a variable rate from the circuit 118 to charge the capacitor 123.

It may be understood that various generators, in addition to an acoustic device, may be used to produce electrical signals having various waveforms. Possible input signals could be (1) sine waveforms, (2) square waveform, (3) sawtooth, (4) rectangular, (5) any mixture of the foregoing, or (6) a complex modulated waveform.

I claim:

1. A device for periodically emitting from a moving location, a pulse of visible light of limited illuminating power which does not illuminate other objects in a darkened environment which comprises:

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- a. a source of electrical potential;
- b. a light emitting diode within the visible spectrum having sharply defined junctions between illumination and darkness and situated at said location and having only said limited illuminating power;
- c. means including an electronic oscillator for periodically energizing said light emitting diode from said source;
- d. means for varying the lengths of said periods; and
- e. means for varying the duration of said visible light emissions during said periods.

2. A device according to claim 1, wherein said light emitting diode is a diffused gallium arsenide phosphide diode.

- 3. A device according to claim 1, which includes:
 - a. a manually graspable enclosure containing at least the electronic oscillator;
 - b. the light emitting diode is mounted remotely from said enclosure on a member which is fixed to and projects from the container;
 - c. said member is flexible and of resilient material, whereby the light emitting diode can swing relatively to the container;
 - d. said potential is direct current and the electronic oscillator includes a unijunction transistor of which:
 - 1. the first base is connected electrically to one terminal of the light emitting diode.
 - 2. the second base is connected electrically through a first resistor to one side of said source of potential;
 - 3. the emitter is connected electrically to the junction of a second resistor, which is variable whereby the lengths of said periods can be varied, and a capacitor which are connected in series with each other and across said source of po-

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tential, the said light emitting diode having its second terminal connected electrically to the other side of said source of potential; and

- e. said light emitting diode has a third resistor in shunt therewith.

4. A device according to claim 1 wherein said potential is direct current and the lengths of said periods are variable and determined at least in part by an external signal, said oscillator including:

- a. a unijunction transistor of which
 - 1. one base is connected electrically to a first terminal of the light emitting diode,
 - 2. another base is connected electrically through a first resistor to one side of said source of potential, and
 - 3. the emitter is connected electrically to the junction of a capacitor and one terminal of a circuit element for controllably conducting a variable current therethrough in accordance with an electrical signal applied to a control part thereof, said capacitor and circuit element being connected in series across said source of potential;
- b. said light emitter has its second terminal connected electrically to the other side of said source of potential; and
- c. a control circuit connected electrically to said control part and adapted to receive said external signal.

5. A device according to claim 4 wherein said circuit element is a second transistor having a base, an emitter and a collector, and said control circuit includes an impedance-matching circuit having an input adapted to be connected to a source of acoustic power to receive energy therefrom and an output connected electrically to said second transistor.

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