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(54) **MARKING APPARATUS AND MARKING METHODS USING MARKING DISPENSER WITH MACHINE-READABLE ID MECHANISM**

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USPC ..... **701/526; 427/136**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,871,557 A 3/1975 Smrt  
3,972,038 A 7/1976 Fletcher et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2623761 10/2008  
CA 2623466 6/2011

(Continued)

OTHER PUBLICATIONS

Bearden, T., "New Identification Technology Raises Concerns over Privacy," PBS Online NewsHour Report, Aug. 17, 2006, pp. 1-5, [http://www.pbs.org/newshour-bb-science-july-dec06-rfid\\_08-17.html](http://www.pbs.org/newshour-bb-science-july-dec06-rfid_08-17.html).

(Continued)

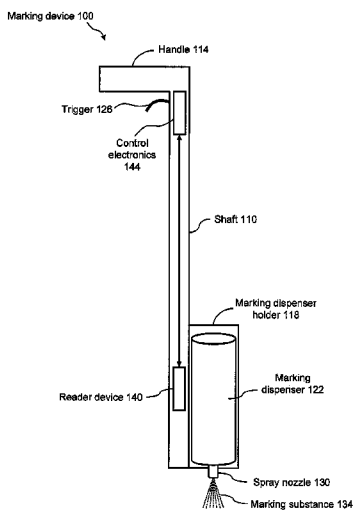
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(57) **ABSTRACT**

Marking devices for dispensing markers on the ground and marking methods are provided. The marking devices and marking methods use a marking dispenser having a machine-readable ID mechanism. The ID mechanism has data storage capability. In one embodiment, the marking dispenser may be provided with a radio-frequency identification (RFID) tag. In another embodiment, the marking dispenser may be provided with a barcode. The type of information that may be encoded in the ID mechanism may include, but is not limited to, product-specific information, user-specific information, other predetermined information of interest, and any combination thereof. The ID information encoded in the ID mechanism may be collected and used for various purposes, such as, but not limited to, real-time product verification, tracking which user location received a batch of marking paint, tracking marking paint inventory, tracking marking paint problems, and tracking marking paint usage.

**22 Claims, 5 Drawing Sheets**



U.S. PATENT DOCUMENTS					
3,974,491 A	8/1976	Sipe	5,848,373 A	12/1998	DeLorme et al.
3,988,922 A	11/1976	Clark et al.	5,916,300 A	6/1999	Kirk et al.
4,258,320 A	3/1981	Schonstedt	5,917,325 A	6/1999	Smith
4,387,340 A	6/1983	Peterman	5,918,565 A	7/1999	Casas
4,388,592 A	6/1983	Schonstedt	5,920,194 A	7/1999	Lewis et al.
4,520,317 A	5/1985	Peterman	5,955,667 A	9/1999	Fyfe
4,536,710 A	8/1985	Dunham	6,026,135 A	2/2000	McFee et al.
4,539,522 A	9/1985	Schonstedt	6,031,454 A	2/2000	Lovejoy et al.
4,590,425 A	5/1986	Schonstedt	6,032,530 A	3/2000	Hock
4,623,282 A	11/1986	Allen	6,037,010 A	3/2000	Kahmann et al.
4,639,674 A	1/1987	Rippingale	6,053,260 A	4/2000	Boon
4,712,094 A	12/1987	Bolson, Sr.	6,061,632 A	5/2000	Dreier
4,747,207 A	5/1988	Schonstedt et al.	6,064,940 A	5/2000	Rodgers
4,803,773 A	2/1989	Schonstedt	6,074,693 A	6/2000	Manning
4,818,944 A	4/1989	Rippingale	6,095,081 A	8/2000	Gochenour
4,839,623 A	6/1989	Schonstedt et al.	6,107,801 A	8/2000	Hopwood
4,839,624 A	6/1989	Schonstedt	6,119,376 A	9/2000	Stump
4,873,533 A	10/1989	Oike	6,127,827 A	10/2000	Lewis
4,899,293 A	2/1990	Dawson et al.	6,130,539 A	10/2000	Polak
4,989,151 A	1/1991	Nuimura	6,138,906 A *	10/2000	DeMayo ..... 235/375
5,001,430 A	3/1991	Peterman et al.	6,140,819 A	10/2000	Peterman et al.
5,006,806 A	4/1991	Rippingale et al.	6,169,958 B1	1/2001	Nagasamy et al.
5,014,008 A	5/1991	Flowerdew	6,188,392 B1	2/2001	O'Connor et al.
5,017,873 A	5/1991	Rippingale et al.	6,188,777 B1	2/2001	Darrell et al.
5,025,150 A	6/1991	Oldham et al.	6,206,282 B1	3/2001	Hayes, Sr. et al.
5,043,666 A	8/1991	Tavernetti et al.	6,234,218 B1	5/2001	Boers
5,045,368 A	9/1991	Cosman et al.	6,240,360 B1	5/2001	Phelan
5,065,098 A	11/1991	Salsman et al.	6,268,731 B1	7/2001	Hopwood et al.
5,093,622 A	3/1992	Balkman	6,282,477 B1	8/2001	Gudat et al.
5,097,211 A	3/1992	Schonstedt	6,285,911 B1	9/2001	Watts et al.
5,114,517 A	5/1992	Rippingale et al.	6,292,108 B1	9/2001	Straser et al.
5,122,750 A	6/1992	Rippingale et al.	6,294,022 B1	9/2001	Eslambolchi et al.
5,136,245 A	8/1992	Schonstedt	6,297,736 B1	10/2001	Lewis
5,138,761 A	8/1992	Schonstedt	6,299,934 B1 *	10/2001	Manning ..... 427/137
5,150,295 A	9/1992	Mattingly	6,308,565 B1	10/2001	French et al.
5,173,139 A	12/1992	Rippingale et al.	6,320,518 B2	11/2001	Saeki et al.
5,206,065 A	4/1993	Rippingale et al.	RE37,574 E	3/2002	Rawlins
5,214,757 A	5/1993	Mauney et al.	6,356,082 B1	3/2002	Alkire et al.
5,231,355 A	7/1993	Rider et al.	6,363,320 B1	3/2002	Chou
5,239,290 A	8/1993	Schonstedt	6,375,038 B1	4/2002	Daansen et al.
5,260,659 A	11/1993	Flowerdew et al.	6,378,220 B1	4/2002	Baioff et al.
5,264,795 A	11/1993	Rider	6,388,629 B1	5/2002	Albats et al.
5,299,300 A	3/1994	Femal	6,390,336 B1	5/2002	Orozco
5,329,464 A	7/1994	Sumic et al.	6,401,051 B1	6/2002	Merriam
5,361,029 A	11/1994	Rider et al.	6,407,550 B1	6/2002	Parakulam et al.
5,365,163 A	11/1994	Satterwhite et al.	6,411,094 B1	6/2002	Gard et al.
5,373,298 A	12/1994	Karouby	6,437,708 B1	8/2002	Brouwer
5,379,045 A	1/1995	Gilbert et al.	6,438,239 B1	8/2002	Kuechen
5,381,338 A	1/1995	Wysocki	6,459,266 B1	10/2002	Fling
5,430,379 A	7/1995	Parkinson et al.	6,476,708 B1	11/2002	Johnson
5,444,364 A	8/1995	Satterwhite et al.	6,477,588 B1	11/2002	Yerazunis
5,467,271 A	11/1995	Abel et al.	6,490,524 B1	12/2002	White et al.
5,471,143 A	11/1995	Doany	6,512,478 B1	1/2003	Chien
5,486,067 A	1/1996	Huynh	6,526,400 B1	2/2003	Takata
5,490,646 A	2/1996	Shaw	6,549,011 B2	4/2003	Flatt
5,517,419 A	5/1996	Lanckton	6,552,548 B1	4/2003	Lewis et al.
5,519,329 A	5/1996	Satterwhite	6,585,133 B1	7/2003	Brouwer
5,529,433 A	6/1996	Huynh	6,600,420 B2	7/2003	Goff et al.
5,530,357 A	6/1996	Cosman et al.	6,617,856 B1	9/2003	Royle et al.
5,543,931 A	8/1996	Lee et al.	6,633,163 B2	10/2003	Fling
5,553,407 A	9/1996	Stump	6,650,293 B1	11/2003	Eslambolchi
5,568,162 A	10/1996	Samsel et al.	6,650,798 B2	11/2003	Russell et al.
5,576,973 A	11/1996	Haddy	6,658,148 B1	12/2003	Fung
5,621,325 A	4/1997	Draper et al.	6,674,276 B2	1/2004	Morgan et al.
5,629,626 A	5/1997	Russell et al.	6,700,526 B2	3/2004	Witten
5,644,237 A	7/1997	Eslambolchi et al.	6,710,741 B2	3/2004	Tucker
5,659,985 A	8/1997	Stump	6,717,392 B2	4/2004	Pearson
5,673,050 A	9/1997	Moussally et al.	6,723,375 B2	4/2004	Zeck et al.
5,689,415 A	11/1997	Calotychos et al.	6,728,662 B2	4/2004	Frost et al.
5,699,244 A	12/1997	Clark, Jr.	6,751,552 B1	6/2004	Minelli
5,704,142 A	1/1998	Stump	6,751,553 B2	6/2004	Young
5,739,785 A	4/1998	Allison et al.	6,751,554 B1	6/2004	Asher et al.
5,751,289 A	5/1998	Myers	6,777,923 B2	8/2004	Pearson
5,751,450 A	5/1998	Robinson	6,778,128 B2	8/2004	Tucker et al.
5,764,127 A	6/1998	Hore et al.	6,798,379 B2	9/2004	Tucker et al.
5,769,370 A	6/1998	Ashjaee	6,799,116 B2	9/2004	Robbins
5,819,859 A	10/1998	Stump et al.	6,815,953 B1	11/2004	Bigelow
5,828,219 A	10/1998	Hanlon et al.	6,819,109 B2	11/2004	Sowers et al.
			6,825,775 B2	11/2004	Fling et al.

6,825,793	B2	11/2004	Taylor, Jr. et al.	2001/0029996	A1	10/2001	Robinson
6,833,795	B1	12/2004	Johnson et al.	2002/0035432	A1	3/2002	Kubica et al.
6,833,811	B2	12/2004	Zeitfuss et al.	2002/0053608	A1	5/2002	Zeck et al.
6,836,231	B2	12/2004	Pearson	2002/0103625	A1	8/2002	Card et al.
6,845,171	B2	1/2005	Shum et al.	2002/0115472	A1	8/2002	Address
6,850,161	B1	2/2005	Elliott et al.	2002/0122000	A1	9/2002	Bradley et al.
6,850,843	B2	2/2005	Smith et al.	2002/0130806	A1	9/2002	Taylor et al.
6,853,303	B2	2/2005	Chen et al.	2002/0130906	A1	9/2002	Miyaki
6,865,484	B2	3/2005	Miyasaka et al.	2003/0012411	A1	1/2003	Sjostrom
6,898,525	B1	5/2005	Minelli	2003/0080897	A1	5/2003	Tranchina
6,898,550	B1	5/2005	Blackadar et al.	2003/0100316	A1	5/2003	Odamura
6,904,361	B1	6/2005	Tallman et al.	2003/0135328	A1	7/2003	Burns et al.
6,941,890	B1	9/2005	Cristo et al.	2003/0168834	A1	9/2003	Ulrich
6,947,028	B2	9/2005	Shkolnikov	2003/0184300	A1	10/2003	Bigelow
6,954,071	B2	10/2005	Flatt et al.	2003/0196585	A1	10/2003	McDonald
6,956,524	B2	10/2005	Tucker et al.	2004/0006425	A1	1/2004	Wood
6,956,564	B1	10/2005	Williams	2004/0051368	A1	3/2004	Caputo
6,958,690	B1	10/2005	Asher et al.	2004/0057795	A1	3/2004	Mayfield et al.
6,968,296	B2	11/2005	Royle	2004/0070535	A1	4/2004	Olsson et al.
6,972,698	B2	12/2005	Deguchi	2004/0124988	A1	7/2004	Leonard et al.
6,975,942	B2	12/2005	Young et al.	2004/0168358	A1	9/2004	Stump et al.
6,977,508	B2	12/2005	Pearson et al.	2004/0210370	A1	10/2004	Gudat
6,992,584	B2	1/2006	Dooley et al.	2004/0220731	A1	11/2004	Tucker
6,993,088	B2	1/2006	Fling et al.	2004/0225444	A1	11/2004	Young et al.
6,999,021	B2	2/2006	Taylor, Jr.	2005/0023367	A1	2/2005	Reighard
7,009,399	B2	3/2006	Olsson et al.	2005/0034074	A1	2/2005	Munson
7,009,519	B2	3/2006	Leonard et al.	2005/0038825	A1	2/2005	Tarabzouni
7,038,454	B2	5/2006	Gard et al.	2005/0040222	A1	2/2005	Robinson et al.
7,042,358	B2	5/2006	Moore	2005/0054457	A1	3/2005	Eyestone et al.
7,048,320	B2	5/2006	Rubel	2005/0055142	A1	3/2005	McMurtry et al.
7,053,789	B2	5/2006	Fling et al.	2005/0057745	A1	3/2005	Bontje
7,057,383	B2	6/2006	Schlapp et al.	2005/0150399	A1	7/2005	Wiley
7,062,414	B2	6/2006	Waite et al.	2005/0156600	A1	7/2005	Olsson
7,079,591	B2	7/2006	Fling et al.	2005/0192727	A1	9/2005	Shostak et al.
7,091,872	B1	8/2006	Bigelow et al.	2005/0206562	A1	9/2005	Willson et al.
7,113,124	B2	9/2006	Waite	2005/0232475	A1	10/2005	Floeder
7,116,244	B2	10/2006	Fling et al.	2005/0278371	A1	12/2005	Funk et al.
7,120,564	B2	10/2006	Pacey	2006/0026020	A1	2/2006	Waite et al.
7,235,980	B2	6/2007	Pearson et al.	2006/0055584	A1	3/2006	Waite et al.
7,285,958	B2	10/2007	Overby et al.	2006/0077095	A1	4/2006	Tucker et al.
7,304,480	B1	12/2007	Pearson	2006/0085133	A1	4/2006	Young
7,310,584	B2	12/2007	Royle	2006/0085396	A1	4/2006	Evans
7,319,387	B2	1/2008	Willson et al.	2006/0109131	A1	5/2006	Sen et al.
7,331,340	B2	2/2008	Barney	2006/0169776	A1	8/2006	Hornbaker
7,336,078	B1	2/2008	Merewether et al.	2006/0220955	A1	10/2006	Hamilton
7,339,379	B2	3/2008	Thompson et al.	2006/0244454	A1	11/2006	Gard
7,342,537	B2	3/2008	Pearson et al.	2006/0254820	A1	11/2006	Gard et al.
7,356,421	B2	4/2008	Gudmundsson et al.	2006/0262963	A1	11/2006	Navulur
7,358,738	B2	4/2008	Overby et al.	2006/0276198	A1	12/2006	Michelon et al.
7,372,247	B1*	5/2008	Giusti et al. .... 324/67	2006/0276985	A1	12/2006	Xu
7,372,276	B2	5/2008	Mulcahey	2006/0282191	A1	12/2006	Gotfried
7,396,177	B2	7/2008	Lapstun et al.	2006/0282280	A1	12/2006	Stotz et al.
7,396,178	B2	7/2008	Lapstun et al.	2006/0285913	A1	12/2006	Koptis et al.
7,400,976	B2	7/2008	Young et al.	2006/0287900	A1	12/2006	Fiore
7,403,012	B2	7/2008	Worsley et al.	2006/0289679	A1	12/2006	Johnson et al.
7,413,363	B2	8/2008	Lapstun et al.	2007/0013379	A1	1/2007	Staples et al.
7,443,154	B1	10/2008	Merewether et al.	2007/0018632	A1	1/2007	Royle et al.
7,451,721	B1	11/2008	Garza et al.	2007/0031042	A1	2/2007	Simental
7,482,973	B2	1/2009	Tucker et al.	2007/0040558	A1	2/2007	Overby et al.
7,500,583	B1	3/2009	Cox	2007/0100496	A1	5/2007	Forell
7,532,127	B2	5/2009	Holman et al.	2007/0219722	A1	9/2007	Sawyer, Jr.
7,636,901	B2	12/2009	Munson	2007/0223803	A1	9/2007	Shindo
7,640,105	B2	12/2009	Nielsen et al.	2007/0268110	A1	11/2007	Little
7,664,530	B2	2/2010	Skelton	2007/0286021	A1	12/2007	Hoemans et al.
7,733,077	B1	6/2010	Merewether et al.	2007/0288195	A1	12/2007	Waite et al.
7,773,095	B1	8/2010	Badrak et al.	2008/0010009	A1	1/2008	Miyoshi
7,834,801	B2	11/2010	Waite et al.	2008/0013940	A1	1/2008	Jung
7,834,806	B2	11/2010	Tucker et al.	2008/0125942	A1	5/2008	Tucker et al.
7,889,124	B2	2/2011	Islam et al.	2008/0180322	A1	7/2008	Islam
7,889,888	B2	2/2011	Deardorr	2008/0204322	A1	8/2008	Oswald et al.
7,929,981	B2	4/2011	Sangberg	2008/0208415	A1	8/2008	Vik
7,978,129	B2	7/2011	Sawyer et al.	2008/0228294	A1	9/2008	Nielsen et al.
7,986,246	B2	7/2011	Angelis et al.	2008/0245299	A1	10/2008	Nielsen et al.
8,081,112	B2	12/2011	Tucker et al.	2008/0255795	A1	10/2008	Shkolnikov
8,106,660	B1	1/2012	Merewether et al.	2008/0310721	A1	12/2008	Yang
8,118,192	B2	2/2012	Daugherty	2009/0004410	A1	1/2009	Thomson et al.
8,144,245	B2	3/2012	Vik	2009/0013928	A1	1/2009	Nielsen et al.
8,264,409	B2	9/2012	Miller	2009/0063258	A1	3/2009	Mueller et al.
8,311,765	B2	11/2012	Nielsen et al.	2009/0085568	A1	4/2009	Cole et al.



WO	WO-9854600	A1	12/1998
WO	WO-9854601	A1	12/1998
WO	WO-9900679	A1	1/1999
WO	WO0194016		12/2001
WO	WO-0228541		4/2002
WO	WO-2004100044	A1	11/2004
WO	WO-2004102242	A1	11/2004
WO	WO-2005052627	A2	6/2005
WO	WO-2006015310	A3	2/2006
WO	WO-2006136776	A1	12/2006
WO	WO-2006136777	A1	12/2006
WO	WO-2007067898	A2	6/2007

## OTHER PUBLICATIONS

Carey, B., "Tracking Shoes," Chicago Tribune Online Edition, Jan. 29, 2007; pp. 1-3; <http://www.chicagotribune.com-services-site-premium-access-registered.intercept>.

Fox, G. et al., "GPS Provides Quick, Accurate Data for Underground Utility Location" (as featured in Apr. 2002 issue of Trenchless Technology, <http://www.woolpert.com-asp-articles-GPS-Provides.asp>, Sep. 14, 2007, pp. 1 and 2.

Trimble Navigation Limited, H-Star Technology Explained, [www.trimble.com](http://www.trimble.com), pp. 1-9, 2005.

Co-pending U.S. Appl. No. 11/685,602, filed Mar. 13, 2007.

Co-pending U.S. Appl. No. 11/696,606, filed Apr. 4, 2007.

Co-pending U.S. Appl. No. 12/236,688, filed Sep. 24, 2008.

Co-pending U.S. Appl. No. 12/363,951, filed Feb. 2, 2009.

Co-pending U.S. Appl. No. 12/364,369, filed Feb. 2, 2009.

Co-pending U.S. Appl. No. 12/364,359, filed Feb. 2, 2009.

Co-pending U.S. Appl. No. 12/364,339, filed Feb. 2, 2009.

Office Action mailed Apr. 28, 2009 from Co-Pending U.S. Appl. No. 11/685,602.

International Search Report and Written Opinion, Application Serial No. PCT/US2009/005348, Mar. 2, 2010.

International Search Report and Written Opinion, Application Serial No. PCT/US2009/005359, Feb. 8, 2010.

Co-pending U.S. Appl. No. 12/539,497, filed Aug. 11, 2009.

Co-Pending U.S. Appl. No. 12/568,087 filed Sep. 28, 2009.

Co-pending U.S. Appl. No. 12/607,843, filed Oct. 28, 2009.

Co-pending U.S. Appl. No. 12/622,768, filed Nov. 20, 2009.

Co-pending U.S. Appl. No. 12/639,041, filed Dec. 16, 2009.

Co-pending U.S. Appl. No. 12/639,373 filed Dec. 16, 2009.

International Search Report and Written Opinion, Application Serial No. PCT/US2008/55796, Oct. 14, 2008.

International Search Report and Written Opinion, Application Serial No. PCT/US2008/55798, Jul. 28, 2008.

International Search Report and Written Opinion, Application Serial No. PCT/US2009/005299, Dec. 12, 2009.

Notice of Allowance dated Nov. 6, 2009 from Co-Pending U.S. Appl. No. 11/685,602.

Office Action dated Nov. 18, 2009 from Co-Pending Canadian Application No. 2,623,466, filed Mar. 4, 2008.

Office Action dated Nov. 23, 2009 from Co-Pending Canadian Application No. 2,623,761, filed Mar. 4, 2008.

Office Action dated Sep. 17, 2009 from Co-Pending U.S. Appl. No. 11/685,602.

U.S. Appl. No. 12/429,947, filed Apr. 24, 2009, Nielsen et al.

U.S. Appl. No. 12/571,411, filed Sep. 30, 2009, Nielsen et al.

U.S. Appl. No. 12/571,408, filed Sep. 30, 2009, Nielsen et al.

U.S. Appl. No. 12/571,401, filed Sep. 30, 2009, Nielsen et al.

U.S. Appl. No. 12/701,496, filed Feb. 5, 2010, Nielsen et al.

U.S. Appl. No. 12/701,468, filed Feb. 5, 2010, Nielsen et al.

U.S. Appl. No. 12/701,447, filed Feb. 5, 2010, Nielsen et al.

U.S. Appl. No. 12/703,958, filed Feb. 11, 2010, Nielsen et al.

U.S. Appl. No. 12/797,169, filed Jun. 9, 2010, Nielsen et al.

U.S. Appl. No. 12/797,202, filed Jun. 9, 2010, Nielsen et al.

U.S. Appl. No. 12/797,211, filed Jun. 9, 2010, Nielsen et al.

U.S. Appl. No. 12/797,227, filed Jun. 9, 2010, Nielsen et al.

U.S. Appl. No. 12/797,243, filed Jun. 9, 2010, Nielsen et al.

U.S. Appl. No. 12/797,262, filed Jun. 9, 2010, Nielsen et al.

U.S. Appl. No. 12/764,164, filed Apr. 21, 2010, Nielsen et al.

U.S. Appl. No. 12/855,977, filed Aug. 13, 2010, Nielsen et al.

U.S. Appl. No. 12/859,394, filed Aug. 19, 2010, Nielsen et al.

U.S. Appl. No. 12/786,929, filed May 25, 2010, Nielsen et al.

U.S. Appl. No. 12/854,370, filed Aug. 11, 2010, Nielsen et al.

Bernold, L. et al. "Equipment operator training in the age of internet2," Proceedings of 19th International Symposium on Automation and Robotics in Construction (ISARC 2002), Sep. 2002 [retrieved on Nov. 12, 2010]. Retrieved from the Internet: <URL: <http://fire.nist.gov/bfrlpubs/build02IPDF/b02059.pdf>>. p. 4, col. 2, para 2.

European Search Report, Application No. 08743671.3, Nov. 16, 2011.

European Search Report, Application No. 08743673.9, Feb. 28, 2011.

GPS Technology Enhancing Underground Utility Locating, Underground Construction Magazine, Apr. 7, 2010, 4 pages, <http://www.undergroundconstructionmagazine.com/print/1034?page=show>.

International Search Report and Written Opinion, Application No. PCT/2010/000389, Jun. 2, 2010.

International Search Report and Written Opinion, Application No. PCT/US10/45161, Oct. 29, 2010.

International Search Report and Written Opinion, Application No. PCT/US10/45409, Nov. 18, 2010.

International Search Report and Written Opinion, Application No. PCT/US10/45969, Nov. 18, 2010.

International Search Report and Written Opinion, Application No. PCT/US2009/003957, Mar. 21, 2011.

International Search Report and Written Opinion, Application No. PCT/US2010/036029, Sep. 3, 2010.

International Search Report and Written Opinion, Application No. PCT/US2011/047807, Dec. 6, 2011.

Jung, H.G., Structure Analysis Based Parking Slot Marking Recognition for Semi-automatic Parking System, Springer-Verlag Berlin Heidelberg 2006, 10 pages.

Notice of Allowance dated Jan. 24, 2012 from U.S. Appl. No. 12/363,951.

Notice of Allowance dated Aug. 25, 2011 from U.S. Appl. No. 11/696,606.

Notice of Allowance dated Apr. 28, 2011 from U.S. Appl. No. 29/356,631.

Notice of Allowance dated Jan. 25, 2012 from Canadian Application No. 2,710,189.

Notice of Allowance dated Nov. 12, 2010 from U.S. Appl. No. 29/356,242.

Notice of Allowance dated Nov. 12, 2010 from U.S. Appl. No. 29/356,633.

Notice of Allowance dated Nov. 12, 2010 from U.S. Appl. No. 29/356,635.

Notice of Allowance dated Nov. 28, 2011 from Canadian Application No. 2,710,269.

Office Action dated Jan. 12, 2012 from U.S. Appl. No. 12/364,369.

Office Action dated Jan. 25, 2012 from U.S. Appl. No. 12/568,087.

Office Action dated Feb. 1, 2011 from Canadian Application No. 2,691,707.

Office Action dated Feb. 9, 2012 from U.S. Appl. No. 12/364,339.

Office Action dated Feb. 28, 2012 from U.S. Appl. No. 12/539,497.

Office Action dated Mar. 2, 2012 from U.S. Appl. No. 12/639,041.

Office Action dated May 24, 2011 from U.S. Appl. No. 12/363,951.

Office Action dated Jun. 16, 2010 from Canadian Application No. 2,691,707.

Office Action dated Sep. 26, 2011 from Canadian Application No. 2,739,119.

Office Action dated Sep. 26, 2011 from Canadian Application No. 2,739,320.

Office Action dated Oct. 4, 2011 from U.S. Appl. No. 12/364,359.

Office Action dated Oct. 20, 2011 from U.S. Appl. No. 12/639,041.

Office Action dated Oct. 24, 2011 from U.S. Appl. No. 12/236,688.

Office Action dated Nov. 15, 2011 from Canadian Application No. 2,691,707.

Office Action dated Dec. 30, 2011 from U.S. Appl. No. 12/701,447.

Office Action dated Jul. 20, 2010 from U.S. Appl. No. 11/696,606.

Office Action dated Jul. 11, 2011 from Canadian Application No. 2713282.

Office Action dated Jun. 28, 2011 from Canadian Application No. 2710269.

- Office Action dated Mar. 3, 2011 from Australian Application No. 2008226627.
- Office Action dated Mar. 9, 2011 from Australian Application No. 2008236526.
- Office Action dated Oct. 6, 2010 from Canadian Application No. 2623761.
- Product Data, Hard Hat Aerosols Marking Paint 2300; Rust-oleum Netherlands B.V., Apr. 2005, 1 page, <http://www.rustoleum.co.uk/downloads/2300%20Marking%20Spray.pdf>.
- Product Data, "Inverted Marking Chalk," Rust-oleum, Jul. 2004, 2 pages, [http://www.policeone.com/pdfs/markingschalkinfo\\_ro.pdf](http://www.policeone.com/pdfs/markingschalkinfo_ro.pdf).
- VIRGINIA Underground utility marking standard, Mar. 2004, 20 pages.
- U.S. Appl. No. 13/686,262, filed Nov. 27, 2012, Nielsen et al.
- U.S. Appl. No. 13/644,226, filed Oct. 3, 2012, Nielsen et al.
- Notice of Allowance dated Aug. 1, 2012 from U.S. Appl. No. 12/364,339.
- Office Action dated Aug. 15, 2012 from Australian Application No. 2010214104.
- Office Action dated Aug. 29, 2012 from U.S. Appl. No. 12/701,447.
- Office Action dated Sep. 4, 2012 from U.S. Appl. No. 12/622,768.
- Notice of Allowance dated Sep. 5, 2012 from U.S. Appl. No. 12/854,370.
- 3M Dynatel, Brochure, 2006, 1-4.
- 3M Dynatel, Locating and Marking System, Brochure, 2007, 1-16.
- Office Action dated Sep. 21, 2012 from U.S. Appl. No. 12/797,202.
- Office Action dated Sep. 25, 2012 from Australian Application No. 2010214053.
- Notice of Allowance dated Oct. 1, 2012 from U.S. Appl. No. 12/607,843.
- Office Action dated Oct. 2, 2012 from Japanese Application No. 2010-502170.
- Office Action dated Oct. 15, 2012 from U.S. Appl. No. 12/797,227.
- Notice of Allowance dated Oct. 17, 2012 from U.S. Appl. No. 12/236,688.
- Office Action dated Oct. 19, 2012 from U.S. Appl. No. 12/797,243.
- Olsson, Office Action dated Sep. 13, 2012 from U.S. Appl. No. 12/827,993.
- Notice of Allowance dated Oct. 25, 2012 from U.S. Appl. No. 12/639,373.
- Notice of Allowance dated Nov. 7, 2012 from U.S. Appl. No. 12/639,041.
- Office Action dated Nov. 14, 2012 from Canadian Application No. 2,750,908.
- Office Action dated Nov. 20, 2012 from U.S. Appl. No. 12/701,468.
- Office Action dated Nov. 21, 2012 from U.S. Appl. No. 12/701,496.
- Office Action dated Nov. 23, 2012 from U.S. Appl. No. 12/855,977.
- Office Action dated Nov. 26, 2012 from U.S. Appl. No. 12/764,164.
- Office Action dated Dec. 5, 2012 from U.S. Appl. No. 12/797,262.
- Notice of Allowance dated Dec. 12, 2012 from U.S. Appl. No. 12/703,958.
- Office Action dated Dec. 18, 2012 from U.S. Appl. No. 12/786,929.
- Office Action dated Dec. 20, 2012 from U.S. Appl. No. 12/571,408.
- Notice of Allowance dated Dec. 21, 2012 from U.S. Appl. No. 12/364,339.
- Office Action dated Jul. 26, 2012 from U.S. Appl. No. 12/639,041.
- Office Action dated Jul. 27, 2012 from European Application No. 08743671.3.
- New Mexico's Recommended Marking Guidelines for Underground Utilities, May 2006, 8 pages.
- Office Action dated Mar. 20, 2012 from U.S. Appl. No. 12/764,164.
- Office Action dated Mar. 29, 2012 from GB Application No. 1107052.1.
- Office Action dated Apr. 10, 2012 from U.S. Appl. No. 12/854,370.
- Office Action dated Apr. 12, 2012 from Canadian Application No. 2,691,707.
- Office Action dated Apr. 13, 2012 from Australian Application No. 2008236526.
- Office Action dated Apr. 17, 2012 from U.S. Appl. No. 12/607,843.
- Office Action dated Apr. 25, 2012 from U.S. Appl. No. 12/363,046.
- Notice of Allowance dated Mar. 9, 2012 from U.S. Appl. No. 12/236,688.
- Office Action dated Mar. 13, 2012 from U.S. Appl. No. 12/364,359.
- Luczak, S., "Increasing Accuracy of Tilt Measurements," Engineering Mechanics, vol. 14, 2007, p. 143-154.
- Notice of Allowance dated Jul. 12, 2012 from U.S. Appl. No. 12/539,497.
- Office Action dated May 1, 2012 from Australian Application No. 2009300362.
- Office Action dated May 15, 2012 from U.S. Appl. No. 12/797,243.
- Office Action dated May 17, 2012 from U.S. Appl. No. 12/364,369.
- Office Action dated Jun. 1, 2012 from U.S. Appl. No. 12/855,977.
- Office Action dated Jun. 4, 2012 from U.S. Appl. No. 12/568,087.
- Office Action dated Jun. 4, 2012 from U.S. Appl. No. 12/703,958.
- Office Action dated Jun. 8, 2012 from U.S. Appl. No. 12/639,041.
- Office Action dated Jun. 13, 2012 from U.S. Appl. No. 12/639,373.
- Office Action dated Jun. 8, 2012 from U.S. Appl. No. 12/701,468.
- Office Action dated Jun. 18, 2012 from U.S. Appl. No. 12/701,496.
- Office Action dated Jul. 2, 2012 from U.S. Appl. No. 12/797,262.
- Office Action dated Jul. 12, 2012 from U.S. Appl. No. 12/571,411.
- Notice of Allowance dated Jan. 8, 2013 from U.S. Appl. No. 12/797,243.
- Notice of Allowance dated Jan. 22, 2013 from U.S. Appl. No. 12/703,958.
- U.S. Appl. No. 13/795,337, filed Mar. 12, 2013, Nielsen et al.
- U.S. Appl. No. 13/797,229, filed Mar. 12, 2013, Nielsen et al.
- U.S. Appl. No. 13/751,862, filed Jan. 28, 2013, Nielsen et al.
- U.S. Appl. No. 13/846,120, filed Mar. 18, 2013, Nielsen et al.
- Notice of Allowance dated Feb. 1, 2013 from U.S. Appl. No. 12/797,202.
- Notice of Allowance dated Feb. 13, 2013 from U.S. Appl. No. 12/701,447.
- Notice of Allowance dated Feb. 20, 2013 from U.S. Appl. No. 12/364,369.
- Notice of Allowance from U.S. Appl. No. 12/622,768 dated Jan. 24, 2013.
- Office Action dated Jan. 9, 2013 from U.S. Appl. No. 12/571,411.
- Office Action received Jan. 18, 2013 from Japanese Application No. 2009-553688.
- Corrected Notice of Allowability from U.S. Appl. No. 12/364,369 dated Apr. 15, 2013.
- Corrected Notice of Allowability from U.S. Appl. No. 12/703,958 dated Apr. 18, 2013.
- Office Action dated Mar. 13, 2013 from Chinese Application No. 201080045879.1.
- Notice of Allowance daed Apr. 25, 2013 from U.S. Appl. No. 12/364,359.

\* cited by examiner

Marking device 100

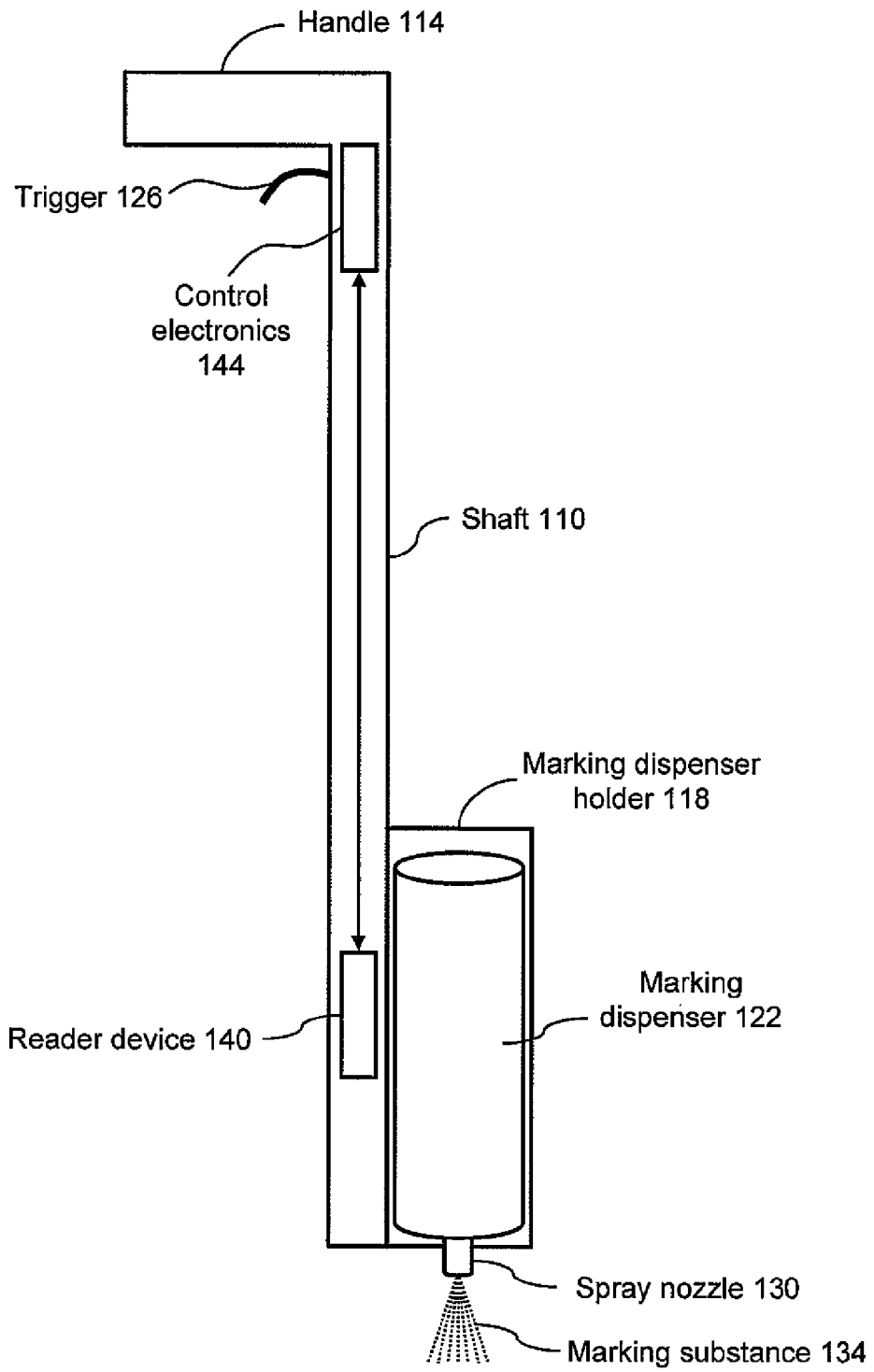
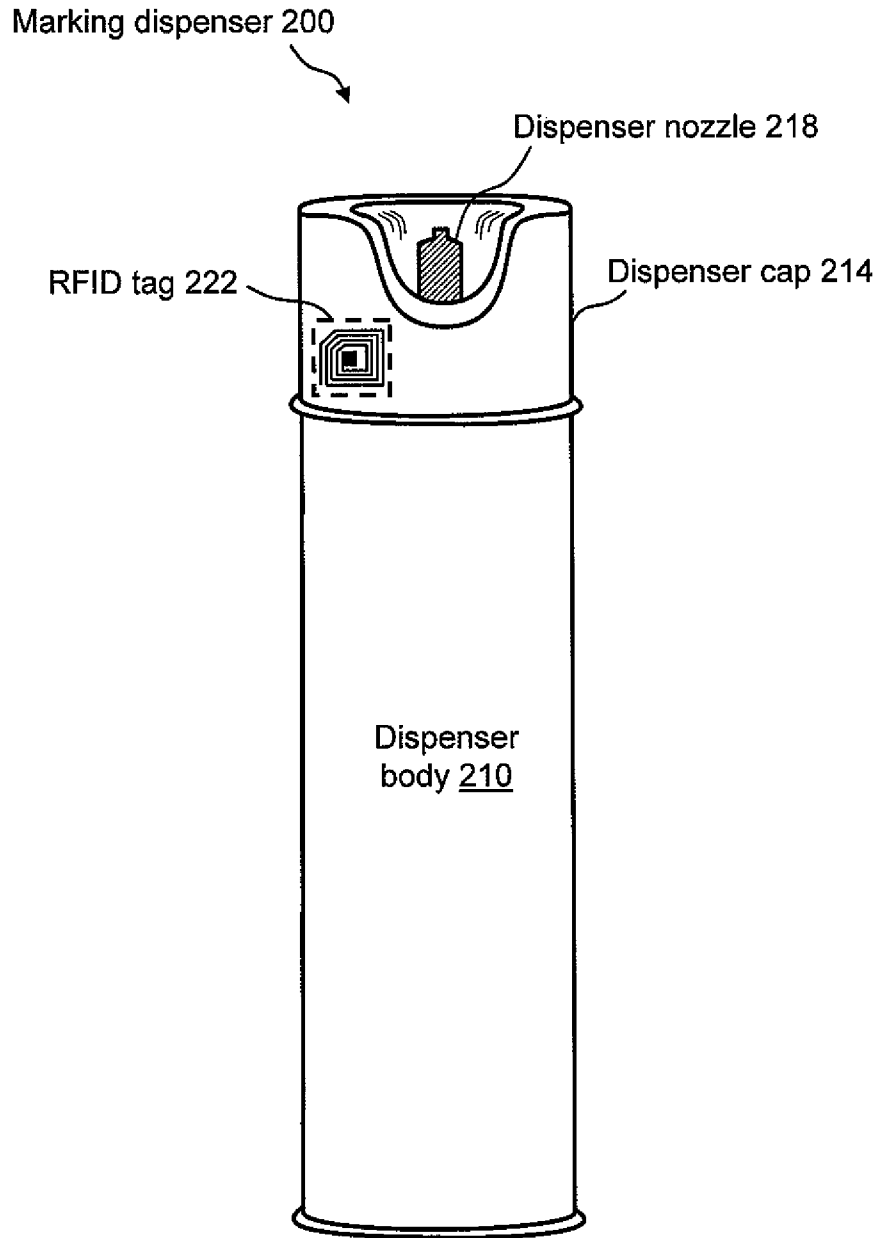


FIG. 1



**FIG. 2**



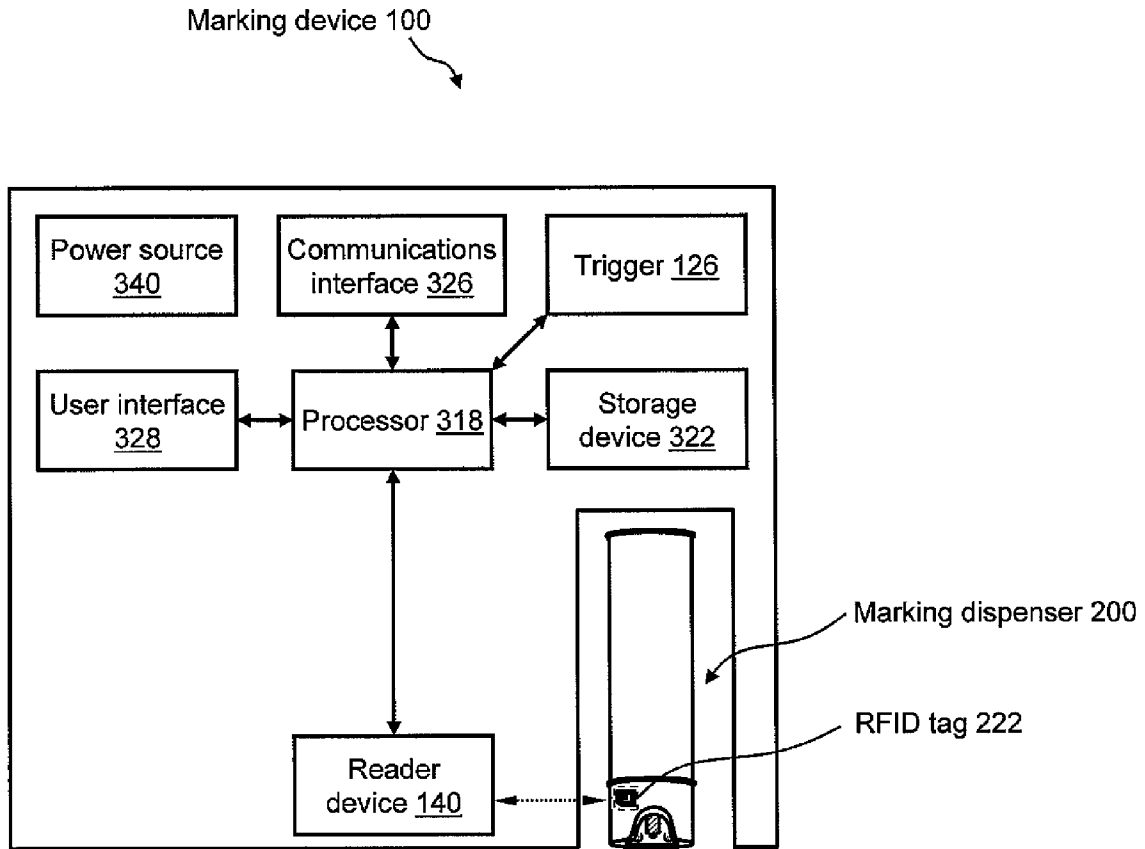
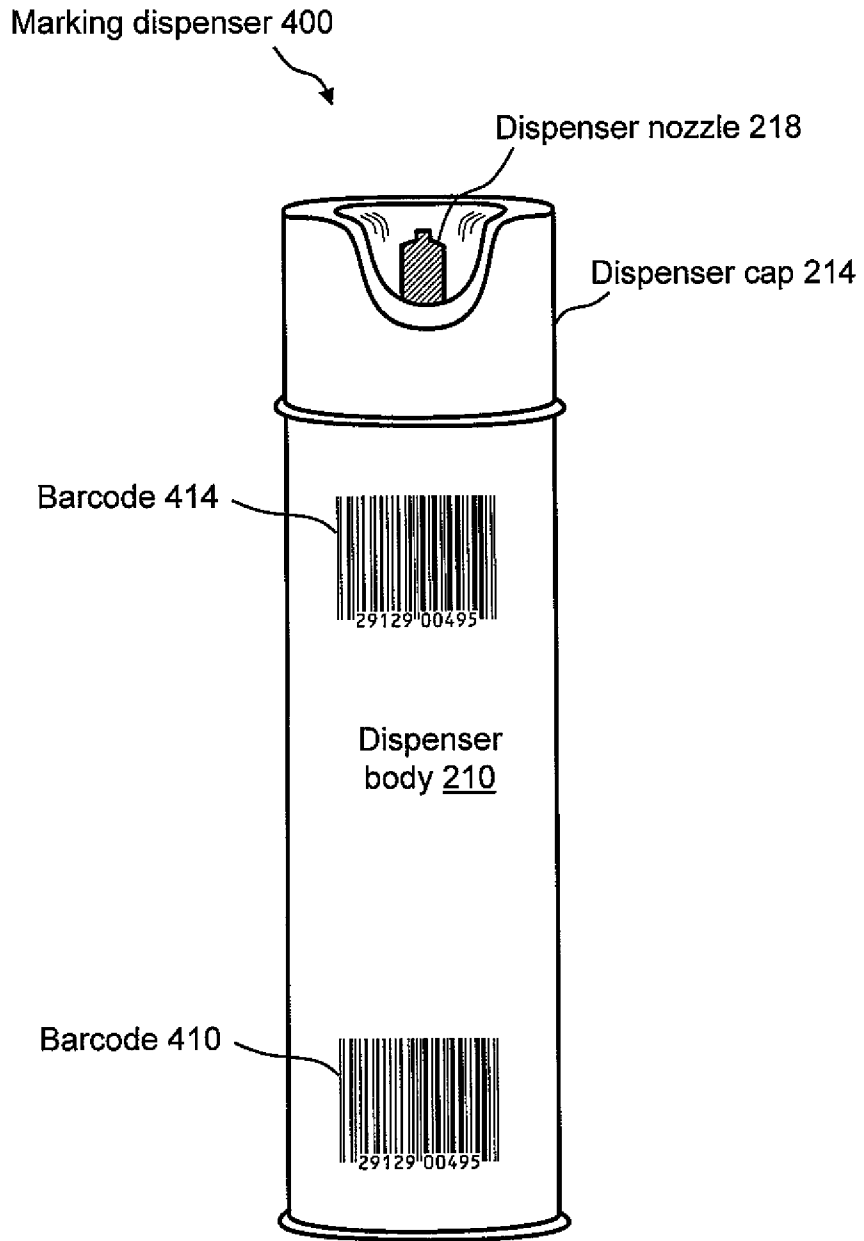


FIG. 3



**FIG. 4**

Method 500

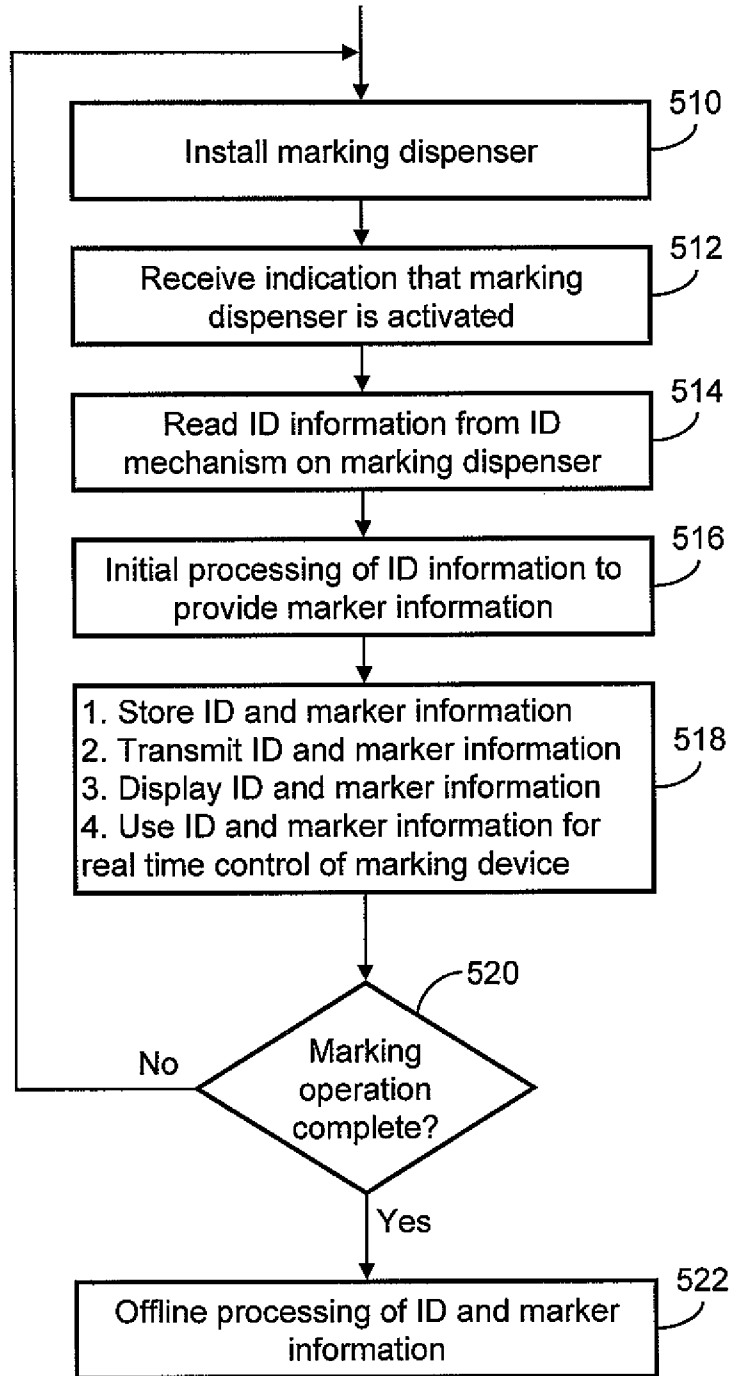


FIG. 5

1

**MARKING APPARATUS AND MARKING  
METHODS USING MARKING DISPENSER  
WITH MACHINE-READABLE ID  
MECHANISM**

CROSS REFERENCE TO RELATED  
APPLICATION

This application claims a priority benefit, under 35 U.S.C. §119(e), to Provisional Application Ser. No. 61/075,882, filed Jun. 26, 2008, which is hereby incorporated by reference in its entirety. This application also claims the benefit, under 35 U.S.C. §120, as a continuation-in-part (CIP) of the following U.S. non-provisional applications: Ser. No. 11/696,606, filed Apr. 4, 2007, entitled "Marking System and Method," and Ser. No. 11/685,602, filed Mar. 13, 2007, entitled "Marking System and Method with Location and/or Time Tracking."

FIELD OF THE INVENTION

The present invention relates generally to the field of marking devices for placing marks on the ground. In particular, the present invention relates to marking devices and marking methods using marking dispensers each having a machine-readable ID mechanism affixed thereto.

BACKGROUND

Marking paint, such as inverted marking spray paint (also known as "upside down paint"), may be used by land surveyors, utility location experts, or anyone that has a need to mark a location on the ground. Marking paint may be used along with paint marking wands and/or paint marking wheels, which provide a convenient method of dispensing the marking paint onto the ground.

In many marking applications, a specified marking paint color may be required for identifying a certain entity. For example, once located, an underground power line may be marked with one color, an underground telephone line may be marked with another color, an underground gas line may be marked with yet another color, and so on. Further, the attributes of marking paint may be important for providing durability and/or ease of removal characteristics. Consequently, the marking paint formulations may vary according to durability and/or ease of removal specifications for different surfaces and uses. For example, municipalities may require that marking paint on streets and sidewalks fade away after only a few days. Therefore, it may be beneficial to develop mechanisms for ensuring, for example, that the proper color and/or formulation of marking paint is being used and/or has been used.

Additionally, in the marking industry, the aggregate cost of the marking paint for marking multiple locations may be substantial. However, while substantial in the aggregate, individual dispensers of marking paint are relatively inexpensive. Accordingly, the consumption of marking paint is hard to track and/or control as the cost of individual dispensers is generally thought of as insignificant by the marking technicians who, therefore, tend to be wasteful. For example, marking paint dispensers are often discarded before being completely emptied. Consequently, over time a significant amount of useful marking paint may be wasted, and, in addition to environmental concerns, the cost of supplying and/or replenishing the marking paint is not optimized.

Accordingly, approaches are needed for easily determining the type of marking paint that is being used in, for example, an

2

underground facility locate operation and for monitoring the consumption of marking paint in the marking industry.

SUMMARY OF THE INVENTION

According to a first aspect of the invention, a marking apparatus is provided to mark the presence or absence of an underground facility in a dig area. The marking apparatus comprises a housing configured to enable dispensing of a marker onto the ground for marking the presence or absence of an underground facility in a dig area; a marking dispenser holder affixed to the housing to hold at least one marking dispenser; an actuator to cause dispensing of the marker from the marking dispenser onto the ground in the dig area, in a marking operation, to mark presence or absence of an underground facility; at least one reader device to read ID information from an ID mechanism affixed to the marking dispenser; and a processing device to generate marker information in response to the ID information received from the reader device, the marker information representing at least one characteristic of the marking substance.

According to a second aspect of the invention, a method is provided for performing a marking operation for marking the presence or absence of an underground facility in a dig area using a marking apparatus that holds at least one marking dispenser. The method comprises dispensing a marker from the marking dispenser onto the ground in the dig area, in a marking operation, to mark the presence or absence of an underground facility, in response to activation of the marking dispenser; reading ID information from an ID mechanism affixed to the marking dispenser; and generating marker information in response to the ID information read from the ID mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of illustrating the present invention, the drawings show aspects of one or more embodiments of the present invention. However, it should be understood that the present invention is not limited to the precise arrangements and instrumentalities shown in the drawings, wherein:

FIG. 1 is a schematic representation of a marking device for use with a marking dispenser having a machine-readable ID mechanism;

FIG. 2 is a front view of a marking dispenser having an RFID tag;

FIG. 3 is a functional block diagram of the marking device of FIG. 1;

FIG. 4 is a front view of a marking dispenser having a barcode; and

FIG. 5 is a flow diagram of a method of using a marking device having a machine-readable ID mechanism.

DETAILED DESCRIPTION

The invention relates to marking devices for dispensing markers on the ground and to marking methods. The marking devices and marking methods use a marking dispenser having a machine-readable ID mechanism affixed thereto. The ID mechanism of the marking dispenser has data storage capability. In one embodiment of the present invention, the marking dispenser may be provided with a radio-frequency identification (RFID) tag. In another embodiment of the present invention, the marking dispenser may be provided with a barcode. The type of information that may be encoded in the ID mechanism of the marking dispenser may include, but is not limited to, product-specific information, user-specific

information, other predetermined information of interest, and any combination thereof. The ID information encoded in the ID mechanism may be collected and used for various purposes, such as, but not limited to, real-time product verification, tracking which user location received a batch of marking paint, tracking marking paint inventory, tracking marking paint problems, and tracking marking paint usage.

FIG. 1 is a schematic representation of a marking device 100, also referred to herein as a “marking apparatus”, that includes at least one reader device for reading an ID mechanism on a marking dispenser. Marking device 100 may include a shaft 110, handle 114 at one end of shaft 110 and a marking dispenser holder 118 for holding a marking dispenser 122 at the end of shaft 110 that is opposite handle 114. Additionally, marking device 100 may include a trigger 126 for actuating a spray nozzle 130 of marking dispenser 122 to dispense a marking substance 134 onto the target of a marking operation, such as the ground. Marking dispenser 122 may be an aerosol canister that contains a quantity of a marking substance 134. Marking substance 134 may be, for example, marking paint, marking chalk, marking dye, marking powder, and the like. In one example, marking dispenser may be an aerosol canister that contains marking paint, such as commercially available marking paint. Marking device 100 may be configured to hold a single marking dispenser or more than one marking dispenser.

A basic marking operation of marking device 100 may be described as follows. A user, such as a locate technician in an underground facility locate application, loads a marking dispenser 122 that contains a quantity of marking substance 134 into marking dispenser holder 118. The user grasps handle 114 of marking device 100 and aims nozzle 130 of marking dispenser 122 at the intended target. The user then pulls trigger 126, which may be mechanically and/or electrically coupled to spray nozzle 130 of marking dispenser 122 in order to dispense marking substance 134 in a specified pattern on the intended target, such as the ground. For example, marking device 100 may be used to mark lines, arrows, geometric shapes, numbers, letters, words, and combinations thereof on the ground.

Marking device 100 further includes at least one reader device 140 and control electronics 144, as described below. In some embodiments, marking device 100 is configured for mounting a single marking dispenser and includes at least one reader device. In other embodiments, marking device 100 is configured for mounting one or more marking dispensers and includes one or more reader devices for each marking dispenser. In further embodiments, marking device 100 includes two or more reader devices of the same or different types.

Marking dispenser 122 includes an ID mechanism 124 integrated therein or thereon. Marking dispenser 122 may be any canister for containing and dispensing a quantity of marking substance, such as marking paint or chalk. For example, marking dispenser 122 may be a standard aerosol canister that contains a quantity of the marking substance, such as, for example, commercially available marking paint.

ID mechanism 124 may be, for example, a passive data storage mechanism that contains encoded information which is machine-readable via reader device 140. In one example, ID mechanism 124 may be an RFID tag device that stores information which may be read by an RFID reader. In another example, ID mechanism 124 may be one or more barcodes that store information which may be read by a barcode reader. The type of information that may be encoded in ID mechanism 124 may include, but is not limited to, product-specific information (e.g., manufacturer, brand, product code, lot or batch number, production date, paint color, paint formulation,

and the like), user-specific information (e.g., office location of using company), other predetermined information of interest, and any combination thereof. More details of the marking dispenser 122 having ID mechanism 124 are described with reference to FIGS. 2 and 4.

FIG. 2 is a front view of a marking dispenser 200 having an RFID tag 222, which is one embodiment of marking dispenser 122. In this embodiment, marking dispenser 200 may include a dispenser body 210, which may be, for example, a metal aerosol canister for holding a quantity of marking paint, a dispenser cap 214, which may be a plastic cap that is mounted on dispenser body 210, and a dispenser nozzle 218 that is integrated into dispenser cap 214. Dispenser nozzle 218 is the mechanism through which the marking substance is dispensed from within dispenser body 210 via the action of, for example, aerosol propellant. The combination of dispenser body 210, dispenser cap 214, and dispenser nozzle 218 may be of the type commercially available for use as marking paint.

RFID tag 222 is integrated with dispenser cap 214 of marking dispenser 200. RFID tag 222 may be a RFID tag device, which may be a microchip (not shown) that is combined with an antenna (not shown) in a compact package that is structured to allow the RFID tag to be attached to an object. The antenna of the RFID tag receives signals from an RFID reader or scanner (not shown) and then transmits a signal containing the data of interest. In one example, RFID tag 222 may be a Generation 2 passive RFID tag that is weather resistant and dual-sided in order to reduce the read range.

Preferably, RFID tag 222 is attached to the inside of dispenser cap 214, in order to provide a tamper-resistant and weather-resistant package. Dispenser cap 214 may be formed of any material that is suitable for use with RFID technology. In one example, dispenser cap 214 may be formed of durable molded plastic.

The location of RFID tag 222 in marking dispenser 200 is not limited to the inside of dispenser cap 214. RFID tag 222 may be attached to any location on marking dispenser 200 where the transmit/receive functionality of RFID tag 222 is ensured. For example, RFID tag 222 may be attached to the outside of dispenser cap 214 or to the outside dispenser body 210.

In a typical paint marking device for marking on the ground, marking dispenser 200 may be installed upside down (i.e., dispenser cap 214-side down).

FIG. 3 is a functional block diagram of an embodiment of marking device 100 of FIG. 1. As shown, marking dispenser 200 having RFID tag 222 thereon is installed in marking device 100. Marking device 100 may include reader device 140, a processor 318, a storage device 322, a communications interface 326, a user interface 328, a trigger 330 and a power source 340.

In the embodiment of FIG. 3, reader device 140 is an RFID reader or scanner device. In this embodiment, the antenna of RFID tag 222 receives signals from reader device 140 and then transmits a signal that has the data of interest encoded therein. The position of RFID tag 222 relative to the location of reader device 140 is important. In one embodiment, reader device 140 may be a low frequency reader, such as a frequency of about 1356 megahertz (MHz), and has a read range from about 6 inches to about 8 inches.

Processor 318 may be any general-purpose processor, controller, or microcontroller device that is capable of controlling reader device 140 and managing the data that is received from RFID tag 222 via reader device 140. In one example, the data that is returned from reader device 140 may be stored locally in storage device 322. Storage device 322 may be any volatile

5

or nonvolatile data storage device, such as, but not limited to, a random access memory (RAM) device and a removable memory device (e.g., a universal serial bus (“USB”) flash drive).

Communications interface **326** may be any wired and/or wireless interface by which data may be transmitted from marking device **100** to an external or remote device, such as a remote computing device. Example wired interfaces may include, but are not limited to, USB ports, RS232 connectors, RJ45 connectors, and any combination thereof. Example wireless interfaces may include, but are not limited to, Bluetooth® technology and IEEE 802.11 technology. Data stored in storage device **322** may be transmitted in real time or non-real time from marking device **100** via communications interface **326**. Alternatively, data that is received from reader device **140** may be transmitted in real time via communications interface **326** with or without being stored locally in storage device **322**.

User interface **328** may include any visual and/or audible device that can be used to provide information (depending on the type and function of ID mechanism **124**) to the user of the marking device **100**. For example, user interface **328** may include visual indicators, such as one or more light emitting diode (LED) devices and/or a display device, and one or more audible devices, such as a buzzer, a beeper, a speaker, and the like. The display device may include a display screen to display ID information read from ID mechanism **124** and/or marker information derived from the ID information. User interface **328** may also include one or more input devices, such as a touch screen or a keypad, to enable user input.

User interface **328** may include a set of visual indicators **328** which provide feedback to the user of the marking device **100**. For example, visual indicators may provide immediate or substantially immediate feedback as to the color or any other characteristic of the marking paint in marking paint dispenser **200**. For example, a light-emitting diode (LED) may be provided for each possible color of marking substance. The visual indicators may include red, orange, green, yellow, and blue LEDs. In one example, when marking dispenser **200** with RFID tag **222** is installed in marking device **100**, reader device **140** scans RFID tag **222**. Processor **318** processes the RFID data to determine the color of the marking substance in marking dispenser **200**. Subsequently, processor **318** activates the LED that corresponds to the color of the marking substance that has been detected. In doing so, substantially immediate feedback is provided to the user of marking device **100**. In this way, the user may verify, for example, that the intended color of marking substance has been installed. Alternatively, information based on the RFID data may be displayed on a display device.

Trigger **330** may be any mechanism by which a read operation of reader device **140** may be initiated. In one example, trigger **330** may be a program function that initiates a read of RFID tag **222** via reader device **140**, such as a periodic read that is performed at set time intervals. In another example, trigger **330** may be an electronic trigger that occurs whenever the trigger **126** (FIG. 1) is pulled by the user to dispense the marking substance in marking dispenser **200**. In this example, processor **318** passes this electronic trigger to reader device **140** anytime that the trigger of the wand is pulled.

The marking device **100** may be the marking device that is described in U.S. patent application Ser. No. 11/696,606, filed Apr. 4, 2007 and published Oct. 9, 2008 as Publication No. 2008/0245299, entitled “Marking system and method” and U.S. patent application Ser. No. 11/685,602, filed Mar. 13, 2007 and published Sep. 19, 2008 as Publication No. 2008/0228294, entitled “Marking system and method with

6

location and/or time tracking,” both of which are incorporated by reference herein in their entirety.

FIG. 4 is a front view of a marking dispenser **400** having at least one barcode, which is another embodiment of the marking dispenser **122**. In this embodiment, marking dispenser **400** is substantially the same as the marking dispenser **200** of FIG. 2, except that RFID tag **222** is replaced with one or more barcodes. For example, a first barcode, such as a barcode **410**, maybe the manufacturer-specific barcode provided by the manufacturer of the marking substance. Optionally, a second barcode, such as a barcode **414**, may be provided that has additional information encoded therein, such as the user-specific information (e.g., office location of using company). Referring to FIG. 3, in the case of using marking dispenser **400** within marking device **100**, reader device **140** may be a barcode reader or scanner.

FIG. 5 is a flow diagram of a method **500** of operating marking device **100** using a marking dispenser having a machine-readable ID mechanism affixed thereto. The method **500** is described with reference to marking device **100** of FIGS. 1 and 3. Method **500** may include, but is not limited to, the following acts.

In act **510**, marking dispenser **122** having machine-readable ID mechanism **124** is installed in the marking device **100**. As described above, examples of the ID mechanism **124** include an RFID tag and a barcode.

In act **512**, the trigger **126** of the marking device is pulled or otherwise activated by the user in order to dispense a quantity of marking substance **134** from the marking dispenser **122** onto the ground. The processor **318** receives an indication that the marking dispenser **122** has been activated to dispense marking substance **134**.

In act **514**, processor **318** causes reader device **140** to read ID information from the ID mechanism **124** on marking dispenser **122**. For example, processor **318** may issue a command to reader device **140** to read ID information from ID mechanism **124** in response to the user activating the trigger **126** of the marking device **100** to dispense marking substance **134** onto the ground. For example, reader device **140** may scan RFID tag **222** (FIG. 2) or barcode **410** (FIG. 4). In other embodiments, the reader device **140** may be instructed to read the ID information from the ID mechanism **124** in response to one or more of a user query, power up of the marking device **100**, a periodic signal, or installation of a marking dispenser in the marking device. The ID information read from ID mechanism **124** is supplied by reader device **140** to processor **318**.

In act **516**, processor **318** performs initial processing of the ID information read from the ID mechanism **124** to provide marker information. By way of example only, the ID information read from the ID mechanism may include a product code and a manufacturer code. The product code, the manufacturer code, or both, may be used to access corresponding product information stored in storage device **322**. The stored product information may include marker information, such as for example, paint color, durability and intended application of the marking paint. In other embodiments, the ID information read from the ID mechanism **124** includes the desired marker information and does not require processing by processor **318**. In this embodiment, the initial processing of act **516** may be optional. Thus, the ID information read from ID mechanism **124** may include information which requires initial processing by processor **318** to provide marker information and/or marker information read directly from ID mechanism **124**.

In block **518**, acts involving utilization of the ID information and/or the marker information are shown. The acts shown

in block 518 may be performed separately or in any combination. The acts of block 518 may be performed or not performed, depending on the operating state of marking device 100 and on the application of marking device 100. Also, additional acts may involve the ID information and/or the marker information, or a selected subset thereof.

In act 518.1, the ID information and/or the marker information, or a selected subset thereof, is stored locally in storage device 322 of marking device 100. The ID information and/or the marker information can be stored separately or with other data in an electronic record of a marking operation or of operation of the marking device. The stored information, or a selected subset thereof, can be processed locally and/or transmitted to a remote device for processing, can be displayed on a display device and/or an indicator, and/or can be used for real-time control of the marking device, for example.

In act 518.2, the ID information and/or the marker information, or a selected subset thereof, is transmitted by communications interface 326 to a remote device. Examples of the remote device include i.e., a computer located in the vehicle of the user or a remote server, or both. Communications interface 326 may utilize wireless communication and/or a wired connection for transmission of the ID information and/or marker information. In one example of a wired connection, when the user returns to his/her home base, the marking device 100 may be connected by a wired connection to a central computing device. In particular, the marking device may be coupled to a docking station (not shown) that is designed to connect with communications interface 326. In doing so, the ID information and marker information that is stored locally within storage device 322 may be transmitted to the central computing device.

In act 518.3, the ID information and/or the marker information, or a selected subset thereof, may be displayed to the user, for example, on a display screen or via indicators. The ID and/or marker information may be for information only or may require an action by the user, such as verifying that the ID information and/or the marker information indicates that the marking dispenser is appropriate for the intended application. The display of ID information and/or marker information provides feedback to the user and permits verification that the intended marking dispenser 122 has been installed.

In act 518.4, the ID information and/or the marker information, or a selected subset thereof, is used for real-time control of the marking device 100. Thus, for example, selected ID information and/or marker information may be compared with reference information, for example, entered by the user. In the absence of a match, dispensing of the marking substance 134 from the marking dispenser 122 may be inhibited automatically. Other real-time control applications are included within the scope of the invention.

In act 520, a determination is made by processor 318 as to whether the marking operation is complete. For example, the user may indicate that it is necessary to install another marking dispenser of the same color in order to complete the marking operation or may indicate that another facility is to be marked at the same site, thus requiring installation of a marking dispenser of a different color. When the marking operation is not complete, the process returns to act 510.

When the marking operation is complete, as determined in act 520, the ID and/or marker information which has been stored in storage device 322 and/or transmitted to a remote device is ready for offline processing. By way of example only, offline processing may include compilation of data for a particular job site or determination of trends and statistics for multiple users. In addition, the ID and/or marker information may be processed for the purpose of tracking the inventory of

marking paint dispensers., More specifically, the ID and/or marker information may be processed in order to analyze the usage of marking dispensers, such as the number of dispensers used and by what users. In another example, the ID and/or marker information may be processed for the purpose of quality control, such as to verify that the proper marking substances have been used in the assigned marking operations. The use of the ID and/or marker information is not limited to that mentioned above. The ID and/or marker information may be used for any purpose (e.g., real-time product verification, tracking what user location received what batch of marking paint, tracking marking paint inventory, tracking marking paint problems, tracking marking paint usage, and the like).

Having thus described several aspects of at least one embodiment of this invention, it is to be appreciated various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements are intended to be part of this disclosure, and are intended to be within the spirit and scope of the invention. Accordingly, the foregoing description and drawings are by way of example only.

What is claimed is:

1. A marking apparatus to mark a presence or an absence of an underground facility in a dig area, the marking apparatus comprising:

a housing configured to enable dispensing of a marker onto the ground for marking the presence or the absence of the underground facility in the dig area;

at least one marking dispenser to hold the marker;

a marking dispenser holder affixed to the housing to hold the at least one marking dispenser;

an actuator to cause dispensing of the marker from the at least one marking dispenser onto the ground in the dig area, in a marking operation, to mark the presence or the absence of an underground facility;

at least one reader device to read ID information from an ID mechanism affixed to the at least one marking dispenser; and

a processing device coupled to the at least one reader device and configured to generate marker information in response to the ID information received from the at least one reader device, the marker information representing at least one characteristic of the marker.

2. A marking apparatus as defined in claim 1, wherein the reader device comprises a radio frequency identification reader.

3. A marking apparatus as defined in claim 1, wherein the reader device comprises a barcode reader.

4. A marking apparatus as defined in claim 1, wherein the marking dispenser holder comprises a spray paint can holder.

5. A marking apparatus as defined in claim 1, wherein the reader device is configured to read at least a product code from the ID mechanism.

6. A marking apparatus as defined in claim 1, wherein the processing device is configured to automatically control at least one operation of the marking apparatus in response to the ID information.

7. A marking apparatus as defined in claim 1, further comprising a communication system, wherein the processing device is configured to transmit at least part of the marker information to a remote device using the communication system.

8. A marking apparatus as defined in claim 1, further comprising a local memory, wherein the processing device is configured to store at least part of the marker information in the local memory.

9

9. A marking apparatus as defined in claim 1, further comprising a user interface, wherein the processing device is configured to provide at least part of the marker information to the user interface.

10. A marking apparatus as defined in claim 1, further comprising a display device, wherein the processing device is configured to display at least part of the marker information on the display device.

11. A marking apparatus as defined in claim 1, further comprising one or more indicators, wherein the processing device is configured to activate at least one of the indicators in response to the marker information.

12. A marking apparatus as defined in claim 1, wherein the reader device is activated to read the ID information from the ID mechanism in response to dispensing of the marker from the marking dispenser.

13. A marking apparatus as defined in claim 1, wherein the reader device is activated to read the ID information from the ID mechanism in response to a user input.

14. A marking apparatus as defined in claim 1, wherein the reader device is activated to read the ID information from the ID mechanism in response to power up of the marking apparatus.

15. A marking apparatus as defined in claim 1, wherein the reader device is activated to read the ID information from the ID mechanism at periodic intervals.

16. A marking apparatus as defined in claim 1, wherein the reader device is activated to read the ID information from the ID mechanism in response to installation of a marking dispenser in the marking dispenser holder.

17. A marking apparatus as defined in claim 1, wherein the processing device is configured to compare information based on the ID information with reference information and to automatically inhibit dispensing of the marker in the absence of a match.

18. A marking apparatus as defined in claim 1, further comprising a communication system, wherein the processing device is configured to transmit at least part of the marker information to a remote device for inventory analysis.

10

19. A marking apparatus to mark a presence or an absence of an underground facility in a dig area, the marking apparatus comprising:

a housing configured to enable dispensing of a marker onto the ground for marking the presence or the absence of the underground facility in the dig area;

at least one marking dispenser to hold the marker;

a marking dispenser holder affixed to the housing to hold at least one marking dispenser, the marker dispenser holder including a spray paint can holder;

an actuator to cause dispensing of the marker from the at least one marking dispenser onto the ground in the dig area, to mark the presence or the absence of the underground facility;

at least one reader device to read ID information from an ID mechanism affixed to the marking dispenser;

a processing device coupled to the at least one reader device and configured to generate marker information in response to the ID information received from the at least one reader device, the marker information representing at least one characteristic of the marker; and

one or more indicators, wherein the processing device is configured to activate at least one of the indicators in response to the marker information.

20. The marking apparatus according to claim 19, wherein the one or more indicators comprises a plurality of LEDs and wherein the processing device is further configured to activate a first LED of the plurality of LEDs having a color corresponding to a color of the marker in response to the ID information received from the reader device.

21. The marking apparatus according to claim 19, wherein the processor is further configured to inhibit actuation of the marking dispenser in response to a conflict between reference information related to the marking operation and ID information received from the reader device.

22. The marking apparatus according to claim 20, wherein the reference information is entered by an operator of the marking apparatus.

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