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Attorneys for Plaintiff, Sterno Home Inc.

**IN THE UNITED STATES DISTRICT COURT  
 FOR THE CENTRAL DISTRICT OF CALIFORNIA**

<p>Sterno Home Inc.,</p> <p style="text-align: center;">Plaintiff,</p> <p style="text-align: center;">v.</p> <p>Shenzhen Liown Electronics Co. Ltd.,              Luminara Worldwide, LLC, Matchless              Candle Co., L&amp;L Candle Company,              LLC, The Light Garden, Inc., RAZ              Imports, Inc., Napa, LLC, d/b/a Napa              Home &amp; Garden, and Boston Warehouse              Trading Corp.</p> <p style="text-align: center;">Defendants.</p>	<p><b>CASE NO.: 8:20-CV-00912</b></p> <p><b>COMPLAINT</b></p> <p><b>DEMAND FOR JURY TRIAL</b></p>
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**COMPLAINT FOR PATENT INFRINGEMENT**

**I. NATURE OF THE ACTION AND SUBJECT MATTER JURISDICTION**

1. This Complaint arises under the patent laws of the United States, Title 35 of the United States Code. This Court has subject matter jurisdiction over this action under 35 U.S.C. § 271 *et seq.*, 28 U.S.C. §§ 1331 and 1338(a).
2. The claims arise out of Defendants' actions regarding the sale and offer for sale of flameless candles that embody patents owned by Plaintiff, Sterno Home Inc.

**II. THE PARTIES**

3. Plaintiff Sterno Home Inc. ("Sterno Home") is a Canadian corporation with a business address at 1 Burbridge Street, Suite 101, Coquitlam, BC V3K 7B2, Canada. Sterno Home is a wholly owned subsidiary of The Sterno Group Companies, LLC, which is headquartered at 1880 Compton, Ave., Suite 101, Corona, California.
4. Defendant L&L Candle Company, LLC ("L&L") is a U.S. Delaware limited liability company with a principal place of business and headquarters in the Southern Division of this district in Orange County at 621 Lunar Avenue, Brea, California 92821.
5. L&L is a joint venture between Luminara Worldwide, LLC ("Luminara") and Shenzhen Liown Electronics Co. Ltd. Shenzhen Liown Electronics Co. Ltd. also has operated or operates under or through the business names Liown Technologies/Beauty Electronics, LLC, Liown Holdings, Inc. and Liown Electronics Co. Ltd. (collectively herein "Liown").
6. Luminara and Liown Holdings, Inc. are listed in records at the Secretary of State of the State of California as being registered members of L&L.

- 1 7. Liown Holdings, Inc. is a lapsed Delaware corporation not registered to do  
2 business in California. A reasonable opportunity for discovery is likely to  
3 show that Liown Holdings, Inc. is 100% owned and controlled by Shenzhen  
4 Liown Electronics Co. Ltd., is a past or current “doing business as” name for  
5 Shenzhen Liown Electronics Co. Ltd., or has not complied with the  
6 corporate formalities required to entitle Shenzhen Liown Electronics Co.  
7 Ltd. to shield itself from liability for the activities of Liown Holdings, Inc.
- 8 8. Defendant Luminara is a member of L&L and is a limited liability company  
9 organized in Delaware with a principal place of business in Eden Prairie,  
10 Minnesota. Luminara is registered to do business in California. A reasonable  
11 opportunity for discovery is likely to show that Luminara, as a member of  
12 L&L, has a place of business in the Southern Division of this district at the  
13 location of the Luminara-Liown L&L joint venture in Brea, California.
- 14 9. Defendant Matchless Candle Co. (“Matchless Candle”) is a California  
15 corporation with a principal place of business in the Southern Division of  
16 this district in Orange County at 509 Mercury Lane, Brea, CA 92821.
- 17 10. The CEO of Matchless Candle, Johnny Yang, is also the CEO of L&L.
- 18 11. Matchless Candle is identified on the L&L website as one of L&L’s  
19 “brands” with links to its flameless candle products, including products  
20 accused in this Complaint.
- 21 12. Defendant Shenzhen Liown Electronics Co. Ltd. is a Chinese alien company  
22 that is the other member of “L&L” and does business in the Southern  
23 Division of this district through that joint venture with Luminara at the Brea,  
24 California, Orange County location, 621 Lunar Avenue, Brea, California  
25 92821.
- 26 13. Liown has a principal place of business in China, at No. 7, Gongye 3rd  
27 Road, Shekou, Nanshan District, Shenzhen, Guangdong, 518067.
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- 1 14. Liown also does business under the names “Liown Electronics” and  
2 “Liown” and operates a website “Liown.com.” That website lists a business  
3 address at 621 Lunar Ave, Brea, CA 92821, in Orange County in this  
4 district, the same address as the address for L&L. <http://liown.com/contact>.
- 5 15. The L&L website (<https://llecandle.com/>) lists “LIGHTLi” as an L&L brand.  
6 The “LIGHTLi” trademark is registered to Liown on the United States  
7 Patent & Trademark Office on-line database.
- 8 16. The Light Garden, Inc. (“TLG”) is a California corporation with a principal  
9 place of business in San Diego county, at 1205 Avenida Chelsea, Vista,  
10 California 92081.
- 11 17. RAZ Imports Inc. (“RAZ”) is a Texas corporation with a principal place of  
12 business at 1020 Eden Road, Arlington, Texas 76001. RAZ Imports Inc. also  
13 operates with, through, or under the name “M&B”, which holds itself out as  
14 a “division” of RAZ Imports.
- 15 18. Napa, LLC d/b/a Napa Home & Garden (“Napa”) is a Virginia limited  
16 liability company with a principal office at 3400 Corporate Way, Suite D,  
17 Duluth, Georgia 30096.
- 18 19. Boston Warehouse Trading Corp. (“BWTC”) is a Massachusetts corporation  
19 with a principal place of business at 59 Davis Ave, Norwood, Massachusetts  
20 and a business location in this district at 2154 W. 190<sup>th</sup> Street, Torrance,  
21 California 90504.
- 22 20. Defendants TLG, RAZ, Napa, and BWTC are collectively referred to herein  
23 as “Distributors”.
- 24 21. A reasonable opportunity for discovery is likely to show that one or more  
25 Defendants acts as a supplier to the Distributors of the accused products in  
26 this Complaint.  
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22. A reasonable opportunity for discovery is likely to show that the Defendants, including Distributors, import, offer for sale, and sell these accused products to consumers in this judicial district and elsewhere in the United States.

### III. JURISDICTION & VENUE

23. The Court has personal jurisdiction over Defendants because Defendants have continuous and systematic contacts with this State and do business in this judicial district.

24. Defendants conduct business in this judicial district by importing, offering for sale, or selling accused products in this Complaint in this judicial district.

25. Liown is an alien company that may be sued in any district, 28 U.S.C. §1391(c)(3), and has significant contacts with the Southern Division of the Central District of California.

26. Defendants sell the accused products in this Complaint through multiple retail outlets across the United States, including outlets in this judicial district. At least some of those outlets are listed on the Luminara website at <https://luminara.com/stores>, including Bed, Bath and Beyond, 13692 Jamboree Road, Irvine, CA, 92602 and Pottery Barn, 3333 Bear Street, Space # 150, Costa Mesa, CA, 92626.

27. A reasonable opportunity for discovery is likely to show that Defendants also sell the accused products in this Complaint online in, and into, this judicial district, using digital platforms including: Liown.com, llcandle.com, matchlesscandleco.com, lightlicandles.com, luminara.com, thelightgarden.com, napahomeandgarden.com, bwtc.com, bethlehemlights.com and razimports.com.

1 28. A reasonable opportunity for discovery is likely to show that the accused  
2 products in this Complaint are sold in, and into, this judicial district via other  
3 online platforms and distributors as well, including sales into in this judicial  
4 district.

#### 5 **IV. BACKGROUND FACTS**

6 29. Plaintiff Sterno Home is an innovator and pioneer in the LED flameless  
7 candle category. Sterno Home's many flameless candle innovations have  
8 been recognized, and granted patents, by the United States Patent and  
9 Trademark Office. (*See* Exhibit 1.)

10 30. Sterno Home is a market leader in commercial sales of flameless candles. It  
11 has made significant investments to develop its flameless candle markets  
12 across the globe. The flameless candle market segment is popular and such  
13 candles have been sold by Sterno Home across the globe and in the United  
14 States, including at well-known retail stores, such as Target, Costco, Bed  
15 Bath & Beyond, Restoration Hardware, Pottery Barn, Crate & Barrel,  
16 Frontgate, Pier 1, Hobby Lobby, Meijer, Kroger, Cost Plus, Joanns and  
17 Michael's. Sterno Home's Mirage®, Mirage® Gold, Sterno Home®,  
18 Candle Impressions® and iFlicker® flameless candles are superiorly crafted,  
19 provide a flicker that gives ambiance of authentic candlelight, and lower the  
20 risk of fire from a real flame. These high quality patented flameless candles  
21 provide a beautifully realistic flame effect.

22 31. Defendants make, use, import, offer for sale, or sell flameless candles that  
23 infringe at least United States Patents 6,719,443, 8,562,186, 9,491,832,  
24 10,247,374, 8,858,043 and 6,616,308. (collectively "Asserted Patents")  
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1 32. Defendants make, use, import, offer for sale, or sell flameless candles under  
2 at least the following names: “Moving Flame,” “Wick-to-Flame”, “Matrix”  
3 (including “Matrixflame”) and “Push Flame” under at least the Luminara,  
4 LIGHTLi, Liown and/or Matchless Candle brands. These flameless candles  
5 and mere colorable variations thereof are referred to herein as the “Accused  
6 Products.” A reasonable opportunity for discovery will likely reveal other  
7 infringing products.

8 33. A reasonable opportunity for discovery will show that Liown makes or has  
9 made the Accused Products in China, and imports them into this judicial  
10 district and other judicial districts in the United States. A reasonable  
11 opportunity for discovery will show that Liown distributes and/or sells  
12 Accused Products to customers located in this judicial district and  
13 throughout the United States.

## 14 **V. PATENT INFRINGEMENT CLAIMS**

### 15 **COUNT I - US PATENT NO. 6,719,443**

16 34. Sterno Home is the owner of U.S. Patent No. 6,719,443 (“‘443 Patent”) with  
17 the exclusive right to sue, and recover damages, for the past and future  
18 infringement thereof. A copy of the ‘443 Patent is attached as Exhibit 2.

19 35. The ‘443 Patent duly issued on April 13, 2004.

20 36. The Defendants make, import, offer for sale, use and/or sell at least the  
21 following flameless candles under at least the following names: “Push  
22 Flame”, “Matrix.”  
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- 1 37. Defendants have and continue to infringe, either literally or under the  
2 doctrine of equivalents, the ‘443 Patent by making, using, selling, offering  
3 for sale, and/or importing the Accused Products embodying the patented  
4 invention, including “Push Flame” and “Matrix,” to customers in the United  
5 States, either directly or through intermediaries, where they have been made  
6 available for sale and sold in California, and/or contributing to and/or  
7 inducing infringement by others under 35 U.S.C. § 271 *et seq.*
- 8 38. A reasonable opportunity for further discovery is likely to show that  
9 Defendants infringing activities have continued, despite Defendants’  
10 knowledge of Plaintiff’s rights in and to the ‘443 Patent and/or with  
11 Defendants’ knowledge that Defendants do not have the right to practice any  
12 invention claimed by the ‘443 Patent. Accordingly, Defendants are willfully  
13 infringing the ‘443 Patent.
- 14 39. Each of these flameless candles, and any mere colorable variations thereof,  
15 infringe at least one claim of the ‘443 Patent. Representative examples of  
16 infringed claims of the ‘443 Patent are shown in Exhibits 8 & 9.

17 **COUNT II - PATENT NO. U.S. 8,562,186**

- 18 40. Sterno Home is the owner of U.S. Patent No. 8,562,186 (“‘186 Patent”) with  
19 the exclusive right to sue, and recover damages, for the past and future  
20 infringement thereof. A copy of the ‘186 Patent is attached as Exhibit 3.
- 21 41. The ‘186 Patent duly issued on October 22, 2013.
- 22 42. The Defendants make, import, offer for sale, use, and/or sell at least the  
23 following flameless candles under at least the following names: “Matrix.”  
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- 1 43. Defendants have and continue to infringe, either literally or under the  
2 doctrine of equivalents, the ‘186 Patent by making, using, selling, offering  
3 for sale, and/or importing the Accused Products embodying the patented  
4 invention, including “Matrix,” to customers in the United States, either  
5 directly or through intermediaries, where they have been made available for  
6 sale and sold in California, and/or contributing to and/or inducing the  
7 infringement by others under 35 U.S.C. § 271 *et seq.*
- 8 44. A reasonable opportunity for discovery is likely to show that Defendants  
9 infringing activities have continued despite Defendants’ knowledge of  
10 Plaintiff’s rights in and to the ‘186 Patent and/or with Defendants’  
11 knowledge that Defendants do not have the right to practice any invention  
12 claimed by the ‘186 Patent. Accordingly, Defendants are willfully infringing  
13 the ‘186 Patent.
- 14 45. Each of these flameless candles, and any mere colorable variations thereof,  
15 infringe at least one claim of the ‘186 Patent. A representative example of an  
16 infringed claim of the ‘186 Patent is shown in Exhibit 10.

17 **COUNT III - PATENT NO. 9,491,832**

- 18 46. Sterno Home is the owner of U.S. Patent No. 9,491,832 (“‘832 Patent”) with  
19 the exclusive right to sue, and recover damages, for the past and future  
20 infringement thereof. A copy of the ‘832 Patent is attached as Exhibit 4.
- 21 47. The ‘832 Patent duly issued on November 8, 2016.
- 22 48. The Defendants make, import, offer for sale, use and/or sell at least the  
23 following flameless candles under at least the following names: “Matrix.”  
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1 49. Defendants have and continue to infringe, either literally or under the  
2 doctrine of equivalents, the ‘832 Patent by making, using, selling, offering  
3 for sale, and/or importing the Accused Products, embodying the patented  
4 invention, including “Matrix,” to customers in the United States, either  
5 directly or through intermediaries, where they have been made available for  
6 sale and sold in California, and/or contributing to and/or inducing the  
7 infringement by others under 35 U.S.C. § 271 *et seq.*

8 50. A reasonable opportunity for discovery is likely to show that Defendants  
9 infringing activities have continued, despite Defendants’ knowledge of  
10 Plaintiff’s rights in and to the ‘832 Patent and/or with Defendants’  
11 knowledge that Defendants do not have the right to practice any invention  
12 claimed by the ‘832 Patent. Accordingly, Defendants are willfully infringing  
13 the ‘832 Patent.

14 51. Each of these flameless candles, and any mere colorable variations thereof,  
15 infringe at least one claim of the ‘832 Patent. Representative examples of  
16 infringed claims of the ‘832 Patent are shown in Exhibit 11.

17 **COUNT IV - PATENT NO. 10,247,374**

18 52. Sterno Home is the owner of U.S. Patent No. 10,247,374 (“‘374 Patent”)  
19 with the exclusive right to sue, and recover damages, for the past and future  
20 infringement thereof. A copy of the ‘374 Patent is attached as Exhibit 5.

21 53. The ‘374 Patent duly issued on April 2, 2019.

22 54. The Defendants make, import, offer for sale, use and/or sell at least the  
23 following flameless candles under at least the following names: “Moving  
24 Flame”, “Wick-to-Flame”, and “Push Flame.”  
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1 55. Defendants have and continue to infringe, either literally or under the  
2 doctrine of equivalents, the '374 Patent by making, using, selling, offering  
3 for sale, and/or importing the Accused Products, embodying the patented  
4 invention, including "Moving Flame", "Wick-to-Flame", and "Push Flame,"  
5 to customers in the United States, either directly or through intermediaries,  
6 where they have been made available for sale and sold in California, and/or  
7 contributing to and/or inducing the infringement by others under 35 U.S.C. §  
8 271 *et seq.*

9 56. A reasonable opportunity for further discovery is likely to show that  
10 Defendants infringing activities have continued, despite Defendants'  
11 knowledge of Plaintiff's rights in and to the '374 Patent and/or with  
12 Defendants' knowledge that Defendants do not have the right to practice any  
13 invention claimed by the '374 Patent. Accordingly, Defendants are willfully  
14 infringing the '374 Patent.

15 57. Each of these flameless candles, and any mere colorable variations thereof,  
16 infringe at least one claim of the '374 patent. Representative examples of  
17 infringed claims of the '374 Patent are shown in Exhibits 12-15.

18 **COUNT V - PATENT NO. 8,858,043**

19 58. Sterno Home is the owner of U.S. Patent No. 8,858,043 ("043 Patent") with  
20 the exclusive right to sue, and recover damages, for the past and future  
21 infringement thereof. A copy of the '043 Patent is attached as Exhibit 6.

22 59. The '043 Patent duly issued on October 14, 2014.

23 60. The Defendants make, import, offer for sale, use and sell at least the  
24 following flameless candles under at least the following names: "Wick to  
25 Flame", "Push Flame."  
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- 1 61. Defendants have and continue to infringe, either literally or under the  
2 doctrine of equivalents, the '043 Patent by making, using, selling, offering  
3 for sale, and/or importing the Accused Products, embodying the patented  
4 invention, "Wick to Flame" and "Push Flame," to customers in the United  
5 States, either directly or through intermediaries, where they have been made  
6 available for sale and sold in California, and/or contributing to and/or  
7 inducing the infringement by others under 35 U.S.C. § 271 *et seq.*
- 8 62. A reasonable opportunity for further discovery is likely to show that  
9 Defendants infringing activities have continued despite Defendants'  
10 knowledge of Plaintiff's rights in and to the '043 Patent and/or with  
11 Defendants' knowledge that Defendants do not have the right to practice any  
12 invention claimed by the '043 Patent. Accordingly, Defendants are willfully  
13 infringing the '043 Patent.
- 14 63. Each of these flameless candles, and any mere colorable variations thereof,  
15 infringe at least one claim of the '043 Patent. Representative examples of  
16 infringed claims of the '043 Patent are shown in Exhibits 16-17.

17 **COUNT VI - PATENT NO. 6,616,308**

- 18 64. Sterno Home is the owner of U.S. Patent No. 6,616,308 ("308 Patent") with  
19 the exclusive right to sue, and recover damages, for the past and future  
20 infringement thereof. A copy of the '308 Patent is attached as Exhibit 7.
- 21 65. The '308 Patent duly issued on July 17, 2018.
- 22 66. The Defendants make, import, offer for sale, use and sell at least the  
23 following flameless candles under at least the following names: "Moving  
24 Flame", "Wick to Flame", "Matrix", "Push Flame."
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1 67. Defendants have and continue to infringe, either literally or under the  
2 doctrine of equivalents, the '308 Patent by making, using, selling, offering  
3 for sale, and/or importing the Accused Products, embodying the patented  
4 invention, "Moving Flame", "Wick to Flame", "Matrix", and "Push Flame,"  
5 to customers in the United States, either directly or through intermediaries,  
6 where they have been made available for sale and sold in California, and/or  
7 contributing to and/or inducing the infringement by others under 35 U.S.C. §  
8 271 *et seq.*

9 68. A reasonable opportunity for further discovery is likely to show that  
10 Defendants infringing activities have continued, despite Defendants'  
11 knowledge of Plaintiff's rights in and to the '308 Patent and/or with  
12 Defendants' knowledge that Defendants do not have the right to practice any  
13 invention claimed by the '308 Patent. Accordingly, Defendants are willfully  
14 infringing the '308 Patent.

15 69. Each of these flameless candles, and any mere colorable variations thereof,  
16 infringe at least one claim of the '308 Patent. Representative examples of  
17 infringed claims of the '308 Patent are shown in Exhibits 18-22.

## 18 VI. DAMAGES AND REMEDIES

19 70. Defendants' infringement has damaged Plaintiff, and a reasonable  
20 opportunity for discovery is likely to show that damage includes lost sales,  
21 lowered prices, and reduced market share.

22 71. The injury to the Plaintiff in the form of lost market share and lowered  
23 prices is irreparable. Plaintiff is entitled to its constitutional guaranty of  
24 exclusivity and Defendants should be enjoined from further infringements.  
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1 72. A reasonable opportunity for discovery is likely to show that mere colorable  
2 variations of the products accused in this Complaint, are made by or for  
3 Liown, Luminara, and/or Matchless Candle and imported into the United  
4 States directly by one or more Distributors, including RAZ, TLG, Napa  
5 and/or BWTC.

6 73. A reasonable opportunity for further discovery is likely to show one or more  
7 claims of the Asserted Patents are infringed by other flameless candle  
8 products produced, sold and distributed by Defendants on an "OEM" basis  
9 for others that are mere colorable variations of the Accused Products.

10 74. Defendants have satisfied applicable marking obligations under 35 U.S.C. §  
11 287.

12 75. A reasonable opportunity for discovery is likely to show that one or more of  
13 the Defendants was aware of one or more of the Asserted Patents prior to the  
14 filing of this case.

15 76. A reasonable opportunity for discovery is likely to show that one or more  
16 Defendants proceeded to infringe despite knowing that there was a high  
17 probability that the Accused Products would infringe one or more of the  
18 Asserted Patents.

19 77. Defendants' infringement was, and going forward is, willful under 35 U.S.C.  
20 § 284.

21 **JURY TRIAL DEMAND**

22 78. Sterno Home requests a jury trial on all issues triable to a jury.

23 **PRAYER FOR RELIEF**

24 Plaintiff respectfully requests that the Court find in its favor and against  
25 Defendants, and that the Court grant Plaintiff the following relief:

26 79. A judgment that the Defendants have infringed the Asserted Patents.  
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80. A judgment awarding Plaintiff all damages adequate to compensate for Defendants' infringement of the Asserted Patents, including lost profits but in no event less than a reasonable royalty.
81. An accounting of the Defendants' profits.
82. An order and judgment permanently enjoining the Defendants and their officers, directors, agents, servants, employees, affiliates, attorneys, and all others acting in concert with them, and their parents, subsidiaries, divisions, successors and assigns, from further acts of infringement of the Asserted Patents.
83. An order requiring Defendants to certify, every three months, that they are in compliance with the injunction and detailing the steps they have taken to ensure that the Accused Products are not sold into or imported into the United States, either through distributors, on digital platforms, or directly.
84. A judgment awarding Plaintiff all damages, costs, and interest, including treble damages, based on any infringement found to be willful, under 35 U.S.C. § 284, with prejudgment interest.
85. A judgment declaring this case to be exceptional and awarding Plaintiff its reasonable attorneys' fees under 35 U.S.C. § 285.
86. Awarding Plaintiff such other and further relief as this Court deems just and proper.

Respectfully submitted,

May 15, 2020

/s/ Christopher V. Carani

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Gregory C. Schodde (*pro hac vice pending*)

Wilhelm L. Rao (*pro hac vice pending*)

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15 **Attorneys for Plaintiff, Sterno Home Inc.**  
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# EXHIBIT 1

**EXHIBIT 1 – ILLUSTRATIVE STERNO HOME PATENTS**

<b>Patent Number</b>	<b>Title</b>
D640396	CANDLE
D734718	FLAMELESS CANDLE RECHARGING TRAY
D751503	FLAMELESS CANDLE RECHARGING TRAY
6616308	IMITATION CANDLE
6719443	ELECTRICALLY ILLUMINATED FLAME SIMULATOR
6719443	ELECTRICALLY ILLUMINATED FLAME SIMULATOR
7093961	LANTERN WITH IMITATION FLAME SOURCE
7360935	IMITATION CANDLE WITH SIMULATED LIGHTED WICK
8157425	ELECTRICALLY ILLUMINATED FLAME SIMULATOR
8282251	FLAMELESS ELECTRONIC CANDLE
8562186	ELECTRICALLY ILLUMINATED FLAME SIMULATOR
8579461	RECHARGABLE FLAMELESS CANDLE SYSTEMS AND METHODS
8662698	FLAMELESS CANDLE CIRCUIT WITH MULTIPLE MODES

<b>Patent Number</b>	<b>Title</b>
8840281	INSERT FOR FLAMELESS CANDLE
8858043	ELECTRICALLY ILLUMINATED FLAME SIMULATOR
8878485	RECHARGABLE FLAMELESS CANDLE SYSTEMS AND METHODS
9068706	ELECTRONIC LUMINARY DEVICE WITH SIMULATED FLAME
9261248	BATTERY POWERED ELECTRONIC CANDLE WITH SPEAKER
9447937	ELECTRONIC LUMINARY DEVICE WITH SIMULATED FLAME
9491832	ELECTRICALLY ILLUMINATED FLAME SIMULATOR
9660468	RECHARGEABLE FLAMELESS CANDLE SYSTEMS AND METHODS
9664349	ARTIFICIAL CANDLE WITH FLAME SIMULATOR
9683713	INSERT FOR FLAMELESS CANDLE
10024507	ELECTRONIC LUMINARY DEVICE WITH SIMULATED FLAME
10036521	ELECTRICALLY ILLUMINATED FLAME SIMULATOR

<b>Patent Number</b>	<b>Title</b>
10247374	ELECTRICALLY ILLUMINATED FLAME SIMULATOR
10352517	ARTIFICIAL CANDLE WITH MOVEABLE PROJECTION SCREEN POSITION
10578264	ARTIFICIAL CANDLE WITH MOVEABLE PROJECTION SCREEN POSITION



# EXHIBIT 2

(12) **United States Patent**  
**Gutstein et al.**

(10) **Patent No.: US 6,719,443 B2**  
(45) **Date of Patent: Apr. 13, 2004**

(54) **ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR**

(56)

**References Cited**

**U.S. PATENT DOCUMENTS**

(76) Inventors: **Robert A. Gutstein**, 23604 Dry Canyon  
old Creek Rd., Calabasas, CA (US)  
91302; **Monita Liu**, 23604 Dry Canyon  
old Creek Rd., Calabasas, CA (US)  
91302

4,510,556 A \* 4/1985 Johnson ..... 362/184  
5,097,180 A \* 3/1992 Ignon et al. .... 315/200 A  
5,924,784 A \* 7/1999 Chliwnyj et al. .... 362/234  
6,053,622 A \* 4/2000 Horowitz et al. .... 362/276  
6,102,548 A \* 8/2000 Mantle et al. .... 362/155  
6,280,053 B1 \* 8/2001 Chien ..... 362/228

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

\* cited by examiner

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(57)

**ABSTRACT**

An electrically powered flame simulator comprises at least two light sources, an integrated circuit electrically connected to the light sources for intermittently illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source for providing power to the integrated circuit. The flame simulator may be mounted in a decorative or ornamental device such as a candle or fire log, or used on decorative clothing, or may be part of a hazard or warning system. One or more solid state light sources may also be used.

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(52) **U.S. Cl.** ..... **362/392; 362/276; 362/252;**  
**362/810; 362/800; 315/200 A; 315/185 R**

(58) **Field of Search** ..... 362/161, 810,  
362/392, 276, 252, 806, 802; 40/428, 431;  
315/200 A, 185 R, 193, 360, 291

**27 Claims, 3 Drawing Sheets**

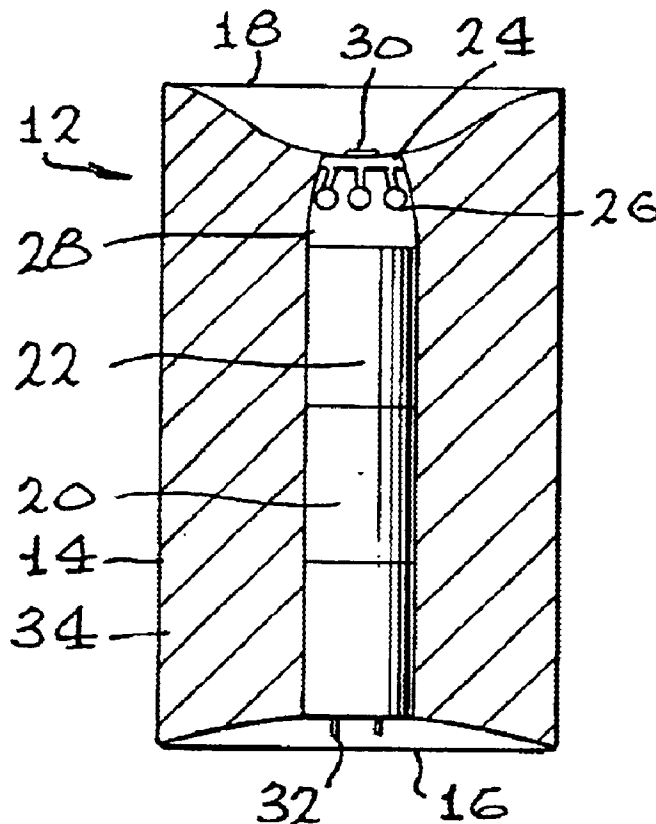


FIG. 1

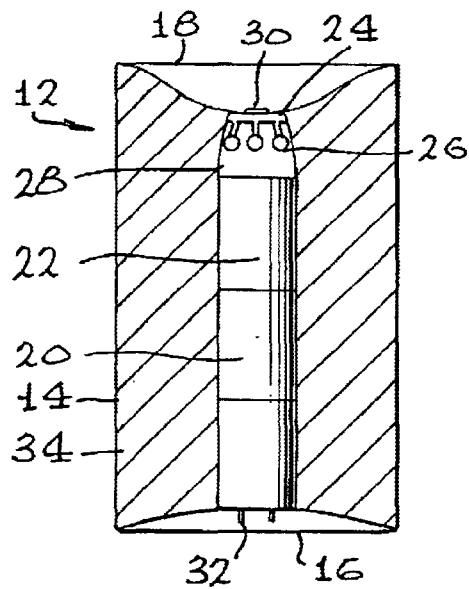


FIG. 3

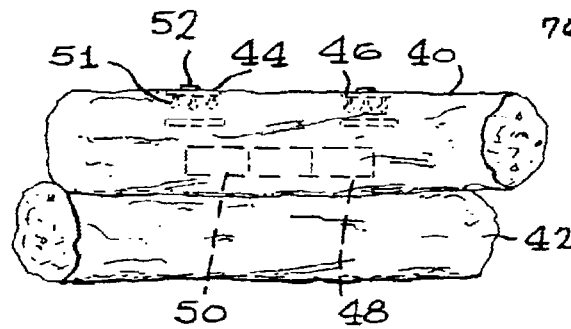
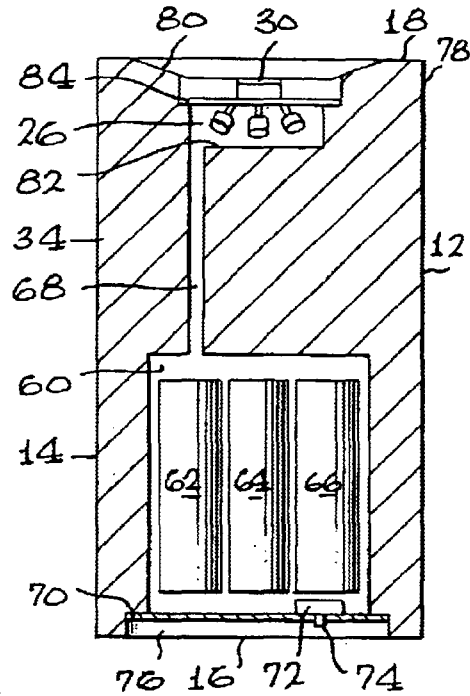


FIG. 2

FIG. 4

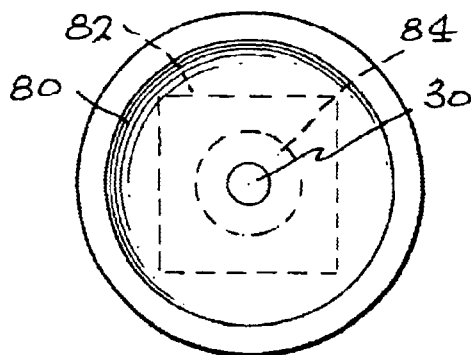
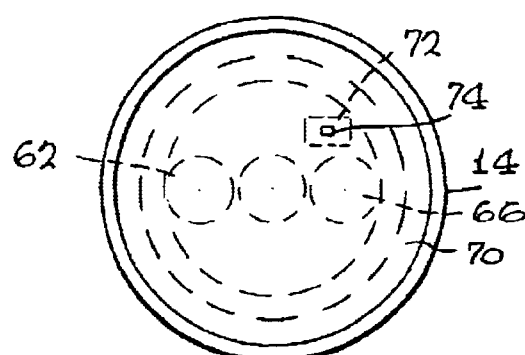
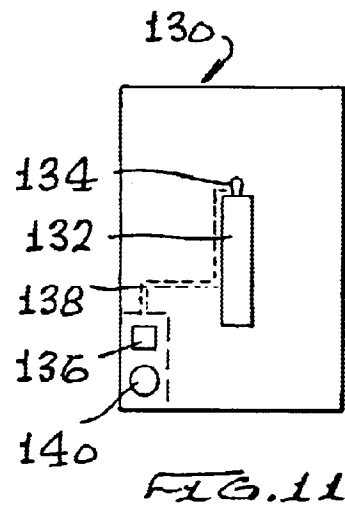
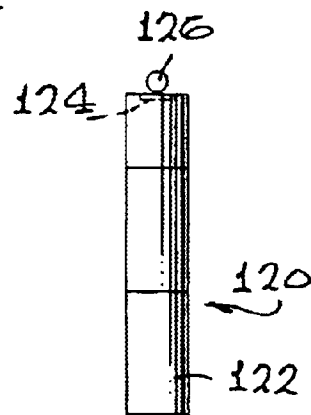
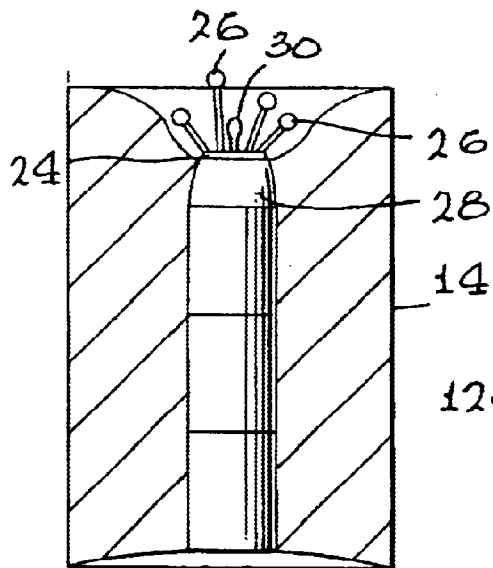
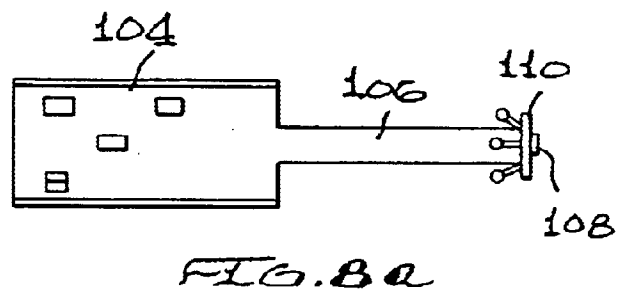
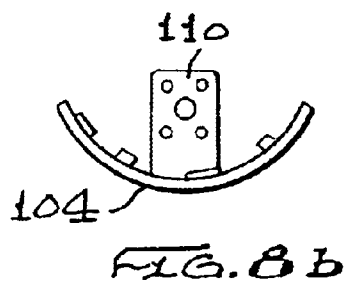
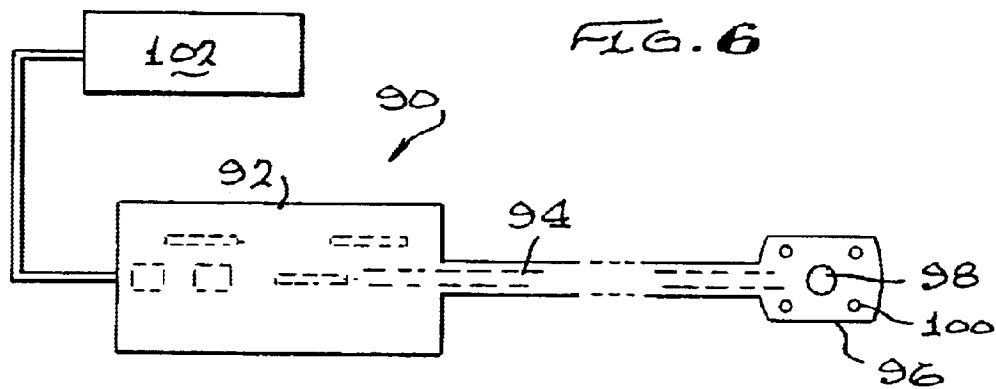
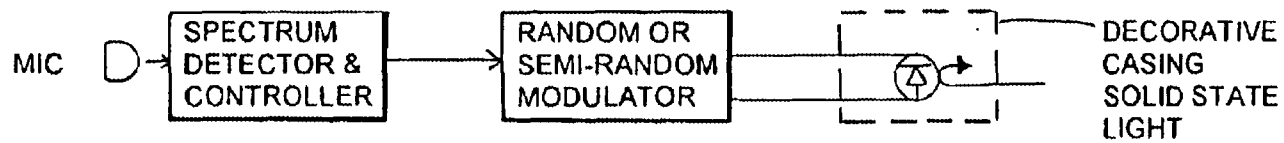
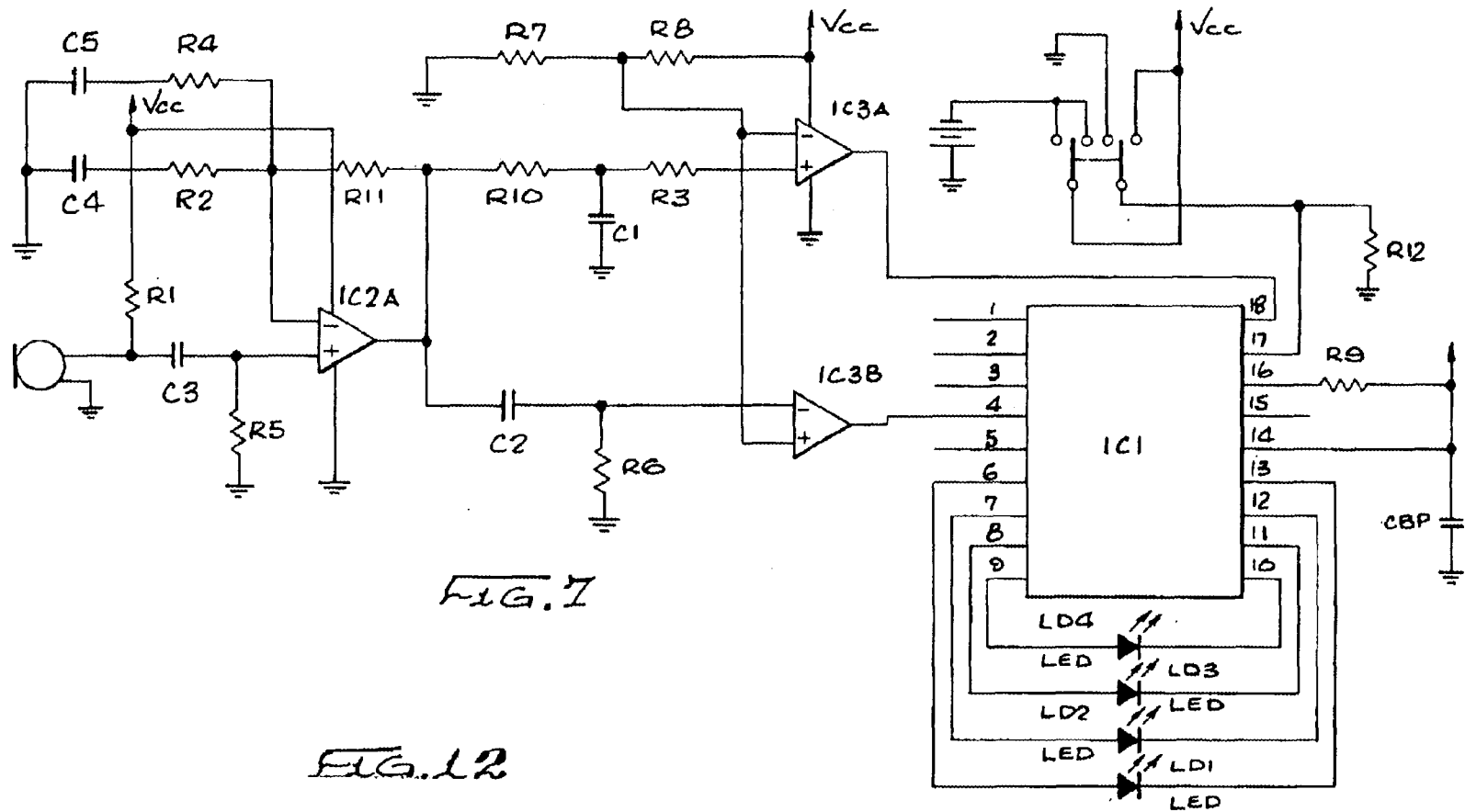


FIG. 5







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**ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR****FIELD AND BACKGROUND OF THE  
INVENTION**

This invention relates to an electrically illuminated flame simulator. Particularly, the invention relates to decorative candles, fire logs, or other devices which may be illuminated so as to produce a flickering flame effect. The flame simulator of the invention would typically be electrically powered by batteries, either disposable or rechargeable, but may also be powered through a regular AC outlet, with or without an AC adaptor.

Candles, fire logs, specially created street lights and other devices which may be used, for example, on clothing, cycles or other products are commonly available and valued for their effect. However, in many instances, where candles, fire logs or related lighting fixtures are used, the lighting produced is from a flame which may typically burn in an oil container, wax candle or the like. There are, of course, natural hazards associated with such a device, since they may result in fire accidents which, if unattended or not properly controlled, can produce extensive damage, smoke or pollution.

The invention therefore utilizes the concept of such decorative elements, but uses, instead of a flame, an electrically illuminated flame simulator which is programmed to operate so that, when observed, is shown to produce a light-flickering effect which is the same as or similar to a burning candle, fire log or the like. However, the invention is not limited to devices such as candles and fire logs, and the electrically illuminated flame simulator of the invention can be used in a wide array of products and conditions, such as in ornamental or decorative street lights, in clothing such as belts, shoes and caps, greeting cards, or on bicycles, scooters and the like. Furthermore, the flickering effect of the flame simulator of the invention may be used to advantage as a hazard warning, such as on road hazard or emergency automobile lights.

Certain devices and methods are known which may have the effect of producing or simulating a real flame. For example, a single specially designed, unstable neon light bulb may be used. Such unstable neon bulbs, however, inherently produce an unnatural "jerky" flickering pattern that may not be easily controlled electronically, and must be operated by high voltage sources. At the least, this makes them generally unsuitable for battery operation. A further example can be found in a single incandescent light bulb whose light output may be modulated by varying the output of an AC or DC voltage source. Such incandescent light bulbs, however, are inherently limited in terms of flickering rate and effect due to retention of filament heat, and draw substantially more current than solid state light sources such as LED lights. Once more, this is not generally suitable for battery operation, at the least.

Where multiple light bulbs each switched on and off may be used for display and decorative purposes, there is an absence of the illusion of light movement characteristic of a flickering flame since the light bulbs are not switched or modulated in a manner which would generate light motion typical of that produced by a real flame.

Linear arrays of "traveling" or "chaser" lights are also known but these arrays are structured and controlled to generate the effect of a large magnitude of light motion in a linear direction, which is coincident with the linear array of

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such lights. Certainly, the effect produced by these linear arrays does not mimic the illusion of a flickering flame.

**SUMMARY OF THE INVENTION**

5 In one aspect, the invention is for an electrically illuminated flame simulator. Preferably, the flame simulator of the invention is associated with an ornamental or decorative device, or with other devices such as hazard indicators. In one form, the flame simulator of the invention may constitute a part of an ornament or decoration such as a candle, fire log, or an indoor or outdoor lighting display, giving the appearance that the ornament is providing a natural flame. Other such decorative uses may make the flame simulator of the invention useful when associated with clothing, such as on belts or caps, greeting cards, or when incorporated into shoes.

When used as a hazard warning, the flame simulator of the invention may be used in conjunction with cycles or cycle clothing, or with road barriers, signs for warning motorists or as emergency lighting for vehicles.

20 In a preferred form, the electrically illuminated flame simulator is used with a decorative candle. The candle itself may be comprised of wax or other conventional materials from which candles are produced, or materials such as plastics which can emulate the look of a candle. The flame simulator of the invention would preferably be located within the candle body so that the flame simulator, when illuminated, can be seen not only from the top of the candle, but also as a glow or source of light emanating from within the candle.

According to another aspect of the invention, the flame simulator may also be used to provide an effect similar to that of a candle when used in a fake fire log intended to produce the effect of a natural burning log.

35 In one form, the flame simulator of the invention comprises at least two light sources, preferably four, such as light bulbs, which may be randomly, sequentially, or semi-randomly illuminated to produce a flickering and moving light effect to resemble a real flame, for example a flame provided by a burning candle. The light sources are preferably light-emitting diodes (LEDs), randomly or semi-randomly illuminated electronically.

In another embodiment, the flame simulator of the invention comprises a single non-filament (solid state) light source, such as an LED light bulb, liquid crystal display, or electro luminescent material, in which such light source is driven by a randomly or semi-randomly modulated voltage source to provide a flickering effect to resemble a real flame.

50 Further, in another aspect of the invention, the illuminated source producing the flame-flickering effect may be operated (namely, activated and deactivated) by externally produced, preselected sounds. Therefore, the electrically illuminated flame simulator of the invention may have associated therewith a microphone integrated as part of the electronics, so that sounds or different frequencies may be programmed to produce a given result, such as the switching on or switching off of the flame simulator.

The flame simulator of the invention may also incorporate other features, including motion detectors, light sensors and the like, so that any ornament or decoration incorporating the flame simulator of the invention will operate automatically, for example, when ambient light conditions reach a certain level, and/or when movement is detected within a specific range.

65 According to one aspect of the invention, there is provided an electrically powered flame simulator comprising: at

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least two light sources; an integrated circuit electrically connected to the light sources for intermittently, such as systematically, randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and a power source for providing power to the integrated circuit. Preferably, the a flame simulator comprises at least four light sources.

The flame simulator preferably includes a switch means for activating and deactivating the integrated circuit. The switch means may have three positions comprising an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time.

The flame simulator may further comprise a microphone connected to the integrated circuit wherein the microphone inputs preselected audio signals which are processed by the integrated circuit to switch the flame simulator between an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time. Preferably, the integrated circuit processes signals from the microphone having a higher frequency, such as those produced by a finger snap, to place the flame simulator in the on position and processes lower frequency signals, such as those produced by blowing, to place the flame simulator in the off position.

The integrated circuit may illuminate the light sources in a random or semi-random operation, in a preselected, predetermined operation, and may function only when selected ambient sound or light conditions are present.

In one form, the flame simulator comprises a body in the shape of a candle in which the flame simulator is contained, the body having an upper end with a mounting means for receiving the integrated circuit and light sources and a chamber therein for receiving the power source.

Preferably, the light sources are light emitting diodes (LEDs). The integrated circuit may be mounted on a rigid base, or on a flexible base which can be shaped so as to conform to the shape of at least a portion of the candle to conserve space.

According to another aspect of the invention, there is provided a candle having an electrically powered flame simulator comprising: a candle body having an upper portion, a lower portion and a chamber therein; and a flame simulator having at least two light sources located near the upper portion of the candle body, an integrated circuit within the candle body and electrically connected to the light sources for intermittently, such as by randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source in the chamber of the candle body for providing power to the integrated circuit.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side view of a candle with the electrically illuminated flame simulator of the invention;

FIG. 2 is a front view of artificial fire logs incorporating a flame simulator of the invention;

FIG. 3 is a schematic side view, showing various components, of an artificial candle with flame simulator of the invention;

FIG. 4 is a top view of the candle shown in FIG. 3 of the drawings;

FIG. 5 is a bottom view of the candle shown in FIG. 3 of the drawings;

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FIG. 6 is a schematic view of the flame simulator of the invention, shown independent of any decorative ornament with which it may be associated;

FIG. 7 is a circuit diagram showing the electronics in one embodiment of the flame simulator of the invention;

FIGS. 8a and 8b show another embodiment of the flame simulator of the invention standing alone, shown as a front view and top view respectively;

FIG. 9 shows a schematic side view of a candle with the electrically illuminated flame simulator of the invention as illustrated in FIG. 1, but with LED light sources which face upwards;

FIG. 10 shows schematically a single "birthday" type candle in accordance with the present invention; and

FIG. 11 shows schematically a greeting card in accordance with the present invention; and

FIG. 12 shows a block diagram of one embodiment of a single light source flame simulator of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

The invention is for a flame simulator which is powered electrically, and comprises a series of bulbs or LEDs which are illuminated randomly, semi-randomly or in a predetermined manner to provide the visual effect of a flickering flame. The device is preferably coupled to an ornament such as a candle or fire log to enhance this effect.

FIG. 1 of the drawings shows schematically a candle 12, generally of cylindrical shape having side wall 14, a base 16, and a top surface 18. The candle 12 comprises a hollowed out central portion 20, generally extending between the top surface 18 and the base 16, which, in the embodiment of FIG. 1, may accommodate a power source such as batteries 22. Near the top surface 18 there is located circuitry 24, the circuitry 24 being connected to LED light sources 26, four of which are shown in the embodiment in FIG. 1 of the drawings. The LED light sources 26 open into a chamber 28, generally formed between the top of the batteries 22 and the undersurface of the circuitry 24. In a variation, the LED light sources 26 may point upwardly.

The circuitry 24 further comprises a microphone 30, at least a portion of which is exposed and not embedded within the candle 12. The microphone 30 has an operative portion thereof exposed to the outside air and is capable of receiving and processing signals of various frequencies, as will be described, which are transmitted to and then processed by the circuitry 24, to activate the LED light sources 26 to provide a flickering flame effect.

At the lower end of the hollow central portion 20, electrical pins 32 are located, and these may be connectable to an electric source (not shown). Such pins 32 may be used for different purposes, such as for recharging the batteries 22 when they are of rechargeable type, or for providing power directly to the circuitry 24 and the LED light sources 26. The batteries could, of course, be disposable, and, in a further variation, the candle 12 would be able to accommodate both disposable and rechargeable batteries.

Preferably, the candle 12 is cylindrically shaped, and may be comprised of wax or a synthetic material which provides a candle-like appearance. The candle 12 may be of desired color or a combination of colors, and may be translucent or opaque. The material of the candle 12 is chosen, and its thickness selected, so that the possibility exists for light from the LED light sources 26 to be viewed not only from the top surface 18 of the candle 12, but also through the body 34 of



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the candle, possibly in a muted or semi-transparent manner to provide a glowing effect.

As will be described below, the LED light sources 26 may be illuminated randomly, semi-randomly, or in a predetermined pattern. However, the overall purpose of illuminating the LED light sources 26 is to do so in such a way that the modulated illumination of each of the LED light sources provides an aesthetic flickering effect when illuminated in combination with the other LED light sources being similarly illuminated, so that the light and movement produced thereby emulates a natural candle flame.

With reference to FIG. 2 of the drawings, there is shown a pair of synthetic fire logs 40 and 42, which may be comprised of conventional materials known to those skilled in the art, and having ornamentation and design features thereon which look like real fire logs. In FIG. 2, which shows only one embodiment of the invention, the fire log 40 has two electric circuits 44 and 46, both of which are substantially identical to each other, and each of which may be powered by battery power source 48. An AC power source may be utilized in an alternative embodiment. The battery power source 48 is preferably contained within a specially hollowed out portion 50 of the fire log 40, and is placed electrically in contact with the circuitry 44 and/or 46 in a conventional manner, not shown in FIG. 2.

Associated with each of the electrical circuits 44 and 46 is a series of LED light sources 51. Each of the electrical circuits 44 and 46 may also include a microphone 52. The electrical circuits 44 and 46, together with their associated LED light sources 51 and microphone 52, operate in essentially the same manner as described with reference to FIG. 1 of the drawings. Thus, each of the LED light sources 51 in the array is activated to illuminate in a random or predetermined manner, so as to give off light at various points along the fire log 40 to provide the effect that the fire log 40 is glowing, or that flames are burning thereon.

Reference is now made to FIG. 3 of the drawings which shows, in side view, a diagrammatic representation of one embodiment of an ornamental candle incorporating the flame simulator of the invention. Where applicable, reference numerals will be used corresponding to those in FIG. 1 of the drawings. In FIG. 3, the candle 12 comprises side wall 14, a base 16, and a top wall 18. These various walls of the candle 12 define a candle body 34.

In the lower half of the candle 12, there is formed a hollow chamber 60 adapted to receive three batteries 62, 64 and 66, which form a battery or power pack. The chamber 60, at an upper portion thereof, leads into a wire channel 68 extending therefrom towards the circuits and light sources above, which will be described.

The chamber 60 is accessed through a removable cover plate 70 near the base 16 of the candle. The batteries 62, 64 and 66 are connected to a power switch 72, contained within the chamber 60, the power switch 72 having a switch lever 74 which extends from within the chamber 60 to outside of the candle 12, through the cover plate 70. In this way, the user has manual access to and control of the switch lever 74 for activating or deactivating the candle 12.

At the base 16 of the candle 12, there is a recessed portion 76, the recessed portion 76 leading to the chamber 60, but, in normal usage, sealed from the chamber 60 by means of the cover plate 70.

At the upper end 78 of the candle 12, there is an upper recess 80 leading into a LED chamber 82. A printed circuit board 84 or an integrated circuit mounted on a board 84 houses the electronics, one embodiment of which is

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described below, for activating the candle 12. Attached to the PC board 84 are four LED light sources 26, which extend from the PC board 84 into the LED chamber 82. A microphone 30 extends upwardly from the PC board 84, into the upper recess 80. The PC board 84 is electrically connected to the power source of batteries 62, 64 and 66 through appropriate electrical connectors which extend through the wire channel 68.

FIG. 6 shows, schematically, a flame simulator 90 independent of the body or ornament on which it may be mounted, including an integrated circuit 92, an arm 94 extending therefrom which supports or contains conductors, preferably flexible conductors, and a support plate 96 at the end of arm 94 which can be arranged at an angle to the arm 94, as required. The support plate 96 includes a microphone 98 and LEDs 100. The integrated circuit 92 is powered by a power source, indicated generally at 102.

With reference to FIG. 7 of the drawings a preferred circuit diagram showing some of the electronics and operation of the equipment is described.

The heart of the system is the integrated circuit IC1 connected to a number of LEDs, LD1-LD4. IC1 systematically or randomly or semi-randomly, at the designer's choice, turns on and off the LEDs simulating the flickering of the candle 12.

Power is applied to all electronic circuitry, where indicated by "VCC", by operation of a switch S1. The switch S1 has three positions: "on"; "off"; and "timed". In the "on" position of switch S1, the integrated circuit IC1 operates in a continuous mode after enablement, and stops only when commanded to do so by the user. That is, in this mode, operation starts and stops under remote control by the user, as explained below. In the "off" position of switch S1, the entire system is shut down, since switch S1 disconnects the battery from VCC. In the "timed" position of the switch S1, after starting operation, the integrated circuit IC1 stops operation automatically after a predetermined time has passed.

In the "on" position of switch S1, typically at least 3 volts (2×1.5V) from the batteries is routed through the switch S1 and applied to all circuitry requiring VCC. All circuit points designated "GND" are connected together representing ground potential for the system. Ground potential (GND) is not switched by the switch S1, except in the "on" position of the switch S1, when GND is applied to a pin 17 of the IC1 to set the functional operation of the IC1 in a continuous mode of operation until a "stop" signal is received on the pin 18 to cease its operation. In the "timed" position of S1, VCC is applied to the pin 17 of the IC1, causing an internal timer in the IC1 to time out and stop operation of the IC1 after a predetermined delay time, e.g., three hours.

In the "on" position of the switch S1, all circuits are powered and in a standby mode, defining an initial quiescent state for the IC1 in which none of the LEDs LD1-LD4 are lit. However, upon the occurrence of a high frequency sound at the microphone MIC1, such as a hand clap or finger snap, a signal is generated at the output of the microphone MIC1 and applied to the + terminal of an operational amplifier IC2A. The IC2A amplifies the sharp sound sensed by the microphone MIC1, and applies the amplified output signal simultaneously to the + input of an IC3A and to the - input of the IC3B, which enables IC1 to begin modulating the LEDs to produce the flickering effect. The circuit may be modified to respond to different frequency signals without altering the principles of the present invention.

R1, C3, R5; C4, CS, R2, R4; R11; and R7, R8 are coupling, frequency compensation, feedback, and biasing



components, the functions and operations of which are familiar to a skilled worker and therefore need not be further described in detail herein. C2 and R6 define a high-pass filter, while R10, C1, and R3 define a low-pass filter arrangement.

In the presence of a sharp, high frequency sound input to the microphone MIC1, high frequency signal components are present at the output of the IC2A, which signal components are passed on only to the – terminal of the IC3B through the high-pass filter C2, R6, i.e., the high frequency signal from the IC2A is blocked from reaching the + terminal of the IC3A due to the presence of the low-pass filter R10, C1, R3.

Thus, the IC3B amplifies its input signal and sends it to a pin 4 of the IC1 as a “start” pulse, initiating the operation of the IC1. When in an operational mode, the IC1, either systematically (e.g., sequentially) or randomly, applies power sufficient to light the LEDs LD1–LD4 individually via pins 6 and 13 for LD1, via pins 7 and 12 for LD2, via pins 8 and 11 for LD3, and via pins 9 and 10 for LD4.

In the “on” switch setting, this condition will continue until the switch S1 is moved to the “off” position, or until a low frequency sound, such as that made by blowing or making a thud-like sound near the microphone MIC1, is sensed by the microphone MIC1.

In the presence of a low frequency sound input to the microphone MIC1, low frequency signal components are present at the output of the IC2A, which signal components are passed on only to the + terminal of the IC3A through the low-pass filter R10, C1, R3, i.e., the low frequency signal from the IC2A is blocked from reaching the – terminal of the IC3B due to the presence of high-pass filter C2, R6.

Thus, the IC3A amplifies its input signal and sends it to a pin 18 of the IC1 as a “stop” pulse, ceasing the operation of the IC1, at which time, the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1. As previously explained, other frequency sounds may be selected to control various functions including on and off functions.

When the switch S1 is moved to the “timed” position, starting the operation of the IC1 is accomplished in the same manner as described above, i.e., by the sensing of a high frequency sound present at the microphone MIC1. However, in the “timed” mode, VCC is applied to the pin 17 of the IC1 through the switch S1. This VCC potential on the pin 17 sets an internal timer to run for the aforementioned predetermined delay time, after which the operation of the IC1 is automatically terminated, and the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1.

It is to be understood that the circuit diagram of FIG. 7 depicts a preferred embodiment for the electronics of the invention, and that other functions may be employed by either reconfiguring the connections to the IC1 and/or by the use of additional, or other, electronic components. Examples of variations of the described circuit would be apparent to a person of ordinary skill in the art. For example, the switch S1 could be modified, or a separate switch could be provided, to operate a modified electronic system in yet another mode in which the microphone MIC1 is disconnected from the system, and starting and stopping operation of the IC1 is accomplished solely by manual control. As another example, the delay for a timed stop could be made selectable with only minor modification of the circuit diagram and the provision of a manual delay time control device.

In FIGS. 8a and 8b there is shown a further embodiment of a circuit board 104, which is arcuate in order to conform with the shape of a battery around which it may be located as a space-saving technique. An arm 106 (or simply wires which are flexible and may be in flexible tubing) preferably extends upwardly or away from the printed circuit board and circuitry 104, and terminates in a support plate 110 substantially at right angles to the arm 106. The plate 110 supports the microphone 108 and LED light sources which would be located, in use, near the upper portion of a candle.

FIG. 9 shows a view of a candle very similar to that illustrated in FIG. 1 of the drawings, but with the light sources 26 pointing upwardly for a slightly different effect. FIG. 10 shows schematically a “birthday” type candle 120 having a battery area 122, a circuit 124 and an LED 126. LED 126 may be substituted by an alternative form of light without altering the principles of the present invention.

A greeting card 130 is illustrated in FIG. 11 and includes a printed candle 132 having an LED light source 134 thereabove which is operated by a circuit 136 to which it is connected by embedded wires 138. A power source 140 is also provided.

The circuit board may be comprised of a flexible material so that its shape can be easily manipulated to fit the space in which it is to be mounted. The circuit board can be connected to the LED light sources through any appropriate electrical connection means so that it can be distanced therefrom, and this also functions as a space-saving technique for confining and mounting the electronics into smaller spaces.

In a preferred embodiment of the invention, there are at least two light bulbs, although more (such as four) are preferable, powered by randomly or sequentially generated voltage sources to produce the flickering effect. In a preferred embodiment, at least two pairs of output ports of a micro-controller may be programmed to provide a seven-segment LED/LCD 12-hour time clock multiplex function. An audio signal is processed, in one embodiment, by a high-frequency filtering circuit, the output of which provides a power-on signal which is responsive to a fingersnap, handclap or the like, as described with reference to FIG. 7. Further, the audio signal may be processed by a low-frequency filtering circuit, the output of which provides a power-off signal, which is responsive to, for example, a blowing sound.

A mode switch or remote control device may be employed to select between the modes of power-off, power-on or power-on with various microphone functions, or power-on for a predetermined period of time.

Another preferred feature of the invention may include the use of LED-type light bulbs, generally in the manner described above, wherein such light bulbs radiate light in a non-parallel and substantially downward direction, so as to illuminate a translucent candle body, as briefly referenced in the description of FIG. 1 of the drawings. Incandescent or neon light bulbs may substitute one or more of the LED light bulbs, and non-micro controller circuitry may be used.

The two light bulbs may be operated by at least two voltage sources, where a voltage source is randomly generated, semi-randomly generated, or sequentially generated, thereby producing the flickering flame and moving light effect.

The flame simulator of the invention may have a signal produced by a microphone and microphone amplifier which triggers the modulated voltage sources into power on and power off states alternately. Frequency equalization may be

applied to the amplifier such as to favor high frequency sounds (such as a finger snap or hand clap) in triggering the power on state, and the frequency equalization may also be applied to the amplifier such as to favor low frequency sounds (such as blowing air) in triggering the power off state. Preferably, at least one of the light bulbs radiates light into or from a translucent candle body, and any two such light bulbs may radiate light in directions that are parallel or non-parallel to one another.

The invention is not limited to the precise details, and variations of the particular electronics and circuitry, as well as the ornaments or devices to which they may be attached, may vary within the disclosure herein. Further, additional features may form part of the invention. For example, a light sensor device may be associated and electrically connected to the circuitry of the invention. The light sensor senses the level of ambient light and may switch on the flame simulator, or place it in a mode receptive to audio signals as described above, only when light levels drop below a pre-selected intensity. In this way, the flame simulator of the invention would only operate during darker periods or in darker environments.

The invention may also include a motion detector associated therewith and electrically connected with the circuitry of the flame simulator of the invention. The inclusion of motion detector sensors would confine operation of the flame simulator of the invention to periods of time when movement, such as that made by people in the vicinity, is present and thereby save power by inoperation when motion is not detected. Another option would be to incorporate heat sensors to restrict operation of the flame simulator to conditions when temperatures drop below or move above pre-selected levels.

What is claimed is:

1. An electrically powered flame simulator comprising:
  - at least two light sources;
  - an integrated circuit electrically connected to the light sources for intermittently illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement;
  - a microphone connected to the integrated circuit wherein the microphone inputs preselected audio sounds which are processed by the integrated circuit to switch the flame simulator between an on position and an off position; and
  - a power source for providing power to the integrated circuit.
2. A flame simulator as claimed in claim 1 comprising at least four light sources.
3. A flame simulator as claimed in claim 1 further comprising switch means for activating and deactivating the integrated circuit.
4. A flame simulator as claimed in claim 3 wherein the switch means has three positions comprising an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time.
5. A flame simulator as claimed in claim 1 wherein the microphone further inputs preselected audio signals which are processed by the integrated circuit to switch the flame simulator to an on-timed position where the flame simulator will remain activated for a predetermined length of time.
6. A flame simulator as claimed in claim 5 wherein the integrated circuit processes signals having a higher frequency to place the flame simulator in the on position and

processes lower frequency signals to place the flame simulator in the off position.

7. A flame simulator as claimed in claim 1 wherein the integrated circuit illuminates the light sources in a random operation.

8. A flame simulator as claimed in claim 1 wherein the integrated circuit illuminates the light sources in a preselected predetermined operation.

9. A flame simulator as claimed in claim 1 further comprising a light sensor for controlling operation of the flame simulator to function only when selected ambient light conditions are present.

10. A flame simulator as claimed in claim 1 further comprising a heat sensor for controlling operation of the flame simulator to function only when selected ambient heat conditions are present.

11. A flame simulator as claimed in claim 1 further comprising a body in the shape of a candle in which the flame simulator is contained, the body having a mounting means for receiving the integrated circuit and light sources and a chamber therein for receiving the power source.

12. A flame simulator as claimed in claim 11 wherein the power source comprises electrical connectors for connection to an external power member.

13. A flame simulator as claimed in claim 11 wherein the power source comprises at least one battery received within the chamber.

14. A flame simulator as claimed in claim 13 wherein the battery is selected from the group consisting of rechargeable and disposable batteries.

15. A flame simulator as claimed in claim 1 wherein all of the light sources are intermittently illuminated.

16. A flame simulator as claimed in claim 1 further comprising a body in the shape of a fire log in which the flame simulator is contained, the body having a receiving means with a mounting means for receiving the integrated circuit and light sources and a chamber therein for receiving the power source.

17. A flame simulator as claimed in claim 1 wherein the power source comprises voltage sources generated by at least one output selected from one of the following: (a) a micro-controller executing seven segment light emitting diode (LED) driver software, (b) a seven segment LED driver circuit, (c) an electronic circuit generating at least one of random pulses, random signals, semi-random pulses, semi-random signals, sequential pulses, or sequential signals.

18. A flame simulator as claimed in claim 1 wherein the light sources are light emitting diodes (LEDs).

19. A flame simulator as claimed in claim 11 wherein the integrated circuit is mounted on a flexible base which can be shaped so as to conform to the shape of at least a portion of the candle to conserve space.

20. A flame simulator as claimed in claim 1 wherein the power source is spaced from the integrated circuit and light source and is electrically in contact therewith by means of extended electrical connectors.

21. A candle-like device having an electrically powered flame simulator comprising:

- a candle-like body having an upper portion, a lower portion and a chamber therein, the upper portion having a concave surface defining a recess therein;
- a flame simulator having at least two light sources located substantially in the recess of the candle-like body, an integrated circuit within the candle-like body and electrically connected to the light sources for intermittently illuminating at least one of the light sources indepen-

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dently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source in the chamber of the candle body for providing power to the integrated circuit.

- 22.** An electrically powered flame simulator comprising: 5  
 at least one solid state type light source;  
 an integrated circuit electrically connected to the light sources for intermittently controlling illumination of the light source such that the light source provides the effect of a flickering movement; 10  
 a microphone associated with the integrated circuit through which predetermined audio sounds can be processed to control the light source;  
 a power source for providing power to the integrated circuit. 15

**23.** A flame simulator as claimed in claim **22** wherein the solid state light source is an LED light bulb.

**24.** A flame simulator as claimed in claim **22** wherein the solid state light source is an electro-luminescent source.

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**25.** A flame simulator as claimed in claim **22** wherein the solid state light source is a liquid crystal source.

**26.** A flame simulator as claimed in claim **1** further comprising a motion detector for controlling operation of the flame simulator to function in response to motion detected within a predetermined range.

**27.** An electrically powered flame simulator comprising:  
 at least two light sources;

an integrated circuit electrically connected independently each of the light sources for intermittently controlling illumination of at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and

a power source for providing power to the integrated circuit.

\* \* \* \* \*

(12) **EX PARTE REEXAMINATION CERTIFICATE** (9825th)

**United States Patent**

**Gutstein et al.**

(10) **Number:** **US 6,719,443 C1**

(45) **Certificate Issued:** **Sep. 4, 2013**

(54) **ELECTRICALLY ILLUMINATED FLAME SIMULATOR**

(75) Inventors: **Robert A. Gutstein**, Calabasas, CA (US); **Monita Liu**, Calabasas, CA (US)

(73) Assignee: **Winvic Sales Inc.**, Markham, Ontario (CA)

(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/010,980, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

**Reexamination Request:**

No. 90/010,980, May 5, 2010

*Primary Examiner* — Kenneth J Whittington

**Reexamination Certificate for:**

Patent No.: **6,719,443**  
Issued: **Apr. 13, 2004**  
Appl. No.: **10/084,272**  
Filed: **Feb. 27, 2002**

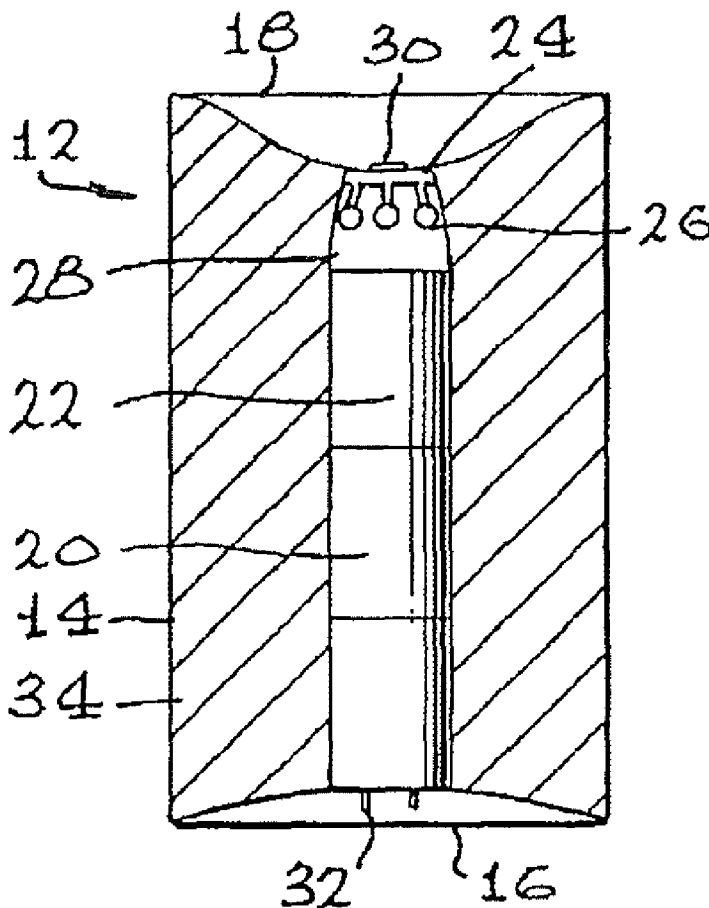
(57) **ABSTRACT**

An electrically powered flame simulator comprises at least two light sources, an integrated circuit electrically connected to the light sources for intermittently illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source for providing power to the integrated circuit. The flame simulator may be mounted in a decorative or ornamental device such as a candle or fire log, or used on decorative clothing, or may be part of a hazzard or warning system. One or more solid state light sources may also be used.

(51) **Int. Cl.**  
**F21V 35/00** (2006.01)

(52) **U.S. Cl.**  
USPC ..... **362/392; 315/185 R; 315/200 A**

(58) **Field of Classification Search**  
USPC ..... **362/569, 161, 810, 392**  
See application file for complete search history.



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**EX PARTE  
REEXAMINATION CERTIFICATE  
ISSUED UNDER 35 U.S.C. 307**

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THE PATENT IS HEREBY AMENDED AS  
INDICATED BELOW.

AS A RESULT OF REEXAMINATION, IT HAS BEEN  
DETERMINED THAT:

10

Claim **21** is cancelled.

Claims **1-20** and **22-27** were not reexamined.

\* \* \* \* \*

# **EXHIBIT 3**

(12) **United States Patent**  
**Gutstein et al.**

(10) **Patent No.:** **US 8,562,186 B2**  
(45) **Date of Patent:** **Oct. 22, 2013**

(54) **ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR**

(56) **References Cited**

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(75) Inventors: **Robert A. Gutstein**, Calabasas, CA  
(US); **Monita Liu**, Calabasas, CA (US)

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(73) Assignee: **Winvic Sales Inc.**, Markham, Ontario  
(CA)

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(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **13/449,100**

(22) Filed: **Apr. 17, 2012**

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(65) **Prior Publication Data**

Reply Brief Filed Applicant in U.S. Appl. No. 90/010,980 dated Jun.  
18, 2012.

US 2012/0201020 A1 Aug. 9, 2012

(Continued)

**Related U.S. Application Data**

(63) Continuation of application No. 12/927,645, filed on  
Nov. 19, 2010, now Pat. No. 8,157,425, which is a  
continuation of application No. 12/586,933, filed on  
Sep. 30, 2009, now abandoned, which is a continuation  
of application No. 12/284,986, filed on Sep. 26, 2008,  
now abandoned, which is a continuation of application  
No. 11/881,303, filed on Jul. 26, 2007, now  
abandoned, which is a continuation of application No.  
11/494,812, filed on Jul. 28, 2006, now abandoned,  
which is a continuation of application No. 10/822,392,  
filed on Apr. 12, 2004, now abandoned, which is a  
continuation of application No. 10/084,272, filed on  
Feb. 27, 2002, now Pat. No. 6,719,443.

*Primary Examiner* — Stephen F Husar

*Assistant Examiner* — Meghan Dunwiddie

(74) *Attorney, Agent, or Firm* — McAndrews Held & Malloy  
Ltd.

(57)

**ABSTRACT**

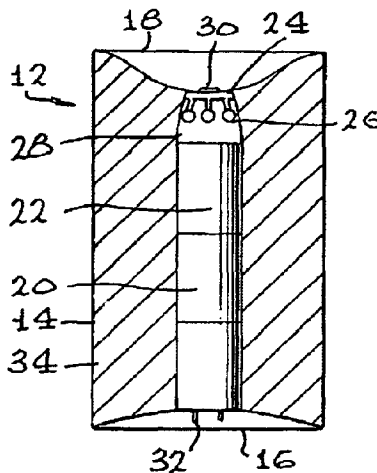
An electrically powered flame simulator comprises at least  
two light sources, an integrated circuit electrically connected  
to the light sources for intermittently illuminating at least one  
of the light sources independently of other light sources such  
that the light sources together provide the effect of a flickering  
movement, and a power source for providing power to the  
integrated circuit. The flame simulator may be mounted in a  
decorative or ornamental device such as a candle or fire log, or  
used on decorative clothing, or may be part of a hazard or  
warning system. One or more solid state light sources may  
also be used.

(51) **Int. Cl.**  
**F21V 21/00** (2006.01)

(52) **U.S. Cl.**  
USPC ..... **362/392**; 362/161; 362/800; 362/812

(58) **Field of Classification Search**  
USPC ..... 362/161, 392, 800, 812  
See application file for complete search history.

**54 Claims, 3 Drawing Sheets**





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FIG. 1

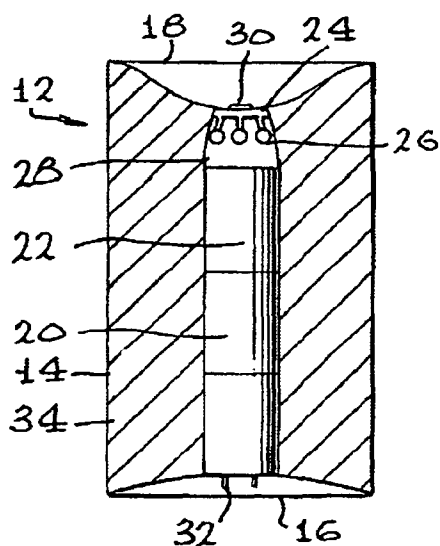


FIG. 3

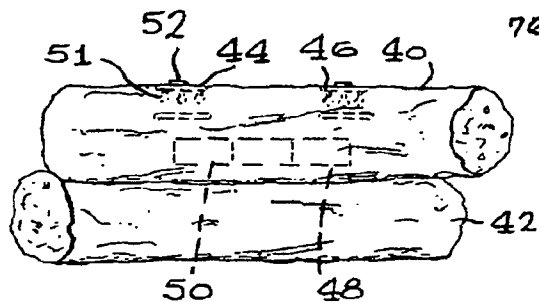
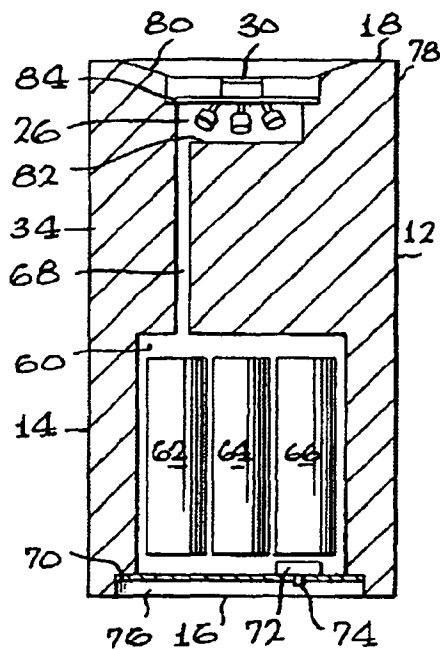


FIG. 2

FIG. 4

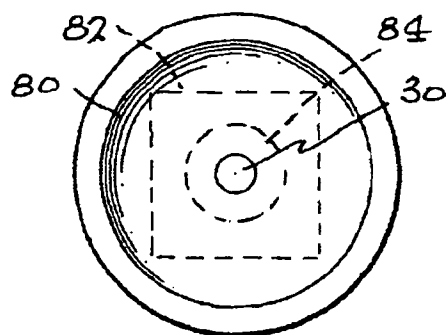
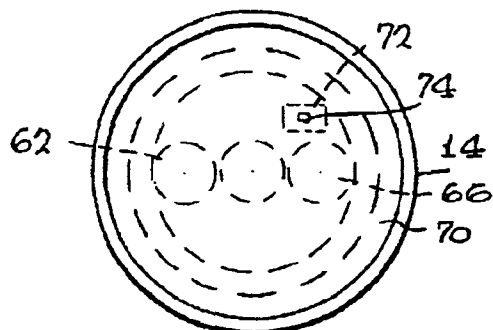
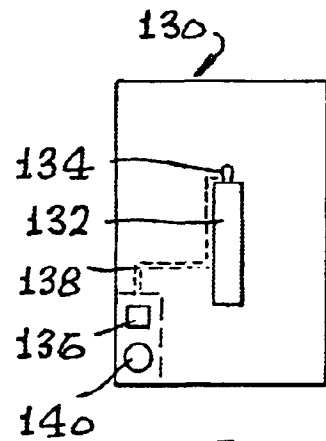
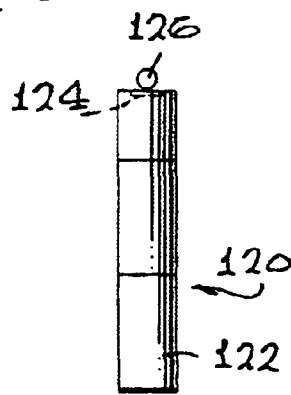
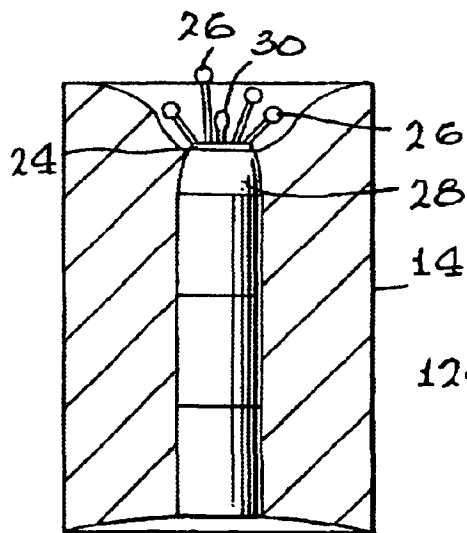
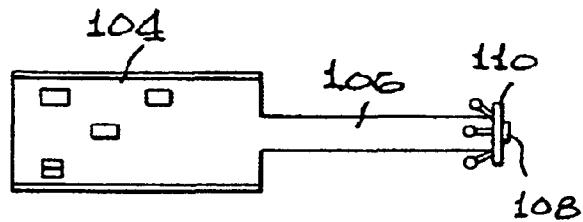
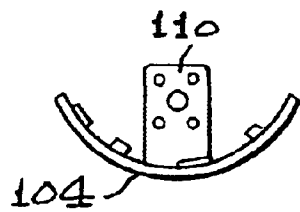
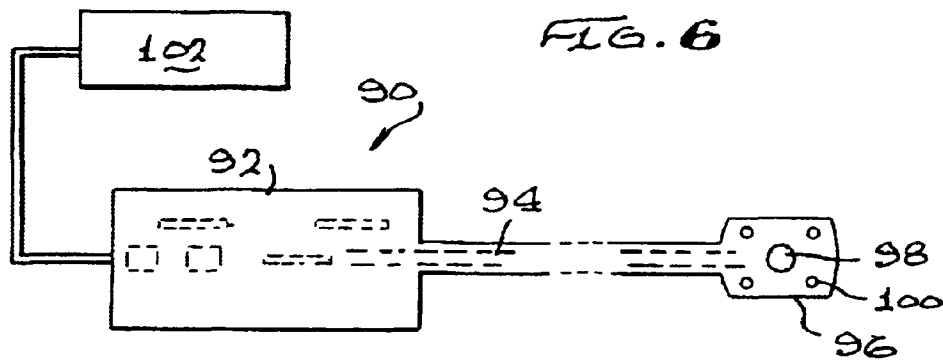


FIG. 5





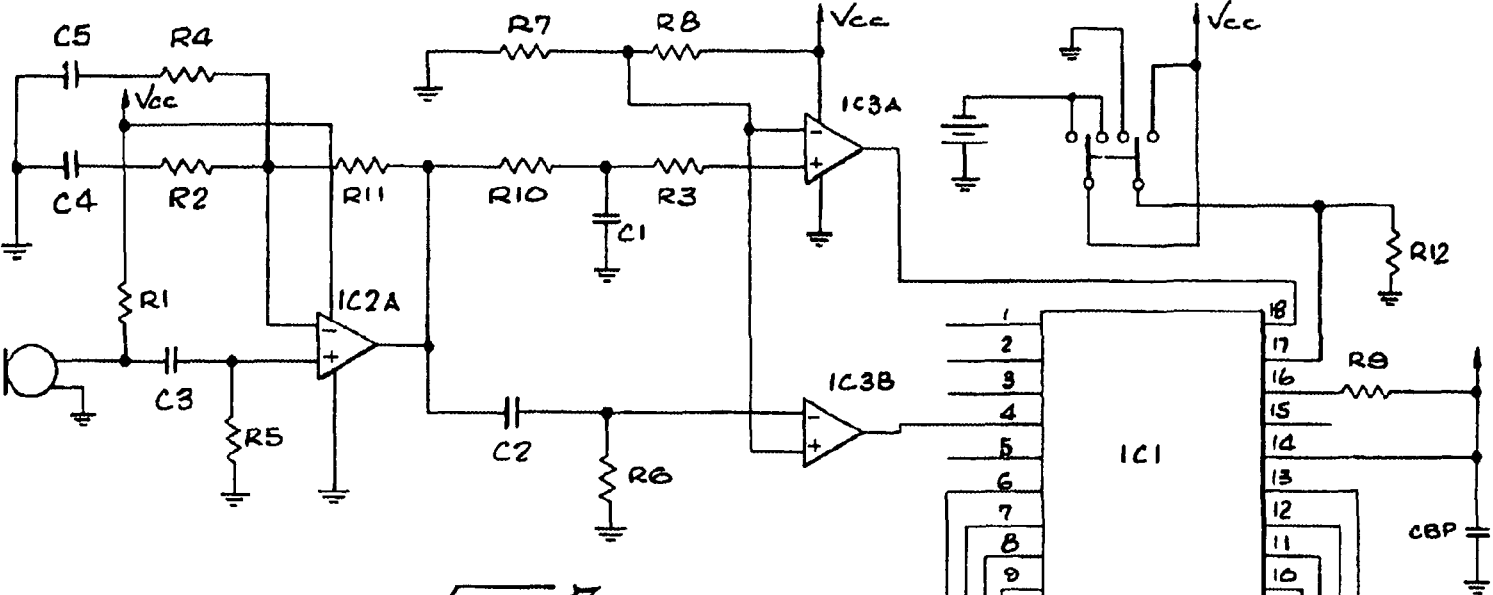
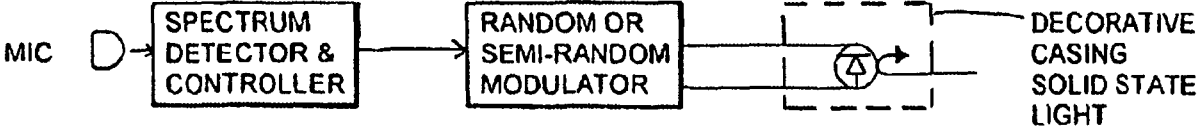


FIG. 7

FIG. 12



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**ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR****CROSS-REFERENCE TO RELATED  
APPLICATIONS**

This application is a continuation of U.S. Ser. No. 12/927, 645 filed Nov. 19, 2010, now U.S. Pat. No. 8,157,425, which is a continuation of U.S. Ser. No. 12/586,933 filed Sep. 30, 2009, (now abandoned), which is a continuation of U.S. Ser. No. 12/284,986 filed Sep. 26, 2008 (now abandoned), which is a continuation of U.S. Ser. No. 11/881,303, filed Jul. 26, 2007 (now abandoned), which is a continuation of U.S. Ser. No. 11/494,812 filed Jul. 28, 2006 (now abandoned), which is a continuation of U.S. Ser. No. 10/822,392 filed Apr. 12, 2004 (now abandoned), which is a continuation of U.S. Ser. No. 10/084,272 filed Feb. 27, 2002, now U.S. Pat. No. 6,719,443.

**FIELD AND BACKGROUND OF THE  
INVENTION**

This invention relates to an electrically illuminated flame simulator. Particularly, the invention relates to decorative candles, fire logs, or other devices which may be illuminated so as to produce a flickering flame effect. The flame simulator of the invention would typically be electrically powered by batteries, either disposable or rechargeable, but may also be powered through a regular AC outlet, with or without an AC adaptor.

Candles, fire logs, specially created street lights and other devices which may be used, for example, on clothing, cycles or other products are commonly available and valued for their effect. However, in many instances, where candles, fire logs or related lighting fixtures are used, the lighting, produced is from a flame which may typically burn in an oil container, wax candle or the like. There are, of course, natural hazards associated with such a device, since they may result in fire accidents which, if unattended or not properly controlled, can produce extensive damage, smoke or pollution.

The invention therefore utilizes the concept of such decorative elements, but uses, instead of a flame, an electrically illuminated flame simulator which is programmed to operate so that, when observed, is shown to produce a light-flickering effect which is the same as or similar to a burning candle, fire log or the like. However, the invention is not limited to devices such as candles and fire logs, and the electrically illuminated flame simulator of the invention can be used in a wide array of products and conditions, such as in ornamental or decorative street lights, in clothing such as belts, shoes and caps, greeting cards, or on bicycles, scooters and the like. Furthermore, the flickering effect of the flame simulator of the invention may be used to advantage as a hazard warning, such as on road hazard or emergency automobile lights.

Certain devices and methods are known which may have the effect of producing or simulating a real flame. For example, a single specially designed, unstable neon light bulb may be used. Such unstable neon bulbs, however, inherently produce an unnatural "jerky" flickering pattern that may not be easily controlled electronically, and must be operated by high voltage sources. At the least, this makes them generally unsuitable for battery operation. A further example can be found in a single incandescent light bulb whose light output may be modulated by varying the output of an AC or DC voltage source. Such incandescent light bulbs, however, are inherently limited in terms of flickering rate and effect due to retention of filament heat, and draw substantially more cur-

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rent than solid state light sources such as LED lights. Once more, this is not generally suitable for battery operation, at the least.

Where multiple light bulbs each switched on and off may be used for display and decorative purposes, there is an absence of the illusion of light movement characteristic of a flickering flame since the light bulbs are not switched or modulated in a manner which would generate light motion typical of that produced by a real flame.

Linear arrays of "traveling" or "chaser" lights are also known but these arrays are structured and controlled to generate the effect of a large magnitude of light motion in a linear direction, which is coincident with the linear array of such lights. Certainly, the effect produced by these linear arrays does not mimic the illusion of a flickering flame.

**SUMMARY OF THE INVENTION**

In one aspect, the invention is for an electrically illuminated flame simulator. Preferably, the flame simulator of the invention is associated with an ornamental or decorative device, or with other devices such as hazard indicators. In one form, the flame simulator of the invention may constitute a part of an ornament or decoration such as a candle, fire log, or an indoor or outdoor lighting display, giving the appearance that the ornament is providing a natural flame. Other such decorative uses may make the flame simulator of the invention useful when associated with clothing, such as on belts or caps, greeting cards, or when incorporated into shoes.

When used as a hazard warning, the flame simulator of the invention may be used in conjunction with cycles or cycle clothing, or with road barriers, signs for warning motorists or as emergency lighting for vehicles.

In a preferred form, the electrically illuminated flame simulator is used with a decorative candle. The candle itself may be comprised of wax or other conventional materials from which candles are produced, or materials such as plastics which can emulate the look of a candle. The flame simulator of the invention would preferably be located within the candle body so that the flame simulator, when illuminated, can be seen not only from the top of the candle, but also as a glow or source of light emanating from within the candle.

According to another aspect of the invention, the flame simulator may also be used to provide an effect similar to that of a candle when used in a fake fire log intended to produce the effect of a natural burning log.

In one form, the flame simulator of the invention comprises at least two light sources, preferably four, such as light bulbs, which may be randomly, sequentially, or semi-randomly illuminated to produce a flickering and moving light effect to resemble a real flame, for example a flame provided by a burning candle. The light sources are preferably light-emitting diodes (LEDs), randomly or semi-randomly illuminated electronically.

In another embodiment, the flame simulator of the invention comprises a single non-filament (solid state) light source, such as an LED light bulb, liquid crystal display, or electro luminescent material, in which such light source is driven by a randomly or semi-randomly modulated voltage source to provide a flickering effect to resemble a real flame.

Further, in another aspect of the invention, the illuminated source producing the flame-flickering effect may be operated (namely, activated and deactivated) by externally produced, preselected sounds. Therefore, the electrically illuminated flame simulator of the invention may have associated therewith a microphone integrated as part of the electronics, so that

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sounds or different frequencies may be programmed to produce a given result, such as the switching on or switching off of the flame simulator.

The flame simulator of the invention may also incorporate other features, including motion detectors, light sensors and the like, so that any ornament or decoration incorporating the flame simulator of the invention will operate automatically, for example, when ambient light conditions reach a certain level, and/or when movement is detected within a specific range.

According to one aspect of the invention, there is provided an electrically powered flame simulator comprising: at least two light sources; an integrated circuit electrically connected to the light sources for intermittently, such as systematically, randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and a power source for providing power to the integrated circuit. Preferably, the a flame simulator comprises at least four light sources.

The flame simulator preferably includes a switch means for activating and deactivating the integrated circuit. The switch means may have three positions comprising an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time.

The flame simulator may further comprise a microphone connected to the integrated circuit wherein the microphone inputs preselected audio signals which are processed by the integrated circuit to switch the flame simulator between an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time. Preferably, the integrated circuit processes signals from the microphone having a higher frequency, such as those produced by a finger snap, to place the flame simulator in the on position and processes lower frequency signals, such as those produced by blowing, to place the flame simulator in the off position.

The integrated circuit may illuminate the light sources in a random or semi-random operation, in a preselected, predetermined operation, and may function only when selected ambient sound or light conditions are present.

In one form, the flame simulator comprises a body in the shape of a candle in which the flame simulator is contained, the body having an upper end with a mounting means for receiving the integrated circuit and light sources and a chamber therein for receiving the power source.

Preferably, the light sources are light emitting diodes (LEDs). The integrated circuit may be mounted on a rigid base, or on a flexible base which can be shaped so as to conform to the shape of at least a portion of the candle to conserve space.

According to another aspect of the invention, there is provided a candle having an electrically powered flame simulator comprising: a candle body having an upper portion, a lower portion and a chamber therein; and a flame simulator having at least two light sources located near the upper portion of the candle body, an integrated circuit within the candle body and electrically connected to the light sources for intermittently, such as by randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source in the chamber of the candle body for providing power to the integrated circuit.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side view of a candle with the electrically illuminated flame simulator of the invention;

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FIG. 2 is a front view of artificial fire logs incorporating a flame simulator of the invention;

FIG. 3 is a schematic side view, showing various components, of an artificial candle with flame simulator of the invention;

FIG. 4 is a top view of the candle shown in FIG. 3 of the drawings;

FIG. 5 is a bottom view of the candle shown in FIG. 3 of the drawings;

FIG. 6 is a schematic view of the flame simulator of the invention, shown independent of any decorative ornament with which it may be associated;

FIG. 7 is a circuit diagram showing the electronics in one embodiment of the flame simulator of the invention;

FIGS. 8a and 8b show another embodiment of the flame simulator of the invention standing alone, shown as a front view and top view respectively;

FIG. 9 shows a schematic side view of a candle with the electrically illuminated flame simulator of the invention as illustrated in FIG. 1, but with LED light sources which face upwards;

FIG. 10 shows schematically a single "birthday" type candle in accordance with the present invention; and

FIG. 11 shows schematically a greeting card in accordance with the present invention; and

FIG. 12 shows a block diagram of one embodiment of a single light source flame simulator of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

The invention is for a flame simulator which is powered electrically, and comprises a series of bulbs or LEDs which are illuminated randomly, semi-randomly or in a predetermined manner to provide the visual effect of a flickering flame. The device is preferably coupled to an ornament such as a candle or fire log to enhance this effect.

FIG. 1 of the drawings shows schematically a candle 12, generally of cylindrical shape having side wall 14, a base 16, and a top surface 18. The candle 12 comprises a hollowed out central portion 20, generally extending between the top surface 18 and the base 16, which, in the embodiment of FIG. 1, may accommodate a power source such as batteries 22. Near the top surface 18 there is located circuitry 24, the circuitry 24 being connected to LED light sources 26, four of which are shown in the embodiment in FIG. 1 of the drawings. The LED light sources 26 open into a chamber 28, generally formed between the top of the batteries 22 and the undersurface of the circuitry 24. In a variation, the LED light sources 26 may point upwardly.

The circuitry 24 further comprises a microphone 30, at least a portion of which is exposed and not embedded within the candle 12. The microphone 30 has an operative portion thereof exposed to the outside air and is capable of receiving and processing signals of various frequencies, as will be described, which are transmitted to and then processed by the circuitry 24, to activate the LED light sources 26 to provide a flickering flame effect.

At the lower end of the hollow central portion 20, electrical pins 32 are located, and these may be connectable to an electric source (not shown). Such pins 32 may be used for different purposes, such as for recharging the batteries 22 when they are of rechargeable type, or for providing power directly to the circuitry 24 and the LED light sources 26. The batteries could, of course, be disposable, and, in a further variation, the candle 12 would be able to accommodate both disposable and rechargeable batteries.



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Preferably, the candle 12 is cylindrically shaped, and may be comprised of wax or a synthetic material which provides a candle-like appearance. The candle 12 may be of desired color or a combination of colors, and may be translucent or opaque. The material of the candle 12 is chosen, and its thickness selected, so that the possibility exists for light from the LED light sources 26 to be viewed not only from the top surface 18 of the candle 12, but also through the body 34 of the candle, possibly in a muted or semi-transparent manner to provide a glowing effect.

As will be described below, the LED light sources 26 may be illuminated randomly, semi-randomly, or in a predetermined pattern. However, the overall purpose of illuminating the LED light sources 26 is to do so in such a way that the modulated illumination of each of the LED light sources provides an aesthetic flickering effect when illuminated in combination with the other LED light sources being similarly illuminated, so that the light and movement produced thereby emulates a natural candle flame.

With reference to FIG. 2 of the drawings, there is shown a pair of synthetic fire logs 40 and 42, which may be comprised of conventional materials known to those skilled in the art, and having ornamentation and design features thereon which look like real fire logs. In FIG. 2, which shows only one embodiment of the invention, the fire log 40 has two electric circuits 44 and 46, both of which are substantially identical to each other, and each of which may be powered by battery power source 48. An AC power source may be utilized in an alternative embodiment. The battery power source 48 is preferably contained within a specially hollowed out portion 50 of the fire log 40, and is placed electrically in contact with the circuitry 44 and/or 46 in a conventional manner, not shown in FIG. 2.

Associated with each of the electrical circuits 44 and 46 is a series of LED light sources 51. Each of the electrical circuits 44 and 46 may also include a microphone 52. The electrical circuits 44 and 46, together with their associated LED light sources 51 and microphone 52, operate in essentially the same manner as described with reference to FIG. 1 of the drawings. Thus, each of the LED light sources 51 in the array is activated to illuminate in a random or predetermined manner, so as to give off light at various points along the fire log 40 to provide the effect that the fire log 40 is glowing, or that flames are burning thereon.

Reference is now made to FIG. 3 of the drawings which shows, in side view, a diagrammatic representation of one embodiment of an ornamental candle incorporating the flame simulator of the invention. Where applicable, reference numerals will be used corresponding to those in FIG. 1 of the drawings. In FIG. 3, the candle 12 comprises side wall 14, a base 16, and a top wall 18. These various walls of the candle 12 define a candle body 34.

In the lower half of the candle 12, there is formed a hollow chamber 60 adapted to receive three batteries 62, 64 and 66, which form a battery or power pack. The chamber 60, at an upper portion thereof, leads into a wire channel 68 extending therefrom towards the circuits and light sources above, which will be described.

The chamber 60 is accessed through a removable cover plate 70 near the base 16 of the candle. The batteries 62, 64 and 66 are connected to a power switch 72, contained within the chamber 60, the power switch 72 having a switch lever 74 which extends from within the chamber 60 to outside of the candle 12, through the cover plate 70. In this way, the user has manual access to and control of the switch lever 74 for activating or deactivating the candle 12.

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At the base 16 of the candle 12, there is a recessed portion 76, the recessed portion 76 leading to the chamber 60, but, in normal usage, sealed from the chamber 60 by means of the cover plate 70.

At the upper end 78 of the candle 12, there is an upper recess 80 leading into a LED chamber 82. A printed circuit board 84 or an integrated circuit mounted on a board 84 houses the electronics, one embodiment of which is described below, for activating the candle 12. Attached to the PC board 84 are four LED light sources 26, which extend from the PC board 84 into the LED chamber 82. A microphone 30 extends upwardly from the PC board 84, into the upper recess 80. The PC board 84 is electrically connected to the power source of batteries 62, 64 and 66 through appropriate electrical connectors which extend through the wire channel 68.

FIG. 6 shows, schematically, a flame simulator 90 independent of the body or ornament on which it may be mounted, including an integrated circuit 92, an arm 94 extending therefrom which supports or contains conductors, preferably flexible conductors, and a support plate 96 at the end of arm 94 which can be arranged at an angle to the arm 94, as required. The support plate 96 includes a microphone 98 and LEDs 100. The integrated circuit 92 is powered by a power source, indicated generally at 102.

With reference to FIG. 7 of the drawings a preferred circuit diagram showing some of the electronics and operation of the equipment is described.

The heart of the system is the integrated circuit IC1 connected to a number of LEDs, LD1-LD4. IC1 systematically or randomly or semi-randomly, at the designer's choice, turns on and off the LEDs simulating the flickering of the candle 12.

Power is applied to all electronic circuitry, where indicated by "VCC", by operation of a switch S1. The switch S1 has three positions: "on"; "off"; and "timed". In the "on" position of switch S1, the integrated circuit IC1 operates in a continuous mode after enablement, and stops only when commanded to do so by the user. That is, in this mode, operation starts and stops under remote control by the user, as explained below. In the "off" position of switch S1, the entire system is shut down, since switch S1 disconnects the battery from VCC. In the "timed" position of the switch S1, after starting operation, the integrated circuit IC1 stops operation automatically after a predetermined time has passed.

In the "on" position of switch S1, typically at least 3 volts (2×1.5V) from the batteries is routed through the switch S1 and applied to all circuitry requiring VCC. All circuit points designated "GND" are connected together representing ground potential for the system. Ground potential (GND) is not switched by the switch S1, except in the "on" position of the switch S1, when GND is applied to a pin 17 of the IC1 to set the functional operation of the IC1 in a continuous mode of operation until a "stop" signal is received on the pin 18 to cease its operation. In the "timed" position of S1, VCC is applied to the pin 17 of the IC1, causing an internal timer in the IC1 to time out and stop operation of the IC1 after a predetermined delay time, e.g., three hours.

In the "on" position of the switch S1, all circuits are powered and in a standby mode, defining an initial quiescent state for the IC1 in which none of the LEDs LD1-LD4 are lit. However, upon the occurrence of a high frequency sound at the microphone MIC1, such as a hand clap or finger snap, a signal is generated at the output of the microphone MIC1 and applied to the + terminal of an operational amplifier IC2A. The IC2A amplifies the sharp sound sensed by the microphone MIC1, and applies the amplified output signal simultaneously to the + input of an IC3A and to the - input of the IC3B, which enables IC1 to begin modulating the LEDs to

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produce the flickering effect. The circuit may be modified to respond to different frequency signals without altering the principles of the present invention.

R1, C3, R5; C4, C5, R2, R4; R11; and R7, R8 are coupling, frequency compensation, feedback, and biasing components, the functions and operations of which are familiar to a skilled worker and therefore need not be further described in detail herein. C2 and R6 define a high-pass filter, while R10, C1, and R3 define a low-pass filter arrangement.

In the presence of a sharp, high frequency sound input to the microphone MIC1, high frequency signal components are present at the output of the IC2A, which signal components are passed on only to the – terminal of the IC3B through the high-pass filter C2, R6, i.e., the high frequency signal from the IC2A is blocked from reaching the + terminal of the IC3A due to the presence of the low-pass filter R10, C1, R3.

Thus, the IC3B amplifies its input signal and sends it to a pin 4 of the IC1 as a “start” pulse, initiating the operation of the IC1. When in an operational mode, the IC1, either systematically (e.g., sequentially) or randomly, applies power sufficient to light the LEDs LD1-LD4 individually via pins 6 and 13 for LD1, via pins 7 and 12 for LD2, via pins 8 and 11 for LD3, and via pins 9 and 10 for LD4.

In the “on” switch setting, this condition will continue until the switch S1 is moved to the “off” position, or until a low frequency sound, such as that made by blowing or making a thud-like sound near the microphone MIC1, is sensed by the microphone MIC1.

In the presence of a low frequency sound input to the microphone MIC1, low frequency signal components are present at the output of the IC2A, which signal components are passed on only to the + terminal of the IC3A through the low-pass filter R10, C1, R3, i.e., the low frequency signal from the IC2A is blocked from reaching the – terminal of the IC3B due to the presence of high-pass filter C2, R6.

Thus, the IC3A amplifies its input signal and sends it to a pin 18 of the IC1 as a “stop” pulse, ceasing the operation of the IC1, at which time, the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1. As previously explained, other frequency sounds may be selected to control various functions including on and off functions.

When the switch S1 is moved to the “timed” position, starting the operation of the IC1 is accomplished in the same manner as described above, i.e., by the sensing of a high frequency sound present at the microphone MIC1. However, in the “timed” mode, VCC is applied to the pin 17 of the IC1 through the switch S1. This VCC potential on the pin 17 sets an internal timer to run for the aforementioned predetermined delay time, after which the operation of the IC1 is automatically terminated, and the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1.

It is to be understood that the circuit diagram of FIG. 7 depicts a preferred embodiment for the electronics of the invention, and that other functions may be employed by either reconfiguring the connections to the IC1 and/or by the use of additional, or other, electronic components. Examples of variations of the described circuit would be apparent to a person of ordinary skill in the art. For example, the switch S1 could be modified, or a separate switch could be provided, to operate a modified electronic system in yet another mode in which the microphone MIC1 is disconnected from the system, and starting and stopping operation of the IC1 is accomplished solely by manual control. As another example, the delay for a timed stop could be made selectable with only

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minor modification of the circuit diagram and the provision of a manual delay time control device.

In FIGS. 8a and 8b there is shown a further embodiment of a circuit board 104, which is arcuate in order to conform with the shape of a battery around which it may be located as a space-saving technique. An arm 106 (or simply wires which are flexible and may be in flexible tubing) preferably extends upwardly or away from the printed circuit board and circuitry 104, and terminates in a support plate 110 substantially at right angles to the arm 106. The plate 110 supports the microphone 108 and LED light sources which would be located, in use, near the upper portion of a candle.

FIG. 9 shows a view of a candle very similar to that illustrated in FIG. 1 of the drawings, but with the light sources 26 pointing upwardly for a slightly different effect. FIG. 10 shows schematically a “birthday” type candle 120 having a battery area 122, a circuit 124 and an LED 126. LED 126 may be substituted by an alternative form of light without altering the principles of the present invention.

A greeting card 130 is illustrated in FIG. 11 and includes a printed candle 132 having an LED light source 134 thereabove which is operated by a circuit 136 to which it is connected by embedded wires 138. A power source 140 is also provided.

The circuit board may be comprised of a flexible material so that its shape can be easily manipulated to fit the space in which it is to be mounted. The circuit board can be connected to the LED light sources through any appropriate electrical connection means so that it can be distanced therefrom, and this also functions as a space-saving technique for confining and mounting the electronics into smaller spaces.

In a preferred embodiment of the invention, there are at least two light bulbs, although more (such as four) are preferable, powered by randomly or sequentially generated voltage sources to produce the flickering effect. In a preferred embodiment, at least two pairs of output ports of a microcontroller may be programmed to provide a seven-segment LED/LCD 12-hour time clock multiplex function. An audio signal is processed, in one embodiment, by a high-frequency filtering circuit, the output of which provides a power-on signal which is responsive to a fingersnap, handclap or the like, as described with reference to FIG. 7. Further, the audio signal may be processed by a low-frequency filtering circuit, the output of which provides a power-off signal, which is responsive to, for example, a blowing sound.

A mode switch or remote control device may be employed to select between the modes of power-off, power-on or power-on with various microphone functions, or power-on for a predetermined period of time.

Another preferred feature of the invention may include the use of LED-type light bulbs, generally in the manner described above, wherein such light bulbs radiate light in a non-parallel and substantially downward direction, so as to illuminate a translucent candle body, as briefly referenced in the description of FIG. 1 of the drawings. Incandescent or neon light bulbs may substitute one or more of the LED light bulbs, and non-micro controller circuitry may be used.

The two light bulbs may be operated by at least two voltage sources, where a voltage source is randomly generated, semi-randomly generated, or sequentially generated, thereby producing the flickering flame and moving light effect.

The flame simulator of the invention may have a signal produced by a microphone and microphone amplifier which triggers the modulated voltage sources into power on and power off states alternately. Frequency equalization may be applied to the amplifier such as to favor high frequency sounds (such as a finger snap or hand clap) in triggering the



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power on state, and the frequency, equalization may also be applied to the amplifier such as to favor low frequency sounds (such as blowing air) in triggering the power off state. Preferably, at least one of the light bulbs radiates light into or from a translucent candle body, and any two such light bulbs may radiate light in directions that are parallel or non-parallel to one another.

The invention is not limited to the precise details, and variations of the particular electronics and circuitry, as well as the ornaments or devices to which they may be attached, may vary within the disclosure herein. Further, additional features may form part of the invention. For example, a light sensor device may be associated and electrically connected to the circuitry of the invention. The light sensor senses the level of ambient light and may switch on the flame simulator, or place it in a mode receptive to audio signals as described above, only when light levels drop below a pre-selected intensity. In this way, the flame simulator of the invention would only operate during darker periods or in darker environments.

The invention may also include a motion detector associated therewith and electrically connected with the circuitry of the flame simulator of the invention. The inclusion of motion detector sensors would confine operation of the flame simulator of the invention to periods of time when movement, such as that made by people in the vicinity, is present and thereby save power by in operation when motion is not detected. Another option would be to incorporate heat sensors to restrict operation of the flame simulator to conditions when temperatures drop below or move above pre-selected levels.

The invention claimed is:

1. An artificial pillar candle having an electrically powered flame simulator comprising: a substantially cylindrical body having permanent exterior surfaces comprising (a) an upper portion having a rim on an upper surface that circumscribes a recess, (b) a lower portion with a lower surface, and (c) a chamber therein, wherein the substantially cylindrical body is self-supporting on the lower surface and has a circumference with a central axis extending through the center of the upper portion and center of the lower portion; a flame simulator having at least two light sources located substantially within the recess; a circuit electrically connected to the light sources for intermittently illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and a power source for providing power to the circuit.

2. The artificial pillar candle of claim 1, wherein a random pulse, random signal, semi-random pulse, semi-random signal, sequential pulse, or a sequential signal illuminate at least one light source to produce a flickering flame and a moving light effect within the recess.

3. The artificial pillar candle of claim 1, wherein the circuit provides a signal to the at least two light sources to emulate the movement of a natural candle flame from within the recess.

4. The artificial pillar candle of claim 1 further comprising a microphone associated with the circuit through which pre-determined audio sounds can be processed to control the light source.

5. The artificial pillar candle of claim 1, wherein the pre-determined audio sounds comprise a high-frequency sound.

6. The artificial pillar candle of claim 4, wherein the pre-determined audio sounds comprise a low-frequency sound.

7. The artificial pillar candle of claim 4, wherein the pre-determined audio sounds comprise different ones of a hand-clap, a finger-snap, or a thud.

8. The artificial pillar candle of claim 4, wherein the pre-determined audio sounds comprise a blowing sound.

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9. The artificial pillar candle of claim 1, wherein the artificial pillar candle further comprises an ON/OFF switch.

10. The artificial pillar candle of claim 1, wherein the artificial pillar candle further comprises an ON/OFF/TIMER switch, wherein the circuit controls the at least two light sources for a period time when the switch is set to the TIMER position.

11. The artificial pillar candle of claim 1, wherein the recess is formed to appear as if burned down by melting of the candle.

12. The artificial pillar candle of claim 1, wherein the power source comprises a battery or an AC source.

13. The artificial pillar candle of claim 1, wherein the power source comprises a rechargeable battery.

14. The artificial pillar candle of claim 1, wherein the at least two light sources are located within the recess so as to be hidden from the plain view of an observer when viewed on a plane perpendicular to the central axis at the height of the rim.

15. The artificial pillar candle of claim 1, wherein the at least two light sources are configured such that, when the at least two light sources are illuminated, the at least two light sources produce light that directly reflects off of a surface of the recess, diffuses through the artificial pillar candle and directly transmits from the recess without reflecting off of the surface of the recess or diffusing through the artificial pillar candle.

16. The artificial pillar candle of claim 1, wherein each light source of the at least two light sources is positioned on its own extension stem connected to the flame simulator.

17. The artificial pillar candle of claim 1, wherein each light source of the at least two light sources is positioned on its own extension stem and discretely connected to the flame simulator.

18. The artificial pillar candle of claim 1, wherein the at least two light sources contain light sources each having (i) a center point through which a first plane passes, the first plane being parallel to a second plane passing through the central axis and (ii) a distance from the first plane to the second plane measured along a plane perpendicular to the central axis that intersects the center point, wherein the distance is substantially the same for each of the light sources.

19. The artificial pillar candle of claim 1, wherein further comprising a central plane that is parallel to and passing through the central axis; a first light source plane that passes through the center point of a first light source and is parallel to said central plane, a second light source plane that passes through the center point of a second light source and is parallel to both said central plane and the first light source plane; a first light source distance between said central plane and said first source plane that is measured along a straight line perpendicular to said central plane and said first light source plane, and a second light source distance between said central plane and said second light source plane that is measured along a straight line perpendicular to said central plane and said second light source plane; said first light source distance being substantially the same as said second light source distance.

20. The artificial pillar candle of claim 1, wherein the at least two light sources contain light sources each having (i) a center point through which a first plane passes, the first plane being parallel to a second plane passing through the central axis and (ii) a distance from the first plane to the second plane measured along a plane perpendicular to the central axis that intersects the center point, wherein the distance is different for each of the light sources.

21. The artificial pillar candle of claim 1, wherein further comprising a central plane that is parallel to and passing

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through the central axis; a first light source plane that intersects the center point of a first light source and is parallel to said central plane, a second light source plane that passes through the center point of a second light source and is parallel to both said central plane and said first light source plane; a first light source distance between said central plane and said first source plane that is measured along a straight line perpendicular to said central plane and said first light source plane, and a second light source distance between said central plane and said second light source plane that is measured along a straight line perpendicular to said central plane and said second light source plane; said first light source distance is greater than said second light source distance.

22. The artificial pillar candle of claim 1, wherein the recess has a greatest depth and the candle has a greatest height and; the greatest depth of the recess is no greater than one-half of the greatest height of the candle.

23. The artificial pillar candle of claim 1, wherein the recess has a greatest depth and the candle has a greatest height and; the ratio of greatest depth of the recess to the greatest height of the candle is between about 1:2 to 1:5.

24. The artificial pillar candle of claim 23, wherein each of the light sources has a light source height measured from the surface of the recess along a plane parallel to the central axis that is less than one-half of the greatest depth of the recess.

25. The artificial pillar candle of claim 1, wherein each of the at least two light sources has a different light source height.

26. The artificial pillar candle of claim 1, wherein at least a portion of each of the at least two light sources are located at and above the surface of the recess and within the recess so as to be hidden from the plain view of an observer when viewed on a plane perpendicular to the central axis at the height of the rim.

27. The artificial pillar candle of claim 1, wherein the artificial pillar candle further comprises a motion detector for controlling operation of the flame simulator to function in response to motion detected within a predetermined range.

28. An artificial pillar candle having an electrically powered flame simulator comprising: a substantially cylindrically-shaped body being translucent and having permanent exterior surfaces comprising (a) an upper portion having a rim on an upper surface that circumscribes a recess, (b) a lower portion with a lower surface, and (c) a chamber therein, wherein the substantially cylindrically-shaped body is self-supporting on the lower surface and has a circumference with a central axis extending through the center of the upper portion and center of the lower portion; a flame simulator having three light sources located substantially in the recess of the artificial pillar candle; a circuit within the substantially cylindrically-shaped body and electrically connected to the light sources for intermittently illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and a power source for providing power to the circuit.

29. The artificial pillar candle of claim 28, wherein the a random pulse, random signal, semi-random pulse, semi-random signal, sequential pulse, or a sequential signal illuminate at least one light source to produce a flickering flame and a moving light effect within the recess.

30. The artificial pillar candle of claim 28, wherein the circuit provides a signal to the at least two light sources to emulate the movement of a natural candle flame from within the recess.

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31. The artificial pillar candle of claim 28 further comprising a microphone associated with the circuit through which predetermined audio sounds can be processed to control the light source.

32. The artificial pillar candle of claim 31, wherein the predetermined audio sounds comprise a high-frequency sound.

33. The artificial pillar candle of claim 31, wherein the predetermined audio sounds comprise a low-frequency sound.

34. The artificial pillar candle of claim 31, wherein the predetermined audio sounds comprise different ones of a hand-clap, a finger-snap, or a thud.

35. The artificial pillar candle of claim 31, wherein the predetermined audio sounds comprise a blowing sound.

36. The artificial pillar candle of claim 31, wherein the artificial pillar candle further comprises an ON/OFF switch.

37. The artificial pillar candle of claim 31, wherein the artificial pillar candle further comprises an ON/OFF/TIMER switch, wherein the circuit controls the at least two light sources for a period time when the switch is set to the TIMER position.

38. The artificial pillar candle of claim 31, wherein the recess is formed to appear as if burned down by melting of the candle.

39. The artificial pillar candle of claim 31, wherein the power source comprises a battery or an AC source.

40. The artificial pillar candle of claim 28, wherein the power source comprises a rechargeable battery.

41. The artificial pillar candle of claim 28, wherein the at least two light sources are located within the recess so as to be hidden from the plain view of an observer when viewed on a plane perpendicular to the central axis at the height of the rim.

42. The artificial pillar candle of claim 28, wherein the at least two light sources are configured such that, when the at least two light sources are illuminated, the at least two light sources produce light that directly reflects off of a surface of the recess, diffuses through the substantially cylindrically-shaped body and directly transmits from the recess without reflecting off of the surface of the recess or diffusing through the substantially cylindrically-shaped body.

43. The artificial pillar candle of claim 28, wherein each light source of the at least two light sources is positioned on its own extension stem connected to the flame simulator.

44. The artificial pillar candle of claim 28, wherein each light source of the at least two light sources is positioned on its own extension stem and discretely connected to the flame simulator.

45. The artificial pillar candle of claim 28, wherein the at least two light sources contain light sources each having (i) a center point through which a first plane passes, the first plane being parallel to a second plane passing through the central axis and (ii) a distance from the first plane to the second plane measured along a plane perpendicular to the central axis that intersects the center point, wherein the distance is substantially the same for each of the light sources.

46. The artificial pillar candle of claim 28, wherein further comprising a central plane that is parallel to and passing through the central axis; a first light source plane that passes through the center point of a first light source and is parallel to said central plane, a second light source plane that passes through the center point of a second light source and is parallel to both said central plane and the first light source plane; a first light source distance between said central plane and said first source plane that is measured along a straight line perpendicular to said central plane and said first light source plane, and a second light source distance between said

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central plane and said second light source plane that is measured along a straight line perpendicular to said central plane and said second light source plane; said first light source distance being substantially the same as said second light source distance.

47. The artificial pillar candle of claim 28, wherein the at least two light sources contain light sources each having (i) a center point through which a first plane passes, the first plane being parallel to a second plane passing through the central axis and (ii) a distance from the first plane to the second plane measured along a plane perpendicular to the central axis that intersects the center point, wherein the distance is different for each of the light sources.

48. The artificial pillar candle of claim 28, wherein further comprising a central plane that is parallel to and passing through the central axis; a first light source plane that intersects the center point of a first light source and is parallel to said central plane, a second light source plane that passes through the center point of a second light source and is parallel to both said central plane and said first light source plane; a first light source distance between said central plane and said first source plane that is measured along a straight line perpendicular to said central plane and said first light source plane, and a second light source distance between said central plane and said second light source plane that is measured along a straight line perpendicular to said central plane and said second light source plane; said first light source distance is greater than said second light source distance.

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49. The artificial pillar candle of claim 28, wherein the recess has a greatest depth and the candle has a greatest height and; the greatest depth of the recess is no greater than one-half of the greatest height of the candle.

50. The artificial pillar candle of claim 28, wherein the recess has a greatest depth and the candle has a greatest height and; the ratio of greatest depth of the recess to the greatest height of the candle is between about 1:2 to 1:5.

51. The artificial pillar candle of claim 49, wherein each of the light sources has a light source height measured from the surface of the recess along a plane parallel to the central axis that is less than one-half of the greatest depth of the recess.

52. The artificial pillar candle of claim 28, wherein each of the at least two light sources has a different light source height.

53. The artificial pillar candle of claim 28, wherein at least a portion of each of the at least two light sources are located at and above the surface of the recess and within the recess so as to be hidden from the plain view of an observer when viewed on a plane perpendicular to the central axis at the height of the rim.

54. The artificial pillar candle of claim 28, wherein the artificial pillar candle further comprises a motion detector for controlling operation of the flame simulator to function in response to motion detected within a predetermined range.

\* \* \* \* \*

# EXHIBIT 4

(12) **United States Patent**  
**Gutstein et al.**

(10) **Patent No.:** **US 9,491,832 B2**  
(45) **Date of Patent:** **Nov. 8, 2016**

(54) **ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR**

(58) **Field of Classification Search**  
CPC ..... F21T 2101/02; H05B 33/0854; F21W  
2121/00  
USPC ..... 362/161, 392, 800, 812  
See application file for complete search history.

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(72) Inventors: **Robert A. Gutstein**, Calabasas, CA  
(US); **Monita Liu**, Calabasas, CA (US)

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(73) Assignee: **NII Northern International Inc.**,  
Vancouver (CA)

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(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

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(65) **Prior Publication Data**

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**Related U.S. Application Data**

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continuation of application No. 14/055,544, filed on  
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Malloy, Ltd.

(51) **Int. Cl.**  
**F21V 21/00** (2006.01)  
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(Continued)

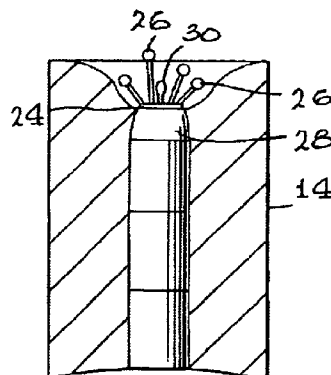
(57) **ABSTRACT**

An electrically powered flame simulator comprises at least two light sources, an integrated circuit electrically connected to the light sources for intermittently illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source for providing power to the integrated circuit. The flame simulator may be mounted in a decorative or ornamental device such as a candle or fire log, or used on decorative clothing, or may be part of a hazard or warning system. One or more solid state light sources may also be used.

(52) **U.S. Cl.**  
CPC ..... **H05B 37/02** (2013.01); **F21S 6/001**  
(2013.01); **F21S 9/02** (2013.01); **F21S 9/022**  
(2013.01); **F21S 10/04** (2013.01); **F21V**  
**23/0442** (2013.01); **F21V 33/0028** (2013.01);  
**F21V 35/00** (2013.01); **H04R 1/028**  
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**16 Claims, 3 Drawing Sheets**



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## Related U.S. Application Data

continuation of application No. 13/449,100, filed on Apr. 17, 2012, now Pat. No. 8,562,186, which is a continuation of application No. 12/927,645, filed on Nov. 19, 2010, now Pat. No. 8,157,425, which is a continuation of application No. 12/586,933, filed on Sep. 30, 2009, now abandoned, which is a continuation of application No. 12/284,986, filed on Sep. 26, 2008, now abandoned, which is a continuation of application No. 11/881,303, filed on Jul. 26, 2007, now abandoned, which is a continuation of application No. 11/494,812, filed on Jul. 28, 2006, now abandoned, which is a continuation of application No. 10/822,392, filed on Apr. 12, 2004, now abandoned, which is a continuation of application No. 10/084,272, filed on Feb. 27, 2002, now Pat. No. 6,719,443.

## (51) Int. Cl.

*F21S 6/00* (2006.01)  
*F21S 9/02* (2006.01)  
*F21S 10/04* (2006.01)  
*F21V 23/04* (2006.01)  
*H05B 33/08* (2006.01)  
*F21V 33/00* (2006.01)  
*F21V 35/00* (2006.01)  
*H04R 1/02* (2006.01)  
*F21Y 101/02* (2006.01)  
*F21W 121/00* (2006.01)

## (52) U.S. Cl.

CPC ..... *F21W 2121/00* (2013.01); *F21Y 2101/02* (2013.01); *Y10S 362/80* (2013.01); *Y10S 362/81* (2013.01); *Y10S 362/812* (2013.01)

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Nov. 8, 2016

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FIG. 1

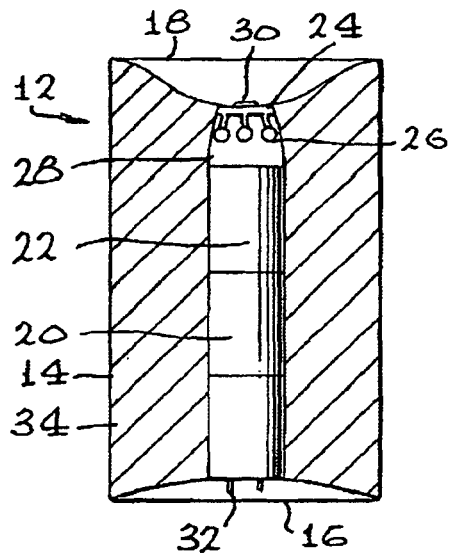


FIG. 3

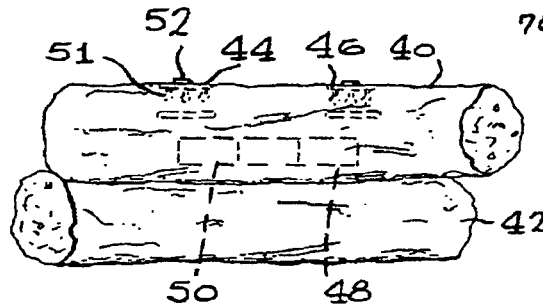
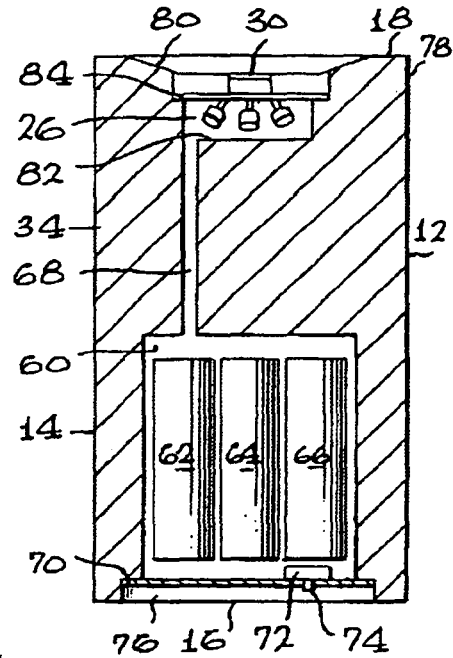


FIG. 2

FIG. 4

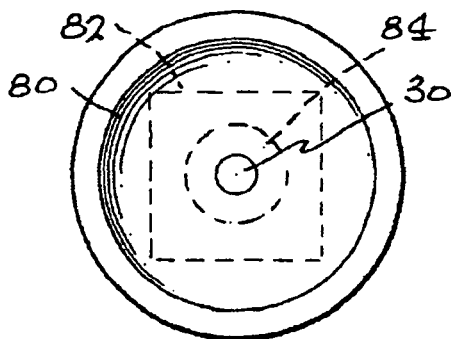
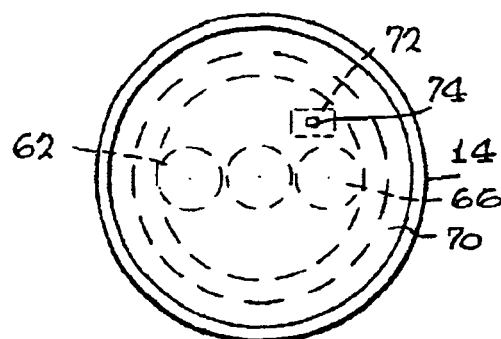
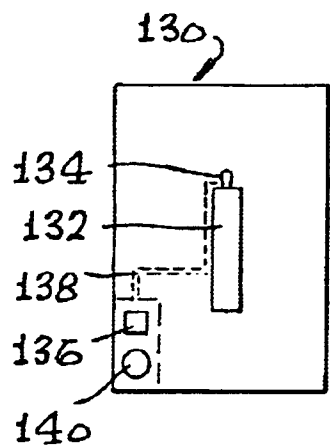
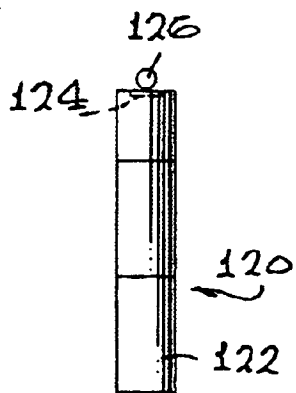
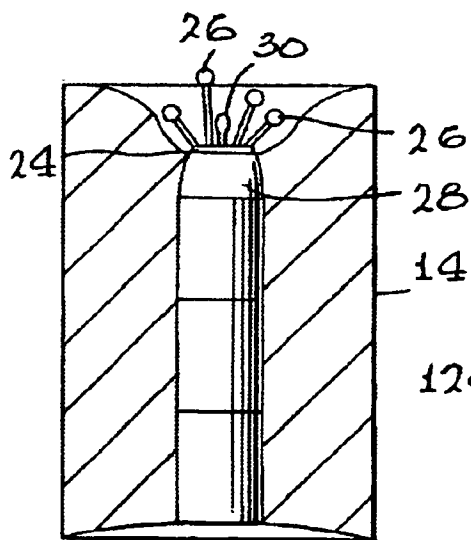
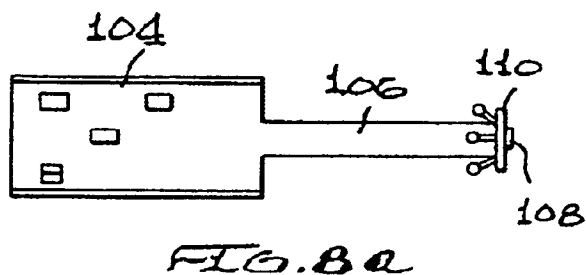
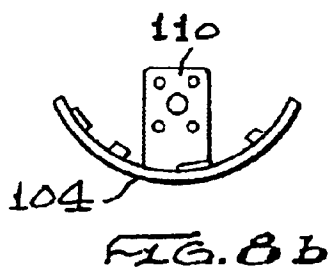
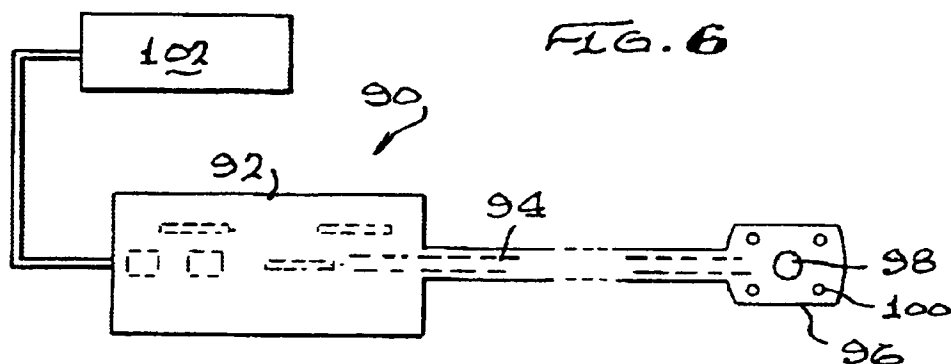
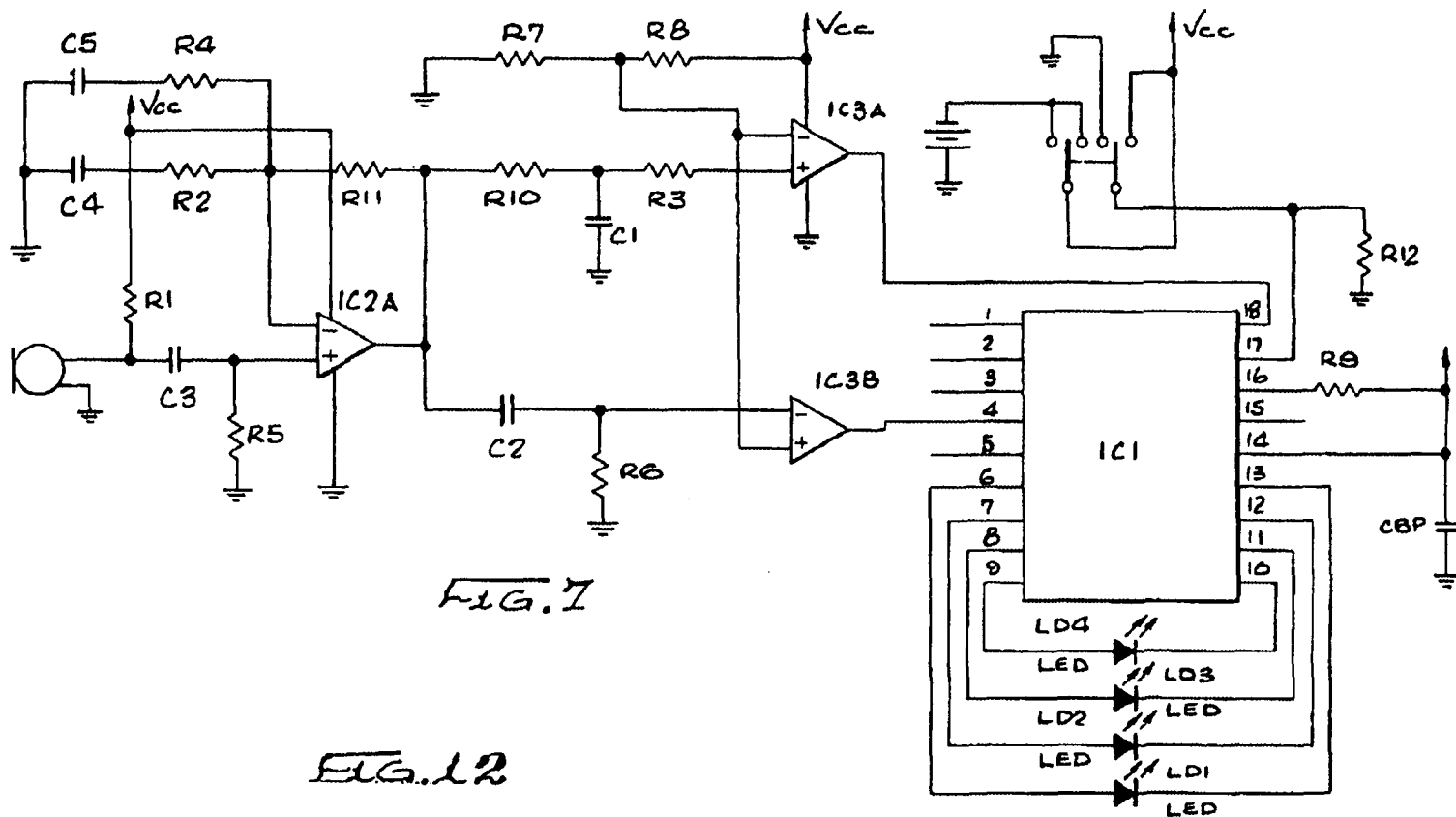


FIG. 5









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**ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR**

## RELATED APPLICATIONS

This application is a continuation of Ser. No. 14/623,308 filed Feb. 16, 2015, which is a continuation of U.S. application Ser. No. 14/055,544 filed Oct. 16, 2013, now U.S. Pat. No. 8,998,461, issued Apr. 7, 2015, which is a continuation of U.S. application Ser. No. 13/449,100 filed Apr. 17, 2012, now U.S. Pat. No. 8,562,186, issued Oct. 22, 2013, which is a continuation of U.S. application Ser. No. 12/927,645 filed Nov. 19, 2010, now U.S. Pat. No. 8,157,425, issued Apr. 17, 2012, which is a continuation of U.S. application Ser. No. 12/586,933 filed Sep. 30, 2009, (now abandoned), which is a continuation of U.S. application Ser. No. 12/284,986 filed Sep. 26, 2008 (now abandoned), which is a continuation of U.S. application Ser. No. 11/881,303, filed Jul. 26, 2007 (now abandoned), which is a continuation of U.S. application Ser. No. 11/494,812 filed Jul. 28, 2006 (now abandoned), which is a continuation of U.S. application Ser. No. 10/822,392 filed Apr. 12, 2004 (now abandoned), which is a continuation of U.S. application Ser. No. 10/084,272 filed Feb. 27, 2002, now U.S. Pat. No. 6,719,443, issued Apr. 13, 2004, all of which are incorporated herein by reference in their entirety. This application is also related to U.S. application Ser. No. 14/152,430 filed on Jan. 10, 2014, now U.S. Pat. No. 8,858,043 issued Oct. 14, 2014, which is also a continuation of U.S. application Ser. No. 14/055,544.

FEDERALLY SPONSORED RESEARCH OR  
DEVELOPMENT

[Not Applicable]

## MICROFICHE/COPYRIGHT REFERENCE

[Not Applicable]

## BACKGROUND OF THE INVENTION

This invention relates to an electrically illuminated flame simulator. Particularly, the invention relates to decorative candles, fire logs, or other devices which may be illuminated so as to produce a flickering flame effect. The flame simulator of the invention would typically be electrically powered by batteries, either disposable or rechargeable, but may also be powered through a regular AC outlet, with or without an AC adaptor.

Candles, fire logs, specially created street lights and other devices which may be used, for example, on clothing, cycles or other products are commonly available and valued for their effect. However, in many instances, where candles, fire logs or related lighting fixtures are used, the lighting, produced is from a flame which may typically burn in an oil container, wax candle or the like. There are, of course, natural hazards associated with such a device, since they may result in fire accidents which, if unattended or not properly controlled, can produce extensive damage, smoke or pollution.

The invention therefore utilizes the concept of such decorative elements, but uses, instead of a flame, an electrically illuminated flame simulator which is programmed to operate so that, when observed, is shown to produce a light-flickering effect which is the same as or similar to a burning candle, fire log or the like. However, the invention is not limited to devices such as candles and fire logs, and

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the electrically illuminated flame simulator of the invention can be used in a wide array of products and conditions, such as in ornamental or decorative street lights, in clothing such as belts, shoes and caps, greeting cards, or on bicycles, scooters and the like. Furthermore, the flickering effect of the flame simulator of the invention may be used to advantage as a hazard warning, such as on road hazard or emergency automobile lights.

Certain devices and methods are known which may have the effect of producing or simulating a real flame. For example, a single specially designed, unstable neon light bulb may be used. Such unstable neon bulbs, however, inherently produce an unnatural "jerky" flickering pattern that may not be easily controlled electronically, and must be operated by high voltage sources. At the least, this makes them generally unsuitable for battery operation. A further example can be found in a single incandescent light bulb whose light output may be modulated by varying the output of an AC or DC voltage source. Such incandescent light bulbs, however, are inherently limited in terms of flickering rate and effect due to retention of filament heat, and draw substantially more current than solid state light sources such as LED lights. Once more, this is not generally suitable for battery operation, at the least.

Where multiple light bulbs each switched on and off may be used for display and decorative purposes, there is an absence of the illusion of light movement characteristic of a flickering flame since the light bulbs are not switched or modulated in a manner which would generate light motion typical of that produced by a real flame.

Linear arrays of "traveling" or "chaser" lights are also known but these arrays are structured and controlled to generate the effect of a large magnitude of light motion in a linear direction, which is coincident with the linear array of such lights. Certainly, the effect produced by these linear arrays does not mimic the illusion of a flickering flame.

## BRIEF SUMMARY OF THE INVENTION

In one aspect, the invention is for an electrically illuminated flame simulator. Preferably, the flame simulator of the invention is associated with an ornamental or decorative device, or with other devices such as hazard indicators. In one form, the flame simulator of the invention may constitute a part of an ornament or decoration such as a candle, fire log, or an indoor or outdoor lighting display, giving the appearance that the ornament is providing a natural flame. Other such decorative uses may make the flame simulator of the invention useful when associated with clothing, such as on belts or caps, greeting cards, or when incorporated into shoes.

When used as a hazard warning, the flame simulator of the invention may be used in conjunction with cycles or cycle clothing, or with road barriers, signs for warning motorists or as emergency lighting for vehicles.

In a preferred form, the electrically illuminated flame simulator is used with a decorative candle. The candle itself may be comprised of wax or other conventional materials from which candles are produced, or materials such as plastics which can emulate the look of a candle. The flame simulator of the invention would preferably be located within the candle body so that the flame simulator, when illuminated, can be seen not only from the top of the candle, but also as a glow or source of light emanating from within the candle.

According to another aspect of the invention, the flame simulator may also be used to provide an effect similar to

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that of a candle when used in a fake fire log intended to produce the effect of a natural burning log.

In one form, the flame simulator of the invention comprises at least two light sources, preferably four, such as light bulbs, which may be randomly, sequentially, or semi-randomly illuminated to produce a flickering and moving light effect to resemble a real flame, for example a flame provided by a burning candle. The light sources are preferably light-emitting diodes (LEDs), randomly or semi-randomly illuminated electronically.

In another embodiment, the flame simulator of the invention comprises a single non-filament (solid state) light source, such as an LED light bulb, liquid crystal display, or electro luminescent material, in which such light source is driven by a randomly or semi-randomly modulated voltage source to provide a flickering effect to resemble a real flame.

Further, in another aspect of the invention, the illuminated source producing the flame-flickering effect may be operated (namely, activated and deactivated) by externally produced, preselected sounds. Therefore, the electrically illuminated flame simulator of the invention may have associated therewith a microphone integrated as part of the electronics, so that sounds or different frequencies may be programmed to produce a given result, such as the switching on or switching off of the flame simulator.

The flame simulator of the invention may also incorporate other features, including motion detectors, light sensors and the like, so that any ornament or decoration incorporating the flame simulator of the invention will operate automatically, for example, when ambient light conditions reach a certain level, and/or when movement is detected within a specific range.

According to one aspect of the invention, there is provided an electrically powered flame simulator comprising: at least two light sources; an integrated circuit electrically connected to the light sources for intermittently, such as systematically, randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and a power source for providing power to the integrated circuit. Preferably, the a flame simulator comprises at least four light sources.

The flame simulator preferably includes a switch means for activating and deactivating the integrated circuit. The switch means may have three positions comprising an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time.

The flame simulator may further comprise a microphone connected to the integrated circuit wherein the microphone inputs preselected audio signals which are processed by the integrated circuit to switch the flame simulator between an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time. Preferably, the integrated circuit processes signals from the microphone having a higher frequency, such as those produced by a finger snap, to place the flame simulator in the on position and processes lower frequency signals, such as those produced by blowing, to place the flame simulator in the off position.

The integrated circuit may illuminate the light sources in a random or semi-random operation, in a preselected, predetermined operation, and may function only when selected ambient sound or light conditions are present.

In one form, the flame simulator comprises a body in the shape of a candle in which the flame simulator is contained, the body having an upper end with a mounting means for

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receiving the integrated circuit and light sources and a chamber therein for receiving the power source.

Preferably, the light sources are light emitting diodes (LEDs). The integrated circuit may be mounted on a rigid base, or on a flexible base which can be shaped so as to conform to the shape of at least a portion of the candle to conserve space.

According to another aspect of the invention, there is provided a candle having an electrically powered flame simulator comprising: a candle body having an upper portion, a lower portion and a chamber therein; and a flame simulator having at least two light sources located near the upper portion of the candle body, an integrated circuit within the candle body and electrically connected to the light sources for intermittently, such as by randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source in the chamber of the candle body for providing power to the integrated circuit.

#### BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a schematic side view of a candle with the electrically illuminated flame simulator of the invention;

FIG. 2 is a front view of artificial fire logs incorporating a flame simulator of the invention;

FIG. 3 is a schematic side view, showing various components, of an artificial candle with flame simulator of the invention;

FIG. 4 is a top view of the candle shown in FIG. 3 of the drawings;

FIG. 5 is a bottom view of the candle shown in FIG. 3 of the drawings;

FIG. 6 is a schematic view of the flame simulator of the invention, shown independent of any decorative ornament with which it may be associated;

FIG. 7 is a circuit diagram showing the electronics in one embodiment of the flame simulator of the invention;

FIGS. 8a and 8b show another embodiment of the flame simulator of the invention standing alone, shown as a front view and top view respectively;

FIG. 9 shows a schematic side view of a candle with the electrically illuminated flame simulator of the invention as illustrated in FIG. 1, but with LED light sources which face upwards;

FIG. 10 shows schematically a single "birthday" type candle in accordance with the present invention; and

FIG. 11 shows schematically a greeting card in accordance with the present invention; and

FIG. 12 shows a block diagram of one embodiment of a single light source flame simulator of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

The invention is for a flame simulator which is powered electrically, and comprises a series of bulbs or LEDs which are illuminated randomly, semi-randomly or in a predetermined manner to provide the visual effect of a flickering flame. The device is preferably coupled to an ornament such as a candle or fire log to enhance this effect.

FIG. 1 of the drawings shows schematically a candle 12, generally of cylindrical shape having side wall 14, a base 16, and a top surface 18. The candle 12 comprises a hollowed out central portion 20, generally extending between the top

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surface 18 and the base 16, which, in the embodiment of FIG. 1, may accommodate a power source such as batteries 22. Near the top surface 18 there is located circuitry 24, the circuitry 24 being connected to LED light sources 26, four of which are shown in the embodiment in FIG. 1 of the drawings. The LED light sources 26 open into a chamber 28, generally formed between the top of the batteries 22 and the undersurface of the circuitry 24. In a variation, the LED light sources 26 may point upwardly.

The circuitry 24 further comprises a microphone 30, at least a portion of which is exposed and not embedded within the candle 12. The microphone 30 has an operative portion thereof exposed to the outside air and is capable of receiving and processing signals of various frequencies, as will be described, which are transmitted to and then processed by the circuitry 24, to activate the LED light sources 26 to provide a flickering flame effect.

At the lower end of the hollow central portion 20, electrical pins 32 are located, and these may be connectable to an electric source (not shown). Such pins 32 may be used for different purposes, such as for recharging the batteries 22 when they are of rechargeable type, or for providing power directly to the circuitry 24 and the LED light sources 26. The batteries could, of course, be disposable, and, in a further variation, the candle 12 would be able to accommodate both disposable and rechargeable batteries.

Preferably, the candle 12 is cylindrically shaped, and may be comprised of wax or a synthetic material which provides a candle-like appearance. The candle 12 may be of desired color or a combination of colors, and may be translucent or opaque. The material of the candle 12 is chosen, and its thickness selected, so that the possibility exists for light from the LED light sources 26 to be viewed not only from the top surface 18 of the candle 12, but also through the body 34 of the candle, possibly in a muted or semi-transparent manner to provide a glowing effect.

As will be described below, the LED light sources 26 may be illuminated randomly, semi-randomly, or in a predetermined pattern. However, the overall purpose of illuminating the LED light sources 26 is to do so in such a way that the modulated illumination of each of the LED light sources provides an aesthetic flickering effect when illuminated in combination with the other LED light sources being similarly illuminated, so that the light and movement produced thereby emulates a natural candle flame.

With reference to FIG. 2 of the drawings, there is shown a pair of synthetic fire logs 40 and 42, which may be comprised of conventional materials known to those skilled in the art, and having ornamentation and design features thereon which look like real fire logs. In FIG. 2, which shows only one embodiment of the invention, the fire log 40 has two electric circuits 44 and 46, both of which are substantially identical to each other, and each of which may be powered by battery power source 48. An AC power source may be utilized in an alternative embodiment. The battery power source 48 is preferably contained within a specially hollowed out portion 50 of the fire log 40, and is placed electrically in contact with the circuitry 44 and/or 46 in a conventional manner, not shown in FIG. 2.

Associated with each of the electrical circuits 44 and 46 is a series of LED light sources 51. Each of the electrical circuits 44 and 46 may also include a microphone 52. The electrical circuits 44 and 46, together with their associated LED light sources 51 and microphone 52, operate in essentially the same manner as described with reference to FIG. 1 of the drawings. Thus, each of the LED light sources 51 in the array is activated to illuminate in a random or

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predetermined manner, so as to give off light at various points along the fire log 40 to provide the effect that the fire log 40 is glowing, or that flames are burning thereon.

Reference is now made to FIG. 3 of the drawings which shows, in side view, a diagrammatic representation of one embodiment of an ornamental candle incorporating the flame simulator of the invention. Where applicable, reference numerals will be used corresponding to those in FIG. 1 of the drawings. In FIG. 3, the candle 12 comprises side wall 14, a base 16, and a top wall 18. These various walls of the candle 12 define a candle body 34.

In the lower half of the candle 12, there is formed a hollow chamber 60 adapted to receive three batteries 62, 64 and 66, which form a battery or power pack. The chamber 60, at an upper portion thereof, leads into a wire channel 68 extending therefrom towards the circuits and light sources above, which will be described.

The chamber 60 is accessed through a removable cover plate 70 near the base 16 of the candle. The batteries 62, 64 and 66 are connected to a power switch 72, contained within the chamber 60, the power switch 72 having a switch lever 74 which extends from within the chamber 60 to outside of the candle 12, through the cover plate 70. In this way, the user has manual access to and control of the switch lever 74 for activating or deactivating the candle 12.

At the base 16 of the candle 12, there is a recessed portion 76, the recessed portion 76 leading to the chamber 60, but, in normal usage, sealed from the chamber 60 by means of the cover plate 70.

At the upper end 78 of the candle 12, there is an upper recess 80 leading into a LED chamber 82. A printed circuit board 84 or an integrated circuit mounted on a board 84 houses the electronics, one embodiment of which is described below, for activating the candle 12. Attached to the PC board 84 are four LED light sources 26, which extend from the PC board 84 into the LED chamber 82. A microphone 30 extends upwardly from the PC board 84, into the upper recess 80. The PC board 84 is electrically connected to the power source of batteries 62, 64 and 66 through appropriate electrical connectors which extend through the wire channel 68.

FIG. 6 shows, schematically, a flame simulator 90 independent of the body or ornament on which it may be mounted, including an integrated circuit 92, an arm 94 extending therefrom which supports or contains conductors, preferably flexible conductors, and a support plate 96 at the end of arm 94 which can be arranged at an angle to the arm 94, as required. The support plate 96 includes a microphone 98 and LEDs 100. The integrated circuit 92 is powered by a power source, indicated generally at 102.

With reference to FIG. 7 of the drawings a preferred circuit diagram showing some of the electronics and operation of the equipment is described.

The heart of the system is the integrated circuit IC1 connected to a number of LEDs, LD1-LD4. IC1 systematically or randomly or semi-randomly, at the designer's choice, turns on and off the LEDs simulating the flickering of the candle 12.

Power is applied to all electronic circuitry, where indicated by "VCC", by operation of a switch S1. The switch S1 has three positions: "on"; "off"; and "timed". In the "on" position of switch S1, the integrated circuit IC1 operates in a continuous mode after enablement, and stops only when commanded to do so by the user. That is, in this mode, operation starts and stops under remote control by the user, as explained below. In the "off" position of switch S1, the entire system is shut down, since switch S1 disconnects the



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battery from VCC. In the “timed” position of the switch S1, after starting operation, the integrated circuit IC1 stops operation automatically after a predetermined time has passed.

In the “on” position of switch S1, typically at least 3 volts (2×1.5V) from the batteries is routed through the switch S1 and applied to all circuitry requiring VCC. All circuit points designated “OND” are connected together representing ground potential for the system. Ground potential (GND) is not switched by the switch S1, except in the “on” position of the switch S1, when GND is applied to a pin 17 of the IC1 to set the functional operation of the IC1 in a continuous mode of operation until a “stop” signal is received on the pin 18 to cease its operation. In the “timed” position of S1, VCC is applied to the pin 17 of the IC1, causing an internal timer in the IC1 to time out and stop operation of the IC1 after a predetermined delay time, e.g., three hours.

In the “on” position of the switch S1, all circuits are powered and in a standby mode, defining an initial quiescent state for the IC1 in which none of the LEDs LD1-LD4 are lit. However, upon the occurrence of a high frequency sound at the microphone MIC1, such as a hand clap or finger snap, a signal is generated at the output of the microphone MIC1 and applied to the + terminal of an operational amplifier IC2A. The IC2A amplifies the sharp sound sensed by the microphone MIC1, and applies the amplified output signal simultaneously to the + input of an IC3A and to the – input of the IC3B, which enables IC1 to begin modulating the LEDs to produce the flickering effect. The circuit may be modified to respond to different frequency signals without altering the principles of the present invention.

R1, C3, R5; C4, C5, R2, R4; R11; and R7, R8 are coupling, frequency compensation, feedback, and biasing components, the functions and operations of which are familiar to a skilled worker and therefore need not be further described in detail herein. C2 and R6 define a high-pass filter, while R10, C1, and R3 define a low-pass filter arrangement.

In the presence of a sharp, high frequency sound input to the microphone MIC1, high frequency signal components are present at the output of the IC2A, which signal components are passed on only to the – terminal of the IC3B through the high-pass filter C2, R6, i.e., the high frequency signal from the IC2A is blocked from reaching the + terminal of the IC3A due to the presence of the low-pass filter R10, C1, R3.

Thus, the IC3B amplifies its input signal and sends it to a pin 4 of the IC1 as a “start” pulse, initiating the operation of the IC1. When in an operational mode, the IC1, either systematically (e.g., sequentially) or randomly, applies power sufficient to light the LEDs LD1-LD4 individually via pins 6 and 13 for LD1, via pins 7 and 12 for LD2, via pins 8 and 11 for LD3, and via pins 9 and 10 for LD4.

In the “on” switch setting, this condition will continue until the switch S1 is moved to the “off” position, or until a low frequency sound, such as that made by blowing or making a thud-like sound near the microphone MIC1, is sensed by the microphone MIC1.

In the presence of a low frequency sound input to the microphone MIC1, low frequency signal components are present at the output of the IC2A, which signal components are passed on only to the + terminal of the IC3A through the low-pass filter R10, C1, R3, i.e., the low frequency signal from the IC2A is blocked from reaching the – terminal of the IC3B due to the presence of high-pass filter C2, R6.

Thus, the IC3A amplifies its input signal and sends it to a pin 18 of the IC1 as a “stop” pulse, ceasing the operation

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of the IC1, at which time, the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1. As previously explained, other frequency sounds may be selected to control various functions including on and off functions.

When the switch S1 is moved to the “timed” position, starting the operation of the IC1 is accomplished in the same manner as described above, i.e., by the sensing of a high frequency sound present at the microphone MIC1. However, in the “timed” mode, VCC is applied to the pin 17 of the IC1 through the switch S1. This VCC potential on the pin 17 sets an internal timer to run for the aforementioned predetermined delay time, after which the operation of the IC1 is automatically terminated, and the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1.

It is to be understood that the circuit diagram of FIG. 7 depicts a preferred embodiment for the electronics of the invention, and that other functions may be employed by either reconfiguring the connections to the IC1 and/or by the use of additional, or other, electronic components. Examples of variations of the described circuit would be apparent to a person of ordinary skill in the art. For example, the switch S1 could be modified, or a separate switch could be provided, to operate a modified electronic system in yet another mode in which the microphone MIC1 is disconnected from the system, and starting and stopping operation of the IC1 is accomplished solely by manual control. As another example, the delay for a timed stop could be made selectable with only minor modification of the circuit diagram and the provision of a manual delay time control device.

In FIGS. 8a and 8b there is shown a further embodiment of a circuit board 104, which is arcuate in order to conform with the shape of a battery around which it may be located as a space-saving technique. An arm 106 (or simply wires which are flexible and may be in flexible tubing) preferably extends upwardly or away from the printed circuit board and circuitry 104, and terminates in a support plate 110 substantially at right angles to the arm 106. The plate 110 supports the microphone 108 and LED light sources which would be located, in use, near the upper portion of a candle.

FIG. 9 shows a view of a candle very similar to that illustrated in FIG. 1 of the drawings, but with the light sources 26 pointing upwardly for a slightly different effect. FIG. 10 shows schematically a “birthday” type candle 120 having a battery area 122, a circuit 124 and an LED 126. LED 126 may be substituted by an alternative form of light without altering the principles of the present invention.

A greeting card 130 is illustrated in FIG. 11 and includes a printed candle 132 having an LED light source 134 thereabove which is operated by a circuit 136 to which it is connected by embedded wires 138. A power source 140 is also provided.

The circuit board may be comprised of a flexible material so that its shape can be easily manipulated to fit the space in which it is to be mounted. The circuit board can be connected to the LED light sources through any appropriate electrical connection means so that it can be distanced therefrom, and this also functions as a space-saving technique for confining and mounting the electronics into smaller spaces.

In a preferred embodiment of the invention, there are at least two light bulbs, although more (such as four) are preferable, powered by randomly or sequentially generated voltage sources to produce the flickering effect. In a preferred embodiment, at least two pairs of output ports of a micro-controller may be programmed to provide a seven-

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segment LED/LCD 12-hour time clock multiplex function. An audio signal is processed, in one embodiment, by a high-frequency filtering circuit, the output of which provides a power-on signal which is responsive to a finger snap, handclap or the like, as described with reference to FIG. 7. Further, the audio signal may be processed by a low-frequency filtering circuit, the output of which provides a power-off signal, which is responsive to, for example, a blowing sound.

A mode switch or remote control device may be employed to select between the modes of power-off, power-on or power-on with various microphone functions, or power-on for a predetermined period of time.

Another preferred feature of the invention may include the use of LED-type light bulbs, generally in the manner described above, wherein such light bulbs radiate light in a non-parallel and substantially downward direction, so as to illuminate a translucent candle body, as briefly referenced in the description of FIG. 1 of the drawings. Incandescent or neon light bulbs may substitute one or more of the LED light bulbs, and non-micro controller circuitry may be used.

The two light bulbs may be operated by at least two voltage sources, where a voltage source is randomly generated, semi-randomly generated, or sequentially generated, thereby producing the flickering flame and moving light effect.

The flame simulator of the invention may have a signal produced by a microphone and microphone amplifier which triggers the modulated voltage sources into power on and power off states alternately. Frequency equalization may be applied to the amplifier such as to favor high frequency sounds (such as a finger snap or hand clap) in triggering the power on state, and the frequency equalization may also be applied to the amplifier such as to favor low frequency sounds (such as blowing air) in triggering the power off state. Preferably, at least one of the light bulbs radiates light into or from a translucent candle body, and any two such light bulbs may radiate light in directions that are parallel or non-parallel to one another.

The invention is not limited to the precise details, and variations of the particular electronics and circuitry, as well as the ornaments or devices to which they may be attached, may vary within the disclosure herein. Further, additional features may form part of the invention. For example, a light sensor device may be associated and electrically connected to the circuitry of the invention. The light sensor senses the level of ambient light and may switch on the flame simulator, or place it in a mode receptive to audio signals as described above, only when light levels drop below a pre-selected intensity. In this way, the flame simulator of the invention would only operate during darker periods or in darker environments.

The invention may also include a motion detector associated therewith and electrically connected with the circuitry of the flame simulator of the invention. The inclusion of motion detector sensors would confine operation of the flame simulator of the invention to periods of time when movement, such as that made by people in the vicinity, is present and thereby save power by in operation when motion is not detected. Another option would be to incorporate heat sensors to restrict operation of the flame simulator to conditions when temperatures drop below or move above pre-selected levels.

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The invention claimed is:

1. An artificial pillar candle comprising:

a substantially cylindrical body including permanent exterior surfaces, wherein the substantially cylindrical body comprises:

an upper portion including a rim on an upper surface that circumscribes a recess;

a lower portion with a lower surface; and

a chamber inside the substantially cylindrical body, wherein the substantially cylindrical body is self-supporting on the lower surface and wherein the substantially cylindrical body has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;

a flame simulator including a plurality of light sources, wherein a first subset of the plurality of light sources is located within the recess below a maximum height of the rim and a second subset of the light sources is located above the maximum height of the rim; and

a circuit electrically connected to the light sources, wherein the circuit is configured to intermittently illuminate at least one of the plurality of light sources independently from other ones of the plurality of light sources such that the illumination of the plurality of light sources over time provide the effect of a movement of a flame.

2. The artificial pillar candle of claim 1, wherein the artificial pillar candle further comprises an ON/OFF switch.

3. The artificial pillar candle of claim 1, wherein the artificial pillar candle further comprises an ON/OFF/TIMER switch, wherein the circuit controls the plurality of light sources for a period time when the switch is set to the TIMER position.

4. The artificial pillar candle of claim 1, wherein the recess is formed to appear as if burned down by melting of the candle.

5. The artificial pillar candle of claim 1, wherein at least a portion of the first subset of the plurality of light sources are located within the recess so as to be hidden from the plain view of an observer when viewed on a plane perpendicular to the central axis at the height of the rim.

6. The artificial pillar candle of claim 1, wherein the plurality of light sources are configured such that, when the plurality of light sources are illuminated, the plurality of light sources produce light that directly reflects off of a surface of the recess, diffuses through the artificial pillar candle and directly transmits from the recess without reflecting off of the surface of the recess or diffusing through the artificial pillar candle.

7. The artificial pillar candle of claim 1, wherein:

the recess has a maximum depth and the candle has a maximum height; and

the maximum depth of the recess is no greater than one-half of the maximum height of the candle.

8. The artificial pillar candle of claim 1, wherein:

the recess has a maximum depth and the candle has a maximum height; and

the ratio of greatest depth of the recess to the maximum height of the candle is between about 1:2 to 1:5.

9. An artificial pillar candle comprising:

a substantially cylindrical body including permanent exterior surfaces, wherein the substantially cylindrical body comprises:

an upper portion including a rim on an upper surface that circumscribes a recess;

a lower portion with a lower surface; and

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a chamber inside the substantially cylindrical body, wherein the substantially cylindrical body is self-supporting on the lower surface and wherein the substantially cylindrical body has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;

a flame simulator including a plurality of light sources, wherein a first subset of the plurality of light sources is located within the recess below a minimum height of the rim and a second subset of the light sources is located above the minimum height of the rim; and

a circuit electrically connected to the light sources, wherein the circuit is configured to intermittently illuminate at least one of the plurality of light sources independently from other ones of the plurality of light sources such that the illumination of the plurality of light sources over time provide the effect of a movement of a flame.

10. The artificial pillar candle of claim 9, wherein the artificial pillar candle further comprises an ON/OFF switch.

11. The artificial pillar candle of claim 9, wherein the artificial pillar candle further comprises an ON/OFF/TIMER switch, wherein the circuit controls the plurality of light sources for a period time when the switch is set to the TIMER position.

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12. The artificial pillar candle of claim 9, wherein the recess is formed to appear as if burned down by melting of the candle.

13. The artificial pillar candle of claim 9, wherein at least a portion of the first subset of the plurality of light sources are located within the recess so as to be hidden from the plain view of an observer when viewed on a plane perpendicular to the central axis at the height of the rim.

14. The artificial pillar candle of claim 9, wherein the plurality of light sources are configured such that, when the plurality of light sources are illuminated, the plurality of light sources produce light that directly reflects off of a surface of the recess, diffuses through the artificial pillar candle and directly transmits from the recess without reflecting off of the surface of the recess or diffusing through the artificial pillar candle.

15. The artificial pillar candle of claim 9, wherein: the recess has a maximum depth and the candle has a maximum height; and the maximum depth of the recess is no greater than one-half of the maximum height of the candle.

16. The artificial pillar candle of claim 9, wherein: the recess has a maximum depth and the candle has a maximum height; and the ratio of greatest depth of the recess to the maximum height of the candle is between about 1:2 to 1:5.

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# EXHIBIT 5

(12) **United States Patent**  
**Gutstein et al.**

(10) **Patent No.:** **US 10,247,374 B2**  
(45) **Date of Patent:** **\*Apr. 2, 2019**

(54) **ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR**

(58) **Field of Classification Search**  
CPC .... F21S 10/04; F21S 6/001; F21S 9/02; F21S  
9/022; F21V 23/04; F21V 23/0442;  
(Continued)

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(73) Assignee: **STERNO HOME INC.**, Vancouver  
(CA)

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(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.  
  
This patent is subject to a terminal dis-  
claimer.

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(21) Appl. No.: **16/043,675**

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Malloy, Ltd.

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(63) Continuation of application No. 15/346,475, filed on  
Nov. 8, 2016, now Pat. No. 10,036,521, which is a  
(Continued)

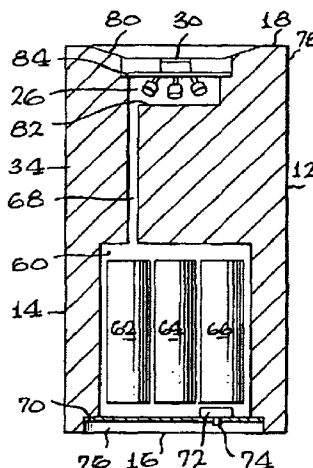
(57) **ABSTRACT**

An electrically powered flame simulator comprises at least  
two light sources, an integrated circuit electrically connected  
to the light sources for intermittently illuminating at least  
one of the light sources independently of other light sources  
such that the light sources together provide the effect of a  
flickering movement, and a power source for providing  
power to the integrated circuit. The flame simulator may be  
mounted in a decorative or ornamental device such as a  
candle or fire log, or used on decorative clothing, or may be  
part of a hazard or warning system. One or more solid state  
light sources may also be used.

(51) **Int. Cl.**  
**F21S 10/04** (2006.01)  
**F21S 6/00** (2006.01)  
(Continued)

(52) **U.S. Cl.**  
CPC ..... **F21S 10/04** (2013.01); **F21S 6/001**  
(2013.01); **F21S 9/02** (2013.01); **F21S 9/022**  
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**10 Claims, 3 Drawing Sheets**



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## Related U.S. Application Data

continuation of application No. 14/848,714, filed on Sep. 9, 2015, now Pat. No. 9,491,832, which is a continuation of application No. 14/623,308, filed on Feb. 16, 2015, now abandoned, which is a continuation of application No. 14/055,544, filed on Oct. 16, 2013, now Pat. No. 8,998,461, which is a continuation of application No. 13/449,100, filed on Apr. 17, 2012, now Pat. No. 8,562,186, which is a continuation of application No. 12/927,645, filed on Nov. 19, 2010, now Pat. No. 8,157,425, which is a continuation of application No. 12/586,933, filed on Sep. 30, 2009, now abandoned, which is a continuation of application No. 12/284,986, filed on Sep. 26, 2008, now abandoned, which is a continuation of application No. 11/881,303, filed on Jul. 26, 2007, now abandoned, which is a continuation of application No. 11/494,812, filed on Jul. 28, 2006, now abandoned, which is a continuation of application No. 10/822,392, filed on Apr. 12, 2004, now abandoned, which is a continuation of application No. 10/084,272, filed on Feb. 27, 2002, now Pat. No. 6,719,443.

## (51) Int. Cl.

**F21S 9/02** (2006.01)  
**F21V 23/04** (2006.01)  
**F21V 23/06** (2006.01)  
**F21V 33/00** (2006.01)  
**F21V 35/00** (2006.01)  
**H04R 1/02** (2006.01)  
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**H05B 37/02** (2006.01)  
**F21W 121/00** (2006.01)  
**F21Y 115/10** (2016.01)  
**F21Y 101/00** (2016.01)

## (52) U.S. Cl.

CPC ..... **F21V 23/04** (2013.01); **F21V 23/0442** (2013.01); **F21V 23/06** (2013.01); **F21V 33/0028** (2013.01); **F21V 35/00** (2013.01); **H04R 1/028** (2013.01); **H05B 33/0845** (2013.01); **H05B 33/0854** (2013.01); **H05B 37/02** (2013.01); **H05B 37/0236** (2013.01); **F21W 2121/00** (2013.01); **F21Y 2101/00** (2013.01); **F21Y 2115/10** (2016.08); **Y10S 362/80** (2013.01); **Y10S 362/81** (2013.01); **Y10S 362/812** (2013.01)

## (58) Field of Classification Search

CPC ..... **F21V 23/06**; **F21V 33/0028**; **F21V 35/00**; **H04R 1/028**; **H05B 33/0845**; **H05B 33/0854**; **H05B 37/02**; **H05B 37/0236**  
 USPC ..... 362/307  
 See application file for complete search history.

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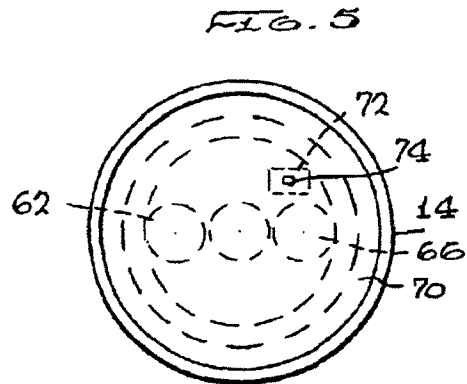
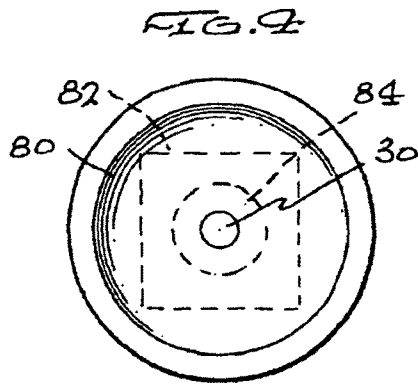
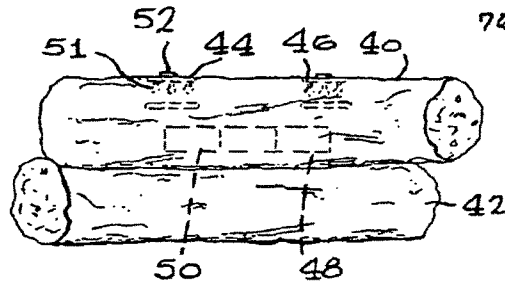
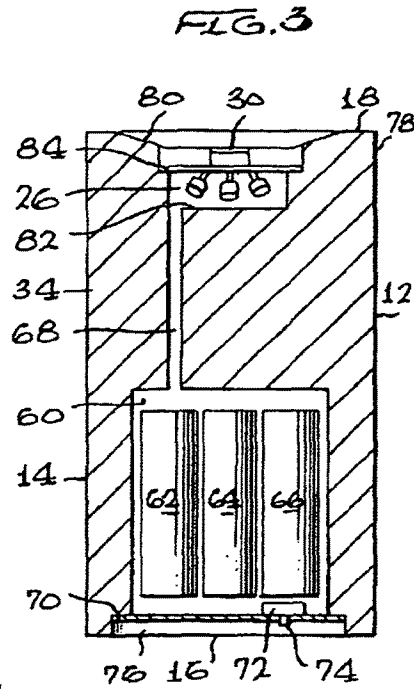
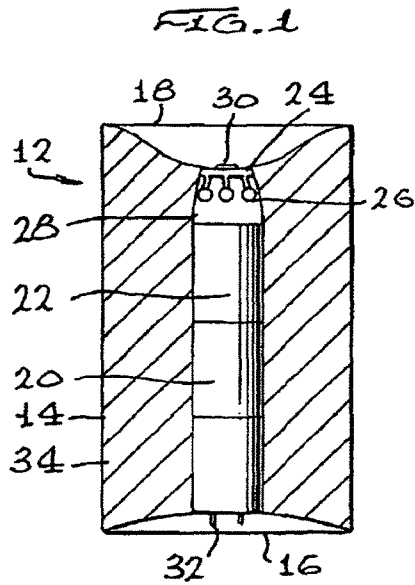
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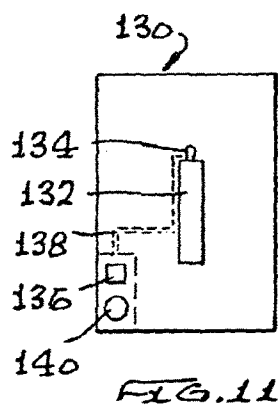
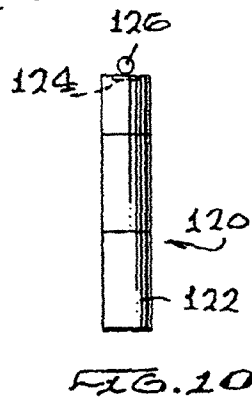
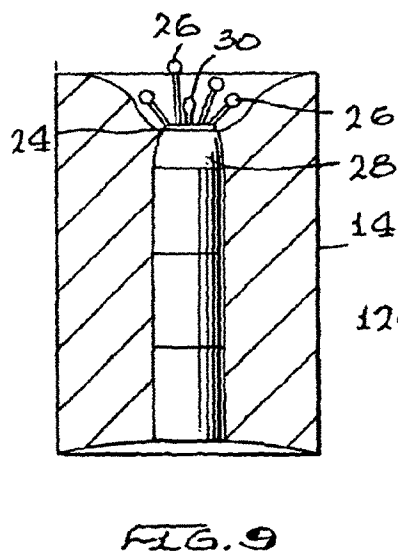
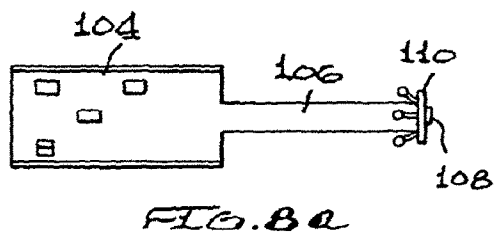
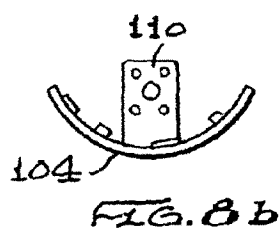
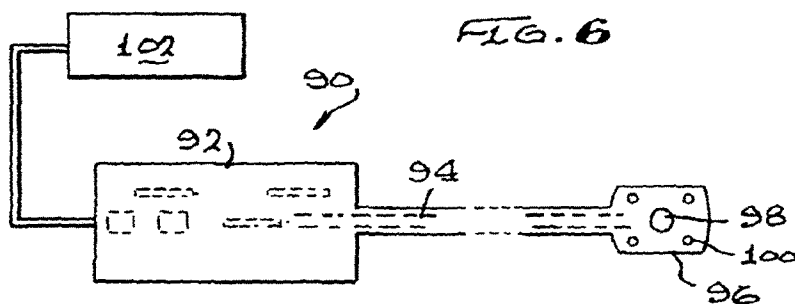
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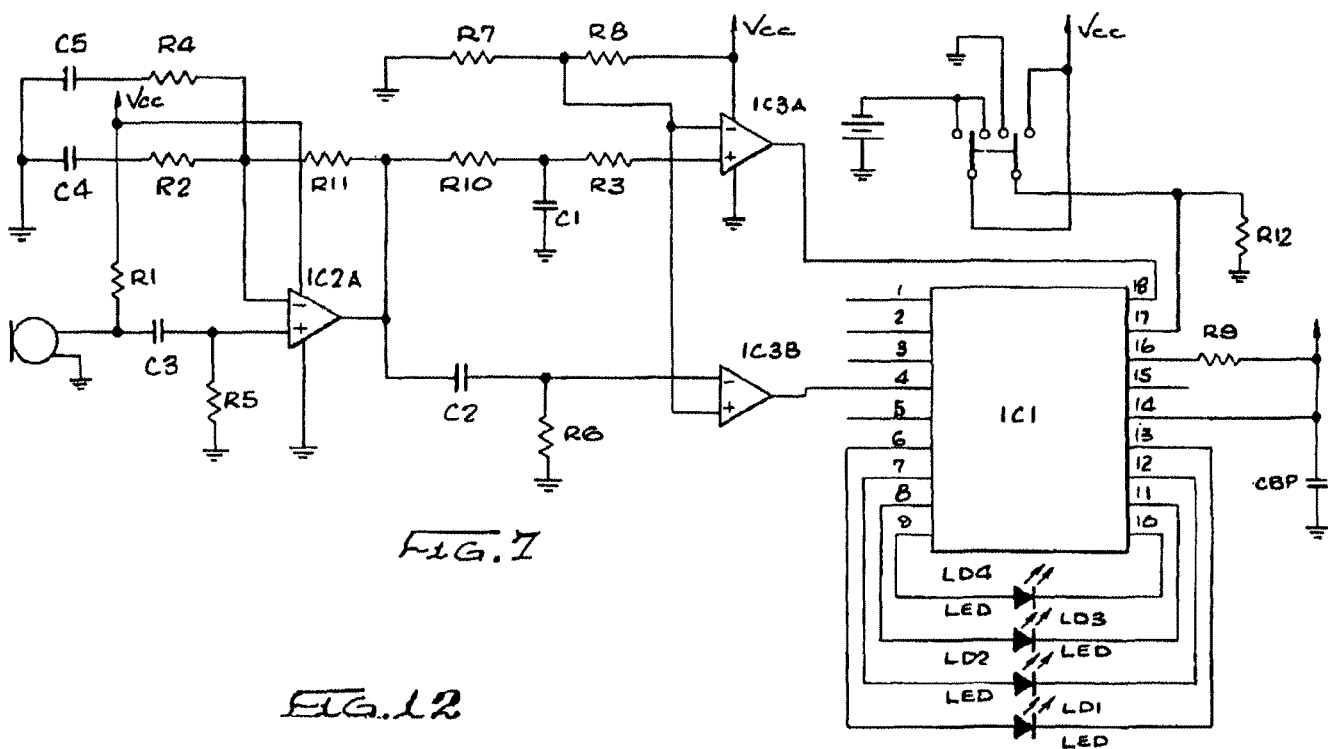
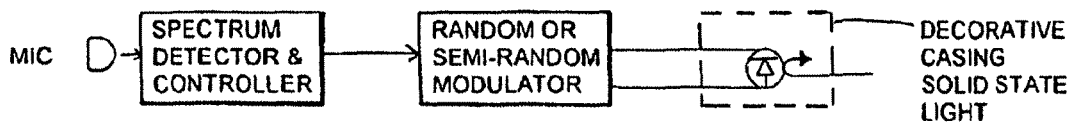


FIG. 1

FIG. 12



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**ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR****RELATED APPLICATIONS**

This application is a continuation of Ser. No. 15/346,475 filed Nov. 8, 2016, which is a continuation of Ser. No. 14/848,714 filed Sep. 9, 2015, now U.S. Pat. No. 9,491,832 issued Nov. 8, 2016, which is a continuation of Ser. No. 14/623,308 filed Feb. 16, 2015 (now abandoned), which is a continuation of U.S. application Ser. No. 14/055,544 filed Oct. 16, 2013, now U.S. Pat. No. 8,998,461, issued Apr. 7, 2015, which is a continuation of U.S. application Ser. No. 13/449,100 filed Apr. 17, 2012, now U.S. Pat. No. 8,562,186, issued Oct. 22, 2013, which is a continuation of U.S. application Ser. No. 12/927,645 filed Nov. 19, 2010, now U.S. Pat. No. 8,157,425, issued Apr. 17, 2012, which is a continuation of U.S. application Ser. No. 12/586,933 filed Sep. 30, 2009, (now abandoned), which is a continuation of U.S. application Ser. No. 12/284,986 filed Sep. 26, 2008 (now abandoned), which is a continuation of U.S. application Ser. No. 11/881,303, filed Jul. 26, 2007 (now abandoned), which is a continuation of U.S. application Ser. No. 11/494,812 filed Jul. 28, 2006 (now abandoned), which is a continuation of U.S. application Ser. No. 10/822,392 filed Apr. 12, 2004 (now abandoned), which is a continuation of U.S. application Ser. No. 10/084,272 filed Feb. 27, 2002, now U.S. Pat. No. 6,719,443, issued Apr. 13, 2004, all of which are incorporated herein by reference in their entirety. This application is also related to U.S. application Ser. No. 14/152,430 filed on Jan. 10, 2014, now U.S. Pat. No. 8,858,043 issued Oct. 14, 2014, which is also a continuation of U.S. application Ser. No. 14/055,544.

**FEDERALLY SPONSORED RESEARCH OR  
DEVELOPMENT**

[Not Applicable]

**MICROFICHE/COPYRIGHT REFERENCE**

[Not Applicable]

**BACKGROUND OF THE INVENTION**

This invention relates to an electrically illuminated flame simulator. Particularly, the invention relates to decorative candles, fire logs, or other devices which may be illuminated so as to produce a flickering flame effect. The flame simulator of the invention would typically be electrically powered by batteries, either disposable or rechargeable, but may also be powered through a regular AC outlet, with or without an AC adaptor.

Candles, fire logs, specially created street lights and other devices which may be used, for example, on clothing, cycles or other products are commonly available and valued for their effect. However, in many instances, where candles, fire logs or related lighting fixtures are used, the lighting, produced is from a flame which may typically burn in an oil container, wax candle or the like. There are, of course, natural hazards associated with such a device, since they may result in fire accidents which, if unattended or not properly controlled, can produce extensive damage, smoke or pollution.

The invention therefore utilizes the concept of such decorative elements, but uses, instead of a flame, an electrically illuminated flame simulator which is programmed to

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operate so that, when observed, is shown to produce a light-flickering effect which is the same as or similar to a burning candle, fire log or the like. However, the invention is not limited to devices such as candles and fire logs, and the electrically illuminated flame simulator of the invention can be used in a wide array of products and conditions, such as in ornamental or decorative street lights, in clothing such as belts, shoes and caps, greeting cards, or on bicycles, scooters and the like. Furthermore, the flickering effect of the flame simulator of the invention may be used to advantage as a hazard warning, such as on road hazard or emergency automobile lights.

Certain devices and methods are known which may have the effect of producing or simulating a real flame. For example, a single specially designed, unstable neon light bulb may be used. Such unstable neon bulbs, however, inherently produce an unnatural "jerky" flickering pattern that may not be easily controlled electronically, and must be operated by high voltage sources. At the least, this makes them generally unsuitable for battery operation. A further example can be found in a single incandescent light bulb whose light output may be modulated by varying the output of an AC or DC voltage source. Such incandescent light bulbs, however, are inherently limited in terms of flickering rate and effect due to retention of filament heat, and draw substantially more current than solid state light sources such as LED lights. Once more, this is not generally suitable for battery operation, at the least.

Where multiple light bulbs each switched on and off may be used for display and decorative purposes, there is an absence of the illusion of light movement characteristic of a flickering flame since the light bulbs are not switched or modulated in a manner which would generate light motion typical of that produced by a real flame.

Linear arrays of "traveling" or "chaser" lights are also known but these arrays are structured and controlled to generate the effect of a large magnitude of light motion in a linear direction, which is coincident with the linear array of such lights. Certainly, the effect produced by these linear arrays does not mimic the illusion of a flickering flame.

**BRIEF SUMMARY OF THE INVENTION**

In one aspect, the invention is for an electrically illuminated flame simulator. Preferably, the flame simulator of the invention is associated with an ornamental or decorative device, or with other devices such as hazard indicators. In one form, the flame simulator of the invention may constitute a part of an ornament or decoration such as a candle, fire log, or an indoor or outdoor lighting display, giving the appearance that the ornament is providing a natural flame. Other such decorative uses may make the flame simulator of the invention useful when associated with clothing, such as on belts or caps, greeting cards, or when incorporated into shoes.

When used as a hazard warning, the flame simulator of the invention may be used in conjunction with cycles or cycle clothing, or with road barriers, signs for warning motorists or as emergency lighting for vehicles.

In a preferred form, the electrically illuminated flame simulator is used with a decorative candle. The candle itself may be comprised of wax or other conventional materials from which candles are produced, or materials such as plastics which can emulate the look of a candle. The flame simulator of the invention would preferably be located within the candle body so that the flame simulator, when



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illuminated, can be seen not only from the top of the candle, but also as a glow or source of light emanating from within the candle.

According to another aspect of the invention, the flame simulator may also be used to provide an effect similar to that of a candle when used in a fake fire log intended to produce the effect of a natural burning log.

In one form, the flame simulator of the invention comprises at least two light sources, preferably four, such as light bulbs, which may be randomly, sequentially, or semi-randomly illuminated to produce a flickering and moving light effect to resemble a real flame, for example a flame provided by a burning candle. The light sources are preferably light-emitting diodes (LEDs), randomly or semi-randomly illuminated electronically.

In another embodiment, the flame simulator of the invention comprises a single non-filament (solid state) light source, such as an LED light bulb, liquid crystal display, or electro luminescent material, in which such light source is driven by a randomly or semi-randomly modulated voltage source to provide a flickering effect to resemble a real flame.

Further, in another aspect of the invention, the illuminated source producing the flame-flickering effect may be operated (namely, activated and deactivated) by externally produced, preselected sounds. Therefore, the electrically illuminated flame simulator of the invention may have associated therewith a microphone integrated as part of the electronics, so that sounds or different frequencies may be programmed to produce a given result, such as the switching on or switching off of the flame simulator.

The flame simulator of the invention may also incorporate other features, including motion detectors, light sensors and the like, so that any ornament or decoration incorporating the flame simulator of the invention will operate automatically, for example, when ambient light conditions reach a certain level, and/or when movement is detected within a specific range.

According to one aspect of the invention, there is provided an electrically powered flame simulator comprising: at least two light sources; an integrated circuit electrically connected to the light sources for intermittently, such as systematically, randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and a power source for providing power to the integrated circuit. Preferably, the a flame simulator comprises at least four light sources.

The flame simulator preferably includes a switch means for activating and deactivating the integrated circuit. The switch means may have three positions comprising an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time.

The flame simulator may further comprise a microphone connected to the integrated circuit wherein the microphone inputs preselected audio signals which are processed by the integrated circuit to switch the flame simulator between an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time. Preferably, the integrated circuit processes signals from the microphone having a higher frequency, such as those produced by a finger snap, to place the flame simulator in the on position and processes lower frequency signals, such as those produced by blowing, to place the flame simulator in the off position.

The integrated circuit may illuminate the light sources in a random or semi-random operation, in a preselected, pre-

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determined operation, and may function only when selected ambient sound or light conditions are present.

In one form, the flame simulator comprises a body in the shape of a candle in which the flame simulator is contained, the body having an upper end with a mounting means for receiving the integrated circuit and light sources and a chamber therein for receiving the power source.

Preferably, the light sources are light emitting diodes (LEDs). The integrated circuit may be mounted on a rigid base, or on a flexible base which can be shaped so as to conform to the shape of at least a portion of the candle to conserve space.

According to another aspect of the invention, there is provided a candle having an electrically powered flame simulator comprising: a candle body having an upper portion, a lower portion and a chamber therein; and a flame simulator having at least two light sources located near the upper portion of the candle body, an integrated circuit within the candle body and electrically connected to the light sources for intermittently, such as by randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source in the chamber of the candle body for providing power to the integrated circuit.

#### BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a schematic side view of a candle with the electrically illuminated flame simulator of the invention;

FIG. 2 is a front view of artificial fire logs incorporating a flame simulator of the invention;

FIG. 3 is a schematic side view, showing various components, of an artificial candle with flame simulator of the invention;

FIG. 4 is a top view of the candle shown in FIG. 3 of the drawings;

FIG. 5 is a bottom view of the candle shown in FIG. 3 of the drawings;

FIG. 6 is a schematic view of the flame simulator of the invention, shown independent of any decorative ornament with which it may be associated;

FIG. 7 is a circuit diagram showing the electronics in one embodiment of the flame simulator of the invention;

FIGS. 8a and 8b show another embodiment of the flame simulator of the invention standing alone, shown as a front view and top view respectively;

FIG. 9 shows a schematic side view of a candle with the electrically illuminated flame simulator of the invention as illustrated in FIG. 1, but with LED light sources which face upwards;

FIG. 10 shows schematically a single "birthday" type candle in accordance with the present invention; and

FIG. 11 shows schematically a greeting card in accordance with the present invention; and

FIG. 12 shows a block diagram of one embodiment of a single light source flame simulator of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

The invention is for a flame simulator which is powered electrically, and comprises a series of bulbs or LEDs which are illuminated randomly, semi-randomly or in a predetermined manner to provide the visual effect of a flickering

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flame. The device is preferably coupled to an ornament such as a candle or fire log to enhance this effect.

FIG. 1 of the drawings shows schematically a candle 12, generally of cylindrical shape having side wall 14, a base 16, and a top surface 18. The candle 12 comprises a hollowed out central portion 20, generally extending between the top surface 18 and the base 16, which, in the embodiment of FIG. 1, may accommodate a power source such as batteries 22. Near the top surface 18 there is located circuitry 24, the circuitry 24 being connected to LED light sources 26, four of which are shown in the embodiment in FIG. 1 of the drawings. The LED light sources 26 open into a chamber 28, generally formed between the top of the batteries 22 and the undersurface of the circuitry 24. In a variation, the LED light sources 26 may point upwardly.

The circuitry 24 further comprises a microphone 30, at least a portion of which is exposed and not embedded within the candle 12. The microphone 30 has an operative portion thereof exposed to the outside air and is capable of receiving and processing signals of various frequencies, as will be described, which are transmitted to and then processed by the circuitry 24, to activate the LED light sources 26 to provide a flickering flame effect.

At the lower end of the hollow central portion 20, electrical pins 32 are located, and these may be connectable to an electric source (not shown). Such pins 32 may be used for different purposes, such as for recharging the batteries 22 when they are of rechargeable type, or for providing power directly to the circuitry 24 and the LED light sources 26. The batteries could, of course, be disposable, and, in a further variation, the candle 12 would be able to accommodate both disposable and rechargeable batteries.

Preferably, the candle 12 is cylindrically shaped, and may be comprised of wax or a synthetic material which provides a candle-like appearance. The candle 12 may be of desired color or a combination of colors, and may be translucent or opaque. The material of the candle 12 is chosen, and its thickness selected, so that the possibility exists for light from the LED light sources 26 to be viewed not only from the top surface 18 of the candle 12, but also through the body 34 of the candle, possibly in a muted or semi-transparent manner to provide a glowing effect.

As will be described below, the LED light sources 26 may be illuminated randomly, semi-randomly, or in a predetermined pattern. However, the overall purpose of illuminating the LED light sources 26 is to do so in such a way that the modulated illumination of each of the LED light sources provides an aesthetic flickering effect when illuminated in combination with the other LED light sources being similarly illuminated, so that the light and movement produced thereby emulates a natural candle flame.

With reference to FIG. 2 of the drawings, there is shown a pair of synthetic fire logs 40 and 42, which may be comprised of conventional materials known to those skilled in the art, and having ornamentation and design features thereon which look like real fire logs. In FIG. 2, which shows only one embodiment of the invention, the fire log 40 has two electric circuits 44 and 46, both of which are substantially identical to each other, and each of which may be powered by battery power source 48. An AC power source may be utilized in an alternative embodiment. The battery power source 48 is preferably contained within a specially hollowed out portion 50 of the fire log 40, and is placed electrically in contact with the circuitry 44 and/or 46 in a conventional manner, not shown in FIG. 2.

Associated with each of the electrical circuits 44 and 46 is a series of LED light sources 51. Each of the electrical

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circuits 44 and 46 may also include a microphone 52. The electrical circuits 44 and 46, together with their associated LED light sources 51 and microphone 52, operate in essentially the same manner as described with reference to FIG. 1 of the drawings. Thus, each of the LED light sources 51 in the array is activated to illuminate in a random or predetermined manner, so as to give off light at various points along the fire log 40 to provide the effect that the fire log 40 is glowing, or that flames are burning thereon.

Reference is now made to FIG. 3 of the drawings which shows, in side view, a diagrammatic representation of one embodiment of an ornamental candle incorporating the flame simulator of the invention. Where applicable, reference numerals will be used corresponding to those in FIG. 1 of the drawings. In FIG. 3, the candle 12 comprises side wall 14, a base 16, and a top wall 18. These various walls of the candle 12 define a candle body 34.

In the lower half of the candle 12, there is formed a hollow chamber 60 adapted to receive three batteries 62, 64 and 66, which form a battery or power pack. The chamber 60, at an upper portion thereof, leads into a wire channel 68 extending therefrom towards the circuits and light sources above, which will be described.

The chamber 60 is accessed through a removable cover plate 70 near the base 16 of the candle. The batteries 62, 64 and 66 are connected to a power switch 72, contained within the chamber 60, the power switch 72 having a switch lever 74 which extends from within the chamber 60 to outside of the candle 12, through the cover plate 70. In this way, the user has manual access to and control of the switch lever 74 for activating or deactivating the candle 12.

At the base 16 of the candle 12, there is a recessed portion 76, the recessed portion 76 leading to the chamber 60, but, in normal usage, sealed from the chamber 60 by means of the cover plate 70.

At the upper end 78 of the candle 12, there is an upper recess 80 leading into a LED chamber 82. A printed circuit board 84 or an integrated circuit mounted on a board 84 houses the electronics, one embodiment of which is described below, for activating the candle 12. Attached to the PC board 84 are four LED light sources 26, which extend from the PC board 84 into the LED chamber 82. A microphone 30 extends upwardly from the PC board 84, into the upper recess 80. The PC board 84 is electrically connected to the power source of batteries 62, 64 and 66 through appropriate electrical connectors which extend through the wire channel 68.

FIG. 6 shows, schematically, a flame simulator 90 independent of the body or ornament on which it may be mounted, including an integrated circuit 92, an arm 94 extending therefrom which supports or contains conductors, preferably flexible conductors, and a support plate 96 at the end of arm 94 which can be arranged at an angle to the arm 94, as required. The support plate 96 includes a microphone 98 and LEDs 100. The integrated circuit 92 is powered by a power source, indicated generally at 102.

With reference to FIG. 7 of the drawings a preferred circuit diagram showing some of the electronics and operation of the equipment is described.

The heart of the system is the integrated circuit IC1 connected to a number of LEDs, LD1-LD4. IC1 systematically or randomly or semi-randomly, at the designer's choice, turns on and off the LEDs simulating the flickering of the candle 12.

Power is applied to all electronic circuitry, where indicated by "VCC", by operation of a switch S1. The switch S1 has three positions: "on"; "off"; and "timed". In the "on"

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position of switch S1, the integrated circuit IC1 operates in a continuous mode after enablement, and stops only when commanded to do so by the user. That is, in this mode, operation starts and stops under remote control by the user, as explained below. In the “off” position of switch S1, the entire system is shut down, since switch S1 disconnects the battery from VCC. In the “timed” position of the switch S1, after starting operation, the integrated circuit IC1 stops operation automatically after a predetermined time has passed.

In the “on” position of switch S1, typically at least 3 volts (2×1.5V) from the batteries is routed through the switch S1 and applied to all circuitry requiring VCC. All circuit points designated “GND” are connected together representing ground potential for the system. Ground potential (GND) is not switched by the switch S1, except in the “on” position of the switch S1, when GND is applied to a pin 17 of the IC1 to set the functional operation of the IC1 in a continuous mode of operation until a “stop” signal is received on the pin 18 to cease its operation. In the “timed” position of S1, VCC is applied to the pin 17 of the IC1, causing an internal timer in the IC1 to time out and stop operation of the IC1 after a predetermined delay time, e.g., three hours.

In the “on” position of the switch S1, all circuits are powered and in a standby mode, defining an initial quiescent state for the IC1 in which none of the LEDs LD1-LD4 are lit. However, upon the occurrence of a high frequency sound at the microphone MIC1, such as a hand clap or finger snap, a signal is generated at the output of the microphone MIC1 and applied to the + terminal of an operational amplifier IC2A. The IC2A amplifies the sharp sound sensed by the microphone MIC1, and applies the amplified output signal simultaneously to the + input of an IC3A and to the – input of the IC3B, which enables IC1 to begin modulating the LEDs to produce the flickering effect. The circuit may be modified to respond to different frequency signals without altering the principles of the present invention.

R1, C3, R5; C4, C5, R2, R4; R11; and R7, R8 are coupling, frequency compensation, feedback, and biasing components, the functions and operations of which are familiar to a skilled worker and therefore need not be further described in detail herein. C2 and R6 define a high-pass filter, while R10, C1, and R3 define a low-pass filter arrangement.

In the presence of a sharp, high frequency sound input to the microphone MIC1, high frequency signal components are present at the output of the IC2A, which signal components are passed on only to the – terminal of the IC3B through the high-pass filter C2, R6, i.e., the high frequency signal from the IC2A is blocked from reaching the + terminal of the IC3A due to the presence of the low-pass filter R10, C1, R3.

Thus, the IC3B amplifies its input signal and sends it to a pin 4 of the IC1 as a “start” pulse, initiating the operation of the IC1. When in an operational mode, the IC1, either systematically (e.g., sequentially) or randomly, applies power sufficient to light the LEDs LD1-LD4 individually via pins 6 and 13 for LD1, via pins 7 and 12 for LD2, via pins 8 and 11 for LD3, and via pins 9 and 10 for LD4.

In the “on” switch setting, this condition will continue until the switch S1 is moved to the “off” position, or until a low frequency sound, such as that made by blowing or making a thud-like sound near the microphone MIC1, is sensed by the microphone MIC1.

In the presence of a low frequency sound input to the microphone MIC1, low frequency signal components are present at the output of the IC2A, which signal components

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are passed on only to the + terminal of the IC3A through the low-pass filter R10, C1, R3, i.e., the low frequency signal from the IC2A is blocked from reaching the – terminal of the IC3B due to the presence of high-pass filter C2, R6.

Thus, the IC3A amplifies its input signal and sends it to a pin 18 of the IC1 as a “stop” pulse, ceasing the operation of the IC1, at which time, the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1. As previously explained, other frequency sounds may be selected to control various functions including on and off functions.

When the switch S1 is moved to the “timed” position, starting the operation of the IC1 is accomplished in the same manner as described above, i.e., by the sensing of a high frequency sound present at the microphone MIC1. However, in the “timed” mode, VCC is applied to the pin 17 of the IC1 through the switch S1. This VCC potential on the pin 17 sets an internal timer to run for the aforementioned predetermined delay time, after which the operation of the IC1 is automatically terminated, and the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1.

It is to be understood that the circuit diagram of FIG. 7 depicts a preferred embodiment for the electronics of the invention, and that other functions may be employed by either reconfiguring the connections to the IC1 and/or by the use of additional, or other, electronic components. Examples of variations of the described circuit would be apparent to a person of ordinary skill in the art. For example, the switch S1 could be modified, or a separate switch could be provided, to operate a modified electronic system in yet another mode in which the microphone MIC1 is disconnected from the system, and starting and stopping operation of the IC1 is accomplished solely by manual control. As another example, the delay for a timed stop could be made selectable with only minor modification of the circuit diagram and the provision of a manual delay time control device.

In FIGS. 8a and 8b there is shown a further embodiment of a circuit board 104, which is arcuate in order to conform with the shape of a battery around which it may be located as a space-saving technique. An arm 106 (or simply wires which are flexible and may be in flexible tubing) preferably extends upwardly or away from the printed circuit board and circuitry 104, and terminates in a support plate 110 substantially at right angles to the arm 106. The plate 110 supports the microphone 108 and LED light sources which would be located, in use, near the upper portion of a candle.

FIG. 9 shows a view of a candle very similar to that illustrated in FIG. 1 of the drawings, but with the light sources 26 pointing upwardly for a slightly different effect. FIG. 10 shows schematically a “birthday” type candle 120 having a battery area 122, a circuit 124 and an LED 126. LED 126 may be substituted by an alternative form of light without altering the principles of the present invention.

A greeting card 130 is illustrated in FIG. 11 and includes a printed candle 132 having an LED light source 134 thereabove which is operated by a circuit 136 to which it is connected by embedded wires 138. A power source 140 is also provided.

The circuit board may be comprised of a flexible material so that its shape can be easily manipulated to fit the space in which it is to be mounted. The circuit board can be connected to the LED light sources through any appropriate electrical connection means so that it can be distanced therefrom, and this also functions as a space-saving technique for confining and mounting the electronics into smaller spaces.

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In a preferred embodiment of the invention, there are at least two light bulbs, although more (such as four) are preferable, powered by randomly or sequentially generated voltage sources to produce the flickering effect. In a preferred embodiment, at least two pairs of output ports of a micro-controller may be programmed to provide a seven-segment LED/LCD 12-hour time clock multiplex function. An audio signal is processed, in one embodiment, by a high-frequency filtering circuit, the output of which provides a power-on signal which is responsive to a finger snap, handclap or the like, as described with reference to FIG. 7. Further, the audio signal may be processed by a low-frequency filtering circuit, the output of which provides a power-off signal, which is responsive to, for example, a blowing sound.

A mode switch or remote control device may be employed to select between the modes of power-off, power-on or power-on with various microphone functions, or power-on for a predetermined period of time.

Another preferred feature of the invention may include the use of LED-type light bulbs, generally in the manner described above, wherein such light bulbs radiate light in a non-parallel and substantially downward direction, so as to illuminate a translucent candle body, as briefly referenced in the description of FIG. 1 of the drawings. Incandescent or neon light bulbs may substitute one or more of the LED light bulbs, and non-micro controller circuitry may be used.

The two light bulbs may be operated by at least two voltage sources, where a voltage source is randomly generated, semi-randomly generated, or sequentially generated, thereby producing the flickering flame and moving light effect.

The flame simulator of the invention may have a signal produced by a microphone and microphone amplifier which triggers the modulated voltage sources into power on and power off states alternately. Frequency equalization may be applied to the amplifier such as to favor high frequency sounds (such as a finger snap or hand clap) in triggering the power on state, and the frequency equalization may also be applied to the amplifier such as to favor low frequency sounds (such as blowing air) in triggering the power off state. Preferably, at least one of the light bulbs radiates light into or from a translucent candle body, and any two such light bulbs may radiate light in directions that are parallel or non-parallel to one another.

The invention is not limited to the precise details, and variations of the particular electronics and circuitry, as well as the ornaments or devices to which they may be attached, may vary within the disclosure herein. Further, additional features may form part of the invention. For example, a light sensor device may be associated and electrically connected to the circuitry of the invention. The light sensor senses the level of ambient light and may switch on the flame simulator, or place it in a mode receptive to audio signals as described above, only when light levels drop below a pre-selected intensity. In this way, the flame simulator of the invention would only operate during darker periods or in darker environments.

The invention may also include a motion detector associated therewith and electrically connected with the circuitry of the flame simulator of the invention. The inclusion of

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motion detector sensors would confine operation of the flame simulator of the invention to periods of time when movement, such as that made by people in the vicinity, is present and thereby save power by in operation when motion is not detected. Another option would be to incorporate heat sensors to restrict operation of the flame simulator to conditions when temperatures drop below or move above pre-selected levels.

The invention claimed is:

1. A flameless candle having an electrically powered flame simulator, the flameless candle comprising:

a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and at least one chamber within the cylindrical body below the recess, wherein the substantially cylindrical body is self-supporting on the lower surface;

a flame simulator comprising at least one light source, wherein the at least one light source is located within the at least one chamber and in an upper region of the candle;

a circuit electrically connected to the flame simulator configured to illuminate the flame simulator;

a power source housed in the at least one chamber and configured to provide power to the circuit; and

a protruding component extending upwardly from the recess, wherein light emanating from the at least one light source projects onto the protruding component.

2. The flameless candle of claim 1, wherein the at least one light source is pointed upwardly.

3. The flameless candle of claim 1, further comprising an ON/OFF/TIMER switch, wherein the circuit controls the at least one light source for a pre-determined period of time when the switch is set to the TIMER position.

4. The flameless candle of claim 1, wherein the at least one light source comprises a plurality of light sources.

5. The flameless candle of claim 4, wherein the circuit is configured to illuminate the at least one light source so as to cause a flickering effect.

6. The flameless candle of claim 5, wherein the circuit is configured to illuminate at least one of the plurality of light sources independently of at least one other one of the plurality of light sources.

7. The flameless candle of claim 1, wherein the circuit is configured to illuminate the at least one light source so as to cause a flickering effect.

8. The flameless candle of claim 1, further comprising a microphone associated with the circuit, wherein the circuit is further configured to process audio sounds received by the microphone.

9. The flameless candle of claim 8, wherein the circuit is further configured to control the at least one light source in response to processing the audio sounds.

10. The flameless candle of claim 1, further comprising a motion detector configured to control the at least one light source in response to a detection of motion.

\* \* \* \* \*

# EXHIBIT 6



(12) **United States Patent**  
**Gutstein et al.**

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(45) **Date of Patent:** **\*Oct. 14, 2014**

(54) **ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR**

**H05B 37/0236** (2013.01); **F21S 9/022**  
(2013.01); **Y10S 362/812** (2013.01)

USPC ..... **362/392**; 362/161; 362/800; 362/812

(71) Applicant: **Winvic Sales Inc.**, Markham (CA)

(58) **Field of Classification Search**

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See application file for complete search history.

(72) Inventors: **Robert A. Gutstein**, Calabasas, CA  
(US); **Monita Liu**, Calabasas, CA (US)

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(73) Assignee: **Winvic Sales Inc.**, Markham, Ontario  
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(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
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This patent is subject to a terminal dis-  
claimer.

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(63) Continuation of application No. 14/055,544, filed on  
Oct. 16, 2013, which is a continuation of application

*Primary Examiner* — Meghan Dunwiddie

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Malloy, Ltd.

(Continued)

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**ABSTRACT**

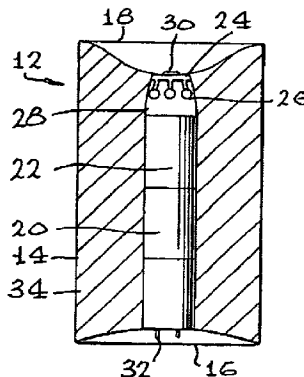
(51) **Int. Cl.**  
**F21V 21/00** (2006.01)  
**F21S 10/04** (2006.01)

An electrically powered flame simulator comprises at least  
two light sources, an integrated circuit electrically connected  
to the light sources for intermittently illuminating at least one  
of the light sources independently of other light sources such  
that the light sources together provide the effect of a flickering  
movement, and a power source for providing power to the  
integrated circuit. The flame simulator may be mounted in a  
decorative or ornamental device such as a candle or fire log, or  
used on decorative clothing, or may be part of a hazard or  
warning system. One or more solid state light sources may  
also be used.

(Continued)

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**2121/00** (2013.01); **F21V 23/0442** (2013.01);  
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(2013.01); **Y10S 362/80** (2013.01); **F21S 6/001**  
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**2101/02** (2013.01); **F21V 33/0028** (2013.01);

**16 Claims, 3 Drawing Sheets**



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**Related U.S. Application Data**

No. 13/449,100, filed on Apr. 17, 2012, now Pat. No. 8,562,186, which is a continuation of application No. 12/927,645, filed on Nov. 19, 2010, now Pat. No. 8,157,425, which is a continuation of application No. 12/586,933, filed on Sep. 30, 2009, now abandoned, which is a continuation of application No. 12/284,986, filed on Sep. 26, 2008, now abandoned, which is a continuation of application No. 11/881,303, filed on Jul. 26, 2007, now abandoned, which is a continuation of application No. 11/494,812, filed on Jul. 28, 2006, now abandoned, which is a continuation of application No. 10/822,392, filed on Apr. 12, 2004, now abandoned, which is a continuation of application No. 10/084,272, filed on Feb. 27, 2002, now Pat. No. 6,719,443.

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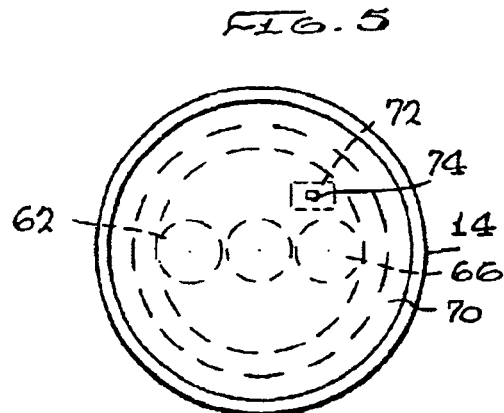
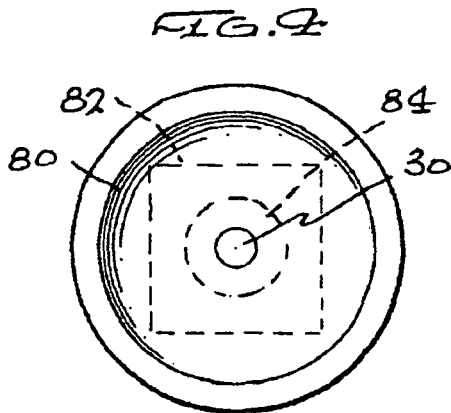
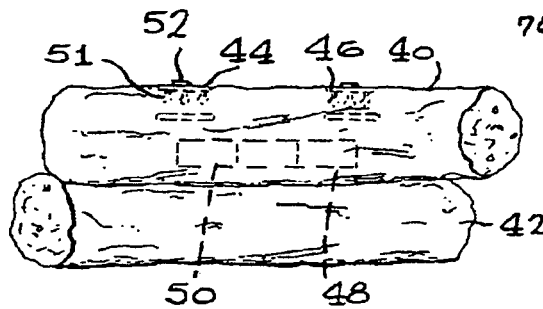
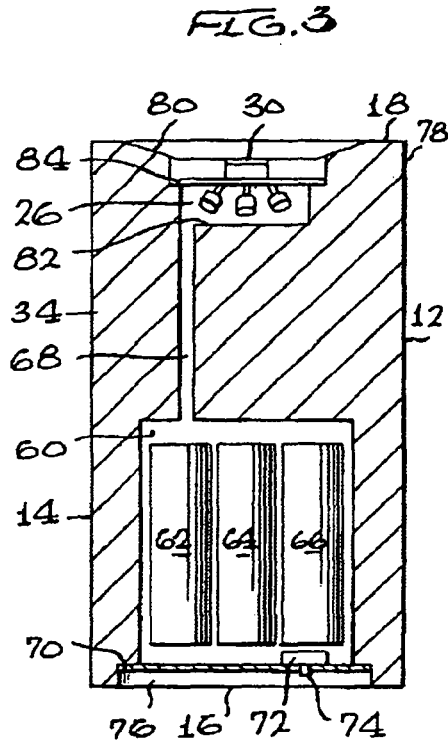
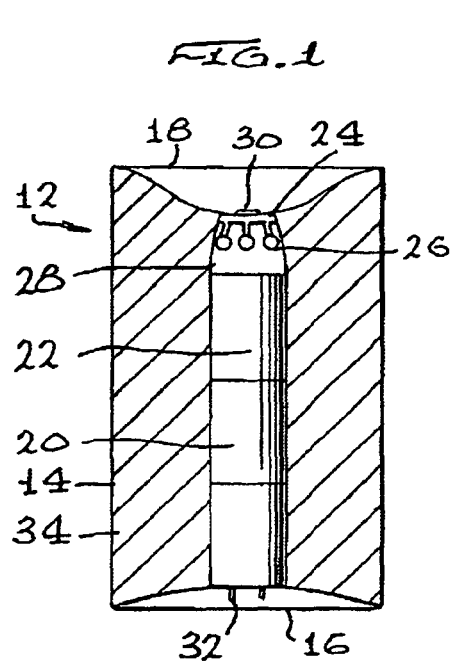
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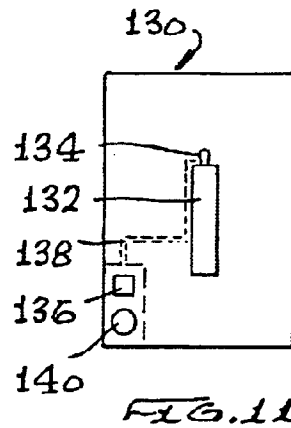
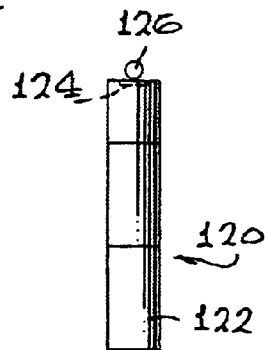
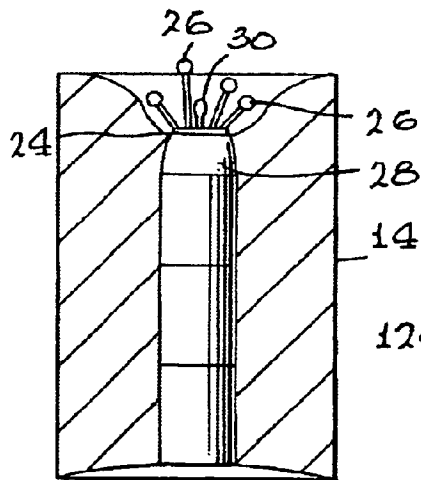
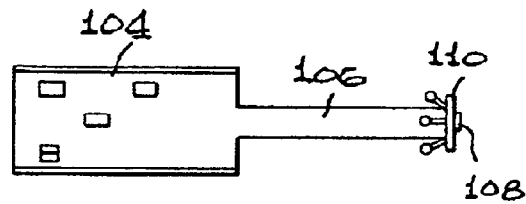
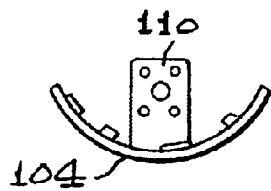
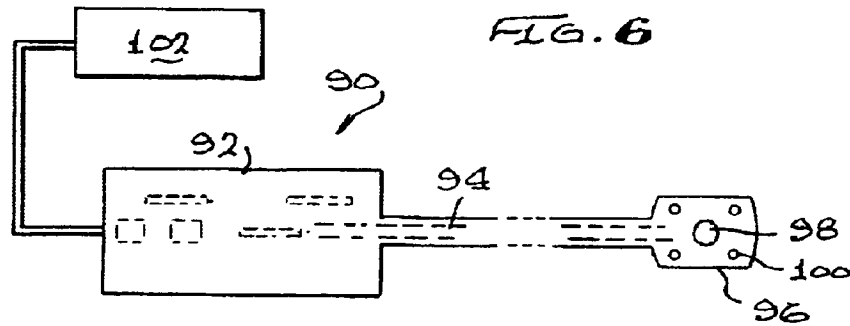
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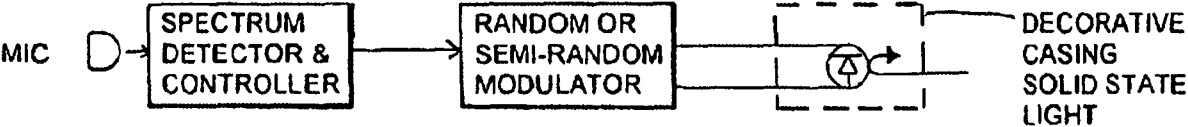
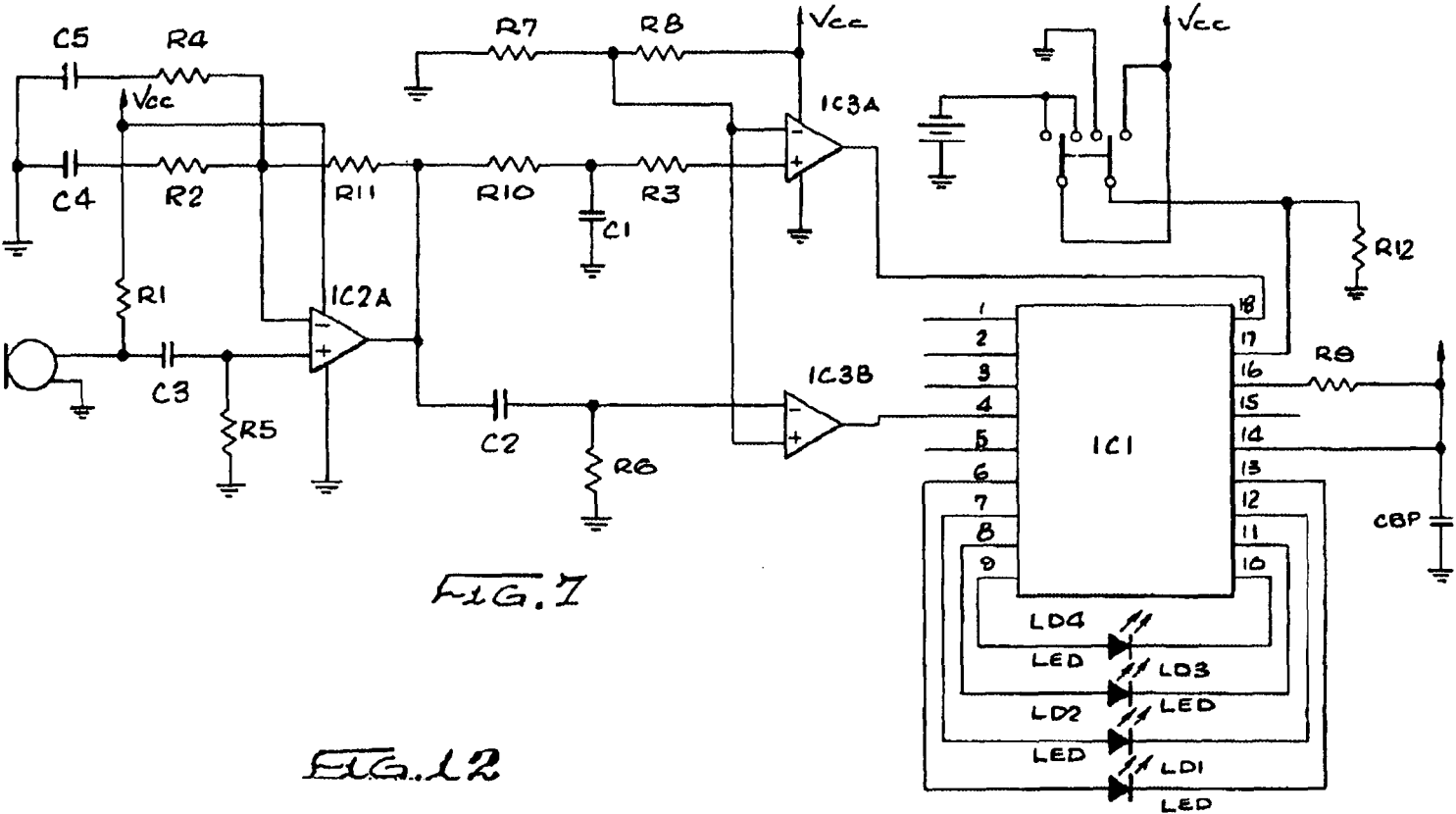
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**ELECTRICALLY ILLUMINATED FLAME  
SIMULATOR****RELATED APPLICATIONS**

This application is a continuation of U.S. application Ser. No. 14/055,544 filed Oct. 16, 2013, which is a continuation of U.S. application Ser. No. 13/449,100 filed Apr. 17, 2012, now U.S. Pat. No. 8,562,186, which is a continuation of U.S. application Ser. No. 12/927,645 filed Nov. 19, 2010, now U.S. Pat. No. 8,157,425, which is a continuation of U.S. application Ser. No. 12/586,933 filed Sep. 30, 2009, (now abandoned), which is a continuation of U.S. application Ser. No. 12/284,986 filed Sep. 26, 2008 (now abandoned), which is a continuation of U.S. application Ser. No. 11/881,303, filed Jul. 26, 2007 (now abandoned), which is a continuation of U.S. application Ser. No. 11/494,812 filed Jul. 28, 2006 (now abandoned), which is a continuation of U.S. application Ser. No. 10/822,392 filed Apr. 12, 2004 (now abandoned), which is a continuation of U.S. application Ser. No. 10/084,272 filed Feb. 27, 2002, now U.S. Pat. No. 6,719,443, all of which are incorporated herein by reference in their entirety.

**FEDERALLY SPONSORED RESEARCH OR  
DEVELOPMENT**

[Not Applicable]

**MICROFICHE/COPYRIGHT REFERENCE**

[Not Applicable]

**BACKGROUND OF THE INVENTION**

This invention relates to an electrically illuminated flame simulator. Particularly, the invention relates to decorative candles, fire logs, or other devices which may be illuminated so as to produce a flickering flame effect. The flame simulator of the invention would typically be electrically powered by batteries, either disposable or rechargeable, but may also be powered through a regular AC outlet, with or without an AC adaptor.

Candles, fire logs, specially created street lights and other devices which may be used, for example, on clothing, cycles or other products are commonly available and valued for their effect. However, in many instances, where candles, fire logs or related lighting fixtures are used, the lighting, produced is from a flame which may typically burn in an oil container, wax candle or the like. There are, of course, natural hazards associated with such a device, since they may result in fire accidents which, if unattended or not properly controlled, can produce extensive damage, smoke or pollution.

The invention therefore utilizes the concept of such decorative elements, but uses, instead of a flame, an electrically illuminated flame simulator which is programmed to operate so that, when observed, is shown to produce a light-flickering effect which is the same as or similar to a burning candle, fire log or the like. However, the invention is not limited to devices such as candles and fire logs, and the electrically illuminated flame simulator of the invention can be used in a wide array of products and conditions, such as in ornamental or decorative street lights, in clothing such as belts, shoes and caps, greeting cards, or on bicycles, scooters and the like. Furthermore, the flickering effect of the flame simulator of the invention may be used to advantage as a hazard warning, such as on road hazard or emergency automobile lights.

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Certain devices and methods are known which may have the effect of producing or simulating a real flame. For example, a single specially designed, unstable neon light bulb may be used. Such unstable neon bulbs, however, inherently produce an unnatural "jerky" flickering pattern that may not be easily controlled electronically, and must be operated by high voltage sources. At the least, this makes them generally unsuitable for battery operation. A further example can be found in a single incandescent light bulb whose light output may be modulated by varying the output of an AC or DC voltage source. Such incandescent light bulbs, however, are inherently limited in terms of flickering rate and effect due to retention of filament heat, and draw substantially more current than solid state light sources such as LED lights. Once more, this is not generally suitable for battery operation, at the least.

Where multiple light bulbs each switched on and off may be used for display and decorative purposes, there is an absence of the illusion of light movement characteristic of a flickering flame since the light bulbs are not switched or modulated in a manner which would generate light motion typical of that produced by a real flame.

Linear arrays of "traveling" or "chaser" lights are also known but these arrays are structured and controlled to generate the effect of a large magnitude of light motion in a linear direction, which is coincident with the linear array of such lights. Certainly, the effect produced by these linear arrays does not mimic the illusion of a flickering flame.

**BRIEF SUMMARY OF THE INVENTION**

In one aspect, the invention is for an electrically illuminated flame simulator. Preferably, the flame simulator of the invention is associated with an ornamental or decorative device, or with other devices such as hazard indicators. In one form, the flame simulator of the invention may constitute a part of an ornament or decoration such as a candle, fire log, or an indoor or outdoor lighting display, giving the appearance that the ornament is providing a natural flame. Other such decorative uses may make the flame simulator of the invention useful when associated with clothing, such as on belts or caps, greeting cards, or when incorporated into shoes.

When used as a hazard warning, the flame simulator of the invention may be used in conjunction with cycles or cycle clothing, or with road barriers, signs for warning motorists or as emergency lighting for vehicles.

In a preferred form, the electrically illuminated flame simulator is used with a decorative candle. The candle itself may be comprised of wax or other conventional materials from which candles are produced, or materials such as plastics which can emulate the look of a candle. The flame simulator of the invention would preferably be located within the candle body so that the flame simulator, when illuminated, can be seen not only from the top of the candle, but also as a glow or source of light emanating from within the candle.

According to another aspect of the invention, the flame simulator may also be used to provide an effect similar to that of a candle when used in a fake fire log intended to produce the effect of a natural burning log.

In one form, the flame simulator of the invention comprises at least two light sources, preferably four, such as light bulbs, which may be randomly, sequentially, or semi-randomly illuminated to produce a flickering and moving light effect to resemble a real flame, for example a flame provided by a burning candle. The light sources are preferably light-emitting diodes (LEDs), randomly or semi-randomly illuminated electronically.

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In another embodiment, the flame simulator of the invention comprises a single non-filament (solid state) light source, such as an LED light bulb, liquid crystal display, or electro luminescent material, in which such light source is driven by a randomly or semi-randomly modulated voltage source to provide a flickering effect to resemble a real flame.

Further, in another aspect of the invention, the illuminated source producing the flame-flickering effect may be operated (namely, activated and deactivated) by externally produced, preselected sounds. Therefore, the electrically illuminated flame simulator of the invention may have associated therewith a microphone integrated as part of the electronics, so that sounds or different frequencies may be programmed to produce a given result, such as the switching on or switching off of the flame simulator.

The flame simulator of the invention may also incorporate other features, including motion detectors, light sensors and the like, so that any ornament or decoration incorporating the flame simulator of the invention will operate automatically, for example, when ambient light conditions reach a certain level, and/or when movement is detected within a specific range.

According to one aspect of the invention, there is provided an electrically powered flame simulator comprising: at least two light sources; an integrated circuit electrically connected to the light sources for intermittently, such as systematically, randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and a power source for providing power to the integrated circuit. Preferably, the a flame simulator comprises at least four light sources.

The flame simulator preferably includes a switch means for activating and deactivating the integrated circuit. The switch means may have three positions comprising an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time.

The flame simulator may further comprise a microphone connected to the integrated circuit wherein the microphone inputs preselected audio signals which are processed by the integrated circuit to switch the flame simulator between an on position, an off position, and an on-timed position where the flame simulator will remain activated for a predetermined length of time. Preferably, the integrated circuit processes signals from the microphone having a higher frequency, such as those produced by a finger snap, to place the flame simulator in the on position and processes lower frequency signals, such as those produced by blowing, to place the flame simulator in the off position.

The integrated circuit may illuminate the light sources in a random or semi-random operation, in a preselected, predetermined operation, and may function only when selected ambient sound or light conditions are present.

In one form, the flame simulator comprises a body in the shape of a candle in which the flame simulator is contained, the body having an upper end with a mounting means for receiving the integrated circuit and light sources and a chamber therein for receiving the power source.

Preferably, the light sources are light emitting diodes (LEDs). The integrated circuit may be mounted on a rigid base, or on a flexible base which can be shaped so as to conform to the shape of at least a portion of the candle to conserve space.

According to another aspect of the invention, there is provided a candle having an electrically powered flame simulator comprising: a candle body having an upper portion, a lower portion and a chamber therein; and a flame simulator having

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at least two light sources located near the upper portion of the candle body, an integrated circuit within the candle body and electrically connected to the light sources for intermittently, such as by randomly or semi-randomly, illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement, and a power source in the chamber of the candle body for providing power to the integrated circuit.

#### BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a schematic side view of a candle with the electrically illuminated flame simulator of the invention;

FIG. 2 is a front view of artificial fire logs incorporating a flame simulator of the invention;

FIG. 3 is a schematic side view, showing various components, of an artificial candle with flame simulator of the invention;

FIG. 4 is a top view of the candle shown in FIG. 3 of the drawings;

FIG. 5 is a bottom view of the candle shown in FIG. 3 of the drawings;

FIG. 6 is a schematic view of the flame simulator of the invention, shown independent of any decorative ornament with which it may be associated;

FIG. 7 is a circuit diagram showing the electronics in one embodiment of the flame simulator of the invention;

FIGS. 8a and 8b show another embodiment of the flame simulator of the invention standing alone, shown as a front view and top view respectively;

FIG. 9 shows a schematic side view of a candle with the electrically illuminated flame simulator of the invention as illustrated in FIG. 1, but with LED light sources which face upwards;

FIG. 10 shows schematically a single "birthday" type candle in accordance with the present invention; and

FIG. 11 shows schematically a greeting card in accordance with the present invention; and

FIG. 12 shows a block diagram of one embodiment of a single light source flame simulator of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

The invention is for a flame simulator which is powered electrically, and comprises a series of bulbs or LEDs which are illuminated randomly, semi-randomly or in a predetermined manner to provide the visual effect of a flickering flame. The device is preferably coupled to an ornament such as a candle or fire log to enhance this effect.

FIG. 1 of the drawings shows schematically a candle 12, generally of cylindrical shape having side wall 14, a base 16, and a top surface 18. The candle 12 comprises a hollowed out central portion 20, generally extending between the top surface 18 and the base 16, which, in the embodiment of FIG. 1, may accommodate a power source such as batteries 22. Near the top surface 18 there is located circuitry 24, the circuitry 24 being connected to LED light sources 26, four of which are shown in the embodiment in FIG. 1 of the drawings. The LED light sources 26 open into a chamber 28, generally formed between the top of the batteries 22 and the undersurface of the circuitry 24. In a variation, the LED light sources 26 may point upwardly.

The circuitry 24 further comprises a microphone 30, at least a portion of which is exposed and not embedded within the candle 12. The microphone 30 has an operative portion thereof exposed to the outside air and is capable of receiving



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and processing signals of various frequencies, as will be described, which are transmitted to and then processed by the circuitry 24, to activate the LED light sources 26 to provide a flickering flame effect.

At the lower end of the hollow central portion 20, electrical pins 32 are located, and these may be connectable to an electric source (not shown). Such pins 32 may be used for different purposes, such as for recharging the batteries 22 when they are of rechargeable type, or for providing power directly to the circuitry 24 and the LED light sources 26. The batteries could, of course, be disposable, and, in a further variation, the candle 12 would be able to accommodate both disposable and rechargeable batteries.

Preferably, the candle 12 is cylindrically shaped, and may be comprised of wax or a synthetic material which provides a candle-like appearance. The candle 12 may be of desired color or a combination of colors, and may be translucent or opaque. The material of the candle 12 is chosen, and its thickness selected, so that the possibility exists for light from the LED light sources 26 to be viewed not only from the top surface 18 of the candle 12, but also through the body 34 of the candle, possibly in a muted or semi-transparent manner to provide a glowing effect.

As will be described below, the LED light sources 26 may be illuminated randomly, semi-randomly, or in a predetermined pattern. However, the overall purpose of illuminating the LED light sources 26 is to do so in such a way that the modulated illumination of each of the LED light sources provides an aesthetic flickering effect when illuminated in combination with the other LED light sources being similarly illuminated, so that the light and movement produced thereby emulates a natural candle flame.

With reference to FIG. 2 of the drawings, there is shown a pair of synthetic fire logs 40 and 42, which may be comprised of conventional materials known to those skilled in the art, and having ornamentation and design features thereon which look like real fire logs. In FIG. 2, which shows only one embodiment of the invention, the fire log 40 has two electric circuits 44 and 46, both of which are substantially identical to each other, and each of which may be powered by battery power source 48. An AC power source may be utilized in an alternative embodiment. The battery power source 48 is preferably contained within a specially hollowed out portion 50 of the fire log 40, and is placed electrically in contact with the circuitry 44 and/or 46 in a conventional manner, not shown in FIG. 2.

Associated with each of the electrical circuits 44 and 46 is a series of LED light sources 51. Each of the electrical circuits 44 and 46 may also include a microphone 52. The electrical circuits 44 and 46, together with their associated LED light sources 51 and microphone 52, operate in essentially the same manner as described with reference to FIG. 1 of the drawings. Thus, each of the LED light sources 51 in the array is activated to illuminate in a random or predetermined manner, so as to give off light at various points along the fire log 40 to provide the effect that the fire log 40 is glowing, or that flames are burning thereon.

Reference is now made to FIG. 3 of the drawings which shows, in side view, a diagrammatic representation of one embodiment of an ornamental candle incorporating the flame simulator of the invention. Where applicable, reference numerals will be used corresponding to those in FIG. 1 of the drawings. In FIG. 3, the candle 12 comprises side wall 14, a base 16, and a top wall 18. These various walls of the candle 12 define a candle body 34.

In the lower half of the candle 12, there is formed a hollow chamber 60 adapted to receive three batteries 62, 64 and 66,

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which form a battery or power pack. The chamber 60, at an upper portion thereof, leads into a wire channel 68 extending therefrom towards the circuits and light sources above, which will be described.

The chamber 60 is accessed through a removable cover plate 70 near the base 16 of the candle. The batteries 62, 64 and 66 are connected to a power switch 72, contained within the chamber 60, the power switch 72 having a switch lever 74 which extends from within the chamber 60 to outside of the candle 12, through the cover plate 70. In this way, the user has manual access to and control of the switch lever 74 for activating or deactivating the candle 12.

At the base 16 of the candle 12, there is a recessed portion 76, the recessed portion 76 leading to the chamber 60, but, in normal usage, sealed from the chamber 60 by means of the cover plate 70.

At the upper end 78 of the candle 12, there is an upper recess 80 leading into a LED chamber 82. A printed circuit board 84 or an integrated circuit mounted on a board 84 houses the electronics, one embodiment of which is described below, for activating the candle 12. Attached to the PC board 84 are four LED light sources 26, which extend from the PC board 84 into the LED chamber 82. A microphone 30 extends upwardly from the PC board 84, into the upper recess 80. The PC board 84 is electrically connected to the power source of batteries 62, 64 and 66 through appropriate electrical connectors which extend through the wire channel 68.

FIG. 6 shows, schematically, a flame simulator 90 independent of the body or ornament on which it may be mounted, including an integrated circuit 92, an arm 94 extending therefrom which supports or contains conductors, preferably flexible conductors, and a support plate 96 at the end of arm 94 which can be arranged at an angle to the arm 94, as required. The support plate 96 includes a microphone 98 and LEDs 100. The integrated circuit 92 is powered by a power source, indicated generally at 102.

With reference to FIG. 7 of the drawings a preferred circuit diagram showing some of the electronics and operation of the equipment is described.

The heart of the system is the integrated circuit IC1 connected to a number of LEDs, LD1-LD4. IC1 systematically or randomly or semi-randomly, at the designer's choice, turns on and off the LEDs simulating the flickering of the candle 12.

Power is applied to all electronic circuitry, where indicated by "VCC", by operation of a switch S1. The switch S1 has three positions: "on"; "off"; and "timed". In the "on" position of switch S1, the integrated circuit IC1 operates in a continuous mode after enablement, and stops only when commanded to do so by the user. That is, in this mode, operation starts and stops under remote control by the user, as explained below. In the "off" position of switch S1, the entire system is shut down, since switch S1 disconnects the battery from VCC. In the "timed" position of the switch S1, after starting operation, the integrated circuit IC1 stops operation automatically after a predetermined time has passed.

In the "on" position of switch S1, typically at least 3 volts (2×1.5V) from the batteries is routed through the switch S1 and applied to all circuitry requiring VCC. All circuit points designated "OND" are connected together representing ground potential for the system. Ground potential (GND) is not switched by the switch S1, except in the "on" position of the switch S1, when GND is applied to a pin 17 of the IC1 to set the functional operation of the IC1 in a continuous mode of operation until a "stop" signal is received on the pin 18 to cease its operation. In the "timed" position of S1, VCC is applied to the pin 17 of the IC1, causing an internal timer in



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the IC1 to time out and stop operation of the IC1 after a predetermined delay time, e.g., three hours.

In the “on” position of the switch S1, all circuits are powered and in a standby mode, defining an initial quiescent state for the IC1 in which none of the LEDs LD1-LD4 are lit. However, upon the occurrence of a high frequency sound at the microphone MIC1, such as a hand clap or finger snap, a signal is generated at the output of the microphone MIC1 and applied to the + terminal of an operational amplifier IC2A. The IC2A amplifies the sharp sound sensed by the microphone MIC1, and applies the amplified output signal simultaneously to the + input of an IC3A and to the – input of the IC3B, which enables IC1 to begin modulating the LEDs to produce the flickering effect. The circuit may be modified to respond to different frequency signals without altering the principles of the present invention.

R1, C3, R5; C4, C5, R2, R4; R11; and R7, R8 are coupling, frequency compensation, feedback, and biasing components, the functions and operations of which are familiar to a skilled worker and therefore need not be further described in detail herein. C2 and R6 define a high-pass filter, while R10, C1, and R3 define a low-pass filter arrangement.

In the presence of a sharp, high frequency sound input to the microphone MIC1, high frequency signal components are present at the output of the IC2A, which signal components are passed on only to the – terminal of the IC3B through the high-pass filter C2, R6, i.e., the high frequency signal from the IC2A is blocked from reaching the + terminal of the IC3A due to the presence of the low-pass filter R10, C1, R3.

Thus, the IC3B amplifies its input signal and sends it to a pin 4 of the IC1 as a “start” pulse, initiating the operation of the IC1. When in an operational mode, the IC1, either systematically (e.g., sequentially) or randomly, applies power sufficient to light the LEDs LD1-LD4 individually via pins 6 and 13 for LD1, via pins 7 and 12 for LD2, via pins 8 and 11 for LD3, and via pins 9 and 10 for LD4.

In the “on” switch setting, this condition will continue until the switch S1 is moved to the “off” position, or until a low frequency sound, such as that made by blowing or making a thud-like sound near the microphone MIC1, is sensed by the microphone MIC1.

In the presence of a low frequency sound input to the microphone MIC1, low frequency signal components are present at the output of the IC2A, which signal components are passed on only to the + terminal of the IC3A through the low-pass filter R10, C1, R3, i.e., the low frequency signal from the IC2A is blocked from reaching the – terminal of the IC3B due to the presence of high-pass filter C2, R6.

Thus, the IC3A amplifies its input signal and sends it to a pin 18 of the IC1 as a “stop” pulse, ceasing the operation of the IC1, at which time, the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1. As previously explained, other frequency sounds may be selected to control various functions including on and off functions.

When the switch S1 is moved to the “timed” position, starting the operation of the IC1 is accomplished in the same manner as described above, i.e., by the sensing of a high frequency sound present at the microphone MIC1. However, in the “timed” mode, VCC is applied to the pin 17 of the IC1 through the switch S1. This VCC potential on the pin 17 sets an internal timer to run for the aforementioned predetermined delay time, after which the operation of the IC1 is automatically terminated, and the circuitry is again returned to its quiescent state awaiting another high frequency sound in the vicinity of the microphone MIC1.

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It is to be understood that the circuit diagram of FIG. 7 depicts a preferred embodiment for the electronics of the invention, and that other functions may be employed by either reconfiguring the connections to the IC1 and/or by the use of additional, or other, electronic components. Examples of variations of the described circuit would be apparent to a person of ordinary skill in the art. For example, the switch S1 could be modified, or a separate switch could be provided, to operate a modified electronic system in yet another mode in which the microphone MIC1 is disconnected from the system, and starting and stopping operation of the IC1 is accomplished solely by manual control. As another example, the delay for a timed stop could be made selectable with only minor modification of the circuit diagram and the provision of a manual delay time control device.

In FIGS. 8a and 8b there is shown a further embodiment of a circuit board 104, which is arcuate in order to conform with the shape of a battery around which it may be located as a space-saving technique. An arm 106 (or simply wires which are flexible and may be in flexible tubing) preferably extends upwardly or away from the printed circuit board and circuitry 104, and terminates in a support plate 110 substantially at right angles to the arm 106. The plate 110 supports the microphone 108 and LED light sources which would be located, in use, near the upper portion of a candle.

FIG. 9 shows a view of a candle very similar to that illustrated in FIG. 1 of the drawings, but with the light sources 26 pointing upwardly for a slightly different effect. FIG. 10 shows schematically a “birthday” type candle 120 having a battery area 122, a circuit 124 and an LED 126. LED 126 may be substituted by an alternative form of light without altering the principles of the present invention.

A greeting card 130 is illustrated in FIG. 11 and includes a printed candle 132 having an LED light source 134 thereabove which is operated by a circuit 136 to which it is connected by embedded wires 138. A power source 140 is also provided.

The circuit board may be comprised of a flexible material so that its shape can be easily manipulated to fit the space in which it is to be mounted. The circuit board can be connected to the LED light sources through any appropriate electrical connection means so that it can be distanced therefrom, and this also functions as a space-saving technique for confining and mounting the electronics into smaller spaces.

In a preferred embodiment of the invention, there are at least two light bulbs, although more (such as four) are preferable, powered by randomly or sequentially generated voltage sources to produce the flickering effect. In a preferred embodiment, at least two pairs of output ports of a microcontroller may be programmed to provide a seven-segment LED/LCD 12-hour time clock multiplex function. An audio signal is processed, in one embodiment, by a high-frequency filtering circuit, the output of which provides a power-on signal which is responsive to a finger snap, handclap or the like, as described with reference to FIG. 7. Further, the audio signal may be processed by a low-frequency filtering circuit, the output of which provides a power-off signal, which is responsive to, for example, a blowing sound.

A mode switch or remote control device may be employed to select between the modes of power-off, power-on or power-on with various microphone functions, or power-on for a predetermined period of time.

Another preferred feature of the invention may include the use of LED-type light bulbs, generally in the manner described above, wherein such light bulbs radiate light in a non-parallel and substantially downward direction, so as to illuminate a translucent candle body, as briefly referenced in

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the description of FIG. 1 of the drawings. Incandescent or neon light bulbs may substitute one or more of the LED light bulbs, and non-micro controller circuitry may be used.

The two light bulbs may be operated by at least two voltage sources, where a voltage source is randomly generated, semi-randomly generated, or sequentially generated, thereby producing the flickering flame and moving light effect.

The flame simulator of the invention may have a signal produced by a microphone and microphone amplifier which triggers the modulated voltage sources into power on and power off states alternately. Frequency equalization may be applied to the amplifier such as to favor high frequency sounds (such as a finger snap or hand clap) in triggering the power on state, and the frequency equalization may also be applied to the amplifier such as to favor low frequency sounds (such as blowing air) in triggering the power off state. Preferably, at least one of the light bulbs radiates light into or from a translucent candle body, and any two such light bulbs may radiate light in directions that are parallel or non-parallel to one another.

The invention is not limited to the precise details, and variations of the particular electronics and circuitry, as well as the ornaments or devices to which they may be attached, may vary within the disclosure herein. Further, additional features may form part of the invention. For example, a light sensor device may be associated and electrically connected to the circuitry of the invention. The light sensor senses the level of ambient light and may switch on the flame simulator, or place it in a mode receptive to audio signals as described above, only when light levels drop below a pre-selected intensity. In this way, the flame simulator of the invention would only operate during darker periods or in darker environments.

The invention may also include a motion detector associated therewith and electrically connected with the circuitry of the flame simulator of the invention. The inclusion of motion detector sensors would confine operation of the flame simulator of the invention to periods of time when movement, such as that made by people in the vicinity, is present and thereby save power by in operation when motion is not detected. Another option would be to incorporate heat sensors to restrict operation of the flame simulator to conditions when temperatures drop below or move above pre-selected levels.

The invention claimed is:

1. A candle having an electrically powered flame simulator comprising:

a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and a chamber therein, wherein the substantially cylindrical body is self-supporting on the lower surface and has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;  
a flame simulator located substantially within the recess;  
a circuit electrically connected to the flame simulator for intermittently illuminating the flame simulator;

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a power source for providing power to the circuit; and  
a microphone associated with the circuit through which audio sounds can be processed.

2. The candle of claim 1, wherein the circuit comprises an integrated circuit configured to process a signal from the microphone.

3. The candle of claim 2, wherein the integrated circuit is configured to process audio sounds through the microphone.

4. The candle of claim 1, wherein at least a portion of the microphone is not embedded within the candle.

5. The candle of claim 1, wherein an operative portion of the microphone is exposed to outside air.

6. The candle of claim 1, wherein the microphone extends upwardly towards the recess.

7. The candle of claim 1, further comprising a switch that operates the candle in a mode in which the microphone is disconnected from the circuit.

8. The candle of claim 1, wherein the circuit is configured to intermittently illuminate the flame simulator to produce a flickering effect.

9. A candle having an electrically powered flame simulator comprising:

a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and a chamber therein, wherein the substantially cylindrical body is self-supporting on the lower surface and has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;  
a flame simulator located substantially within the recess;  
a circuit electrically connected to the flame simulator for illuminating the flame simulator;  
a power source for providing power to the circuit; and  
a microphone associated with the circuit so that sounds can be programmed.

10. The candle of claim 9, wherein the circuit comprises an integrated circuit configured to process a signal from the microphone.

11. The candle of claim 10, wherein the integrated circuit is configured to process audio sounds through the microphone.

12. The candle of claim 9, wherein at least a portion of the microphone is not embedded within the candle.

13. The candle of claim 9, wherein an operative portion of the microphone is exposed to outside air.

14. The candle of claim 9, wherein the microphone extends upwardly towards the recess.

15. The candle of claim 9, further comprising a switch that operates the candle in a mode in which the microphone is disconnected from the circuit.

16. The candle of claim 10, wherein the circuit is configured to intermittently illuminate the flame simulator to produce a flickering effect.

\* \* \* \* \*

# EXHIBIT 7

(12) **United States Patent**  
**Jensen et al.**

(10) **Patent No.:** **US 6,616,308 B2**  
(45) **Date of Patent:** **Sep. 9, 2003**

(54) **IMITATION CANDLE**

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(65) **Prior Publication Data**

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(51) **Int. Cl.**<sup>7</sup> ..... **F21V 11/00**

(52) **U.S. Cl.** ..... **362/351; 362/392; 362/190**

(58) **Field of Search** ..... **362/351, 392, 362/810, 800, 190**

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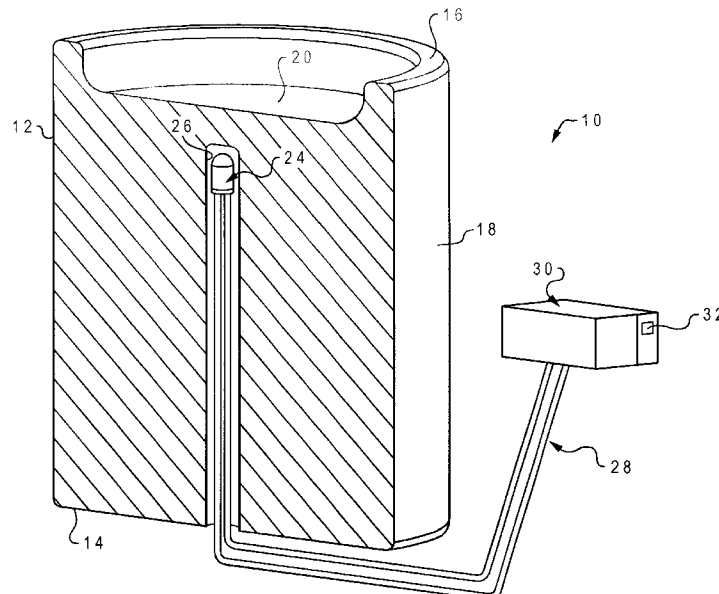
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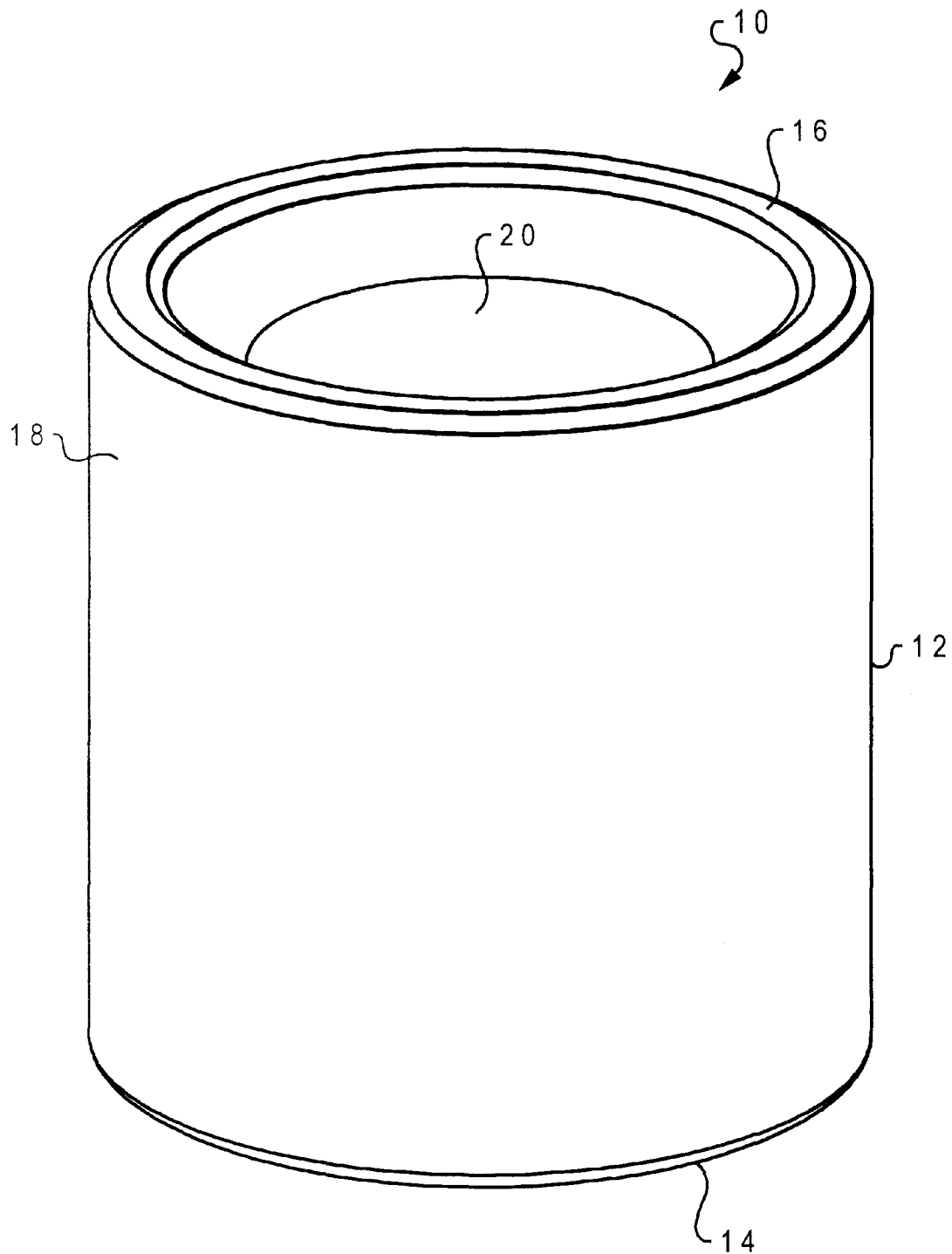
(74) *Attorney, Agent, or Firm*—Paul W. O'Malley; Susan L. Firestone

(57) **ABSTRACT**

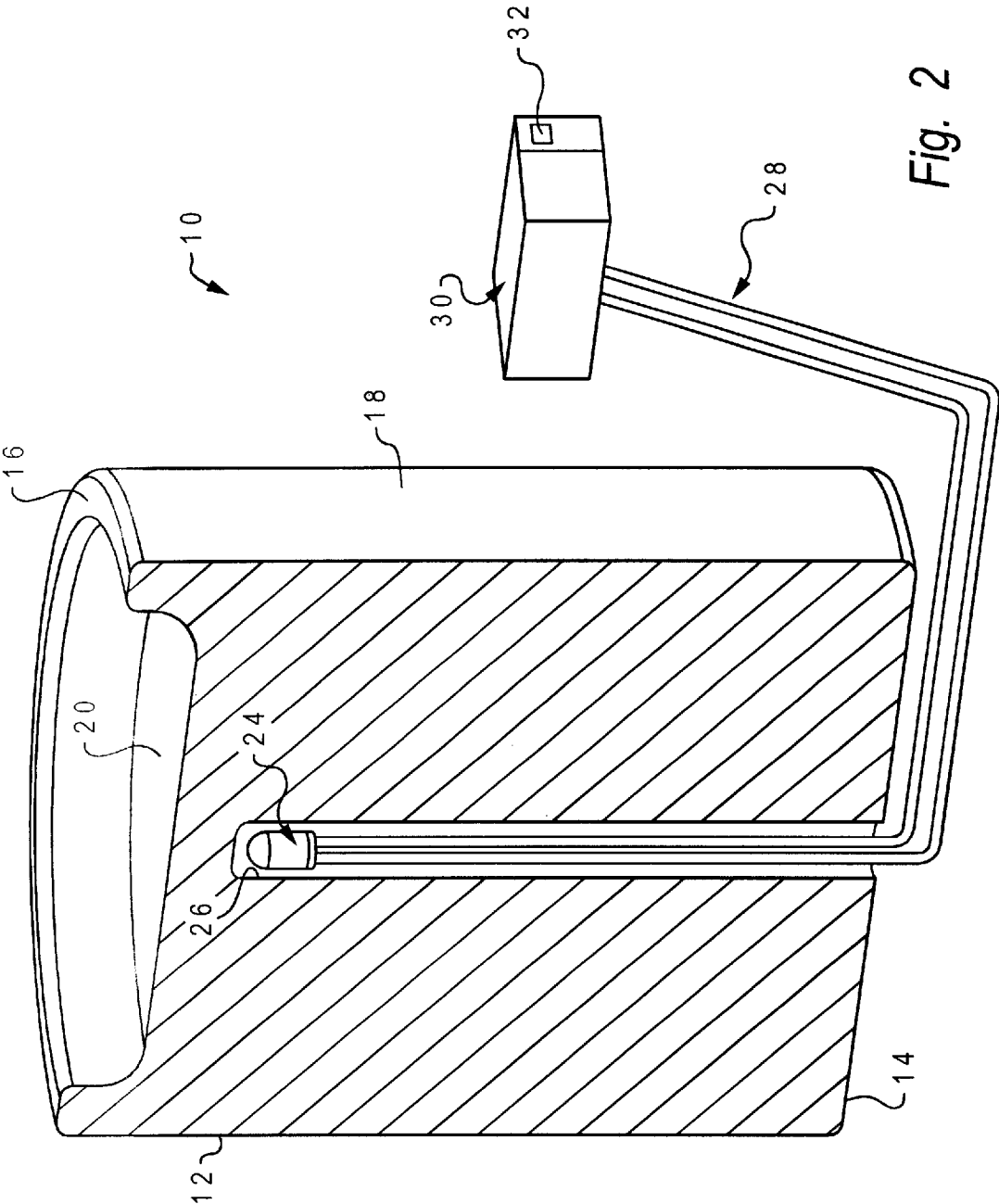
An imitation candle is made from a translucent material having light transmissive properties similar to paraffin. The imitation candle is shaped to appear reduced by burning. An LED, or similar high intensity light source, is set in a cavity within the imitation candle. The LED preferably produces amber light to better resemble the color of candle light. The imitation candle diffuses the light emitted from the LED to create a warm, natural looking glow. Light emission levels from the LED are varied in a pseudo-random manner to simulate the flicker of candle light.

**9 Claims, 4 Drawing Sheets**





*Fig. 1*



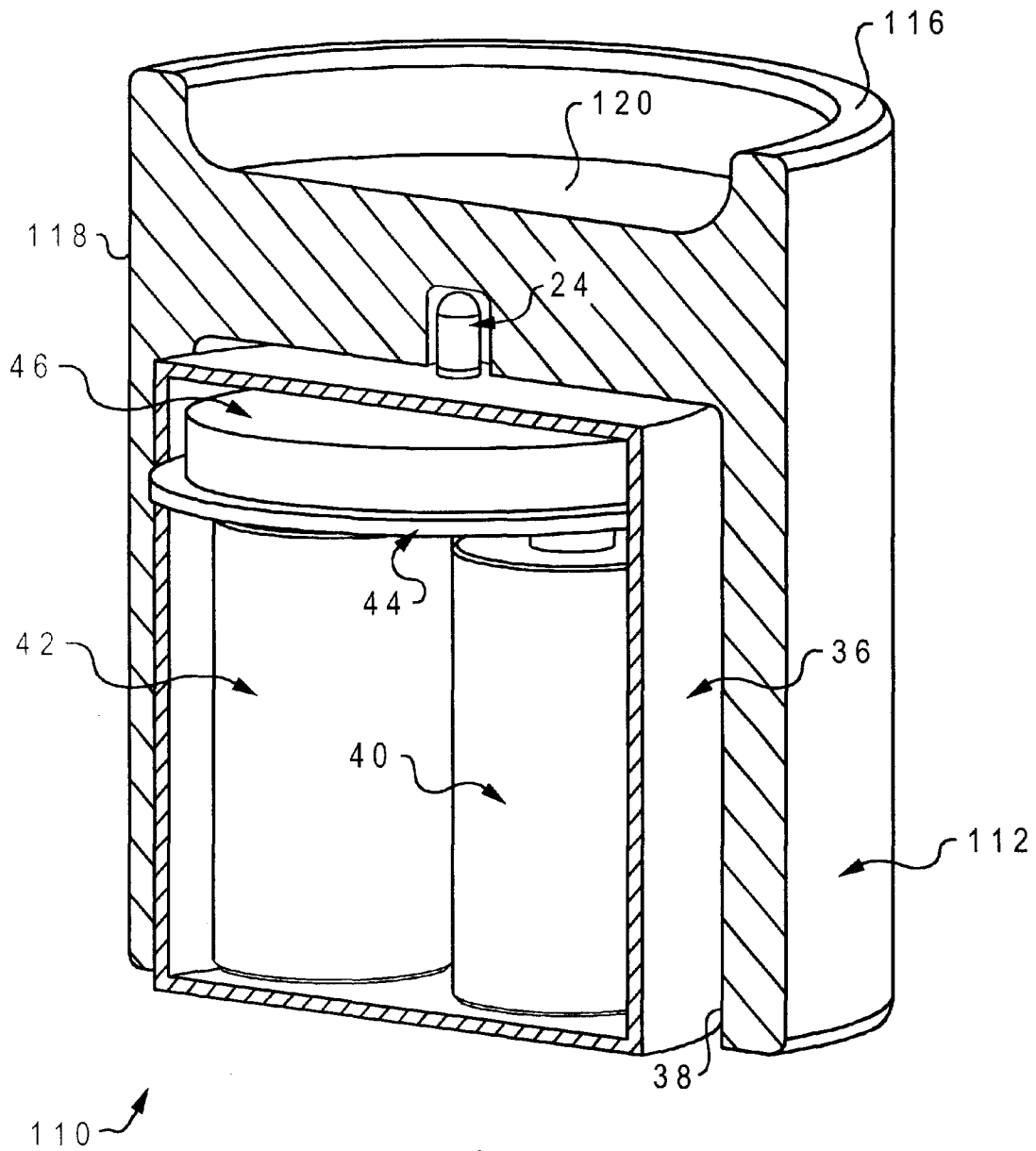
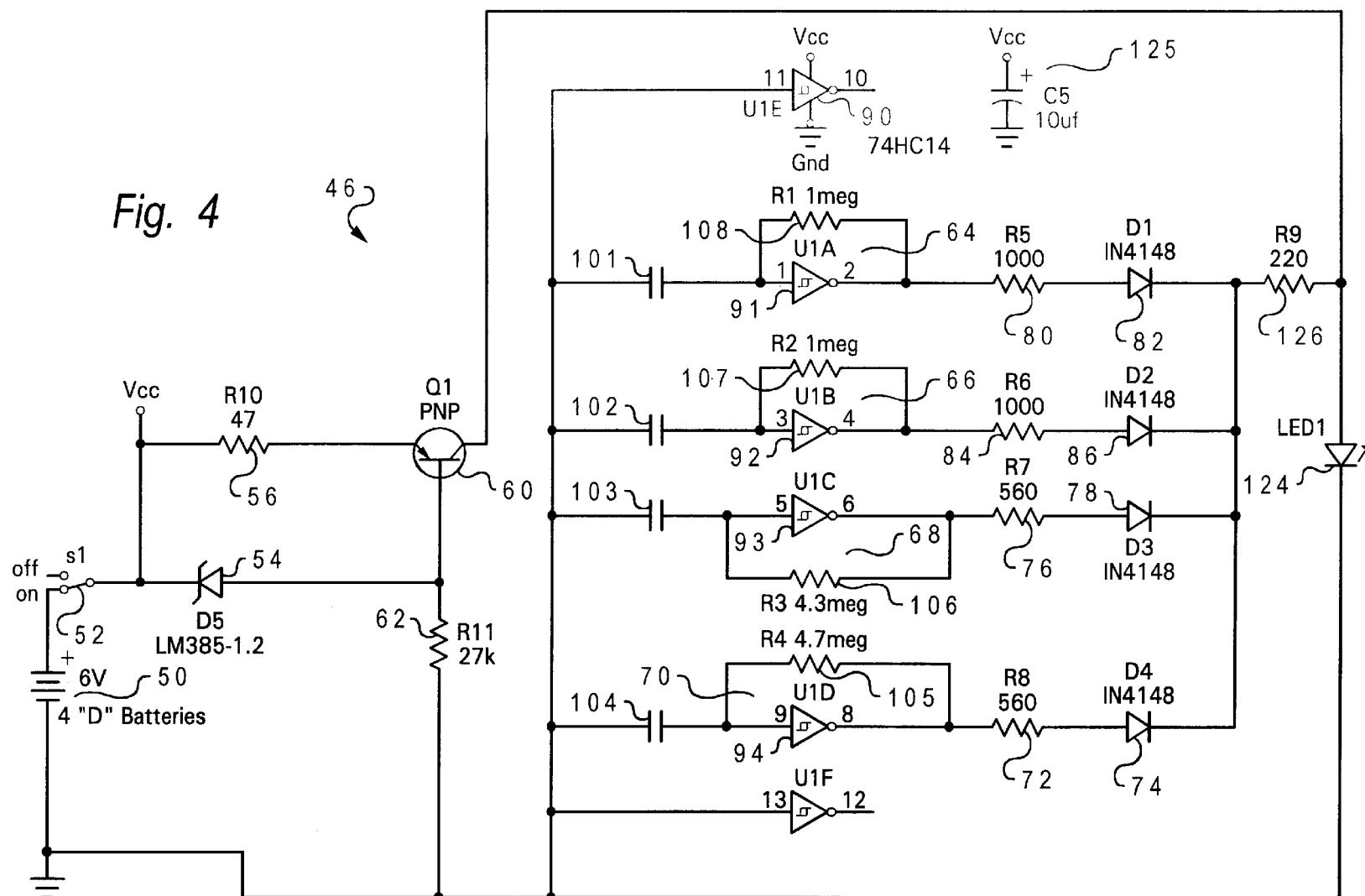


Fig. 3





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**IMITATION CANDLE****BACKGROUND TO THE INVENTION****1. Field of the Invention**

The present invention relates to low level luminaries and more particularly to an imitation candle used primarily for ornamentation and establishing ambience.

**2. Description of the Problem**

Many people find candle light pleasant. The flickering of light and movement of shadows across a floor or on a nearby wall can be almost hypnotically soothing. As a result, candles have remained popular for generations since the invention of more practical electrical lighting, especially for decorative and mood setting purposes. This has remained so notwithstanding the hazard posed by open flames and the consequent danger of household fires. Few people consider it safe to leave a lit candle unattended.

Consequently, numerous manufacturers have attempted to meet a demand for a candle like luminary using electrical illumination. There are many imitation candles available that use incandescent lamps or LED's as a light source. While these address people's concern with the open flame, most try to implement the appearance of a realistic flame using a specially shaped bulb or lens that is exposed to view. Typically, the bulb or lens sits on top of a thin cylindrical sleeve, which is shaped and colored to resemble a candle. The results are typically disappointing, especially when these devices are not illuminated. The visible, flame shaped artificial light source makes the imitation candle as a whole appear artificial. The result can look more like a caricature of a candle than a real candle. The color of incandescent light can leave something to be desired in many candles as well.

The use of frosted glass cylinders around incandescent light sources to diffuse light is known. Such products are pleasant and popular. However, the light produced by an incandescent source can be quite broad, and the top of the lamp must be open to allow heat to escape. Another product, sold by Eternalight, Inc. of Cortaro, Ariz., provides a plurality of LEDs arranged on a base inside a frosted glass cylinder. A computer is used to control current supplied the LEDs to change the color and intensity of the light emitted to give an artificial flame shape and motion and to vary the intensity of the artificial flame. A similar product is sold by Norrex Enterprises, Inc. of Blauvelt, N.Y. In both cases the products place the artificial flame above a base. A frosted glass cylinder, open at the top, is then set on the base. The appearance is intended to be of a candle inside a glass lamp.

Candles of course do not all come in one shape or size. While a classical image of a candle is of a long, thin, tapering rod, which stands upright in a candle stick and which leaves its flame exposed as it burns down, many candles come as a relatively short to circumference block or cylinder which is self supporting. Such candles commonly leave the outer wall of the candle intact as the candlewick burns down. When this happens, the candle flame is no longer visible when viewed from the side. This results in a diffuse, flickering glow visible through the paraffin wall of the candle.

**SUMMARY OF THE INVENTION**

One object of the invention is to provide an electrical candle that provides realistic candle like light.

Another object of the invention is to provide an electrical candle that presents a realistic appearance when the candle is not lit.

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Yet another object of the invention is to provide an imitation candle that uses a light-sensing device to turn the light source off during the day.

Still another object of the invention is to provide a flicker circuit that provides three or more distinct light levels that vary in a pseudo-random manner to provide a realistic variation in light output akin to a candle flame being disturbed by gentle air currents. A realistic flicker provides one more subconscious cue that the candle is real.

Yet another object of the invention is to provide a luminary that gives a very realistic representation of a broad, self supporting candle that has burned down to the point where the flame is not visible.

These and other objects are achieved as is now described. The imitation candle of the present invention hides the light source within the body of the luminary which gives the body a glow in much the same way that a real wax candle glows when illuminated by a depressed flame. There is no shaped imitation flame to betray the fact that the candle is not real. The light source is preferably a light emitting diode enclosed within the translucent material forming the body of the luminary. The translucent material surrounds the light emitting diode on the sides and top at least to an extent necessary to make direct viewing of the light emitting diode inconvenient. The light emitting diode is positioned near the top of the body so that the top is brighter than the lower parts of the candlestick, which again simulates the appearance of a real candle. Placing the light emitting diode near the top also creates a hot spot of light that can be seen in the translucent material when viewed from above. Recessing the top within the side walls presents the appearance of a candle that has already been burning for some length of time. The body of the imitation candle can be made from real wax to further enhance the imitation candle's realism. Alternatively, frosted glass or plastic materials may be used.

The invention provides an imitation candle having a body made from a translucent material having optically transmissive properties similar to candle paraffin. In a preferred embodiment the body of the imitation candle has a relatively large base or circumference relative to its height and is self supporting. The candle body is shaped to simulate a candle which has partially burned down, for example by forming a depression into an upper surface of a cylindrical candle body. A light emitting body, or similar small, high intensity light source, is set in a cavity enclosed within the translucent material. An emission color, such as amber, is selected for the LED to produce a light similar in color to candle light. The translucent material of the candle body diffuses the light emitted from the LED to create a warm, natural looking glow. When viewed from the side, the result is a very close approximation to a real candle when the wick has burned down to the point that the flame is not directly visible. The LED is preferably placed near the top of the translucent material but centered horizontally. The thinner material directly above the LED causes less diffusion of the light and produces a high intensity area of light that simulates the appearance of a candle flame when the candle is viewed from above.

The LED is preferably a super bright LED. Power consumption is low enough at low illumination levels that reasonable lifetimes can be achieved using batteries as a power source. Alternately, a wall-cube style power supply could be used to supply power and eliminate the need periodically to replace batteries. Alternately, rechargeable batteries can be used in conjunction with a solar cell or other recharging means. A simple circuit using multiple oscillators

running at nearly the same frequency creates a realistic, pseudo-random flicker for light emitted by the LED. A simple light sensing device can be used to turn the LED off during daylight hours and extend battery life in battery operated versions of the candle.

Additional effects, features and advantages will be apparent in the written description that follows.

### BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a preferred embodiment of the imitation candle of the invention.

FIG. 2 is a partial cutaway view of an embodiment of the invention.

FIG. 3 is a partial cutaway view of a preferred embodiment of the invention.

FIG. 4 is a circuit schematic for a luminary of the preferred embodiment.

### DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings and in particular to FIG. 1 a preferred embodiment of the invention will be described. An imitation candle **10** includes a body **12** with a horizontal lower surface **14** on which it rests, an upper surface **16** and a cylindrical vertical side wall **18** between the lower and upper surfaces. Imitation candle **10** is preferably sized to resemble a self supporting candle having a relatively large circumference compared to its height. Slender, tapering bodies resembling classical candles, and other shapes, are possible and such configurations are within the scope of the invention, but embodiments using such shapes may not provide as esthetically a pleasing appearance in use due to the expectation that a flame be visible. While imitation candle **10** is illustrated as being cylindrical, other horizontal cross sectional shapes are possible, such as rectangular, as well as irregular shapes. Upper surface **16** includes an indented or depressed central region **20**, which is preferably shaped to resemble a top portion of candle which has been reduced by melting to feed a flame supported from a central wick.

FIG. 2 shows a preferred embodiment of the invention in a cutaway view. A light source body **24** preferably emits light from a small area, which is preferably achieved by incorporating a super bright light emitting diode (LED). Light source body **24** is placed near the surface forming depressed central region **20** in a cavity **26** which extends from the lower horizontal surface **14** of body **12** to a point just below the upper surface **16**. The material forming body **12** is preferably relatively thick and translucent and is shaped to resemble a candle that has been burning long enough to have burned away the inner portion of the wax (here depressed central region **20**). The material can be wax, frosted glass, or plastic and is chosen to diffuse the light from the light source body **24** so that, when viewed from the side, the light is evenly scattered and provides a fairly evenly distributed glow. Pigments added to relatively clear plastics or glass with frosted surfaces should also produce satisfactory results, although wax is preferred.

The light intensity on cylindrical vertical sidewall **18** of the candle body **12** will be roughly proportional to the square of the distance between the light source body **24** and the surface. The thickness of material directly above the light source body **24** can be selected to generate a 'hot spot' of fairly intense light that is similar in size to the diameter of a real candle's flame. This hot spot imitates the candle flame that would normally be visible if a real candle is viewed from the top. Generally though, light source body **24** is positioned so as not to be conveniently directly viewable from outside of body **12**. In other words, optically diffusing material is preferably interposed between a casual viewer and the light source body **24** from most if not all directions.

Light source body **24** is connected to a remote power source **30** by leads **28**. Remote power source **30** may be taken to be a conventional step down power supply which may be plugged into a household wall socket. Alternatively, a source of power may be provided by an internal battery. A switch **32**, which may be manually activated, timer based, light sensitive, or even accept remote control commands, may be incorporated into the power supply. The remote power source **30** would typically be hidden in a base designed to look like a typical candle stand or it could be disguised as, or hidden in, another decorative element. The housing for remote power source **30** preferably includes a flicker circuit (described below) to cause the LED in the light source body **24** to vary in brightness in a pseudo-random manner to simulate the flickering of a real candle flame. Yet another option is to provide a solar cell that charges one or more rechargeable batteries.

FIG. 3 shows an alternative embodiment of the invention in which an imitation candle **110** incorporates a replaceable battery inside candle body **112**. Light source body **24** incorporates a super bright LED as described above. A battery housing **36** is enclosed in an enlarged lower cavity **38** and holds two batteries **40** and **42** used as a power source. A printed circuit board **44** and light source energization circuit **46** are positioned in the housing **36**. Embodiments of the invention using a single cell with a step up power supply can be used to save space in small candles. Additional cells or larger batteries can be used in large candles. The exterior configuration of body **112** of imitation candle **110** is generally similar to imitation candle **10**, with a depressed central region **120** set in an upper surface **116**, and a cylindrical vertical side wall **118**.

FIG. 4 illustrates representative energization electronics **46** for driving an LED **124**. A power source **50** is provided by four size D batteries. Different power sources can be used depending upon desired battery life or the desired brightness to be obtained from the LED. As mentioned above, alternatives include combinations of solar cells and rechargeable batteries or an outside line source of power. LED **124** is preferably provided in a Global Opto G-L202YTT-T amber light emitting diode package. Energization electronics may be switched on and off using a switch **52** which is attached at one pole to the positive terminal of battery **50**. Switch **52** may be a photosensitive device, such a photosensitive transistor. Battery **50** also supplies  $V_{CC}$  within energization electronics **46**.

LEDs have a constant voltage drop when conducting current and the intensity of light emission from an LED is controlled by varying the current sourced to the LED. Accordingly, the LED energization circuit **46** sources a varying amount of current to LED **124**. The first major element of energization circuit **46** is a base current source provided by zener diode **54**, resistors **56** and **62**, and a PNP transistor **60**, which sources current to the load, here a light

emitting diode **124**. The voltage source provided by battery **50** is connected to the transistor **60** emitter by resistor **56** and to base of the transistor by reverse oriented zener diode **54**. The transistor is assured of being constantly biased on by the voltage drop set by the reverse breakdown voltage of zener diode **54** as long as battery voltage remains the minimum required for zener breakdown operation. Thus transistor **60** sources current to the load through which the current returns to ground. As a result LED **124** always produces a minimum level of light output when the device is on.

Variation in light output is effected by variably increasing the current supplied to LED **124**. A hex inverter, such as a SN74HC14N hex inverter, available from Texas Instruments of Dallas, Tex., is used to implement several parallel oscillators or clocks. All of the oscillators are identically constructed though external component values may be altered. In the preferred embodiment 4 of 6 available inverters (**91–94**) are used with resistors (**105–108**) providing feedback from the outputs of the inverters to the inputs. Capacitors **101–104** are connected from the inputs of inverters **91–94** to set the operating frequency of the oscillators. The connection of  $V_{CC}$  to the inverters is represented for inverter **90** (U1E) only but is identical for each of inverters **91–94**.

Oscillators **68** and **70** are designed to be low frequency oscillators running at approximately 2 Hz. Oscillators **68** and **70**, formed using inverters **94** and **93**, can use similar timing components to run at approximately a 10% difference in frequency. The 10% difference in frequency prevents oscillators **68** and **70** from synchronizing with each other or drifting past one another too slowly. Low frequency oscillators **68** and **70** provide current to the LED **124** through series connected resistors and forward biased diodes **76** and **78**, and **72** and **74**, respectively, to a summing junction. As a result, current flow through LED **124** is increased from the minimum set by the current source formed by PNP transistor **60** pseudo-randomly. When either of oscillators **68** or **70** is high, it supplies extra current to LED **124** and the LED becomes slightly brighter. When both of oscillators **68** and **70** are high, a third, higher level of current is supplied to the LED **124**. The three current levels (both high, only one high, or both low) provide three brightness levels that can be selected by the choice of values for resistors **76** and **72** and the current from the current source. As long as the two oscillators are not synchronized, the three brightness levels will vary in a pseudo-random manner as the oscillators drift. Loose component tolerances are acceptable as contributing to the degree of randomness in current sourced to LED **124**.

In some applications oscillators **68** and **70** may be set to have as great as a 2:1 variation in frequency. The rate at which the oscillators drift past one another is consequential to the appearance of the luminary.

In the preferred embodiment oscillator **66**, formed using inverter **92**, operates at about 8 Hz. and provides two more current levels. Three parallel current sources allow for a total of six brightness levels. Again the output from the inverter is fed through a series connected resistor **84** and forward biased diode **86** to a summing junction and then by resistor **126** to LED **124**. The value chosen for resistor **84** is higher than for resistors **78** and **74** with the result that oscillator **66** makes a smaller current contribution to LED **124** than oscillators **68** and **70**. This contributes still more to the impression of randomness in the light output of LED **124** by providing that changes in light output occur in differing sized steps. Oscillator **64**, formed using inverter **91**, is also set to run at about 8 Hz. The resistance of resistor **80** is comparable to that of resistor **84** so that oscillator **64** contributes a current comparable to the current supplied by

oscillator **66**. The current from inverter **91** is routed to LED **124** by resistor **80** and diode **82** to the summing junction and then by resistor **126**. A capacitor **125** may be connected between  $V_{CC}$  and ground to short circuit noise to ground preventing circuit noise from causing the oscillators to synchronize with one another.

As shown, two of the gates of the hex inverter are not used, but these gates could be used to create two more oscillators with outputs driving additional candles using multiple LEDs or supplying additional current levels to a single LED.

The invention provides an imitation candle that provides realistic candle like light while retaining a candle-like appearance when unlit. The light produced by the invention has a multitude of light levels that vary in a pseudo-random manner to provide variation in light output akin to a candle flame being disturbed by gentle air currents. The imitation candle of the invention can be readily used with decorative light fixtures that would typically use a candle, while sparing the user from the need of periodically cleaning the fixture of wax. The imitation candle can also serve as a stand alone luminary or it can be readily used in a variety of fixtures, such as outdoor landscape lights, patio lights, solar powered lights, night lights, etc.

While the invention is shown in only one of its forms, it is not thus limited but is susceptible to various changes and modifications without departing from the spirit and scope of the invention.

What is claimed is:

1. An ornamental illumination apparatus comprising:
  - a light diffusing body having permanent exterior surfaces including an upper surface with a depressed center section which appears reduced by melting;
  - a cavity within the light diffusing body; and
  - a small high intensity light source disposed within the cavity to illuminate from below the bottom of the depressed center section more brightly than the other surfaces of the light diffusing body.
2. An ornamental illumination apparatus as claimed in claim 1, wherein the light diffusing body further comprises a lower surface and the light diffusing body is self supporting on the lower surface.
3. An ornamental illumination apparatus as claimed in claim 2, wherein the light diffusing body is made of candle wax.
4. An ornamental illumination apparatus as claimed in claim 2, wherein the small high intensity light source is a super bright light emitting diode having a predominant emission color of amber.
5. An ornamental illumination apparatus as claimed in claim 4, further comprising:
  - an energization circuit connected to the light emitting diode having a plurality of oscillators contributing varying portions of an energization current to the light emitting diode;
  - a power source;
  - the plurality of oscillators connectable to the power source, each oscillator being tuned to oscillate at a different frequency; and
  - a summing junction combining the outputs of the plurality of oscillators to produce a pseudo-random variation in the energization current.
6. An ornamental illumination apparatus as claimed in claim 5, further comprising a second cavity and wherein the power source is a replaceable battery positionable in the second cavity.

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7. An ornamental illumination apparatus as claimed in claim 5, wherein the power source is a wall socket compatible power supply.

8. An imitation candle comprising:

an optically translucent body shaped and sized to resemble a candle of sufficient diameter to support a depressed flame while leaving its outer walls intact;

a light source disposed within the optically translucent body having a light emission point at an anticipated location for the depressed flame where it cannot be conveniently directly viewed from outside the optically translucent body;

a power supply; and

a flicker energization signal generator connected between the power supply and the light point source for delivering a varying energization signal to the light source.

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9. An imitation candle as claimed in claim 8, further comprising:

the light source being a super bright light emitting diode;

the flicker energization signal generator having a plurality of oscillators tuned to run at nearly the same frequency and to drift with respect to one another to produce component signals for a pseudo-random flicker energization signal; and


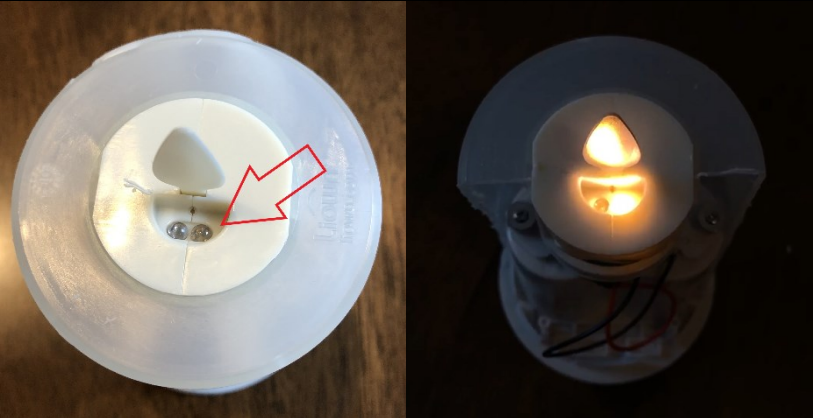
a summer combining the components of the pseudo-random flicker energization signal and connected to apply the pseudo-random flicker energization signal to the super bright light emitting diode.

\* \* \* \* \*

# **EXHIBIT 8**

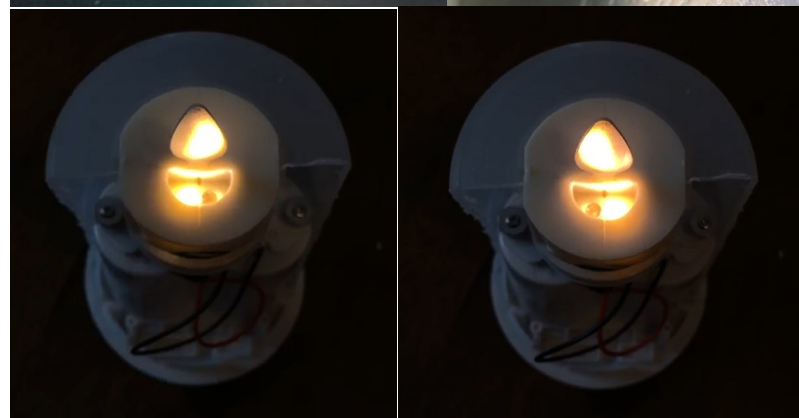
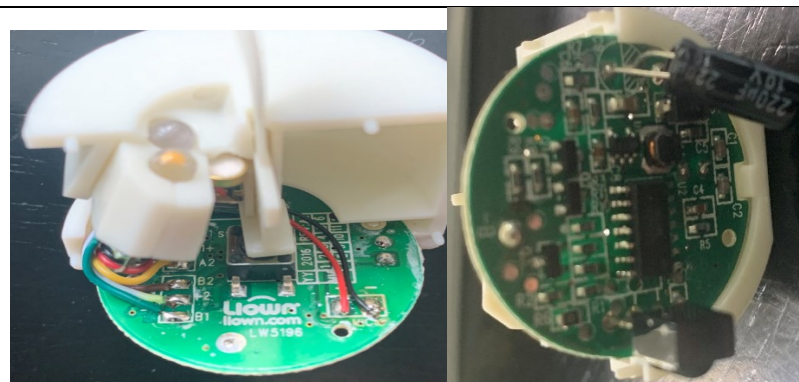


**Infringement of U.S. Patent No. 6,719,443 by Push Flame Candle**

Claims	Push Flame Candle
<p>[22.Pre] An electrically powered flame simulator comprising:</p>	 The image shows the retail packaging for the 'Push Flame' candle on the left and the candle itself, which is lit, on the right. The packaging is a white box with a clear window showing the candle. Text on the box includes 'PUSH FLAME', 'UNSCENTED LED CANDLE', '3"x 4.5" OBLIQUE EDGE', and 'Distributed by RAZ IMPORTS INC.'. The candle is a thick, white, cylindrical shape with a flame that mimics a real candle flame.
<p>[22.A] at least one solid state type light source;</p>	 The image shows the internal components of the candle on the left and the candle itself, which is lit, on the right. The internal view shows a white plastic base with a central opening. A red arrow points to a small, glowing LED light source. The candle is shown in a dark setting, highlighting the flame.

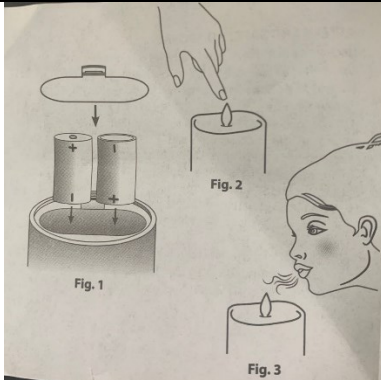
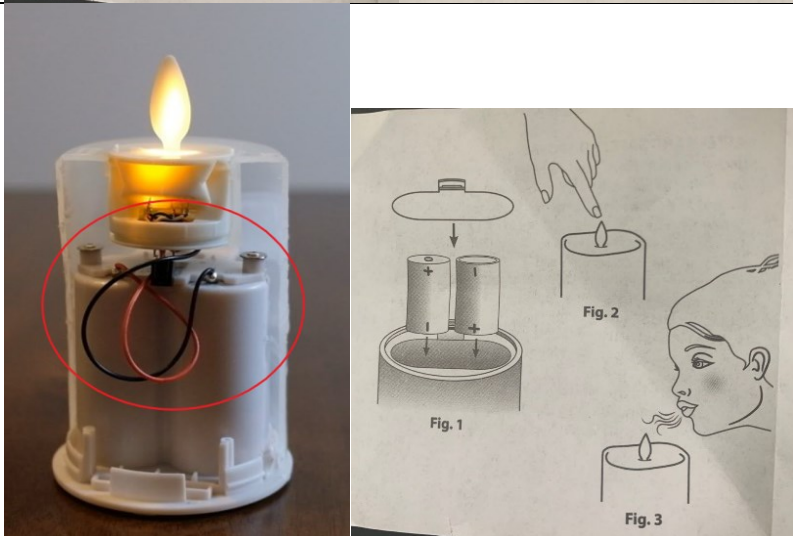


[22.B] an integrated circuit electrically connected to the light sources for intermittently controlling illumination of the light source such that the light source provides the effect of a flickering movement;



[22.C] a microphone associated with the integrated circuit through which predetermined audio sounds can be processed to control the light source;

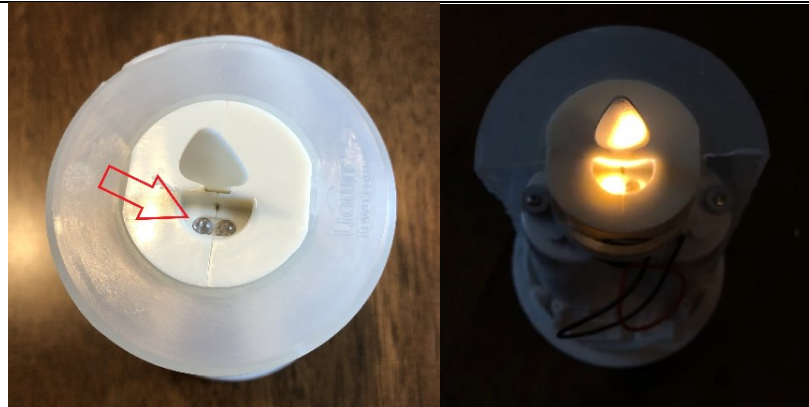


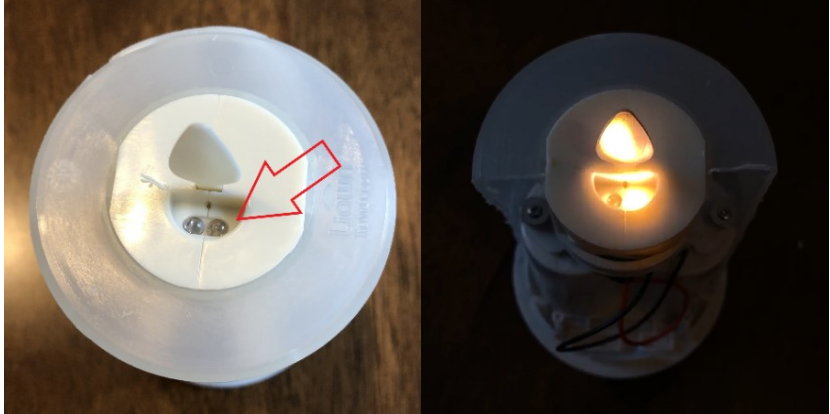
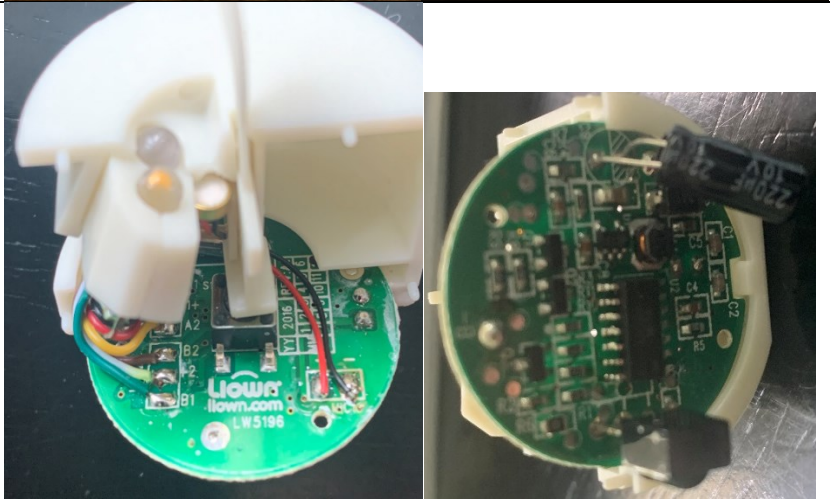
	 <p><b>BATTERY INSTALLATION</b></p> <ul style="list-style-type: none"> <li>• To release battery cover on the bottom, push the tab and lift.</li> <li>• Install two D Alkaline batteries. Be sure batteries are inserted in the proper direction (per polarity marking inside candle) and replace battery cover (Fig. 1).</li> </ul> <p><b>CANDLE OPERATION</b></p> <ul style="list-style-type: none"> <li>• To turn ON, push the flame once. (Fig. 2) Push the flame again to turn OFF.</li> <li>• To activate the five-hour daily timer, push to turn ON the candle, then push again and hold the flame. Candle will blink twice and automatically turn on at the set time every day and turn off after five hours.</li> <li>• <b>BLOW OUT feature:</b> Turn OFF candle by blowing at the flame (Fig. 3). Using this feature does not deactivate timer settings.</li> </ul> <p><b>REMOTE READY</b></p> <ul style="list-style-type: none"> <li>• Remote control sold separately.</li> </ul> <p><b>CANDLE MAINTENANCE</b></p> <ul style="list-style-type: none"> <li>• Clean with a soft, dry cloth.</li> <li>• If needed, use a damp cloth and mild household soap.</li> </ul>
<p>[22.D] a power source for providing power to the integrated circuit.</p>	

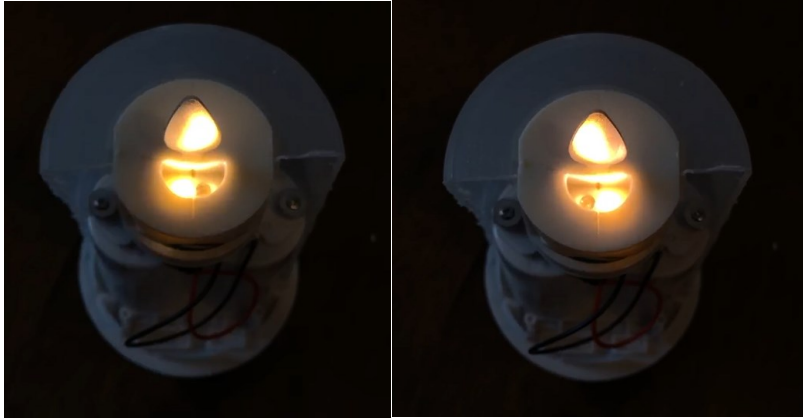
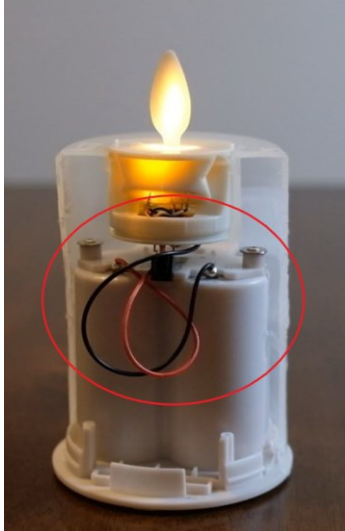
[27.Pre] An electrically powered flame simulator comprising:



[27.A]at least two light sources;




	
<p>[27.B] an integrated circuit electrically connected independently each of the light sources for intermittently controlling illumination of at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and</p>	

	
<p>[27.C] a power source for providing power to the integrated circuit.</p>	

# EXHIBIT 9

**Infringement of U.S. Patent No. 6,719,443 by Matrix Candle**

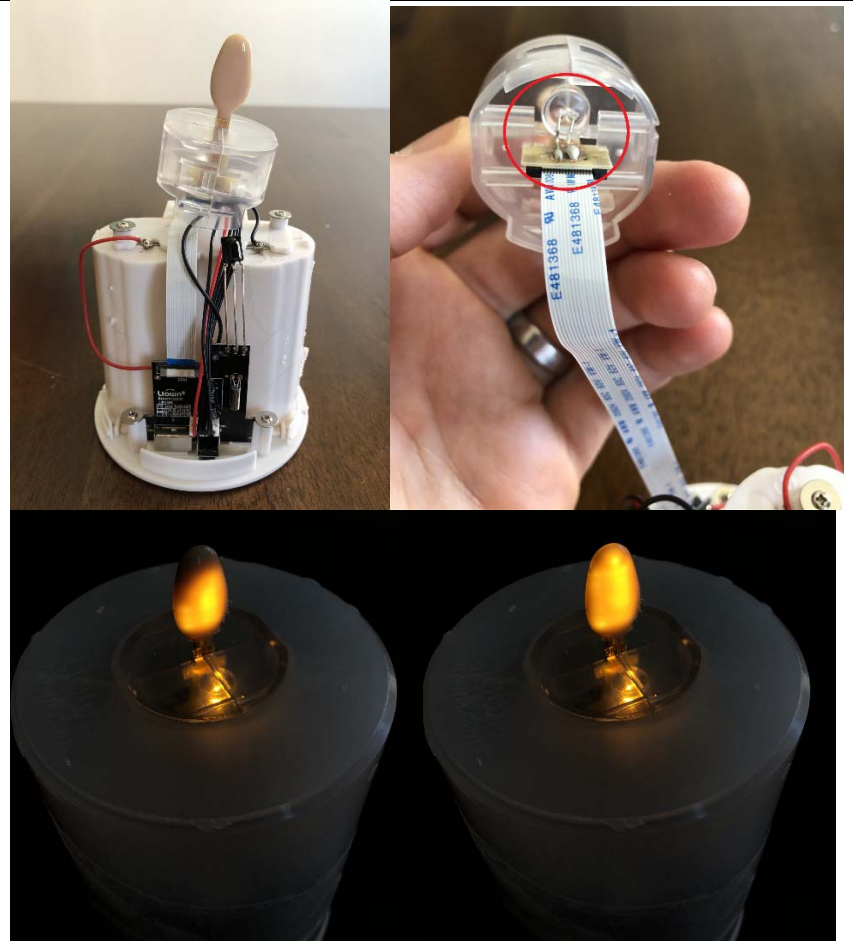
Claims	Matrix Candle
<p>[27.Pre] An electrically powered flame simulator comprising:</p>	



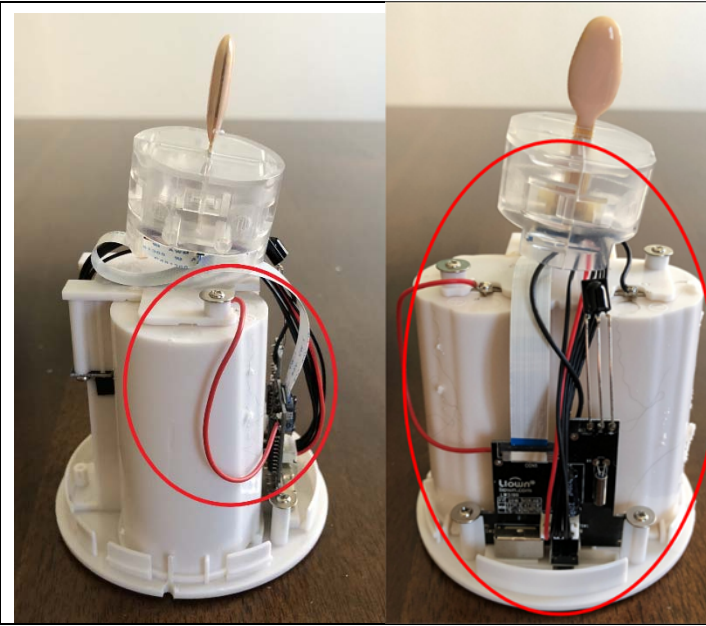
[27.A] at least two light sources;



[27.B] an integrated circuit electrically connected independently each of the light sources for intermittently controlling illumination of at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement; and






[27.C] a power source for providing power to the integrated circuit.



# EXHIBIT 10

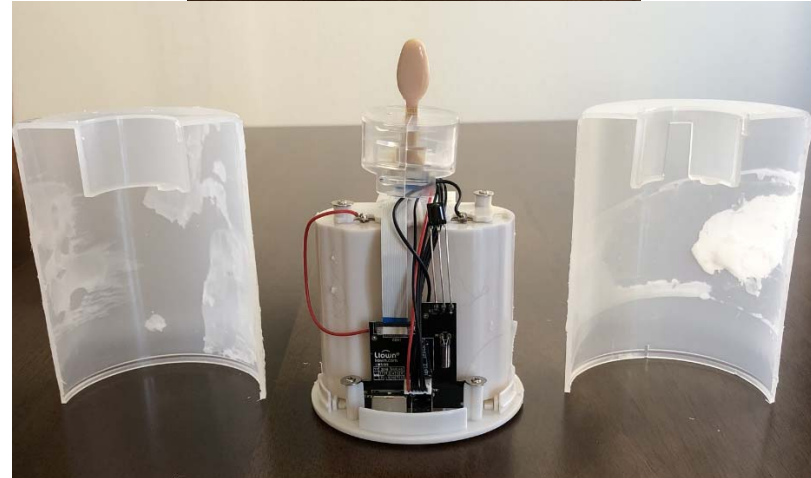
**Infringement of U.S. Patent No. 8,562,186 by Matrix Candle**

Claims	Matrix Candle
<p>[1.Pre] An artificial pillar candle having an electrically powered flame simulator comprising:</p>	 
<p>[1.A] a substantially cylindrical body having permanent exterior surfaces comprising (a) an upper portion having a rim on an upper surface that circumscribes a recess,</p>	

[1.B] (b) a lower portion with a lower surface, and



[1.C] (c) a chamber therein, wherein the substantially cylindrical body is self-supporting on the lower surface and has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;

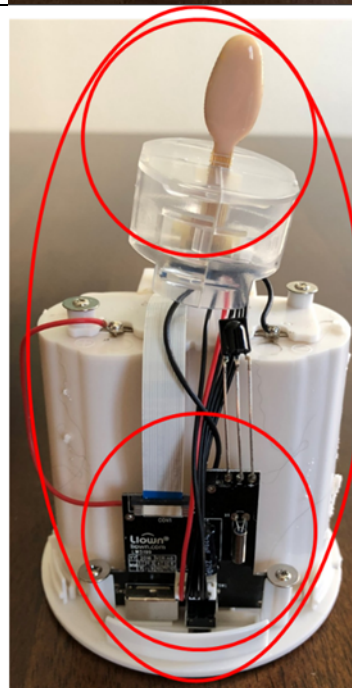




[1.D] a flame simulator having at least two light sources located substantially within the recess;





[1.E] a circuit electrically connected to the light sources for intermittently illuminating at least one of the light sources independently of other light sources such that the light sources together provide the effect of a flickering movement;





# **EXHIBIT 11**

**Infringement of U.S. Patent No. 9,491,832 by Matrix Candle**

Claims	Matrix Candle
<p>[1.Pre] An artificial pillar candle comprising:</p>	
<p>[1.A] a substantially cylindrical body including permanent exterior surfaces, wherein the substantially cylindrical body comprises:</p>	

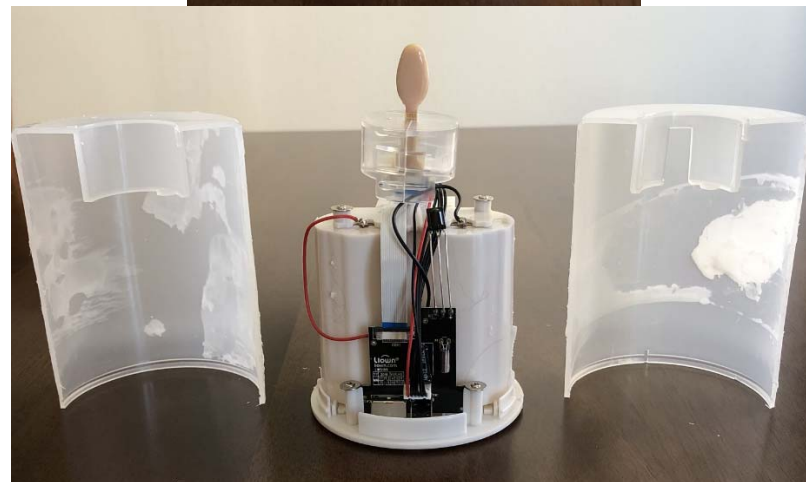
[1.B] an upper portion including a rim on an upper surface that circumscribes a recess;



[1.C] a lower portion with a lower surface; and



[1.D] a chamber inside the substantially cylindrical body, wherein the substantially cylindrical body is self-supporting on the lower surface and wherein the substantially cylindrical body has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;

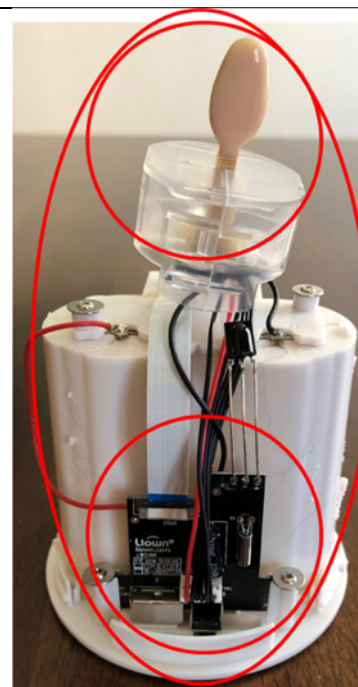


[1.E] a flame simulator including a plurality of light sources, wherein a first subset of the plurality of light sources is located within the recess below a maximum height of the rim and a second subset of the light sources is located above the maximum height of the rim; and





[1.F] a circuit electrically connected to the light sources, wherein the circuit is configured to intermittently illuminate at least one of the plurality of light sources independently from other ones of the plurality of light sources such that the illumination of the plurality of light sources over time provide the effect of a movement of a flame.



[9.Pre] An artificial pillar candle comprising:



[9.A] a substantially cylindrical body including permanent exterior surfaces, wherein the substantially cylindrical body comprises:



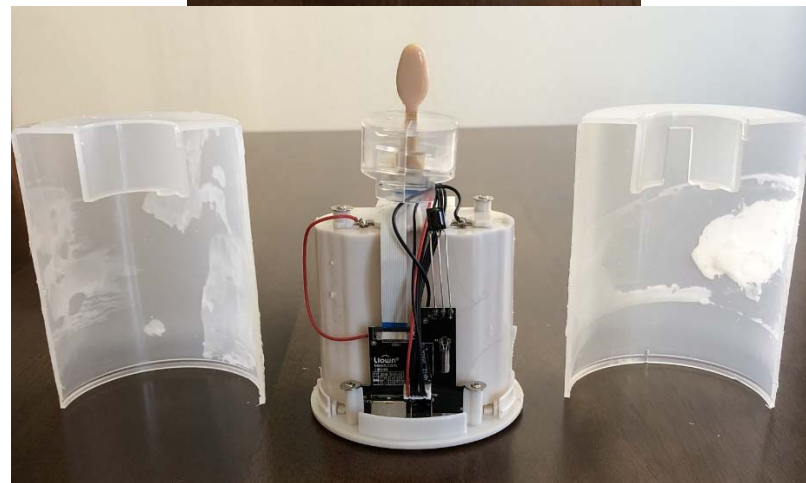
[9.B] an upper portion including a rim on an upper surface that circumscribes a recess;



[9.C] a lower portion with a lower surface; and



[9.D] a chamber inside the substantially cylindrical body, wherein the substantially cylindrical body is self-supporting on the lower surface and wherein the substantially cylindrical body has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;



[9.E] a flame simulator including a plurality of light sources, wherein a first subset of the plurality of light sources is located within the recess below a minimum height of the rim and a second subset of the light sources is located above the minimum height of the rim; and



[9.F] a circuit electrically connected to the light sources, wherein the circuit is configured to intermittently illuminate at least one of the plurality of light sources independently from other ones of the plurality of light sources such that the illumination of the plurality of light sources over time provide the effect of a movement of a flame.

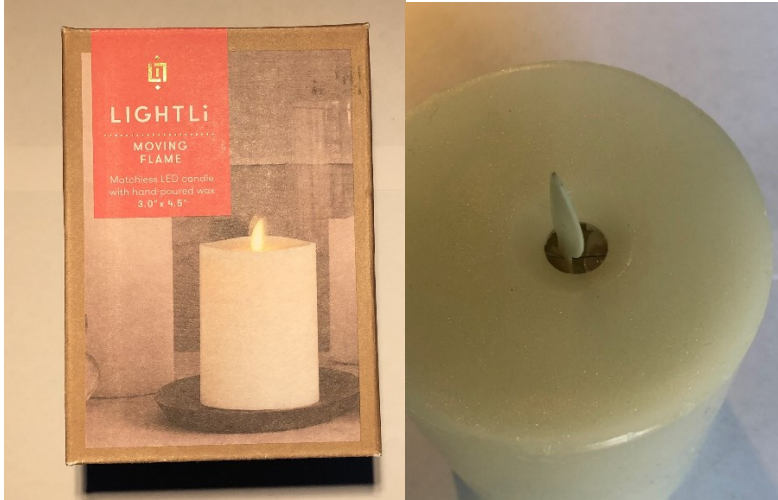
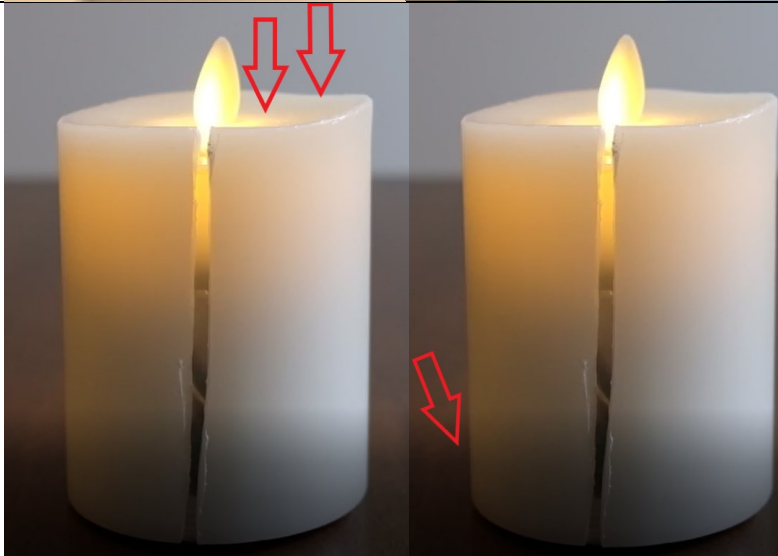


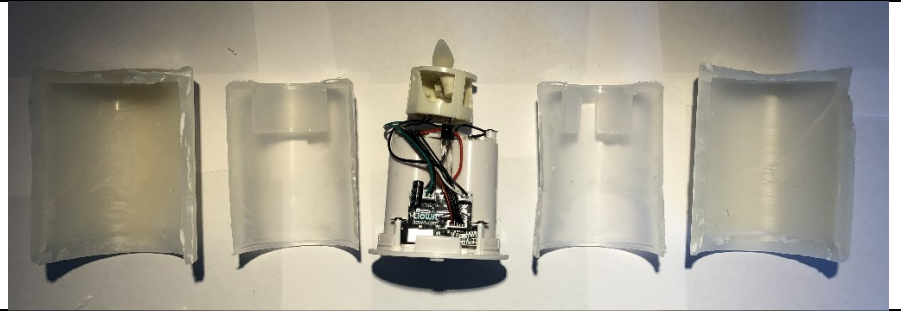



# **EXHIBIT 12**

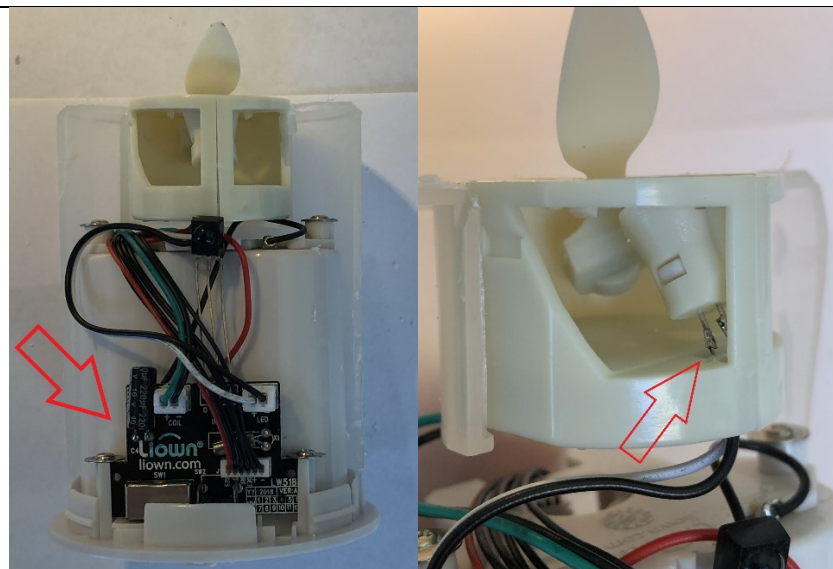


**Infringement of U.S. Patent No. 10,247,374 by LIGHTLi Moving Flame Candles**

Claims	LIGHTLi Moving Flame Candles
<p>[1.Pre] A flameless candle having an electrically powered flame simulator, the flameless candle comprising:</p>	 <p>The image shows a box of LIGHTLi Moving Flame candles on the left. The box is white with a red label that reads 'LIGHTLi MOVING FLAME' and 'Matchless LED candle with timed power-off mode 3.0" x 4.0"'. To the right of the box is a close-up photograph of the top of a white candle, showing a small, dark, circular recessed area in the center of the wax surface.</p>
<p>[1.A] a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and at least one chamber within the cylindrical body below the recess, wherein the substantially cylindrical body is self-supporting on the lower surface;</p>	 <p>The image shows two photographs of a white candle with a vertical slit cut into its side. The left photograph shows the candle with a flame, and two red arrows point down towards the slit. The right photograph shows the candle with a flame, and a red arrow points down towards the slit. The slit reveals the internal structure of the candle, which appears to be a hollow cylinder with a central vertical channel.</p>

	
<p>[1.B] a flame simulator comprising at least one light source, wherein the at least one light source is located within the at least one chamber and in an upper region of the candle;</p>	

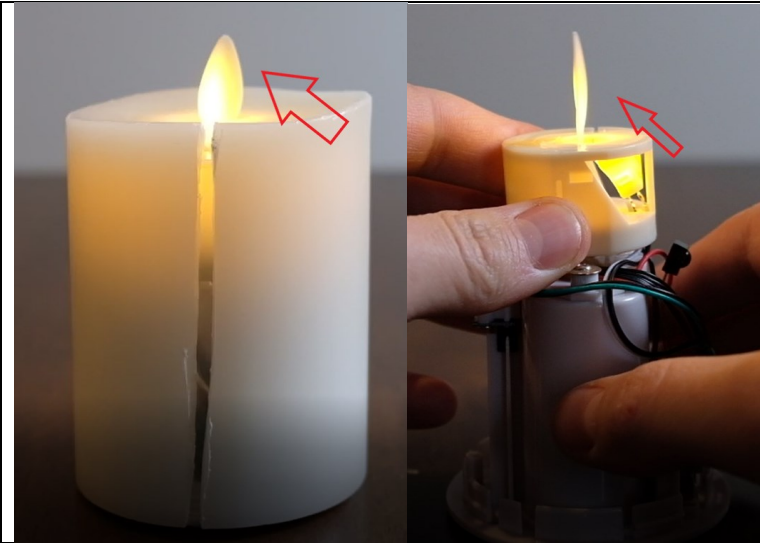
[1.C] a circuit electrically connected to the flame simulator configured to illuminate the flame simulator;



[1.D] a power source housed in the at least one chamber and configured to provide power to the circuit; and



[1.E] a protruding component extending upwardly from the recess, wherein light emanating from the at least one light source projects onto the protruding component.

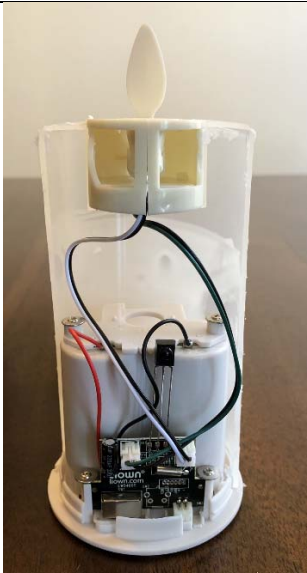
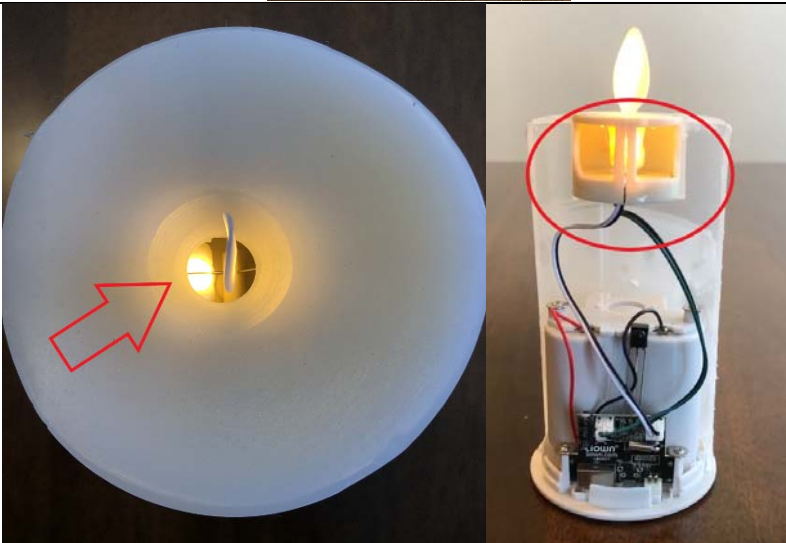


# **EXHIBIT 13**

**Infringement of U.S. Patent No. 10,247,374 by Matchless Moving Flame Candles**

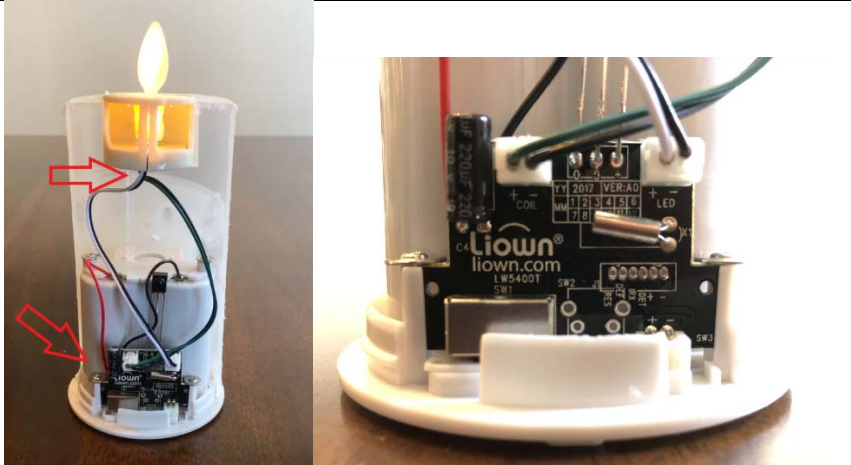
Claims	Matchless Moving Flame Candle
<p>[1.Pre] A flameless candle having an electrically powered flame simulator, the flameless candle comprising:</p>	
<p>[1.A] a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and at least one chamber within the cylindrical body below the recess, wherein the substantially cylindrical body is self-supporting on the lower surface;</p>	



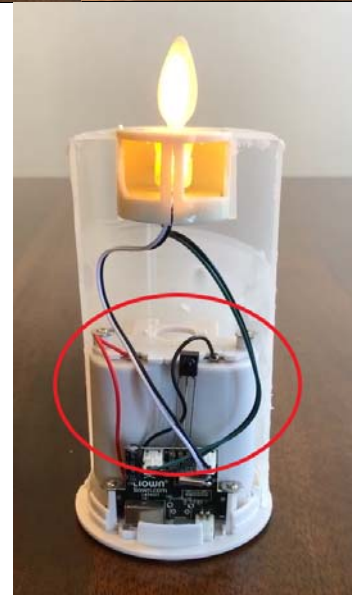
	
<p>[1.B] a flame simulator comprising at least one light source, wherein the at least one light source is located within the at least one chamber and in an upper region of the candle;</p>	



[1.C] a circuit electrically connected to the flame simulator configured to illuminate the flame simulator;



[1.D] a power source housed in the at least one chamber and configured to provide power to the circuit; and





[1.E] a protruding component extending upwardly from the recess, wherein light emanating from the at least one light source projects onto the protruding component.



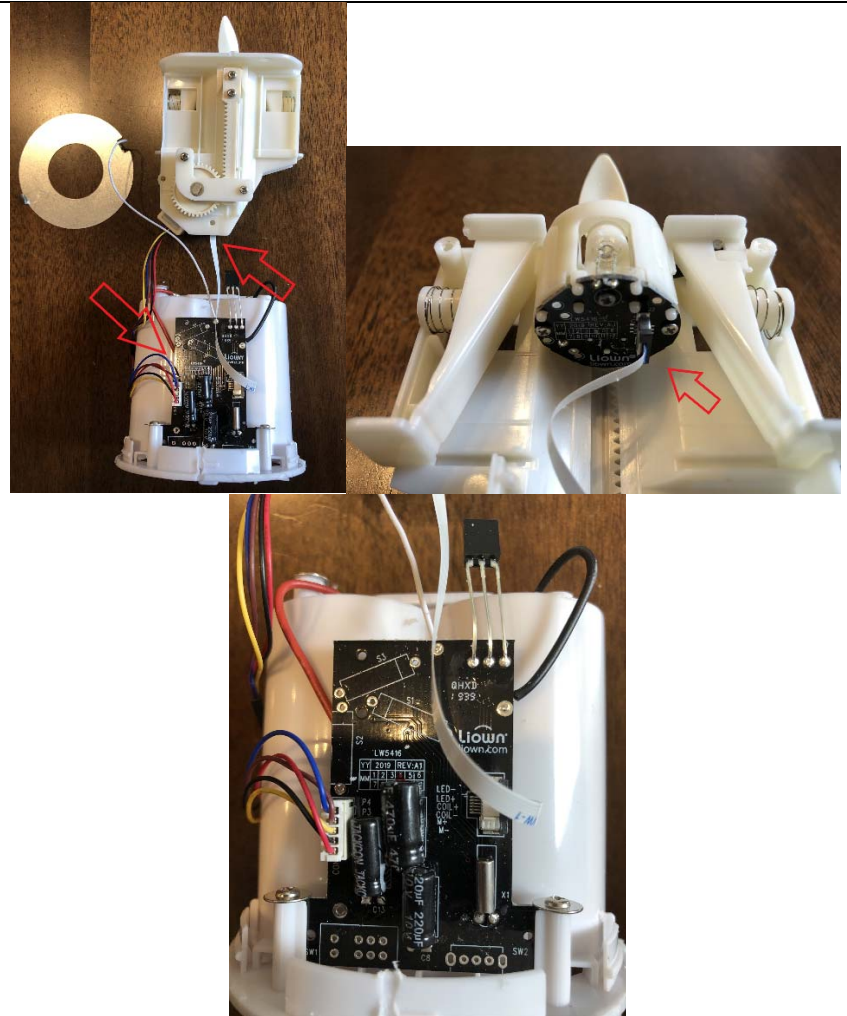
# EXHIBIT 14

**Infringement of U.S. Patent No. 10,247,374 by Wick-to-Flame Candles**

Claims	Wick-to-Flame Candle
<p>[1.Pre] A flameless candle having an electrically powered flame simulator, the flameless candle comprising:</p>	 <p>The image shows the product packaging for 'LIGHTLI MOVING FLAME' on the left, which is a box with a blue and white design. It features a picture of the candle and text including 'Flameless LED candle with heated poured wax 3.8" x 7.2"', 'WICK-TO-FLAME', 'REALISTIC WHEN ON', and 'REALISTIC WHEN OFF'. To the right of the box is a photograph of the candle itself, which is a white, tapered cylinder with a lit flame simulator on top.</p>
<p>[1.A] a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and at least one chamber within the cylindrical body below the recess, wherein the substantially cylindrical body is self-supporting on the lower surface;</p>	 <p>The image shows two close-up photographs of the candle. The left photo shows the top of the candle with a lit flame simulator. Two red arrows point to the rim of the upper portion. The right photo shows the side of the candle with a lit flame simulator. A red arrow points to the lower surface of the candle, which is the base.</p>

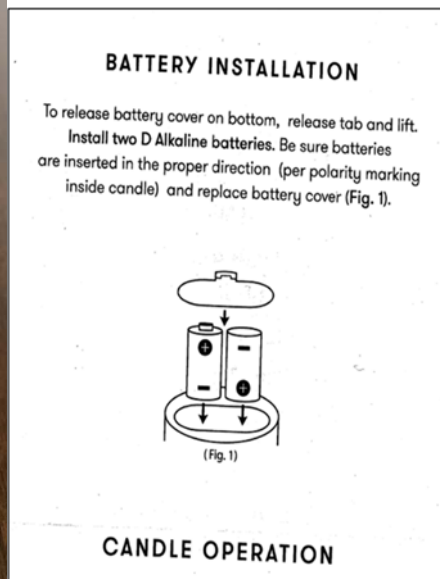
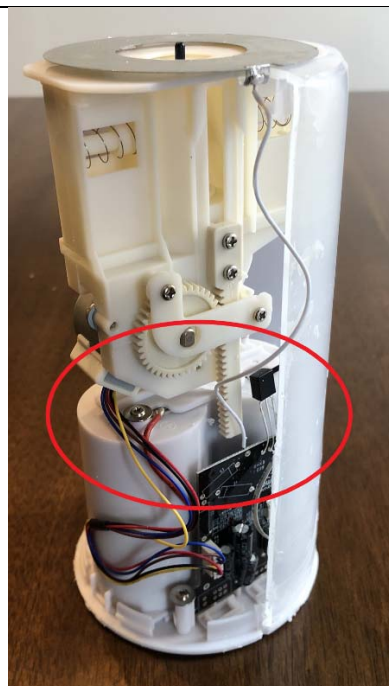


[1.C] a circuit electrically connected to the flame simulator configured to illuminate the flame simulator;





[1.D] a power source housed in the at least one chamber and configured to provide power to the circuit; and

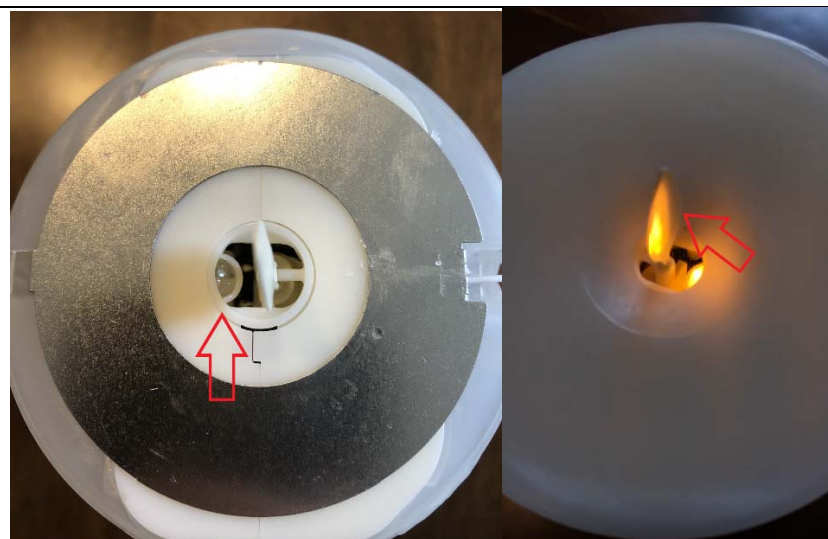


[1.E] a protruding component extending upwardly from the recess, wherein light emanating from the at least one light source projects onto the protruding component.





[2] The flameless candle of claim 1, wherein the at least one light source is pointed upwardly.



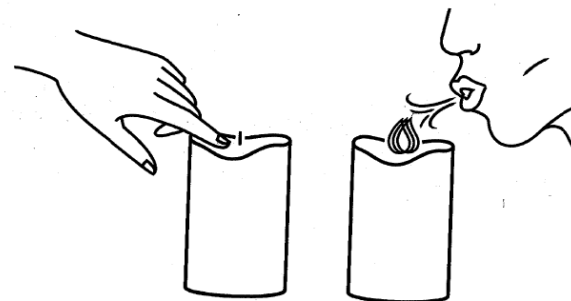
[8] The flameless candle of claim 1, further comprising a microphone associated with the circuit, wherein the circuit is further configured to process audio sounds received by the microphone.



## CANDLE OPERATION

Turn candle on by firmly touching the top of the candle, close to the center. Touch to turn ON. Wick will retract and the Moving Flame will emerge with light. Touch again to turn OFF (Fig. 2). Moving Flame will retract and wick will rise again for OFF setting.

Alternatively, turn OFF candle by blowing on the flame, just like you would blow out a traditional burning flame candle.



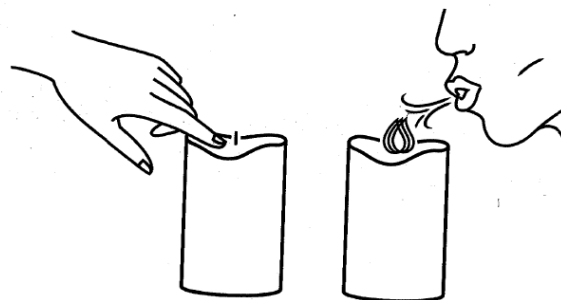
[9] The flameless candle of claim 8, wherein the circuit is further configured to control the at least one light source in response to processing the audio sounds.



## CANDLE OPERATION



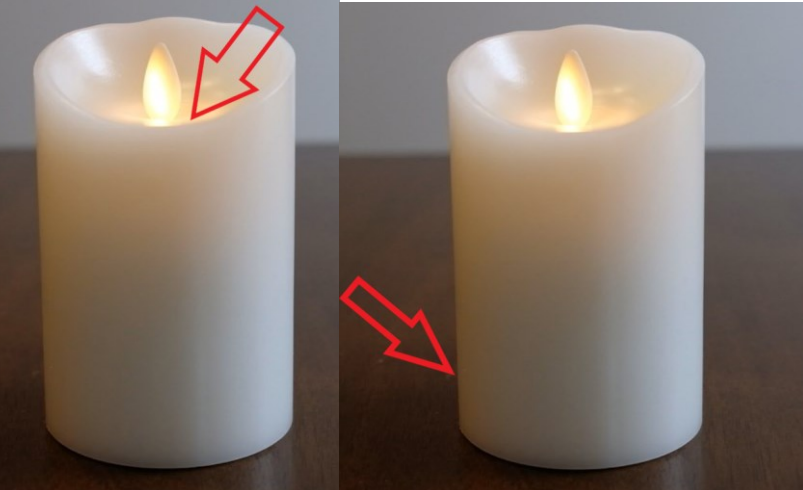
Turn candle on by firmly touching the top of the candle, close to the center. Touch to turn ON. Wick will retract and the Moving Flame will emerge with light. Touch again to turn OFF (Fig. 2). Moving Flame will retract and wick will rise again for OFF setting.


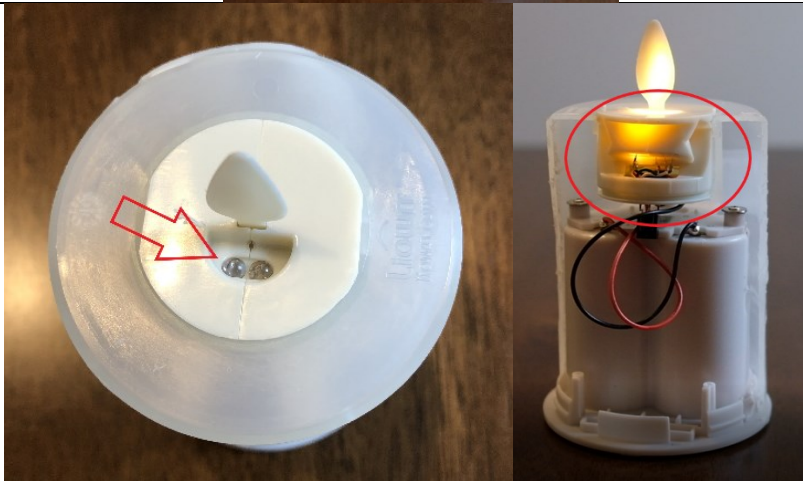
Alternatively, turn OFF candle by blowing on the flame, just like you would blow out a traditional burning flame candle.



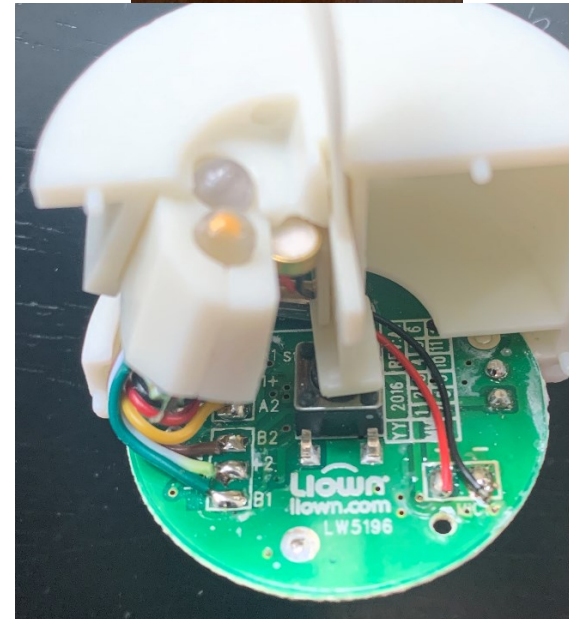
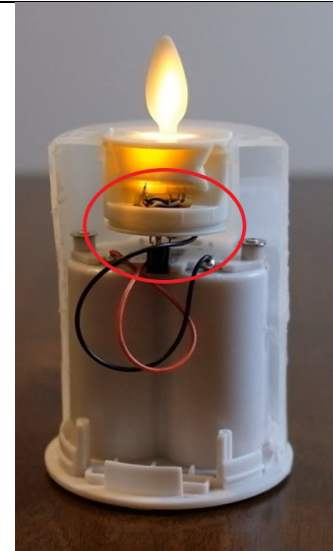
# EXHIBIT 15

**Infringement of U.S. Patent No. 10,247,374 by Push Flame Candles**

Claims	Push Flame Candle
<p>[1.Pre] A flameless candle having an electrically powered flame simulator, the flameless candle comprising:</p>	 
<p>[1.A] a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and at least one chamber within the cylindrical body below the recess, wherein the substantially cylindrical body is self-supporting on the lower surface;</p>	

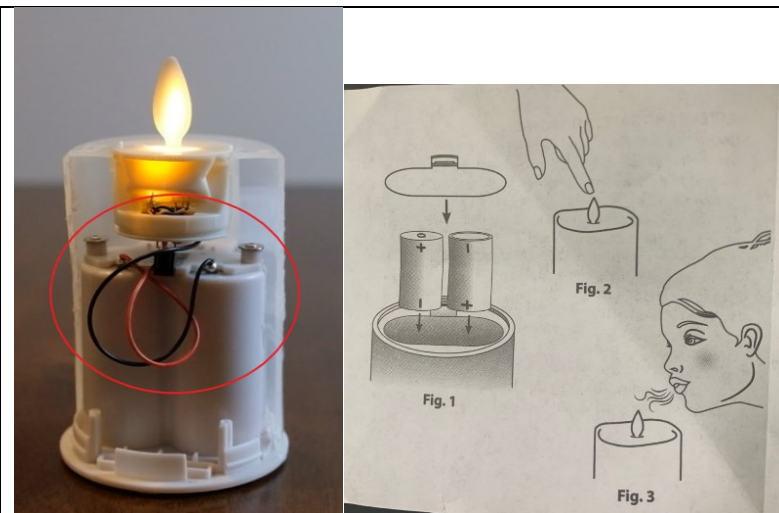
	
<p>[1.B] a flame simulator comprising at least one light source, wherein the at least one light source is located within the at least one chamber and in an upper region of the candle;</p>	

[1.C] a circuit electrically connected to the flame simulator configured to illuminate the flame simulator;

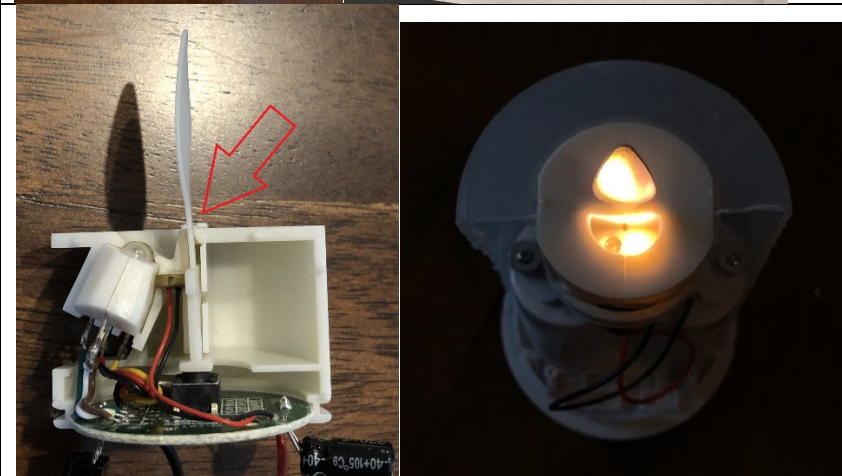




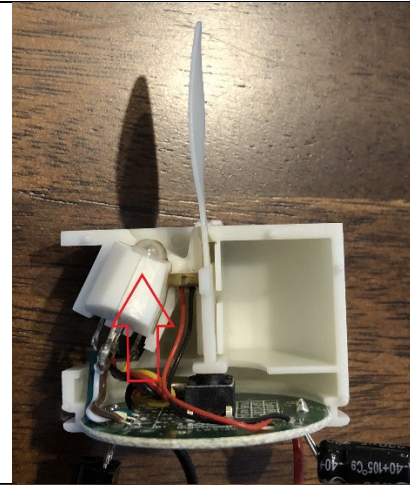
[1.D] a power source housed in the at least one chamber and configured to provide power to the circuit; and



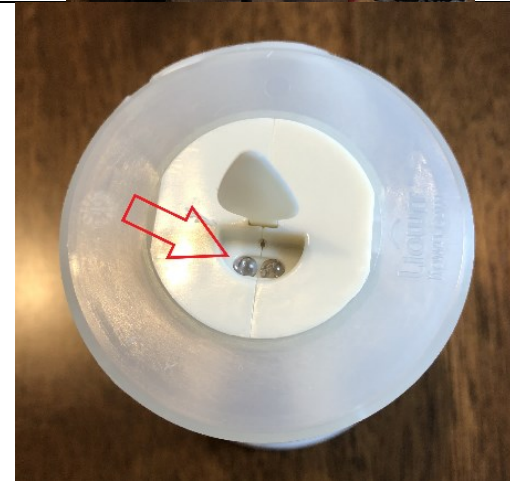
[1.E] a protruding component extending upwardly from the recess, wherein light emanating from the at least one light source projects onto the protruding component.



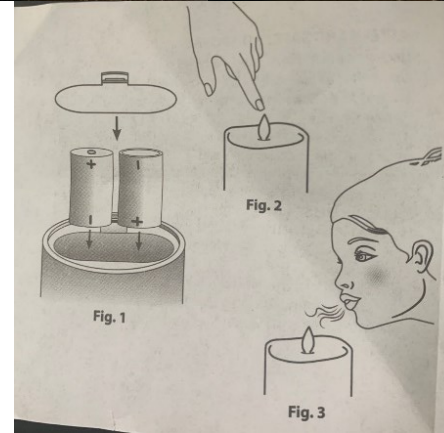
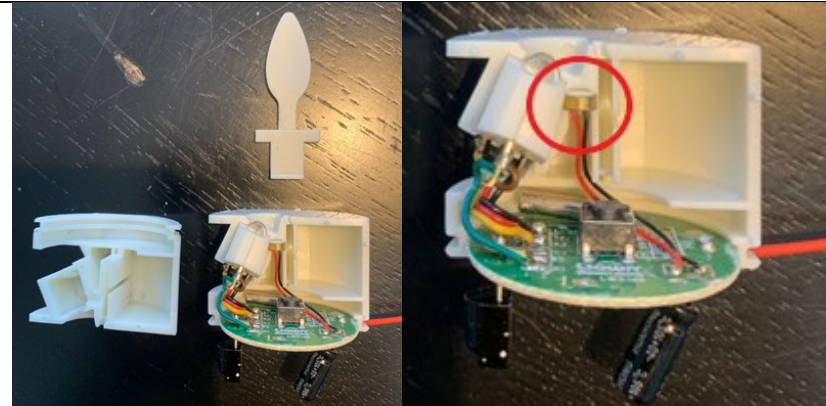
[2] The flameless candle of claim 1, wherein the at least one light source is pointed upwardly.



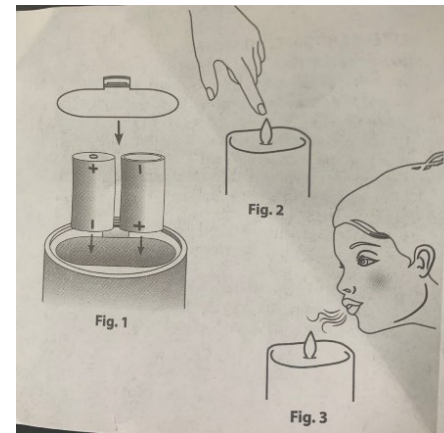
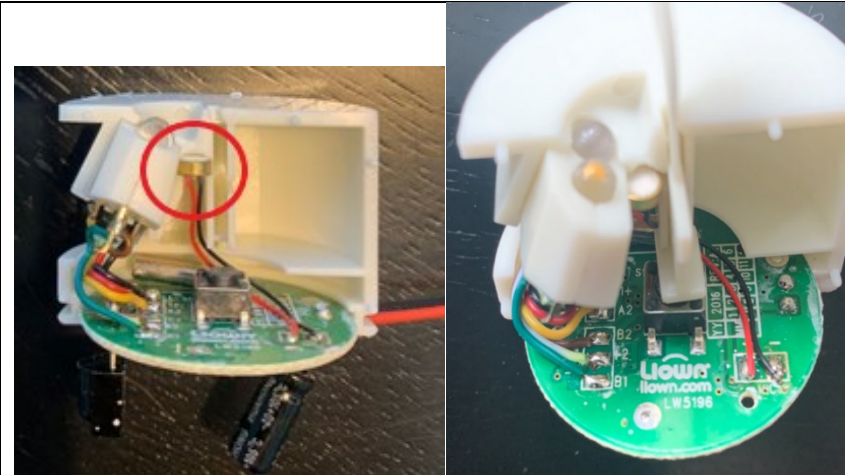
[4] The flameless candle of claim 1, wherein the at least one light source comprises a plurality of light sources.



[8] The flameless candle of claim 1, further comprising a microphone associated with the circuit, wherein the circuit is further configured to process audio sounds received by the microphone.





[9] The flameless candle of claim 8, wherein the circuit is further configured to control the at least one light source in response to processing the audio sounds.

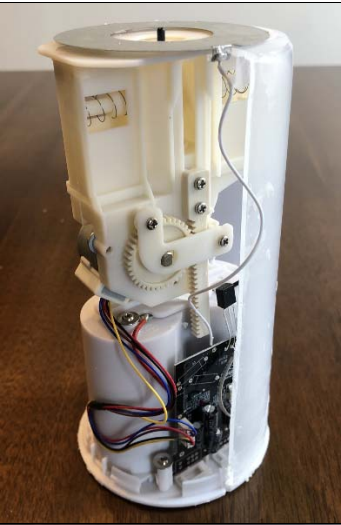



# **EXHIBIT 16**

**Infringement of U.S. Patent No. 8,858,043 by Wick-to-Flame Candles**

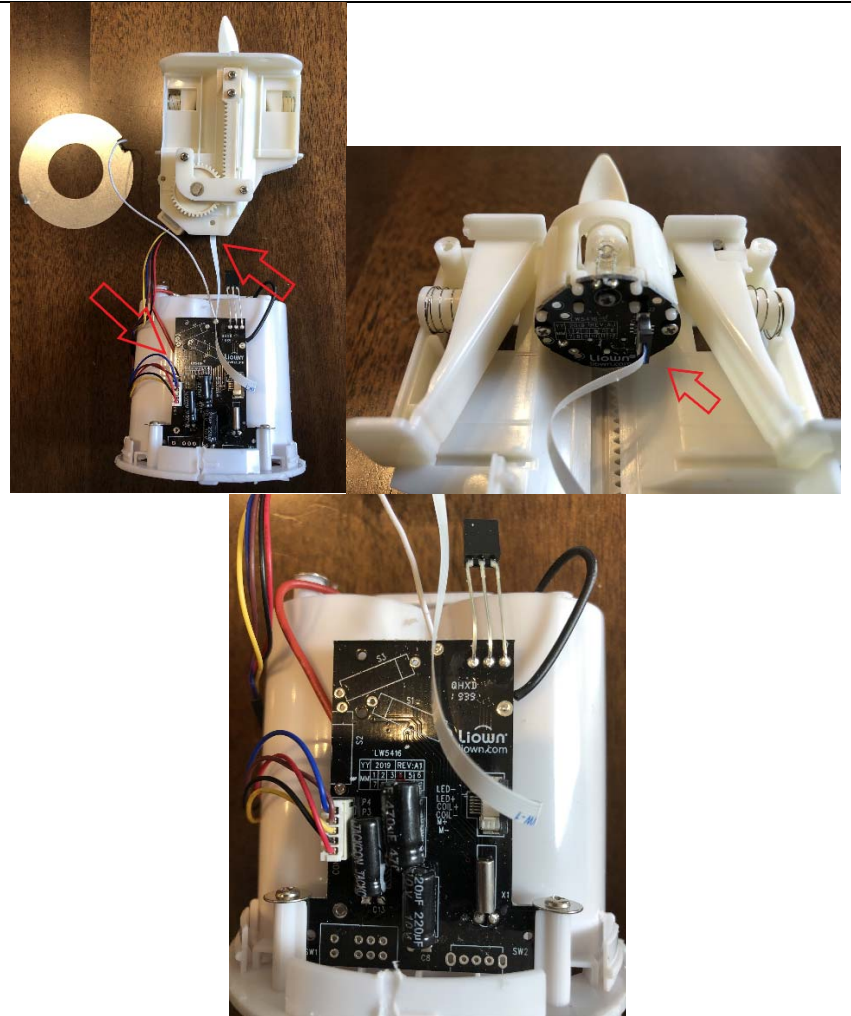
Claims	Wick-to-Flame Candle
<p>[9.Pre] A candle having an electrically powered flame simulator comprising:</p>	 <p>The image shows a product box for 'LIGHTLI MOVING FLAME' candles. The box is dark blue with white text and features a picture of the candle. Text on the box includes 'LIGHTLI', 'MOVING FLAME', 'Flameless LED candle with heat-poured wax 3.8" x 7.2"', 'WICK-TO-FLAME', 'REALISTIC WHEN ON', and 'REALISTIC WHEN OFF'. To the right of the box is a close-up of a single white candle with a lit flame.</p>
<p>[9.A] a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and a chamber therein, wherein the substantially cylindrical body is self-supporting on the lower surface and has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;</p>	 <p>The image shows two close-up views of the lit candle. The left view shows the rim of the upper portion with two red arrows pointing to it. The right view shows the lower surface of the candle with a red arrow pointing to it.</p>



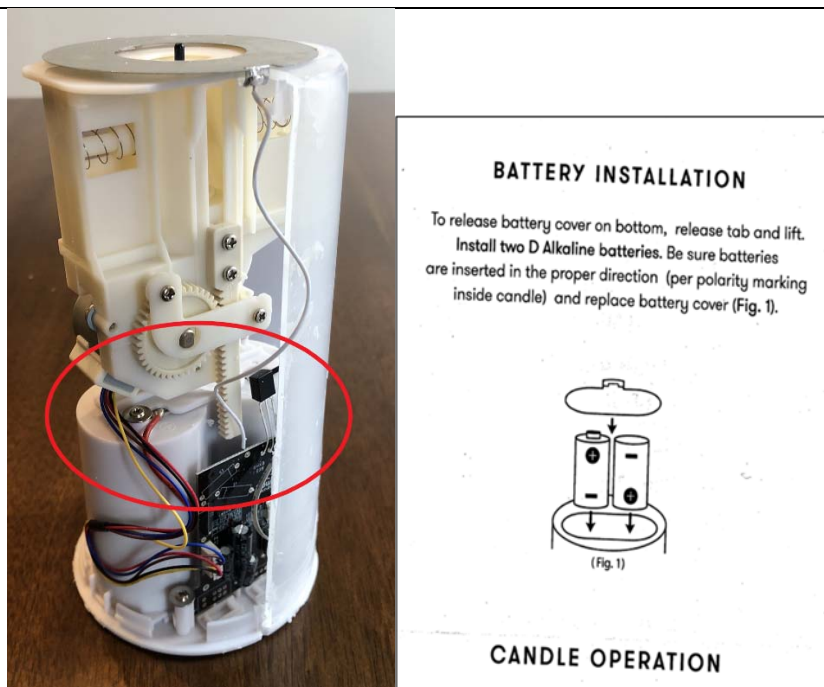
	
<p>[9.B] a flame simulator located substantially within the recess;</p>	



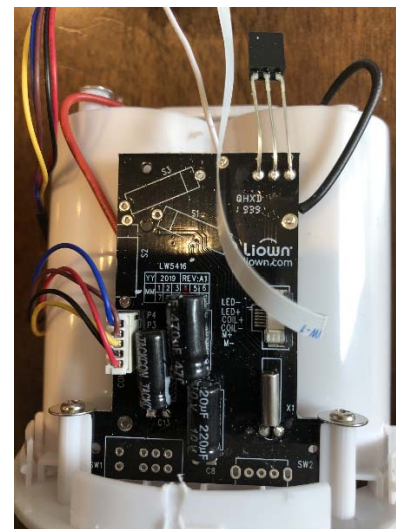
[9.C] a circuit electrically connected to the flame simulator for illuminating the flame simulator;



[9.D] a power source for providing power to the circuit; and


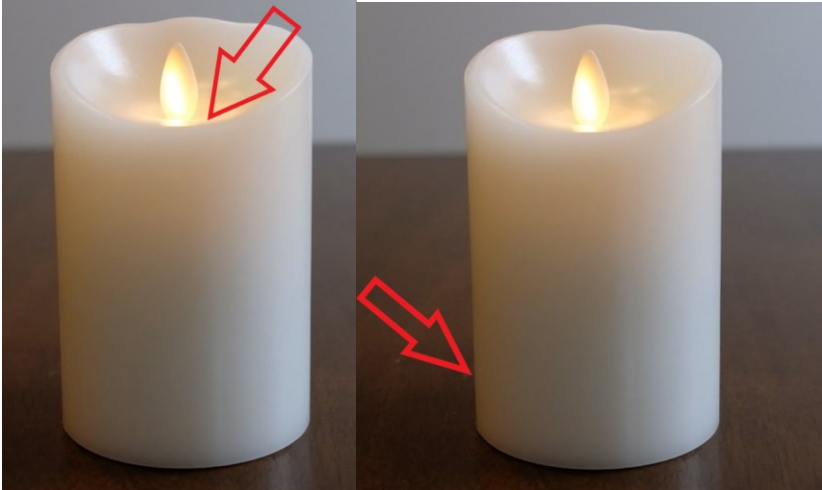




[9.E] a microphone associated with the circuit so that sounds can be programmed.



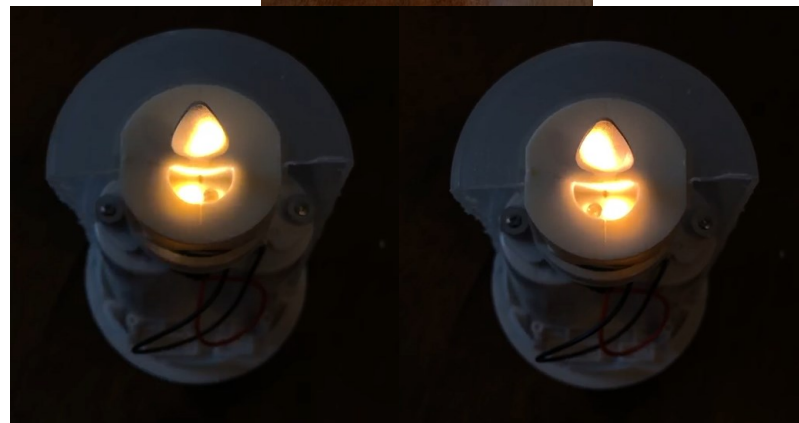
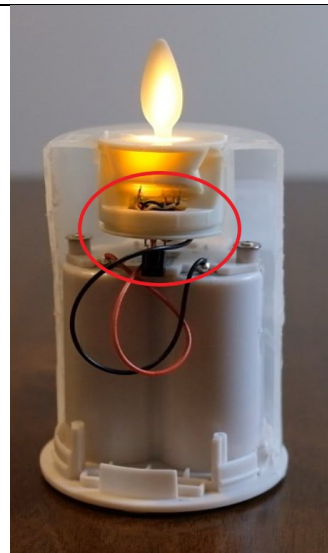
# EXHIBIT 17

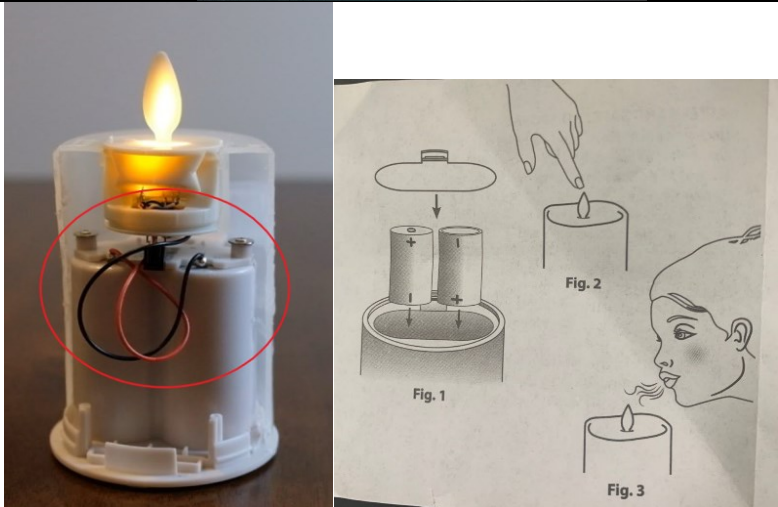
**Infringement of U.S. Patent No. 8,858,043 by Liown (RAZ) Push Flame Candles**

Claims	Liown (RAZ) Push Flame Candle
<p>[1.Pre] A candle having an electrically powered flame simulator comprising:</p>	
<p>[1.A] a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and a chamber therein, wherein the substantially cylindrical body is self-supporting on the lower surface and has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;</p>	

	
<p>[1.B] a flame simulator located substantially within the recess;</p>	

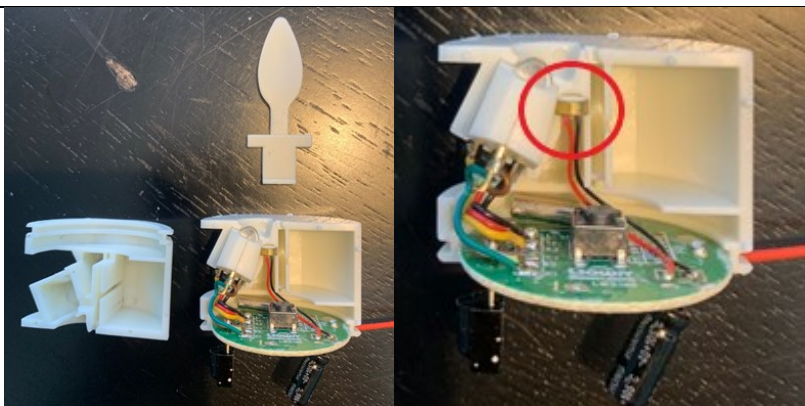
[1.C] a circuit electrically connected to the flame simulator for intermittently illuminating the flame simulator;



	
<p>[1.D] a power source for providing power to the circuit; and</p>	



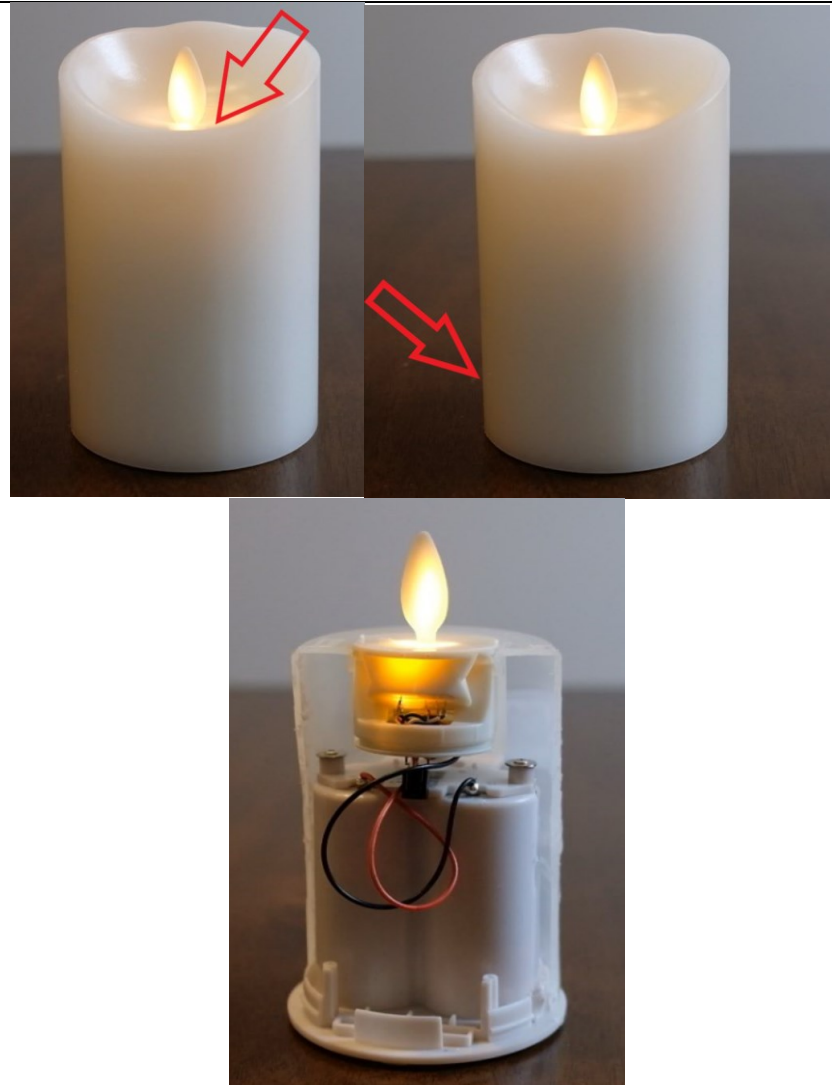
[1.E] a microphone associated with the circuit through which audio sounds can be processed.



[9.Pre] A candle having an electrically powered flame simulator comprising:



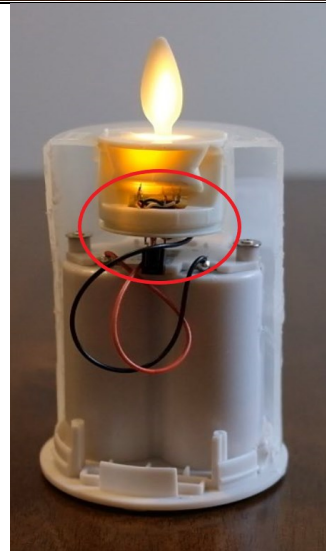
[9.A] a substantially cylindrical body having permanent exterior surfaces comprising an upper portion having a rim on an upper surface that circumscribes a recess, a lower portion with a lower surface, and a chamber therein, wherein the substantially cylindrical body is self-supporting on the lower surface and has a circumference with a central axis extending through the center of the upper portion and center of the lower portion;

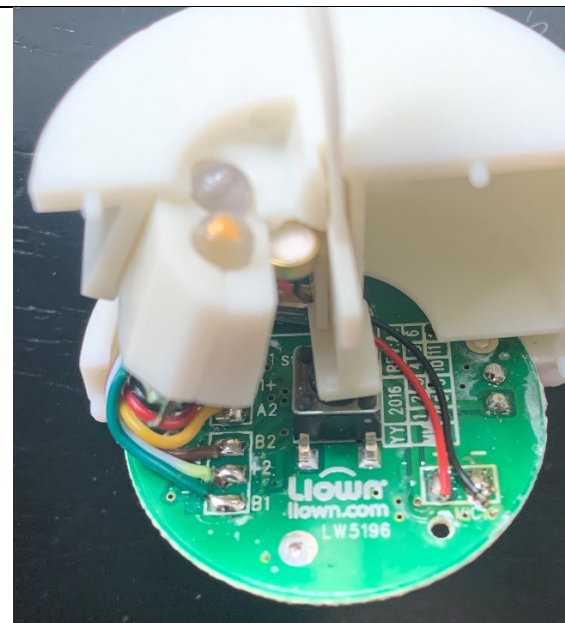


[9.B] a flame simulator located substantially within the recess;

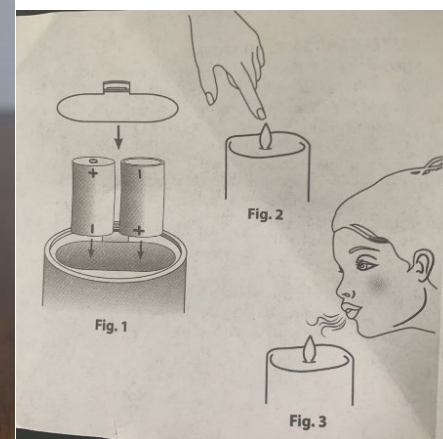
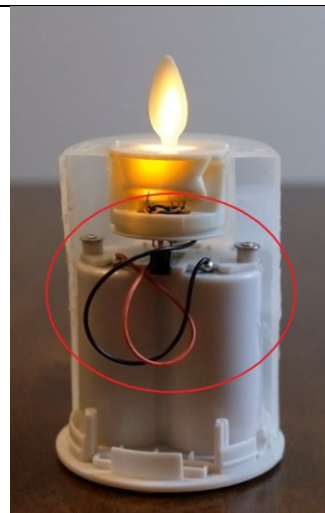


[9.C] a circuit electrically connected to the flame simulator for illuminating the flame simulator;

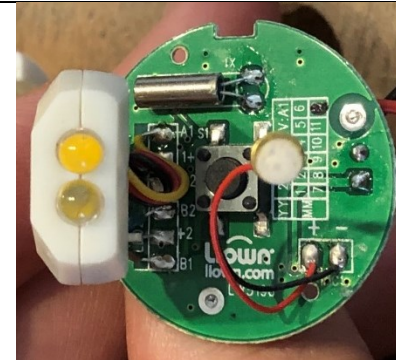




[9.D] a power source for providing power to the circuit; and

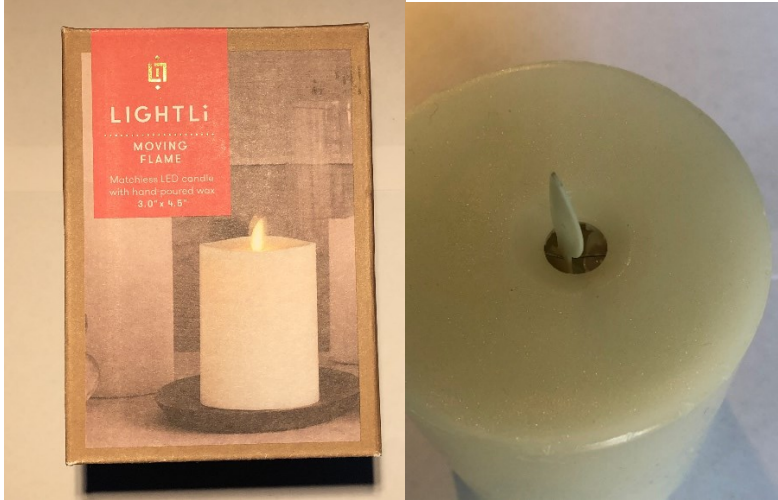



[9.E] a microphone associated with the circuit so that sounds can be programmed.



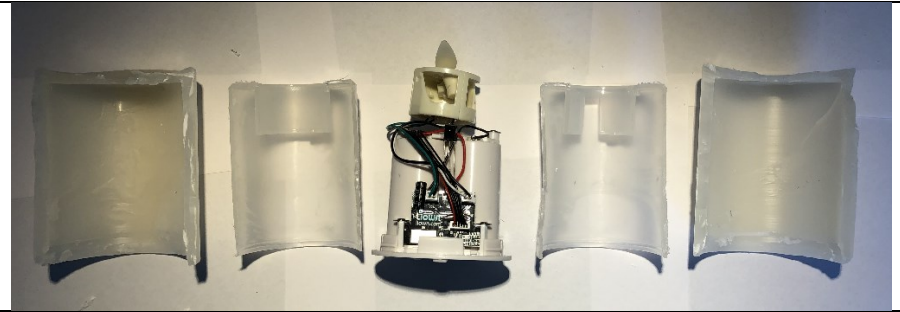
# **EXHIBIT 18**

**Infringement of U.S. Patent No. 6,616,308 by LIGHTLi Moving Flame Candles**

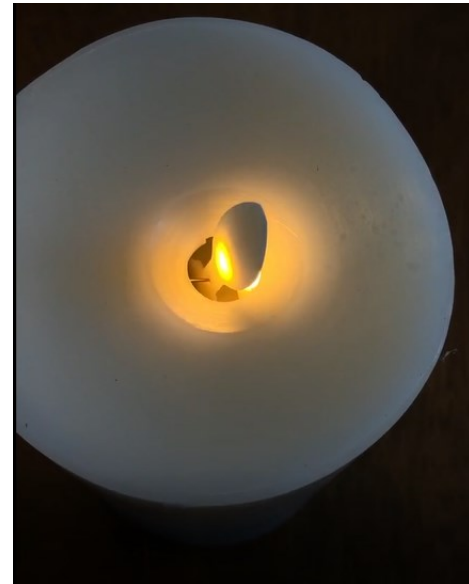
Claims	LIGHTLi Moving Flame Candle
<p>[1.Pre] An ornamental illumination apparatus comprising:</p>	
<p>[1.A] a light diffusing body having permanent exterior surfaces including an upper surface with a depressed center section which appears reduced by melting;</p>	



[1.B] a cavity within the light diffusing body; and




[1.C] a small high intensity light source disposed within the cavity to illuminate from below the bottom of the depressed center section more brightly than the other surfaces of the light diffusing body.



# EXHIBIT 19

**Infringement of U.S. Patent No. 6,616,308 by Matchless Moving Flame Candles**

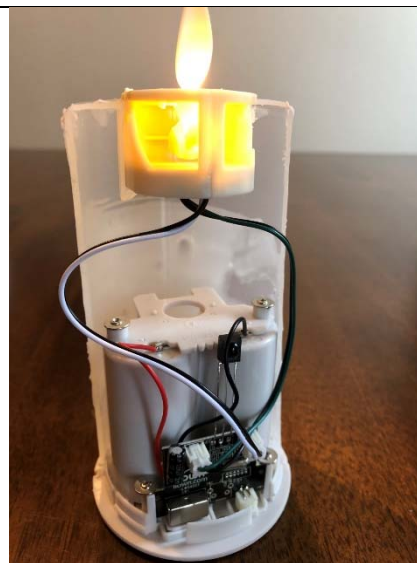
Claims	Matchless Moving Flame Candle
<p>[1.Pre] An ornamental illumination apparatus comprising:</p>	

[1.A] a light diffusing body having permanent exterior surfaces including an upper surface with a depressed center section which appears reduced by melting;



[1.B] a cavity within the light diffusing body; and





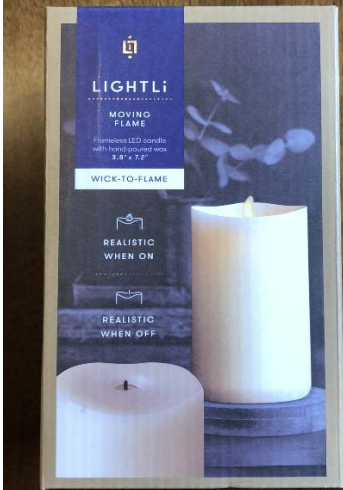

[1.C] a small high intensity light source disposed within the cavity to illuminate from below the bottom of the depressed center section more brightly than the other surfaces of the light diffusing body.



# **EXHIBIT 20**



**Infringement of U.S. Patent No. 6,616,308 by LIGHTLi Wick-to-Flame Candles**

Claims	LIGHTLi Wick-to-Flame Candle
<p>[1.Pre] An ornamental illumination apparatus comprising:</p>	
<p>[1.A] a light diffusing body having permanent exterior surfaces including an upper surface with a depressed center section which appears reduced by melting;</p>	

[1.B] a cavity within the light diffusing body; and







[1.C] a small high intensity light source disposed within the cavity to illuminate from below the bottom of the depressed center section more brightly than the other surfaces of the light diffusing body.



# EXHIBIT 21

# Infringement of U.S. Patent No. 6,616,308 by Matrix Candles

Claims	Matrix Candle
[1.Pre] An ornamental illumination apparatus comprising:	 
[1.A] a light diffusing body having permanent exterior surfaces including an upper surface with a depressed center section which appears reduced by melting;	 

[1.B] a cavity within the light diffusing body; and



[1.C] a small high intensity light source disposed within the cavity to illuminate from below the bottom of the depressed center section more brightly than the other surfaces of the light diffusing body.



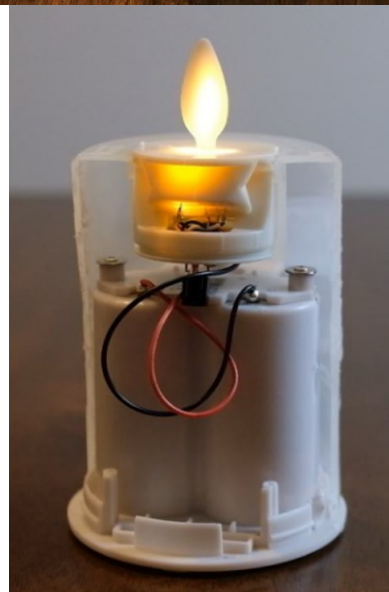
# **EXHIBIT 22**



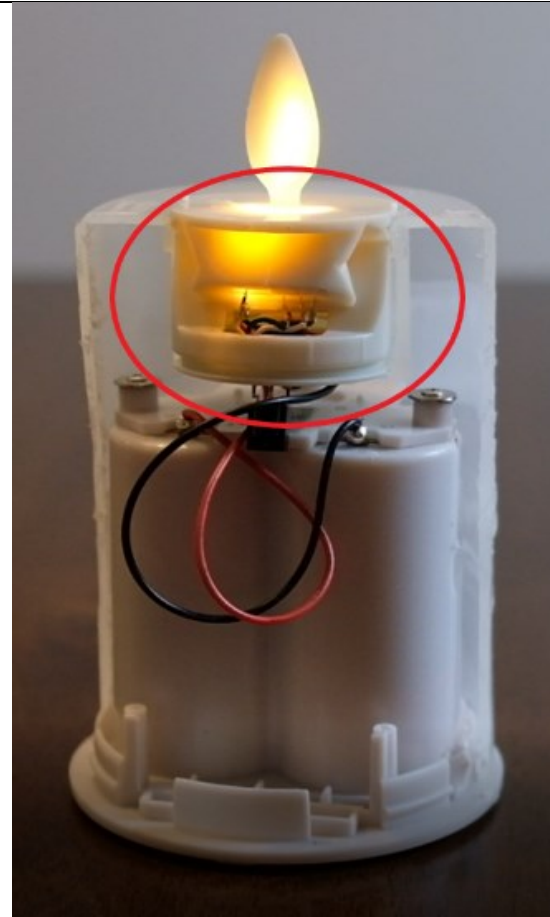
# Infringement of U.S. Patent No. 6,616,308 by Push Flame Candles

Claims	Push Flame Candle
[1.Pre] An ornamental illumination apparatus comprising:	
[1.A] a light diffusing body having permanent exterior surfaces including an upper surface with a depressed center section which appears reduced by melting;	

[1.B] a cavity within the light diffusing body; and



[1.C] a small high intensity light source disposed within the cavity to illuminate from below the bottom of the depressed center section more brightly than the other surfaces of the light diffusing body.





[Pre.8] An imitation candle comprising:



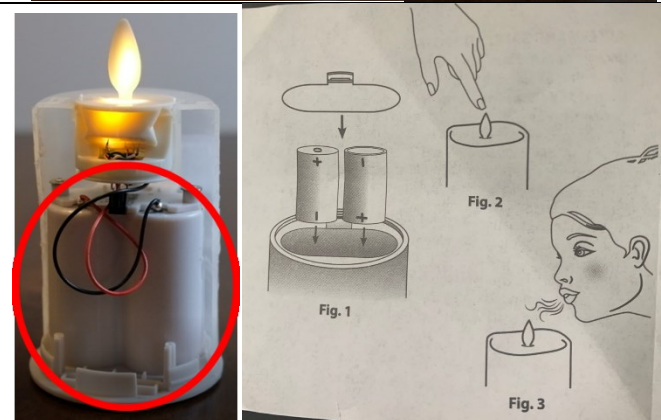
[8.A] an optically translucent body shaped and sized to resemble a candle of sufficient diameter to support a depressed flame while leaving its outer walls intact;



[8.B] a light source disposed within the optically translucent body having a light emission point at an anticipated location for the depressed flame where it cannot be conveniently directly viewed from outside the optically translucent body;



[8.C] a power supply;



[8.D] and a flicker energization signal generator connected between the power supply and the light point source for delivering a varying energization signal to the light source.

