US009883566B1

(12) **United States Patent**
Chen

(10) **Patent No.: US 9,883,566 B1**
(45) **Date of Patent: Jan. 30, 2018**

(54) **CONTROL OF MODULAR LIGHTED ARTIFICIAL TREES**

(71) Applicant: **Willis Electric Co., Ltd.**, Taipei (TW)

(72) Inventor: **Johnny Chen**, Taipei (TW)

(73) Assignee: **Willis Electric Co., Ltd.**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 172 days.

(21) Appl. No.: **14/702,224**

(22) Filed: **May 1, 2015**

Related U.S. Application Data

(60) Provisional application No. 61/987,160, filed on May 1, 2014.

(51) **Int. Cl.**

H05B 37/02	(2006.01)
F21V 33/00	(2006.01)
F21V 23/06	(2006.01)
F21V 23/00	(2015.01)
F21S 4/00	(2016.01)
H05B 33/08	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H05B 37/0272*** (2013.01); ***A47G 33/06*** (2013.01); ***F21S 4/002*** (2013.01); ***F21V 23/001*** (2013.01); ***F21V 23/06*** (2013.01); ***F21V 33/0028*** (2013.01); ***H05B 33/0845*** (2013.01); ***H05B 33/0857*** (2013.01); *F21W 2121/04* (2013.01)

(58) **Field of Classification Search**

CPC H05B 37/0272; H05B 33/0845; H05B 33/0857; A47G 33/06; A47G 33/04; A47G 2033/0827; F21S 4/002; F21S 4/10; F21V 23/001; F21V 23/06; F21V 33/0028; F21V 23/003; F21W 2121/04

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

377,953 A 2/1888 Mills
438,310 A 10/1890 Edison
(Continued)

FOREIGN PATENT DOCUMENTS

CA 1182513 A 2/1985
CN 2102058 U 4/1992
(Continued)

OTHER PUBLICATIONS

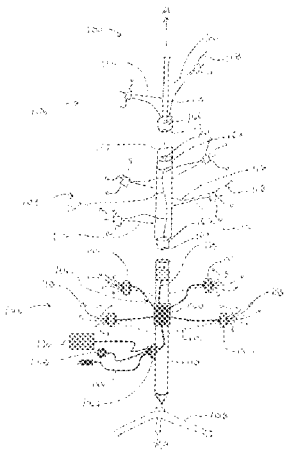
Holtek, "HT2040A Christmas Light Controller" (Mar. 26, 1997) 9 pgs.
(Continued)

Primary Examiner — Bao Q Truong
(74) *Attorney, Agent, or Firm* — Christensen, Fonder, Dardi & Herbert PLLC

(57) **ABSTRACT**

A lighting power and control system for an artificial lighted tree. The system includes: a first primary controller including a processor; a first plurality of sub-controllers, each including a processor, each of the first plurality of sub-controllers in electrical communication with the first primary controller; and a first plurality of lighting elements, each of the first plurality of lighting elements in direct electrical communication with one of the first plurality of sub-controllers. The first primary controller controls each of the first plurality of sub-controllers, and each of the first plurality of sub-controllers selectively powers the plurality of lighting elements according to commands issued by the primary controller.

20 Claims, 10 Drawing Sheets



(51) **Int. Cl.**

A47G 33/06	(2006.01)
F21W 121/04	(2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

735,010	A	7/1903	Zahl
860,406	A	7/1907	McGahan
1,314,008	A	8/1919	McWilliams
1,372,777	A	3/1921	Samuel et al.
1,495,695	A	5/1924	Karr
1,536,332	A	5/1925	Dam
1,590,220	A	6/1926	Wurts
1,694,974	A	12/1928	Glover
2,025,189	A	12/1935	Yanchenko
2,050,364	A	8/1936	Morton
2,072,337	A	3/1937	Kamm
2,112,281	A	3/1938	Ferris
2,186,351	A	1/1940	Stojaneck
2,188,529	A	1/1940	Corina
2,229,211	A	1/1941	Korengold
2,679,911	A	8/1948	Bhend
2,466,499	A	4/1949	Sokolik
2,484,596	A	10/1949	Waltz
2,533,374	A	12/1950	Hyland
2,563,713	A	8/1951	Frei et al.
2,570,751	A	10/1951	Benander
2,636,069	A	4/1953	Gilbert
2,782,296	A	2/1957	Walter
2,806,938	A	9/1957	Henry
2,857,506	A	10/1958	Minteer
2,863,037	A	12/1958	Johnstone
2,910,842	A	11/1959	Sensenig
2,932,811	A	4/1960	Abraham et al.
2,969,456	A	1/1961	Raymaley
2,973,546	A	3/1961	Roche
2,984,813	A	5/1961	Bossi
3,107,966	A	10/1963	Bonhomme
3,115,435	A	12/1963	Abramson
3,118,617	A	1/1964	Hellrich
3,120,351	A	2/1964	Kirsten
3,131,112	A	4/1964	Abramson
3,214,579	A	10/1965	Pacini
3,233,207	A	2/1966	Ahroni et al.
3,286,088	A	11/1966	Ahroni
3,296,430	A	1/1967	Eckert
3,345,482	A	10/1967	Lou
3,398,260	A	8/1968	Martens
3,409,867	A	11/1968	Lessner
3,470,527	A	9/1969	Bonhomme
3,504,169	A	3/1970	Freeburger
3,513,063	A	3/1970	Sloane
3,521,216	A	7/1970	Tolegian
3,522,579	A	8/1970	Matsuya
3,571,586	A	3/1971	Duckworth
3,574,102	A	4/1971	Hermanson
3,585,564	A	6/1971	Skjervoll
3,594,260	A	7/1971	Dieffenbach
3,603,780	A	9/1971	Lu
3,616,107	A	10/1971	Kershner
3,617,732	A	11/1971	Fisher
3,640,496	A	2/1972	Duncan
3,663,924	A	5/1972	Gerlat
3,704,366	A	11/1972	Korb et al.
3,715,708	A	2/1973	Lloyd et al.
3,728,787	A	4/1973	McDonough
3,748,488	A	7/1973	David, Jr.
3,764,862	A	10/1973	Jankowski
3,783,437	A	1/1974	Graff et al.
3,806,399	A	4/1974	Cocjin
3,808,450	A	4/1974	Davis, Jr.
3,812,380	A	5/1974	Davis, Jr.
3,819,457	A	6/1974	Mottel
3,819,459	A	6/1974	Wren
3,834,976	A	9/1974	Mottel
3,862,434	A	1/1975	Davis, Jr.
3,864,580	A	2/1975	Davis, Jr.
3,914,786	A	10/1975	Grossi
3,970,834	A	7/1976	Smith
3,971,619	A	7/1976	Rohrssen
3,985,924	A	10/1976	Pritza
4,012,631	A	3/1977	Creager
4,020,201	A	4/1977	Miller
4,045,868	A	9/1977	Ammon et al.
4,057,735	A	11/1977	Davis, Jr.
4,097,917	A	6/1978	McCaslin
4,109,345	A	8/1978	Sargent et al.
4,125,781	A	11/1978	Davis, Jr.
4,140,823	A	2/1979	Weskamp
4,153,860	A	5/1979	Vonick
4,161,768	A	7/1979	Gauthier et al.
4,215,277	A	7/1980	Weiner et al.
4,245,875	A	1/1981	Shaffer et al.
4,248,916	A	2/1981	Chase
4,273,814	A	6/1981	Koehler
4,291,075	A	9/1981	Puleo
4,305,980	A	12/1981	Koehler
4,340,841	A	7/1982	Schupp
4,343,842	A	8/1982	Chase
4,437,782	A	3/1984	Geisthoff
4,447,279	A	5/1984	Boisvert et al.
4,451,510	A	5/1984	Boisvert et al.
4,462,065	A	7/1984	Rhodes
4,493,523	A	1/1985	Leong et al.
4,496,615	A	1/1985	Huang
4,516,193	A	5/1985	Murphy
4,519,666	A	5/1985	Williams et al.
4,546,041	A	10/1985	Keane et al.
4,573,102	A	2/1986	Norwood
4,590,105	A	5/1986	Shaffer
4,620,270	A	10/1986	Laasko
4,631,650	A	12/1986	Ahroni
4,636,106	A	1/1987	Waisbrod
4,659,597	A	4/1987	Lau
4,662,775	A	5/1987	Faul
4,675,575	A	6/1987	Smith et al.
4,678,926	A	7/1987	Davis
4,712,299	A	12/1987	Loewen et al.
4,720,272	A	1/1988	Durand
4,727,449	A	2/1988	Fleck
4,753,600	A	6/1988	Williams
4,759,729	A	7/1988	Kemppainen et al.
4,769,579	A	9/1988	Jou
4,772,215	A	9/1988	Falk
4,774,113	A	9/1988	Shaffer
4,775,922	A	10/1988	Engel
4,777,573	A	10/1988	Liao
4,779,177	A	10/1988	Ahroni
4,789,570	A	12/1988	Maddock
4,799,902	A	1/1989	Laudig et al.
4,805,075	A	2/1989	Damore
4,807,098	A	2/1989	Ahroni
4,808,885	A	2/1989	Bausch et al.
4,855,880	A	8/1989	Mancusi, Jr.
4,859,205	A	8/1989	Fritz
4,867,690	A	9/1989	Thumma
4,870,547	A	9/1989	Crucefix
4,870,753	A	10/1989	Pfeffer et al.
4,890,000	A	12/1989	Chou
4,894,019	A	1/1990	Howard
4,899,266	A	2/1990	Ahroni
4,908,743	A	3/1990	Miller
4,921,426	A	5/1990	Kawasaki et al.
4,934,964	A	6/1990	Mazelle
5,015,510	A	5/1991	Smith
5,033,976	A	7/1991	Sarian et al.
5,051,877	A	9/1991	Liao
5,071,362	A	12/1991	Martens et al.
5,073,132	A	12/1991	Nottrott
5,088,669	A	2/1992	Zinnbauer
5,091,834	A	2/1992	Kao et al.
5,104,608	A	4/1992	Pickering
5,109,324	A	4/1992	Ahroni
5,121,310	A	6/1992	Ahroni
5,128,595	A	7/1992	Hara

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,139,343 A 8/1992 Lin
5,149,282 A 9/1992 Donato et al.
5,154,508 A 10/1992 Ahroni
5,213,407 A 5/1993 Eisenbraun
5,217,382 A 6/1993 Sparks
5,218,233 A 6/1993 Takahashi
5,281,158 A 1/1994 Lin
5,300,864 A 4/1994 Allen, Jr.
5,334,025 A 8/1994 Föhl
5,342,661 A 8/1994 Wilcox, II
5,349,780 A 9/1994 Dyke
5,350,315 A 9/1994 Cheng et al.
5,366,386 A 11/1994 Liao
5,376,752 A 12/1994 Limeris et al.
5,380,215 A 1/1995 Huang
5,389,008 A 2/1995 Cheng et al.
5,390,463 A 2/1995 Sollner
D356,246 S 3/1995 Adams
5,409,403 A 4/1995 Falossi et al.
5,422,766 A 6/1995 Hack et al.
5,438,154 A 8/1995 Segan et al.
5,442,258 A 8/1995 Shibata
5,453,664 A 9/1995 Harris
5,455,750 A 10/1995 Davis et al.
5,456,620 A 10/1995 Kaminski
5,481,444 A 1/1996 Schulz
D367,257 S 2/1996 Buelow et al.
5,492,429 A 2/1996 Hodges
5,517,390 A 5/1996 Zins
5,518,425 A 5/1996 Tsai
5,536,538 A 7/1996 Hartung
5,541,818 A 7/1996 Ng et al.
5,550,720 A 8/1996 Carroll
5,559,681 A 9/1996 Duarte
5,560,975 A 10/1996 Casper
D375,483 S 11/1996 Tashiro
5,580,159 A 12/1996 Liu
5,586,905 A 12/1996 Marshall et al.
5,605,395 A 2/1997 Peng
5,607,328 A 3/1997 Joly
5,624,283 A 4/1997 Hotea
5,626,419 A 5/1997 Lin
5,629,587 A 5/1997 Gray et al.
5,639,157 A 6/1997 Yeh
5,652,032 A 7/1997 Kaczor et al.
5,653,616 A 8/1997 Hotea
5,695,279 A 12/1997 Sonnleitner et al.
5,702,262 A 12/1997 Brown et al.
5,702,268 A 12/1997 Lien et al.
5,707,136 A 1/1998 Byers
5,709,457 A 1/1998 Hara
5,712,002 A 1/1998 Reilly, III
5,720,544 A 2/1998 Shu
5,722,766 A 3/1998 Shu
5,727,872 A 3/1998 Liou
5,758,545 A 6/1998 Fevre et al.
5,759,062 A 6/1998 Chen
5,775,933 A 7/1998 Chen
5,776,559 A 7/1998 Woolford
5,776,599 A 7/1998 Haluska et al.
5,785,412 A 7/1998 Wu et al.
5,788,361 A 8/1998 Lee
5,791,765 A 8/1998 Lin
5,791,940 A 8/1998 Chen et al.
5,807,134 A 9/1998 Hara
5,816,849 A 10/1998 Schmidt
5,816,862 A 10/1998 Tseng
5,820,248 A 10/1998 Ferguson
5,822,855 A 10/1998 Szczesny et al.
5,828,183 A 10/1998 Wang et al.
5,829,865 A 11/1998 Ahroni
5,834,901 A 11/1998 Shen
5,839,819 A 11/1998 Pan
5,848,838 A 12/1998 Presta
5,852,348 A 12/1998 Lin
5,854,541 A 12/1998 Chou
5,855,705 A 1/1999 Gauthier
5,860,731 A 1/1999 Martinez
5,860,830 A 1/1999 Wu
5,869,151 A 2/1999 Chong
5,878,989 A 3/1999 Allman
5,893,634 A 4/1999 Wang
5,908,238 A 6/1999 Huang
5,921,806 A 7/1999 Shuey
5,934,793 A 8/1999 Rahman
5,937,496 A 8/1999 Benoit et al.
5,938,168 A 8/1999 Adams
5,957,723 A 9/1999 Gort-Barten
5,966,393 A 10/1999 Hide et al.
5,971,810 A 10/1999 Taylor
5,979,859 A 11/1999 Vartanov et al.
6,004,006 A 12/1999 Wang
6,007,362 A 12/1999 Davis et al.
6,030,670 A 2/2000 Chang
6,053,774 A 4/2000 Lin
6,056,427 A 5/2000 Kao
6,065,233 A 5/2000 Rink
6,079,848 A 6/2000 Ahroni
6,084,357 A 7/2000 Janning
6,086,395 A 7/2000 Lloyd et al.
6,091,204 A 7/2000 Chen
6,095,874 A 8/2000 Quaranta
6,099,920 A 8/2000 Kao
6,102,740 A 8/2000 Murakami et al.
6,111,201 A 8/2000 Drane et al.
6,113,430 A 9/2000 Wu
6,116,563 A 9/2000 Tsai
6,117,503 A 9/2000 Lee et al.
6,120,312 A 9/2000 Shu
6,123,433 A 9/2000 Chen
6,139,376 A 10/2000 Ooya et al.
6,147,367 A 11/2000 Yang et al.
6,149,448 A 11/2000 Haller et al.
6,155,697 A 12/2000 Ahroni
6,162,515 A 12/2000 Hill
6,203,169 B1 3/2001 Coushaine et al.
6,217,191 B1 4/2001 Wu et al.
6,217,199 B1 4/2001 Lo
6,228,442 B1 5/2001 Coco
6,241,559 B1 6/2001 Taylor
6,245,425 B1 6/2001 McCullough et al.
6,257,736 B1 7/2001 Fehrenbach
6,257,740 B1 7/2001 Gibboney, Jr.
6,257,793 B1 7/2001 Lin
6,261,119 B1 7/2001 Green
6,273,584 B1 8/2001 Wang et al.
6,276,120 B1 8/2001 Adriaensen et al.
6,283,797 B1 9/2001 Wu
6,285,140 B1 9/2001 Ruxton
6,292,901 B1 9/2001 Lys et al.
6,320,327 B1 11/2001 Lavatelli et al.
6,328,593 B1 12/2001 Chang et al.
6,347,965 B1 2/2002 Pan
D454,110 S 3/2002 Andre et al.
6,354,719 B1 3/2002 Pan
6,361,368 B1 3/2002 Tseng
6,363,607 B1 4/2002 Chen et al.
6,368,130 B1 4/2002 Fukuda
6,407,411 B1 6/2002 Wojnarowski et al.
6,452,317 B1 9/2002 Tseng
6,457,839 B1 10/2002 Grandoit
6,458,435 B1 10/2002 Lai
6,514,581 B1 2/2003 Gregory
6,533,437 B1 3/2003 Ahroni
6,541,800 B2 4/2003 Barnett et al.
6,544,070 B1 4/2003 Radliff
6,547,584 B2 4/2003 Myer et al.
6,571,340 B1 5/2003 Lee
6,576,844 B1 6/2003 Kamata
6,580,182 B2 6/2003 Janning
6,588,914 B1 7/2003 Tang
6,592,094 B1 7/2003 Kao
6,595,657 B1 7/2003 Shieh
D478,310 S 8/2003 Andre et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,609,814	B2	8/2003	Ahroni	
6,623,291	B1	9/2003	Tsai	
6,634,766	B1	10/2003	Gordon	
6,641,417	B2	11/2003	Tanaka	
6,644,836	B1	11/2003	Adams	
6,653,797	B2	11/2003	Puleo, Sr. et al.	
D483,721	S	12/2003	Kim et al.	
6,666,734	B2	12/2003	Fukatsu	
6,672,750	B1	1/2004	Kao	
D486,385	S	2/2004	Smith-Kielland et al.	
6,733,167	B1	5/2004	Kao	
6,752,512	B2	6/2004	Pan	
6,774,549	B2	8/2004	Tsai et al.	
6,794,825	B1	9/2004	Kao	
6,805,463	B2	10/2004	Shieh	
6,824,293	B2	11/2004	Chang	
6,830,358	B2	12/2004	Allen	
6,840,655	B2	1/2005	Shen	
6,840,802	B2	1/2005	Shepherd	
6,866,394	B1	3/2005	Hutchins et al.	
6,869,316	B2	3/2005	Hinkle et al.	
6,883,951	B2	4/2005	Wu	
6,884,083	B2	4/2005	Shepherd	
6,908,215	B2	6/2005	Wu	
6,929,383	B1	8/2005	Janning	
D509,797	S	9/2005	Milan	
6,942,355	B1	9/2005	Castiglia	
6,951,405	B2	10/2005	Yao	
6,957,971	B2	10/2005	Wu	
6,962,498	B2	11/2005	Kohen	
7,021,598	B2	4/2006	Kao	
7,029,145	B2	4/2006	Frederick	
7,045,965	B2	5/2006	Li et al.	
7,052,156	B2	5/2006	Primeau	
7,055,980	B2	6/2006	Wu	
7,055,981	B2	6/2006	Yao	
7,066,628	B2	6/2006	Allen	
7,066,739	B2	6/2006	McLeish	
7,108,514	B2	9/2006	Chen et al.	
D530,277	S	10/2006	Lin	
7,132,139	B2	11/2006	Yang	
7,144,610	B1	12/2006	Estes et al.	
7,145,105	B2	12/2006	Gaulard	
7,147,518	B2	12/2006	Marechal et al.	
7,186,050	B2	3/2007	Dean et al.	
7,192,303	B2	3/2007	Kohen	
7,204,720	B1	4/2007	Shiu	
7,207,844	B2	4/2007	Peng	
7,235,815	B2	6/2007	Wang	
7,253,556	B1	8/2007	Gibboney	
7,253,714	B1	8/2007	Tsui	
7,264,392	B2	9/2007	Massabki et al.	
7,270,450	B2	9/2007	Chan	
7,311,566	B2	12/2007	Dent	
7,315,692	B2	1/2008	Chow	
7,318,744	B2	1/2008	Kuo	
7,326,091	B2	2/2008	Nania et al.	
7,371,115	B1	5/2008	Hsieh et al.	
7,393,019	B2	7/2008	Taga et al.	
7,422,489	B1	9/2008	Tseng	
D580,355	S	11/2008	Hussaini et al.	
7,445,824	B2	11/2008	Leung et al.	
7,453,194	B1	11/2008	Gibboney	
D582,846	S	12/2008	Lett	
7,462,066	B2	12/2008	Kohen	
D585,384	S	1/2009	Andre et al.	
7,473,024	B2	1/2009	Gibboney	
7,527,508	B1	5/2009	Lee et al.	
7,554,266	B1	6/2009	Chen	
D598,374	S	8/2009	Sasada	
7,575,362	B1	8/2009	Hsu	
7,581,870	B2	9/2009	Massabki et al.	
7,585,187	B2	9/2009	Daily et al.	
7,585,552	B2	9/2009	Meseke	
7,609,006	B2	10/2009	Gibboney	
D608,685	S	1/2010	Krize	
7,652,210	B2	1/2010	White	
D609,602	S	2/2010	Krize	
D611,409	S	3/2010	Green et al.	
7,695,298	B2	4/2010	Arndt et al.	
7,893,627	B2	2/2011	Li	
D638,355	S	5/2011	Chen	
8,007,129	B2	8/2011	Yang	
8,047,700	B2	11/2011	Massabki et al.	
8,053,042	B1	11/2011	Loomis	
8,062,718	B2	11/2011	Schooley	
8,092,255	B2	1/2012	Wang	
8,096,833	B2	1/2012	Tobey	
8,100,546	B2	1/2012	Lutz et al.	
8,113,889	B2	2/2012	Zhang et al.	
8,132,360	B2	3/2012	Jin et al.	
8,132,649	B2	3/2012	Rogers	
8,203,275	B2	6/2012	Ruxton	
8,235,737	B2	8/2012	Cheng et al.	
8,298,633	B1	10/2012	Chen	
8,348,466	B2	1/2013	Plumb et al.	
D678,211	S	3/2013	Chen	
8,390,306	B2	3/2013	Hamann et al.	
8,450,950	B2	5/2013	McRae	
8,454,186	B2	6/2013	Chen	
8,454,187	B2	6/2013	Chen	
8,469,734	B2	6/2013	Chen	
8,469,750	B2	6/2013	Chen	
D686,523	S	7/2013	Chen	
8,491,323	B2	7/2013	Ishibashi	
8,534,186	B2	9/2013	Glucksman et al.	
8,562,175	B2	10/2013	Chen	
8,568,015	B2	10/2013	Chen	
8,569,960	B2 *	10/2013	Chen	A47G 33/06 315/185 R
8,573,548	B2	11/2013	Kuhn et al.	
8,592,845	B2	11/2013	Chen	
D696,153	S	12/2013	Chen	
8,608,342	B2	12/2013	Chen	
8,777,648	B2	7/2014	Kitajima et al.	
8,853,721	B2	10/2014	Chen	
8,863,416	B2	10/2014	Leung et al.	
8,870,404	B1	10/2014	Chen	
8,876,321	B2	11/2014	Chen	
8,916,242	B2	12/2014	Fu et al.	
8,959,810	B1	2/2015	Leung et al.	
8,974,072	B2	3/2015	Chen	
9,044,056	B2	6/2015	Chen	
9,055,777	B2	6/2015	Chen	
9,066,617	B2	6/2015	Chen	
9,119,495	B2	9/2015	Leung et al.	
9,140,438	B2	9/2015	Chen	
9,157,587	B2	10/2015	Chen	
9,157,588	B2	10/2015	Chen	
9,179,793	B2	11/2015	Chen	
9,220,361	B1	12/2015	Chen	
9,222,656	B2	12/2015	Chen	
9,243,788	B2	1/2016	Chen	
9,402,498	B2	8/2016	McRae	
9,439,528	B2	9/2016	Chen	
9,441,800	B1	9/2016	Chen	
9,441,823	B1	9/2016	Chen	
9,526,286	B2	12/2016	Chen	
9,572,446	B2	2/2017	Chen	
9,593,831	B2 *	3/2017	Yu	F21V 23/06
9,648,919	B2	5/2017	Chen	
9,617,074	B2	6/2017	Chen	
9,677,748	B1	6/2017	Chen	
9,677,749	B2	6/2017	Chen	
9,700,169	B2	7/2017	Wong	
2002/0002015	A1	1/2002	Mochizuki et al.	
2002/0097573	A1	7/2002	Shen	
2002/0109989	A1	8/2002	Chuang	
2002/0118540	A1	8/2002	Ingrassia	
2002/0149936	A1	10/2002	Mueller et al.	
2003/0096542	A1	5/2003	Kojima	
2003/0121781	A1	7/2003	Prohaska et al.	
2003/0142494	A1	7/2003	Ahroni	
2003/0198044	A1	10/2003	Lee	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0198048	A1	10/2003	Frederick
2003/0206412	A1	11/2003	Gordon
2003/0218412	A1	11/2003	Shieh
2003/0231779	A1	12/2003	Billington
2004/0004435	A1	1/2004	Hsu
2004/0012950	A1	1/2004	Pan
2004/0080281	A1	4/2004	Pan
2004/0090770	A1	5/2004	Primeau
2004/0096596	A1	5/2004	Palmer, III et al.
2004/0105270	A1	6/2004	Shieh
2004/0115984	A1	6/2004	Rudy et al.
2004/0145916	A1	7/2004	Wu
2004/0161552	A1	8/2004	Butts, Jr.
2004/0182597	A1	9/2004	Smith et al.
2005/0048226	A1	3/2005	Gary et al.
2005/0077525	A1	4/2005	Lynch et al.
2005/0122723	A1	6/2005	Frederick
2005/0239308	A1	10/2005	Cummings et al.
2005/0249892	A1	11/2005	Rocheleau
2005/0286267	A1	12/2005	Wang
2006/0000634	A1	1/2006	Arakawa
2006/0048397	A1	3/2006	King et al.
2006/0146578	A1	7/2006	Kuo
2006/0158138	A1	7/2006	Walter
2006/0164834	A1	7/2006	Kao
2006/0270250	A1	11/2006	Allen
2006/0274556	A1	12/2006	Massabki et al.
2007/0091606	A1	4/2007	Reed
2007/0092664	A1	4/2007	Chun
2007/0159109	A1	7/2007	Gibboney
2007/0177402	A1	8/2007	Wu
2007/0230174	A1	10/2007	Hicks et al.
2007/0253191	A1	11/2007	Chin et al.
2007/0273296	A9	11/2007	Janning
2008/0007951	A1	1/2008	Chan
2008/0025024	A1	1/2008	Yu
2008/0107840	A1	5/2008	Leung et al.
2008/0149791	A1	6/2008	Bradley
2008/0186731	A1	8/2008	Graham
2008/0186740	A1	8/2008	Huang et al.
2008/0205020	A1	8/2008	Vich
2008/0283717	A1	11/2008	Kim et al.
2008/0296604	A1	12/2008	Chou et al.
2008/0303446	A1	12/2008	Ding
2008/0307646	A1	12/2008	Zaderej et al.
2009/0002991	A1	1/2009	Huang
2009/0003012	A1	1/2009	Hsu
2009/0023315	A1	1/2009	Pfeiffer
2009/0059578	A1	3/2009	Lau
2009/0213620	A1	8/2009	Lee
2009/0260852	A1	10/2009	Schaffer
2009/0289560	A1	11/2009	Oliva
2010/0000065	A1	1/2010	Cheng et al.
2010/0053991	A1	3/2010	Boggs
2010/0067242	A1	3/2010	Fung
2010/0072747	A1	3/2010	Krize
2010/0099287	A1	4/2010	Colburn et al.
2010/0136808	A1	6/2010	Vanzo
2010/0159713	A1	6/2010	Nishihira et al.
2010/0195332	A1	8/2010	Wasem
2010/0196628	A1	8/2010	Shooley
2010/0263911	A1	10/2010	Watanabe
2011/0062875	A1	3/2011	Altamura
2011/0076425	A1	3/2011	Cheng et al.
2011/0256750	A1	10/2011	Chen
2012/0009360	A1	1/2012	Fu et al.
2012/0076957	A1	3/2012	Chen
2012/0098465	A1	4/2012	Rothschild
2013/0093334	A1	4/2013	Lin et al.
2013/0108808	A1	5/2013	Leung et al.
2013/0119893	A1	5/2013	Chen
2013/0120971	A1	5/2013	Chen
2013/0163231	A1	6/2013	Chen
2013/0301245	A1	11/2013	Chen
2013/0301247	A1	11/2013	Chen
2013/0308301	A1	11/2013	Chen
2013/0309908	A1	11/2013	Sandoval et al.
2014/0087094	A1	3/2014	Leung et al.
2014/0215864	A1	8/2014	Fischer, Jr. et al.
2014/0268689	A1	9/2014	Chen
2014/0287618	A1	9/2014	Chen
2014/0334134	A1	11/2014	Loomis
2015/0029703	A1	1/2015	Chen
2015/0070878	A1	3/2015	Yu
2015/0157159	A1	6/2015	Leung et al.
2015/0272250	A1	10/2015	Chen
2016/0007430	A1	1/2016	Kidakarn
2016/0021957	A1	1/2016	Chen
2016/0021958	A1	1/2016	Chen
2016/0033097	A1	2/2016	Chen

FOREIGN PATENT DOCUMENTS

CN	2242654	Y	12/1996
CN	1181693		5/1998
CN	2332290	Y	8/1999
CN	2484010	Y	4/2002
CN	1509670	A	7/2004
CN	2631782	Y	8/2004
CN	2751226	Y	1/2006
CN	100409504	C	9/2007
CN	100409506	C	8/2008
CN	201187701	Y	1/2009
CN	201829727	U	5/2011
CN	102224645	A	10/2011
CN	202473314	U	10/2012
DE	8436328		4/1985
DE	10235081	A1	2/2004
EP	434425	A1	6/1991
EP	0552741		7/1993
EP	0342050	B1	8/1995
EP	0727842		8/1996
EP	895742	B1	2/1999
EP	0920826	A1	6/1999
EP	1 049 206	A2	11/2000
EP	1763115	A2	3/2007
EP	2533374	A1	12/2012
FR	1215214		4/1960
GB	1150390		4/1969
GB	1245214		9/1971
GB	2112281	A	7/1983
GB	2137086	A	10/1984
GB	2 169 198	A	7/1986
GB	2172135	A	9/1986
GB	2178910	A	2/1987
GB	2208336	A	3/1989
GB	2221104	A	1/1990
GB	2396686	A	6/2004
JP	H11121123	A	4/1999
WO	WO 91/10093		7/1991
WO	WO 96/24966		8/1996
WO	WO 96/26661	A1	9/1996
WO	WO 2002/075862		9/2002
WO	WO 2004/008581	A1	1/2004
WO	WO 2007/140648	A1	12/2007
WO	WO 2009/115860	A1	9/2009
WO	WO 2010/082049	A1	2/2010

OTHER PUBLICATIONS

Mosdesign Semiconductor Corp. "8 Functions Xmas Light Control" (May 14, 2002) (2 pgs.).

* cited by examiner

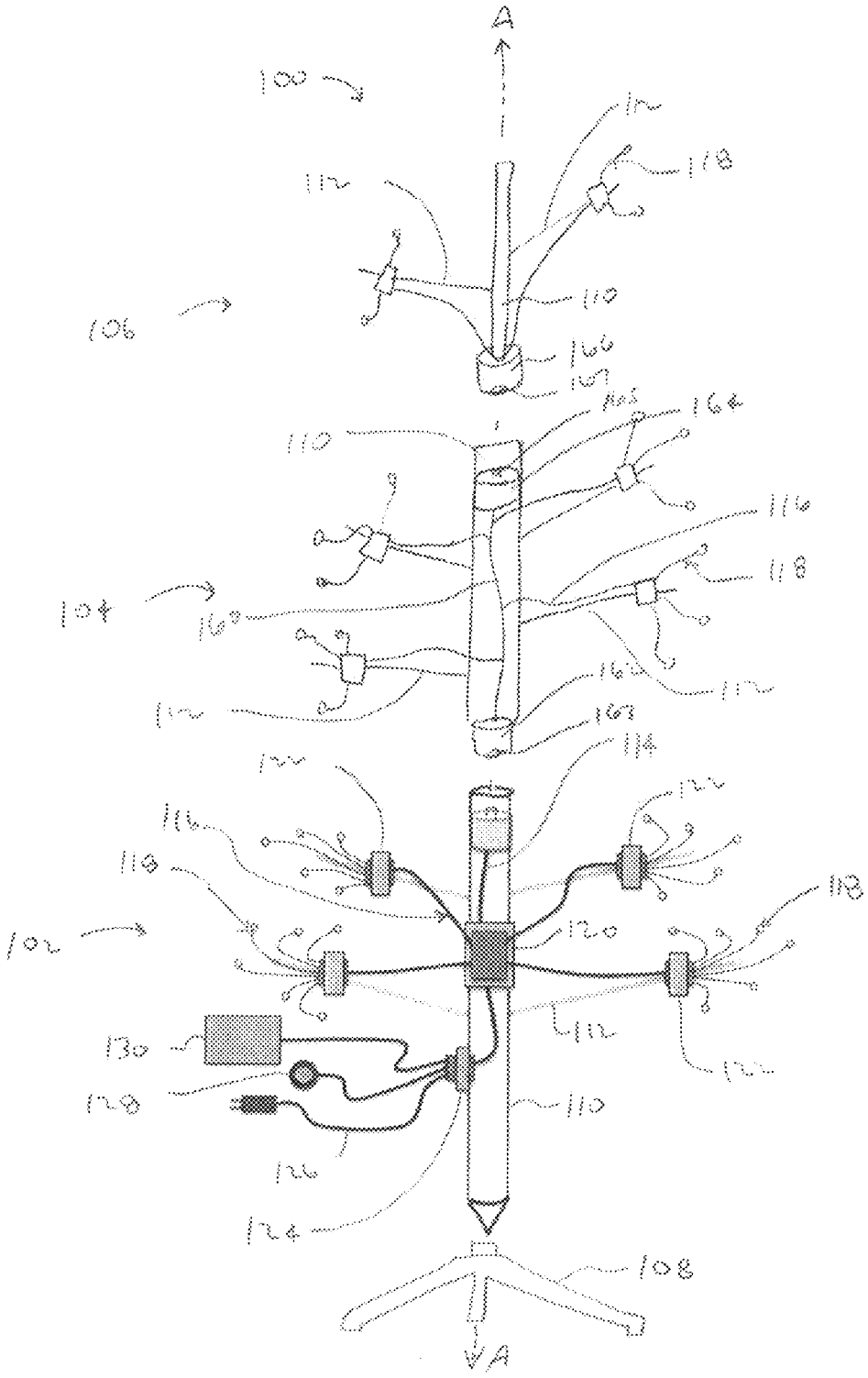

A
100
112
118
110
106
166
167
110
164
116
118
104
160
112
167
114
112
116
110
102
120
112
130
128
110
126
124
108
A

FIG. 1

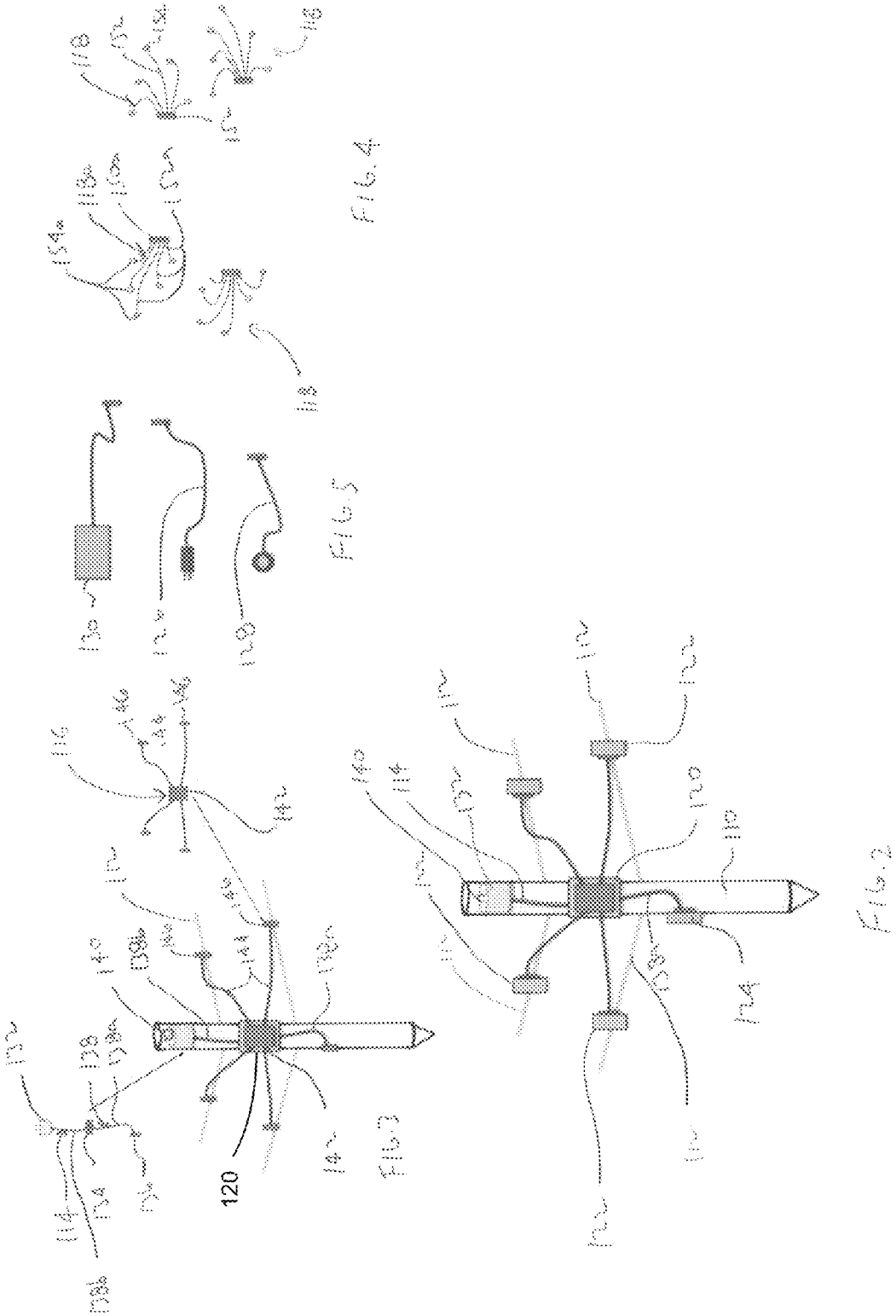


FIG 2

FIG 3

FIG 4

FIG 5

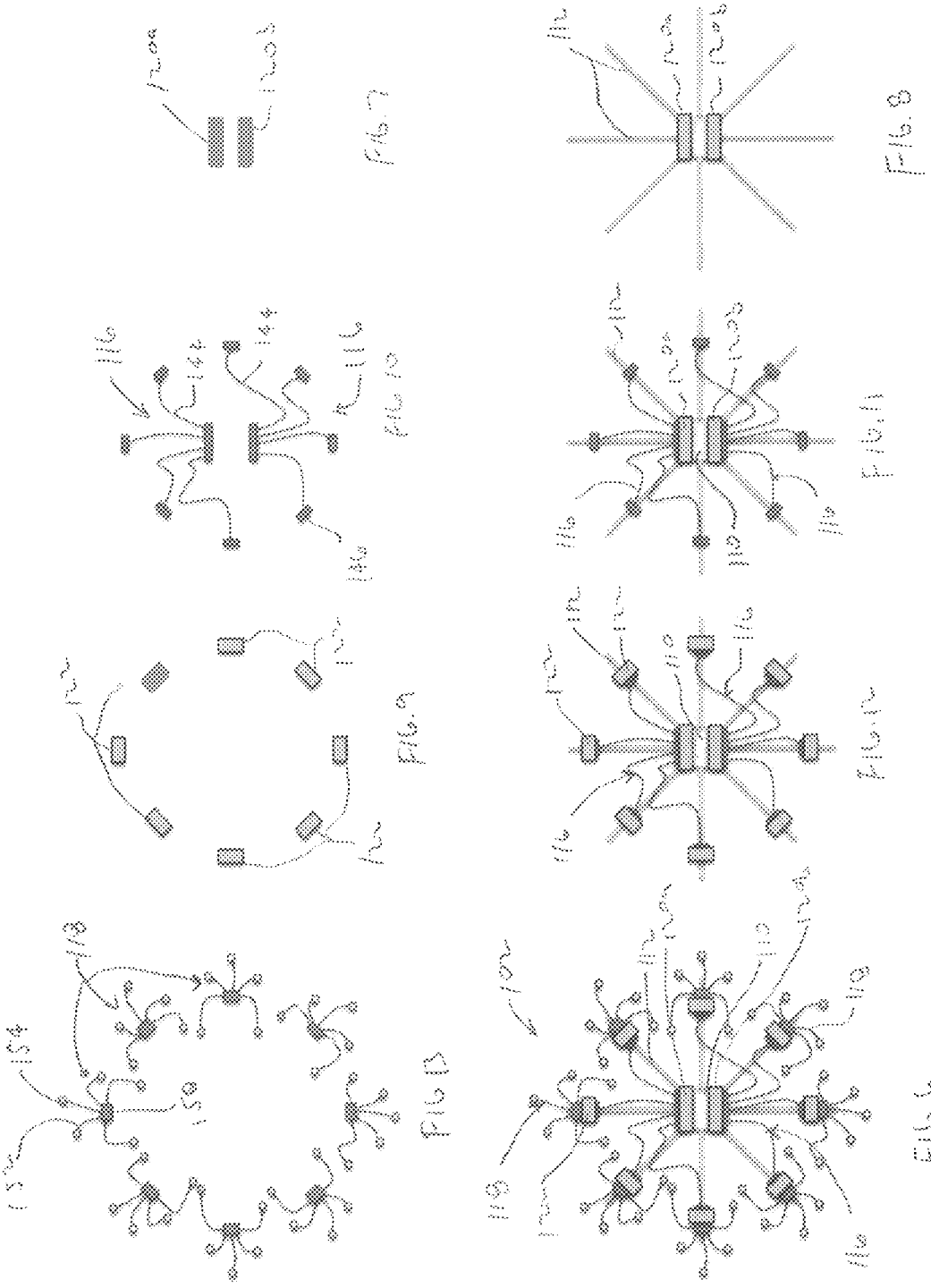


FIG. 4
FIG. 5
FIG. 6
FIG. 7
FIG. 8
FIG. 9
FIG. 10
FIG. 11
FIG. 12

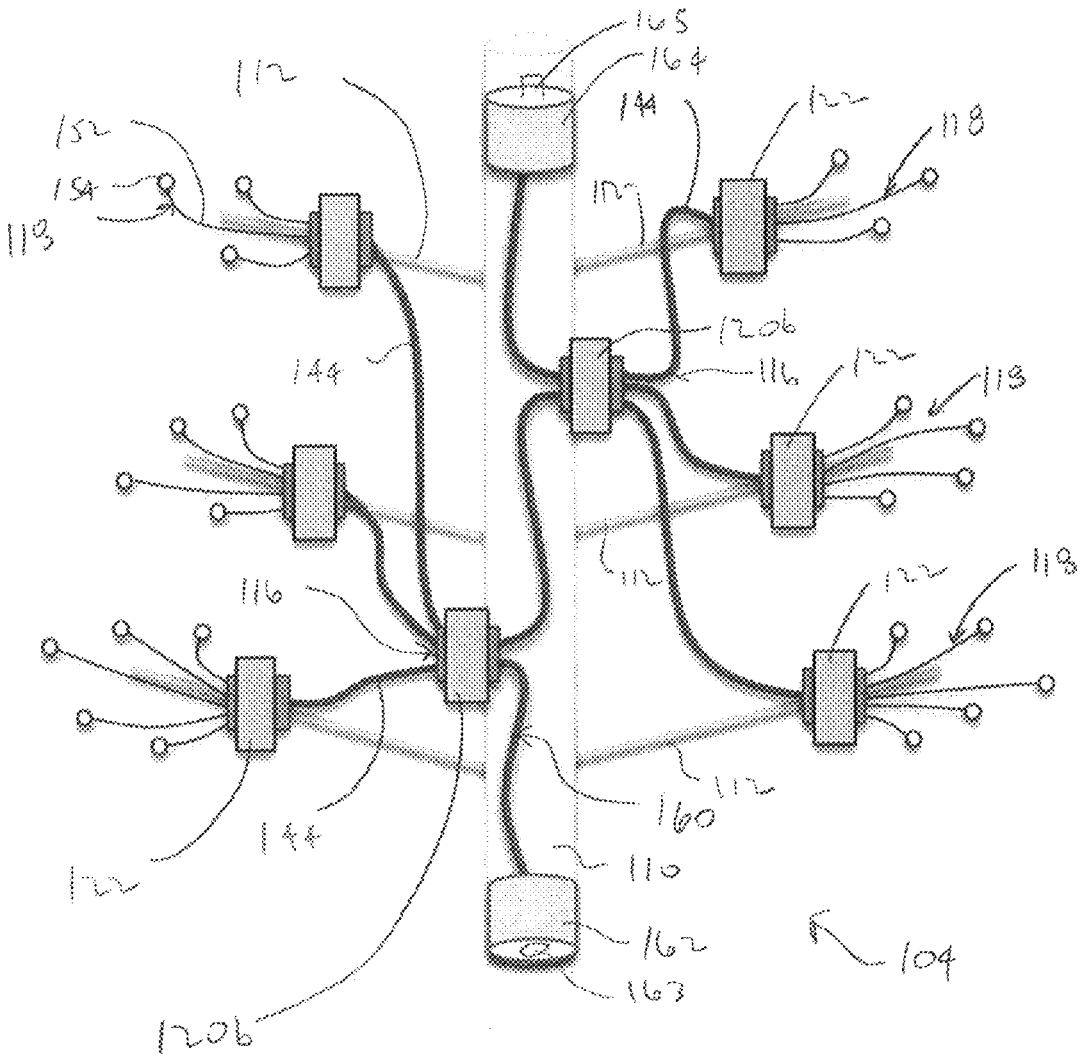


FIG. 14

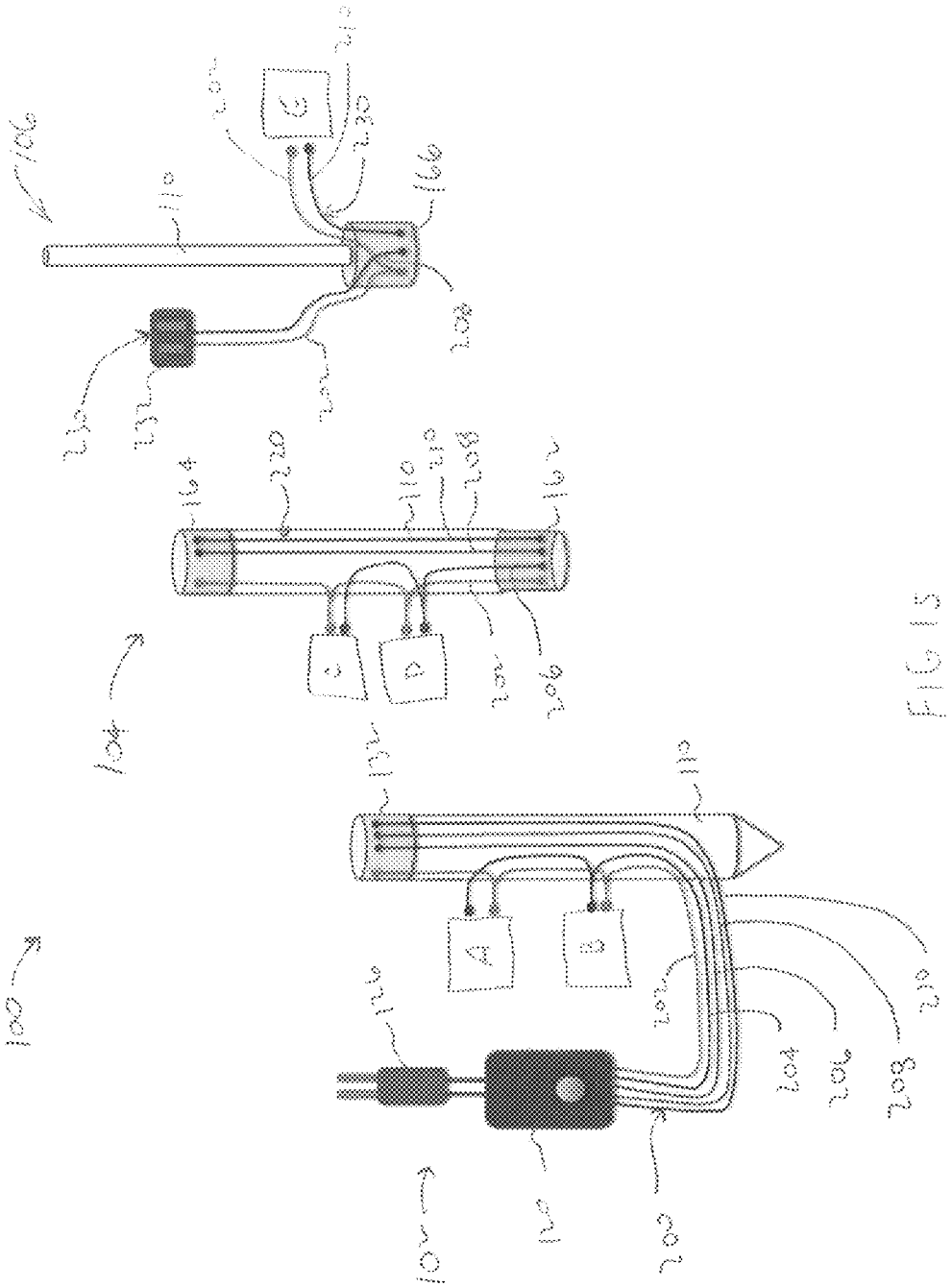

100
101
102
104
106
108
110
112
114
116
118
120
122
124
126
128
130
132
134
136
138
140
142
144
146
148
150
152
154
156
158
160
162
164
166
168
170
172
174
176
178
180
182
184
186
188
190
192
194
196
198
200
202
204
206
208
210
212

FIG 15

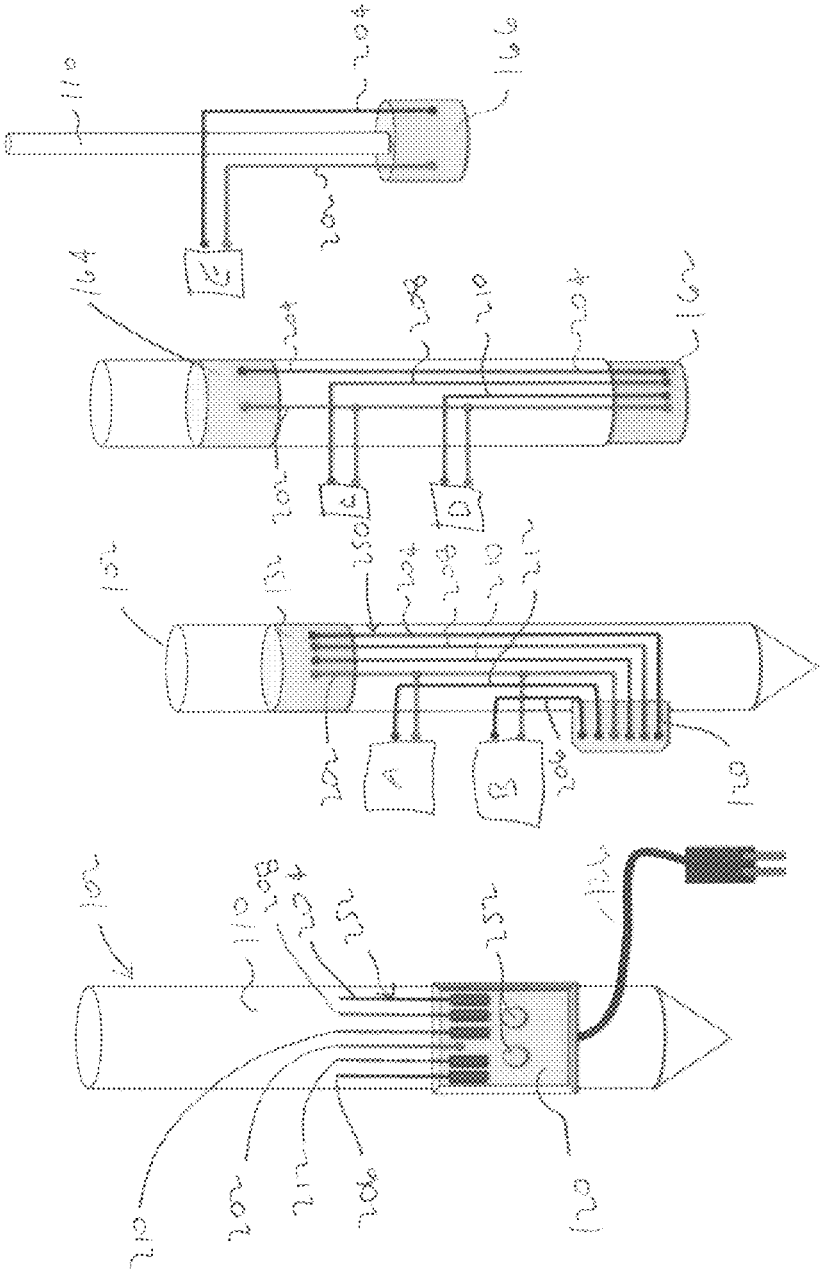
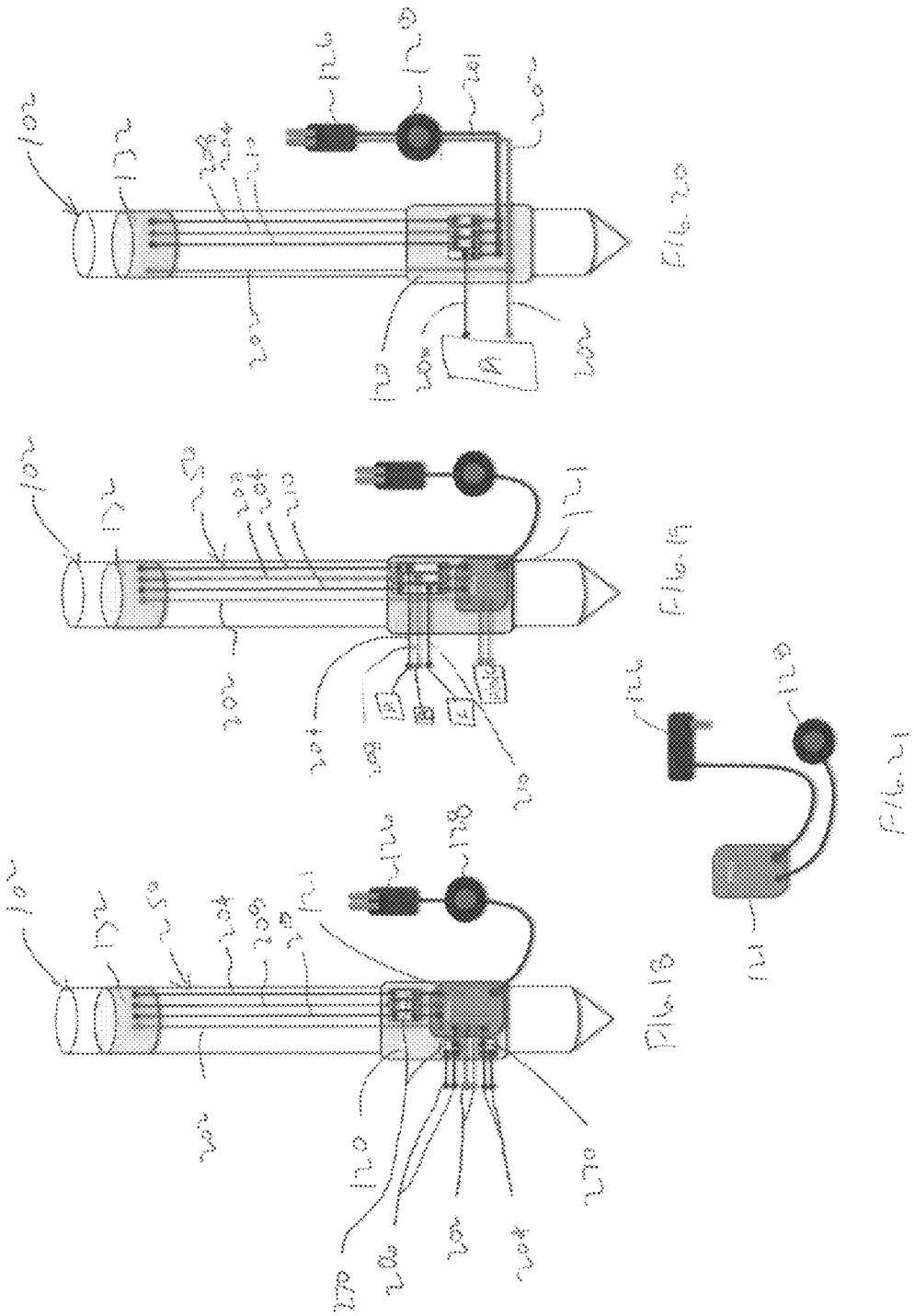


FIG 16

FIG 17



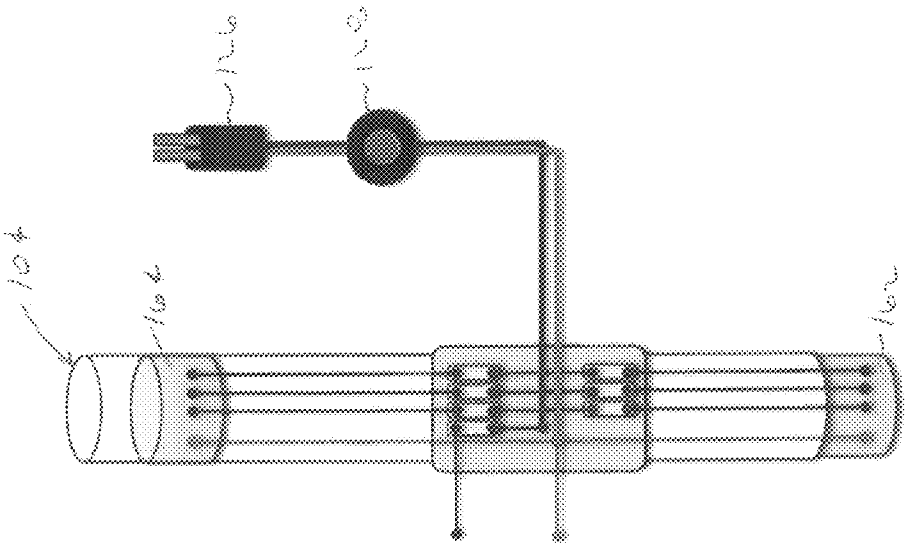


FIG. 23

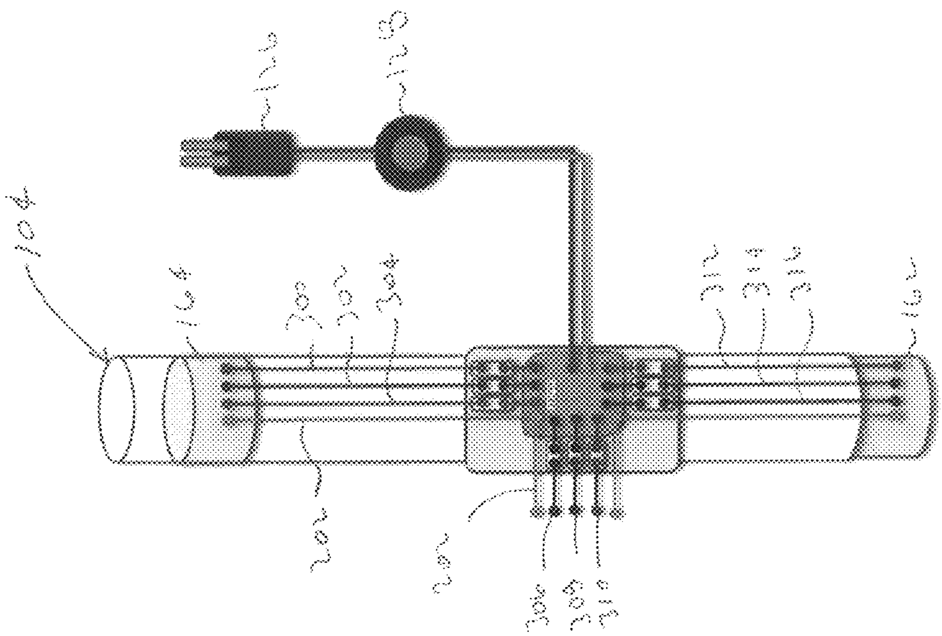


FIG. 22

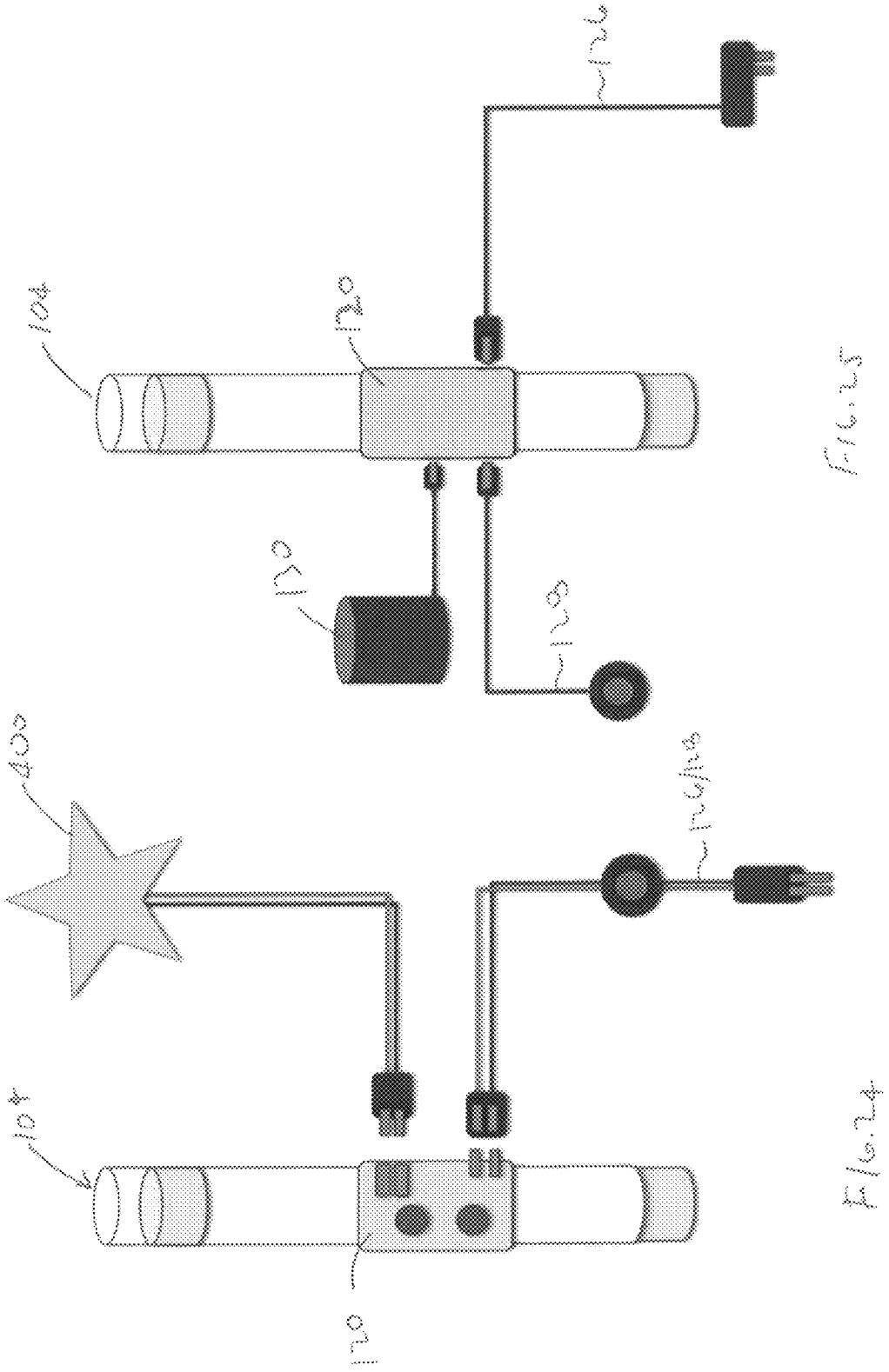
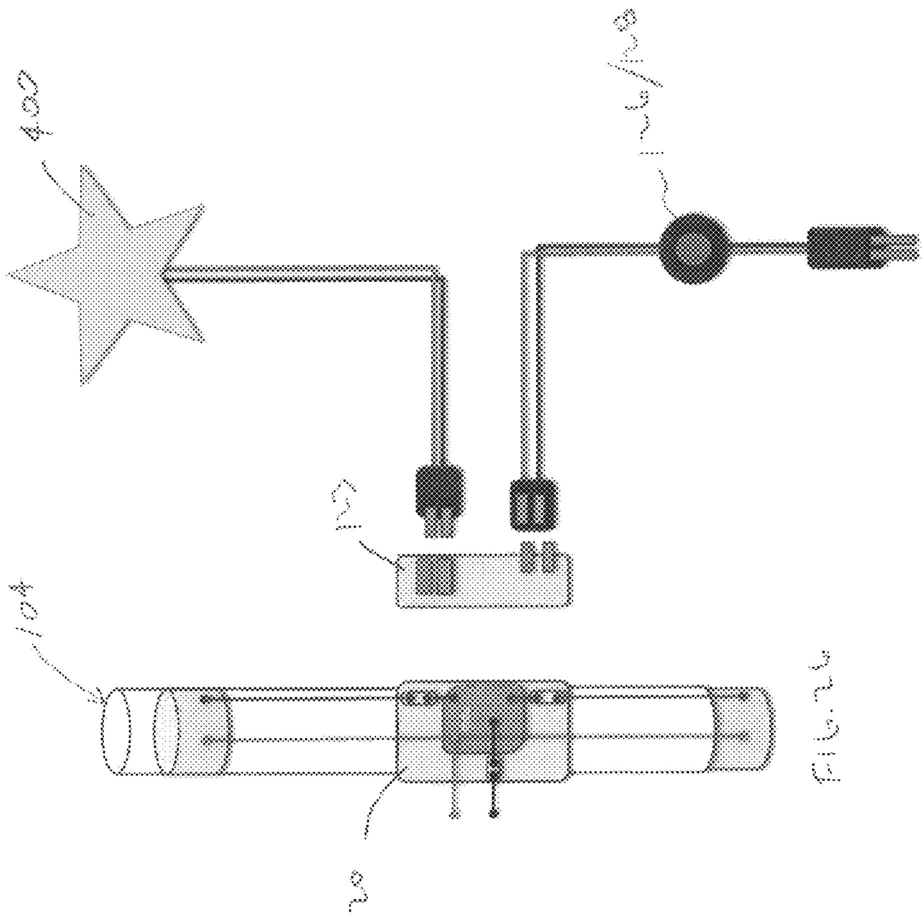


FIG. 2E

FIG. 2A



CONTROL OF MODULAR LIGHTED ARTIFICIAL TREES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of Provisional Application No. 61/987,160, filed May 1, 2014, which is incorporated herein in its entirety by reference.

FIELD OF THE INVENTION

The present invention is generally directed to lighted artificial trees. More specifically, the present invention is directed to controlling electronic features, including lights, of lighted artificial trees having multiple tree and trunk sections.

BACKGROUND OF THE INVENTION

Artificial lighted trees often include decorative light strings distributed about the branches of the trees. Such decorative light strings may be of the traditional type having power plugs that may be connected to one another, and to an external power supply. Such well known configurations require that multiple power plugs of multiple light strings be plugged in, resulting in a web of wires wound about the branches of the tree.

Not only are such traditional systems tedious to assemble, but such systems provide limited control of the individual light strings and their lamps.

SUMMARY OF THE INVENTION

An embodiment of the invention includes a lighting power and control system for an artificial lighted tree, the system comprising: a first primary controller including a processor, a first plurality of sub-controllers, each including a processor, each of the first plurality of sub-controllers in electrical communication with the first primary controller; a first plurality of lighting elements, each of the first plurality of lighting elements in direct electrical communication with one of the first plurality of sub-controllers; wherein the first primary controller controls each of the first plurality of sub-controllers, and each of the first plurality of sub-controllers selectively powers the plurality of lighting elements according to commands issued by the primary controller.

Another embodiment comprises an artificial lighted tree for powering and controlling electrically powered lighting elements, the tree comprising a first tree portion and a second tree portion. The first tree portion includes: a first trunk portion; a first plurality of branches coupled to the first trunk portion; a first plurality of lighting elements distributed about the first plurality of branches; a first trunk electrical connector inserted at least partially into the first trunk portion and including at least three electrical terminals; a first set of power wires in electrical connection with the first trunk electrical connector and the primary controller; a first primary controller including a processor, the first primary controller in electrical connection with the first set of power wires and the first plurality of lighting elements, and in electrical connection with at least one of the three electrical terminals of the first trunk electrical connector. The second tree portion includes: a second trunk portion; a second plurality of branches coupled to the second trunk portion; a second plurality of lighting elements distributed about the second plurality of branches; and a second trunk electrical connector inserted at least partially into the second trunk portion and including at least three electrical terminals, the three electrical terminals configured to electrically connect to the three electrical terminals of the first trunk connector. The first tree portion is configured to couple to the second tree portion such that the first trunk electrical connector engages the second trunk electrical connector enabling power to be transmitted from the first tree portion to the second tree section, and enabling data from the primary controller to be transmitted to the second tree section.

Another embodiment comprises an artificial lighted tree for powering and controlling electrically powered lighting elements, the tree comprising a first tree portion and a second tree portion. The first tree portion includes: a first trunk portion; a first plurality of branches coupled to the first trunk portion; a first plurality of lighting elements distributed about the first plurality of branches; a first trunk electrical connector inserted at least partially into the first trunk portion and including at least three electrical terminals; a first set of power wires in electrical connection with the first trunk electrical connector. The second tree portion includes: a second trunk portion; a second plurality of branches coupled to the second trunk portion; a second plurality of lighting elements distributed about the second plurality of branches; and a first trunk electrical connector inserted at least partially into the second trunk portion and including at least three electrical terminals, the three electrical terminals configured to electrically connect to the at least three electrical terminals of the first trunk connector; a second trunk electrical connector inserted at least partially into the second trunk portion and including a plurality of electrical terminals, the second trunk electrical connector having fewer electrical terminals as compared to the first trunk electrical connector. The first tree portion is configured to couple to the second tree portion such that the first trunk electrical connector of the first tree portion engages the first trunk electrical connector of the second tree portion, thereby enabling power to be transmitted from the first tree portion to the second tree portion.

BRIEF DESCRIPTION OF THE FIGURES

The invention can be understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

FIG. **1** is a front view of a controllable lighted artificial tree according to an embodiment;

FIG. **2** is a front view of a first tree section of the tree of FIG. **1**, according to an embodiment;

FIG. **3** is another view of the tree section of FIG. **2**, with selected components shown;

FIG. **4** depicts lighting harness of the tree of FIG. **1**, according to an embodiment;

FIG. **5** depicts optional control components of the tree of FIG. **1**;

FIG. **6** depicts a two-controller control system mounted on a tree, according to an embodiment;

FIG. **7** depicts a pair of controllers of the tree section of FIG. **6**;

FIG. **8** depicts the pair of controllers of the tree section of FIG. **7** mounted to a tree, according to an embodiment;

FIG. **9** depicts secondary controllers distributed about the tree section of FIG. **6**, according to an embodiment;

FIG. **10** depicts a wiring distribution layout of two primary wiring assemblies of the tree section of FIG. **6**;

FIGS. **11** and **12** depict primary controllers and primary wiring assemblies mounted to a tree;

FIG. **13** depicts a distribution scheme for multiple lighting assemblies, according to an embodiment;

FIG. **14** depicts an embodiment of a tree section with a power interface portion, according to an embodiment;

FIG. **15** depicts a single-controller tree configured for 3-way lighting control, according to an embodiment;

FIGS. **16-17** depict a single-controller tree section configured for 5-way lighting control, according to embodiments;

FIGS. **18-20** depict single-controller tree sections, according to embodiments;

FIG. **21** depicts a control switch and power plug connected to a controller, according to an embodiment; and

FIGS. **22-26** depict tree sections having a controller in a middle tree section, according to an embodiment.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

Referring to FIG. **1**, an embodiment of controllable lighted artificial tree **100** is depicted. Tree **100** includes multiple tree sections, which as depicted, includes first section **102**, second section **104** and third section **106**. As depicted, first tree section **102** comprises a lower section tree, second tree section **104** comprises a middle section, and third tree section **106** comprises an upper tree section. Although three tree sections are depicted, it will be understood that lighted artificial tree **100** may comprise more or fewer tree sections, such as one section, two sections, four sections, and so on.

In an embodiment, tree **100** may also include tree stand **108** configured to support tree **100** in an upright position along vertical Axis A.

As will be described further below, each tree section joins to one or more adjacent tree sections both mechanically and electrically along Axis A to form completed tree **100**. As will also be described further below, lights of tree **100** may be controlled by a master or primary controller, and in some cases, also controlled by multiple sub-controllers to create various lighting effects. Embodiments of the invention include efficient wiring layouts and assemblies or harnesses that facilitate modular construction of tree **100** as well as extensive control over individual tree lights.

Referring also to FIGS. **2-5**, in an embodiment, tree section **102** includes trunk portion **110**, branches **112** coupled to trunk **110**, trunk wiring assembly **114**, one or more primary wiring assemblies **116**, a plurality of lighting wiring assemblies **118**, one or more primary controllers **120**, a plurality of secondary controllers **122**, power interface portion **124**, and power cord **126**. In an embodiment, and as depicted, tree **100** may also include control switch **128** and wireless receiver **130**.

For the sake of illustration, in FIGS. **1-5**, wiring assemblies are simplified such that wire connections are depicted as a single line connecting two elements, though it will be understood that such wire connections may comprise two, three, four, or more conductors or wires for conducting power and/or data.

Trunk portion **110** may comprise a generally hollow, cylindrical structure as depicted, though in other embodiments, trunk portion **110** may be generally solid, with cavities for receiving portions of wiring and componentry. One end of trunk portion **110** may be narrower than another end of trunk portion **110** so as to be inserted into a trunk portion of an adjacent tree section; alternatively, an end of trunk portion **110** may receive a narrower end of a trunk portion of an adjacent tree section.

Branches **112** are connected or coupled to trunk portion **110**. In an embodiment, branches **112** are pivotally connected to trunk portion **110** about a hinge or other pivot point. In an embodiment, light strings, light sets, and light elements are distributed upon an exterior of branches **112**, as will be described further below.

Trunk wiring assembly **114**, in an embodiment, comprises trunk electrical connector **132**, controller connector **134**, junction connector **136**, and trunk wire set **138**. In an embodiment, trunk wire set **138** may comprise a plurality of wires or conductors. In one such embodiment, trunk wire set **138** includes wire set **138***a* connecting junction connector **136** to controller connector **134** and wire set **138***b* connecting controller connector **134** to trunk electrical connector **132**. In an embodiment, each of wire set **138***a* and **138***b* comprise two or more electrical conductors. In one such embodiment, each wire set **138***a* and **138***b* comprise a ground conductor and a power conductor. In an embodiment, each wire set **138***a* and **138***b* also comprises one or more conductors for transmitting communication data.

In an embodiment, trunk wiring assembly **114** is located substantially entirely within a cavity formed by trunk portion **110**. In another embodiment, portions of trunk wiring assembly **114** may be located outside trunk portion **110**, such as portions of trunk electrical connector **132**, which may extend partially outside an end of trunk portion **110**, a portion of control connector **134** which may extend through an opening of trunk portion **110** to connect to controller **120**, and so on.

Trunk electrical connector **132** includes electrical terminal set **140**, electrically connected to trunk wire assembly **138**. Trunk electrical connector **132** and its terminal set **140** are configured to couple to a corresponding trunk electrical connector and terminal set of second tree section **104**, thereby electrically connecting tree section **102** and **104**, and their respective trunk wiring assemblies.

Controller connector **134** comprises an electrical connector with conductive terminals electrically connected to trunk wire set **138***b*. Controller connector **134** couples to controller **120** to electrically connect wire set **138***b* and trunk electrical connector **132** to controller **134**. In an embodiment, controller connector **134** connects to controller **120** within an interior of trunk portion **110**.

Junction connector **136**, comprises an electrical connector with conductive terminals electrically connected to trunk wire set **138***a*. Junction connector **136** couples to power interface portion **124** to make an electrical connection between wire set **138***a* and power interface portion **124**, thereby also electrically connecting power interface portion **124** to controller **120**.

Primary wiring assembly **116** includes central connector or interface **142**, a plurality of wire sets **144**, and a plurality of secondary controller connectors **144**. In an embodiment, primary wiring assembly **116** is substantially on an exterior portion of tree section **102**. Interface **142** is configured to

interface or connect to primary controller **120** to electrically connect connector wire sets **144** and their respective connectors **146** to primary controller **120**. Wire sets **144** may comprise a pair of conductors, such as first and second power transmission conductors, and may also include additional data transmission wires. Connectors **146** are configured to electrically connect wire sets **144** to subcontrollers or secondary controllers **122**, and thereby electrically and communicatively connect primary controller **120** with secondary controllers **122**.

In an embodiment, primary wiring assembly **116** couples to master controller **120** and may couple directly or indirectly to trunk portion **110**. Connectors **146** may couple directly or indirectly to branches **112**.

In an embodiment, tree section **102** includes a single primary wiring assembly **116**. In an alternate embodiment, as depicted in FIGS. **6-13**, tree section **102** may include more than one primary wiring assembly **116**.

Referring still to FIGS. **1-5**, tree **100** and tree section **102** includes a plurality of lighting wire assemblies **118**. In an embodiment, each lighting wiring assembly **118** includes connector **150**, lighting wire set **152** and lighting element **154**.

Connectors **150** electrically and mechanically connect lighting wire sets **152** to respective connectors **146** of primary wiring assembly **116**. In an embodiment, each connector **146** electrically connects multiple wire sets **152** such that all light elements **154** are electrically connected. In one such embodiment, all light elements **154** receive the same electrical signal from a secondary controller **122**. In one such embodiment, all light elements **154** for a lighting wire assembly **118** would be powered on and off at the same time. In another such embodiment, although a common signal is received, light elements **154** receive a communication signal that selectively turns individual light elements **154** on and off in a predetermined manner.

Lighting wire sets **152** may include a plurality of conductors, such as a pair of power conducting wires and in some embodiments, additional conductors dedicated to communicating data from secondary controller **122** and/or primary controller **120**.

Light elements **154** may comprise any of a variety of lights or lamps, such as incandescent bulbs, light-emitting diodes, and so on. Light elements **154** may also include light or lamp holders for connecting lamps to wire sets. In an embodiment, the lamp holders may comprise a housing and conductive terminals, and in some embodiments, a lens cover.

As will be described further below with respect to FIGS. **6-13**, lighting wire assemblies **118** may be distributed about branches **112**.

In an embodiment, primary controller **120** comprises may include a housing, PC board and in some embodiments, a selector switch. PC board **140** may include power conditioning electronics, including a voltage regulator and so on, a controller such as a microcontroller, microprocessor, processor, or similar, as well as memory, and other control electronics. A selector switch, such as a switch integral to controller **120**, or an external switch, such as switch **128**, may be in communication with the PC board and controller may comprise a rotary, pushbutton, or similar switch operable by a user.

In an embodiment, tree **100** and tree section **102** comprise a single primary controller **120**. In another embodiment, tree **100** and tree section **102** comprise a pair of primary controllers, or even multiple primary controllers **120**. In one such embodiment, tree section **102** includes two primary controllers **120**; in an embodiment the two controllers are in communication with each other; in an embodiment, one of the two controllers controls the other controller, serving as a master controller or master primary controller.

In an embodiment, tree **100** and tree section **102** may include a plurality of secondary controllers **122**, as depicted. In an alternate embodiment, tree **100** and tree section **102** does not include any secondary controllers **122**, but rather, controls light elements **154** via one or more primary controllers **120**, one of which may be a master controller. Secondary controllers **122** may include power conditioning electronics, a controller such as a microcontroller, microprocessor, or similar, memory, and other control electronics. In an embodiment including power conditioning electronics, secondary controllers **122** include voltage regulators for regulating and adjusting voltage delivered to light elements **154**.

As will be discussed further below, primary controller **120** and/or secondary controllers **122** may include software programs having stored algorithms for controlling light elements **154** of tree **100**. In an embodiment, groups of light elements **154** corresponding to individual lighting assemblies **118** are controlled separately by group. In another embodiment, each light element **154** may be controlled individually to create various lighting effects.

Power interface portion **124** may comprise a junction box, panel, or other mechanical and electrical interface. In an embodiment power interface portion **124** is mounted to, or otherwise coupled to, trunk portion **110**. In other embodiments, power interface portion **124** may not be coupled to trunk portion **110**; in one such embodiment, power interface portion **124** may be connected.

In an embodiment, power interface portion **124** comprises a housing and conductive terminals, and is configured to receive a conductive end of power cord **126**, and optional components such as control switch **128** and wireless receiver **130**. Power interface portion **124** may also be configured to receive audio input from an external source, via a wired or wireless connection. In one such embodiment, power interface portion **124** includes audio jacks for receiving a cord from device transmitting an audio data signal, the signal being transmitted to controller **120**.

Power interface portion **124** is in electrical communication with primary controller **120** via wire set **138***a*.

In an embodiment, power cord **126** includes a pair of conductors, and is configured to transmit or conduct power received from an external power source. In an embodiment, power cord **126** directly transmits power received to master controller **120** or other portions of tree **100**. In one such embodiment, power cord **126** is configured to transmit alternating-current (AC) power, and as such, may have limited or no power conditioning circuitry. In an alternate embodiment, power cord **126** may include power-conditioning or transforming circuitry for transforming an incoming power from the external power source to an outgoing power for use by tree **100**. In one such embodiment, power cord **126** transforms incoming AC power to outgoing direct-current (DC) power.

In an embodiment, tree **100** includes control switch **128**. Control switch **128** may comprise a foot-pedal activated switch as depicted, or in other embodiments, may comprise other switch configurations and components. Control switch **128** may be modular in nature, and in some cases, removably attached to power interface portion **124**, thereby communicatively coupling control switch **128** to tree **100**, and in some embodiments, to primary controller **120**. In an embodiment, control switch **128** may be used to turn power on and off, or

may be used to select various functions of tree **100**, such as light display functions, musical functions, combinations thereof, and other functions relating to lights, sound and possibly movement.

Wireless receiver **130**, in an embodiment, may be modular in nature, and in some cases removably, or otherwise attached to power interface portion **124**. In an embodiment, wireless receiver **130** includes wiring **160**, connector **162**, and receiver portion **164**. In an embodiment, wiring **160** defines a length of wiring that allows receiver portion **164** to be placed in a position for maximum reception, such as at a branch end away from trunk portion **110**, or near a top or bottom portion of tree **100**, unobstructed from branches, or some other convenient location.

Wireless receiver **130** may comprise a receiver or transceiver, and may be configured to operate over any of a number of known wireless networks using known wireless protocols, including radio-frequency, infrared, Bluetooth, Wi-Fi, Z-Wave, ZigBee, and so on. In an embodiment, wireless receiver **130** is configured to receive a wireless signal from an external remote control device, such as a smartphone or other remote controller, and to transmit the received signal, including data, to primary controller **120**.

Referring to FIGS. **6-13**, top plan views of tree section **102** and its wiring assemblies are depicted.

Referring specifically to FIG. **6**, a top plan of tree section **102** is depicted. In this embodiment, tree section **102** includes two primary controllers **120**. In an embodiment, the two primary controllers **120** are in communication with one another; in one such embodiment, one of the two controllers **120** controls the other controller, serving as a master controller.

As depicted, the wiring layout for tree section **102** is particularly efficient. In this embodiment, a wiring system for tree section **102** is split into two primary wiring assemblies **116**, each communicatively coupled to a primary controller **120**, such that approximately half of light elements **154** are controlled by one controller **120**, and the other half controlled by the other controller. In an embodiment, tree **100** comprises only one true master primary controller **120**, such that a second primary controller **120** is actually a sub-controller **120***b* under the control of master primary controller **120***a*. In such an embodiment, there are three levels of controllers: master primary controller **120***a*, one or more primary controllers **120***b*, and multiple secondary controllers **122**, for a multi-tiered control system.

In an embodiment, each primary wiring assembly is communicatively coupled to multiple secondary controllers **122** and associated multiple lighting assemblies **118**.

In an embodiment, each branch has one lighting assembly **118** and one secondary controller; in other embodiments, lighting assemblies **118** may be associated with more than one branch **112**, or one branch may have more than one lighting assembly **118**.

Because multiple light elements **154** of a light assembly **118** are controlled by, or communicate through, a primary wire set **144**, the number of wires needed to attach a primary controller **120** is minimized. If each light element **154** were to have its own wires connecting to a master controller **120**, the amount of wiring in tree section **102** would be vastly increased, and much more complicated.

Referring to FIGS. **7** and **8**, a pair of master controllers **120** are depicted, one on each side of tree section **102**.

Referring to FIG. **9**, secondary controllers **122** are distributed about tree section **102**. In an embodiment, secondary controllers **122** are distributed approximately equidistantly from one another. In an embodiment, secondary controllers **122** are located at approximately the same height relative to the ground upon which tree **100** is placed; in another embodiment, secondary controllers **122** are located at different heights of tree section **102** so as to be mounted on branches of different heights.

FIG. **10** depicts a wiring distribution layout or configuration of two primary wiring assemblies **116**. As depicted, each primary wiring assembly **116** is positioned so as to allow each wire set **144** to be attached to, placed adjacent to, or near, one or more branches **112**.

FIGS. **11** and **12** further depict primary controllers **120** and primary wiring assemblies **116** attached to trunk portion **110** and branches **112**.

FIG. **13** depicts an embodiment of a distribution scheme for multiple lighting assemblies **118**.

Referring again to FIGS. **1-3**, in an embodiment, a master controller **120** is placed on trunk portion **110** at a location above a first set of branches **112** at a first height, and below a second set of branches **112** at a second height, such that some wires **144** are positioned above connector **142**, and some below.

Referring to FIG. **14**, an embodiment of tree section **104** is depicted. Tree section **104**, in an embodiment, includes many of the components of tree section **102**, with the exception of power interface portion **124**. Tree section **104** also includes a somewhat different trunk wiring assembly **160**, as compared to trunk wiring assembly **114**.

In this embodiment, trunk wiring assembly **160** includes first trunk electrical connector **162** with electrical terminals **163** and second trunk electrical connector **164** with electrical terminals **165**. In an embodiment, trunk electrical connector **164** configured to mechanically and electrically connect to trunk electrical connector **132**. In an embodiment trunk electrical connector **162** is similar to trunk electrical connector **132**, but is configured to connect to trunk electrical connector **164** when tree section **102** is coupled to tree section **104** along trunk portion **100** and Axis A, such that the electrical terminals **140** and **163** make electrical connection, thereby electrically connecting trunk wiring assembly **114** to trunk wiring assembly **160**.

When tree section **104** is coupled to tree section **102**, power and in some cases, communication data, is transferred through trunk electrical connector **160** to primary controllers **120**, and to trunk electrical connector **164** and its electrical terminals **165**.

Referring again to FIG. **1**, tree section **106** is configured to couple to tree section **104**, such that trunk electrical connector **166** connects to trunk electrical connector **164**, such that terminals **165** are in electrical connection with terminals **166**.

When tree section **102** is coupled to tree section **104**, and tree section **106** is coupled to tree section **104**, power is transmitted throughout tree **100** to all three sections. In an embodiment, data relating to the control of light elements **154** is also transmitted throughout tree **100**. In an embodiment, separate data is not transmitted to light elements **154**, though light elements **154** may be turned on and off by transmitting or interrupting power to light elements **154**.

In an embodiment, tree section **104** includes two primary controllers **120***b*, which may be subcontrollers controlled by master controller **120***b* of tree section **102**.

Once assembled, in operation, light elements **154** may be controlled in groups or individually by a combination of primary controllers **120** commanding secondary controllers **122** to selectively turn light elements **154** on and off, or to control other functions of light elements **154**. In an embodiment, selected light elements may be controlled to randomly

turn on and off to create a twinkling effect; voltage to selected light elements **154** may be controlled, such as by ramping up or down, to create a "fade" effect, wherein the brightness of light element **154** is varied. Other visual effects may be created as each light element **154**, or group of light elements of lighting assembly **118**, is controlled.

In an embodiment, light elements **154** may comprise one or more LEDs. In one such embodiment, each light element **154** includes multiple LEDs, such as one red, one green, and one blue, or an RGB diode set. In an embodiment, primary controller **120** and/or secondary controller **122** may control such a light element **154** to create a variety of color combinations. If all light elements **154** comprise such RGB diode sets, then an entire tree can be made to change color.

When light elements **154** are wired and controlled individually, no mechanical or electrical bypass shunts or mechanisms are needed to keep other light elements **154** from losing power in the case of a single bulb being defective.

As described above, control of light elements **154** is accomplished by a "tiered" set of controllers, with one master primary controller **120** controlling one or more subcontrol primary controllers **120**, and each subcontrol primary controller controlling multiple secondary controllers **122**. Each secondary controller **122** controls a group of light elements, either collectively, in sub groups, or individually, to create nearly any lighting effect.

In an embodiment, a master controller, such as controller **120***a* provides commands to subcontrollers **120***b*, which each command a plurality of secondary controllers **122**. In an embodiment, each light element **154** is associated with a data address for further control of individual light elements **154**. In other embodiments, no such address is required.

The algorithms and software for such lighting effects may be pre-programmed into any of the controllers, and/or may be received by wireless receiver **130** via a remote control device. The remote control device may be used to transmit such programming to tree **100** wirelessly. In an embodiment, a remote control device may comprise any type of computer for creating and/or transmitting light control programs to tree **100**.

In addition to light-control programming, tree **100** may also include audible or musical programming. In an embodiment tree **100** includes a speaker, which may be in wired or wireless communication with tree **100** and in some embodiments, master controller **120**.

Consequently, tree **100** of FIGS. **1-14** includes multiple controllers and an efficient wiring distribution system for creating a wide variety of visual and audible displays. **124**

Referring to FIGS. **15-17**, single controller embodiments of tree **100** are depicted.

Referring specifically to FIG. **15**, single-controller embodiments of tree sections **102**, **104**, and **106** configured for "3-way" control of light elements, and with an accessory power plug, are depicted. "3-way" control means independent electrical control over three groups, sets, or items, such as three groups of light elements **154**, or three groups of light assemblies **118**, or three groups, each group consisting of multiple sets of light assemblies **118**, such that power to a first group can be manipulated independent of how either of the other two groups are powered or manipulated. In this embodiment, power is transmitted throughout all three tree sections **102**, **104**, and **106**. Further, each individual tree section is powerable separately from the other tree sections. In other words, power to light elements of tree section **102** may be controlled exclusive of power to light elements of tree sections **104** and **106**. Similarly, light elements of tree sections **104** and **106** may be controlled independent of the other tree sections. The unique combination of controller, wiring scheme, and trunk electrical connectors enable such features.

In an embodiment, first tree section **102** includes power plug **126**, which may be configured for AC or DC operation, controller **120**, trunk portion **110**, trunk electrical connector **132**, wire set **200**, light set A and light set B.

Wire set **200**, in an embodiment comprises conductors **202**, **204**, **206**, **208**, and **210** extending within trunk portion **110**. In an embodiment, conductor **202** may comprise a set of conductors, which may comprise a first power polarity, such as ground or neutral. Conductor **202** may be common to all light elements of tree **100** and any other electronic devices of tree **100**.

In an embodiment, conductors **204**, **206**, **208**, and **210** each transmit a power signal. As depicted, conductor **204** is electrically connected to light sets A and B, such that together, conductor **202** and **204** provide power to light sets A and B.

Conductors **206**, **208**, and **210** extend to trunk electrical connector **132**, as does conductor **202**, such that trunk electrical connector **132** comprises a 4-pin connector, which in an embodiment, includes a common ground/neutral/negative terminal, and three separately controllable power/live/positive terminals.

Light sets A and B are depicted in block form, and are understood to comprise any variety of light elements **154** as described above; the light elements **154** being connected electrically in any configuration, including in series, parallel, parallel-series, and series-parallel.

In such an embodiment, individual light elements **154** are not individually controllable, though light elements **154** of independent tree sections are controllable as a group.

Tree section **104** includes a trunk portion **110**, electrical connector **162**, wire set **220**, trunk electrical connector **162**, trunk electrical connector **164** and light sets C and D. Wire set **220** comprises conductors **202**, **206**, **208**, and **210**. Light sets C and D are electrically connected to conductors **202** and **206**, which transmit power to light elements of the light sets.

Trunk electrical connector **162** is a 4-terminal connector configured to electrically connect to 4-pin trunk electrical connector **132**.

Conductors **202**, **208**, and **210** extend within trunk portion **110** to trunk electrical connector **164**.

Light sets C and D are controlled by controller **120** which selectively powers light sets C and D together via selective powering of conductor **206**.

Tree section **106** includes a trunk portion **110**, which may be narrower than trunk portions **110** of tree sections **102** and **104**, trunk electrical connector **166**, wire set **222**, light set E, and accessory power plug assembly **230**.

Wire set **222**, in an embodiment, comprises conductors **202**, **208**, and **210**.

Trunk electrical connector **166**, in an embodiment, comprises a 3-terminal, or 3-pin, electrical connector.

Conductors **202** and **210** provide power to light set E, while conductors **202** and **208** provide power to accessory power plug **230**.

Accessory power plug assembly **230** provides power to accessory items like tree top ornaments, musical ornaments, and so on. In an embodiment assembly **230** provides power that is different than the power provided to light sets A-E; in an embodiment assembly **230** provides power that is the same as the power provided to light sets A-E. Conductors **202** and **208** may comprise a length sufficient to locate the

plug end **232** of assembly **230** a predetermined distance from trunk portion **110**. In an embodiment, conductors **202** and **208** may each extend 0.5 ft to 2 ft from trunk portion **110**, providing sufficient length to be connected to a powered accessory. In an embodiment, conductors **202** and **208** extend a length that is 50% to 100% of the length of trunk portion **110**, so as to provide power to a powered accessory mounted atop trunk portion **110** of tree section **106**.

As described in part above, in operation, controller **120** controls groups of light sets or light elements by selectively powering any combination of conductors **204**, **206**, **208**, or **210** to create flashing, fading, on/off or other visual effects.

As also described above, the multi-way control of light sets and tree sections is accomplished by having a tiered trunk electrical connector system, whereby the number of controllable power conductors **204-210**, and the number of terminals per trunk electrical connector, decreases from a first tree section to the adjacent, then more distal tree sections. In other words, trunk electrical connectors **132** and **162** are 4-terminal connectors forming a first coupling point between tree section **102** and **104**, while trunk electrical connectors **164** and **166** are 3-terminal connectors forming a second coupling point between tree sections **104** and **106**. In an embodiment not including accessory power plug assembly **230**, trunk electrical connectors **164** and **166** may comprise 2-terminal trunk electrical connectors.

For trees **100** having additional tree sections, or for additional control, the number of terminals of trunk electrical connectors would be increased at each junction, but would decrease for each coupling point further away from controller **120**.

Referring to FIGS. **16** and **17**, a single controller, 5-way controlled tree **100** is depicted. This embodiment of tree **100** is substantially similar to the 3-way tree **100** of FIG. **15**, though tree **100** of FIGS. **16** and **17** allows for control over a greater number of light element groups (or other powered devices). In an embodiment, and as depicted, tree **100** includes tree sections **102**, **104**, and **106**, and is based on a single controller configured to control five pairs of conductors corresponding to five groups of light elements. FIG. **16** is a front perspective view of three tree sections **102**, **104**, and **106**; FIG. **17** is a left-side perspective view of tree section **102**.

Referring still to FIGS. **16** and **17**, tree section **102** comprises trunk portion **110**, controller **120**, power cord **126**, trunk electrical connector **132**, wire set **250** and light sets A and B.

Wire set **250** includes conductor **202**, which may comprise a common ground, neutral, or negative conductor comprising one of a pair of power conductors, and multiple electrically live or positive conductors **204**, **206**, **208**, **210** and **212**. As depicted, wire set **202** includes five such positive polarity conductors, though in other embodiments, it will be understood that more or fewer such conductors may be used. Conductors **202** and **212** provide power to light set A; conductors **202** and **206** provide power to light set B.

Controller **120** is configured to selective power any combination of conductors **204**, **206**, **208**, **210**, and **212**. As depicted, controller **120** may be mounted directly to trunk portion **110**, and may include integral push buttons **252** for selecting light display features or programs of controller **120**.

Trunk electrical connector **132** comprises a 4-terminal connector.

Tree section **104** comprises 4-terminal connector **162** and two-terminal trunk electrical connector **164**. Conductors **202** and **208** provide power to light set C; conductors **202** and **210** provide power to light set D. Power for tree section **106** is transmitted via conductors **202** and **204** from connector **162** to **164**.

Tree section **106** comprises trunk portion **110**, 2-terminal trunk electrical connector **166**, wire set **260** comprising conductors **202** and **204**, and light set E. Light set E is powered by conductors **202** and **204**.

As described in part above, the combination of the wiring layout and use of different types of trunk electrical connectors enables independent control of each of light sets A-E, such that various lighting displays may be created and implemented.

Referring to FIGS. **18-20**, embodiments of tree section **102** for a single controller tree **100** are depicted.

Referring specifically to FIG. **18**, tree section **102** is configured for 5-way control, similar to tree section **102** as depicted in FIG. **17**. FIG. **18** shows additional detail.

In this embodiment, controller **120** includes processor **121** and multiple terminal blocks **270** for electrically connecting processor **121** to conductors **202-210**. Also in this embodiment, additional conductors are depicted allowing additional light sets to be powered by tree section **102**.

Further, power cord **126** and control switch **128** are combined. In an embodiment, control switch **128** selectively turns power received through power cord **126** on and off.

FIG. **19** depicts another embodiment of tree section **102**, and comprises controller **120** with terminal blocks **170**, and wire set **280**. In this configuration, controller **120** and wire set **280** are configured for 3-way operation. Tree section **102** of FIG. **19** differs from tree section **102** of FIG. **15** in that each tree section **102**, **104**, and **106** has each of conductors **204**, **208**, and **210**, such that each tree section has three pairs of controllable power pairs. In such an embodiment, three light sets, such as light set A, B, and C (not depicted) may be controlled on each tree section.

Alternatively, each conductor **204**, **208**, and **210** can electrically connect to a multi-lamp light element, such an RGB LED, of a set of multi-lamp light elements, thereby controlling the color of the lamp.

Referring to FIG. **20**, another embodiment of tree section **102** is depicted. In this embodiment, on/off control is accomplished via switch **128**. Power is conducted through conductors **201** and **202**. Power to a light set A, or other powered device, is transmitted or conducted through conductors **202** and **206**. Conductor **201** is in electrical connection with conductors **204**, **208**, and **210**, transmitting power over three conductors and one neutral conductor via connector **132**.

FIG. **21** depicts an alternate embodiment of control switch **128** and power plug **126** connected to a processor **121**. In such a configuration, processor **121** receives power from plug **126**, and reacts to control signals from switch **128**.

FIGS. **22-26** depict alternate embodiments of tree section **104** of a single-controller tree **100**, wherein controller **120** is no longer located in tree section **102**, but rather is located in tree section **104**. Such a configuration allows for greater control of light sets and tree sections, as well as facilitating standard, more efficient wire layouts. As depicted, a tree configured with tree section **100** can utilize all 4-terminal conductors, yet accomplish 9-way control via nine control outputs from the processor or controller **120** controlling nine different conductors **300-316**. Conductors **202** serve as a common, ground, or neutral conductors.

In this configuration, three groups of light sets on tree section **104** are powered by power conductor pairs (**202**, **306**), (**202**,**308**), and (**202**, **310**); three groups of conductors provide power to tree section **102**: (**202**, **312**), (**202**, **314**),

and (**202**, **316**); and three groups of conductors provide power to tree section **106**: (**202**, **300**), (**202**, **302**), and (**202**, **304**).

Although nine selectively controlled conductors of a second polarity are depicted, it will be understood that the number of conductors can be more or fewer for greater or lesser control of powered light sets and devices.

As compared to placing controller **120** in the lower tree section, placing controller **120** in a middle tree section allows for greater control without having to use a great number of terminals in the trunk electrical connectors. If 9-way control was desired in a controller connected in a non-central or middle tree section, trunk electrical connector **132** would need to comprise 7 terminals, which would possibly require larger than normal trunk diameters, and could cause problems with arcing or shorting between terminals as the terminals would necessarily be placed close to one another due to the limited space.

FIG. **23** depicts another embodiment of a tree section **104** having a middle hub or connector system.

FIG. **24** depicts an embodiment of tree section **104**, which may be substantially the same as tree section **104** of FIG. **22**, with the addition of removable, locking, or otherwise non-integrated power plug/switch combination **126**/**128** and powered accessory **400**. In this embodiment, optional powered accessory **400** comprises a lighted tree top ornament, and a power outlet at controller **120**.

FIG. **25** depicts an embodiment of tree section **104** with optional wireless receiver **130**, switch **128** and cord **126**, any of which may be modular and/or detachably received by controller assembly **120**.

FIG. **26** depicts tree section **104** configured for 3-way control: lights of tree section **102**, **104**, and **106** are controlled independent of other sections, e.g., tree section **102** may be turned on and off, faded, or otherwise controlled independent of power to other tree sections. Further, such control is accomplished via 2-terminal trunk electrical connectors **132** and **162**, rather than 4-terminal connectors.

Further, controller **120** is modular and includes detachable portion **123** for receiving various embodiments of switch/power cord combination **126**/**128** and powered accessory **400**.

Embodiments of the invention also include methods of controlling light elements of a lighted artificial tree as described herein.

The embodiments above are intended to be illustrative and not limiting. Additional embodiments are within the claims. In addition, although aspects of the present invention have been described with reference to particular embodiments, those skilled in the art will recognize that changes can be made in form and detail without departing from the spirit and scope of the invention, as defined by the claims.

Persons of ordinary skill in the relevant arts will recognize that the invention may comprise fewer features than illustrated in any individual embodiment described above. The embodiments described herein are not meant to be an exhaustive presentation of the ways in which the various features of the invention may be combined. Accordingly, the embodiments are not mutually exclusive combinations of features; rather, the invention may comprise a combination of different individual features selected from different individual embodiments, as understood by persons of ordinary skill in the art.

Any incorporation by reference of documents above is limited such that no subject matter is incorporated that is contrary to the explicit disclosure herein. Any incorporation by reference of documents above is further limited such that no claims included in the documents are incorporated by reference herein. Any incorporation by reference of documents above is yet further limited such that any definitions provided in the documents are not incorporated by reference herein unless expressly included herein.

For purposes of interpreting the claims for the present invention, it is expressly intended that the provisions of Section **112**, sixth paragraph of 35 U.S.C. are not to be invoked unless the specific terms "means for" or "step for" are recited in a claim.

What is claimed:

1. An artificial lighted tree for powering and controlling electrically powered lighting elements, comprising:

a first tree section including:

a first trunk portion;

a first plurality of branches coupled to the first trunk portion;

a first plurality of lighting elements distributed about the first plurality of branches;

a first trunk electrical connector inserted at least partially into the first trunk portion and including at least three electrical terminals for conducting power, data, or both power and data;

a first set of power wires in electrical connection with the at least three electrical terminals of the first trunk electrical connector;

a first primary controller including a processor, the first primary controller in electrical connection with the first set of power wires and the first plurality of lighting elements, and in electrical connection with at least one of the three electrical terminals of the first trunk electrical connector; and

a second tree section, including:

a second trunk portion;

a second plurality of branches coupled to the second trunk portion;

a second plurality of lighting elements distributed about the second plurality of branches; and

a second trunk electrical connector inserted at least partially into the second trunk portion and including at least three electrical terminals, the three electrical terminals configured to electrically connect to the three electrical terminals of the first trunk connector;

wherein the first tree section is configured to couple to the second tree section such that the first trunk electrical connector engages the second trunk electrical connector enabling power to be transmitted from the first tree section to the second tree section, and enabling data from the primary controller to be transmitted to the second tree section, and

wherein the first tree section includes a first plurality of sub-controllers, each including a processor, each of the first plurality of sub-controllers in electrical communication with the first primary controller, and configured to control at least a portion of the plurality of first lighting elements.

2. The lighted artificial tree of claim **1**, wherein the primary controller is coupled to an exterior portion of the first trunk portion and the first set of power wires is at least partially inside an interior cavity of the first trunk portion.

3. The lighted artificial tree of claim **2**, wherein each of the plurality of sub-controllers is located external to the first trunk portion.

4. The lighted artificial tree of claim **1**, further comprising a third tree section configured to couple mechanically and electrically to the first tree section such that the first tree section is between the second tree section and the third tree

section when the first, second, and third trunk portions are aligned along a common vertical axis.

5. The lighted artificial tree of claim **4**, wherein the first primary controller is the only primary controller.

6. The lighted artificial tree of claim **1**, further comprising a receiver in electrical communication with the primary controller and for receiving wireless control signals from an external control device.

7. The lighted artificial tree of claim **6**, wherein the external control device comprises a mobile telephone.

8. An artificial lighted tree for powering and controlling electrically powered lighting elements, comprising:

a first tree section including:

a first trunk portion;

a first plurality of branches coupled to the first trunk portion;

a first plurality of lighting elements distributed about the first plurality of branches;

a first trunk electrical connector inserted at least partially into the first trunk portion and including at least four electrical terminals;

a first set of power wires in electrical connection with the first trunk electrical connector;

a first controller, the first controller in electrical connection with the first set of power wires and the first plurality of lighting elements, and in electrical connection with at least one of the four electrical terminals of the first trunk electrical connector;

a first plurality of second controllers, each of the first plurality of second controllers in electrical connection with the first controller, and each of the first plurality of second controllers configured to control an individual light element of the first plurality of lighting elements; and

a second tree section, including:

a second trunk portion;

a second plurality of branches coupled to the second trunk portion;

a second plurality of lighting elements distributed about the second plurality of branches;

a second trunk electrical connector inserted at least partially into the second trunk portion and including at least four electrical terminals, the four electrical terminals configured to electrically connect to the four electrical terminals of the first trunk connector; and

a second plurality of second controllers, each of the second plurality of second controllers in electrical connection with the second trunk electrical connector, and each of the second plurality of second controllers configured to control an individual light element of the second plurality of lighting elements; and

wherein the first tree section is configured to couple to the second tree section such that the first trunk electrical connector engages the second trunk electrical connector enabling power to be transmitted from the first tree section to the second tree section.

9. The lighted artificial tree of claim **8**, wherein each light element of the plurality of first light elements is associated with a data address.

10. The lighted artificial tree of claim **8**, further comprising a third tree section connectable to the second tree section, the third tree section including a third trunk electrical connector having four electrical terminals or fewer, but not less than two electrical terminals.

11. The lighted artificial tree of claim **8**, further comprising a power cord configured to conduct alternating-current (AC) power, electrical circuitry configured to transform AC power to DC power, and an accessory power-plug assembly configured to provide AC power to an electrical accessory, the power cord in electrical connection with two terminals of the first trunk electrical connector for conducting AC power to the first and second tree sections and to the accessory power-plug assembly, the electrical circuitry in electrical connection to the first controller and providing DC power to the first controller and first plurality of lighting elements.

12. The lighted artificial tree of claim **8**, wherein the primary controller is coupled to an exterior portion of the first trunk portion and the first set of power wires is at least partially inside an interior cavity of the first trunk portion.

13. The lighted artificial tree of claim **8**, further comprising a third tree section configured to couple mechanically and electrically to the first tree section such that the first tree section is between the second tree section and the third tree section when the first, second, and third trunk portions are aligned along a common vertical axis.

14. The lighted artificial tree of claim **8**, further comprising a receiver in electrical communication with the first controller and for receiving wireless control signals from an external control device.

15. The lighted artificial tree of claim **8**, wherein the first plurality of lighting elements comprises a light element having multiple LEDs.

16. An artificial lighted tree for powering and controlling electrically powered lighting elements, comprising:

a first tree section including:

a first trunk portion;

a first plurality of branches coupled to the first trunk portion;

a first plurality of lighting elements distributed about the first plurality of branches, each of the lighting elements associated with a data address, and each of the lighting elements including at least two light-emitting diodes (LEDs);

a first trunk electrical connector inserted at least partially into the first trunk portion and including at least two electrical terminals;

a first set of power wires in electrical connection with the first trunk electrical connector;

a first controller, the first controller in electrical connection with the first set of power wires and the first plurality of lighting elements, and in electrical connection with at least one of the two electrical terminals of the first trunk electrical connector, the first controller configured to output an electrical signal;

a first plurality of second controllers, each of the first plurality of second controllers in electrical communication with the first controller, and each of the first plurality of second controllers configured to receive the electrical signal from the first controller and selectively power the at least two LEDs of each of the light elements of the first plurality of lighting elements based on the electrical signal and the data addresses of the lighting elements; and

a second tree section, including:

a second trunk portion;

a second plurality of branches coupled to the second trunk portion;

a second plurality of lighting elements distributed about the second plurality of branches each of the lighting

elements associated with a data address, and each of the lighting elements including at least two light-emitting diodes (LEDs);

a second trunk electrical connector inserted at least partially into the second trunk portion and including at least two electrical terminals, the at least two electrical terminals configured to electrically connect to the at least two electrical terminals of the first trunk connector; and

a second plurality of second controllers, each of the second plurality of second controllers in electrical connection with second trunk electrical connector and each of the plurality of second controllers configured to selectively power the at least two LEDs of each of the light elements of the second plurality of lighting elements based on the electrical signal output by the first controller; and

wherein the first tree section is configured to couple to the second tree section such that the first trunk electrical connector engages the second trunk electrical connector enabling power and the electrical signal to be transmitted from the first tree section to the second tree section.

17. The lighted artificial tree of claim **16**, wherein the first trunk electrical connector comprises four electrical terminals, and the lighted artificial tree further comprises a power cord configured to conduct alternating-current (AC) power, electrical circuitry configured to transform AC power to DC power, and an accessory power-plug assembly configured to provide AC power to an electrical accessory, the power cord in electrical connection with a first two of the four terminals of the first trunk electrical connector for conducting AC power to the first and second tree sections and to the accessory power-plug assembly, the electrical circuitry in electrical connection to the first controller and providing DC power to the first controller and first plurality of lighting elements, and the second two of the electrical terminals of the first trunk electrical connector in electrical connection with the first controller so as to transmit the electrical signal to the first trunk electrical connector.

18. The lighted artificial tree of claim **16**, wherein the primary controller is coupled to an exterior portion of the first trunk portion and the first set of power wires is at least partially inside an interior cavity of the first trunk portion.

19. The lighted artificial tree of claim **16**, further comprising a third tree section configured to couple mechanically and electrically to the first tree section such that the first tree section is between the second tree section and the third tree section when the first, second, and third trunk portions are aligned along a common vertical axis.

20. The lighted artificial tree of claim **16**, wherein the first controller comprises a processor, housing, and a selector switch for selecting a light function of the tree.

* * * * *