US00RE48572E

(19) **United States**

(12) **Reissued Patent**

Garner et al.

(10) **Patent Number: US RE48,572 E**

(45) **Date of Reissued Patent: *Jun. 1, 2021**

(54) **PLANTING UNIT FOR A SEEDING MACHINE HAVING BLOCKING MEMBER TO CONTROL HAND-OFF OF SEED FROM A SEED METER TO A SEED DELIVERY SYSTEM**

(71) Applicant: **Deere & Company**, Moline, IL (US)

(72) Inventors: **Elijah B. Garner**, Bettendorf, IA (US); **Michael E. Friestad**, Rock Island, IL (US); **Nathan A. Mariman**, Geneseo, IL (US)

(73) Assignee: **Deere & Company**, Moline, IL (US)

(*) Notice: This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/799,617**

(22) Filed: **Oct. 31, 2017**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **9,510,502**
Issued: **Dec. 6, 2016**
Appl. No.: **14/215,182**
Filed: **Mar. 17, 2014**

U.S. Applications:

(63) Continuation of application No. 13/072,175, filed on Mar. 25, 2011, now Pat. No. 8,671,856, which is a (Continued)

(51) **Int. Cl.**
A01C 7/16 (2006.01)
A01C 7/08 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***A01C 7/16*** (2013.01); ***A01C 7/042*** (2013.01); ***A01C 7/08*** (2013.01); ***A01C 7/12*** (2013.01); ***A01C 7/127*** (2013.01)

(58) **Field of Classification Search**
CPC A01C 7/17; A01C 7/12; A01C 7/08; A01C 7/042; A01C 7/027; A01C 7/04; A01C 7/046
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,439 A 12/1852 Colver
13,986 A 12/1855 Hurd
(Continued)

FOREIGN PATENT DOCUMENTS

AU 6198680 3/1981
BE 335843 9/1926
(Continued)

OTHER PUBLICATIONS

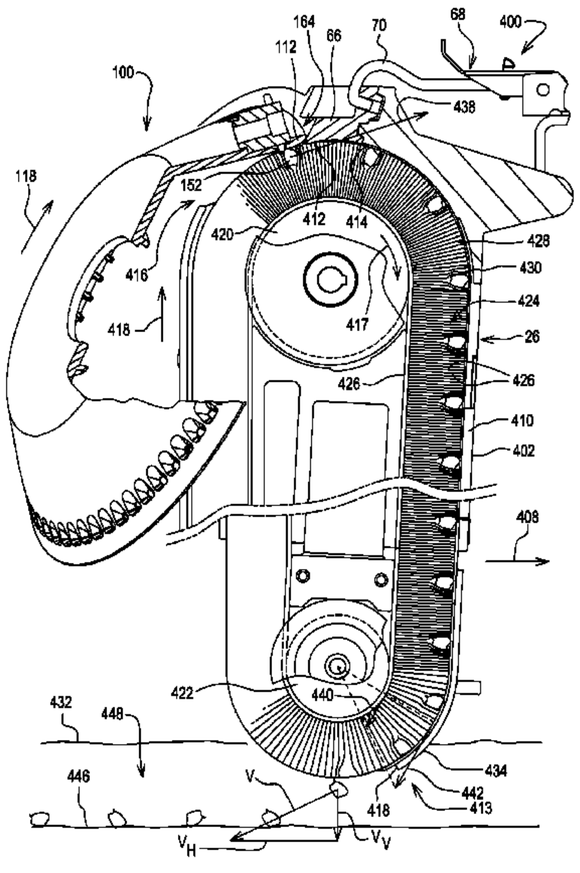
Brazilian Office Action issued in counterpart application No. BR112013024393-7 dated Sep. 27, 2017 (8 pages, Statement of Relevance included).
(Continued)

Primary Examiner — Jeffrey L Gellner

(57) **ABSTRACT**

A planting unit for a seeding machine having a seed meter with a metering member that moves seed sequentially along a first path to a release position at which the seed is moving in a first direction and a delivery system adapted to take seed from the metering member at the release position and control movement of the seed from the seed meter to a discharge location adjacent a seed furrow formed in soil beneath the seeding machine. The delivery system, at the release position, moves seed in a second direction along a second path. A blocking member located adjacent the first path immediately preceding the release position prevents movement of the seed in the second direction until the seed has passed the blocking member.

36 Claims, 22 Drawing Sheets



Related U.S. Application Data

continuation-in-part of application No. 12/363,968, filed on Feb. 2, 2009, now Pat. No. 7,918,168.

(51) **Int. Cl.**

A01C 7/04	(2006.01)
A01C 7/12	(2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

140,493	A		7/1873	Fulghum et al.
540,458	A		6/1895	Robbins
658,348	A		9/1900	Crowley
697,874	A		4/1902	Oldham
1,220,684	A		3/1917	Ray
1,264,454	A		4/1918	Terrell et al.
1,376,933	A		6/1921	Gould, Jr.
1,397,689	A		11/1921	Krotz
1,480,963	A		1/1924	Sproull
1,506,294	A		8/1924	Faber
1,566,187	A		12/1925	Fifer
1,976,315	A		10/1934	White
1,997,791	A		4/1935	Hoberg et al.
2,053,390	A		9/1936	Bateman et al.
2,054,552	A		9/1936	Wakeham
2,141,044	A		12/1938	Rassmann
2,144,044	A		1/1939	Birdseye
2,250,719	A		7/1941	McKahin
2,340,163	A		1/1944	White
2,440,846	A		5/1948	Cannon
2,462,276	A		2/1949	Mueller
2,510,658	A		6/1950	Rassmann
2,566,406	A		9/1951	Dougherty
2,589,762	A		3/1952	Barnett et al.
2,673,536	A		3/1954	Skinner
2,684,781	A		7/1954	Allen et al.
2,882,977	A		4/1959	Smith et al.
2,960,258	A		11/1960	Dodwell
2,975,936	A		3/1961	Rousek
2,980,043	A		4/1961	Beck
3,077,290	A		2/1963	Rehder
3,122,283	A		2/1964	Walters
3,154,032	A		10/1964	Kappelmann
3,156,201	A		11/1964	Tweedale
3,176,636	A		4/1965	Wilcox et al.
3,208,413	A		9/1965	Dinges
3,253,739	A		5/1966	Martin
3,272,159	A		9/1966	Sanderson
3,325,060	A		6/1967	Rehder
3,329,310	A		7/1967	Ramsay
3,343,507	A		9/1967	Smith
3,413,941	A		12/1968	Roberson
3,468,441	A		9/1969	Longman
3,526,344	A		9/1970	Koning
3,552,601	A		1/1971	Hansen et al.
3,561,380	A		2/1971	Adams, Jr.
3,570,424	A		3/1971	Wigham
3,636,897	A		1/1972	Brink
3,648,631	A		3/1972	Fiedler et al.
3,690,511	A		9/1972	Wigham
3,693,833	A		9/1972	Weitz
3,757,995	A		9/1973	Armstrong
3,773,224	A		11/1973	Winslow
3,841,522	A		10/1974	Hatcher
3,860,146	A		1/1975	Bauman et al.
3,880,100	A		4/1975	Gillies et al.
3,889,883	A		6/1975	Anderson
3,903,815	A		9/1975	Winkler
3,913,503	A		10/1975	Becker
3,923,206	A		12/1975	Gillies et al.
3,971,446	A		7/1976	Nienberg
3,976,214	A		8/1976	Etwell
3,982,661	A		9/1976	Feltrop
3,990,606	A		11/1976	Gugenhan
3,999,690	A		12/1976	Deckler
4,002,266	A		1/1977	Beebe
4,008,826	A		2/1977	Carree
4,009,668	A		3/1977	Brass et al.
4,010,778	A		3/1977	Aggen
4,023,509	A		5/1977	Hanson
4,026,437	A		5/1977	Biddle
4,029,235	A		6/1977	Grataloup
4,037,755	A		7/1977	Reuter
4,074,830	A		2/1978	Adams et al.
4,156,395	A		5/1979	Edwards et al.
4,162,744	A		7/1979	Barker et al.
4,193,523	A		3/1980	Koning
4,221,305	A		9/1980	Freeman et al.
4,239,126	A		12/1980	Dobson et al.
4,282,985	A		8/1981	Yamamoto
4,306,509	A		12/1981	Hassan et al.
4,314,514	A		2/1982	Binder
4,324,347	A	*	4/1982	Thomas A01C 7/04 221/237
4,333,561	A		6/1982	Schlegel
4,449,642	A		5/1984	Dooley
4,450,979	A		5/1984	Deckler
4,519,494	A		5/1985	McEvoy et al.
4,555,624	A		11/1985	Steffen
4,561,939	A		12/1985	Justus
4,600,122	A		7/1986	Lundie et al.
4,613,056	A		9/1986	Olson
4,628,841	A		12/1986	Powilleit
4,635,215	A		1/1987	Friend
4,646,941	A		3/1987	Grosse-Scharmann et al.
4,653,410	A		3/1987	Typpi
4,664,290	A		5/1987	Martin et al.
4,793,511	A		12/1988	Ankum et al.
4,896,615	A		1/1990	Hood, Jr. et al.
4,896,616	A		1/1990	Wintersteiger et al.
4,915,258	A	*	4/1990	Olson ..... A01C 5/062 193/2 R
4,949,869	A		8/1990	Ribouleau
5,025,736	A		6/1991	Anderson
5,058,766	A		10/1991	Deckler
5,167,317	A		12/1992	Van der Schoot et al.
5,170,909	A		12/1992	Lundie et al.
5,383,371	A		1/1995	Laitinen
5,402,741	A		4/1995	Truax et al.
5,431,117	A		7/1995	Steffans et al.
5,501,366	A		3/1996	Fiorido
5,533,458	A		7/1996	Bergland et al.
5,601,209	A		2/1997	Barsi et al.
5,650,609	A		7/1997	Mertins et al.
5,720,233	A		2/1998	Lodico et al.
5,784,871	A		7/1998	Glancey et al.
5,784,985	A		7/1998	Lodico et al.
5,802,994	A		9/1998	Kinkead et al.
5,810,974	A		9/1998	Laapotti
5,855,303	A		1/1999	Gregor
5,918,726	A		7/1999	Temmink
5,936,234	A		8/1999	Thomas et al.
5,975,283	A		11/1999	Riffe
5,992,338	A		11/1999	Romans
6,000,528	A		12/1999	Van Maanen
6,024,033	A		2/2000	Kinkead et al.
6,047,652	A		4/2000	Prairie et al.
6,142,086	A		11/2000	Richard
6,173,664	B1		1/2001	Heimbuch
6,202,944	B1		3/2001	McCroy
6,237,514	B1		5/2001	Romans
6,244,201	B1		6/2001	Mauch et al.
6,269,758	B1		8/2001	Sauder
6,293,438	B1		9/2001	Woodruff
6,305,303	B1		10/2001	Wright et al.
6,332,413	B1		12/2001	Stufflebeanm et al.
6,352,042	B1		3/2002	Martin et al.
6,499,414	B2		12/2002	Dunham
6,516,733	B1		2/2003	Sauder et al.
6,564,730	B2		5/2003	Crabb et al.
6,567,764	B2		5/2003	Kaji et al.
6,581,535	B2		6/2003	Barry et al.
6,640,732	B2		11/2003	Prairie et al.
6,651,570	B1		11/2003	Thiemke

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,681,706	B2	1/2004	Sauder et al.	
6,718,892	B1	4/2004	Rosenboom	
6,729,249	B2	5/2004	Sauder et al.	
6,748,885	B2	6/2004	Sauder et al.	
6,752,095	B1	6/2004	Rylander et al.	
6,913,541	B2	7/2005	Chen	
6,932,236	B2	8/2005	Ven Huizen	
6,994,038	B2	2/2006	Mariman et al.	
7,086,269	B2	8/2006	Sauder et al.	
7,093,548	B2	8/2006	Eben et al.	
7,162,963	B2	1/2007	Sauder et al.	
7,185,596	B2	3/2007	Thiemke et al.	
7,334,532	B2	2/2008	Sauder et al.	
7,343,868	B2	3/2008	Stephens et al.	
7,404,366	B2	7/2008	Mariman	
7,448,334	B2	11/2008	Mariman et al.	
7,490,565	B2	2/2009	Holly	
7,513,200	B2	4/2009	Friestad	
7,617,785	B2	11/2009	Wendte	
7,631,606	B2	12/2009	Sauder et al.	
7,661,377	B2	2/2010	Keaton et al.	
7,726,251	B1	6/2010	Peterson et al.	
7,854,205	B2	12/2010	Beaujot	
7,918,168	B2 *	4/2011	Garner	A01C 7/127 111/171
7,918,968	B1	4/2011	Baker et al.	
7,938,073	B2	5/2011	Dunham et al.	
7,975,631	B2	7/2011	Heiss, Jr.	
7,994,377	B2	8/2011	Coupard et al.	
8,001,913	B2	8/2011	Snipes et al.	
8,074,586	B2	12/2011	Garner et al.	
8,078,367	B2	12/2011	Sauder et al.	
8,221,047	B2	7/2012	Petersen et al.	
8,276,529	B2	10/2012	Garner et al.	
8,336,471	B2	12/2012	Gilstring	
8,375,874	B2	2/2013	Peterson et al.	
8,413,371	B2	4/2013	Davidson et al.	
8,468,960	B2	6/2013	Garner et al.	
8,522,699	B2	9/2013	Garner et al.	
8,543,238	B2	9/2013	Straeter	
8,618,465	B2	12/2013	Tevs et al.	
8,671,856	B2	3/2014	Garner et al.	
8,746,159	B2	6/2014	Garner et al.	
8,752,490	B2	6/2014	Beaujot	
8,789,482	B2	7/2014	Garner et al.	
8,800,457	B2	8/2014	Garner et al.	
8,813,663	B2	8/2014	Garner et al.	
8,843,281	B2	9/2014	Wilhelmi et al.	
8,850,995	B2	10/2014	Garner et al.	
8,850,997	B2	10/2014	Silbernagel et al.	
8,850,998	B2	10/2014	Garner et al.	
8,869,719	B2	10/2014	Garner et al.	
8,985,037	B2	3/2015	Radtke et al.	
9,144,190	B2	9/2015	Henry et al.	
9,216,860	B2	12/2015	Friestad et al.	
9,237,687	B2	1/2016	Sauder et al.	
9,258,939	B2	2/2016	Borgmann et al.	
9,258,940	B2	2/2016	McCloskey	
9,265,191	B2	2/2016	Sauder et al.	
9,301,441	B2	4/2016	Friestad et al.	
9,313,941	B2	4/2016	Garner et al.	
9,313,943	B2	4/2016	Zumdome et al.	
9,332,689	B2	5/2016	Baurer et al.	
9,345,188	B2	5/2016	Garner et al.	
9,345,189	B2	5/2016	Harmelink et al.	
9,433,141	B2	9/2016	Friestad et al.	
9,445,539	B2	9/2016	Rans	
9,468,142	B2	10/2016	Bastin et al.	
9,480,199	B2	11/2016	Garner et al.	
9,510,502	B2	12/2016	Garner et al.	
9,578,802	B2	2/2017	Radtke et al.	
9,622,402	B2	4/2017	Kinzenbaw et al.	
9,633,491	B2	4/2017	Wonderlich	
9,635,802	B2	5/2017	Rains et al.	
9,635,804	B2	5/2017	Carr et al.	
9,661,799	B2	5/2017	Garner et al.	
9,686,905	B2	6/2017	Garner et al.	
9,686,906	B2	6/2017	Garner et al.	
9,693,498	B2	7/2017	Zumdome et al.	
9,699,955	B2	7/2017	Garner et al.	
9,713,298	B2	7/2017	Garner	
9,730,377	B2	8/2017	Kowalchuk	
9,733,634	B2	8/2017	Prickel	
9,750,178	B2	9/2017	Kinzenbaw et al.	
9,756,779	B2	9/2017	Wilhelmi et al.	
9,769,978	B2	9/2017	Radtke	
9,775,279	B2	10/2017	Garner et al.	
9,795,078	B2	10/2017	Garner et al.	
9,801,328	B2	10/2017	Garner et al.	
9,807,922	B2	11/2017	Garner et al.	
9,807,924	B2	11/2017	Garner et al.	
9,814,176	B2	11/2017	Kowalchuk	
9,820,429	B2	11/2017	Garner et al.	
9,839,178	B2	12/2017	Garner et al.	
9,861,025	B2	1/2018	Schaefer et al.	
9,861,031	B2	1/2018	Garner et al.	
9,872,424	B2	1/2018	Baurer et al.	
9,883,625	B2	2/2018	Koch et al.	
9,888,622	B2	2/2018	Henry	
9,897,922	B2	2/2018	Enomoto et al.	
9,936,625	B2	4/2018	Wendte et al.	
9,936,630	B2	4/2018	Johnson et al.	
9,936,631	B1	4/2018	Hubner et al.	
9,949,426	B2	4/2018	Radtke et al.	
9,974,230	B2	5/2018	Sauder et al.	
9,999,175	B2	6/2018	Baurer et al.	
10,004,173	B2	6/2018	Garner et al.	
10,051,782	B2	8/2018	Wilhelmi et al.	
10,058,023	B2	8/2018	Conrad et al.	
10,143,127	B2	12/2018	Wilhelmi et al.	
10,165,724	B2	1/2019	Nilson et al.	
10,206,325	B2	2/2019	Schoeny et al.	
10,206,326	B2	2/2019	Garner et al.	
10,257,973	B2	4/2019	Hubner et al.	
10,296,017	B2	5/2019	Schoeny et al.	
10,398,077	B2	9/2019	Radtke	
10,433,476	B2	10/2019	Jagow et al.	
10,448,561	B2	10/2019	Schoeny et al.	
10,455,757	B2	10/2019	Sauder et al.	
10,470,358	B2	11/2019	Sauder et al.	
10,485,159	B2	11/2019	Wilhelmi et al.	
10,524,410	B2	1/2020	Schoeny et al.	
10,537,055	B2	1/2020	Gresch et al.	
10,582,655	B2	3/2020	Kowalchuk	
10,602,656	B2	3/2020	Bartelson et al.	
10,729,063	B2	8/2020	Garner et al.	
10,743,460	B2	8/2020	Gilbert et al.	
10,765,057	B2	9/2020	Radtke et al.	
10,772,256	B2	9/2020	Stuber	
10,806,070	B2	10/2020	Garner et al.	
10,820,489	B2	11/2020	Garner et al.	
10,823,748	B2	11/2020	Allgaier	
10,842,072	B2	11/2020	Wilhelmi et al.	
2002/0043201	A1	4/2002	Dunham	
2002/0050238	A1	5/2002	Crabb et al.	
2003/0159631	A1	8/2003	Sauder et al.	
2003/0167986	A1	9/2003	Sauder et al.	
2003/0183647	A1	10/2003	Ven Huizen	
2005/0235890	A1	10/2005	Mariman et al.	
2006/0278726	A1	12/2006	Holly	
2006/0283363	A1	12/2006	Wollman et al.	
2007/0039528	A1	2/2007	Sauder et al.	
2007/0039529	A1	2/2007	Sauder et al.	
2007/0107645	A1	5/2007	Mariman et al.	
2007/0125284	A1	6/2007	Mariman	
2008/0053352	A1	3/2008	Friestad	
2010/0010667	A1	1/2010	Sauder et al.	
2010/0107944	A1	5/2010	Snipes et al.	
2010/0192818	A1	8/2010	Garner et al.	
2010/0192819	A1	8/2010	Garner et al.	
2010/0192821	A1	8/2010	Garner et al.	
2010/0224110	A1	9/2010	Mariman	
2010/0300341	A1	12/2010	Peterson et al.	
2012/0067260	A1	3/2012	Garner et al.	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2012/0067261	A1	3/2012	Garner et al.
2013/0192504	A1	8/2013	Sauder et al.
2013/0298810	A1	11/2013	Garner et al.
2014/0196642	A1	7/2014	Garner et al.
2015/0013581	A1	1/2015	Garner et al.
2015/0216111	A1	8/2015	Garner et al.
2015/0230397	A1	8/2015	Garner et al.
2015/0238003	A1	8/2015	Swane
2015/0305231	A1	10/2015	Garner et al.
2016/0128273	A1	5/2016	Garner et al.
2016/0135363	A1	5/2016	Sauder et al.
2016/0174458	A1	6/2016	Thacker
2016/0234996	A1	8/2016	Sauder et al.
2017/0049040	A1	2/2017	Kinzenbaw
2017/0127604	A1	5/2017	Wilhelmi et al.
2017/0332546	A1	11/2017	Garner et al.
2017/0359949	A1	12/2017	Garner et al.
2018/0007824	A1	1/2018	Radtke
2018/0049367	A1	2/2018	Garner et al.
2018/0153094	A1	2/2018	Radtke et al.
2018/0184578	A1	7/2018	Stuber
2018/0192577	A1	7/2018	Smith et al.
2019/0098827	A1	4/2019	Gilbert et al.
2019/0098828	A1	4/2019	Wilhelmi et al.
2019/0219606	A1	7/2019	Radtke et al.
2019/0223372	A1	7/2019	Koch et al.
2019/0230846	A1	8/2019	Koch et al.
2019/0239425	A1	8/2019	Garner et al.
2019/0239426	A1	8/2019	Garner et al.
2019/0246551	A1	8/2019	Campbell et al.
2019/0254224	A1	8/2019	Garner et al.
2019/0289774	A1	9/2019	Prystupa et al.
2019/0289778	A1	9/2019	Koch et al.
2019/0307057	A1	10/2019	Sauder et al.
2019/0343037	A1	11/2019	Werner et al.
2019/0364724	A1	12/2019	Radtke et al.
2020/0000011	A1	1/2020	Hubner et al.
2020/0000012	A1	1/2020	Hubner et al.
2020/0000016	A1	1/2020	Hubner et al.
2020/0000017	A1	1/2020	Marler, III et al.
2020/0000018	A1	1/2020	Boetsch
2020/0344941	A1	11/2020	Garner et al.
2021/0059104	A1	3/2021	Garner et al.
2021/0059105	A1	3/2021	Garner et al.
2021/0059106	A1	3/2021	Garner et al.
2021/0068337	A1	3/2021	Garner et al.
2021/0076558	A1	3/2021	Garner et al.

FOREIGN PATENT DOCUMENTS

BR	PI 8501300	A	11/1985
BR	PI 9701145-2	A	12/1998
BR	PI 0104497-4	A	5/2002
BR	PI 0305993-6	A	5/2005
BR	PI 0605292-4	A	9/2007
BR	PI 0604798-0	A	11/2007
BR	PI 0703545-4	A	4/2008
CA	2154022	A1	7/1996
CA	2485250	C	2/2014
CA	2806410	C	8/2017
CA	3032575	A1	8/2019
CN	2180028		10/1994
DE	389840		2/1924
DE	1090458		10/1960
DE	2011462	A1	9/1971
DE	2826658		1/1980
DE	8400142	U1	5/1984
DE	3405031	C1	4/1985
DE	102007031576	A1	1/2009
EP	0014622	A1	8/1980
EP	0047577	A2	3/1982
EP	0152048	A2	8/1985
EP	0049330	B1	1/1986
EP	0158985	B1	1/1990
EP	0182220	B1	4/1990
EP	0457679	B1	1/1995
EP	0606541	B1	1/1997
EP	0981270	A1	3/2000
EP	0801523	B1	12/2000
EP	1219155	A1	7/2002
EP	1236387	A1	9/2002
EP	0953280	B1	7/2003
EP	1560157	A2	8/2005
EP	2213152		8/2010
EP	2213153		8/2010
EP	2215903	B1	9/2011
EP	2213152	B1	12/2011
EP	2213153	B1	1/2012
EP	2747541		4/2016
EP	2747541	B1	4/2016
EP	2688385	B1	7/2016
EP	3056073	A1	8/2016
EP	2974582	B1	9/2017
EP	2449871	B1	12/2018
EP	3409092	B1	12/2018
EP	3586583	A1	1/2020
FR	858062	A	11/1940
FR	1026090	A	4/1953
FR	1408127		6/1965
FR	1503687	A	12/1967
FR	2210887	A5	7/1974
FR	2414288		8/1979
FR	2414288	A1	8/1979
FR	2574243	A1	6/1986
FR	2591061	A1	6/1987
FR	2635432	A1	2/1990
FR	2638054		4/1990
GB	190418381	A	10/1904
GB	482789	A	4/1938
GB	926217	A	5/1963
GB	989145	A	4/1965
GB	2012534		8/1979
GB	2057835		4/1981
JP	56-024815		3/1981
JP	64003306		7/1986
JP	61-33858		10/1986
JP	H0530815	B2	10/1995
JP	H1159886	A	3/1999
JP	2007117941	A	5/2007
NL	1005451		9/1998
RU	2044436	C1	9/1995
RU	2343675	C1	1/2009
SU	948316	A1	8/1982
WO	WO 98/049884	A1	11/1998
WO	WO 2005/011358	A1	2/2005
WO	WO 2005/065441	A1	7/2005
WO	WO 2010059101	A1	5/2010
WO	WO 2010124360	A1	11/2010
WO	WO 2013/049198	A1	4/2013
WO	WO 2016/054715	A1	4/2016
WO	WO 2017/117638	A1	7/2017
WO	WO 2019/050944	A1	3/2019
WO	WO 2019/068582	A1	4/2019
WO	WO 2019/091871	A1	5/2019
WO	WO 2019/202194	A1	10/2019
WO	WO 2019/241856	A1	10/2019
WO	WO 2020/014752	A1	1/2020

OTHER PUBLICATIONS

Canadian Patent Office Action for Application No. 2,831,041 dated Nov. 23, 2018 (3 pages).

Brazilian Office Action issued in counterpart application No. BR 11 2013 024393 7 dated Nov. 7, 2017 (8 pages, which includes a Statement of Relevance).

USPTO, Office Action for U.S. Appl. No. 14/170,225, dated Aug. 27, 2015 (230.0192X1).

USPTO, Office Action for U.S. Appl. No. 14/170,315, dated Sep. 3, 2015 (230.0192X2).

Petition for *Inter Partes* Review of U.S. Pat. No. 9,510,502 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on May 24, 2019, in 77 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Exhibit 1002 to Petition for *Inter Partes* Review of U.S. Pat. No. 9,510,502 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Randal K. Taylor, filed on May 24, 2019, in 130 pages.
Precision Planting LLC and AGCO Corporation's initial invalidity contentions pursuant to Paragraph 4.d. of the District of Delaware Default Standard for Discovery, served Jul. 12, 2019, in 657 pages.
Exhibit 01 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to Australian Patent No. AU-A1-61 986/80 to Hedderwick ("Hedderwick '80 App."), served Jul. 12, 2019, in 98 pages.
Exhibit 02 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to Belgian Patent No. 335843 to Wodke ("Wodke"), served Jul. 12, 2019, in 74 pages.
Exhibit 03 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to German Published Patent No. DE1090458B to Witte ("Witte"), served Jul. 12, 2019, in 103 pages.
Exhibit 04 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to German Published Patent Application No. 28,26,658 to Holdt ("Holdt"), served Jul. 12, 2019, in 76 pages.
Exhibit 05 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to German Patent No. 389840 to Hempel ("Hempel"), served Jul. 12, 2019, in 69 pages.
Exhibit 06 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to French Patent No. 1,408,127 to Plinke ("Plinke"), served Jul. 12, 2019, in 65 pages.
Exhibit 07 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to French Published Patent Application No. 2,414,288 A1 to Benac ("Benac"), served Jul. 12, 2019, in 123 pages.
Exhibit 08 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to French Published Patent Application No. 2638054A1 to Damonnevile ("Damonneville"), served Jul. 12, 2019, in 109 pages.
Exhibit 09 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to UK Patent Application No. GB2,012,534A to Curtis ("Curtis"), served Jul. 12, 2019, in 86 pages.
Exhibit 10 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to UK Published Patent Application No. 2,057,835 A to Hedderwick ("Hedderwick '835"), served Jul. 12, 2019, in 100 pages.
Exhibit 11 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to Japanese Utility Model Application JP 56-024815 ("Yamahata"), served Jul. 12, 2019, in 94 pages.
Exhibit 12 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to Japanese Utility Model Registration Publication No. JP 61-33858 Y2 to Yamatake ("Yamatake"), served Jul. 12, 2019, in 71 pages.
Exhibit 13 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to Japanese Published Patent JP64003306Y2 to Koyama ("Koyama"), served Jul. 12, 2019, in 77 pages.
Exhibit 14 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to Netherlands Patent Application No. 1,005,451C2 to Pronk ("Pronk"), served Jul. 12, 2019, in 63 pages.
Exhibit 15 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S Patent Application Publication No. 2003/0159631 to Sauder et al. ("Sauder '631 App."), served Jul. 12, 2019, in 179 pages.
Exhibit 16 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Patent Application Publication No. 2003/0167986A1 to Sauder et al. ("Sauder '986 App."), served Jul. 12, 2019, in 72 pages.
Exhibit 17 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Patent Application Publication No. US 2003/0183647 A1 to Ven Huizen ("Ven Huizen '647 App."), served Jul. 12, 2019, in 115 pages.
Exhibit 18 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Patent Application Publication No. 2006/0278726 A1 to Holly ("Holly '726 App."), served Jul. 12, 2019, in 83 pages.
Exhibit 19 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Patent Application Publication No. US 2006/0283363 A1 to Wollman ("Wollman"), served Jul. 12, 2019, in 128 pages.
Exhibit 20 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Patent Application Publication No. 2007/039528 A1 to Sauder et al. ("Sauder '528 App."), served Jul. 12, 2019, in 89 pages.
Exhibit 21 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Patent Application Publication No. 2010/0107944 to Snipes et al. ("Snipes"), served Jul. 12, 2019, in 97 pages.
Exhibit 22 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Patent Application Publication No. 2010/0192819 ("Garner"), served Jul. 12, 2019, in 45 pages.
Exhibit 23 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 1,376,933 to Gould ("Gould"), served Jul. 12, 2019, in 74 pages.
Exhibit 24 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 2,566,406 to Dougherty ("Dougherty"), served Jul. 12, 2019, in 72 pages.
Exhibit 25 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 2,684,781 to Allen et al. ("Allen"), served Jul. 12, 2019, in 70 pages.
Exhibit 26 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,077,290 to Rehder ("Rehder '290"), served Jul. 12, 2019, in 98 pages.
Exhibit 27 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,253,739 to Martin ("Martin '739"), served Jul. 12, 2019, in 124 pages.
Exhibit 28 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,272,159 to Sanderson ("Sanderson"), served Jul. 12, 2019, in 69 pages.
Exhibit 29 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,325,060 to Rehder ("Rehder '060"), served Jul. 12, 2019, in 67 pages.
Exhibit 30 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,329,310 ("Ramsay"), served Jul. 12, 2019, in 125 pages.
Exhibit 31 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,413,941 ("Roberson"), served Jul. 12, 2019, in 81 pages.
Exhibit 32 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,468,441 to Longman ("Longman"), served Jul. 12, 2019, in 140 pages.
Exhibit 33 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,561,380 to Adams ("Adams"), served Jul. 12, 2019, in 75 pages.
Exhibit 34 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,570,424 to Wigham ("Wigham '424"), served Jul. 12, 2019, in 66 pages.
Exhibit 35 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,690,511 to Wigham ("Wigham '511"), served Jul. 12, 2019, in 91 pages.
Exhibit 36 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,841,522 to Hatcher ("Hatcher"), served Jul. 12, 2019, in 101 pages.
Exhibit 37 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,913,503 to Becker ("Becker"), served Jul. 12, 2019, in 64 pages.
Exhibit 38 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 3,982,661 to Feltrop ("Feltrop"), served Jul. 12, 2019, in 73 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Exhibit 39 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,023,509 to Hanson ("Hanson"), served Jul. 12, 2019, in 100 pages.
Exhibit 40 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,026,437 to Biddle ("Biddle"), served Jul. 12, 2019, in 71 pages.
Exhibit 41 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,029,235 ("Grataloup"), served Jul. 12, 2019, in 94 pages.
Exhibit 42 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,193,523 to Koning ("Koning"), served Jul. 12, 2019, in 106 pages.
Exhibit 43 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,239,126 to Dobson et al. ("Dobson"), served Jul. 12, 2019, in 72 pages.
Exhibit 44 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,306,509, ("Hassan"), served Jul. 12, 2019, in 71 pages.
Exhibit 45 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,324,347 to Thomas ("Thomas"), served Jul. 12, 2019, in 68 pages.
Exhibit 46 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,449,642 ("Dooley"), served Jul. 12, 2019, in 130 pages.
Exhibit 47 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,450,979 to Deckler ("Deckler '979"), served Jul. 12, 2019, in 79 pages.
Exhibit 48 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,519,494 to McEvoy ("McEvoy"), served Jul. 12, 2019, in 55 pages.
Exhibit 49 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,628,841 to Powilleit ("Powilleit"), served Jul. 12, 2019, in 79 pages.
Exhibit 50 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,896,615 to Hood et al. ("Hood"), served Jul. 12, 2019, in 81 pages.
Exhibit 51 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 4,915,258 to Olson ("Olson"), served Jul. 12, 2019, in 74 pages.
Exhibit 52 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 5,058,766 to Deckler ("Deckler '766"), served Jul. 12, 2019, in 69 pages.
Exhibit 53 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 5,167,317 to Van der Schoot ("Van der Schoot"), served Jul. 12, 2019, in 56 pages.
Exhibit 54 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 5,402,741 to Traux et al. ("Traux"), served Jul. 12, 2019, in 74 pages.
Exhibit 55 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 5,431,117 to Steffens et al. ("Steffens"), served Jul. 12, 2019, in 66 pages.
Exhibit 56 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 5,784,985 to Lodico et al. ("Lodico"), served Jul. 12, 2019, in 68 pages.
Exhibit 57 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 5,802,994 to Kinkead ("Kinkead"), served Jul. 12, 2019, in 67 pages.
Exhibit 58 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 5,918,726 ("Temmink"), served Jul. 12, 2019, in 106 pages.
Exhibit 59 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 5,992,338 ("Romans"), served Jul. 12, 2019, in 159 pages.
Exhibit 60 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,000,528(A) to Van Maanen ("Van Maanen"), served Jul. 12, 2019, in 64 pages.
Exhibit 61 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,173,664 to Heimbuch ("Heimbuch"), served Jul. 12, 2019, in 71 pages.
Exhibit 62 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,244,201 to Mauch et al. ("Mauch"), served Jul. 12, 2019, in 85 pages.
Exhibit 63 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,269,758 to Sauder ("Sauder '758"), served Jul. 12, 2019, in 72 pages.
Exhibit 64 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,352,042 to Martin et al. ("Martin'042"), served Jul. 12, 2019, in 67 pages.
Exhibit 65 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,516,733 to Sauder et al. ("Sauder '733"), served Jul. 12, 2019, in 108 pages.
Exhibit 66 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,581,535 ("Barry"), served Jul. 12, 2019, in 62 pages.
Exhibit 67 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,651,570 to Thiemke ("Thiemke"), served Jul. 12, 2019, in 90 pages.
Exhibit 68 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,681,706 to Sauder et al. ("Sauder '706"), served Jul. 12, 2019, in 157 pages.
Exhibit 69 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,748,885 ("Sauder '885"), served Jul. 12, 2019, in 210 pages.
Exhibit 70 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 6,932,236 to Ven Huizen ("Ven Huizen '236"), served Jul. 12, 2019, in 78 pages.
Exhibit 71 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 7,086,269 ("Sauder '269"), served Jul. 12, 2019, in 125 pages.
Exhibit 72 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 7,162,963 to Sauder ("Sauder '963"), served Jul. 12, 2019, in 116 pages.
Exhibit 73 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 7,490,565 B2 to Holly ("Holly '565"), served Jul. 12, 2019, in 86 pages.
Exhibit 74 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 7,617,785 to Wendte ("Wendte"), served Jul. 12, 2019, in 76 pages.
Exhibit 75 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 7,631,606 B2 to Sauder et al. ("Sauder '606"), served Jul. 12, 2019, in 81 pages.
Exhibit 76 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to U.S. Pat. No. 7,938,073 to Dunham et al. ("Dunham"), served Jul. 12, 2019, in 87 pages.
Exhibit 77 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to William Rowlan Ritchie, Aspects of Seed Transfer Within a Direct Drilling Coulter (Opener) (1982) (M.S. thesis, Massey University) (on file with author) ("Ritchie"), served Jul. 12, 2019, in 72 pages.
Exhibit 78 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to Breece, et al., Fundamentals of Machine Operation (198) ("Breece"), served Jul. 12, 2019, in 226 pages.
Exhibit 79 to Precision Planting LLC and AGCO Corporation's initial invalidity contentions relating to L.P. Bufton, The Influence of Seed-Drill Design on the Spatial Arrangement of Seedlings and on Seedling Emergence, 72 Acta Horticulturae 135 (1978) ("Bufton"), served Jul. 12, 2019, in 57 pages.
Ritchie, William Rowlan. Aspects of seed transfer within a direct drilling coulter (opener): a thesis presented in partial fulfilment of the requirements for the degree of Master of Agricultural Science in Agricultural Mechanisation at Massey University. Diss. Massey University, 1982, in 162 pages.
Breece, H. Edward, Harold V. Hansen, and Thomas A. Hoerner. Fundamentals of machine operation: planting. J. Deere, 1975, in 184 pages.
Bufton, L. P. "The influence of seed-drill design on the spatial arrangement of seedlings and on seedling emergence." Symposium on the Timing of Field vegetable Production 72. 1977, in 23 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Final Joint Claim Construction Chart, filed Oct. 25, 2019, in 18 pages.
Exhibit A to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 8,813,663 to Garner et al., filed Oct. 25, 2019, in 17 pages.
Exhibit B to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 9,480,199 to Garner et al., filed Oct. 25, 2019, in 17 pages.
Exhibit C to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 9,820,429 to Garner et al., filed Oct. 25, 2019, in 18 pages.
Exhibit D to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 9,699,955 to Garner et al., filed Oct. 25, 2019, in 18 pages.
Exhibit E to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 9,807,924 to Garner et al., filed Oct. 25, 2019, in 18 pages.
Exhibit F to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 9,686,906 to Garner et al., filed Oct. 25, 2019, in 18 pages.
Exhibit G to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 9,861,031 to Garner et al., filed Oct. 25, 2019, in 17 pages.
Exhibit H to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 10,004,173 Garner et al., filed Oct. 25, 2019, in 18 pages.
Exhibit I to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 8,850,998 to Garner et al., filed Oct. 25, 2019, in 23 pages.
Exhibit J to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 9,661,799 to Garner et al., filed Oct. 25, 2019, in 24 pages.
Exhibit K to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 9,510,502 to Garner et al., filed Oct. 25, 2019, in 33 pages.
Exhibit L to the Final Joint Claim Construction Chart, relating to U.S. Pat. No. 8,850,995 to Garner et al., filed Oct. 25, 2019, in 17 pages.
Exhibit M to the Final Joint Claim Construction Chart.
Exhibit N to the Final Joint Claim Construction Chart.
Exhibit O to the Final Joint Claim Construction Chart.
Exhibit P to the Final Joint Claim Construction Chart.
Exhibit Q to the Final Joint Claim Construction Chart.
Exhibit R to the Final Joint Claim Construction Chart.
Exhibit S to the Final Joint Claim Construction Chart.
Exhibit T to the Final Joint Claim Construction Chart.
Exhibit U to the Final Joint Claim Construction Chart.
Exhibit V to the Final Joint Claim Construction Chart.
Exhibit W to the Final Joint Claim Construction Chart.
Exhibit X to the Final Joint Claim Construction Chart.
Exhibit Y to the Final Joint Claim Construction Chart.
Exhibit Z to the Final Joint Claim Construction Chart.
Exhibit AA to the Final Joint Claim Construction Chart.
Joint Claim Construction Brief, filed Oct. 25, 2019, in 143 pages.
Joint Appendix B to Joint Claim Construction Brief, filed Oct. 25, 2019, in 4 pages.
Exhibits 1-15 to Joint Claim Construction Brief, filed Oct. 25, 2019, in 142 pages.
Exhibits 16-28 to Joint Claim Construction Brief, filed Oct. 25, 2019, in 300 pages.
Exhibits 29-31 to Joint Claim Construction Brief, filed Oct. 25, 2019, in 29 pages.
Exhibits 32-33 to Joint Claim Construction Brief, filed Oct. 25, 2019, in 102 pages.
Amended Final joint Claim Construction Chart, filed Dec. 2, 2019, in 18 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Dec. 28, 2020, in 45 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Dec. 31, 2020, in 47 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Jan. 11, 2021, in 46 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Dec. 15, 2020, in 48 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Dec. 15, 2020, in 42 pages.
International Search Report and Written Opinion, re PCT Application No. PCT/US2012/030306, dated Jun. 20, 2012, in 12 pages.
International Search Report and Written Opinion, re PCT Application No. PCT/US2012/030281, dated Jun. 20, 2012, in 6 pages.
International Search Report and Written Opinion, re PCT Application No. PCT/US2012/030326, dated Mar. 18, 2013, in 8 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 10152013.8, dated May 27, 2010, in 7 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 15152645.6, dated Jun. 18, 2015, in 6 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 15152614.2, dated Jun. 18, 2015, 7 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 15152071.5, dated Jun. 18, 2015, in 7 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 15152076.4, dated Jun. 18, 2015, in 7 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 12764844.2, dated Jun. 10, 2015, in 6 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 12763381.6, dated Jun. 12, 2015, in 6 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 12765056.2, dated Jun. 11, 2015, in 7 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 10736588.4, dated Jul. 16, 2013, in 9 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 11862395.8, dated Jun. 9, 2015, in 6 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 11862750.4, dated Aug. 28, 2014, in 7 pages.
Extended European Search Report and Written Opinion issued in European Patent Application No. 10152014.6, dated May 27, 2010, in 6 pages.
Petition for Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Plating, LLC and AGCO Corp., filed on May 29, 2019, in 92 pages.
Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Douglas S. Prairie, filed on May 29, 2019, in 131 pages.
Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Mar. 20, 2020, in 104 pages.
Exhibit 2200 to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Mar. 20, 2020, in 303 pages.
Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Jun. 26, 2020, in 41 pages.
Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision

(56) **References Cited**

OTHER PUBLICATIONS

Planting, LLC and AGCO Corp.: Reply Declaration of Douglas S. Prairie in Support of Petitioners' Reply to Patent Owner Response, filed Jun. 26, 2020, in 124 pages.
Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Aug. 5, 2020, in 41 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Nov. 30, 2020, in 49 pages.
Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed Mar. 20, 2020, in 15 pages.
Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodney L. Schmidt, filed Mar. 20, 2020, in 9 pages.
Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Mar. 20, 2020, in 11 pages.
Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Declaration of William R. Hough, filed Mar. 20, 2020, in 24 pages.
Exhibit 2230 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Mar. 20, 2020, in 29 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Aug. 17, 2020, in 6 pages.
Exhibit 2272 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Deere's Trial Demonstratives, filed Aug. 20, 2020, in 223 pages.
Exhibit 1147-1 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 2, filed Aug. 21, 2020, in 150 pages.
Exhibit 1147-2 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 2, filed Aug. 21, 2020, in 143 pages.
Excerpt(s) from Kramer, Samuel Noah. "History Begins at Sumer: Twenty-seven Firsts." Man's Recorded History (1959), in 13 pages (filed as Exhibit 1019 to the Inter Partes Review of U.S. Pat. No. 8,813,663 filed on behalf of Precision Planting, LLC and AGCO Corp.).
Petition for Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on May 31, 2019, in 90 pages.
Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Douglas S. Prairie, filed on May 31, 2019, in 106 pages.
Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Mar. 20, 2020, in 106 pages.
Exhibit 2205 to Patent Owner Response for the Inter Partes Review of U.S. Patent No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Mar. 20, 2020, in 297 pages.
Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Jun. 29, 2020, in 42 pages.
Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Reply Declaration of Douglas S. Prairie in Support of Petitioners' Reply to Patent Owner Response, filed Jun. 29, 2020, in 128 pages.
Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Aug. 5, 2020, in 40 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Nov. 30, 2020, in 39 pages.
Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed Mar. 20, 2020, in 15 pages.
Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodney L. Schmidt, filed Mar. 20, 2020, in 9 pages.
Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Mar. 20, 2020, in 11 pages.
Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Delaration of William R. Hough, filed Mar. 20, 2020, in 24 pages.
Exhibit 2235 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Mar. 20, 2020, in 29 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Aug. 17, 2020, in 6 pages.
Exhibit 2272 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Deere's Trial Demonstratives, filed Aug. 20, 2020, in 223 pages.
Exhibit 1147-1 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 2, filed Aug. 21, 2020, in 150 pages.
Exhibit 1147-2 to the Inter Partes Review of U.S. Pat. No. 9,480,199 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 2, filed Aug. 21, 2020, in 143 pages.
Petition for Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on May 30, 2019, in 99 pages.
Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Randal K. Taylor, filed on May 30, 2019, in 156 pages.
Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Mar. 20, 2020, in 90 pages.
Exhibit 2206 to Patent Owner Response for the Inter Partes Review of U.S. Patent No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Mar. 20, 2020, in 266 pages.
Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,686,906, filed on behalf of Precision Planting, LLC and AGCO Corp., filed Jun. 26, 2020, in 37 pages.
Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Reply Declaration of Randal Taylor in Support of Petitioners' Reply to Patent Owner Response, filed Jun. 26, 2020, in 99 pages.
Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Aug. 5, 2020, in 42 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Dec. 2, 2020, in 37 pages.
Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed Mar. 20, 2020, in 15 pages.
Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodney L. Schmidt, filed Mar. 20, 2020, in 9 pages.
Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Mar. 20, 2020, in 11 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Declaration of William R. Hough, filed Mar. 20, 2020, in 24 pages.
Exhibit 2236 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Mar. 20, 2020, in 29 pages.
Exhibit 2271 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Excerpt(s) from the Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Aug. 5, 2020, in 6 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Aug. 17, 2020, in 5 pages.
Exhibit 2272 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Deere's Trial Demonstratives, filed Aug. 20, 2020, in 223 pages.
Exhibit 1147-1 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 2, filed Aug. 21, 2020, in 150 pages.
Exhibit 1147-2 to the Inter Partes Review of U.S. Pat. No. 9,686,906 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 2, filed Aug. 21, 2020, in 143 pages.
Petition for Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on May 31, 2019, in 90 pages.
Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Douglas S. Prairie, filed on May 31, 2019, in 138 pages.
Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Mar. 24, 2020, in 107 pages.
Exhibit 2202 to Patent Owner Response for the Inter Partes Review of U.S. Patent No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Mar. 24, 2020, in 307 pages.
Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,699,955, filed on behalf of Precision Planting, LLC and AGCO Corp., filed Jun. 29, 2020, in 40 pages.
Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Reply Declaration of Douglas S. Prairie in Support of Petitioners' Reply to Patent Owner Response, filed Jun. 29, 2020, in 119 pages.
Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Aug. 7, 2020, in 42 pages.
Exhibit 2018 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Randal K. Taylor, filed Nov. 14, 2019, in 156 pages.
Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed Mar. 24, 2020, in 15 pages.
Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodney L. Schmidt, filed Mar. 24, 2020, in 9 pages.
Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Mar. 24, 2020, in 11 pages.
Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Declaration of William R. Hough, filed Mar. 24, 2020, in 24 pages.
Exhibit 2232 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Mar. 24, 2020, in 29 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Aug. 17, 2020, in 6 pages.
Exhibit 2272 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Deere's Trial Demonstratives, filed Aug. 20, 2020, in 223 pages.
Exhibit 1147-1 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 2, filed Aug. 21, 2020, in 150 pages.
Exhibit 1147-2 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 2, filed Aug. 21, 2020, in 143 pages.
Excerpt(s) from Grove, Phillip. Webster's third new international dictionary. Merriam-Webster Incorporated, 2002 (definition of nip), in 4 pages (filed as Exhibit 1025 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp.).
Excerpt(s) from Staff, Merriam-Webster. Merriam-Webster's collegiate dictionary. vol. 2. Merriam-Webster, 2004 (definition of nip), in 3 pages (filed as Exhibit 1026 to the Inter Partes Review of U.S. Pat. No. 9,699,955 filed on behalf of Precision Planting, LLC and AGCO Corp).
Petition for Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on May 29, 2019, in 96 pages.
Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Randal K. Taylor, filed on May 29, 2019, in 141 pages.
Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on Mar. 24, 2020, in 91 pages.
Exhibit 2207 to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Mar. 24, 2020, in 269 pages.
Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,807,924, filed on behalf of Precision Planting, LLC and AGCO Corp., filed Jun. 26, 2020, in 37 pages.
Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Reply Declaration of Randal Taylor in Support of Petitioners' Reply to Patent Owner Response, filed Jun. 26, 2020, in 97 pages.
Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Aug. 7, 2020, in 42 pages.
Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed on Mar. 24, 2020, in 15 pages.
Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodney L. Schmidt, filed Mar. 24, 2020, in 9 pages.
Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Mar. 24, 2020, in 11 pages.
Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Declaration of William R. Hough, filed Mar. 24, 2020, in 24 pages.
Exhibit 2237 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Mar. 24, 2020, in 29 pages.
Exhibit 2271 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Excerpt(s) from the Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Aug. 7, 2020, in 6 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Aug. 17, 2020, in 5 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Exhibit 2272 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Deere's Trial Demonstratives, filed Aug. 20, 2020, in 223 pages.
Exhibit 1147-1 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 2, filed Aug. 21, 2020, in 150 pages.
Exhibit 1147-2 to the Inter Partes Review of U.S. Pat. No. 9,807,924 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 2, filed Aug. 21, 2020, in 143 pages.
Petition for Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on May 31, 2019, in 102 pages.
Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Douglas S. Prairie, filed on May 31, 2019, in 156 pages.
Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Apr. 23, 2020, in 114 pages.
Exhibit 2204 to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James. L. Glancey, Ph.D., P.E., filed Apr. 23, 2020, in 334 pages.
Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Jul. 31, 2020, in 45 pages.
Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Reply Declaration of Douglas S. Prairie in Support of Petitioners' Reply to Patent Owner Response, filed Jul. 31, 2020 in 128 pages.
Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Sep. 11, 2020, in 45 pages.
Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed Apr. 23, 2020, in 15 pages.
Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodney L. Schmidt, filed Apr. 23, 2020, in 9 pages.
Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Apr. 23, 2020, in 11 pages.
Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Declaration of William R. Hough, filed Apr. 23, 2020, in 24 pages.
Exhibit 2234 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Apr. 23, 2020, in 30 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Jul. 30, 2020, in 6 pages.
Exhibit 2275 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Deere's Trial Demonstratives, filed Oct. 2, 2020, in 250 pages.
Exhibit 1146-1 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 3, filed Oct. 1, 2020, in 93 pages.
Exhibit 1146-2 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 3, filed Oct. 1, 2020, in 84 pages.
Exhibit 1146-3 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 3 of 3, filed Oct. 1, 2020, in 106 pages.
Excerpt(s) from Grove, Phillip. Webster's third new international dictionary. Merriam-Webster Incorporated, 2002 (definition of sweep), in 3 pages (filed as Exhibit 1032 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp).
Excerpt(s) from Dictionary, Concise Oxford English. "Edited by Catherine Soanes and Angus Stevenson." (2008) (definition of adjacent), in 3 pages (filed as Exhibit 1144 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp).
Excerpt(s) from Guralnik, David Bernard, and Michael Agnes. Webster's new world college dictionary. Wiley Pub., 2009 (definition of adjacent), in 3 pages (filed as Exhibit 1145 to the Inter Partes Review of U.S. Pat. No. 9,820,429 filed on behalf of Precision Planting, LLC and AGCO Corp).
Petition for Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on May 29, 2019, in 95 pages.
Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Douglas S. Prairie, filed on May 29, 2019, in 140 pages.
Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Mar. 24, 2020, in 100 pages.
Exhibit 2201 to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James L. Glancey, Ph.D. P.E., filed Mar. 24, 2020, in 304 pages.
Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Jun. 26, 2020, in 40 pages.
Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Reply Declaration of Douglas S. Prairie in Support of Petitioners' Reply to Patent Owner Response, filed Jun. 26, 2020, in 125 pages.
Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Aug. 7, 2020, in 43 pages.
Final Written Decision for the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp., issued Dec. 4, 2020, in 49 pages.
Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed Mar. 24, 2020, in 15 pages.
Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodbey L. Schmidt, filed Mar. 24, 2020, in 9 pages.
Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Mar. 24, 2020, in 11 pages.
Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Declaration of William R. Hough, filed Mar. 24, 2020, in 24 pages.
Exhibit 2231 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Mar. 24, 2020, in 29 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Aug. 17, 2020, in 6 pages.
Exhibit 2272 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp., Deere's Trial Demonstratives, filed Aug. 20, 2020, in 223 pages.
Exhibit 1147-1 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 2, filed Aug. 21, 2020, in 150 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Exhibit 1147-2 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 2, filed Aug. 21, 2020, in 143 pages.

Schmidt Ag Services | Seed (accessed on May 28, 2020), in 1 page. URL: https://schmidtag.com/seed/ (filed as Exhibit 1063 to the Inter Partes Review of U.S. Pat. No. 9,861,031, filed on behalf of Precision Planting, LLC and AGCO Corp.).

History of IA Crops—Living History Farms | leaning-fields (accessed on May 28, 2020), in 2 pages. URL: https://www.lhf.org/learning-fields (filed as Exhibit 1064 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Excerpt(s) from Berube, Margery S., and David A. Jost, eds. The American heritage college dictionary. Houghton Mifflin, 2010 (definition of accelerate), in 3 pages (filed as Exhibit 1071 to the Inter Partes Review of U.S. Pat. No 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Exhibit 1094 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp., Comparison of Petitioner's Proposed Combination and SpeedTube, filed Jun. 26, 2020, in 1 page.

Field demo shows planter hits mark at high speed | The Western Producer (published on Sep. 5, 2015) (accessed on May 4, 2020), in 1 page. URL: https://www.producer.com/2014/09/field-demo-shows-planter-hits-mark-at-high-speed/ (filed as Exhibit 1104 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Deere Abandons Proposed Acquisition of Precision Planting from Monsanto | Decision to Terminate Deal Preserves Competition in High-Speed Precision Planting Systems Market (published on May 1, 2017) (accessed on May 27, 2020), in 2 pages. URL: https://www.justice.gov/opa/pr/deere-abandons-proposed-acquistion -precision-planting-monsanto (filed as Exhibit 1077 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Top 5 Farms with the Largest Acreage in the U.S. | Successful Farming (published Sep. 28, 2019) (accessed Jun. 16, 2020), in 8 pages. URL: https://222.agriculture.com/farm-management/farm-land/top-5-farms-with-the-largest-acreage-in-the-us (filed as Exhibit 1081 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Merriam-Webster.com Dictionary, (definition of ipse dixit) (accessed on Jun. 6, 2020), in 2 pages). URL: https://www.merriam-webster.com/dictionary/ipse%20dixit (filed as Exhibit 1090 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Merriam-Webster.com Dictionary, (definition of just) (accessed on Jun. 7, 2020), in 13 pages). URL: https://www.merriam-webster.com/dictionary/just (filed as Exhibit 1095 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Maestro delivers accurate corn seed placement at 10 m.p.h. | The Western Producer (published May 31, 2013) (accessed May 4, 2020) in 2 pages. URL: https://www.producer.com/2013/05/maestro-delivers-accurate-corn-seed-placement-at-10-m-p-h/ (filed as Exhibit 1103 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Excerpts from Kepner, R. A., R. Bainer, and E. L. Barger. "Principles of farm machinery third edition." (1978), in 12 pages (filed as Exhibit 1106 to the Inter Partes Review of U.S. Pat. No. 9,891,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Excerpts from Waite, Maurice. Oxford American desk dictionary and thesaurus. Oxford University Press (definition of loop), in 3 pages (filed as Exhibit 1110 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Excerpt(s) from Dictionary, Concise Oxford English. "Edited by Catherine Soanes and Angus Stevenson." (2008) (definition of capture), in 3 pages (filed as Exhibit 1116 to the Inter Partes Review of U.S. Pat. No. 9,861,031, filed on behalf of Precision Planting, LLC and AGCO Corp.).

Sloan Support | John Deere ExactEmerge: Buy New or Retrofit? (published Jun. 14, 2017) (accessed Apr. 29, 2020) in 7 pages. URL: https://sloansupport.com/2017/06/14/john-deere-exactemerge-buy-new-or-retrofit/ (filed as Exhibit 1121 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Sloan Implement | ExactEmerge Retrofit Kit (accessed Apr. 29, 2020), in 4 pages. URL: https://www.sloans.com/feature-products/exact-emerge-retrofit-kit/ (filed as Exhibit 1122 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Sloan Implement | Web Specials (published Apr. 2, 2020) (accessed Apr. 29, 2020), in 33 pages. URL: http://www.sloans.com/flyer/web-specials/ (filed as Exhibit 1123 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Excerpt(s) from Hunt, Donnell. Farm power and machinery management. Waveland Press, 2008, in 6 pages (filed as Exhibit 1128 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Chen, Jiafa, et al. "The genetic basis of natural variation in kernel size and related traits using a four-way cross population in maize." PLoS One 11.4 (2016): e0153428, in 12 pages (filed as Exhibit 1138 to the Inter Partes Review of U.S. Pat. No. 9,861,031 filed on behalf of Precision Planting, LLC and AGCO Corp.).

Petition for Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on Jun. 3, 2019, in 108 pages.

Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Douglas S. Prairie, filed on Jun. 3, 2019, in 163 pages.

Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Apr. 22, 2020, in 104 pages.

Exhibit 2203 to Patent Owner Response for the Inter Partes Review of U.S. Pat. No 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Apr. 22, 2020, in 315 pages.

Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Jul. 31, 2020, in 40 pages.

Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Reply Declaration of Douglas S. Prairie in Support of Petitioners' Reply to Patent Owner Response, filed Jul. 31, 2020, in 129 pages.

Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Sep. 11, 2020, in 42 pages.

Exhibit 2018 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Randal K. Taylor, filed on Nov. 14, 2019, in 156 pages.

Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed Apr. 22, 2020, in 15 pages.

Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodney L. Schmidt, filed Apr. 22, 2020, in 9 pages.

Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Apr. 22, 2020, in 11 pages.

Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Declaration of William R. Hough, filed Apr. 22, 2020, in 24 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Exhibit 2233 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Apr. 22, 2020, in 29 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Aug. 17, 2020, in 6 pages.
Exhibit 2275 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Deere's Trial Demonstratives, filed Oct. 2, 2020, in 250 pages.
Exhibit 1146-1 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 3, filed Oct. 1, 2020, in 93 pages.
Exhibit 1146-2 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 3, filed Oct. 1, 2020, in 84 pages.
Exhibit 1146-3 to the Inter Partes Review of U.S. Pat. No. 10,004,173 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presenation—Part 3 of 3, filed Oct. 1, 2020, in 106 pages.
Petition for Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp., filed on May 31, 2019, in 91 pages.
Exhibit 1002 to Petition for Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Douglas S. Prairie, filed on May 31, 2019, in 126 pages.
Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Apr. 27, 2020, in 64 pages.
Exhibit 2208 to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Dr. James L. Glancey, Ph.D., P.E., filed Apr. 27, 2020, in 174 pages.
Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Aug. 3, 2020, in 39 pages.
Exhibit 1135 to Reply to Patent Owner Response for the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Reply Declaration of Douglas S. Prairie in Support of Petitioners' Reply to Patent Owner Response, filed Aug. 3, 2020, in 83 pages.
Patent Owner Sur-Reply for the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp., filed Sep. 11, 2020, in 31 pages.
Exhibit 2018 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Randal K. Taylor, filed Nov. 14, 2019, in 156 pages.
Exhibit 2025 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Daniel B. Thiemke, filed Apr. 27, 2020, in 15 pages.
Exhibit 2031 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Rodney L. Schmidt, filed Apr. 27, 2020, in 9 pages.
Exhibit 2032 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Lucas Veale, filed Apr. 27, 2020, in 11 pages.
Exhibit 2033 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Redacted Declaration of William R. Hough, filed Apr. 27, 2020, in 24 pages.
Exhibit 2238 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Raj Paul, filed Apr. 27, 2020, in 29 pages.
Exhibit 1141 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Declaration of Myles McDonagh, filed Aug. 3, 2020, in 6 pages.
Exhibit 2275 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Deere's Trial Demonstratives, filed Oct. 2, 2020, in 250 pages.
Exhibit 1146-1 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 1 of 3, filed Oct. 1, 2020, in 93 pages.
Exhibit 1146-2 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 2 of 3, filed Oct. 1, 2020, in 84 pages.
Exhibit 1146-3 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.: Petitioners' Trial Hearing Presentation—Part 3 of 3, filed Oct. 1, 2020, in 106 pages.
Excerpt(s) from Cald, I. "Cambridge Advanced Learner's Dictionary, ed. by Patrick Gillard, Kate Woodford & Guy Jackson." (2003), in 3 pages (filed as Exhibit 1033 to the Inter Partes Review of U.S. Pat. No. 9,807,922 filed on behalf of Precision Planting, LLC and AGCO Corp.).
Ahmadi, Mojtaba. Developing a New Powered Seed Delivery System with Constant Seed Release Speed Using Two Confronting Belts. Diss. North Dakota State University, 2018, in 76 pages.
Continental Bucket Elevator & Seed Belts Product Information (accessed first on May 19, 2020), in 2 pages. URL: https://www.continental-industry.com/en/Solutions/Conveyor-Belt-Systems/Processing-special-belts/Seeding-Harvesting/Products/Product-Range/Bucket-Elevator-Seed-Belts.
Kinze Manufacturing, Inc. and AG Leader Technology, Inc.'s Counterclaims, Answer, and Affirmative Defenses to Deere's First Amendment Complaint, filed Mar. 15, 2021, in 217 pages.
International Search Report and Written Opinion of the International Searching Authority, issued in International Patent Application No. PCT/US2012/030326, dated Mar. 18, 2013, 8 pages.
Monosem Pneumatic Planter Operator's Manual, NG Plus Mounted Planter, dated 1994, in 70 pages.
Monosem Pneumatic Planter Operator's Manual, NG Plus Mounted Planter, dated 2000, in 51 pages.
Deere & Company Operator's Manual, 494A 495A Corn Planters, dated 1967, in 68 pages.
Deere & Company Operator's Manual, 694A, 695A, 894A Corn Planters, dated 1966, in 68 pages.
Deere & Company Operator's Manual, 694A, 695A, 894A Corn Planters, dated 1967, in 64 pages.
Deere & Company Operator's Manual, 71 Flexi-Planter, dated 1988, in 140 pages.
Deere & Company Product Brochure, 494-A and 495-A Four-Row Corn Planters, dated 1962, in 24 pages.
Kinze Manufacturing, Inc. And Ag Leader Technology, Inc.'s Counterclaims, Answer, and Affirmative Defenses, filed Feb. 8, 2021, in 193 pages.
Breece, H. Edward, Harold V. Hansen, and Thomas a. Hoerner. Fundamentals of machine operations: planting. J. Deere, 1981, in 179 pages.

* cited by examiner

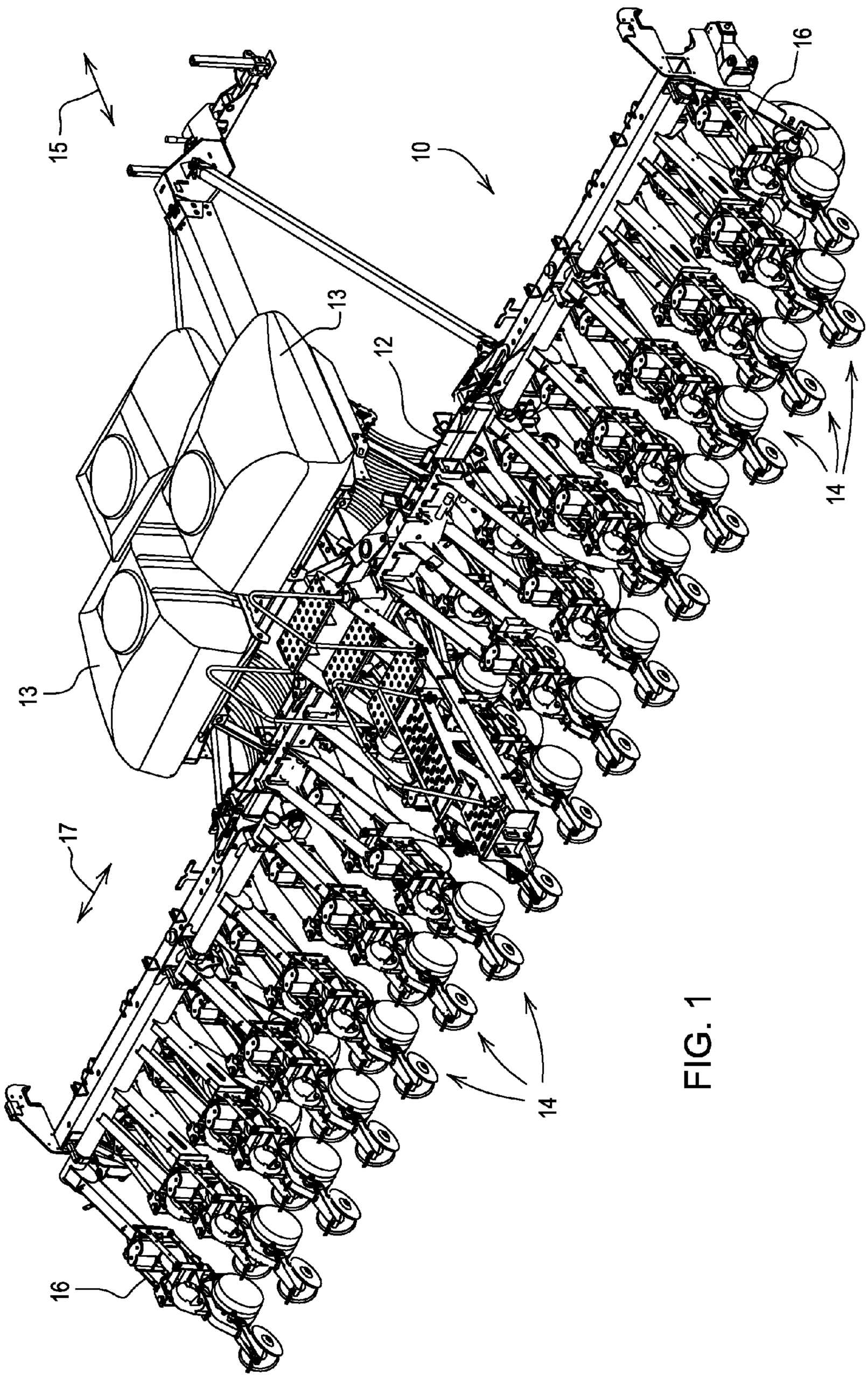


FIG. 1

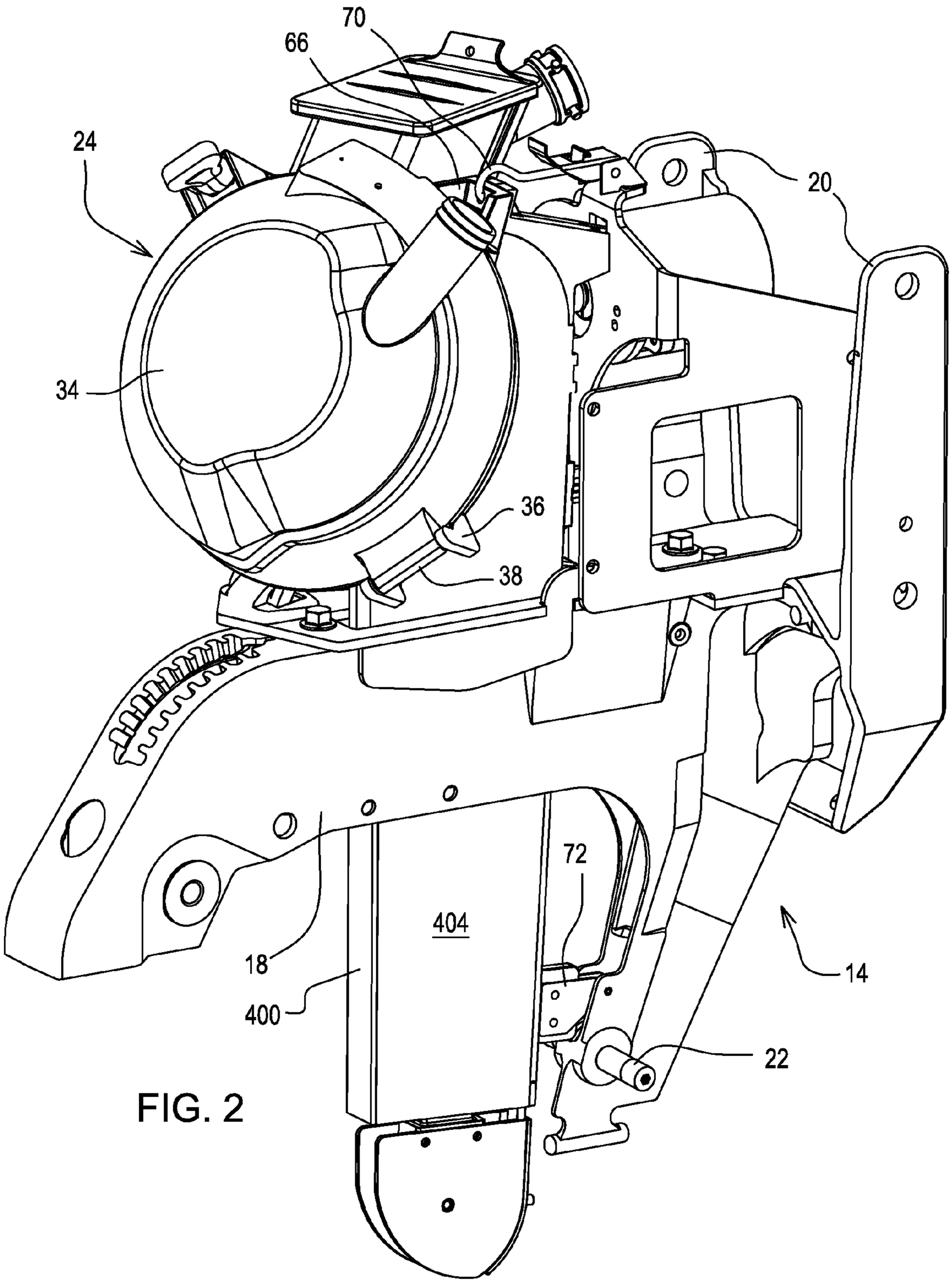


FIG. 2

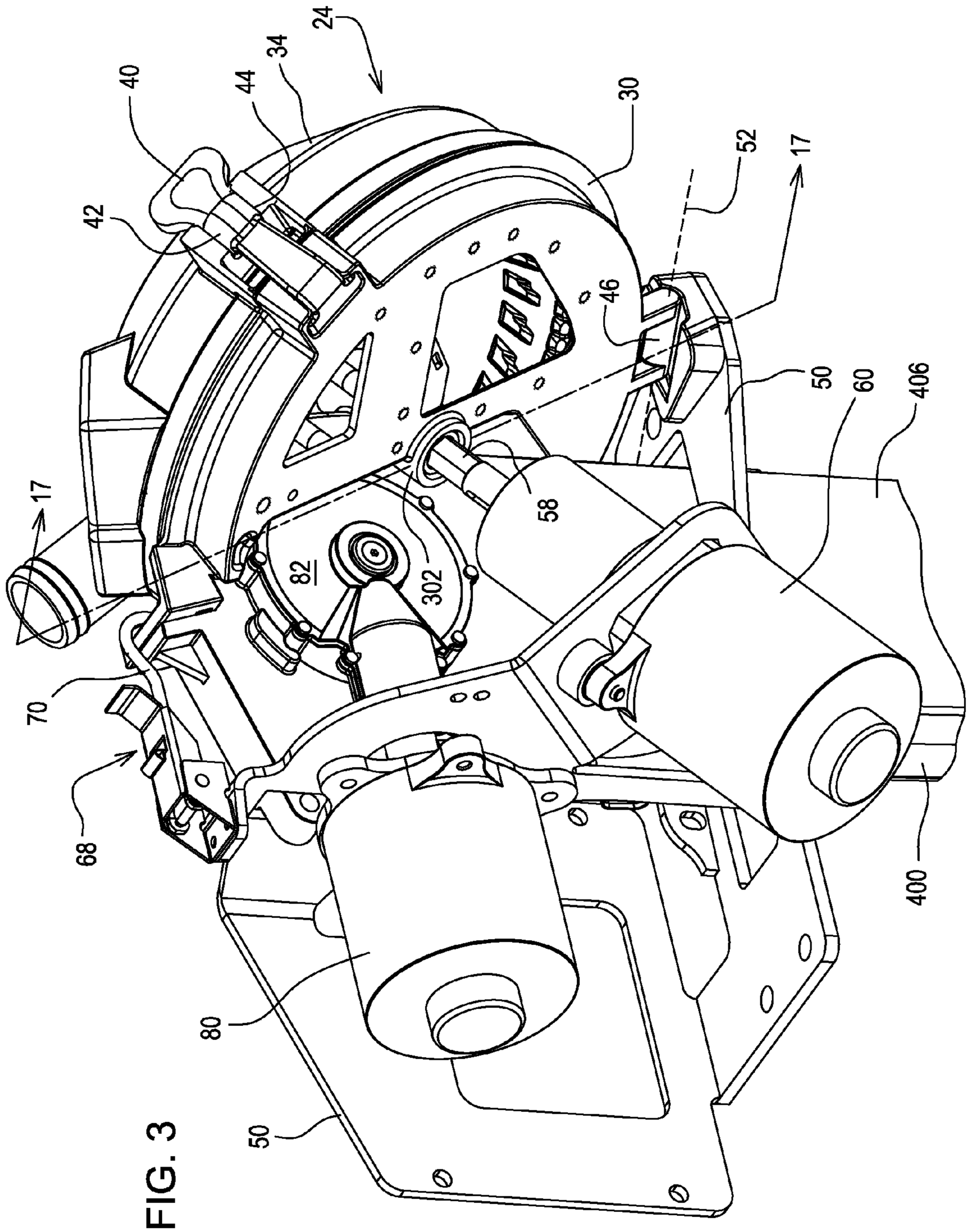


FIG. 3

FIG. 4

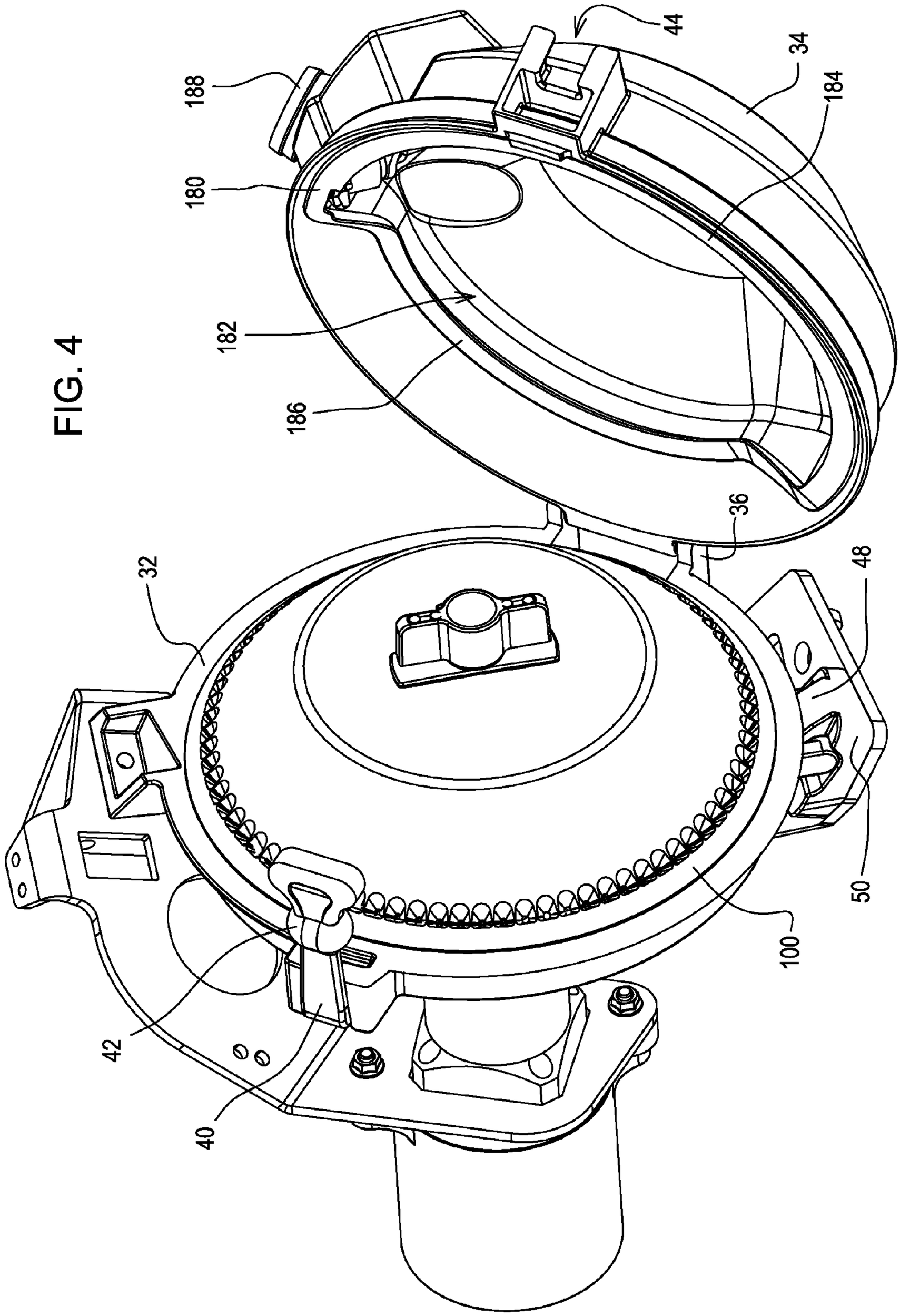
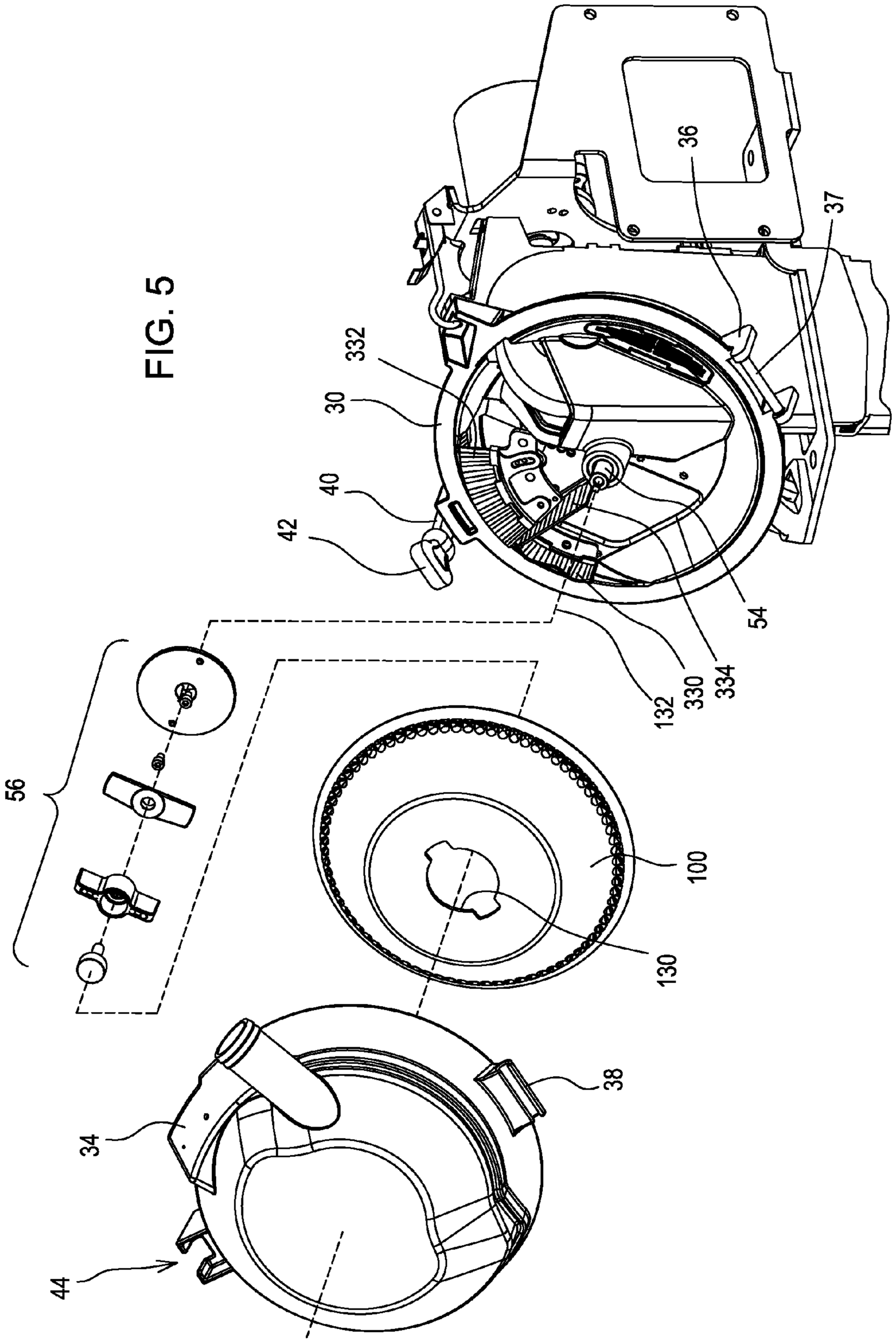


FIG. 5



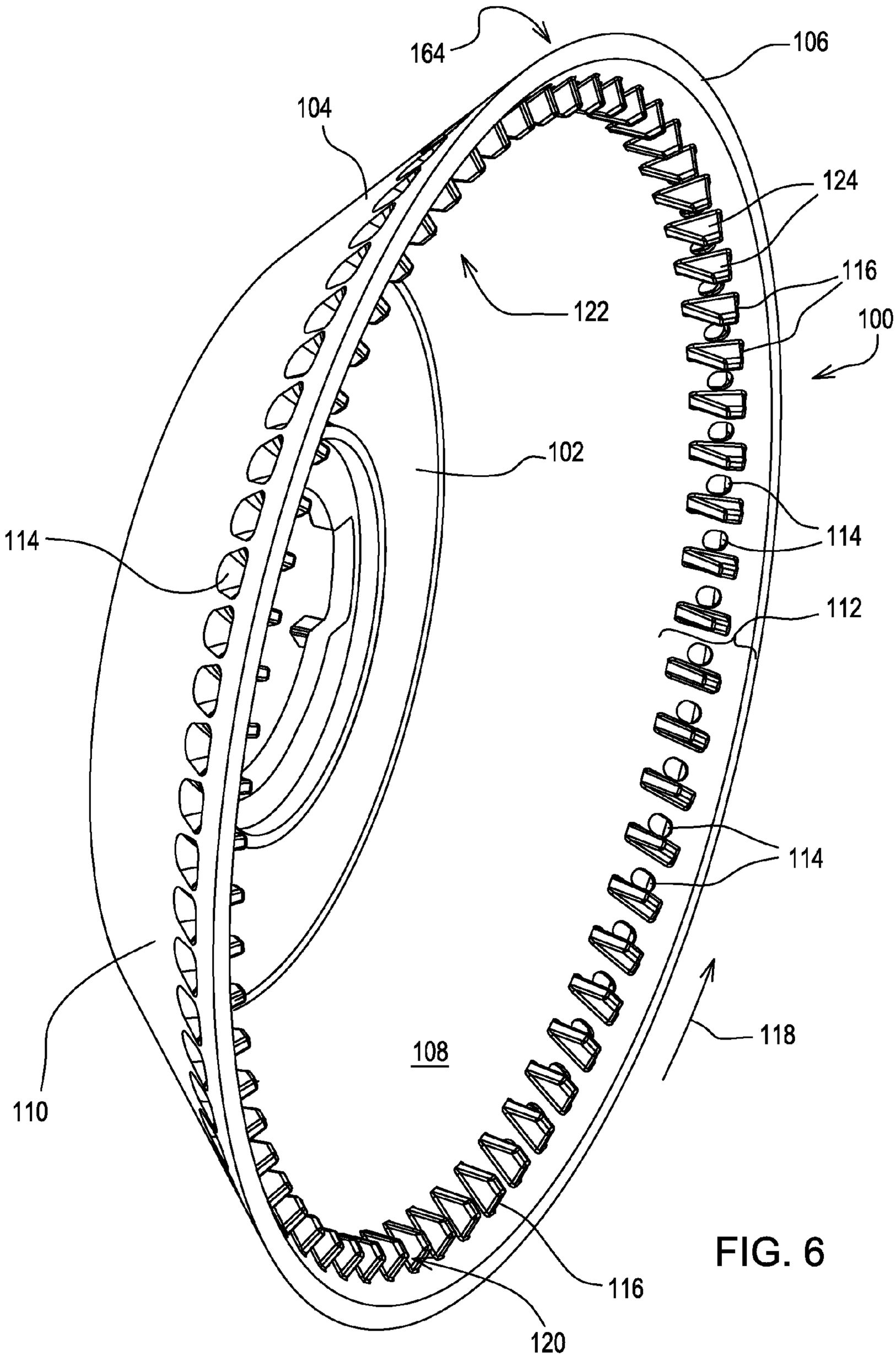

164
106
104
124
116
122
100
102
114
114
112
114
110
108
118
116
120

FIG. 6

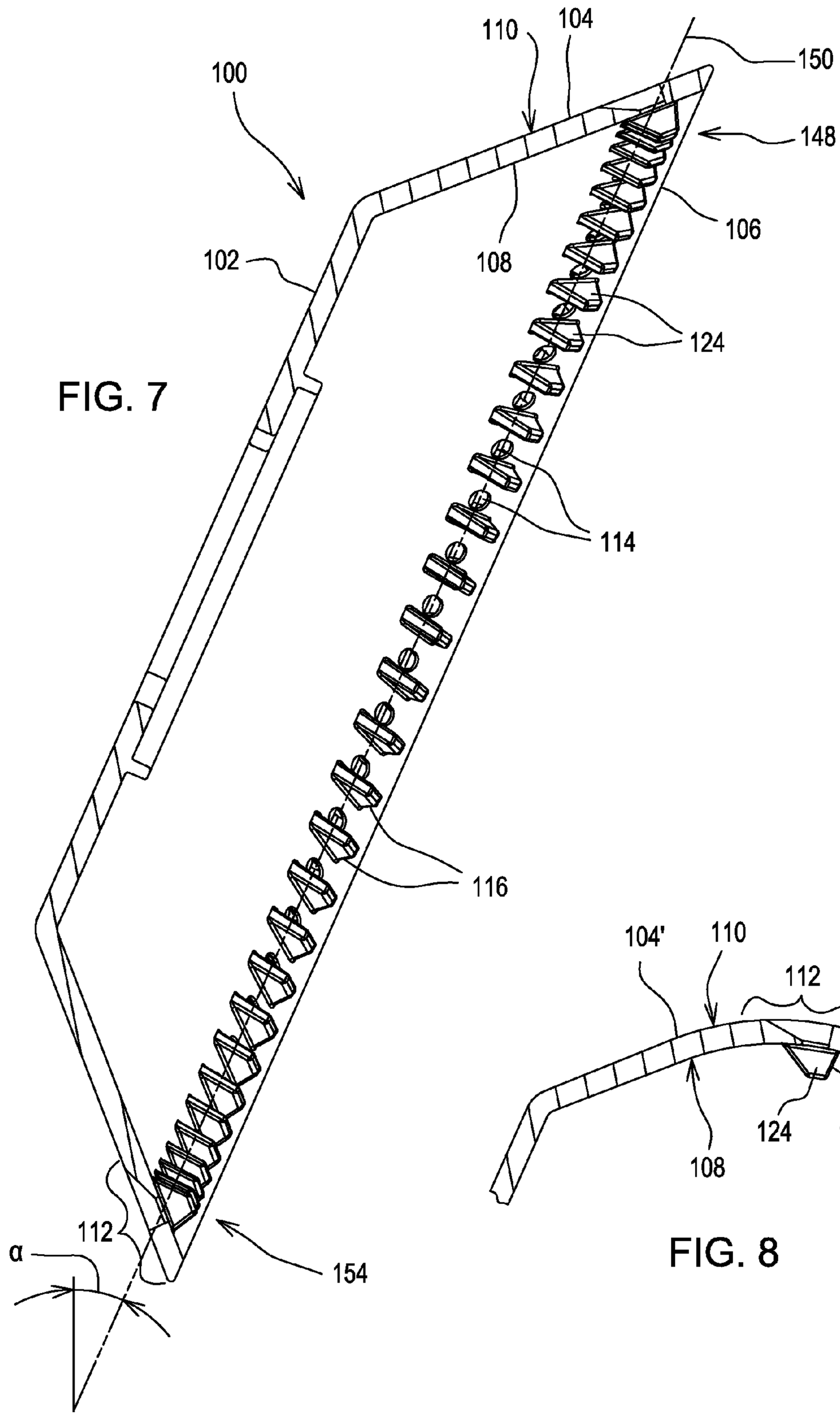

110
104
150
100
148
106
102
108
124
114
116
112
α
154

FIG. 7

104'
110
112
106
108
124
116

FIG. 8

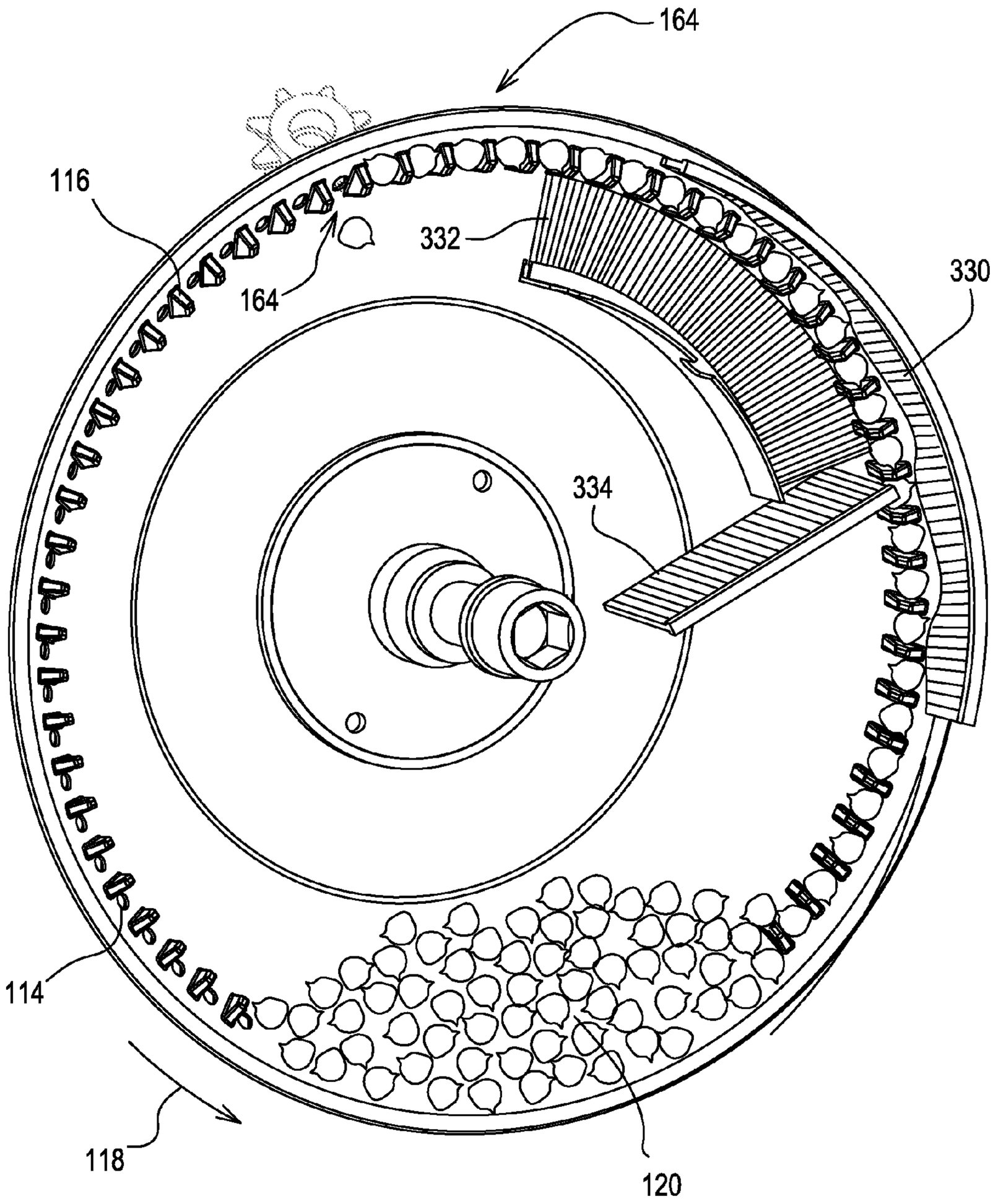


FIG. 9

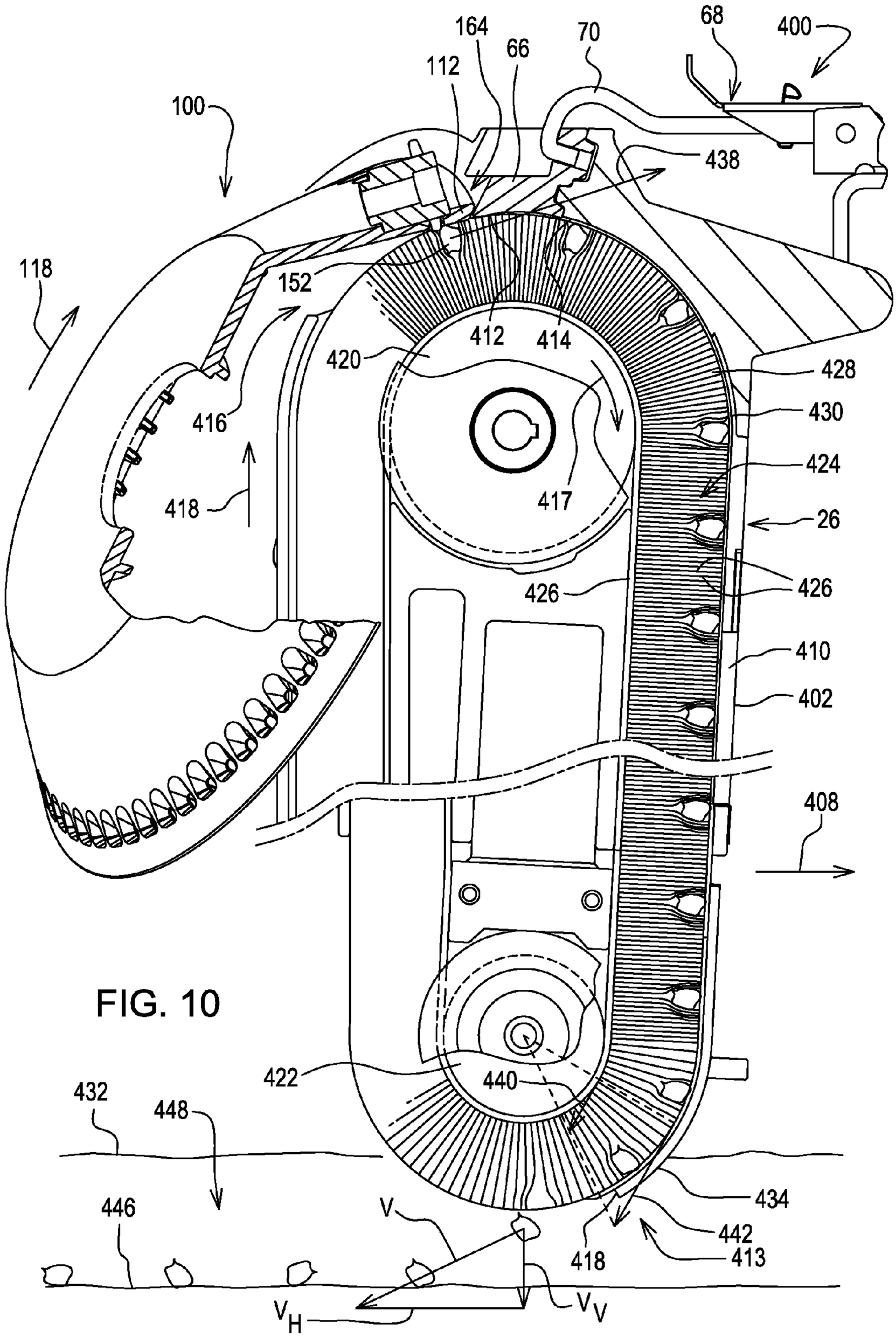

164
66
70
68
400
112
100
438
118
152
412
414
420
428
430
416
424
418
417
26
426
426
410
402
408
422
440
432
448
434
446
V
442
413
418
V_H
V_V

FIG. 10

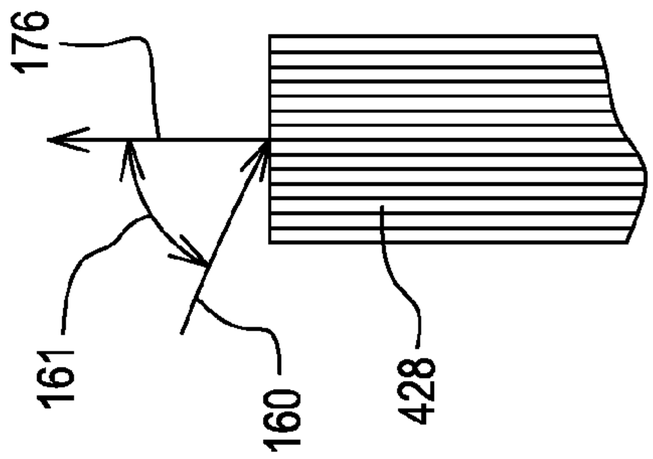


FIG. 13

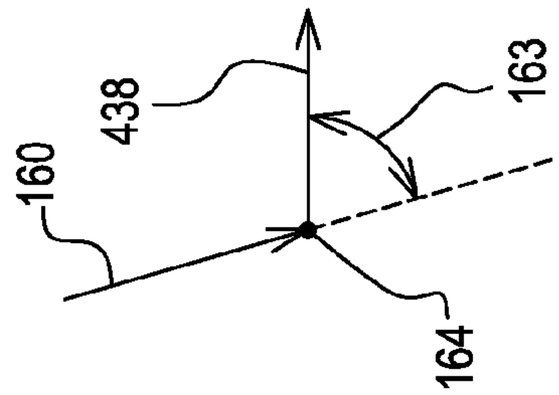


FIG. 14

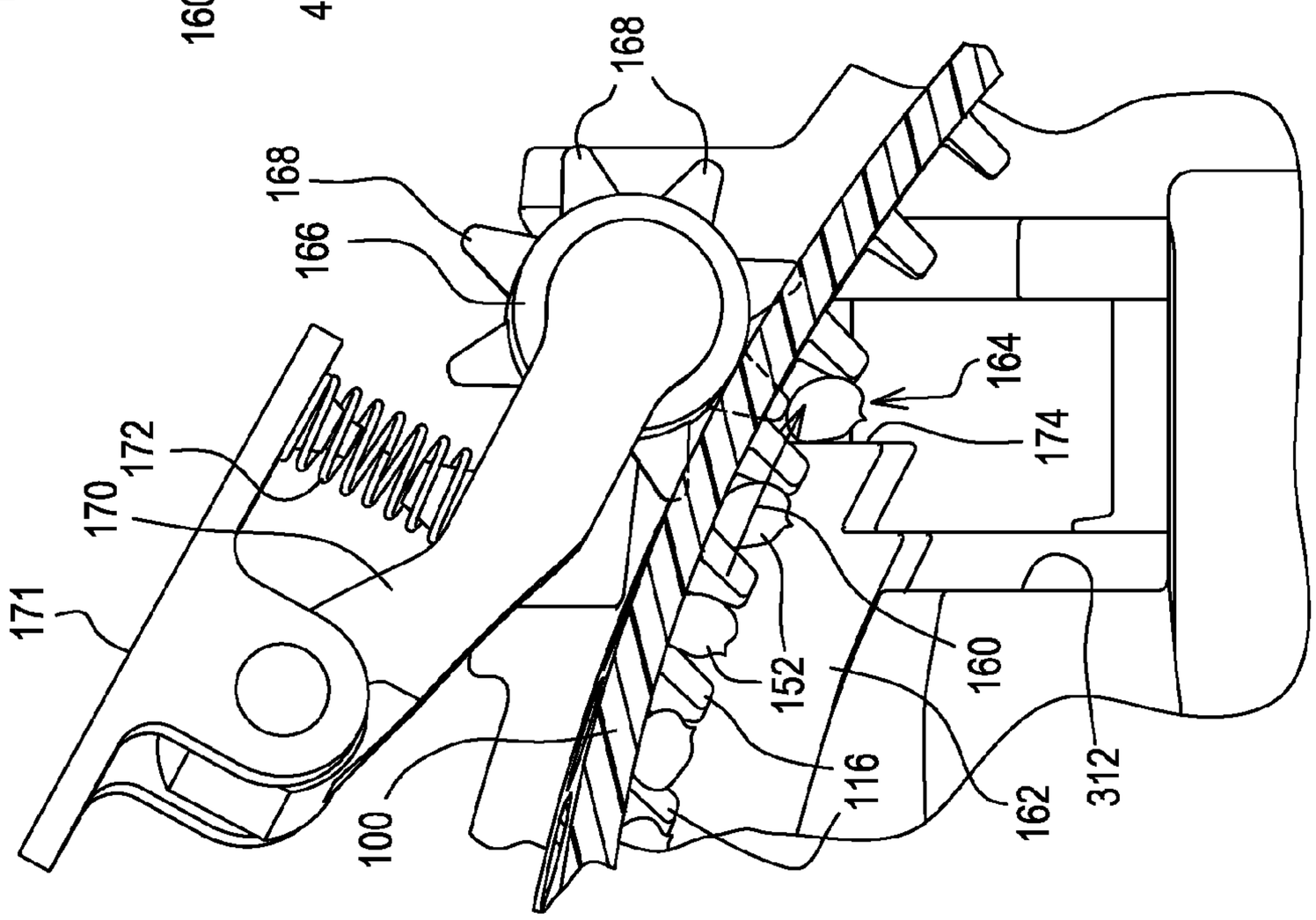


FIG. 12

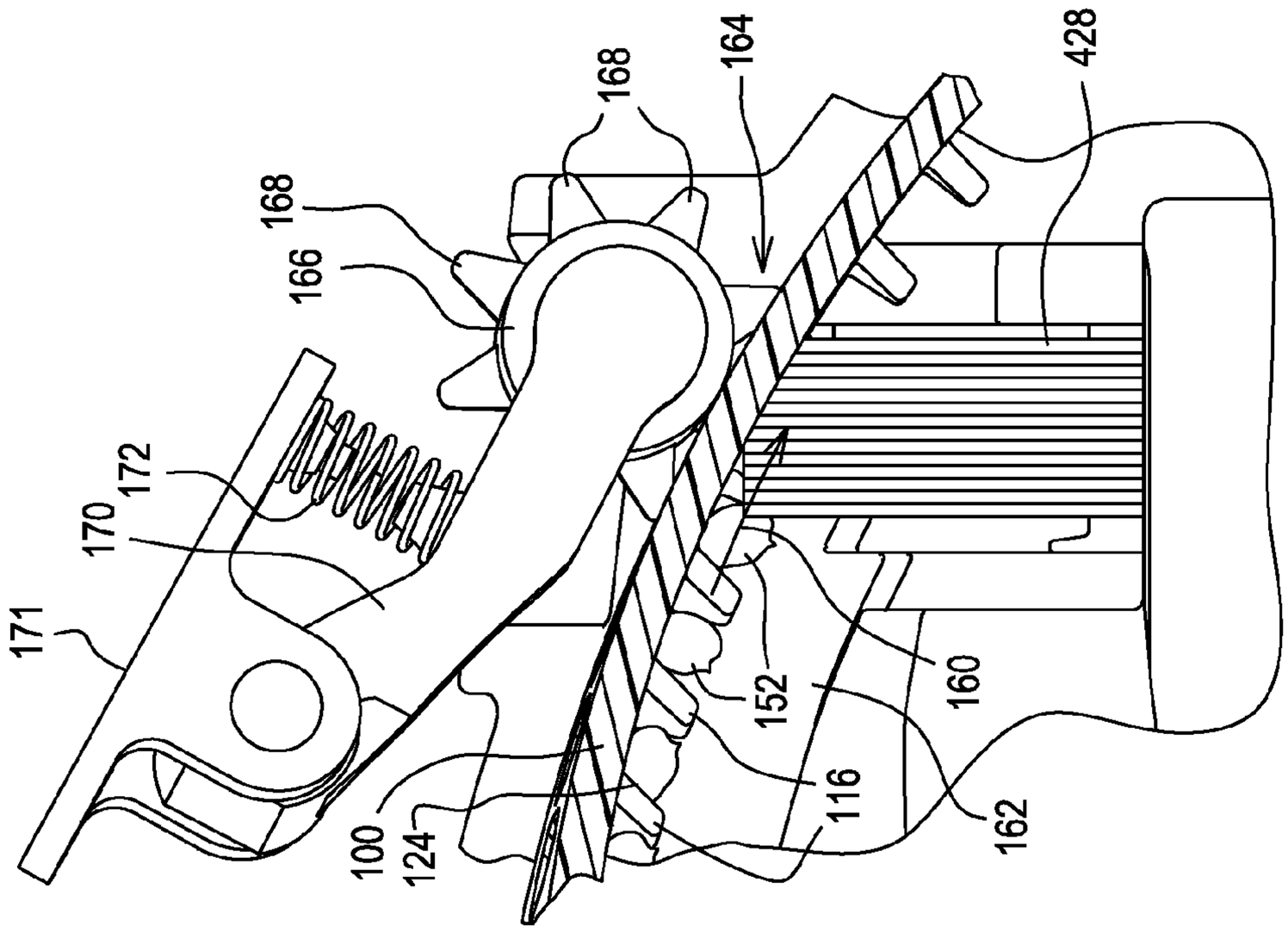


FIG. 11

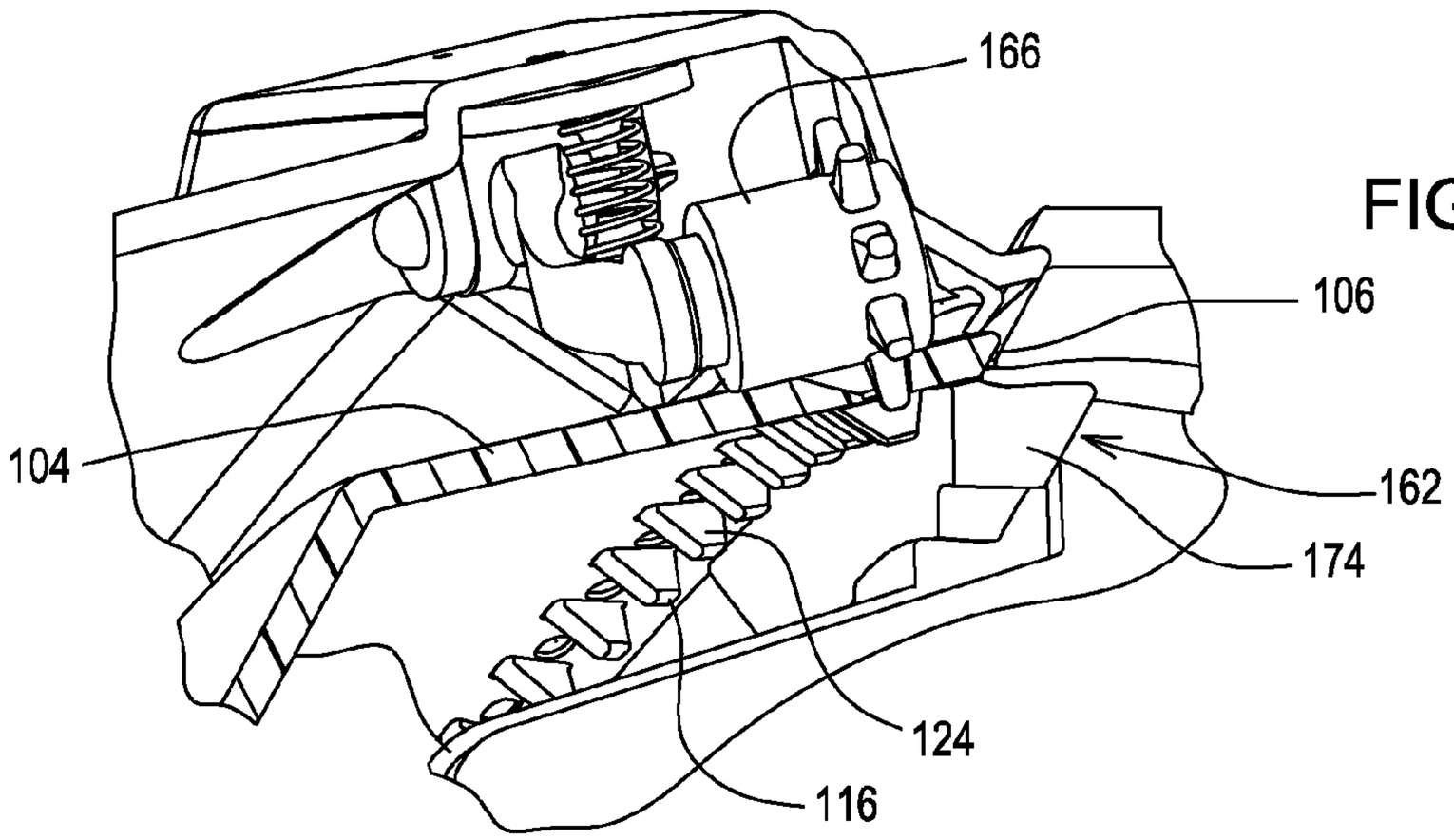


FIG. 15

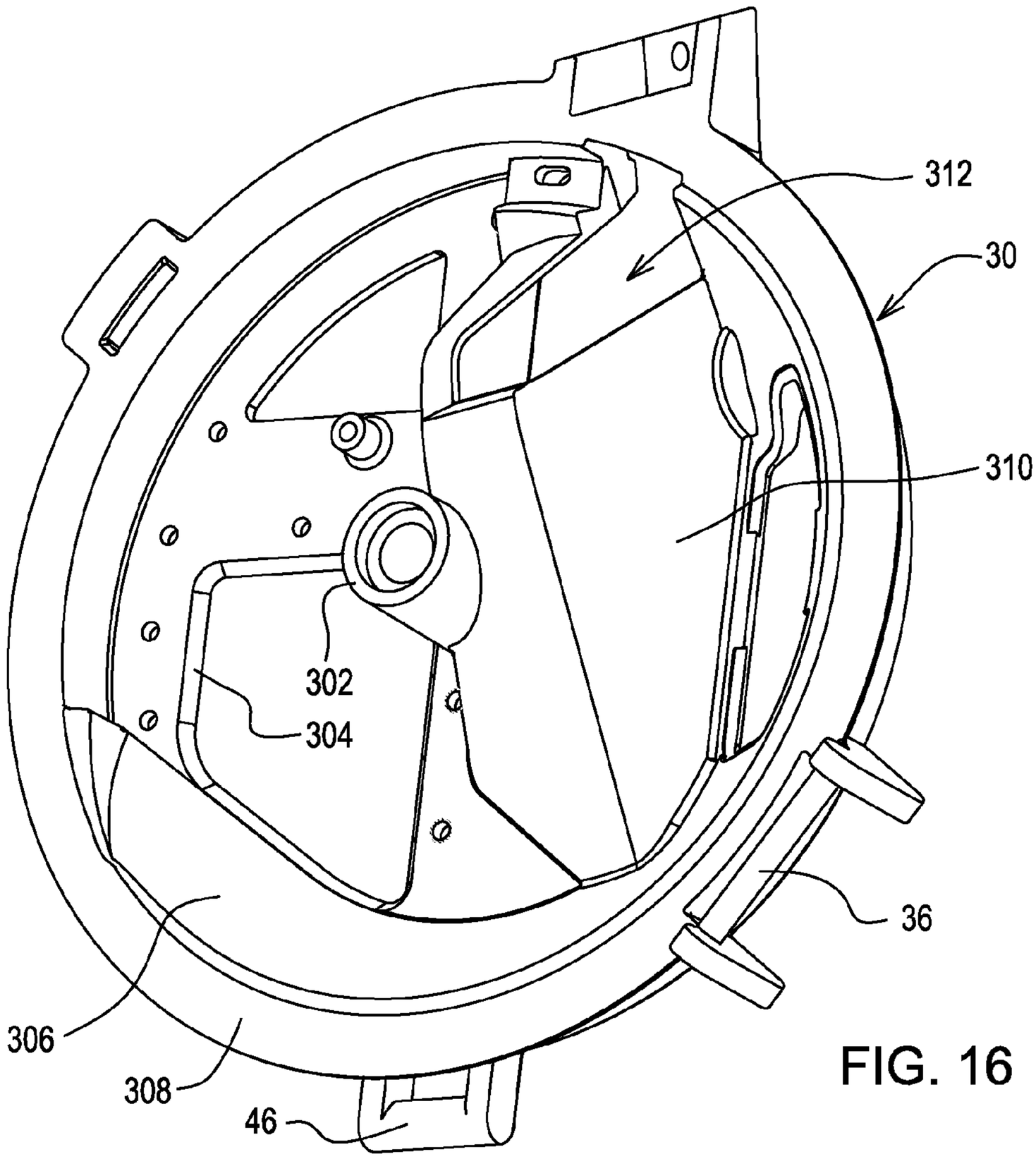


FIG. 16

FIG. 17

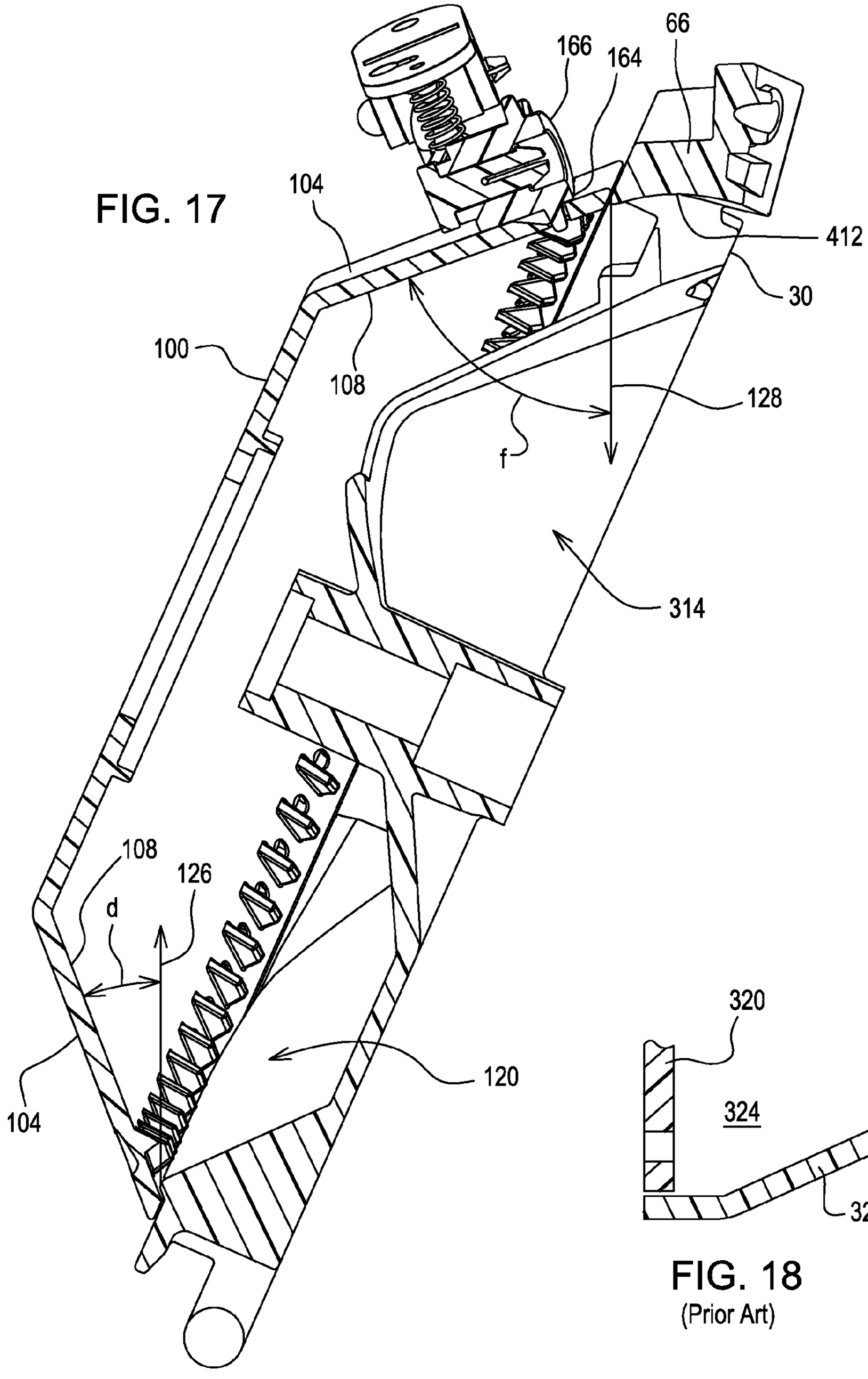


FIG. 18
(Prior Art)

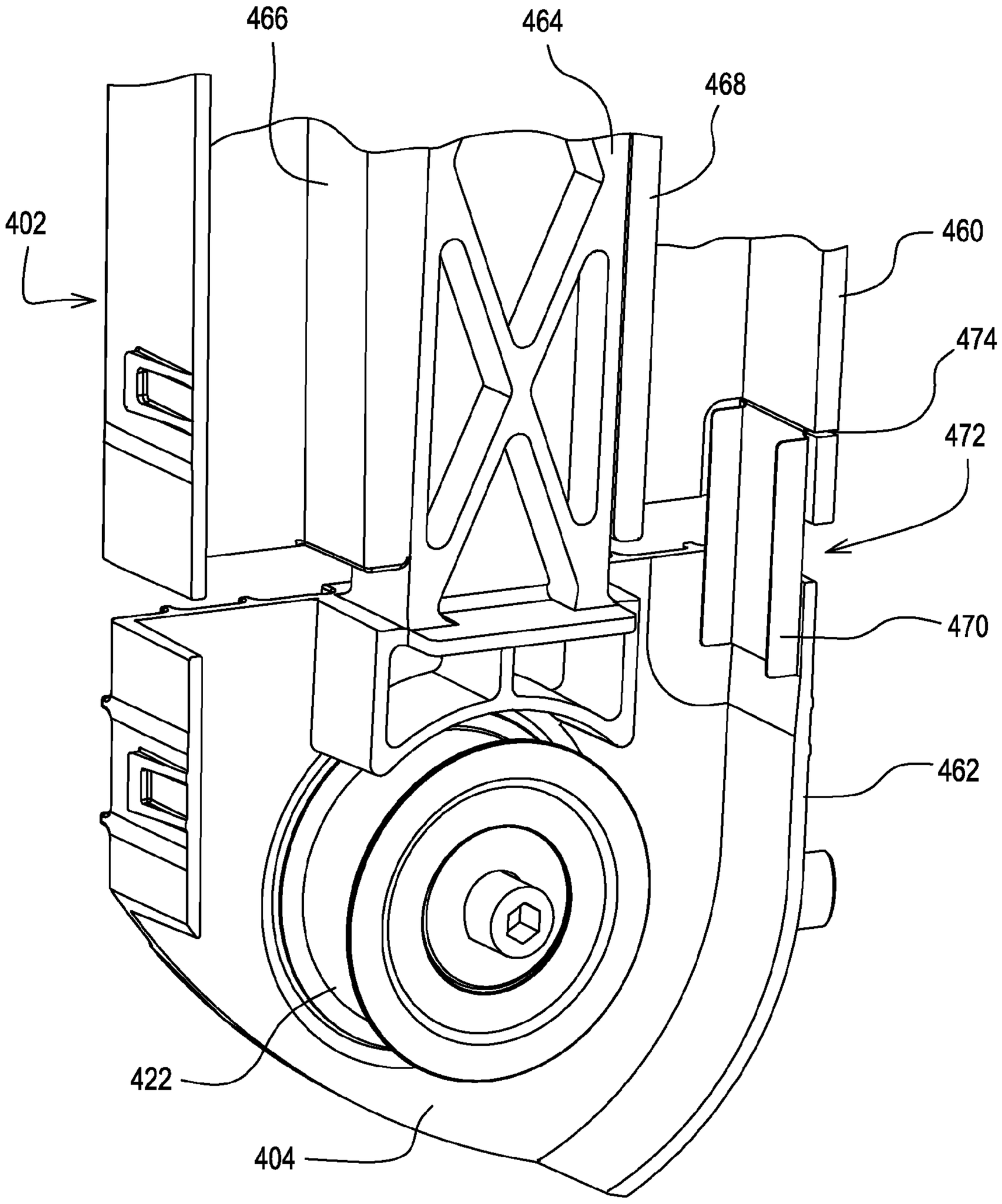
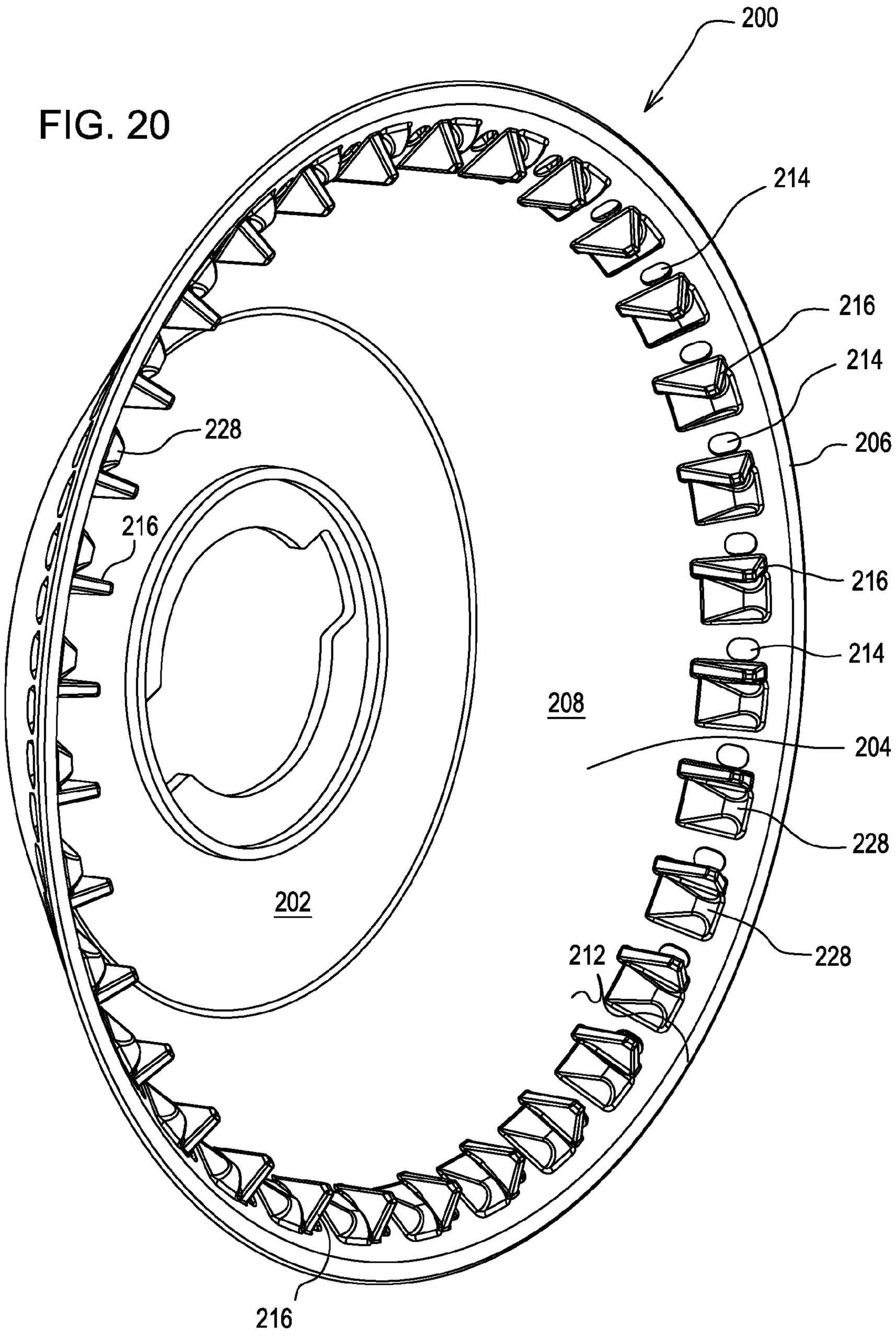


FIG. 19

FIG. 20



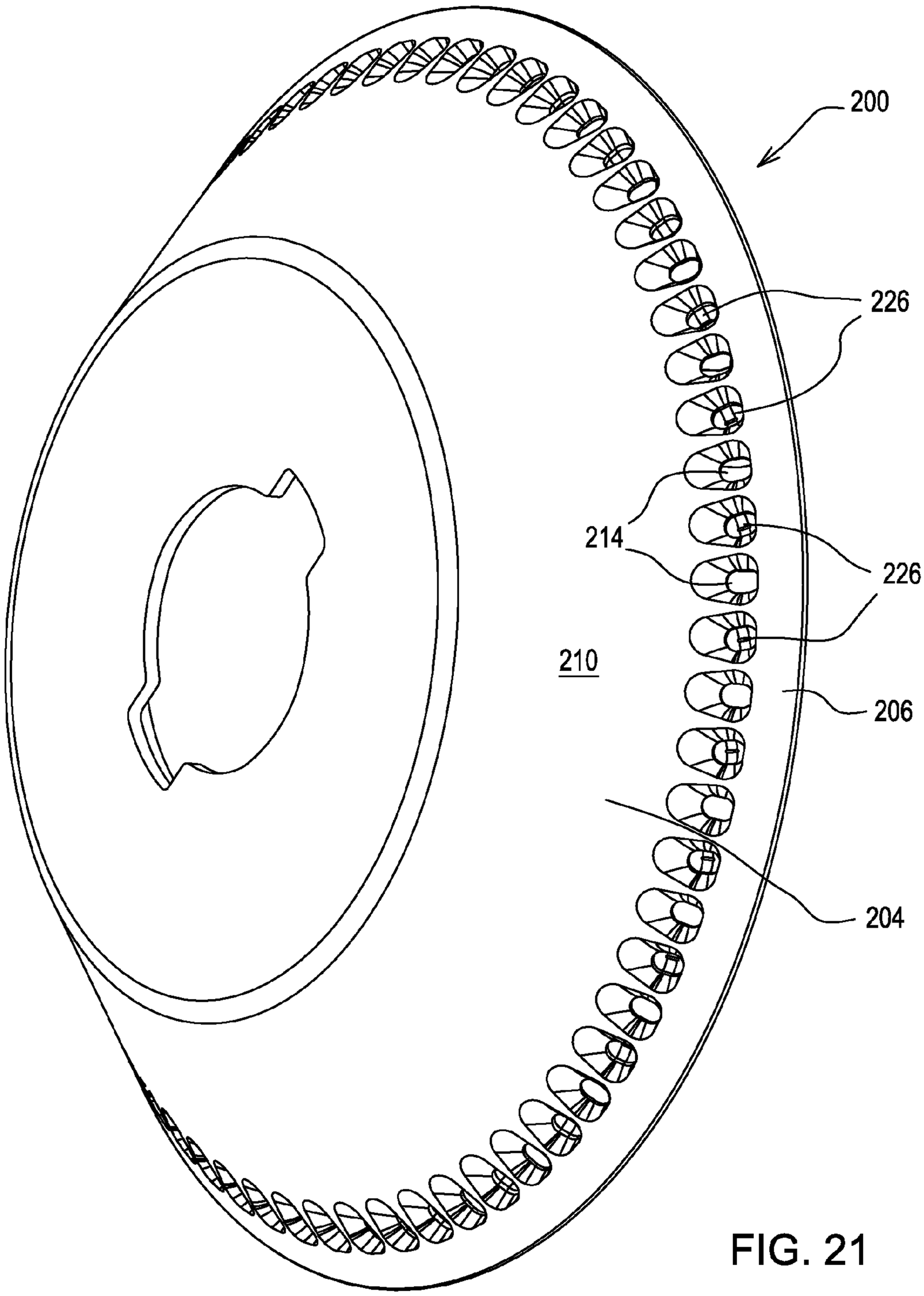


FIG. 21

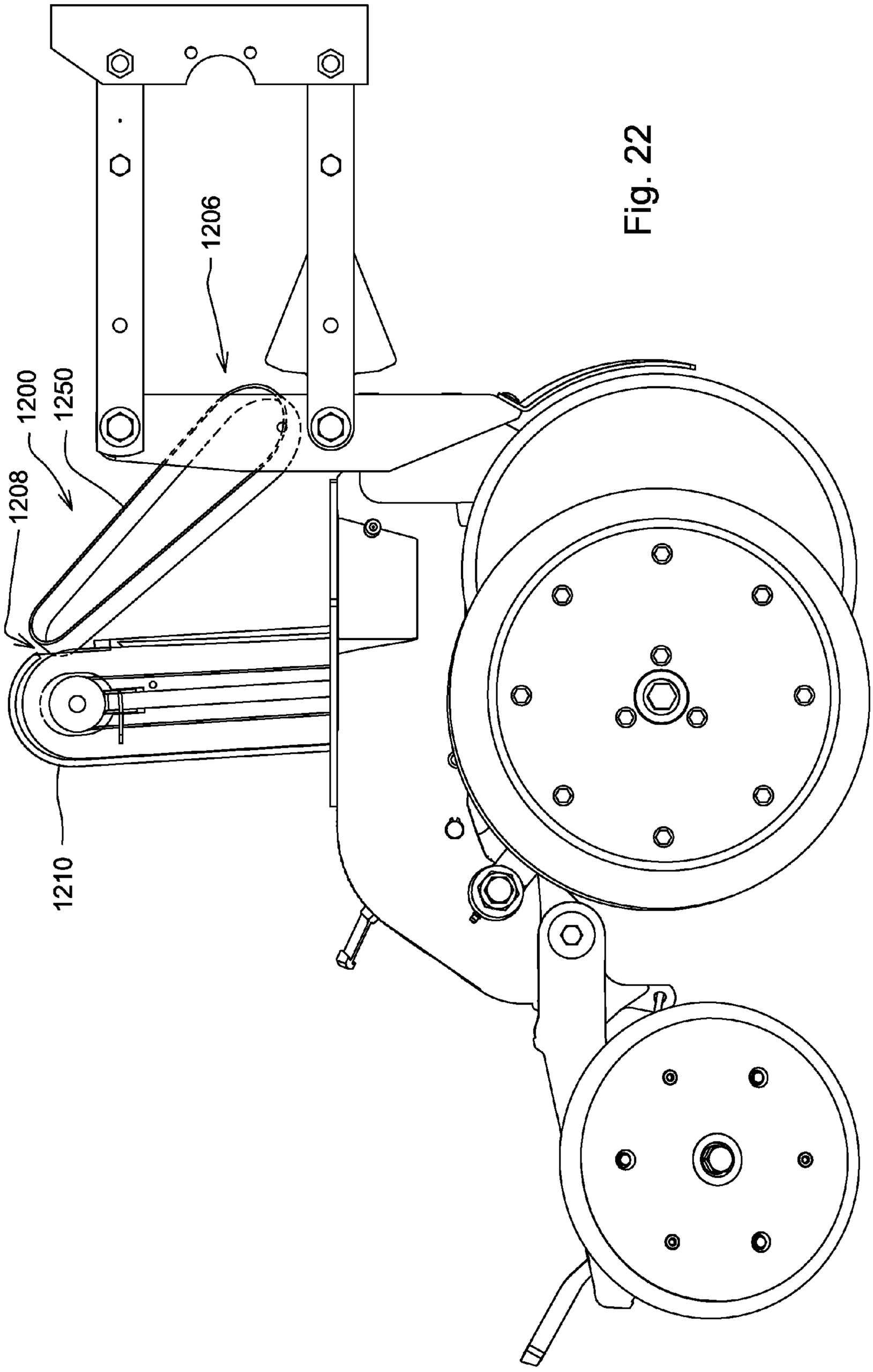


Fig. 22

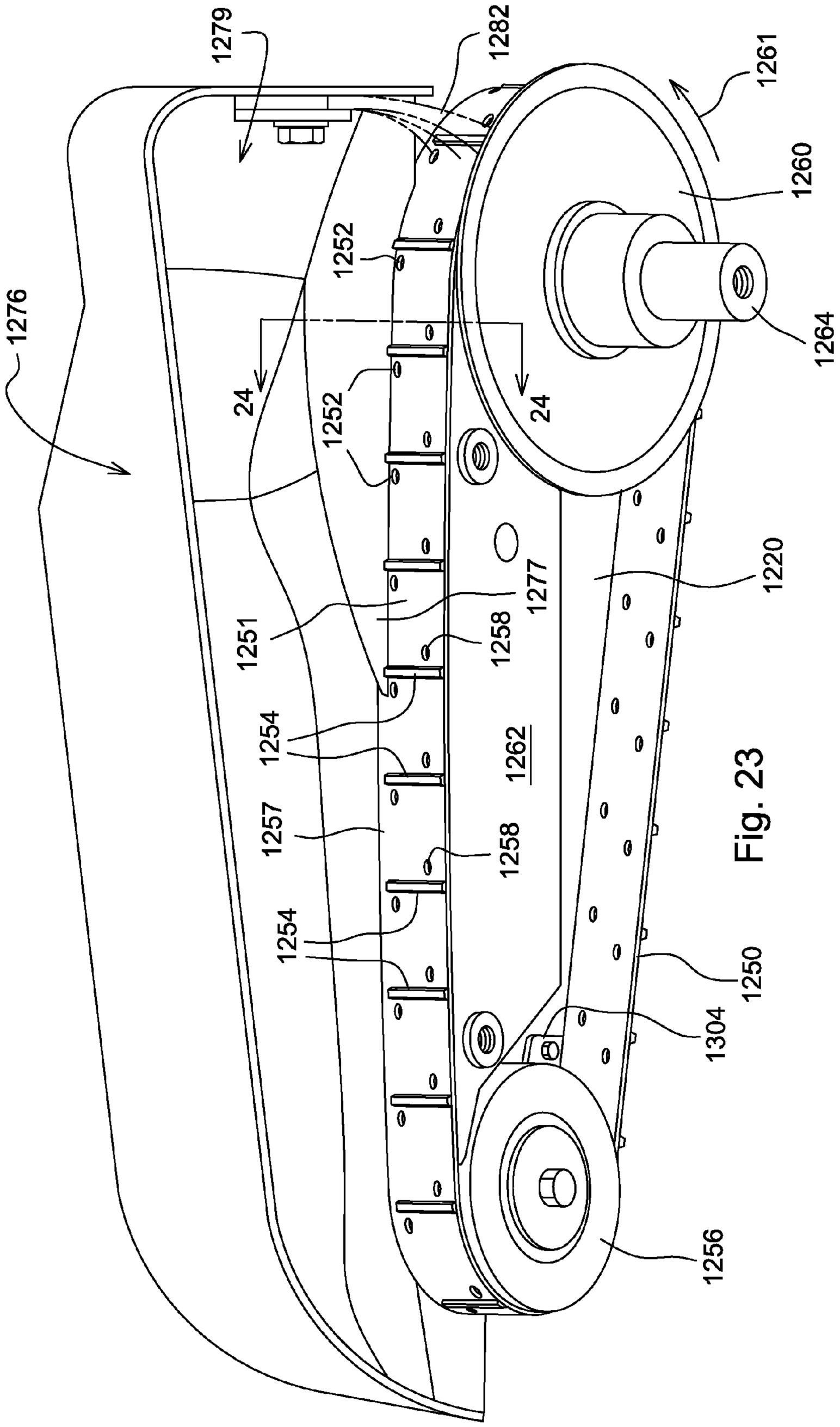

1279
1282
1261
1260
1252
1276
1264
24
1252
24
1251
1277
1220
1258
1254
1262
1257
1258
1254
1250
1304
1256

Fig. 23

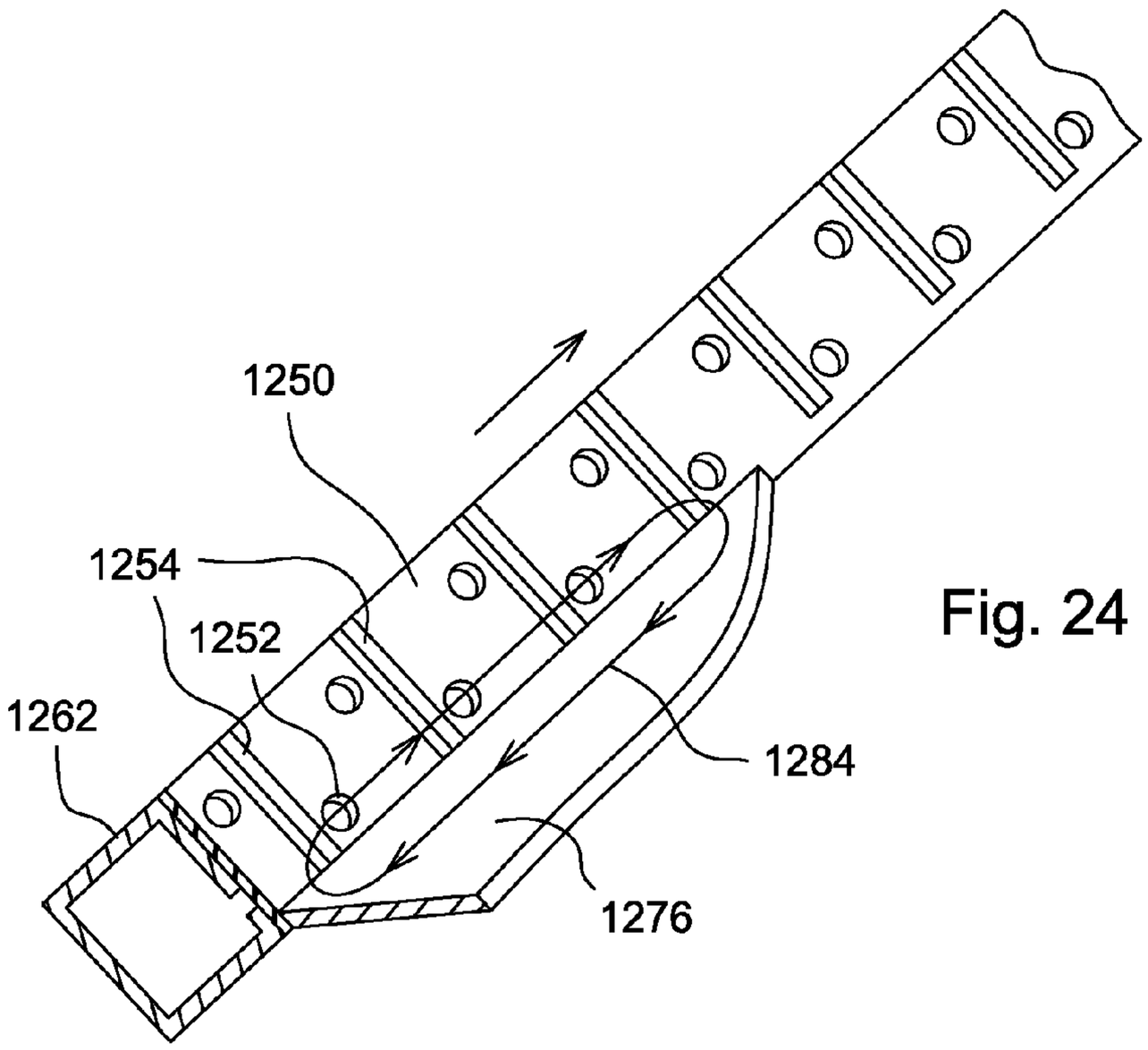


Fig. 24

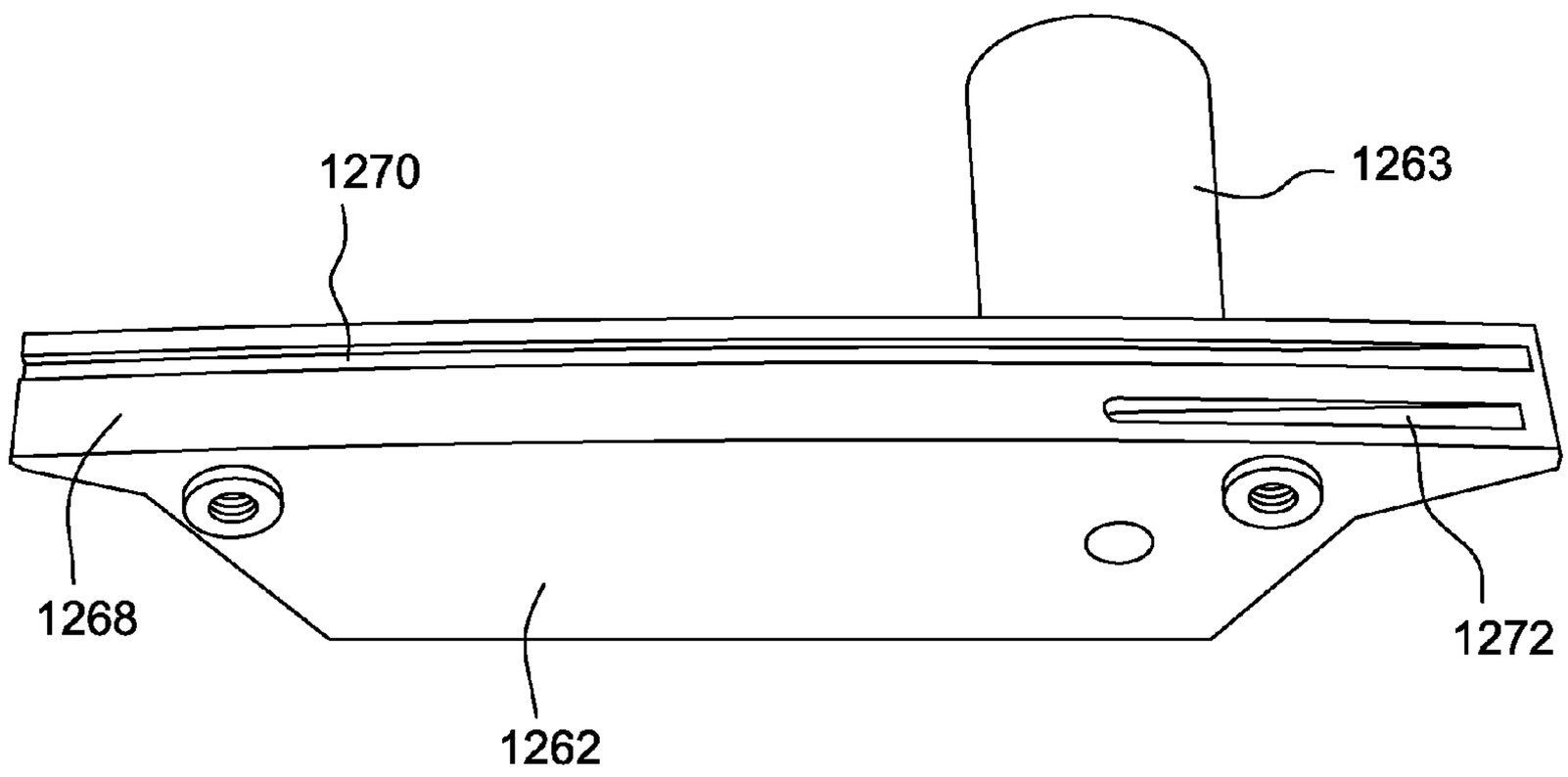
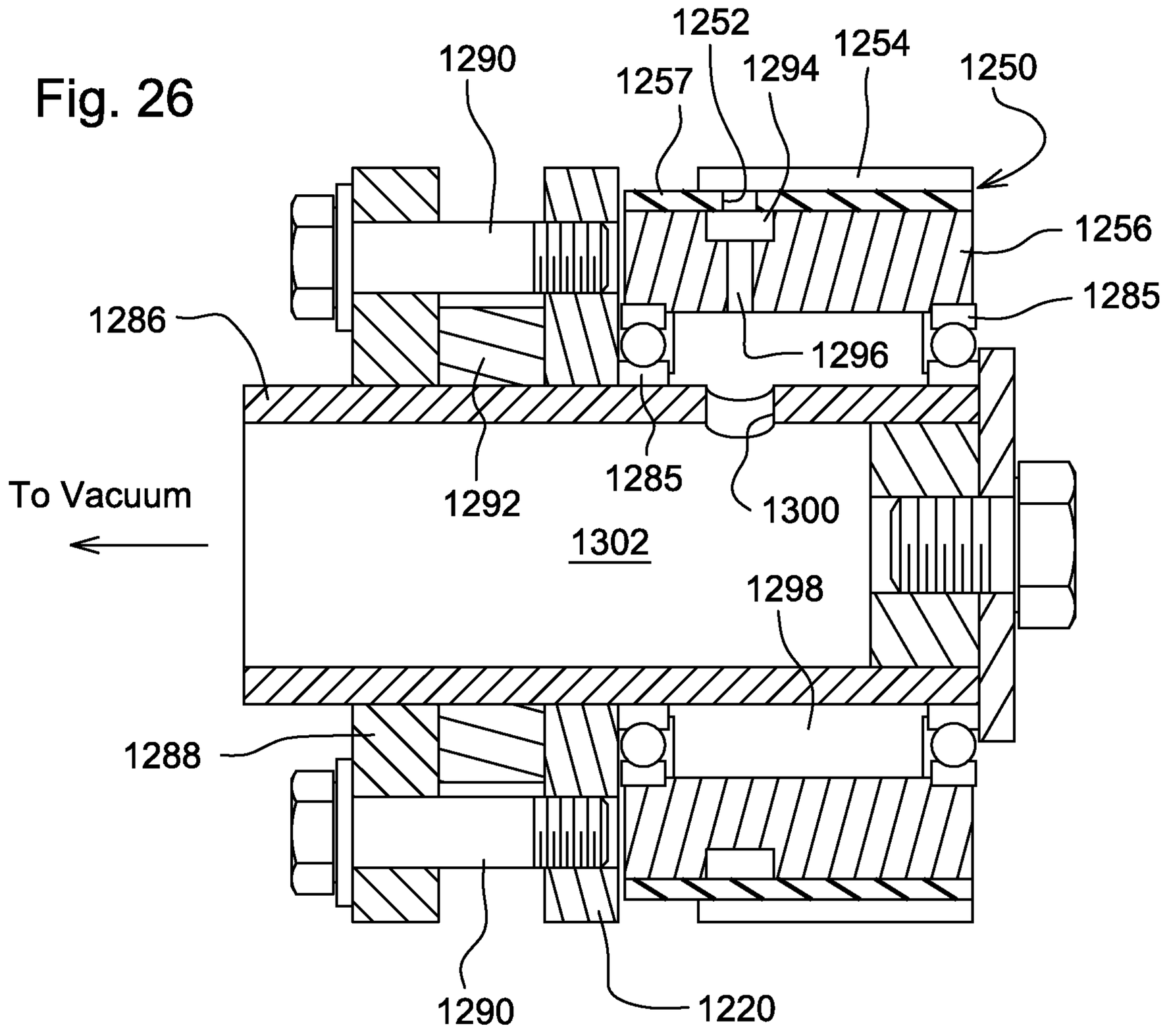


Fig. 25

Fig. 26


1252
1290
1254
1257
1294
1250
1256
1285
1286
1296
1285
1292
1300
To Vacuum
1302
1298
1288
1290
1220

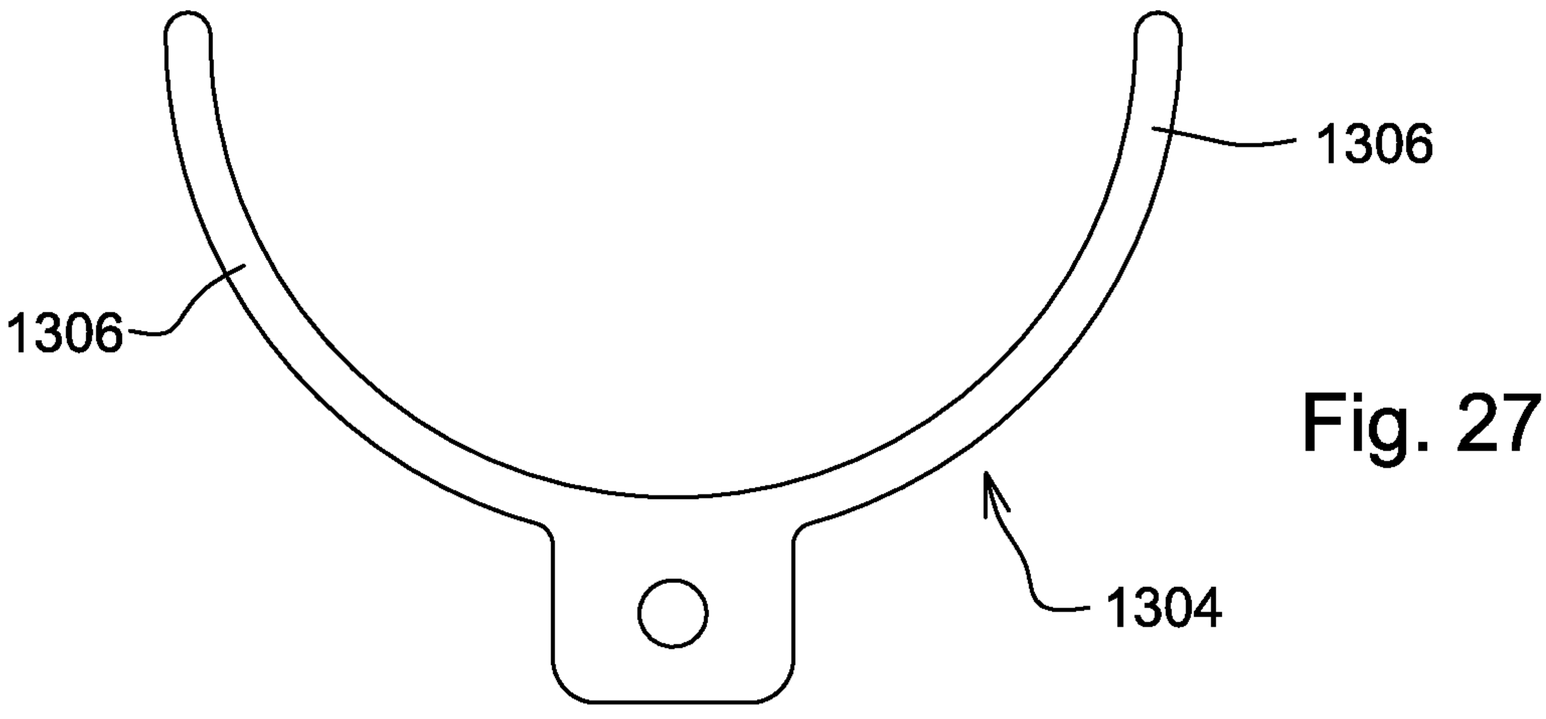

1306
1306
1304

Fig. 27

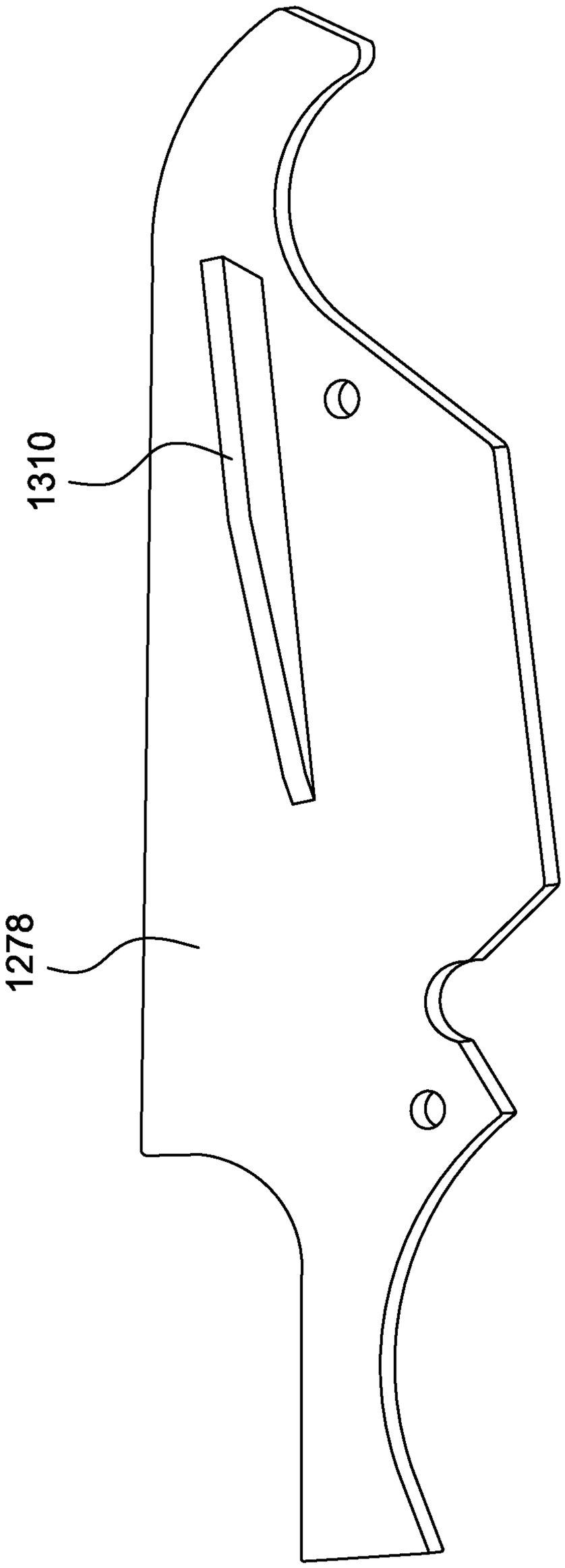


Fig. 28

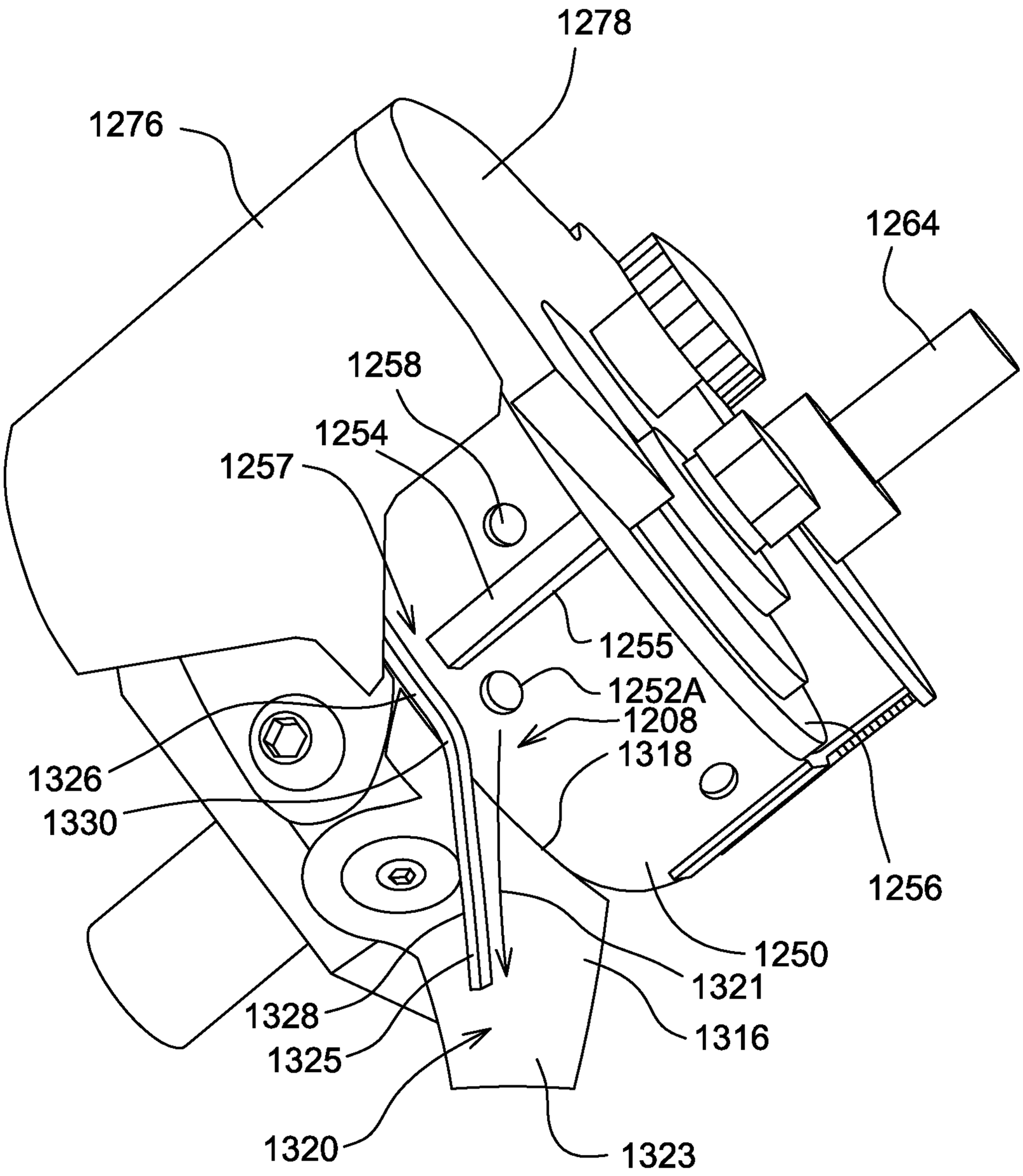

1278
1276
1264
1258
1254
1257
1255
1252A
1208
1318
1326
1330
1256
1250
1321
1328
1325
1316
1320
1323

Fig. 29

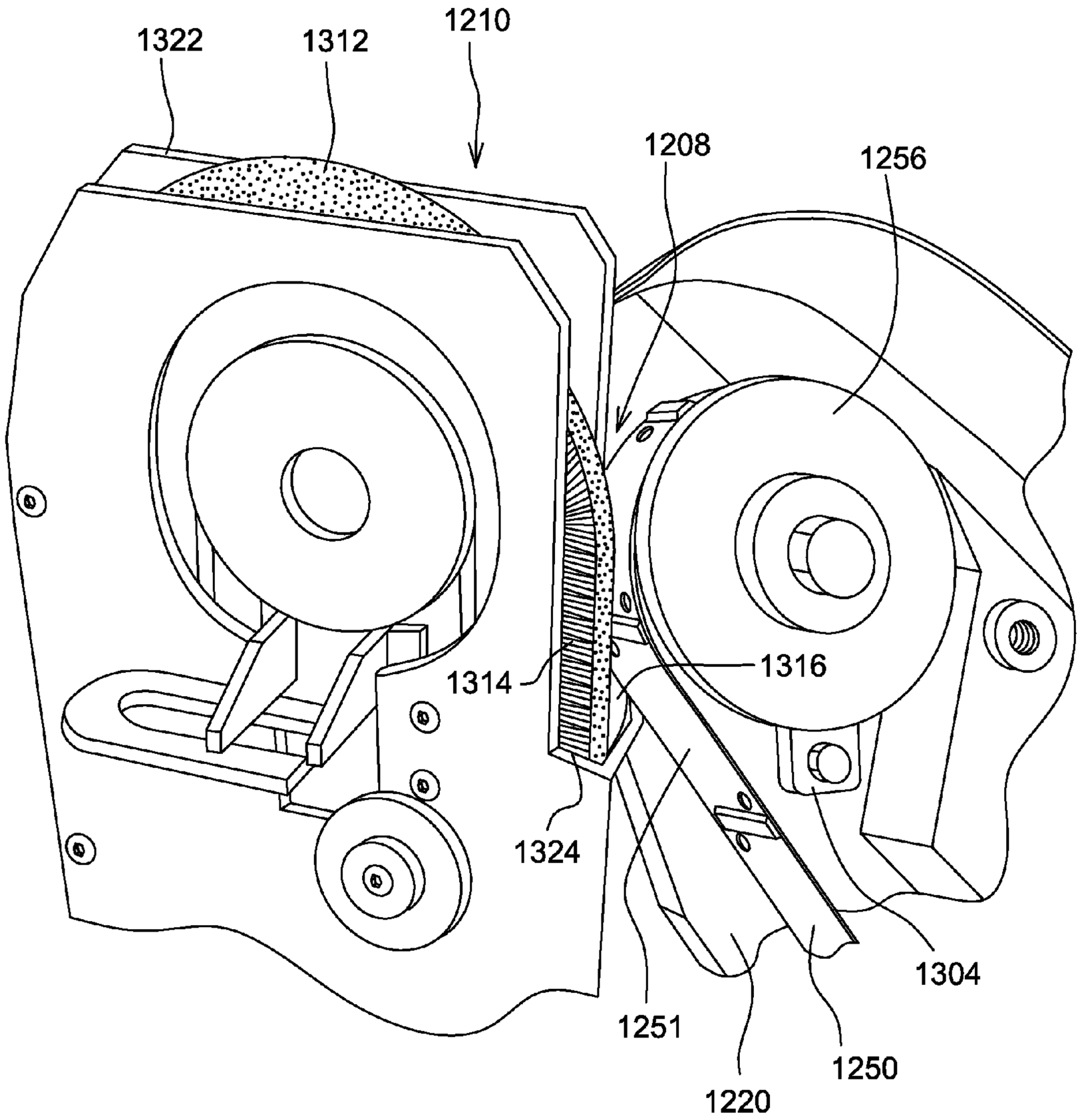


Fig. 30

PLANTING UNIT FOR A SEEDING MACHINE HAVING BLOCKING MEMBER TO CONTROL HAND-OFF OF SEED FROM A SEED METER TO A SEED DELIVERY SYSTEM

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

CROSS REFERENCE TO RELATED APPLICATION

This application *is a reissue of U.S. patent application Ser. No. 14/215,182, filed Mar. 17, 2014, now U.S. Pat. No. 9,510,502, which* is a Continuation of U.S. patent application Ser. No. 13/072,175, *filed Mar. 25, 2011,* now U.S. Pat. No. 8,671,856, which is a Continuation-in-part of U.S. patent application Ser. No. 12/363,968, filed Feb. 2, 2009, now U.S. Pat. No. 7,918,168.

FIELD

The following relates to a planting unit for a seeding machine and more particularly to a planting unit having a seed meter and seed delivery system.

BACKGROUND

Various types of seed meters have been developed that use an air pressure differential, either vacuum or positive pressure, to adhere seed to a metering member. The metering member takes seed from a seed pool and sequentially discharges single seeds. (In some cases, multiple seeds may be discharged at a time.) One common type of seed meter is shown in U.S. Pat. No. 5,170,909. There, a seed disk **48** contained in a housing is used to meter the seed. The seed pool is positioned on one side of the disk at a lower portion thereof while vacuum is applied to the opposite side of the disk. As the disk is rotated, individual seeds from the seed pool are adhered by the vacuum to apertures that extend though the disk. When the seed reaches a desired release position, the vacuum is terminated, allowing the seed to drop from the disk, through a seed tube to a furrow formed in the soil below.

Flexible belts have also been used in an air pressure differential seed meter. One example is shown in US patent application 2010/0192818 A1. There, a flexible belt having an array of apertures therein is movable along a path in a housing. A seed pool is formed on one side of the belt. Vacuum applied on the opposite side of the belt along a portion of the belt path adheres seed to the apertures, allowing the belt to move the seed to a release position where the vacuum is cut-off. The seed then falls or is removed from the belt.

When seed falls by gravity from the meter through the seed tube, it can be difficult to maintain accurate and consistent seed spacing at planting speeds greater than about 8 kph (5 mph). To maintain spacing accuracy, a seed delivery system that controls the seed as the seed moves from the seed meter to the soil is desirable. One such delivery system is shown in U.S. patent application 2010/0192819-A1. With such a delivery system, the hand-off of seed from the disk of

U.S. Pat. No. 5,170,909 to the delivery system is difficult to achieve In a consistent manner. While the hand-off of seed may be improved with the use of a belt meter, there is still a need for a more consistent and reliable hand-of seed from the seed meter to the delivery system.

SUMMARY

A planting unit for a seeding machine is provided having a seed meter with a metering member that moves seed sequentially along a first path to a release position at which the seed is moving in a first direction and a delivery system adapted to take seed from the metering member at the release position and control movement of the seed from the seed meter to a discharge location adjacent a seed furrow formed in soil beneath the seeding machine. The delivery system, at the release position, moves seed in a second direction along a second path. A blocking member or guide located adjacent the first path immediately preceding the release position prevents movement of the seed in the second direction until the seed has passed the blocking member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a common agricultural planter;

FIG. **2** is a side perspective view of a planting unit frame, seed meter and seed delivery system;

FIG. **3** is an enlarged perspective view of the seed meter and delivery system drives;

FIG. **4** is a perspective view of the seed meter with the cover open illustrating the metering member;

FIG. **5** is an exploded perspective view of the seed meter of FIG. **4**;

FIG. **6** is a perspective view of the metering member of FIG. **4**;

FIG. **7** is side cross-section of the metering member of FIG. **6** illustrating the orientation of the metering member installed in a seed meter mounted to a planting unit;

FIG. **8** is a fragmentary cross-section of an alternative metering member;

FIG. **9** is a elevational view of the inside of the metering member of FIG. **6**;

FIG. **10** is a side sectional view of the metering member and seed delivery system;

FIG. **11** is a sectional view of the hand-off of seed from the metering member to the delivery system including the delivery system brush belt;

FIG. **12** is a sectional view like FIG. **11** without the delivery system brush belt;

FIG. **13** is a schematic illustration the direction of entry of seed into the brush belt;

FIG. **14** is a schematic illustration of the direction of travel of the seed on the metering member and in the delivery system at the release position of seed from the metering member;

FIG. **15** is side sectional view of the metering member and delivery system at the hand-off without the brush belt;

FIG. **16** is a perspective view of the inner side of the seed meter housing;

FIG. **17** is a side sectional view of the metering member and meter housing illustrating the seed pool formed by the metering member and housing;

FIG. **18** is side sectional view like FIG. **17** illustrating a prior art seed meter with a disk metering member;

FIG. **19** is a perspective view of the lower end of the delivery system;

FIGS. **20** and **21** are perspective views of an alternative metering member;

FIG. **22** is a schematic side view of another arrangement of the seed meter and seed delivery system;

FIG. **23** is a perspective view of the seed meter of FIG. **22** partially disassembled;

FIG. **24** is perspective view of the seed meter as seen along the line **24-24** of FIG. **23**;

FIG. **25** is a perspective view of the vacuum manifold of the seed meter of FIG. **23**;

FIG. **26** is a sectional view of the idler pulley mounting structure of the seed meter of FIG. **23**;

FIG. **27** is a plan view of a vacuum control member in the seed meter of FIG. **23**;

FIG. **28** is a perspective view of the seed meter housing cover of the seed meter of FIG. **23**;

FIG. **29** is perspective view of the upper end of the seed meter of FIG. **23**; and

FIG. **30** is a perspective view showing the seed meter of FIG. **23** in relation to the seed deliver system.

DETAILED DESCRIPTION

An agricultural seeding machine **10** is shown in FIG. **1** as a row crop planter. Seeding machine **10** has a central frame **12** on which are mounted a plurality of individual planting units **14**. The seeding machine **10** has a fore-aft direction shown by the arrow **15** and a transverse direction shown by the arrow **17**. Each planting unit **14** is coupled to the central frame **12** by a parallel linkage **16** so that the individual planting units **14** may move up and down to a limited degree relative to the frame **12**. Large storage tanks **13** hold seed that is delivered pneumatically to a mini-hopper on each planting unit. Each planting unit **14** has a frame member **18** (FIG. **2**) to which the components of the planting unit are mounted. The frame member **18** includes a pair of upstanding arms **20** at the forward end of thereof. The arms **20** are coupled to the rearward ends of the parallel linkage **16**. Furrow opening disks (not shown) are attached to shaft **22** in a known manner to form an open furrow in the soil beneath the seeding machine into which seed is deposited. Closing and packing wheels (not shown) are also mounted to the frame member **18** in a known manner to close the furrow over the deposited seed and to firm the soil in the closed furrow. A seed meter **24** and a seed delivery system **400** are also attached to the frame member **18** of the planting unit.

The meter **24** includes a housing **30** (FIG. **3**) and a cover **34**. The housing **30** and the cover **34** are coupled to one another by complementary hinge features **36** and **38** (see FIG. **5**) on the housing and cover respectively. Hinge feature **36** includes a pivot pin **37** coupled to the housing while the feature **38** is an integrally formed hook that wraps around the pivot pin allowing the cover **34** to pivot about the axis of the pin **37**. An elastomeric latch member **40** is coupled to the housing **30** and has an enlarged portion **42** that is seated into a socket **44** formed in the cover to hold the cover in a closed position on the housing **30**.

The housing **30** is formed with a second hinge element in the form of a pivot pin **46** (FIG. **3**). Pivot pin **46** is seated into a hook member **48** (FIG. **4**) of the mounting frame **50** attached to the frame member **18**. This allows the seed meter **24** to pivot relative to the planting unit frame member **18** about an axis **52**. A drive spindle **54** is carried by the housing **30** and has a drive hub **56** (FIG. **5**) on the end thereof. The

spindle **54** couples to the output shaft **58** of electric motor **60** to drive the seed meter when in the assembled position shown in FIG. **3**. The seed meter **24** is coupled to the delivery system by a latch mechanism **68** including a metal rod **70** having a hook at one end seated into an aperture in the meter housing **30** when latched. The delivery system further has a mounting hook **72**, partially shown in FIG. **2**, which attaches to the planting unit frame member **18** to support the delivery system.

The delivery system **400** is driven by an electric motor **80**, also carried by the mounting frame **50**. The output shaft of motor **80** is connected to the delivery system through a right-angle drive **82**. While electric motors have been shown to drive both the seed meter and the seed delivery system, it will be appreciated by those skilled in the art that other types of motors, such as hydraulic, pneumatic, etc. can be used as well as various types of mechanical drive systems.

With reference to FIG. **6**, a metering member **100** of the seed meter is shown in greater detail. These metering member **100** is shown as a single piece, concave bowl shaped body. The bowl shaped body has a base portion **102** from which extends a sidewall **104**. Sidewall **104** terminates in an outer edge **106**. The sidewall has a radially inner surface **108** and a radially outer surface **110**. Adjacent the outer edge **106**, the sidewall has a rim portion **112** shown by the bracket in FIG. **6**. The rim portion **112** extends radially outwardly and axially toward the outer edge **106**. In the rim portion **112**, there is an annular array of apertures **114** that extend through the sidewall between the inner and outer surfaces **108** and **110**. The metering member **100** is mounted in the meter housing for rotation in the direction of the arrow **118** in FIG. **6**. In operation, as the metering member rotates, individual seeds from a seed pool **120** located at a bottom portion of the metering member are adhered to the apertures **114** on the inner surface **108** of the sidewall and sequentially carried upward to a release position **164** at an upper portion of the metering member. Thus, the inner surface is also known as the seed side of the metering member. A series of raised features or projections, such as paddles **116**, extend from the inner surface **108** of the sidewall **104** typically with one paddle located behind each aperture **114** in the direction of rotation. Each paddle forms a confronting surface **124** behind the associated aperture in the direction of rotation to push the seed adhered to the aperture into the delivery system as described below. As explained above, it is the rim portion **112** of the metering member that performs the function of drawing individual seeds from the seed pool and sequentially moving seed to the release position to supply seed individually to the seed delivery system **400**.

The base portion **102** of the metering member contains a central drive aperture **130** (FIG. **5**) used to mount the metering member on a rotational drive hub **56** for rotation about the axis **132** in a manner similar to mounting a flat seed disk in a seed meter as is well known. When mounted to the housing **30**, the metering member **100** cooperates with the housing to form a trough to hold the seed pool **120** as described more fully below. The axis **132** is inclined to both a horizontal plane as well as to a vertical plane extending fore and aft of the seeding machine and a vertically plane extending transversely to the seeding machine.

With reference to FIG. **7**, the metering member **100** is shown in a sectional view. The base portion **102** is a generally planar while the rim portion **112** of the inner surface of the sidewall **104** is outwardly flared, that is, extending both radially outward and axially. As shown in FIG. **7**, the rim portion is frusto-conical. Alternatively, as shown in FIG. **8** in connection with a metering member

sidewall **104'**, the inner surface of the sidewall rim portion **112** may be frusto-spherical in shape. Furthermore, while the rim portion **112** has been shown as being outwardly flared, the rim portion could be generally cylindrical without any outward flair, that is, extending only axially. The metering member **100** can be formed as one piece or constructed of multiple pieces. The metering member can be most easily molded of plastic such as polycarbonate, nylon, polypropylene or urethane. However, other plastics can be used as well as other materials such as metal, etc. The metering member **100** is sufficiently rigid to be self-sustaining in shape without additional supporting structure. This is in contrast to the flexible belt metering member shown in U.S. Pat. No. 2,960,258 where it be belt member is preferably of a flexible elastomeric material and is supported within a support ring. Being self-sustaining in shape, the metering member does not need any supporting structure to hold a shape. As a self-sustaining, the metering member may be rigid or the metering member may be flexible to change shape when acted upon in a manner similar to the flexible seed disk of U.S. Pat. No. 7,661,377.

As previously mentioned, the metering member **100** can be mounted to a drive hub through the central drive aperture **130** in the base portion **102**. Mounting through the central drive aperture **130** provides both mounting support of the metering member as well as the rotational drive of the metering member. Alternatively, support for the metering member can be provided on the outer surface of the sidewall. A groove may be formed in the outer surface of the sidewall to receive rollers that support the metering member. If the groove is also formed with drive teeth, one of the rollers could be driven by a motor to rotate the metering member. With such alternative arrangements possible, it is not necessary that the metering member have a base portion. The function of metering seed is performed by the sidewall and thus, the sidewall is the only required portion of the metering member.

As shown in FIG. **7**, the metering member **100**, when mounted in the meter housing, is oriented at an incline to the vertical as shown. In this orientation, the apertures **114** lie in a plane **150** inclined at an angle a relative to vertical. In this orientation, an upper portion **148** of the metering member overhangs or extends beyond a lower portion **154**. As described below, this allows access to the upper portion **148** of the metering member for the mechanical seed delivery system **400**. As shown, the angle a is approximately 24°. However, any angle will suffice as long as the upper portion **148** extends beyond the lower portion sufficiently for access for the seed delivery system from below the metering member at the seed release position.

The seed pool **120** is formed at the bottom of the metering member **100** as shown in FIG. **9**. Vacuum is applied to the outer surface **110**, causing individual seeds to be adhered to the apertures **114** as the apertures travel through the seed pool. As the metering member rotates as shown by the arrow **118**, seed is moved upward to a release position **164** at the upper portion **148** of the metering member. The release position is slightly past the top or 12 O'clock position on the circular path of travel of the seed such that the seed is moving somewhat downward at the release position. This facilitates the seed's entry into the delivery system as more fully described below. Also, by being past the top point of the path, the delivery system is off center relative to the metering member providing clearance between the delivery system and the seed meter drive. At the release position **164**, the inner surface of the rim portion of the metering member is facing downward such that seed is adhered beneath the metering member or is hanging from the metering member. See FIG. **10**. The seed delivery system **400** is also positioned beneath the upper portion of the metering member at the release position **164** to take the seed from the metering member as shown in FIG. **10**.

Delivery system **400** includes a housing **402** having a left sidewall **404** (see FIG. **19**) and a right sidewall **406** (see FIG. **3**). The terms left and right are used in relationship to the direction of travel of the seeding machine shown by the arrow **408**. Connecting the left and right sidewalls to one another is an edge wall **410**. An upper opening **416** is formed in the edge wall and sidewalls to allow seed to enter into the housing **402**. A lower opening **418** is provided at the lower end forming a discharge location **413** for the seed. A pair of pulleys **420** and **422** are mounted inside the housing **402**. The pulleys a support a belt **424** for rotation within the housing. One of the two pulleys is a drive pulley while the other pulley is an idler pulley. The belt has a flexible base member **426** to engage the pulleys. Elongated bristles **428** extend from the base member **426**. The bristles are joined to the base member at proximal, or radially inner, ends of the bristles. Distal, or radially outer, ends **430** of the bristles touch or are close to touching the inner surface of the housing edge wall **410**.

As shown at the top of FIG. **10**, a seed **152** is at the release position on the metering member **100** and has just been inserted into the bristles **428** of the delivery system. At the release position, the rim portion **112** of the metering member sidewall **104** is generally tangent to the stationary inner surface **412** across which the brush bristles **428** sweep. The surface **412** is on a latch portion **66** of the housing **30**. The surface **412** is a continuation of the inner surface **414** of the delivery system housing **402**. Once the seed is captured in the delivery system, the seed moves in the direction of the belt, shown by the arrow **417**. The direction of travel of the seed immediately upon capture by the delivery system **400** is shown by the vector **438**.

Prior to release of the seed from the metering member, the seed is moving in the direction of vector **160** which is slightly downward into the bristles **428**. With reference to FIG. **13**, the vector **160** of the seed direction is at an angle **161** of about 60° to the length of the bristles **428** shown by the arrow **176**. As shown in FIG. **11**, the brush belt is positioned so that seed enters the bristles at the corner of the brush belt. The brush can be positioned so that the seed enters the brush through the distal ends of the bristles or through the side of the bristles.

The relationship between the seed direction vector **160** on the metering member and the seed direction vector **438** when the seed is first in the brush belt is shown in FIG. **14** illustrating the two vectors in the plane containing both vectors at the release position **164**. The angle **163** between the vectors is at least 35° and preferably between 50° and 80°. This shows the cross-feed of the seed into the bristles, meaning that the seed, prior to the release position is moving substantially in a different direction than the brush bristles are moving. This is in contrast to the arrangement shown in FIG. 3 of the previously mentioned U.S. patent application 2010/0192819-A1 where the seed on the metering disk at the release is moving in substantially the same direction as the brush bristles. This is also the relationship by which the bristles sweep over the inner surface of the sidewall relative to the travel direction of seed.

FIGS. **11** and **12** show a blocking member **162** carried by the meter housing **30**. Blocking member **162** is positioned adjacent a path of travel of seed **152** leading to the release position **164** and prevents movement of seed from the

metering member prior to reaching the release position. Once the seed has passed the end **174** of the blocking member **162**, the seed is free to move with the brush bristles in the direction of the vector **438** in FIG. **10**. The blocking member ensures that the seed is consistently feed into the brush belt in the center of the belt, widthwise, rather than allowing the seed to enter the belt at random positions across the belt width. As shown in FIG. **15**, the blocking member is located beneath the sidewall **104** of the metering member **100** between the paddles **116** and the outer edge **106** of the metering member. The confronting surfaces **124** of the paddles **116** push seed into the brush bristles. The paddles or projections **116** travel further into the brush bristles, that is deeper into the bristles from their distal ends, as the projections cross the width of the brush as seen in FIG. **11**. Once seed is in the brush bristles, the seed is swept over the inner surface of the metering member, from the apertures **114** to the outer edge **106** of the metering member in the direction of the vector **438**. The delivery system could be arranged to sweep seed in the opposite direction, that is, away from the outer edge **106** of the metering member.

To further ensure consistent release of seed from the metering member and hand-off to the delivery system, an ejector **166**, carried by the cover **34** rides on the outer surface of the metering member rim portion. See FIGS. **11**, **12** and **15**. The ejector **166** is in the form of a star wheel having a number of projections **168**. The projections **168** extend into the apertures **114** from the outer surface **110** of the sidewall **104** and force seed out of the apertures **114**. The ejector is caused to rotate by rotation of the metering member **100** due to the projections **168** engaging in the apertures **114**. The ejector is mounted to the cover **34** via a pivot arm **170** and bracket **171**. The ejector **166** is biased against the metering member by a spring **172**.

Turning attention once again to FIG. **4**, a flexible seal **180** is shown on the inner side of the cover **34**. This seal bears against the outer surface **110** of the metering member **100** forming a vacuum chamber within the interior **182** of the seal. A first portion **184** of the seal is spaced radially further out on the metering member than is the second portion **186** of the seal. In the area of the seal first portion **184**, vacuum is applied to the apertures **114**, causing seed to adhered thereto. There is no vacuum applied to the apertures adjacent and outside of the seal second portion **186**. A port **188** in the cover **34** is adapted to connect the interior of the cover to a vacuum source in a known manner for a vacuum seed meter. The seed release position **164** is within the vacuum chamber. Thus, the brush belt and the ejector are working in opposition to the vacuum applied to the apertures **114** to release the seed from the metering member.

With reference to FIG. **16**, The inside of the housing **30** is shown. The housing includes a central boss **302** for the drive spindle **54**. The housing also includes an opening **304** to receive seed from a mini-hopper, not shown, mounted to the outside of the housing and surrounding the opening **304**. Below the opening **304**, the housing wall forms a ramp **306** extending downward toward the lower end **308** of the housing. The ramp cooperates with the inner surface **108** of the metering member to hold the seed pool **120**. The housing includes an inward projection **310** forming a cavity **314** (FIG. **17**) on the outside of the housing into which the upper end if the delivery system **400** is placed. The projection is open at the upper end, forming a downward looking opening **312** from the interior of the housing to the exterior. This opening **312** allows the brush belt **424** to access the inner surface of the **108** of the metering member and carry seed from the housing.

FIG. **17** illustrates the orientation of the metering member and the cooperation of the housing **30** and metering member **100** to form a trough for the seed pool **120** at the lower end of the metering member. FIG. **17** shows the orientation of the metering member when the seeding machine **10** is on level ground. At the lower end of the metering member, the sidewall **104** is inclined to the vertical such that the inner surface **108** is at an angle d to the vertical vector **126**. As illustrated in FIG. **17**, the inner surface is approximately 21° from vertical. The orientation of the housing adjacent the metering member, forming the other side of the trough, is not critical. Seed from the seed pool **120** sits on top of the inner surface **108** and a component of the force of gravity is perpendicular to the inner surface **108**. When operating on a hillside, if the meter is tilted clockwise or counter-clockwise, as viewed in FIG. **17**, the inner surface **108** remains inclined and gravity still has a component perpendicular to the inner surface. This is in contrast to a typical disk seed meter shown in FIG. **18** with a vertically oriented disk **320** cooperating with a housing wall **322** for form a seed pool **324**. If this meter is tilted counterclockwise as viewed, seed from the pool will still bear against the disk. However, if the meter is tilted clockwise, seed from the pool will fall away from the disk, allowing for decreased metering performance in terms of seed being picked-up by the disk. Evaluation of the meter has shown improved meter performance on a hillside when the angle d is as small as 5° and as large as 75°. Better performance is achieved when the angle d is between 10° and 50° while the optimum performance is in the range of 20° to 40°. This last range provides considerable tilting of the seed meter on a hillside in any direction before performance begins to decrease.

At the upper end of the metering member, at the release position **164**, the inner surface **108** has an angle f to a downward vertical vector **128** in the range of 50° to 90° with the closer to 90° being the better for hand-off of seed from the metering member to the brush belt. As shown, the angle f is approximately 68°. The different orientations of the inner surface **108** relative to vertical at the seed trough and at the release position is accomplished with a metering member that is rigid. Such variation is not possible with the flat disk metering member shown in FIG. **18**.

As described above, seed is adhered to the apertures **114** in the metering member due to the vacuum applied to the outer surface of the metering member creating a pressure differential on opposite sides of the metering member. As an alternative to vacuum on the outer side of the metering member, the pressure differential can be created by a positive pressure between the housing **30** and the metering member **100**. Such a system would require seals between the metering member **100** and the housing **30** to create a positive pressure chamber. In a positive pressure arrangement, the cover **34** only serves as a cover for the rotating metering member.

It is possible that more than one seed will be adhered to a given aperture **114**. To prevent more than one seed at a time from being transferred to the brush belt, a pair of doubles eliminators or singulators are attached to the housing **30** along the path of seed from the seed pool to the release position **164**. The singulators are in the form of brushes **330** and **332** (FIGS. **5** and **9**). Brush **330** has bristles extending substantially axially and brushes seed on the apertures **114** by extending inwardly from the outer edge **106** of the metering member. The bristles of brush **330** are of varying length, to engage the seed at several discrete locations along the length of the brush **330**. The brush **332** has bristles extending substantially radially and engaging the inner

surface of the metering member sidewall inside of the paddles **116** and extend along the sidewall to the apertures **114**. Both brushes **330** and **332** act to slightly disturb seed on the aperture and cause excess seed to fall off. Once removed, the excess seed falls back to the seed pool **120**. The brushes can be fixed in position or they can be adjustable to change the degree to which the brushed disturb seed on the metering member. A third brush **334** is shown which extends generally radially of the metering member. The brush **334** serves to define a boundary to the seed pool **120**. The brushes **330**, **332** and **334** are mounted to the housing **30**.

Returning again to FIG. **10**, once seed is captured or trapped in the bristles **428**, the delivery system controls the movement of seed from the seed meter to the discharge location. The seeds are held in the bristles such that the seeds can not move vertically relative to the bristles **428** or relative to other seeds in the delivery system. Particularly, during travel of the seeds along the vertical side of the delivery system, the seeds are held on at least the top and bottom of the seeds to prevent any relative movement between the seed and the brush belt. Thus, the relative position of the seeds to one another is not affected by dynamics of the planting unit while moving across a field. The seed is carried by the bristles from the upper opening **416** to the lower opening **418** with the movement of the seed controlled at all times from the upper opening to the lower opening.

The lower opening **418** of the delivery system housing is positioned as close to the bottom **446** of the seed trench or furrow **448** as possible. As shown, the lower opening **418** is near or below the soil surface **432** adjacent the seed furrow. The bottom of the delivery system should be no more than one or two inches, (2.5-5 cm) above the soil surface **432**. If possible, the lower end of the delivery system should be below the soil surface **432**. The housing edge wall **410** forms an exit ramp **434** at the lower opening **418**. The lower opening **418** and the ramp **434** are positioned along the curve in the belt path around the pulley **422**. The seed, being carried by the bristle's distal ends, increases in linear speed around the pulley **422** as the distal ends of the bristles travel a greater distance around the pulley **422** than does the base member **426** of the belt. This speed difference is shown by the two arrows **440** and **442**.

At discharge, the seed has a velocity shown by the vector V. This velocity has a vertical component V_V and a horizontal component V_H. The belt is operated at a speed to produce a horizontal velocity component V_H that is approximately equal to, but in the opposite direction of, the seeding machine forward velocity shown by arrow **408**. As a result, the horizontal velocity of the seed relative to the ground is zero or approximately zero. This minimizes rolling of the seed in the seed trench.

Seed can be inserted into the brush bristles at essentially an infinite number of positions. This enables the brush to be operated at the speed necessary to produce the desired horizontal velocity component to the seed, independent of the seed population. The seed meter, on the other hand, must be operated at a speed that is a function of both the forward travel speed of the seeding machine and the desired seed population. Because the belt **424** can be loaded with seed at essentially an infinite number of positions, the belt speed can be operated independently of the seed meter speed. This is not the case with other seed delivery systems, such as that disclosed in U.S. Pat. No. 6,681,706 where the delivery system of FIG. **2** has a belt with flights to carry the seed. The belt speed must be timed to the seed meter speed to ensure that one or more flights pass the seed meter for each seed that is discharged from the meter.

While it is desirable to match the seed rearward velocity to the seeding machine forward velocity to minimize seed relative velocity to the soil, with some seed types, it may be necessary to operate the brush belt at a different speed to ensure the seed is discharged from the brush bristles.

The interior of the lower portion of delivery system housing is shown in FIG. **19**. The delivery system housing **402** is a two-piece housing having an upper housing member **460** and a lower housing member **462**. The lower housing member carries the lower pulley **422**. The lower housing member has an upwardly extending rod portion **464** that slides within a channel formed by walls **466** and **468** in the upper housing member. Springs, not shown, push downward on the rod portion **464** to bias the lower housing member downward. The brush belt **424**, wrapped about the pulleys **420** and **422**, holds the upper and lower housing members together. The belt **424** is tensioned by the springs acting on the rod portion **464**. A U-shaped metal strip **470** is attached to the upper housing member **460** and bridges the gap **472** between the upper and lower housing members to provide a continuous surface for holding seed in the housing between the upper opening **416** and the lower opening **418**. The metal strip has a tab at the upper end thereof bent over and inserted into a slot **474** in the upper housing member **460** to hold the metal strip **470** in place. If needed, a fastener, such as a nut and bolt, may be placed through the rod portion **464** and the upper housing member **460** to fix the upper and lower housing members together.

Different metering members may be used for different seed types. The metering member **100** is intended for soybeans and other crops planted with a fairly close seed spacing. Corn, which is planted at a greater seed spacing uses a metering member **200** shown in FIGS. **20** and **21**. Metering member **200** is constructed in a similar fashion as metering member **100** and like components are given the same reference numeral with the addition of **100**. However, metering member **200** has half the number of apertures **214** as the metering member **100**. To avoid the need to replace the ejector **166** when changing metering members, the metering member **200** has recess **226** extending into the sidewall **204** on the outer surface **210** of the sidewall between each aperture **214**. The recesses **226** provide clearance for the projections **168** of the ejector **166** that are arranged to be inserted in each aperture **114** of the metering member **100**. The recesses **226** are not open to the inner surface **208** of the sidewall **204**. Thus there are additional projections **228** on the inner surface of the sidewall **204** between the apertures **214**. Alternatively, the projections **228** and the paddles **216** can be formed as a single projections extending from the inner surface **208**.

The blocking member or guide is shown in another arrangement of the seed meter and delivery system described in connection with FIGS. 22-31 from the parent application, U.S. patent application Ser. No. 12/363,968, filed Feb. 2, 2009. with reference to FIG. **22**, a belt meter **1200** is shown schematically to illustrate the relationship of the belt **1250** relative to the row unit structure. The belt **1250** lies in a plane that is inclined relative to all three axes, that is the plane of the belt is inclined relative to a vertical fore and aft plane, inclined relative to a vertical transverse plane and inclined relative to a horizontal plane. Furthermore, the seed pickup region **1206** is positioned at the lower end of the belt **1250** while the seed release position or location **1208** is located at the upper end of the belt **1250**. In the embodiment shown in FIG. **22**, the seed is removed from the belt **1250** at the release location by a seed delivery system **1210**. The seed delivery system **1210** is like seed delivery system **400**

described above containing a brush belt **1312** to grip and carry seed. The seed delivery system **1210** moves the seed from the seed meter belt to the lower end of the row unit between the furrow opening disks where it is deposited into the furrow formed in the soil. The seed meter **1200** is described fully below with reference to FIGS. **23-30**.

The seed meter **1200** has a frame member **1220** in the form of a plate which is mounted to the row unit frame in a suitable manner. The frame member **1220** supports the upper idler pulley **1256** and the lower drive pulley **1260** about which the belt **1250** is wrapped. A gearbox and drive motor (not shown) are coupled to the shaft **264** to drive the pulley **1260** and belt counterclockwise as viewed in FIG. **23** and shown by the arrow **1261**. The frame member **1220** also carries a vacuum manifold **1262** having a hollow interior vacuum chamber **1266**. A vacuum port **1263** extends from the opposite side of the vacuum chamber through the frame member **1220**. The manifold **1262** has an outer wall **11268** (FIG. **25**) containing a main slot **1270** extending the length of the outer wall. A secondary slot **11272** extends only a short portion of the length of the outer wall.

The belt **1250** has an outer seed engaging face or side **11251**. The belt **1250** includes a row of first apertures **11252** which overlie the slot **1270** in the manifold **1262**. The apertures **11252** to extend through the belt, allowing air to flow through the belt. The belt further has a plurality of features **11254** formed as ribs extending from the seed face **1251**. The features **1254** each for a confronting face **1255** shown in FIG. **29** facing in the travel direction of the belt. In this embodiment, the feature **1254** forms the confronting face **1255** extending outward from the seed side **1251** of the belt. In the embodiment shown, the features **1254** do not extend laterally to both side edges of the belt, but leaves a flat edge zone **1257** along one edge of the belt. An optional second row of apertures **1258** in the belt are positioned to pass over the secondary slot **1272** in the manifold outer wall **1268**. The apertures **1258** are only in communication with the vacuum chamber **1266** for the short portion of the path of the apertures **1258** over the slot **1272**.

A housing **1276** is attached to the frame member **1220** and closely positioned to the belt **1250**. A portion **1277** of the housing **1276** overlies the flat edge zone **1257** of the belt. The housing **1276**, the belt **1250**, and a cover **1278** (shown in FIG. **28**) form a small chamber **1279** which holds a pool of seed **1280**. A brush **1282** mounted to the housing **1276** sweeps across the face **1251** of the belt and seals the chamber **1279** at the location where the belt enters the chamber to prevent seed from escaping the chamber **1279**. Seed enters in the chamber **1279** through a suitable port, not shown, in the housing **1276** or housing cover **1278**.

The belt **1250** and housing **1276** form a V-shaped trough for the seed pool that extends uphill in the direction of belt travel. The confronting faces **1255** formed by the features **1254** of the belt engage the seed in the pool to agitate the seed creating a circular flow of seed as shown by the broken line **1284** of FIG. **24**. Since the belt forms one side of the V-shaped trough, seed will always remain in contact with the belt regardless of tilt or inclination of the planter, as long as sufficient seed is present in the seed pool. An advantage of the seed meter is that when the vacuum shut off, seed on the belt falls back into the seed pool. This is in contrast to disk meters where a portion of the seed on the disk above the seed tube will fall to the ground upon vacuum shut-off.

The idler pulley **1256** is supported by a bearing set **1285** on a tube **1286** (FIG. **26**). A flange **1288** welded to the tube **1286** is attached to the frame member **1220** by bolts **1290**. A spacer **1292** is positioned between the flange and frame member **1220**. The idler pulley **1256** has a groove **1294** in its outer periphery which is in line with the belt apertures **1252**. Channels **1296** extend radially through the pulley **1256** to an annular chamber **1298** surrounding the tube **1286**. An opening **1300** in the tube **1286** provides communication between the chamber **1298** and the hollow interior **1302** of the tube. The tube is connected to the vacuum source whereby the vacuum is applied to the apertures **1252** in the belt as the belt travels over the pulley **1256**. A fork **1304** is attached to the frame member **1220** with tines **1306** seated in the groove **1294** in the idler pulley. The tines filled the groove **1294** to cut off the vacuum and create the seed release location **1208**. The tines **1306** extend from the seed release location to the vacuum manifold in the direction of rotation of the idler pulley to seal the vacuum chamber and the groove in the idler pulley.

The housing cover **1278** mounts to the manifold and covers the open side of the housing **1276** as shown in FIG. **29**. A doubles the eliminator **1310** is mounted to the housing cover and, when assembled, lies on top of the belt **1250**. The doubles eliminator **1310** is roughly wedge-shaped and progressively increases in width in the travel direction of the belt to increase its coverage over the apertures **1252**. The doubles eliminated **1310** causes doubles or multiples of seed to be removed from the belt resulting in a single seed covering each aperture **1252**.

In operation, as the belt rotates, the confronting face **1255** engage and agitate seed in the seed pool at the bottom of the housing **1276**. Seed from the seed pool will be adhered to the belt at each aperture **1252** due to the vacuum applied to the apertures from the interior of the manifold **1262** or by positive air pressure on the seed side of the belt. By virtue of the main slot **1270**, the seeds will continue to be retained on the belt as the belt travels from the seed pick-up region **1206** to the idler pulley **1256**. Due to the groove in the idler pulley, the vacuum is maintained on the apertures as the belt travels around the pulley until the seed and the aperture reaches the tine **1306** of the fork **1304**. Upon reaching the tine **1306**, the vacuum is terminated and the seed is released from the belt **1250**. Alternatively, the seed can be mechanically removed from the belt or removed by a combination of vacuum termination and mechanical removal or the seeds can be removed mechanically while the vacuum is still applied.

The second row of apertures **1258** will also operate to retain a seed therein while the aperture **1258** travels over the shorter slot **1272**. By picking up seed, the apertures **1258** act to further agitate the seed pool. In addition, when the apertures **1258** reach the downstream end **273** of the secondary slot **1272**, the seed is released from the belt. The release location from the aperture **1258** causes the seed to pass over one of the apertures **1252** as the seed falls. If the aperture **1252** failed to pick-up a seed and is empty, the falling seed may be retained thereon. If the aperture **1252** is not empty, but instead picked-up multiple seeds, the falling seed may collide with the multiple seeds and assist in removing one or more of the multiple seeds. In this fashion, the falling seed operates to avoid errors in terms either no seed or multiple seeds on an aperture **1252**.

At the seed release position **1208**, the seed is transferred from the metering belt **1252** to the seed delivery system **1210**. The seed delivery system **1210** includes an endless member also wrapped around pulleys and contained within a housing **1322**. The housing has an upper opening **1324** through which seed is admitted into the delivery system. The endless member is shown in the form of a brush belt **1312** having bristles **1314** that sweep across the face **1251** of the

belt **1250** to remove the seed therefrom. At the seed release position **1208**, a transition plate **1316** is positioned adjacent the belt **1250**. The transition plate has a curved first edge **1318** abutting the edge of the belt as the belt travels around the idler pulley. The brush belt bristles will engage a seed in the aperture **1252**A at the location shown in FIG. **19** and will sweep the seed off the belt and across the face **1320** of the transition plate **1316** in the direction of the arrow **1321**. The confronting face **1255** behind the aperture **1252**A serves as a back stop to prevent the brush from knocking the seed off the metering belt. The confronting face **1255** pushes the seed into the brush bristles. The downward extending tab portion **1323** of the transition plate projects into the housing of the delivery system **1210** to allow the brush to continuously trap seed as the seed moves off the belt **1250**, over the transition plate **1316** and into the interior of the delivery system housing where the seed is trapped by the brush bristles and the interior surface of the delivery system housing **1322**. A guide **1325** projects from the surface of the transition plate to guide the seed and keep the seed from being swept off the meter belt prematurely. The guide forms an upstanding wall having a first portion **1326** adjacent the path of seed on the belt **1250** immediately prior to the release position **1208**. A second portion **1328** of the upstanding wall extends in the direction of seed travel in the brush belt **1312**. Seed must pass the corner or bend **1330** in the upstanding wall before it can be moved off the meter belt **1250** by the seed delivery system.

The guide **1325** and blocking member **162** ensure seed entry into the brush belt in a consistent manner and in the same location across the width of the brush belt. This consistent hand-off of seed from the seed meter to the seed delivery system helps to improve placement accuracy of the seed in the furrow in the soil.

Having described the seed meter and delivery system, it will become apparent that various modifications can be made without departing from the scope of the accompanying claims.

What is claimed is:

1. A seed delivery apparatus for transferring seed to a furrow, the seed delivery apparatus secured to a seeding machine, the seed delivery apparatus comprising:

a housing having a first opening through which seed is received and a second opening through which seed exits;

an endless member positioned within the housing; and

a drive member operably configured to control the movement of the endless member in cooperation with movement of the seeding machine,

wherein the seeding machine is operable in a seeding direction at a first seeding speed and at a second seeding speed, and wherein the drive member is configured to discharge seed with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the first seeding speed in a first mode and at a speed in the directional component approximately equal to the second seeding speed in a second mode.

2. The seed delivery apparatus of claim **1**, wherein the seeding machine is operable in a seeding direction and at seeding speed, and wherein the drive member is configured to discharge seed with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the seeding speed *to minimize rolling of the seed in the trench.*

3. The seed delivery apparatus of claim **1**, wherein the drive member is operable at a first speed and at a second speed different than the first speed.

4. The seed delivery apparatus of claim **1**, wherein the drive member is a variable speed drive member.

[5. The seed delivery apparatus of claim **1**, wherein the drive member is a first drive member operable at a first speed, and further including a second drive member operable at a second speed and configured to control movement of the endless member in cooperation with movement of the seeding machine.**]**

6. The seed delivery apparatus of claim **1**, wherein the drive member speed is proportional to movement of the seeding machine.

7. A seed delivery apparatus for transferring seed to a furrow, the seed delivery apparatus secured to a seeding machine, the seed delivery apparatus comprising:

a housing having a first opening through which seed is received and a second opening through which seed exits;

an endless member positioned within the housing; and

a drive member operably configured to control a discharge of seed from the second opening in cooperation with movement of the seeding machine,

wherein the seeding machine is operable in a seeding direction at a first seeding speed and at a second seeding speed, and wherein the drive member is configured to discharge seed with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the first seeding speed in a first mode and at a speed in the directional component approximately equal to the second seeding speed in a second mode.

8. The seed delivery apparatus of claim **7**, wherein the seeding machine is operable in a seeding direction and at seeding speed, and wherein the drive member is configured to discharge seed with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the seeding speed *to minimize rolling of the seed in the trench.*

9. The seed delivery apparatus of claim **7**, wherein the seeding machine is operable in a first mode at a first seeding speed and in a second mode at a second seeding speed, and wherein the drive member is configured to discharge the seed with a first seed spacing in the furrow during the first mode and is further configured to discharge the seed with a second seed spacing in the furrow during the second mode, wherein the second seed spacing approximately equals the first seed spacing.

10. The seed delivery apparatus of claim **7**, wherein the drive member is operable at a first speed and at a second speed different than the first speed.

11. The seed delivery apparatus of claim **7**, wherein the drive member is a variable speed drive member.

[12. The seed delivery apparatus of claim **7**, wherein the drive member is a first drive member operable at a first speed, and further including a second drive member operable at a second speed and configured to control the movement of the endless member in cooperation with movement of the seeding machine.**]**

13. A method of transferring seed to a furrow with a seed delivery apparatus secured to a seeding machine, the method comprising:

receiving a seed into a housing through a first opening;

controlling movement of the seed within the housing in cooperation with movement of the seeding machine;

conveying the seed from the first opening to a second opening; and

discharging the seed through the second opening directly to the furrow,

wherein the seeding machine is operable in a seeding direction and at a seeding speed, and wherein discharging the seed through the second opening means discharging the seed with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the seeding speed

wherein the seeding machine is operable in the seeding direction and at a first seeding speed and at a second seeding speed, and wherein discharging the seed through the second opening means discharging the seed with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the first seeding speed in a first mode and at a speed in the directional component approximately equal to the second seeding speed in a second mode.

14. The method of claim **13**, wherein controlling movement of the seed within the housing means controlling movement of an endless member positioned within the housing.

15. The method of claim **14**, wherein controlling movement of the seed within the housing means controlling a drive member configured to drive the endless member.

16. The method of claim **15**, wherein controlling the drive member means controlling the drive member at a first speed and controlling the drive member at a second speed different than the first speed.

17. The method of claim **14**, wherein controlling movement of the seed within the housing means controlling a variable speed drive member configured to drive the endless member.

[18. The method of claim **14**, wherein controlling movement of the seed within the housing in cooperation with movement of the seeding machine means selectively controlling a first drive member configured to drive the endless member and selectively controlling a second drive member configured to drive the endless member.**]**

19. The method of claim **13**, wherein controlling movement of the seed within the housing in cooperation with movement of the seeding machine means controlling movement of the seed within the housing in response to an operating speed of the seeding machine.

20. The method of claim **13**, wherein controlling movement of the seed within the housing in cooperation with movement of the seeding machine means controlling movement of the seed within the housing in response to an operating direction of travel of the seeding machine.

21. The method of claim **13**, wherein discharging the seed through the second opening means selectively discharging the seed at a speed responsive to an operating speed of the seeding machine.

22. The method of claim **13**, wherein the seeding machine is operable in a first mode at a first seeding speed and in a second mode at a second seeding speed, and wherein discharging the seed through the second opening means discharging the seed such that a seed spacing in the furrow during the first mode is equal to a seed spacing in the furrow during the second mode.

23. A seed delivery apparatus for transferring seed to a furrow, the seed delivery apparatus secured to a seeding machine, the seed delivery apparatus comprising:

a housing having a first opening through which seed is received and a second opening through which seed exits;

an endless member positioned within the housing; and

a drive member operably configured to control the movement of the endless member in cooperation with movement of the seeding machine,

wherein the seeding machine is operable in a seeding direction at a first seeding speed and at a second seeding speed, and wherein the drive member is configured to drive the endless member to discharge seeds from the seed delivery apparatus with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the first seeding speed in a first mode and at a speed in the directional component approximately equal to the second seeding speed in a second mode.

24. The seed delivery apparatus of claim 23, wherein the drive member is operable at a first speed and at a second speed different than the first speed.

25. The seed delivery apparatus of claim 23, wherein the drive member is a variable speed drive member.

26. The seed delivery apparatus of claim 23, wherein the drive member is configured to discharge the seed with a first seed spacing in the furrow during the first mode and is further configured to discharge the seed with a second seed spacing in the furrow during the second mode, wherein the second seed spacing approximately equals the first seed spacing.

27. The seed delivery apparatus of claim 23, wherein the drive member is operable at a speed proportional to movement of the seeding machine.

28. The seed delivery apparatus of claim 23, wherein the furrow is formed into a soil through a soil surface, and wherein the second opening is below the soil surface.

29. A seed delivery apparatus for transferring seed to a furrow, the seed delivery apparatus secured to a seeding machine, the seed delivery apparatus comprising:

a housing having a first opening through which seed is received and a second opening through which seed exits;

an endless member positioned within the housing; and

a drive member operably configured to control a discharge of seed from the second opening in cooperation with movement of the seeding machine,

wherein the seeding machine is operable in a seeding direction at a first seeding speed and at a second seeding speed, and wherein the drive member is configured to drive the endless member to discharge seeds from the seed delivery apparatus with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the first seeding speed in a first mode and at a speed in the directional component approximately equal to the second seeding speed in a second mode.

30. The seed delivery apparatus of claim 29, wherein the drive member is operable at a first speed and at a second speed different than the first speed.

31. The seed delivery apparatus of claim 29, wherein the drive member is a variable speed drive member.

32. The seed delivery apparatus of claim 29, wherein the drive member is configured to discharge the seed with a first seed spacing in the furrow during the first mode and is further configured to discharge the seed with a second seed

spacing in the furrow during the second mode, wherein the second seed spacing approximately equals the first seed spacing.

33. The seed delivery apparatus of claim 29, wherein the drive member is operable at a speed proportional to movement of the seeding machine.

34. The seed delivery apparatus of claim 29, wherein the furrow is formed into a soil through a soil surface, and wherein the second opening is below the soil surface.

35. A method of transferring seed to a furrow with a seed delivery apparatus secured to a seeding machine, the method comprising:

receiving a seed into a housing through a first opening;

controlling a drive member configured to drive an endless member positioned within the housing in cooperation with movement of the seeding machine;

conveying the seed from the first opening to a second opening; and

discharging the seed through the second opening directly to the furrow,

wherein the seeding machine is operable in a seeding direction and at a first seeding speed and at a second seeding speed, and wherein discharging the seed through the second opening means discharging the seed from the seed delivery apparatus with the drive member and with a directional component equal and opposite to the seeding direction and at a speed in the directional component approximately equal to the first seeding speed in a first mode and at a speed in the directional component approximately equal to the second seeding speed in a second mode.

36. The method of claim 35, wherein controlling the drive member means controlling the drive member at a first speed and controlling the drive member at a second speed different than the first speed.

37. The method of claim 35, wherein controlling the drive member means controlling a variable speed drive member configured to drive the endless member.

38. The method of claim 35, wherein discharging the seed through the second opening means discharging the seed such that a seed spacing in the furrow during the first mode is equal to a seed spacing in the furrow during the second mode.

39. The method of claim 35, wherein the furrow is formed into a soil through a soil surface, and wherein discharging the seed through the second opening directly to the furrow means discharging the seed through the second opening below the soil surface.

* * * * *