US00D787087S

(12) United States Design Patent

Duffy et al.

(10) Patent No.: US D787,087 S
(45) Date of Patent: ** May 16, 2017

(54) **HOUSING**

(71) Applicant: **HandyLab, Inc.**, Franklin Lakes, NJ (US)

(72) Inventors: **Patrick Duffy**, Whitmore Lake, MI (US); **Kerry Wilson**, Elkhart, IN (US); **Kalyan Handique**, Ypsilanti, MI (US); **Jeff Williams**, Chelsea, MI (US)

(73) Assignee: **HandyLab, Inc.**, Franklin Lakes, NJ (US)

(**) Term: **15 Years**

(21) Appl. No.: **29/554,066**

(22) Filed: **Feb. 8, 2016**

Related U.S. Application Data

(63) Continuation of application No. 13/474,980, filed on May 18, 2012, now abandoned, which is a continuation of application No. 12/178,584, filed on Jul. 23, 2008, now Pat. No. 8,182,763, which is a continuation-in-part of application No. 12/173,023, filed on Jul. 14, 2008, now Pat. No. 8,133,671, said application No. 12/178,584 is a continuation-in-part of application No. 12/218,498, filed on Jul. 14, 2008, now Pat. No. 9,186,677.

(51) **LOC (10) Cl.** **24-02**

(52) **U.S. Cl.**
USPC **D24/227**

(58) **Field of Classification Search**
USPC D24/224–230, 232, 216–217; 422/569, 422/551–553, 560–563, 400; 211/126.1, 211/74, 70.1; 206/443
CPC B01L 9/06; B01L 9/065; G01N 35/025
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,434,314 A 10/1922 Raich
1,616,419 A 2/1927 Wilson
(Continued)

FOREIGN PATENT DOCUMENTS

CA 2294819 1/1999
CN 1968754 A 5/2007
(Continued)

OTHER PUBLICATIONS

Bollet, C. et al., "A simple method for the isolation of chromosomal DNA from Gram positive or acid-fast bacteria", Nucleic Acids Research, vol. 19, No. 8 (1991), p. 1955.
(Continued)

Primary Examiner — Susan Bennett Hattan
Assistant Examiner — Rebecca Tsehaye
(74) *Attorney, Agent, or Firm* — Knobbe, Martens, Olson & Bear, LLP

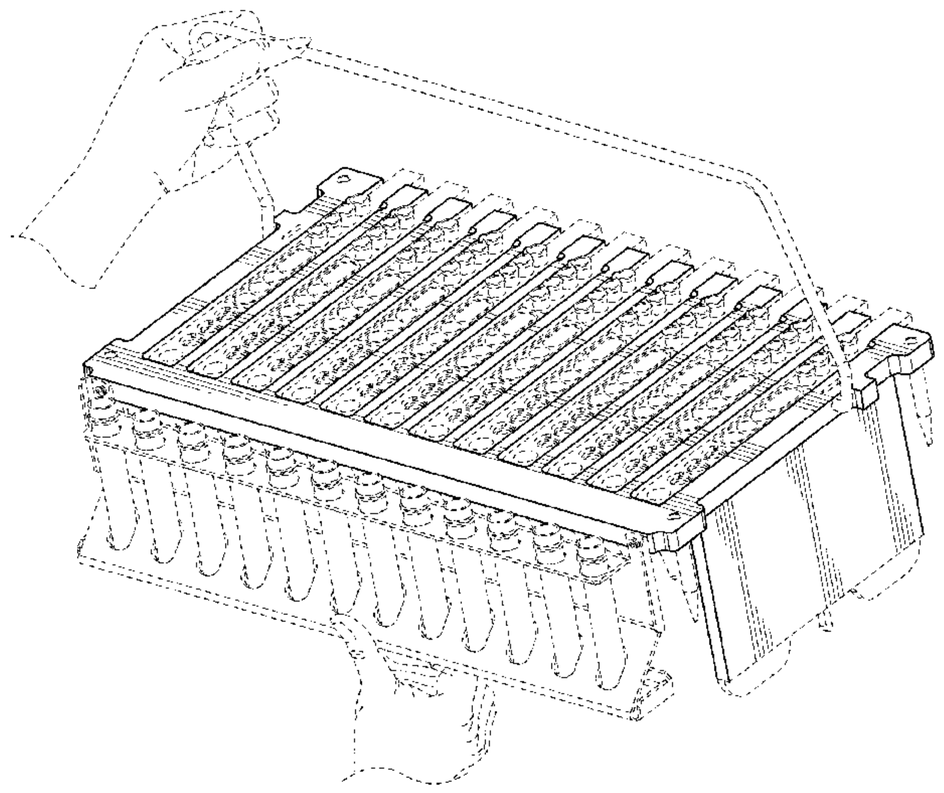
(57) **CLAIM**

The ornamental design for a housing, as shown and described.

DESCRIPTION

FIG. **1** is a front, top, and first side perspective view of a housing embodying our new design;
FIG. **2** is a front, top, and second side perspective view thereof;
FIG. **3** is first side view thereof;
FIG. **4** is a back perspective view thereof;
FIG. **5** is a front and top perspective view thereof; and,
FIG. **6** is a partial top perspective view thereof.
Broken lines are used to illustrate features of the housing which form no part of the claimed design. Broken lines showing a user's hands, sample tubes, and reagent holders are for the purpose of illustrating environment and form no part of the claimed design.

1 Claim, 6 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

1,733,401	A	8/1930	Lovekin
D189,404	S	12/1960	Nicolle
3,528,449	A	9/1970	Witte et al.
3,813,316	A	5/1974	Chakrabarty et al.
3,905,772	A	9/1975	Hartnett et al.
3,985,649	A	10/1976	Eddelman
4,018,089	A	4/1977	Dzula et al.
4,018,652	A	4/1977	Lanham et al.
4,038,192	A	7/1977	Serur
4,055,395	A	10/1977	Honkawa et al.
D249,706	S	9/1978	Adamski
4,139,005	A	2/1979	Dickey
D252,157	S	6/1979	Kronish et al.
D252,341	S	7/1979	Thomas
D254,687	S	4/1980	Fadler et al.
4,212,744	A	7/1980	Oota
D261,033	S	9/1981	Armbruster
D261,173	S	10/1981	Armbruster
4,301,412	A	11/1981	Hill et al.
4,439,526	A	3/1984	Columbus
4,457,329	A	7/1984	Werley et al.
4,466,740	A	8/1984	Kano et al.
4,504,582	A	3/1985	Swann
4,522,786	A	6/1985	Ebersole
D279,817	S	7/1985	Chen et al.
D282,208	S	1/1986	Lowry
4,599,315	A	7/1986	Terasaki et al.
4,612,873	A	9/1986	Eberle
4,612,959	A	9/1986	Costello
D288,478	S	2/1987	Carlson et al.
4,647,432	A	3/1987	Wakatake
4,654,127	A	3/1987	Baker et al.
4,673,657	A	6/1987	Christian
4,678,752	A	7/1987	Thorne et al.
4,683,195	A	7/1987	Mullis et al.
4,683,202	A	7/1987	Mullis
D292,735	S	11/1987	Lovborg
4,720,374	A	1/1988	Ramachandran
4,724,207	A	2/1988	Hou et al.
4,798,693	A	1/1989	Mase et al.
4,800,022	A	1/1989	Leonard
4,841,786	A	6/1989	Schulz
D302,294	S	7/1989	Hillman
4,871,779	A	10/1989	Killat et al.
4,895,650	A	1/1990	Wang
4,919,892	A	4/1990	Plumb
4,921,809	A	5/1990	Schiff et al.
4,935,342	A	6/1990	Seligson et al.
4,946,562	A	8/1990	Guruswamy
4,949,742	A	8/1990	Rando et al.
D310,413	S	9/1990	Bigler et al.
4,963,498	A	10/1990	Hillman
4,967,950	A	11/1990	Legg et al.
D312,692	S	12/1990	Bradley
4,978,502	A	12/1990	Dole et al.
4,978,622	A	12/1990	Mishell et al.
4,989,626	A	2/1991	Takagi et al.
5,001,417	A	3/1991	Pumphrey et al.
5,004,583	A	4/1991	Guruswamy et al.
5,048,554	A	9/1991	Kremer
5,053,199	A	10/1991	Keiser et al.
5,060,823	A	10/1991	Perlman
5,061,336	A	10/1991	Soane
5,064,618	A	11/1991	Baker et al.
5,071,531	A	12/1991	Soane
5,091,328	A	2/1992	Miller
D324,426	S	3/1992	Fan et al.
5,096,669	A	3/1992	Lauks et al.
D325,638	S	4/1992	Sloat et al.
5,126,002	A	6/1992	Iwata et al.
5,126,022	A	6/1992	Soane et al.
D328,135	S	7/1992	Fan et al.
D328,794	S	8/1992	Frenkel et al.
5,135,627	A	8/1992	Soane
5,135,872	A	8/1992	Pouletty et al.
5,147,606	A	9/1992	Charlton et al.
5,169,512	A	12/1992	Wiedenmann et al.
D333,522	S	2/1993	Gianino
5,186,339	A	2/1993	Heissler
5,192,507	A	3/1993	Taylor et al.
5,208,163	A	5/1993	Charlton et al.
5,217,694	A	6/1993	Gibler et al.
5,223,226	A	6/1993	Wittmer et al.
5,229,297	A	7/1993	Schnipelsky et al.
D338,275	S	8/1993	Fischer et al.
5,250,263	A	10/1993	Manz
5,252,743	A	10/1993	Barrett et al.
5,256,376	A	10/1993	Callan et al.
5,275,787	A	1/1994	Yuguchi et al.
5,282,950	A	2/1994	Dietze et al.
5,296,375	A	3/1994	Kricka et al.
5,304,477	A	4/1994	Nagoh et al.
5,304,487	A	4/1994	Wilding et al.
D347,478	S	5/1994	Pinkney
5,311,896	A	5/1994	Kaartinen et al.
5,311,996	A	5/1994	Duffy et al.
5,316,727	A	5/1994	Suzuki et al.
5,327,038	A	7/1994	Culp
5,339,486	A	8/1994	Persic, Jr.
D351,475	S	10/1994	Gerber
D351,913	S	10/1994	Hieb et al.
5,364,591	A	11/1994	Green et al.
5,372,946	A	12/1994	Cusak et al.
5,374,395	A	12/1994	Robinson
5,389,339	A	2/1995	Petschek et al.
D356,232	S	3/1995	Armstrong et al.
5,397,709	A	3/1995	Berndt
5,401,465	A	3/1995	Smethers et al.
5,411,708	A	5/1995	Moscetta et al.
5,414,245	A	5/1995	Hackleman
5,415,839	A	5/1995	Zaun et al.
5,416,000	A	5/1995	Allen et al.
5,422,271	A	6/1995	Chen et al.
5,422,284	A	6/1995	Lau
5,427,946	A	6/1995	Kricka et al.
5,443,791	A	8/1995	Cathcart et al.
5,474,796	A	12/1995	Brennan
D366,116	S	1/1996	Biskupski
5,486,335	A	1/1996	Wilding et al.
5,494,639	A	2/1996	Grzegorzewski
5,498,392	A	3/1996	Wilding et al.
5,503,803	A	4/1996	Brown
5,516,410	A	5/1996	Schneider et al.
5,519,635	A	5/1996	Miyake et al.
5,529,677	A	6/1996	Schneider et al.
5,559,432	A	9/1996	Logue
5,565,171	A	10/1996	Dovichi et al.
5,569,364	A	10/1996	Hooper et al.
5,578,270	A	11/1996	Reichler et al.
5,578,818	A	11/1996	Kain et al.
5,579,928	A	12/1996	Anukwuem
5,580,523	A	12/1996	Bard
5,582,884	A	12/1996	Ball et al.
5,585,069	A	12/1996	Zanucchi et al.
5,585,089	A	12/1996	Queen et al.
5,585,242	A	12/1996	Bouma et al.
5,587,128	A	12/1996	Wilding et al.
5,589,136	A	12/1996	Northrup et al.
5,593,838	A	1/1997	Zanzucchi et al.
5,595,708	A	1/1997	Berndt
5,599,432	A	2/1997	Manz et al.
5,599,503	A	2/1997	Manz et al.
5,599,667	A	2/1997	Arnold, Jr. et al.
5,601,727	A	2/1997	Bormann et al.
5,603,351	A	2/1997	Cherukuri et al.
5,605,662	A	2/1997	Heller et al.
5,609,910	A	3/1997	Hackleman
D378,782	S	4/1997	LaBarbera et al.
5,628,890	A	5/1997	Carter et al.
5,630,920	A	5/1997	Friese et al.
5,631,337	A	5/1997	Sassi et al.
5,632,876	A	5/1997	Zanzucchi et al.
5,632,957	A	5/1997	Heller et al.
5,635,358	A	6/1997	Wilding et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,637,469	A		6/1997	Wilding et al.
5,639,423	A		6/1997	Northrup et al.
5,639,428	A		6/1997	Cottingham
5,643,738	A		7/1997	Zanzucchi et al.
5,645,801	A		7/1997	Bouma et al.
5,646,039	A		7/1997	Northrup et al.
5,646,049	A		7/1997	Tayi
5,647,994	A		7/1997	Tuunanen et al.
5,651,839	A		7/1997	Rauf
5,652,141	A		7/1997	Henco et al.
5,652,149	A		7/1997	Mileaf et al.
D382,346	S		8/1997	Buhler et al.
D382,647	S		8/1997	Staples et al.
5,667,976	A		9/1997	Van Ness et al.
5,671,303	A		9/1997	Shieh et al.
5,674,394	A		10/1997	Whitmore
5,674,742	A		10/1997	Northrup et al.
5,681,484	A		10/1997	Zanzucchi et al.
5,681,529	A		10/1997	Taguchi et al.
5,683,657	A		11/1997	Mian
5,699,157	A		12/1997	Parce et al.
5,700,637	A		12/1997	Southern
5,705,813	A		1/1998	Apffel et al.
5,721,136	A		2/1998	Finney et al.
5,725,831	A		3/1998	Reichler et al.
5,726,026	A		3/1998	Wilding et al.
5,726,404	A		3/1998	Brody
5,726,944	A		3/1998	Pelley et al.
5,731,212	A		3/1998	Gavin et al.
5,744,366	A		4/1998	Kricka et al.
5,746,978	A		5/1998	Bienhaus et al.
5,747,666	A		5/1998	Willis
5,750,015	A		5/1998	Soane et al.
5,755,942	A		5/1998	Zanzucchi et al.
5,762,874	A		6/1998	Seaton et al.
5,763,262	A		6/1998	Wong et al.
5,770,029	A		6/1998	Nelson et al.
5,770,388	A		6/1998	Vorpahl
5,772,966	A		6/1998	Maracas et al.
5,779,868	A		7/1998	Parce et al.
5,783,148	A		7/1998	Cottingham et al.
5,787,032	A		7/1998	Heller et al.
5,788,814	A		8/1998	Sun et al.
5,800,600	A		9/1998	Lima-Marques et al.
5,800,690	A		9/1998	Chow et al.
5,804,436	A		9/1998	Okun et al.
D399,959	S		10/1998	Prokop et al.
5,827,481	A		10/1998	Bente et al.
5,842,106	A		11/1998	Thaler et al.
5,842,787	A		12/1998	Kopf-Sill et al.
5,846,396	A		12/1998	Zanzucchi et al.
5,846,493	A		12/1998	Bankier et al.
5,849,208	A		12/1998	Hayes et al.
5,849,486	A		12/1998	Heller et al.
5,849,489	A		12/1998	Heller
5,849,598	A		12/1998	Wilson et al.
5,852,495	A		12/1998	Parce
5,856,174	A		1/1999	Lipshutz et al.
5,858,187	A		1/1999	Ramsey et al.
5,858,188	A		1/1999	Soane et al.
5,863,502	A		1/1999	Southgate et al.
5,863,708	A		1/1999	Zanzucchi et al.
5,863,801	A		1/1999	Southgate et al.
5,866,345	A		2/1999	Wilding et al.
5,869,004	A		2/1999	Parce et al.
5,869,244	A		2/1999	Martin et al.
5,872,010	A		2/1999	Karger et al.
5,872,623	A		2/1999	Stabile et al.
5,874,046	A		2/1999	Megerle
5,876,675	A		3/1999	Kennedy
5,880,071	A		3/1999	Parce et al.
5,882,465	A		3/1999	McReynolds
5,883,211	A		3/1999	Sassi et al.
5,885,432	A		3/1999	Hooper et al.
5,885,470	A		3/1999	Parce et al.
5,895,762	A		4/1999	Greenfield et al.
5,900,130	A		5/1999	Benvegnu et al.
5,912,124	A		6/1999	Kumar
5,912,134	A		6/1999	Shartle
5,914,229	A		6/1999	Loewy
5,916,522	A		6/1999	Boyd et al.
5,916,776	A		6/1999	Kumar
5,919,646	A		7/1999	Okun et al.
5,919,711	A		7/1999	Boyd et al.
5,922,591	A		7/1999	Anderson et al.
5,927,547	A		7/1999	Papen et al.
5,928,880	A		7/1999	Wilding et al.
5,929,208	A		7/1999	Heller et al.
D413,391	S		8/1999	Lapeus et al.
5,932,799	A		8/1999	Moles
5,935,401	A		8/1999	Amigo
5,939,291	A		8/1999	Loewy et al.
5,942,443	A		8/1999	Parce et al.
D413,677	S		9/1999	Dumitrescu et al.
D414,271	S	*	9/1999	Mendoza D24/224
5,948,227	A		9/1999	Dubrow
5,948,363	A		9/1999	Gaillard
5,948,673	A		9/1999	Cottingham
5,955,028	A		9/1999	Chow
5,955,029	A		9/1999	Wilding et al.
5,957,579	A		9/1999	Kopf-Sill et al.
5,958,203	A		9/1999	Parce et al.
5,958,694	A		9/1999	Nikiforov
5,959,221	A		9/1999	Boyd et al.
5,959,291	A		9/1999	Jensen
5,964,995	A		10/1999	Nikiforov et al.
5,964,997	A		10/1999	McBride
5,965,001	A		10/1999	Chow et al.
5,965,410	A		10/1999	Chow et al.
5,965,886	A		10/1999	Sauer et al.
5,968,745	A		10/1999	Thorp et al.
5,972,187	A		10/1999	Parce et al.
5,973,138	A		10/1999	Collis
D417,009	S		11/1999	Boyd
5,976,336	A		11/1999	Dubrow et al.
5,980,704	A		11/1999	Cherukuri et al.
5,980,719	A		11/1999	Cherukuri et al.
5,981,735	A		11/1999	Thatcher et al.
5,989,402	A		11/1999	Chow et al.
5,992,820	A		11/1999	Fare et al.
5,993,611	A		11/1999	Moroney, III et al.
5,993,750	A		11/1999	Ghosh et al.
5,997,708	A		12/1999	Craig
6,001,229	A		12/1999	Ramsey
6,001,231	A		12/1999	Kopf-Sill
6,001,307	A		12/1999	Naka et al.
6,004,515	A		12/1999	Parce et al.
6,007,690	A		12/1999	Nelson et al.
6,010,607	A		1/2000	Ramsey
6,010,608	A		1/2000	Ramsey
6,010,627	A		1/2000	Hood, III
6,012,902	A		1/2000	Parce
D420,747	S		2/2000	Dumitrescu et al.
D421,130	S		2/2000	Cohen et al.
6,024,920	A		2/2000	Cunanan
D421,653	S		3/2000	Purcell
6,033,546	A		3/2000	Ramsey
6,043,080	A		3/2000	Lipshutz et al.
6,046,056	A		4/2000	Parce et al.
6,048,734	A		4/2000	Burns et al.
6,054,034	A		4/2000	Soane et al.
6,054,277	A		4/2000	Furcht et al.
6,056,860	A		5/2000	Amigo et al.
6,057,149	A		5/2000	Burns et al.
6,062,261	A		5/2000	Jacobson et al.
6,063,341	A		5/2000	Fassbind et al.
6,063,589	A		5/2000	Kellogg et al.
6,068,752	A		5/2000	Dubrow et al.
6,071,478	A		6/2000	Chow
6,074,725	A		6/2000	Kennedy
6,074,827	A		6/2000	Nelson et al.
D428,497	S		7/2000	Lapeus et al.
6,086,740	A		7/2000	Kennedy
6,096,509	A		8/2000	Okun et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,100,541	A	8/2000	Nagle et al.	
6,102,897	A	8/2000	Lang	
6,103,537	A	8/2000	Ullman et al.	
6,106,685	A	8/2000	McBride et al.	
6,110,343	A	8/2000	Ramsey et al.	
6,117,398	A	9/2000	Bienhaus et al.	
6,123,205	A	9/2000	Dumitrescu et al.	
6,123,798	A	9/2000	Gandhi et al.	
6,130,098	A	10/2000	Handique et al.	
6,132,580	A	10/2000	Mathies et al.	
6,132,684	A	10/2000	Marino	
6,133,436	A	10/2000	Koster et al.	
D433,759	S	11/2000	Mathis et al.	
6,143,250	A	11/2000	Tajima	
6,149,787	A	11/2000	Chow et al.	
6,149,872	A	11/2000	Mack et al.	
6,156,199	A	12/2000	Zuk, Jr.	
6,158,269	A	12/2000	Dorenkott et al.	
6,167,910	B1	1/2001	Chow	
6,168,948	B1	1/2001	Anderson et al.	
6,171,850	B1	1/2001	Nagle et al.	
6,174,675	B1	1/2001	Chow et al.	
6,180,950	B1	1/2001	Olsen	
D438,311	S	2/2001	Yamanishi et al.	
6,190,619	B1	2/2001	Kilcoin et al.	
D438,632	S	3/2001	Miller	
D438,633	S	3/2001	Miller	
D439,673	S	3/2001	Brophy et al.	
6,197,595	B1	3/2001	Anderson et al.	
6,211,989	B1	4/2001	Wulf et al.	
6,213,151	B1	4/2001	Jacobson et al.	
6,221,600	B1	4/2001	MacLeod et al.	
6,228,635	B1	5/2001	Armstrong et al.	
6,232,072	B1	5/2001	Fisher	
6,235,175	B1	5/2001	Dubrow et al.	
6,235,313	B1	5/2001	Mathiowitz et al.	
6,235,471	B1	5/2001	Knapp et al.	
6,236,456	B1	5/2001	Giebeler et al.	
6,236,581	B1	5/2001	Foss et al.	
6,238,626	B1	5/2001	Higuchi et al.	
6,251,343	B1	6/2001	Dubrow et al.	
6,254,826	B1	7/2001	Acosta et al.	
6,259,635	B1	7/2001	Khouri et al.	
6,261,431	B1	7/2001	Mathies et al.	
6,267,858	B1	7/2001	Parce et al.	
D446,306	S	8/2001	Ochi et al.	
6,271,021	B1	8/2001	Burns et al.	
6,274,089	B1	8/2001	Chow et al.	
6,280,967	B1	8/2001	Ransom et al.	
6,281,008	B1	8/2001	Komai et al.	
6,284,113	B1	9/2001	Bjornson et al.	
6,284,470	B1	9/2001	Bitner et al.	
6,287,254	B1	9/2001	Dodds	
6,287,774	B1	9/2001	Nikiforov	
6,291,248	B1	9/2001	Haj-Ahmad	
6,294,063	B1	9/2001	Becker et al.	
6,302,134	B1	10/2001	Kellogg et al.	
6,302,304	B1	10/2001	Spencer	
6,303,343	B1	10/2001	Kopf-sill	
6,306,273	B1	10/2001	Wainright et al.	
6,306,590	B1	10/2001	Mehta et al.	
6,316,774	B1	11/2001	Giebeler et al.	
6,319,469	B1	11/2001	Mian et al.	
6,322,683	B1	11/2001	Wolk et al.	
6,326,083	B1	12/2001	Yang et al.	
6,326,147	B1	12/2001	Oldham et al.	
6,326,211	B1	12/2001	Anderson et al.	
6,334,980	B1	1/2002	Hayes et al.	
6,337,435	B1	1/2002	Chu et al.	
6,353,475	B1	3/2002	Jensen et al.	
6,358,387	B1	3/2002	Kopf-sill et al.	
6,366,924	B1	4/2002	Parce	
6,368,561	B1	4/2002	Rutishauser et al.	
6,368,871	B1	4/2002	Christel et al.	
6,370,206	B1	4/2002	Schenk	
6,375,185	B1	4/2002	Lin	
6,375,901	B1	4/2002	Robotti et al.	
6,379,884	B2	4/2002	Wada et al.	
6,379,929	B1	4/2002	Burns et al.	
6,379,974	B1	4/2002	Parce et al.	
6,382,254	B1	5/2002	Yang et al.	
6,391,541	B1	5/2002	Petersen et al.	
6,391,623	B1	5/2002	Besemer et al.	
6,395,161	B1	5/2002	Schneider et al.	
6,398,956	B1	6/2002	Coville et al.	
6,399,025	B1	6/2002	Chow	
6,399,389	B1	6/2002	Parce et al.	
6,399,952	B1	6/2002	Maher et al.	
6,401,552	B1	6/2002	Elkins	
6,403,338	B1	6/2002	Knapp et al.	
6,408,878	B2	6/2002	Unger et al.	
6,413,401	B1	7/2002	Chow et al.	
6,416,642	B1	7/2002	Alajoki et al.	
6,420,143	B1	7/2002	Kopf-sill	
6,425,972	B1	7/2002	McReynolds	
D461,906	S	8/2002	Pham	
6,428,987	B2	8/2002	Franzen	
6,430,512	B1	8/2002	Gallagher	
6,432,366	B2	8/2002	Ruediger et al.	
6,440,725	B1	8/2002	Pourahmadi et al.	
D463,031	S	9/2002	Slomski et al.	
6,444,461	B1	9/2002	Knapp et al.	
6,447,661	B1	9/2002	Chow et al.	
6,447,727	B1	9/2002	Parce et al.	
6,448,064	B1	9/2002	Vo-Dinh et al.	
6,453,928	B1	9/2002	Kaplan et al.	
6,461,570	B2	10/2002	Ishihara et al.	
6,465,257	B1	10/2002	Parce et al.	
6,468,761	B2	10/2002	Yang et al.	
6,472,141	B2	10/2002	Nikiforov	
D466,219	S *	11/2002	Wynschenk	D24/227
6,475,364	B1	11/2002	Dubrow et al.	
D467,348	S	12/2002	McMichael et al.	
D467,349	S	12/2002	Niedbala et al.	
6,488,897	B2	12/2002	Dubrow et al.	
6,495,104	B1	12/2002	Unno et al.	
6,498,497	B1	12/2002	Chow et al.	
6,500,323	B1	12/2002	Chow et al.	
6,500,390	B1	12/2002	Boulton et al.	
D468,437	S	1/2003	McMenamy et al.	
6,506,609	B1	1/2003	Wada et al.	
6,509,193	B1	1/2003	Tajima	
6,511,853	B1	1/2003	Kopf-sill et al.	
D470,595	S	2/2003	Crisanti et al.	
6,515,753	B2	2/2003	Maher	
6,517,783	B2	2/2003	Horner et al.	
6,520,197	B2	2/2003	Deshmukh et al.	
6,521,188	B1	2/2003	Webster	
6,524,456	B1	2/2003	Ramsey et al.	
6,524,790	B1	2/2003	Kopf-sill et al.	
D472,324	S	3/2003	Rumore et al.	
6,534,295	B2	3/2003	Tai et al.	
6,537,771	B1	3/2003	Farinas et al.	
6,540,896	B1	4/2003	Manz et al.	
6,544,734	B1	4/2003	Briscoe et al.	
6,547,942	B1	4/2003	Parce et al.	
6,555,389	B1	4/2003	Ullman et al.	
6,556,923	B2	4/2003	Gallagher et al.	
D474,279	S	5/2003	Mayer et al.	
D474,280	S	5/2003	Niedbala et al.	
6,558,916	B2	5/2003	Veerapandian et al.	
6,558,945	B1	5/2003	Kao	
6,569,607	B2	5/2003	McReynolds	
6,572,830	B1	6/2003	Burdon et al.	
6,575,188	B2	6/2003	Parunak	
6,576,459	B2	6/2003	Miles et al.	
6,579,453	B1	6/2003	Bächler et al.	
6,589,729	B2	7/2003	Chan et al.	
6,592,821	B1	7/2003	Wada et al.	
6,597,450	B1	7/2003	Andrews et al.	
6,602,474	B1	8/2003	Tajima	
6,613,211	B1	9/2003	McCormick et al.	
6,613,512	B1	9/2003	Kopf-sill et al.	
6,613,580	B1	9/2003	Chow et al.	

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,613,581	B1	9/2003	Wada et al.
6,614,030	B2	9/2003	Maher et al.
6,620,625	B2	9/2003	Wolk et al.
6,623,860	B2	9/2003	Hu et al.
6,627,406	B1	9/2003	Singh et al.
D480,814	S	10/2003	Lafferty et al.
6,632,655	B1	10/2003	Mehta et al.
6,633,785	B1	10/2003	Kasahara et al.
D482,796	S	11/2003	Oyama et al.
6,640,981	B2	11/2003	Lafond et al.
6,649,358	B1	11/2003	Parce et al.
6,664,104	B2	12/2003	Pourahmadi et al.
6,669,831	B2	12/2003	Chow et al.
6,670,153	B2	12/2003	Stern
D484,989	S	1/2004	Gebrian
6,672,458	B2	1/2004	Hansen et al.
6,681,616	B2	1/2004	Spaid et al.
6,681,788	B2	1/2004	Parce et al.
6,685,813	B2	2/2004	Williams et al.
6,692,700	B2	2/2004	Handique
6,695,009	B2	2/2004	Chien et al.
6,706,519	B1	3/2004	Kellogg et al.
6,720,148	B1	4/2004	Nikiforov
6,730,206	B2	5/2004	Ricco et al.
6,733,645	B1	5/2004	Chow
6,734,401	B2	5/2004	Bedingham et al.
6,737,026	B1	5/2004	Bergh et al.
6,740,518	B1	5/2004	Duong et al.
D491,272	S	6/2004	Alden et al.
D491,273	S	6/2004	Biegler et al.
D491,276	S	6/2004	Langille
6,750,661	B2	6/2004	Brooks et al.
6,752,966	B1	6/2004	Chazan
6,756,019	B1	6/2004	Dubrow et al.
6,764,859	B1	7/2004	Kreuwel et al.
6,766,817	B2	7/2004	da Silva
6,773,567	B1	8/2004	Wolk
6,777,184	B2	8/2004	Nikiforov et al.
6,783,962	B1	8/2004	Olander et al.
D495,805	S	9/2004	Lea et al.
6,787,015	B2	9/2004	Lackritz et al.
6,787,016	B2	9/2004	Tan et al.
6,787,111	B2	9/2004	Roach et al.
6,790,328	B2	9/2004	Jacobson et al.
6,790,330	B2	9/2004	Gascoyne et al.
6,811,668	B1	11/2004	Berndt et al.
6,818,113	B2	11/2004	Williams et al.
6,819,027	B2	11/2004	Saraf
6,824,663	B1	11/2004	Boone
D499,813	S	12/2004	Wu
D500,142	S	12/2004	Crisanti et al.
D500,363	S	12/2004	Fanning et al.
6,827,831	B1	12/2004	Chow et al.
6,827,906	B1	12/2004	Bjornson et al.
6,838,156	B1	1/2005	Neyer et al.
6,838,680	B2	1/2005	Maher et al.
6,852,287	B2	2/2005	Ganesan
6,858,185	B1	2/2005	Kopf-Sill et al.
6,859,698	B2	2/2005	Schmeisser
6,861,035	B2	3/2005	Pham et al.
6,878,540	B2	4/2005	Pourahmadi et al.
6,878,755	B2	4/2005	Singh et al.
6,884,628	B2	4/2005	Hubbell et al.
6,887,693	B2	5/2005	McMillan et al.
6,893,879	B2	5/2005	Petersen et al.
6,900,889	B2	5/2005	Bjornson et al.
6,905,583	B2	6/2005	Wainright et al.
6,905,612	B2	6/2005	Dorian et al.
6,906,797	B1	6/2005	Kao et al.
6,908,594	B1	6/2005	Schaevitz et al.
6,911,183	B1	6/2005	Handique et al.
6,914,137	B2	7/2005	Baker
6,915,679	B2	7/2005	Chien et al.
6,918,404	B2	7/2005	Dias da Silva
D508,999	S	8/2005	Fanning et al.
6,939,451	B2	9/2005	Zhao et al.
6,942,771	B1	9/2005	Kayyem
6,958,392	B2	10/2005	Fomovskaia et al.
D512,155	S	11/2005	Matsumoto
6,964,747	B2	11/2005	Banerjee et al.
6,977,163	B1	12/2005	Mehta
6,984,516	B2	1/2006	Briscoe et al.
D515,707	S	2/2006	Shinohara et al.
D516,221	S	2/2006	Wohlstadter et al.
7,001,853	B1	2/2006	Brown et al.
7,004,184	B2	2/2006	Handique et al.
D517,554	S	3/2006	Yanagisawa et al.
7,010,391	B2	3/2006	Handique et al.
7,023,007	B2	4/2006	Gallagher
7,024,281	B1	4/2006	Unno
7,036,667	B2	5/2006	Greenstein et al.
7,037,416	B2	5/2006	Parce et al.
7,038,472	B1	5/2006	Chien
7,039,527	B2	5/2006	Tripathi et al.
7,040,144	B2	5/2006	Spaid et al.
7,049,558	B2	5/2006	Baer et al.
D523,153	S	6/2006	Akashi et al.
7,055,695	B2	6/2006	Greenstein et al.
7,060,171	B1	6/2006	Nikiforov et al.
7,066,586	B2	6/2006	da Silva
7,069,952	B1	7/2006	McReynolds et al.
7,099,778	B2	8/2006	Chien
D528,215	S	9/2006	Malmsater
7,101,467	B2	9/2006	Spaid
7,105,304	B1	9/2006	Nikiforov et al.
D531,321	S	10/2006	Godfrey et al.
7,118,910	B2	10/2006	Unger et al.
7,138,032	B2	11/2006	Gandhi et al.
D534,280	S	12/2006	Gomm et al.
7,148,043	B2	12/2006	Kordunsky et al.
7,150,814	B1	12/2006	Parce et al.
7,150,999	B1	12/2006	Shuck
D535,403	S	1/2007	Isozaki et al.
7,160,423	B2	1/2007	Chien et al.
7,161,356	B1	1/2007	Chien
7,169,277	B2	1/2007	Ausserer et al.
7,169,618	B2	1/2007	Skold
D537,951	S	3/2007	Okamoto et al.
D538,436	S	3/2007	Patadia et al.
7,192,557	B2	3/2007	Wu et al.
7,195,986	B1	3/2007	Bousse et al.
7,205,154	B2	4/2007	Corson
7,208,125	B1	4/2007	Dong
7,235,406	B1	6/2007	Woudenberg et al.
7,247,274	B1	7/2007	Chow
D548,841	S	8/2007	Brownell et al.
D549,827	S	8/2007	Maeno et al.
7,252,928	B1	8/2007	Hafeman et al.
7,270,786	B2	9/2007	Parunak et al.
D554,069	S	10/2007	Bolotin et al.
D554,070	S	10/2007	Bolotin et al.
7,276,208	B2	10/2007	Sevigny et al.
7,276,330	B2	10/2007	Chow et al.
7,288,228	B2	10/2007	Lefebvre
D556,914	S	12/2007	Okamoto et al.
7,303,727	B1	12/2007	Dubrow et al.
D559,995	S	1/2008	Handique et al.
7,323,140	B2	1/2008	Handique et al.
7,332,130	B2	2/2008	Handique
7,338,760	B2	3/2008	Gong et al.
D566,291	S	4/2008	Parunak et al.
7,351,377	B2	4/2008	Chazan et al.
D569,526	S	5/2008	Duffy et al.
7,374,949	B2	5/2008	Kuriger
7,390,460	B2	6/2008	Osawa et al.
7,419,784	B2	9/2008	Dubrow et al.
7,422,669	B2	9/2008	Jacobson et al.
7,440,684	B2	10/2008	Spaid et al.
7,476,313	B2	1/2009	Siddiqi
7,494,577	B2	2/2009	Williams et al.
7,494,770	B2	2/2009	Wilding et al.
7,514,046	B2	4/2009	Kechagia et al.
7,518,726	B2	4/2009	Rulison et al.
7,521,186	B2	4/2009	Burd Mehta

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,527,769	B2		5/2009	Bunch et al.
D595,423	S		6/2009	Johansson et al.
7,553,671	B2		6/2009	Sinclair
D596,312	S		7/2009	Giraud et al.
D598,566	S		8/2009	Allaer
D599,234	S		9/2009	Ito
7,595,197	B2		9/2009	Brasseur
7,604,938	B2		10/2009	Takahashi et al.
7,635,588	B2		12/2009	King et al.
7,645,581	B2		1/2010	Knapp et al.
7,670,559	B2		3/2010	Chien et al.
7,674,431	B2		3/2010	Ganesan
7,704,735	B2		4/2010	Facer et al.
7,723,123	B1		5/2010	Murphy et al.
D618,820	S		6/2010	Wilson et al.
7,727,371	B2		6/2010	Kennedy et al.
7,727,477	B2		6/2010	Boronkay et al.
7,744,817	B2		6/2010	Bui
D621,060	S		8/2010	Handique
D628,305	S	*	11/2010	Gorrec D24/229
7,867,776	B2		1/2011	Kennedy et al.
D632,799	S		2/2011	Canner et al.
7,892,819	B2		2/2011	Wilding et al.
D637,737	S		5/2011	Wilson et al.
7,998,708	B2		8/2011	Handique et al.
8,088,616	B2		1/2012	Handique
8,105,783	B2		1/2012	Handique
8,110,158	B2		2/2012	Handique
8,133,671	B2		3/2012	Williams et al.
8,182,763	B2	*	5/2012	Duffy B01L 7/52 211/194
8,246,919	B2	*	8/2012	Herchenbach B01L 9/06 211/71.01
8,273,308	B2		9/2012	Handique et al.
D669,597	S		10/2012	Cavada et al.
8,287,820	B2		10/2012	Williams et al.
8,323,584	B2		12/2012	Ganesan
8,323,900	B2		12/2012	Handique et al.
8,324,372	B2		12/2012	Brahmasandra et al.
8,415,103	B2		4/2013	Handique
8,420,015	B2		4/2013	Ganesan et al.
8,440,149	B2		5/2013	Handique
8,470,586	B2		6/2013	Wu et al.
8,473,104	B2		6/2013	Handique et al.
D686,749	S	*	7/2013	Trump D24/230
D692,162	S		10/2013	Lentz et al.
8,679,831	B2		3/2014	Handique et al.
D702,854	S	*	4/2014	Nakahana D24/227
8,685,341	B2		4/2014	Ganesan
8,703,069	B2		4/2014	Handique et al.
8,709,787	B2		4/2014	Handique
8,710,211	B2		4/2014	Brahmasandra et al.
8,734,733	B2		5/2014	Handique
D710,024	S	*	7/2014	Guo D24/230
8,765,076	B2		7/2014	Handique et al.
8,852,862	B2		10/2014	Wu et al.
8,883,490	B2		11/2014	Handique et al.
8,894,947	B2		11/2014	Ganesan et al.
8,895,311	B1		11/2014	Handique et al.
D729,404	S	*	5/2015	Teich D24/230
9,028,773	B2		5/2015	Ganesan
9,040,288	B2		5/2015	Handique et al.
9,051,604	B2		6/2015	Handique
9,080,207	B2		7/2015	Handique et al.
D742,027	S		10/2015	Lentz et al.
9,186,677	B2		11/2015	Williams et al.
9,217,143	B2		12/2015	Brahmasandra et al.
9,238,223	B2		1/2016	Handique
9,259,734	B2		2/2016	Williams et al.
9,259,735	B2		2/2016	Handique et al.
9,347,586	B2		5/2016	Williams et al.
2001/0005489	A1		6/2001	Roach et al.
2001/0012492	A1		8/2001	Acosta et al.
2001/0016358	A1		8/2001	Osawa et al.
2001/0021355	A1		9/2001	Baugh et al.
2001/0023848	A1		9/2001	Gjerde et al.
2001/0038450	A1		11/2001	McCaffrey et al.
2001/0046702	A1		11/2001	Schembri
2001/0048899	A1		12/2001	Marouiss et al.
2001/0055765	A1		12/2001	O'Keefe et al.
2002/0001848	A1		1/2002	Bedingham et al.
2002/0008053	A1		1/2002	Hansen et al.
2002/0009015	A1		1/2002	Laugharn, Jr. et al.
2002/0014443	A1		2/2002	Hansen et al.
2002/0015667	A1		2/2002	Chow
2002/0021983	A1		2/2002	Comte et al.
2002/0037499	A1		3/2002	Quake et al.
2002/0039783	A1		4/2002	McMillan et al.
2002/0053399	A1		5/2002	Soane et al.
2002/0054835	A1		5/2002	Robotti et al.
2002/0055167	A1		5/2002	Pourahmadi et al.
2002/0058332	A1		5/2002	Quake et al.
2002/0060156	A1		5/2002	Mathies et al.
2002/0068357	A1		6/2002	Mathies et al.
2002/0068821	A1		6/2002	Gundling
2002/0131903	A1		9/2002	Ingenhoven et al.
2002/0141903	A1		10/2002	Parunak et al.
2002/0142471	A1		10/2002	Handique et al.
2002/0143297	A1		10/2002	Francavilla et al.
2002/0143437	A1		10/2002	Handique et al.
2002/0155477	A1		10/2002	Ito
2002/0169518	A1		11/2002	Luoma et al.
2002/0187557	A1		12/2002	Hobbs et al.
2002/0192808	A1		12/2002	Gambini et al.
2003/0008308	A1		1/2003	Enzelberger et al.
2003/0019522	A1		1/2003	Parunak
2003/0022392	A1		1/2003	Hudak
2003/0049174	A1		3/2003	Ganesan
2003/0049833	A1		3/2003	Chen et al.
2003/0059823	A1		3/2003	Matsunaga et al.
2003/0064507	A1		4/2003	Gallagher et al.
2003/0070677	A1		4/2003	Handique et al.
2003/0072683	A1		4/2003	Stewart et al.
2003/0073106	A1		4/2003	Johansen et al.
2003/0083686	A1		5/2003	Freeman et al.
2003/0087300	A1		5/2003	Knapp et al.
2003/0096310	A1		5/2003	Hansen et al.
2003/0099954	A1		5/2003	Miltenyi et al.
2003/0127327	A1		7/2003	Kurnik
2003/0136679	A1		7/2003	Bohn et al.
2003/0156991	A1		8/2003	Halas et al.
2003/0186295	A1		10/2003	Colin et al.
2003/0190608	A1		10/2003	Blackburn et al.
2003/0199081	A1		10/2003	Wilding et al.
2003/0211517	A1		11/2003	Carulli et al.
2004/0014202	A1		1/2004	King et al.
2004/0014238	A1		1/2004	Krug et al.
2004/0018116	A1		1/2004	Desmond et al.
2004/0018119	A1		1/2004	Massaro
2004/0022689	A1		2/2004	Wulf et al.
2004/0029258	A1		2/2004	Heaney et al.
2004/0029260	A1		2/2004	Hansen et al.
2004/0037739	A1		2/2004	McNeely et al.
2004/0053290	A1		3/2004	Terbrueggen et al.
2004/0063217	A1		4/2004	Webster et al.
2004/0072278	A1		4/2004	Chou et al.
2004/0072375	A1		4/2004	Gjerde et al.
2004/0086427	A1		5/2004	Childers et al.
2004/0086956	A1		5/2004	Bachur
2004/0141887	A1		7/2004	Mainquist et al.
2004/0151629	A1		8/2004	Pease et al.
2004/0157220	A1		8/2004	Kurnool et al.
2004/0161788	A1		8/2004	Chen et al.
2004/0189311	A1		9/2004	Glezer et al.
2004/0200909	A1		10/2004	McMillan et al.
2004/0209331	A1		10/2004	Ririe
2004/0209354	A1		10/2004	Mathies et al.
2004/0219070	A1		11/2004	Handique
2004/0224317	A1		11/2004	Kordunsky et al.
2004/0235154	A1		11/2004	Oh et al.
2004/0240097	A1		12/2004	Evans
2005/0009174	A1		1/2005	Nikiforov et al.
2005/0013737	A1		1/2005	Chow et al.
2005/0037471	A1		2/2005	Liu et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0041525	A1	2/2005	Pugia et al.	
2005/0042639	A1	2/2005	Knapp et al.	
2005/0048540	A1	3/2005	Inami et al.	
2005/0058574	A1	3/2005	Bysouth et al.	
2005/0058577	A1	3/2005	Micklash et al.	
2005/0064535	A1	3/2005	Favuzzi et al.	
2005/0069898	A1	3/2005	Moon et al.	
2005/0084424	A1	4/2005	Ganesan et al.	
2005/0106066	A1	5/2005	Saltsman et al.	
2005/0121324	A1	6/2005	Park et al.	
2005/0129580	A1	6/2005	Swinehart et al.	
2005/0133370	A1	6/2005	Park et al.	
2005/0135655	A1	6/2005	Kopf-sill et al.	
2005/0142036	A1	6/2005	Kim et al.	
2005/0152808	A1	7/2005	Ganesan	
2005/0158781	A1	7/2005	Woudenberg et al.	
2005/0170362	A1	8/2005	Wada et al.	
2005/0186585	A1	8/2005	Juncosa et al.	
2005/0196321	A1	9/2005	Huang	
2005/0202470	A1	9/2005	Sundberg et al.	
2005/0202504	A1	9/2005	Anderson et al.	
2005/0208676	A1	9/2005	Kahatt	
2005/0214172	A1	9/2005	Burgisser	
2005/0220675	A1	10/2005	Reed et al.	
2005/0227269	A1	10/2005	Lloyd et al.	
2005/0233370	A1	10/2005	Ammann et al.	
2005/0238545	A1	10/2005	Parce et al.	
2005/0272079	A1	12/2005	Burns et al.	
2006/0041058	A1	2/2006	Yin et al.	
2006/0057039	A1	3/2006	Morse et al.	
2006/0057629	A1	3/2006	Kim	
2006/0062696	A1	3/2006	Chow et al.	
2006/0094108	A1	5/2006	Yoder et al.	
2006/0113190	A1	6/2006	Kurnik	
2006/0133965	A1	6/2006	Tajima et al.	
2006/0134790	A1	6/2006	Tanaka et al.	
2006/0148063	A1	7/2006	Fauzzi et al.	
2006/0165558	A1	7/2006	Witty et al.	
2006/0165559	A1	7/2006	Greenstein et al.	
2006/0166233	A1	7/2006	Wu et al.	
2006/0177376	A1	8/2006	Tomalia et al.	
2006/0177855	A1	8/2006	Utermohlen et al.	
2006/0183216	A1	8/2006	Handique	
2006/0201887	A1	9/2006	Siddiqi	
2006/0205085	A1	9/2006	Handique	
2006/0207944	A1	9/2006	Siddiqi	
2006/0210435	A1	9/2006	Alavie et al.	
2006/0223169	A1	10/2006	Bedingham et al.	
2006/0246493	A1	11/2006	Jensen et al.	
2006/0246533	A1	11/2006	Fathollahi et al.	
2006/0269641	A1	11/2006	Atwood et al.	
2006/0269961	A1	11/2006	Fukushima et al.	
2007/0004028	A1	1/2007	Lair et al.	
2007/0009386	A1	1/2007	Padmanabhan et al.	
2007/0020699	A1	1/2007	Carpenter et al.	
2007/0026421	A1	2/2007	Sundberg et al.	
2007/0042441	A1	2/2007	Masters et al.	
2007/0054413	A1*	3/2007	Aviles	G01N 35/025 436/180
2007/0077648	A1	4/2007	Okamoto et al.	
2007/0092901	A1	4/2007	Ligler et al.	
2007/0098600	A1	5/2007	Kayyem et al.	
2007/0099200	A1	5/2007	Chow et al.	
2007/0104617	A1	5/2007	Coulling et al.	
2007/0116613	A1	5/2007	Elsener	
2007/0154895	A1	7/2007	Spaid et al.	
2007/0177147	A1	8/2007	Parce	
2007/0178607	A1	8/2007	Prober et al.	
2007/0184463	A1	8/2007	Molho et al.	
2007/0184547	A1	8/2007	Handique et al.	
2007/0196237	A1	8/2007	Neuzil et al.	
2007/0196238	A1	8/2007	Kennedy et al.	
2007/0199821	A1	8/2007	Chow	
2007/0215554	A1	9/2007	Kreuwel et al.	
2007/0218459	A1	9/2007	Miller et al.	
2007/0231213	A1	10/2007	Prabhu et al.	
2007/0243626	A1	10/2007	Windeyer et al.	
2007/0261479	A1	11/2007	Spaid et al.	
2007/0269861	A1	11/2007	Williams et al.	
2007/0292941	A1	12/2007	Handique et al.	
2008/0000774	A1	1/2008	Park et al.	
2008/0003649	A1	1/2008	Maltezos et al.	
2008/0017306	A1	1/2008	Liu et al.	
2008/0050804	A1	2/2008	Handique et al.	
2008/0056948	A1	3/2008	Dale et al.	
2008/0069729	A1	3/2008	McNeely	
2008/0075634	A1*	3/2008	Herchenbach	B01L 9/06 422/400
2008/0090244	A1	4/2008	Knapp et al.	
2008/0095673	A1	4/2008	Xu	
2008/0118987	A1	5/2008	Eastwood et al.	
2008/0124723	A1	5/2008	Dale et al.	
2008/0149840	A1	6/2008	Handique et al.	
2008/0160601	A1	7/2008	Handique	
2008/0176230	A1	7/2008	Owen et al.	
2008/0182301	A1	7/2008	Handique et al.	
2008/0192254	A1	8/2008	Kim et al.	
2008/0226502	A1	9/2008	Jonsmann et al.	
2008/0247914	A1	10/2008	Edens et al.	
2008/0262213	A1	10/2008	Wu et al.	
2008/0308500	A1	12/2008	Brassard	
2009/0047180	A1	2/2009	Kawahara	
2009/0047713	A1	2/2009	Handique	
2009/0066339	A1	3/2009	Glezer et al.	
2009/0129978	A1	5/2009	Wilson et al.	
2009/0130719	A1	5/2009	Handique	
2009/0130745	A1	5/2009	Williams et al.	
2009/0131650	A1	5/2009	Brahmasandra et al.	
2009/0134069	A1	5/2009	Handique	
2009/0136385	A1	5/2009	Handique et al.	
2009/0136386	A1*	5/2009	Duffy	B01L 7/52 422/400
2009/0155123	A1	6/2009	Williams et al.	
2009/0189089	A1	7/2009	Bedingham et al.	
2009/0221059	A1	9/2009	Williams et al.	
2009/0223925	A1	9/2009	Morse et al.	
2010/0009351	A1	1/2010	Brahmasandra et al.	
2010/0173393	A1	7/2010	Handique et al.	
2010/0284864	A1	11/2010	Holenstein et al.	
2011/0008825	A1	1/2011	Ingber et al.	
2011/0027151	A1	2/2011	Handique et al.	
2011/0158865	A1	6/2011	Miller et al.	
2011/0207140	A1	8/2011	Handique et al.	
2011/0210257	A9	9/2011	Handique et al.	
2011/0300033	A1	12/2011	Battisti	
2012/0022695	A1	1/2012	Handique et al.	
2012/0085416	A1	4/2012	Ganesan	
2012/0122108	A1	5/2012	Handique	
2012/0160826	A1	6/2012	Handique	
2012/0171759	A1	7/2012	Williams et al.	
2012/0183454	A1	7/2012	Handique	
2012/0258463	A1*	10/2012	Duffy	B01L 7/52 435/6.12
2013/0037564	A1	2/2013	Williams et al.	
2013/0071851	A1	3/2013	Handique et al.	
2013/0096292	A1	4/2013	Brahmasandra et al.	
2013/0101990	A1	4/2013	Handique et al.	
2013/0164832	A1	6/2013	Ganesan et al.	
2013/0183769	A1	7/2013	Tajima	
2013/0217013	A1	8/2013	Steel et al.	
2013/0217102	A1	8/2013	Ganesan et al.	
2013/0251602	A1	9/2013	Handique et al.	
2013/0280131	A1	10/2013	Handique et al.	
2013/0288358	A1	10/2013	Handique et al.	
2013/0315800	A1*	11/2013	Yin	B01L 9/523 422/552
2014/0030798	A1	1/2014	Wu et al.	
2014/0045186	A1	2/2014	Gubatayao et al.	
2014/0206088	A1	7/2014	Lentz et al.	
2014/0212882	A1	7/2014	Handique et al.	
2014/0227710	A1	8/2014	Handique et al.	
2014/0297047	A1	10/2014	Ganesan et al.	
2014/0323357	A1	10/2014	Handique et al.	
2014/0323711	A1	10/2014	Brahmasandra et al.	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2014/0329301	A1	11/2014	Handique et al.	
2014/0342352	A1	11/2014	Handique et al.	
2014/0377850	A1	12/2014	Handique et al.	
2015/0064702	A1	3/2015	Handique et al.	
2015/0118684	A1	4/2015	Wu et al.	
2015/0133345	A1	5/2015	Handique et al.	
2015/0142186	A1	5/2015	Handique et al.	
2015/0152477	A1	6/2015	Ganesan et al.	
2015/0174579	A1*	6/2015	Iten	B01L 9/543 422/560
2015/0315631	A1	11/2015	Handique et al.	
2015/0328638	A1	11/2015	Handique et al.	
2015/0376682	A1	12/2015	Handique	
2016/0102305	A1	4/2016	Brahmasandra et al.	
2016/0107161	A1	4/2016	Lentz et al.	
2016/0250635	A1	9/2016	Handique	
2016/0250640	A1	9/2016	Williams et al.	

FOREIGN PATENT DOCUMENTS

CN	103540518		1/2014
DE	19929734		12/1999
DE	19833293	C1	1/2000
EP	0365828	A2	5/1990
EP	0483620	A2	5/1992
EP	0766256		4/1997
EP	0688602	A2	2/2001
EP	1077086	A2	2/2001
EP	1346772	A2	9/2003
EP	1541237	A2	6/2005
EP	1574586	A2	9/2005
EP	1792656	A1	6/2007
EP	2372367	A1	10/2011
FR	2672301		8/1992
FR	2795426		12/2000
GB	2453432	A	4/2009
JP	S50-100881		8/1975
JP	58212921	A	12/1983
JP	S62-119460		5/1987
JP	H01-502319		8/1989
JP	H 03181853		8/1991
JP	04-053555	U	5/1992
JP	06-064156	U	9/1994
JP	07-020010		1/1995
JP	H07-290706		11/1995
JP	H08-122336		5/1996
JP	H08-211071		8/1996
JP	H08-285859		11/1996
JP	H09-325151		12/1997
JP	2001-502790		1/1998
JP	H 11-501504		2/1999
JP	H 11503315		3/1999
JP	2000-514928		4/1999
JP	H 11316226		11/1999
JP	H11-515106		12/1999
JP	2000-180455		6/2000
JP	2000-275255		10/2000
JP	2001-502319		2/2001
JP	2001-204462		7/2001
JP	2001-509437		7/2001
JP	3191150	B2	7/2001
JP	2001-515216		9/2001
JP	2001-523812		11/2001
JP	2001-523813		11/2001
JP	2001-527220		12/2001
JP	2002-503331		1/2002
JP	2002-085961		3/2002
JP	2002-517735		6/2002
JP	2002-215241		7/2002
JP	2002-540382		11/2002
JP	2002-544476		12/2002
JP	2003-500674		1/2003
JP	2003-047839	A	2/2003
JP	2003-047840	A	2/2003
JP	2003-516125		5/2003
JP	2003-164279		6/2003
JP	2003-185584		7/2003
JP	2003-299485		10/2003
JP	2003-329693		11/2003
JP	2003-329696		11/2003
JP	2004-506179	A	2/2004
JP	2004-150797	A	5/2004
JP	2004-531360	A	10/2004
JP	2004-533838		11/2004
JP	2004-361421		12/2004
JP	2004-536291		12/2004
JP	2005-009870		1/2005
JP	2005-010179		1/2005
JP	2005-511264		4/2005
JP	2005-514718		5/2005
JP	2005-518825		6/2005
JP	2005-176613	A	7/2005
JP	2005-192439		7/2005
JP	2005-192554		7/2005
JP	2005-204661		8/2005
JP	2005-525816		9/2005
JP	2005-291954	A	10/2005
JP	2005-532043		10/2005
JP	2005-323519		11/2005
JP	2006-021156	A	1/2006
JP	2006-094866	A	4/2006
JP	2006-145458		6/2006
JP	2006-167569		6/2006
JP	2007-074960		3/2007
JP	2007-097477		4/2007
JP	2007-101364		4/2007
JP	2007-510518		4/2007
JP	2007-514405	A	6/2007
JP	2007-178328		7/2007
JP	2009-542207		12/2009
WO	WO 88/06633		9/1988
WO	WO 90/12350		10/1990
WO	WO 92/05443		4/1992
WO	WO 94/11103		5/1994
WO	WO 96/04547		2/1996
WO	WO 97/05492		2/1997
WO	WO 97/21090		6/1997
WO	WO 98/00231		1/1998
WO	WO 98/22625		5/1998
WO	WO 98/35013		8/1998
WO	WO 98/49548		11/1998
WO	WO 98/53311		11/1998
WO	WO 99/01688		1/1999
WO	WO 99/09042		2/1999
WO	WO 99/12016		3/1999
WO	WO 99/33559		7/1999
WO	WO 01/05510		1/2001
WO	WO 01/14931		3/2001
WO	WO 01/27614		4/2001
WO	WO 01/28684		4/2001
WO	WO 01/41931		6/2001
WO	WO 01/54813		8/2001
WO	WO 01/89681		11/2001
WO	WO 02/072264		9/2002
WO	WO 02/078845		10/2002
WO	WO 03/007677		1/2003
WO	WO 03/012325		2/2003
WO	WO 03/012406		2/2003
WO	WO 03/048295		6/2003
WO	WO 03/055605		7/2003
WO	WO 03/076661		9/2003
WO	WO 03/087410		10/2003
WO	WO 2004/007081		1/2004
WO	WO 2004/048545		6/2004
WO	WO 2004/055522		7/2004
WO	WO 2004/056485		7/2004
WO	WO 2004/074848		9/2004
WO	WO 2004/094986		11/2004
WO	WO 2005/008255		1/2005
WO	WO 2005/011867		2/2005
WO	WO 2005/030984		4/2005
WO	WO 2005/107947		11/2005
WO	WO 2005/108571		11/2005

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

WO	WO 2005/108620	11/2005
WO	WO 2005/116202	12/2005
WO	WO 2005/118867	12/2005
WO	WO 2005/120710	12/2005
WO	WO 2006/010584	2/2006
WO	WO 2006/032044	3/2006
WO	WO 2006/035800	4/2006
WO	WO 2006/043642	4/2006
WO	WO 2006/066001	6/2006
WO	WO 2006/079082	7/2006
WO	WO 2006/081995	8/2006
WO	WO 2006/113198	10/2006
WO	WO 2006/119280	11/2006
WO	WO 2007/044917	4/2007
WO	WO 2007/050327	5/2007
WO	WO 2007/064117	6/2007
WO	WO 2007/091530	8/2007
WO	WO 2007/112114	10/2007
WO	WO 2008/030914	3/2008
WO	WO 2008/060604	5/2008
WO	WO 2009/012185	1/2009
WO	WO 2009/054870	4/2009
WO	WO 2010/118541	10/2010
WO	WO 2010/140680	12/2010
WO	WO 2011/101467	8/2011

OTHER PUBLICATIONS

Brahmasandra et al., On-chip DNA detection in microfabricated separation systems, SPIE Conference on Microfluidic Devices and Systems, 1998, vol. 3515, pp. 242-251, Santa Clara, CA.

Breadmore, M.C. et al., "Microchip-Based Purification of DNA from Biological Samples", Anal. Chem., vol. 75 (2003), pp. 1880-1886.

Brody, et al., Diffusion-Based Extraction in a Microfabricated Device, Sensors and Actuators Elsevier, 1997, vol. A58, No. 1, pp. 13-18.

Broyles et al., "Sample Filtration, Concentration, and Separation Integrated on Microfluidic Devices" Analytical Chemistry (American Chemical Society), (2003) 75(11): 2761-2767.

Burns et al., "An Integrated Nanoliter DNA Analysis Device", Science 282:484-487 (1998).

Carlen et al., "Paraffin Actuated Surface Micromachined Valve," in IEEE MEMS 2000 Conference, Miyazaki, Japan, (Jan. 2000) pp. 381-385.

Chung, Y. et al., "Microfluidic chip for high efficiency DNA extraction", Miniaturisation for Chemistry, Biology & Bioengineering, vol. 4, No. 2 (Apr. 2004), pp. 141-147.

Goldmeyer et al., "Identification of *Staphylococcus aureus* and Determination of Methicillin Resistance Directly from Positive Blood Cultures by Isothermal Amplification and a Disposable Detection Device", J Clin Microbiol. (Apr. 2008) 46(4): 1534-1536.

Handique et al, "Microfluidic flow control using selective hydrophobic patterning", SPIE, (1997) 3224: 185-194.

Handique et al., On-Chip Thermopneumatic Pressure for Discrete Drop Pumping, Analytical Chemistry, American Chemical Society, Apr. 15, 2001, vol. 73, No. 8, 1831-1838.

Handique, K. et al., "Nanoliter-volume discrete drop injection and pumping in microfabricated chemical analysis systems", Solid-State Sensor and Actuator Workshop (Hilton Head, South Carolina, Jun. 8-11, 1998) pp. 346-349.

Handique, K. et al., "Mathematical Modeling of Drop Mixing in a Slit-Type Microchannel", J. Micromech. Microeng., 11:548-554 (2001).

Handique, K. et al., "Nanoliter Liquid Metering in Microchannels Using Hydrophobic Patterns", Anal. Chem., 72(17):4100-4109 (2000).

He, et al., Microfabricated Filters for Microfluidic Analytical Systems, Analytical Chemistry, American Chemical Society, 1999, vol. 71, No. 7, pp. 1464-1468.

Ibrahim, et al., Real-Time Microchip PCR for Detecting Single-Base Differences in Viral and Human DNA, Analytical Chemistry, American Chemical Society, 1998, 70(9): 2013-2017.

Khandurina et al., Microfabricated Porous Membrane Structure for Sample Concentration and Electrophoretic Analysis, Analytical Chemistry American Chemical Society, 1999, 71(9): 1815-1819.

Kopp et al., Chemical Amplification: Continuous-Flow PCR on a Chip, www.sciencemag.org, 1998, vol. 280, pp. 1046-1048.

Kuo et al., "Remnant cationic dendrimers block RNA migration in electrophoresis after monophasic lysis", J Biotech. (2007) 129: 383-390.

Kutter et al., Solid Phase Extraction on Microfluidic Devices, J. Microcolumn Separations, John Wiley & Sons, Inc., 2000, 12(2): 93-97.

Lagally et al., Single-Molecule DNA Amplification and Analysis in an Integrated Microfluidic Device, Analytical Chemistry, American Chemical Society, 2001, 73(3): 565-570.

Livache et al., "Polypyrrole DNA chip on a Silicon Device: Example of Hepatitis C Virus Genotyping", Analytical Biochemistry, (1998) 255: 188-194.

Mascini et al., "DNA electrochemical biosensors", Fresenius J. Anal. Chem., 369: 15-22, (2001).

Meyers, R.A., Molecular Biology and Biotechnology: A Comprehensive Desk Reference; VCH Publishers, Inc. New York, NY; (1995) pp. 418-419.

Nakagawa et al., Fabrication of amino silane-coated microchip for DNA extraction from whole blood, J of Biotechnology, Mar. 2, 2005, vol. 116, pp. 105-111.

Northrup et al., A Miniature Analytical Instrument for Nucleic Acids Based on Micromachined Silicon Reaction Chambers, Analytical Chemistry, American Chemical Society, 1998, 70(5): 918-922.

Oleschuk et al., Trapping of Bead-Based Reagents within Microfluidic Systems: On-chip Solid-Phase Extraction and Electrochromatography, Analytical Chemistry American Chemical Society 2000, 72(3): 585-590.

Plambeck et al., "Electrochemical Studies of Antitumor Antibiotics", J Electrochem Soc.: Electrochemical Science and Technology (1984), 131(11): 2556-2563.

Roche, et al. "Ectodermal commitment of insulin-producing cells derived from mouse embryonic stem cells" Faseb J (2005) 19: 1341-1343.

Ross et al., Analysis of DNA Fragments from Conventional and Microfabricated PCR Devices Using Delayed Extraction MALDI-TOF Mass Spectrometry, Analytical Chemistry, American Chemical Society, 1998, 70(10). 2067-2073.

Shoffner et al., Chip PCR.I. Surface Passivation of Microfabricated Silicon-Glass Chips for PCR, Nucleic Acids Research, Oxford University Press, (1996) 24(2): 375-379.

Smith, K. et al., "Comparison of Commercial DNA Extraction Kits for Extraction of Bacterial Genomic DNA from Whole-Blood Samples", Journal of Clinical Microbiology, vol. 41, No. 6 (Jun. 2003), pp. 2440-2443.

Tanaka et al., "Modification of DNA extraction from maize using polyamidoamine-dendrimer modified magnetic particles", Proceedings of the 74th Annual Meeting of the Electrochemical Society of Japan, Mar. 29, 2007. Faculty of Engineering Science University of Tokyo. 2 pages.

Wang, "Survey and Summary, from DNA Biosensors to Gene Chips", Nucleic Acids Research, 28(16):3011-3016, (2000).

Waters et al., Microchip Device for Cell Lysis, Multiplex PCR Amplification, and Electrophoretic Sizing, Analytical Chemistry, American Chemical Society, 1998, 70(1): 158-162.

Weigl, et al., Microfluidic Diffusion-Based Separation and Detection, www.sciencemag.org, 1999, vol. 283, pp. 346-347.

Wu et al., "Polycationic dendrimers interact with RNA molecules: polyamine dendrimers inhibit the catalytic activity of Candida ribozymes", Chem Commun. (2005) 3: 313-315.

Yoza et al., "Fully Automated DNA Extraction from Blood Using Magnetic Particles Modified with a Hyperbranched Polyamidoamine Dendrimer", J Biosci Bioeng, 2003, 95(1): 21-26.

Yoza et al., DNA extraction using bacterial magnetic particles modified with hyperbranched polyamidoamine dendrimer, J Biotechnol., Mar. 20, 2003, 101(3): 219-228.

(56) **References Cited**

OTHER PUBLICATIONS

Zhou et al., "Cooperative binding and self-assembling behavior of cationic low molecular-weight dendrons with RNA molecules", Org Biomol Chem. (2006) 4(3): 581-585.
Zhou et al., "PAMAM dendrimers for efficient siRNA delivery and potent gene silencing", Chem Comm.(Camb.) (2006) 22: 2362-2364.
International Search Report and Written Opinion dated Apr. 4, 2008 for PCT/US07/007513, filed Mar. 26, 2007.
International Search Report and Written Opinion dated Jan. 5, 2009 for PCT/US2007/024022, filed Nov. 14, 2007.
International Search Report dated Jun. 17, 2009 for Application No. PCT/US2008/008640, filed Jul. 14, 2008.
International Preliminary Report on Patentability and Written Opinion dated Jan. 19, 2010 for Application No. PCT/US2008/008640, filed Jul. 14, 2008.
Allemand et al., "pH-Dependent Specific Binding and Combing of DNA", Biophys J. (1997) 73(4): 2064-20070.
Harding et al., "DNA isolation using Methidium-Spermine-Sepharose", Meth Enzymol. (1992) 216: 29-39.
Harding et al., "Rapid isolation of DNA from complex biological samples using a novel capture reagent—methidium-spermine-sepharose", Nucl Acids Res. (1989) 17(17): 6947-6958.
Labchem; Sodium Hydroxide, 0,5N (0.5M); Safety Data Sheet, 2015; 8 pages.

* cited by examiner

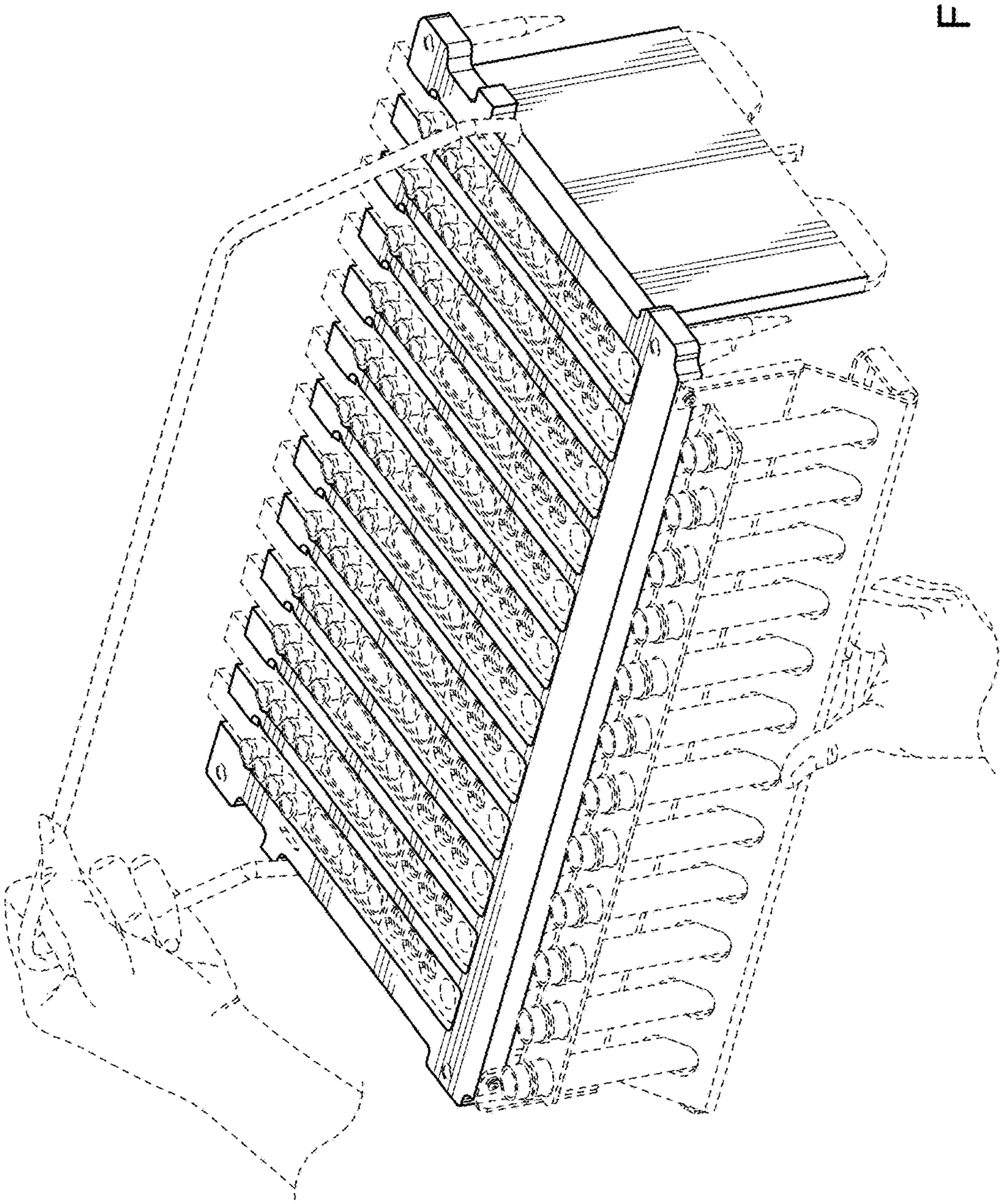


FIG. 1

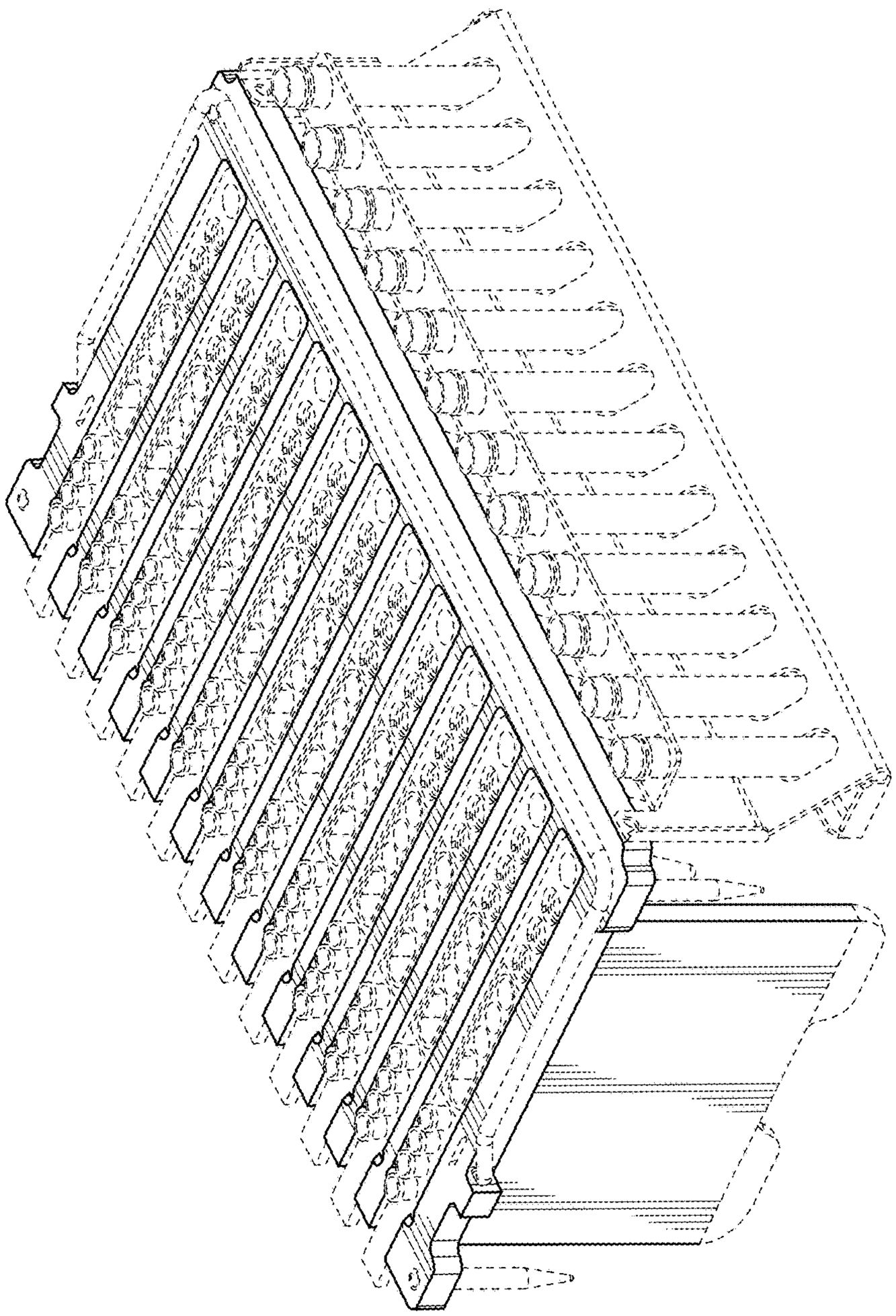


FIG. 2

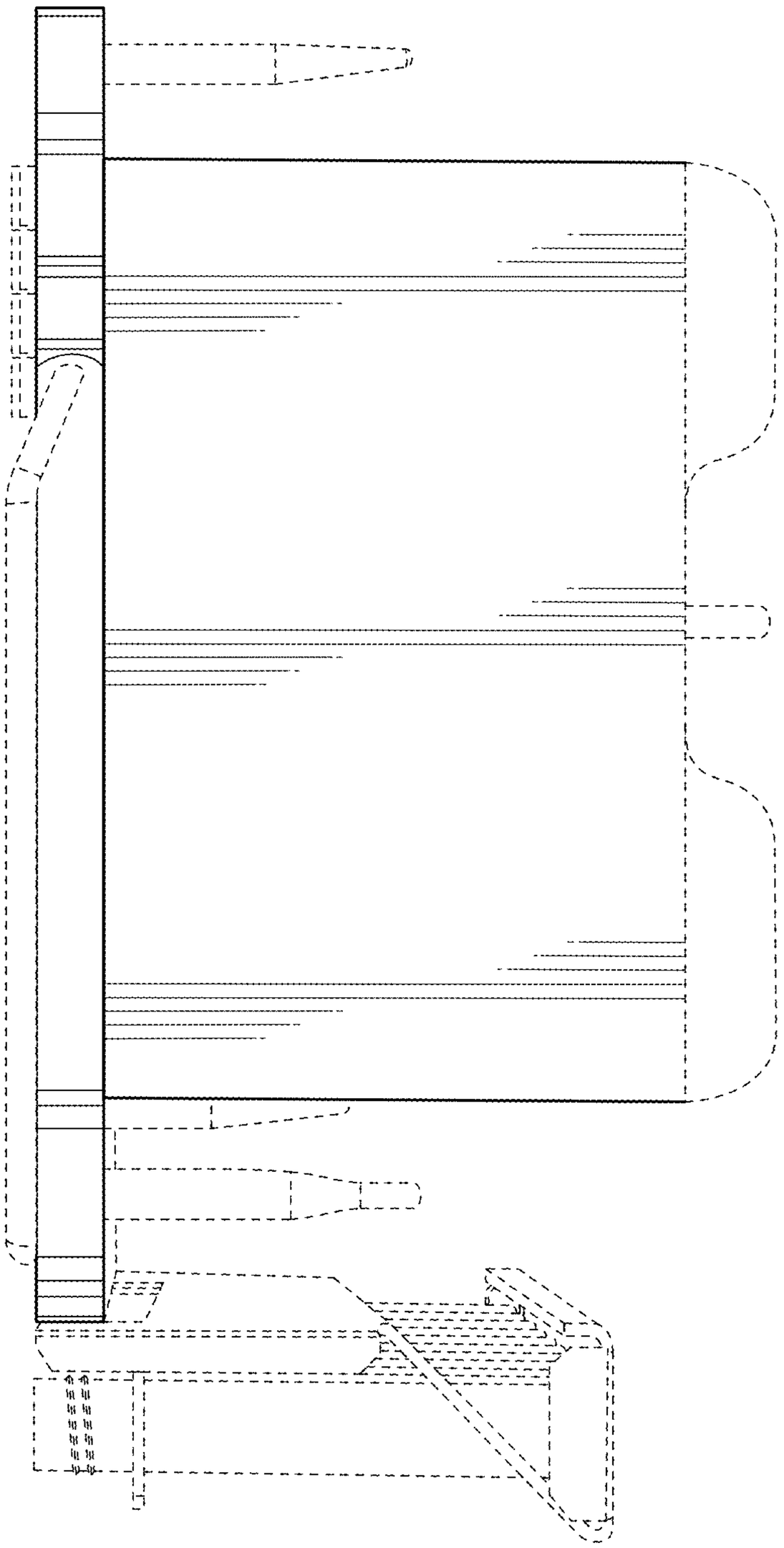


FIG. 3

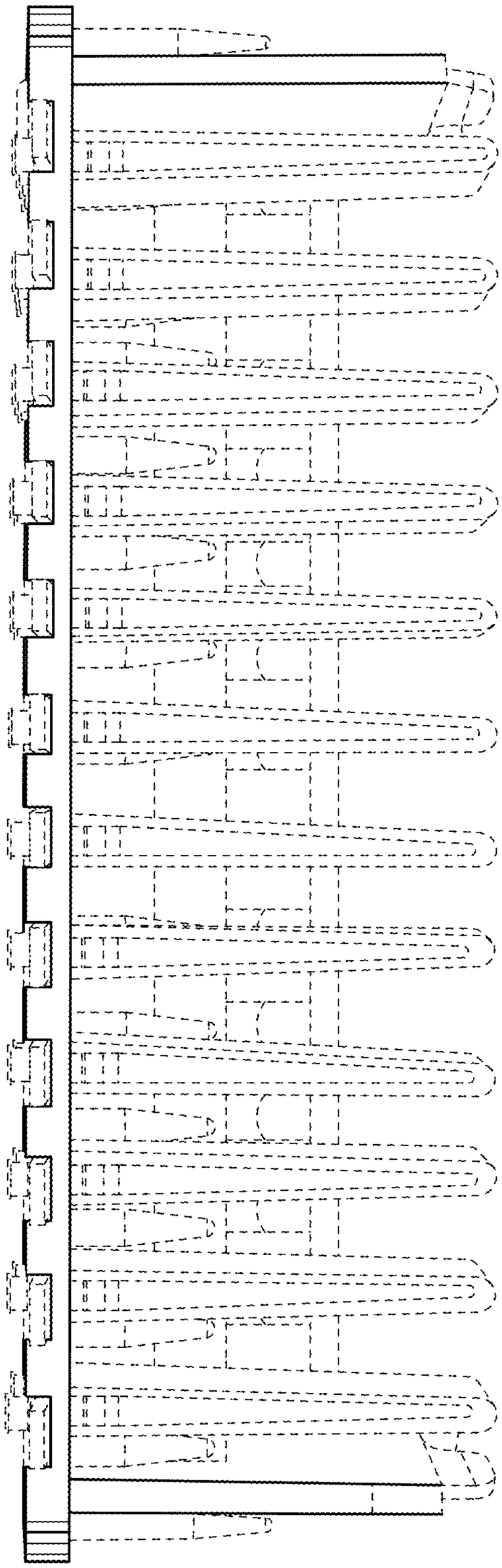


FIG. 4

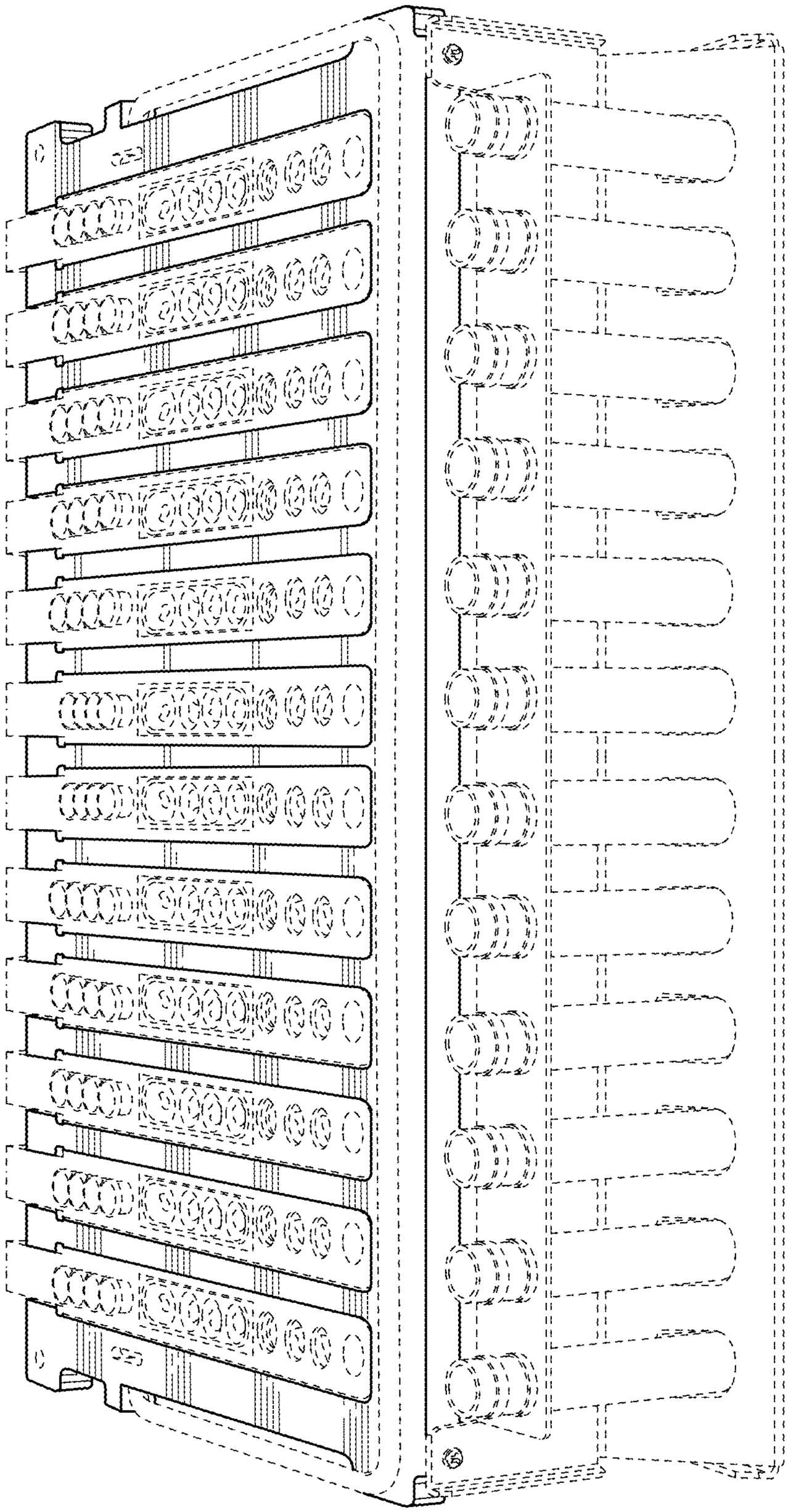


FIG. 5

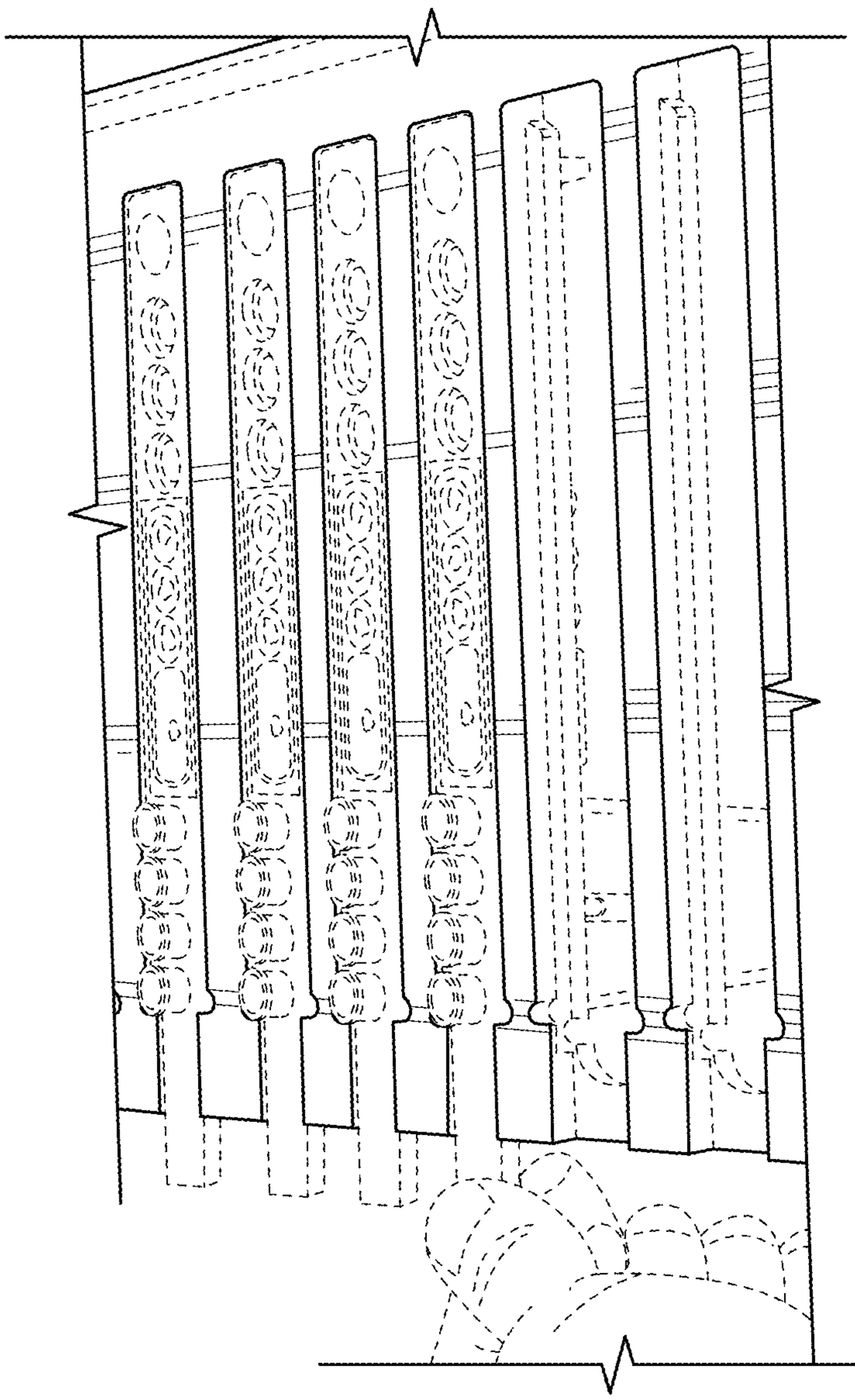


FIG. 6