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(54) **ROW-CLEARING UNIT FOR AGRICULTURAL IMPLEMENT**

(71) Applicant: **Dawn Equipment Company**, Sycamore, IL (US)

(72) Inventor: **Joseph D. Bassett**, Sycamore, IL (US)

(73) Assignee: **Dawn Equipment Company**, Sycamore, IL (US)

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(56) **References Cited**

U.S. PATENT DOCUMENTS

114,002	A	4/1871	Godfrey
353,491	A	2/1886	Wells
523,508	A	7/1894	Bauer et al.
736,369	A	8/1903	Dynes et al.
803,088	A	10/1905	Barker

(Continued)

FOREIGN PATENT DOCUMENTS

BE	551372	10/1956
CA	530673	9/1956

(Continued)

OTHER PUBLICATIONS

Case Corporation Brochure, Planters 900 Series Units/Modules Product Information, Aug. 1986 (4 pages).

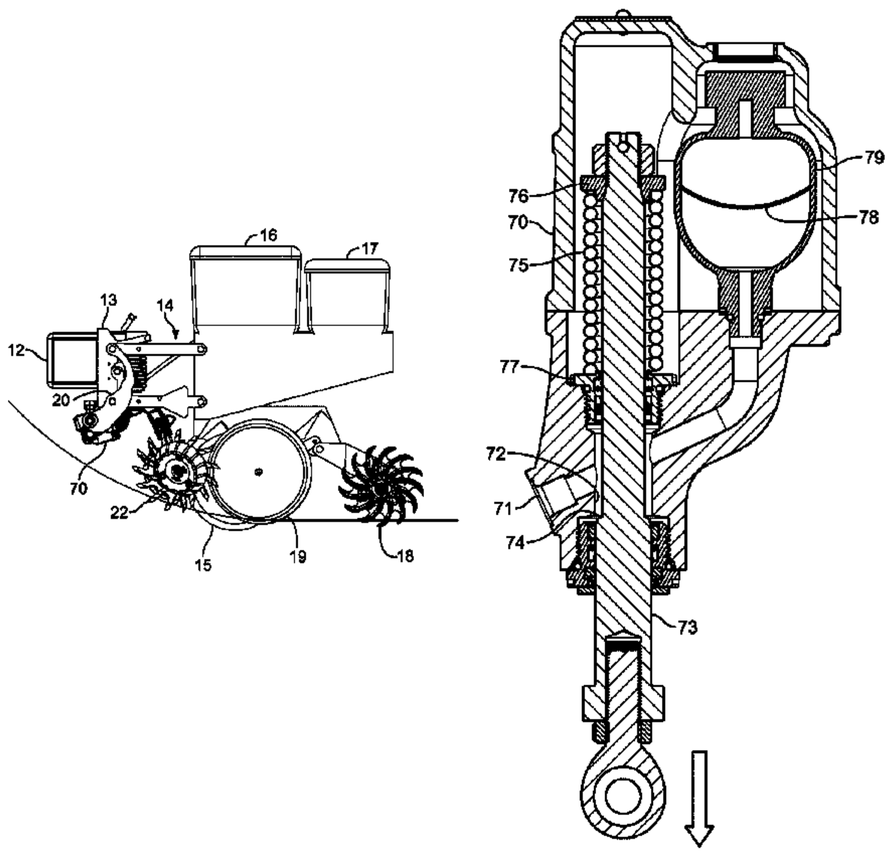
(Continued)

Primary Examiner — Christopher J Novosad
(74) *Attorney, Agent, or Firm* — Nixon Peabody LLP

(57) **ABSTRACT**

An agricultural row-clearing unit for use with an agricultural row unit attached to a towing frame hitched to a tractor comprises an attachment frame adapted to be rigidly connected to the towing frame, a support element having a leading end pivotally connected to the attachment frame for vertical pivoting movement relative to the attachment frame, at least one agricultural tool mounted on the trailing end of the support element, and a hydraulic cylinder connected between the attachment frame and the support element for pivoting the support element around the pivotal connection to the attachment frame. The hydraulic cylinder includes a movable rod coupling the cylinder to the support element, a cavity within the cylinder for receiving pressurized hydraulic fluid for advancing the rod in a direction that pivots the support element downwardly toward the soil, and an energy storage device coupled to the rod and the cylinder to apply a retracting force to the rod to bias the support element in a direction that urges the agricultural tool(s) upwardly away from the soil.

46 Claims, 8 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

1,134,462	A		4/1915	Kendrick
1,158,023	A		10/1915	Beaver
1,247,744	A		11/1917	Trimble
1,260,752	A		3/1918	Casaday
1,321,040	A		11/1919	Hoffman
1,391,593	A		9/1921	Sweeting
1,398,668	A		11/1921	Bordsen
1,791,462	A		2/1931	Bermel
1,901,299	A		3/1933	Johnson
1,901,778	A		3/1933	Schlag
2,014,334	A		9/1935	Johnson
2,058,539	A		10/1936	Welty et al.
2,269,051	A		1/1942	Cahoy
2,341,143	A		2/1944	Herr
2,505,276	A		4/1950	Boroski
2,561,763	A		7/1951	Waters et al.
2,593,176	A		4/1952	Patterson
2,611,306	A		9/1952	Strehlow et al.
2,612,827	A		10/1952	Baggette et al.
2,691,353	A		10/1954	Secondo
2,692,544	A		10/1954	Jessup
2,715,286	A		8/1955	Saveson
2,754,622	A		7/1956	Rohnert
2,771,044	A		11/1956	Putifer
2,773,343	A		12/1956	Oppel
2,777,373	A		1/1957	Pursche
2,799,234	A		7/1957	Chancey
2,805,574	A		9/1957	Jackson, Jr. et al.
2,925,872	A		2/1960	Darnell
2,960,358	A		11/1960	Christison
3,010,744	A		11/1961	Hollis
3,014,547	A		12/1961	Van der Lely
3,038,424	A		6/1962	Johnson
3,042,121	A		7/1962	Broetzman et al.
3,057,092	A		10/1962	Curlett
3,058,243	A		10/1962	McGee
3,065,879	A		11/1962	Jennings et al.
3,110,973	A		11/1963	Reynolds
3,122,901	A		3/1964	Thompson
3,123,152	A		3/1964	Biskis
3,188,989	A		6/1965	Johnston
3,213,514	A		10/1965	Evans
3,250,109	A		5/1966	Spyridakis
3,314,278	A		4/1967	Bergman
3,319,589	A		5/1967	Moran
3,351,139	A		11/1967	Schmitz et al.
3,355,930	A		12/1967	Fedorov
3,370,450	A		2/1968	Scheucher
3,420,273	A		1/1969	Greer
3,433,474	A	*	3/1969	Piret 267/64.16
3,447,495	A		6/1969	Miller et al.
3,539,020	A		11/1970	Andersson et al. 74/527
3,543,603	A		12/1970	Gley 74/529
3,561,541	A		2/1971	Woelfel 172/265
3,576,098	A		4/1971	Brewer 56/295
3,581,685	A		6/1971	Taylor 111/7
3,593,720	A		7/1971	Botterill et al. 130/27
3,606,745	A		9/1971	Girodat 56/20
3,635,495	A		1/1972	Orendorff 280/415
3,653,446	A		4/1972	Kalmon 172/4
3,701,327	A		10/1972	Krumholz 111/81
3,708,019	A		1/1973	Ryan 172/470
3,718,191	A		2/1973	Williams 172/196
3,749,035	A		7/1973	Cayton et al. 111/85
3,753,341	A		8/1973	Berg, Jr. et al. 56/400.04
3,766,988	A		10/1973	Whitesides 172/548
3,774,446	A		11/1973	Diehl 73/194
3,939,846	A		2/1976	Drozhzhin et al. 130/27
3,945,532	A		3/1976	Marks 222/55
3,975,890	A		8/1976	Rodger 56/208
4,009,668	A		3/1977	Brass et al. 111/85
4,018,101	A		4/1977	Mihalic 74/493
4,044,697	A		8/1977	Swanson 111/66
4,055,126	A		10/1977	Brown et al. 111/85
4,058,171	A		11/1977	van der Lely 172/713
4,063,597	A		12/1977	Day 172/126
4,096,730	A		6/1978	Martin 72/352
4,099,576	A		7/1978	Jilani 172/555
4,122,715	A		10/1978	Yokoyama et al. 73/228
4,129,082	A		12/1978	Betulius 111/7
4,141,200	A		2/1979	Johnson 56/10.2
4,141,302	A		2/1979	Morrison, Jr. et al. 111/52
4,141,676	A		2/1979	Jannen et al. 417/539
4,142,589	A		3/1979	Schlagenhauf 172/510
4,147,305	A		4/1979	Hunt 239/167
4,149,475	A		4/1979	Bailey et al. 111/66
4,157,661	A		6/1979	Schindel 73/228
4,173,259	A		11/1979	Heckenkamp 172/10
4,182,099	A		1/1980	Davis et al. 56/16.4
4,187,916	A		2/1980	Harden et al. 172/146
4,191,262	A		3/1980	Sylvester 172/459
4,196,567	A		4/1980	Davis et al. 56/13.7
4,196,917	A		4/1980	Oakes et al. 280/463
4,206,817	A		6/1980	Bowerman 172/559
4,208,974	A		6/1980	Dreyer et al. 111/85
4,213,408	A		7/1980	West et al. 111/85
4,225,191	A		9/1980	Knoski 301/9
4,233,803	A		11/1980	Davis et al. 56/14.9
4,241,674	A		12/1980	Mellinger 111/52
4,280,419	A		7/1981	Fischer 111/80
4,295,532	A		10/1981	Williams et al. 172/184
4,301,870	A		11/1981	Carre et al. 172/7
4,307,674	A		12/1981	Jennings et al. 111/85
4,311,104	A		1/1982	Steilen et al. 111/85
4,317,355	A		3/1982	Hatsuno et al. 72/342
4,359,101	A		11/1982	Gagnon 172/38
4,375,837	A		3/1983	van der Lely et al. 172/68
4,377,979	A		3/1983	Peterson et al. 111/52
4,407,371	A		10/1983	Hohl 172/253
4,430,952	A		2/1984	Murray 111/85
4,433,568	A		2/1984	Kondo 72/356
4,438,710	A		3/1984	Paladino 111/3
4,445,445	A		5/1984	Sterrett 111/7
4,461,355	A		7/1984	Peterson et al. 172/156
4,481,830	A		11/1984	Smith et al. 73/861.71
4,499,775	A		2/1985	Lasoen 73/862.57
4,506,610	A		3/1985	Neal 111/87
4,508,178	A		4/1985	Cowell et al. 172/239
4,528,920	A		7/1985	Neumeyer 111/85
4,530,405	A		7/1985	White 172/126
4,537,262	A		8/1985	van der Lely 172/146
4,538,688	A		9/1985	Szucs et al. 172/555
4,550,122	A		10/1985	David et al. 172/158
4,553,607	A		11/1985	Behn et al. 172/156
4,580,506	A		4/1986	Fleischer et al. 111/7
4,596,200	A		6/1986	Gafford et al. 111/85
4,603,746	A		8/1986	Swales 172/559
4,604,906	A		8/1986	Scarpa 73/861.74
4,630,773	A		12/1986	Ortlip 239/1
4,643,043	A		2/1987	Furuta et al. 74/503
4,646,620	A		3/1987	Buchl 91/1
4,650,005	A		3/1987	Tebben 172/430
4,669,550	A		6/1987	Sittre 172/559
4,671,193	A		6/1987	States 111/73
4,674,578	A		6/1987	Bexten et al. 172/126
4,703,809	A		11/1987	Van den Ende 172/147
4,726,304	A		2/1988	Dreyer et al. 111/73
4,738,461	A		4/1988	Stephenson et al. 280/400
4,744,316	A		5/1988	Lienemann et al. 111/69
4,762,075	A		8/1988	Halford 111/73
4,765,190	A		8/1988	Strubbe 73/861.72
4,768,387	A		9/1988	Kemp et al. 73/861.73
4,779,684	A		10/1988	Schultz 171/62
4,785,890	A		11/1988	Martin 172/29
4,825,957	A		5/1989	White et al. 172/126
4,825,959	A		5/1989	Wilhelm 172/720
4,920,901	A		5/1990	Pounds 111/164
4,926,767	A		5/1990	Thomas 111/187
4,930,431	A		6/1990	Alexander 111/164
4,986,367	A		1/1991	Kinzenbaw 172/126
4,998,488	A		3/1991	Hansson 111/187
5,015,997	A		5/1991	Strubbe 340/684
5,027,525	A		7/1991	Haukaas 33/624
5,033,397	A		7/1991	Colburn, Jr. 111/118

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,065,632	A		11/1991	Reuter	73/861.73
5,074,227	A		12/1991	Schwitters	111/137
5,076,180	A		12/1991	Schneider	111/139
5,092,255	A		3/1992	Long et al.	111/167
5,129,282	A		7/1992	Bassett et al.	74/529
5,136,934	A		8/1992	Darby, Jr.	100/125
5,190,112	A		3/1993	Johnston et al.	172/245
5,234,060	A		8/1993	Carter	172/413
5,240,080	A		8/1993	Bassett et al.	172/740
5,255,617	A		10/1993	Williams et al.	111/140
5,269,237	A		12/1993	Baker et al.	111/121
5,282,389	A		2/1994	Faivre et al.	73/861.73
5,285,854	A		2/1994	Thacker et al.	172/176
5,333,694	A		8/1994	Roggenbuck et al.	172/156
5,337,832	A		8/1994	Bassett	172/504
5,341,754	A		8/1994	Winterton	111/139
5,346,019	A		9/1994	Kinzenbaw et al.	172/311
5,346,020	A		9/1994	Bassett	172/540
5,349,911	A		9/1994	Holst et al.	111/139
5,351,635	A		10/1994	Hulicsko	111/135
5,379,847	A		1/1995	Snyder	172/128
5,394,946	A		3/1995	Clifton et al.	172/139
5,398,771	A		3/1995	Hornung et al.	172/311
5,419,402	A		5/1995	Heintzman	172/551
5,427,192	A		6/1995	Stephenson et al.	180/53.1
5,443,023	A		8/1995	Carroll	111/191
5,443,125	A		8/1995	Clark et al.	172/608
5,461,995	A	*	10/1995	Winterton	111/139
5,462,124	A		10/1995	Rawson	172/569
5,473,999	A		12/1995	Rawson et al.	111/127
5,477,682	A		12/1995	Tobiasz	60/583
5,477,792	A		12/1995	Bassett et al.	111/121
5,479,868	A		1/1996	Bassett	111/139
5,479,992	A		1/1996	Bassett	172/4
5,485,796	A		1/1996	Bassett	111/33
5,485,886	A		1/1996	Bassett	172/763
5,497,717	A		3/1996	Martin	111/191
5,497,837	A		3/1996	Kehrney	172/619
5,499,683	A		3/1996	Bassett	172/4
5,499,685	A		3/1996	Downing, Jr.	172/699
5,517,932	A		5/1996	Ott et al.	111/193
5,524,525	A		6/1996	Nikkel et al.	91/179
5,531,171	A		7/1996	Whitesel et al.	111/121
5,542,362	A		8/1996	Bassett	111/120
5,544,709	A		8/1996	Lowe et al.	172/661
5,562,165	A		10/1996	Janelle et al.	172/4
5,590,611	A		1/1997	Smith	111/127
5,603,269	A		2/1997	Bassett	111/52
5,623,997	A		4/1997	Rawson et al.	172/156
5,640,914	A		6/1997	Rawson	111/140
5,657,707	A		8/1997	Dresher et al.	111/139
5,660,126	A		8/1997	Freed et al.	111/140
5,685,245	A		11/1997	Bassett	111/62
5,704,430	A		1/1998	Smith et al.	172/29
5,709,271	A		1/1998	Bassett	172/4
5,727,638	A		3/1998	Wodrich et al.	172/414
5,852,982	A		12/1998	Peter	111/118
5,868,207	A		2/1999	Langbakk et al.	172/274
5,878,678	A		3/1999	Stephens et al.	111/139
RE36,243	E		7/1999	Rawson et al.	111/121
5,970,891	A		10/1999	Schlagel	111/135
5,970,892	A		10/1999	Wendling et al.	111/139
5,988,293	A		11/1999	Brueggen et al.	172/414
6,067,918	A		5/2000	Kirby	111/121
6,164,385	A		12/2000	Buchl	172/239
6,223,663	B1		5/2001	Wendling et al.	111/139
6,223,828	B1		5/2001	Paulson et al.	171/63
6,237,696	B1		5/2001	Mayerle	172/558
6,253,692	B1		7/2001	Wendling et al.	
6,314,897	B1		11/2001	Hagny	111/192
6,325,156	B1		12/2001	Barry	172/518
6,330,922	B1		12/2001	King	172/166
6,331,142	B1		12/2001	Bischoff	460/112
6,343,661	B1		2/2002	Thompson et al.	172/444
6,347,594	B1		2/2002	Wendling et al.	111/167
6,382,326	B1		5/2002	Goins et al.	172/239
6,389,999	B1		5/2002	Duello	111/200
6,453,832	B1		9/2002	Schaffert	111/150
6,454,019	B1		9/2002	Prairie et al.	172/677
6,460,623	B1		10/2002	Knussman et al.	
6,516,595	B2		2/2003	Rhody et al.	56/10.2 E
6,530,334	B2		3/2003	Hagny	111/189
6,575,104	B2		6/2003	Brummelhuis	111/139
6,644,224	B1		11/2003	Bassett	111/157
6,701,856	B1		3/2004	Zoke et al.	111/121
6,701,857	B1		3/2004	Jensen et al.	111/200
6,786,130	B2		9/2004	Steinlage et al.	91/390
6,834,598	B2		12/2004	Jüptner	111/140
6,840,853	B2		1/2005	Foth	460/111
6,886,650	B2		5/2005	Bremmer	180/89.13
6,912,963	B2		7/2005	Bassett	111/163
6,986,313	B2		1/2006	Halford et al.	111/186
6,997,400	B1		2/2006	Hanna et al.	239/383
7,004,090	B2		2/2006	Swanson	111/119
7,044,070	B2		5/2006	Kaster et al.	111/62
7,063,167	B1		6/2006	Staszak et al.	172/328
7,159,523	B2		1/2007	Bourgault et al.	111/187
7,222,575	B2		5/2007	Bassett	111/140
7,290,491	B2		11/2007	Summach et al.	111/181
7,360,494	B2		4/2008	Martin	111/164
7,360,495	B1		4/2008	Martin	111/164
7,438,006	B2		10/2008	Mariman et al.	111/164
7,451,712	B2		11/2008	Bassett et al.	111/140
7,523,709	B1		4/2009	Kiest	111/119
7,540,333	B2		6/2009	Bettin et al.	172/744
7,575,066	B2		8/2009	Bauer	172/540
7,584,707	B2		9/2009	Sauder et al.	111/140
7,665,539	B2		2/2010	Bassett et al.	172/540
7,743,718	B2		6/2010	Bassett	111/135
7,870,827	B2		1/2011	Bassett	111/119
7,938,074	B2		5/2011	Liu	111/200
7,946,231	B2		5/2011	Martin et al.	111/60
8,146,519	B2		4/2012	Bassett	111/119
8,151,717	B2		4/2012	Bassett	111/135
8,327,780	B2		12/2012	Bassett	111/119
8,359,988	B2		1/2013	Bassett	111/135
8,380,356	B1		2/2013	Zielke et al.	700/284
8,386,137	B2		2/2013	Sauder et al.	701/50
8,393,407	B2		3/2013	Freed	172/551
8,408,149	B2		4/2013	Rylander	111/140
6,644,224	C1		6/2013	Bassett	111/157
6,912,963	C1		6/2013	Bassett	111/163
7,222,575	C1		7/2013	Bassett	111/140
8,544,397	B2		10/2013	Bassett	111/167
8,544,398	B2		10/2013	Bassett	111/167
8,550,020	B2		10/2013	Sauder et al.	111/200
8,573,319	B1		11/2013	Casper et al.	172/4
8,634,992	B2		1/2014	Sauder et al.	701/50
8,636,077	B2		1/2014	Bassett	172/195
2002/0162492	A1		11/2002	Juptner	111/140
2006/0102058	A1		5/2006	Swanson	111/119
2006/0191695	A1		8/2006	Walker et al.	172/452
2006/0237203	A1		10/2006	Miskin	172/799.5
2007/0044694	A1		3/2007	Martin	111/121
2007/0272134	A1		11/2007	Baker et al.	111/163
2008/0093093	A1		4/2008	Sheppard et al.	172/2
2008/0236461	A1		10/2008	Sauder et al.	111/170
2008/0256916	A1		10/2008	Vaske et al.	56/13.5
2010/0019471	A1		1/2010	Ruckle et al.	280/504
2010/0108336	A1		5/2010	Thomson et al.	172/795
2010/0180695	A1		7/2010	Sauder et al.	73/862.045
2010/0198529	A1		8/2010	Sauder et al.	702/41
2010/0282480	A1		11/2010	Breker et al.	172/170
2011/0247537	A1		10/2011	Freed	111/140
2011/0313575	A1		12/2011	Kowalchuk et al.	700/282
2012/0167809	A1		7/2012	Bassett	111/119
2012/0186216	A1		7/2012	Vaske et al.	56/367
2012/0210920	A1		8/2012	Bassett	111/140
2012/0216731	A1		8/2012	Schilling et al.	111/69
2012/0232691	A1		9/2012	Green et al.	700/231
2012/0255475	A1		10/2012	Mariman et al.	111/149
2012/0305274	A1		12/2012	Bassett	172/5
2013/0000535	A1		1/2013	Martin et al.	111/149
2013/0032363	A1		2/2013	Curry et al.	172/4

(56) **References Cited**

U.S. PATENT DOCUMENTS

2013/0112121	A1	5/2013	Achen et al.	111/14
2013/0112124	A1	5/2013	Bergen et al.	111/151
2013/0133904	A1	5/2013	Bassett	172/239
2013/0146318	A1	6/2013	Bassett	172/5
2013/0192186	A1	8/2013	Bassett	56/10.2 E
2013/0199808	A1	8/2013	Bassett	172/260.5
2013/0213676	A1	8/2013	Bassett	172/260.5
2013/0248212	A1	9/2013	Bassett	172/4
2013/0264078	A1	10/2013	Bassett	172/260.5
2013/0306337	A1	11/2013	Bassett	172/260.5
2013/0333599	A1	12/2013	Bassett et al.	111/62
2014/0026748	A1	1/2014	Stoller et al.	91/418
2014/0026792	A1	1/2014	Bassett	111/121
2014/0033958	A1	2/2014	Bassett	111/193
2014/0034339	A1	2/2014	Sauder et al.	172/2
2014/0034343	A1	2/2014	Sauder et al.	172/664
2014/0034344	A1	2/2014	Bassett	172/5
2014/0048001	A1	2/2014	Bassett	111/59
2014/0048295	A1	2/2014	Bassett	172/2
2014/0048296	A1	2/2014	Bassett	172/4
2014/0048297	A1	2/2014	Bassett	172/4
2014/0060864	A1	3/2014	Martin et al.	172/260.5

FOREIGN PATENT DOCUMENTS

DE	335464		9/1921	
DE	1108971		6/1961	
DE	24 02 411		7/1975	
EP	2 497 348	A1	9/2012	A01B 79/00
GB	1 574 412		9/1980	111/123
GB	2 056 238	A	10/1982	
JP	54-57726		5/1979	74/529
SU	392897		8/1973	
SU	436778		7/1974	
SU	611201		6/1978	74/527
SU	625648		9/1978	
SU	1410884	A1	7/1988	
SU	1466674		3/1989	111/124
WO	WO 2011/161140	A1	12/2011	A01C 7/20
WO	WO 2012/149367	A1	1/2012	A01C 5/00
WO	WO 2012/149415	A1	1/2012	A01B 63/11
WO	WO 2012/167244	A1	12/2012	A01B 5/00
WO	WO 2013/025898	A1	2/2013	B60C 23/02

OTHER PUBLICATIONS

Buffalo Farm Equipment All Flex Cultivator Operator Manual, Apr. 1990 (7 pages).

Shivvers, Moisture Trac 3000 Brochure, Aug. 21, 1990 (5 pages).

The New Farm, "*New Efficiencies in Nitrogen Application,*" Feb. 1991, p. 6 (1 page).

Hiniker Company, Flow & Acreage Continuous Tracking System Monitor Demonstration Manuel, date estimated as early as Feb. 1991 (7 pages).

Russnogle, John, "*Sky Spy: Gulf War Technology Pinpoints Field and Yields,*" Top Producer, A Farm Journal Publication, Nov. 1991, pp. 12-14 (4 pages).

Borgelt, Steven C., "*Sensor Technologies and Control Strategies for Managing Variability,*" University of Missouri, Apr. 14-16, 1992 (15 pages).

Buffalo Farm Equipment Catalog on Models 4600, 4630, 4640, and 4620, date estimated as early as Feb. 1992 (4 pages).

Hiniker 5000 Cultivator Brochure, date estimated as early as Feb. 1992 (4 pages).

Hiniker Series 5000 Row Cultivator Rigid and Folding Toolbar Operator's Manual, date estimated as early as Feb. 1992 (5 pages).

Orthman Manufacturing, Inc., Rowcrop Cultivator Booklet, date estimated as early as Feb. 1992 (4 pages).

Yetter Catalog, date estimated as early as Feb. 1992 (4 pages).

Exner, Rick, "*Sustainable Agriculture: Practical Farmers of Iowa Reducing Weed Pressure in Ridge-Till,*" Iowa State University University Extension, http://www.extension.iastate.edu/Publications/SA2.pdf, Jul. 1992, Reviewed Jul. 2009, retrieved Nov. 2, 2012 (4 pages).

Finck, Charlene, "*Listen to Your Soil,*" Farm Journal Article, Jan. 1993, pp. 14-15 (2 pages).

Acu-Grain, "*Combine Yield Monitor 99% Accurate? 'You Bet Your Bushels*!!'" date estimated as early as Feb. 1993 (2 pages).

John Deere, New 4435 Hydro Row-Crop and Small-Grain Combine, date estimated as early as Feb. 1993 (8 pages).

Vansichen, R. et al., "*Continuous Wheat Yield Measurement on a Combine,*" date estimated as early as Feb. 1993 (5 pages).

Yetter 2010 Product Catalog, date estimated as early as Jan. 2010 (2 pages).

Yetter Cut and Move Manual, Sep. 2010 (28 pages).

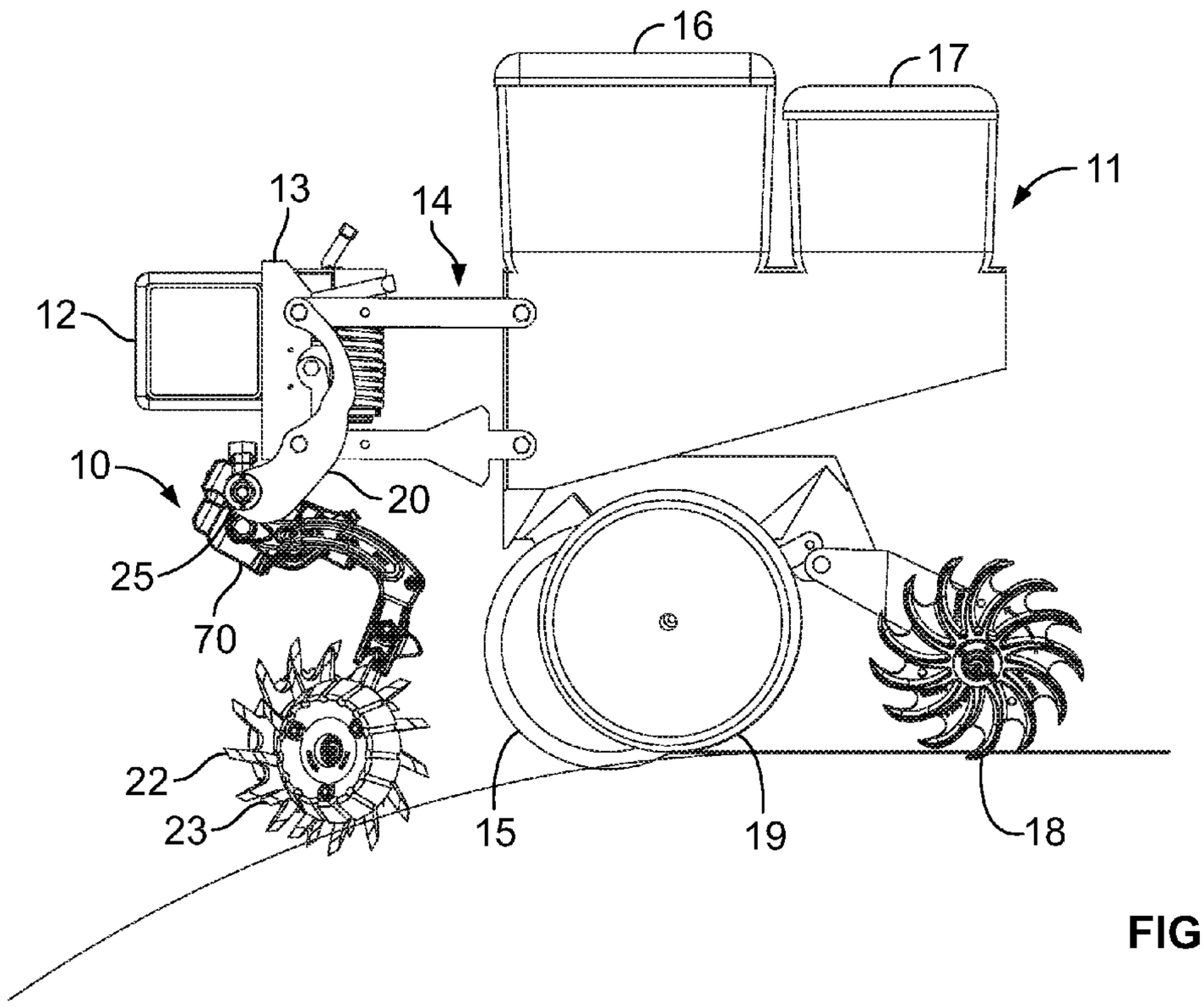
John Deere, Seat Catalog, date estimated as early Sep. 2011 (19 pages).

Martin Industries, LLC Paired 13" Spading Closing Wheels Brochure, date estimated as early as Jun. 6, 2012, pp. 18-25 (8 pages).

Vogt, Willie, "*Revisiting Robotics,*" http://m.farmindustrynews.com/farm-equipment/revisiting-robotics, Dec. 19, 2013 (3 pages).

John Deere, New Semi-Active Sea Suspension, http://www.deere.com/en_US/parts/agparts/semiactiveseat.html, date estimated as early as Jan. 2014, retrieved Feb. 6, 2014 (2 pages).

* cited by examiner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17
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12
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70
22
23
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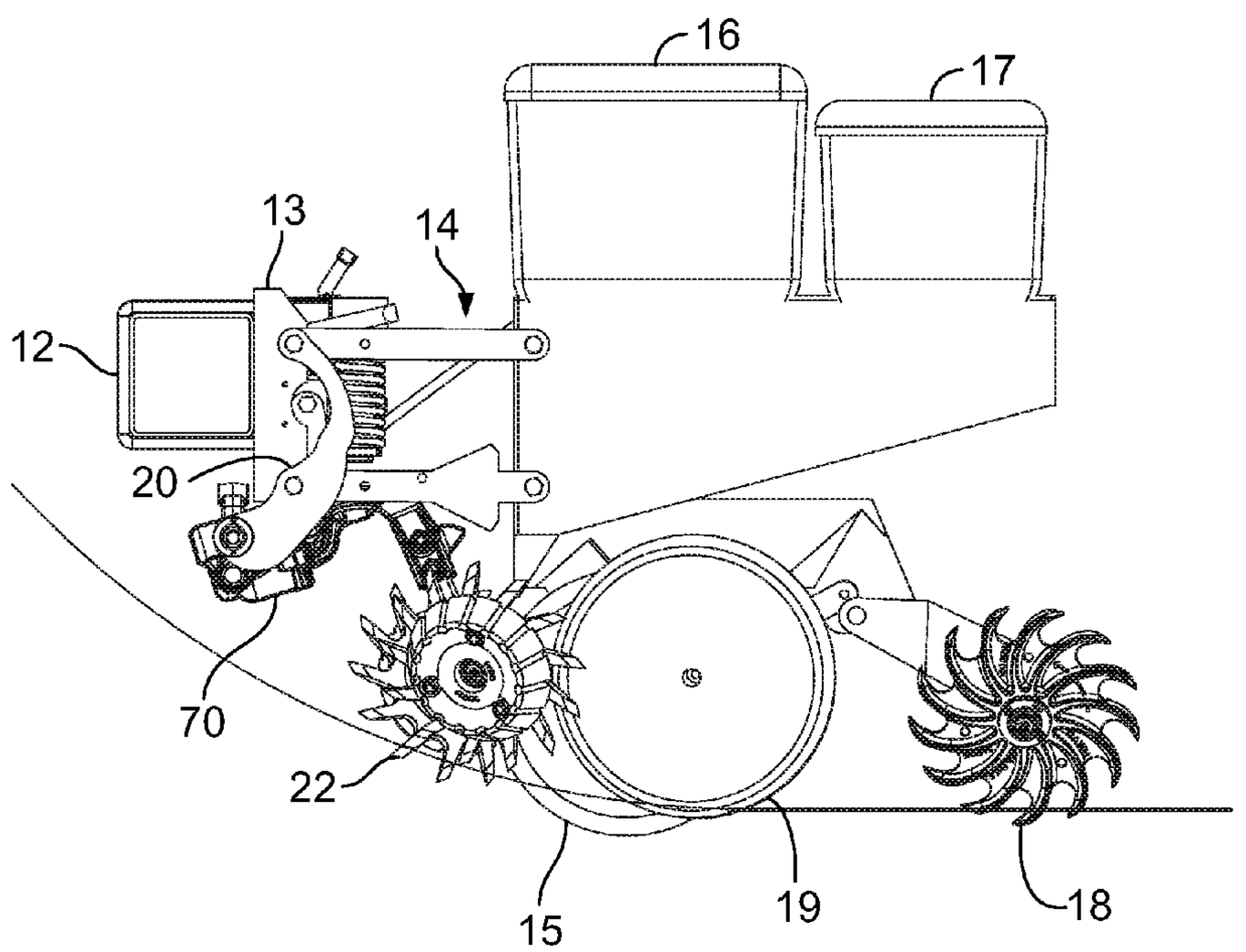
19
18

FIG. 1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13
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70
22
15
19
18

FIG. 2

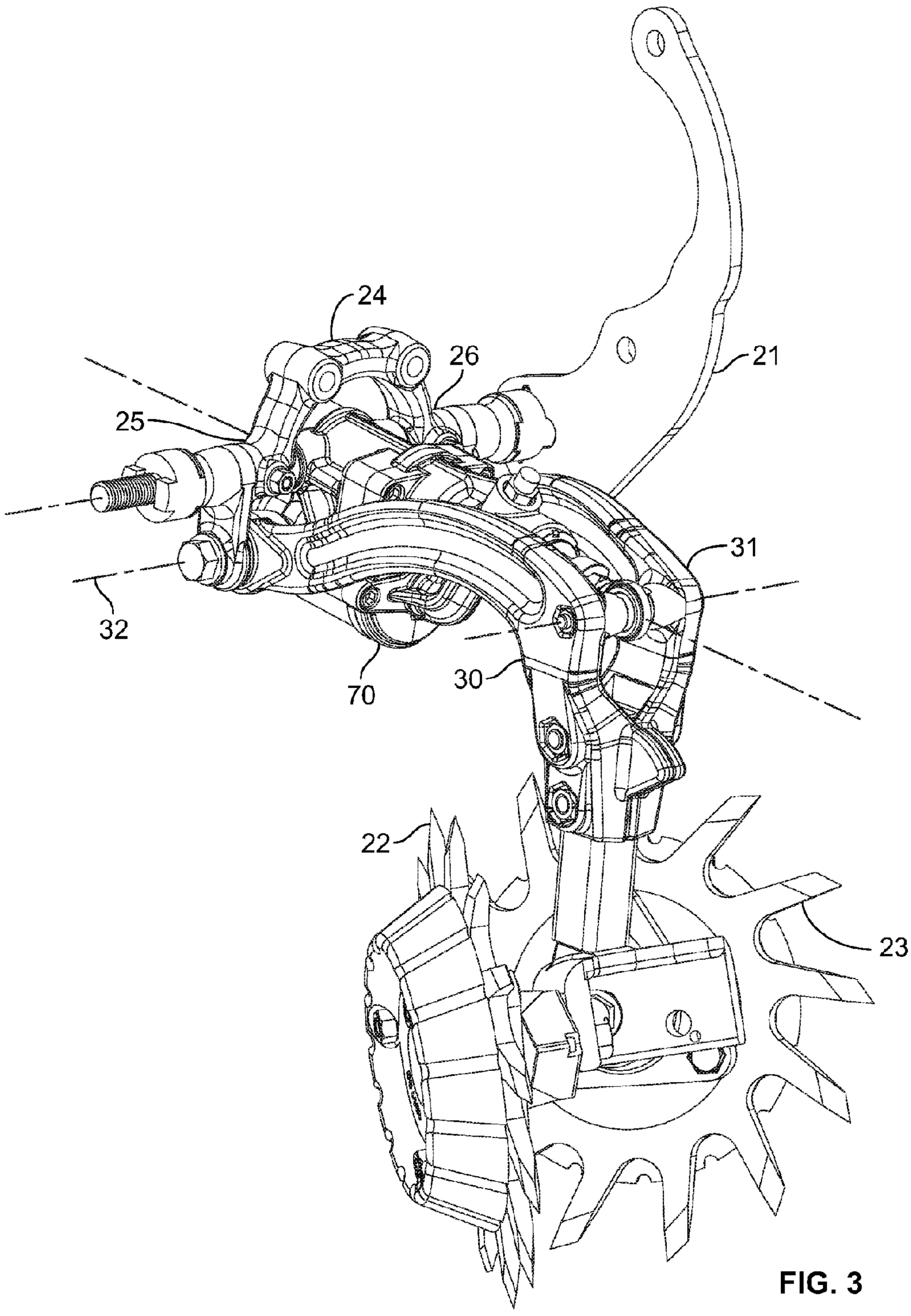

FIG. 3

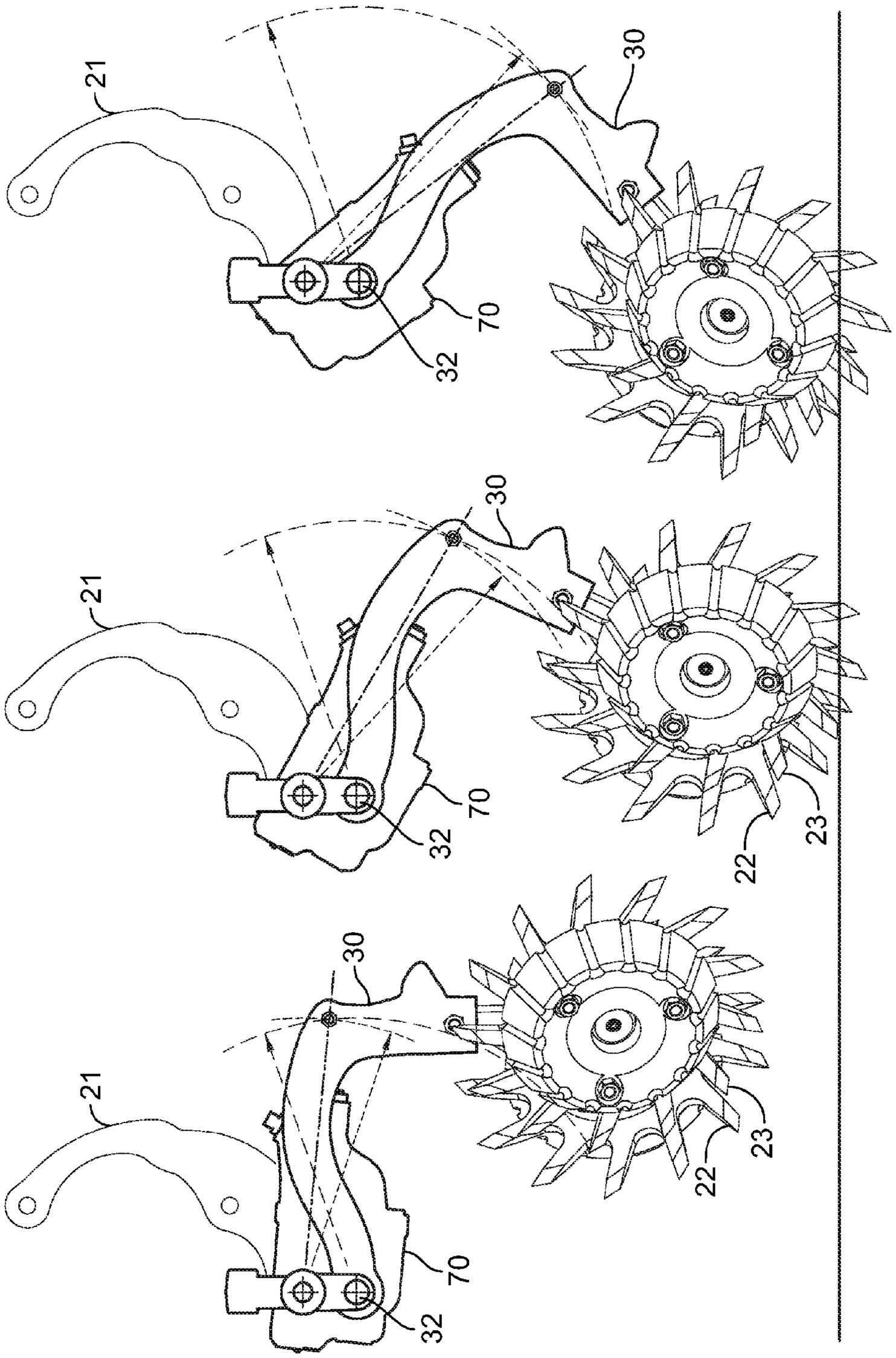

FIG. 6

FIG. 5

FIG. 4

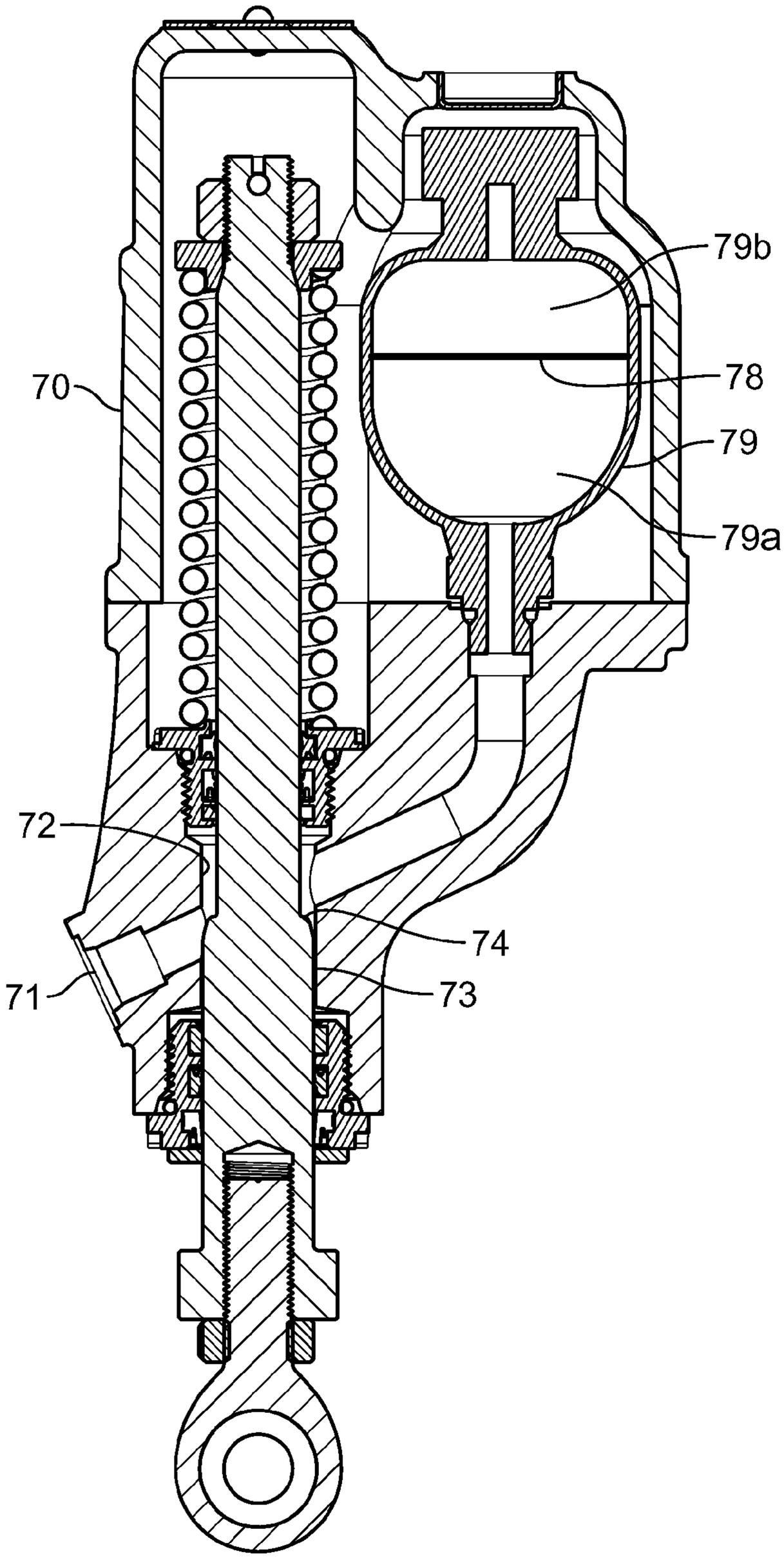

FIG. 7

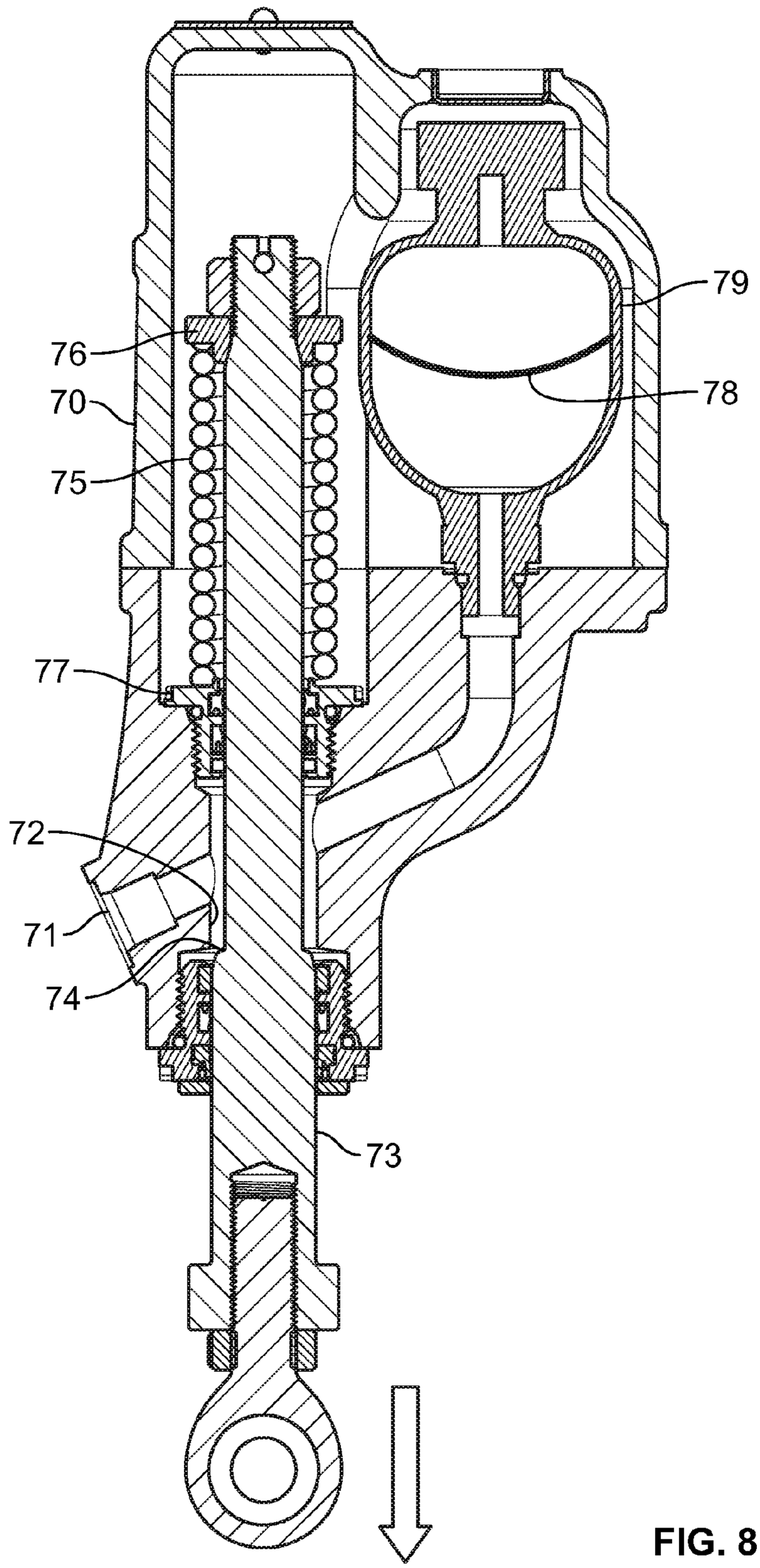

FIG. 8

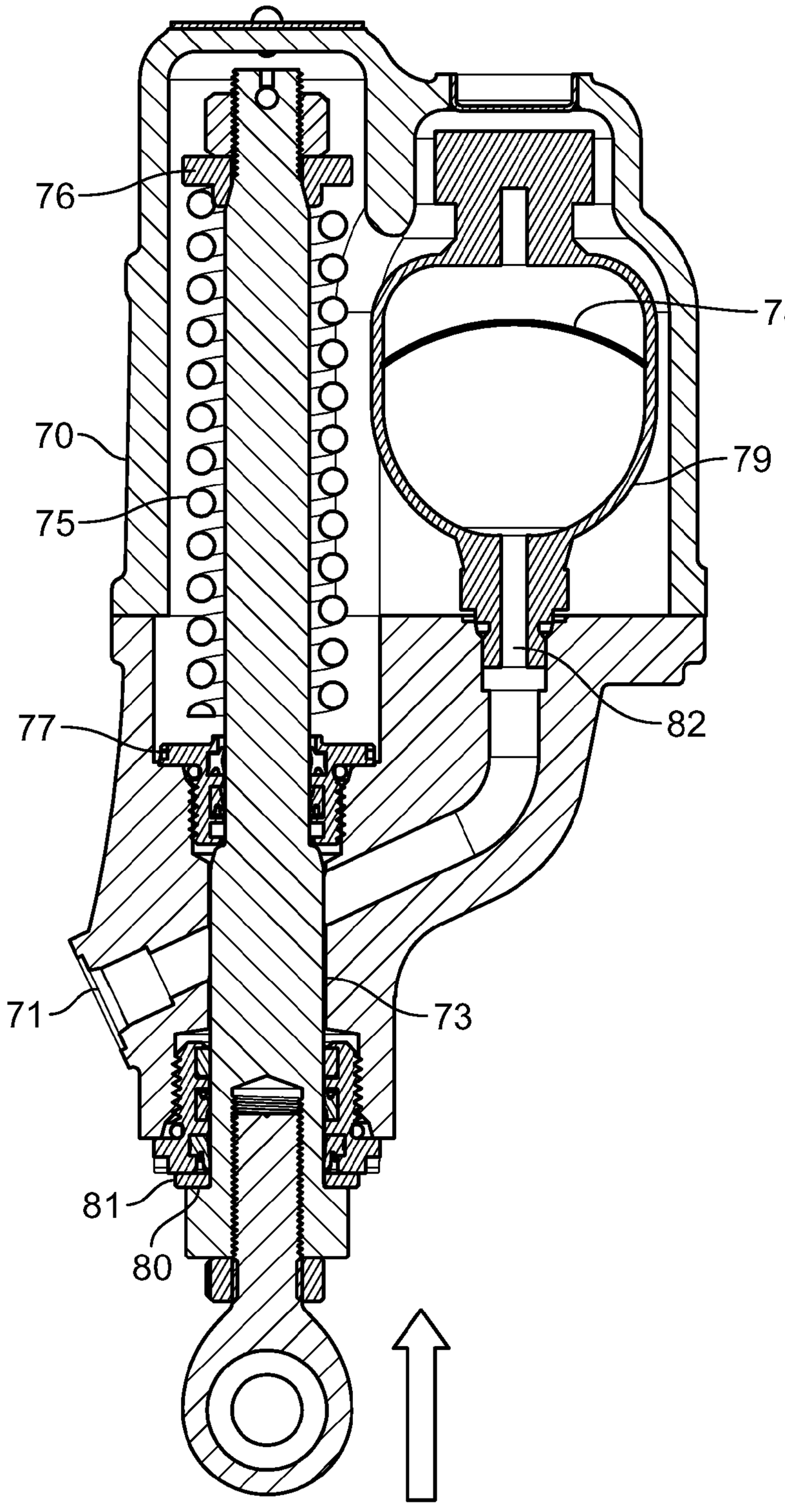

FIG. 9

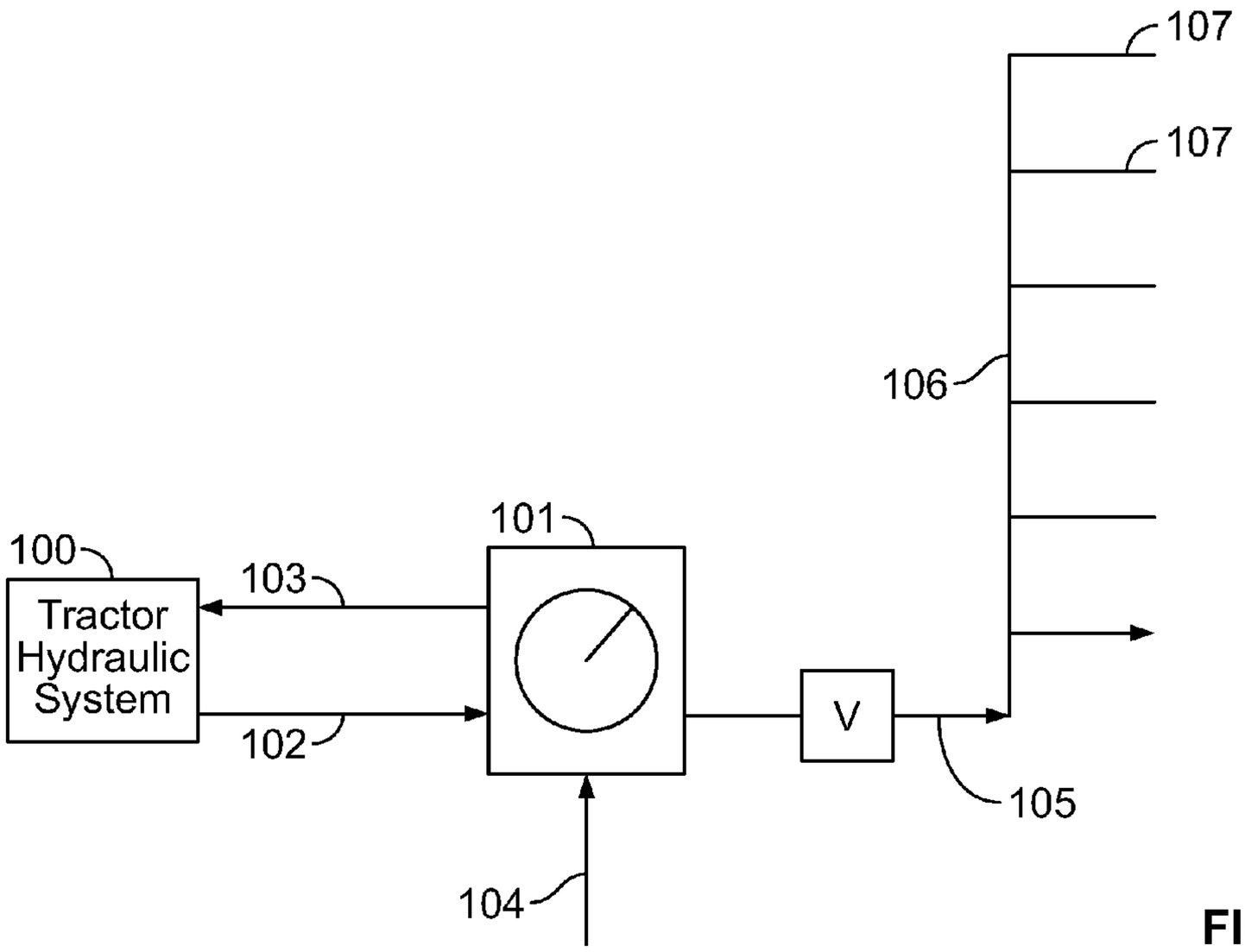
107
107
106
100
Tractor Hydraulic System
103
101
102
V
105
104

FIG. 10

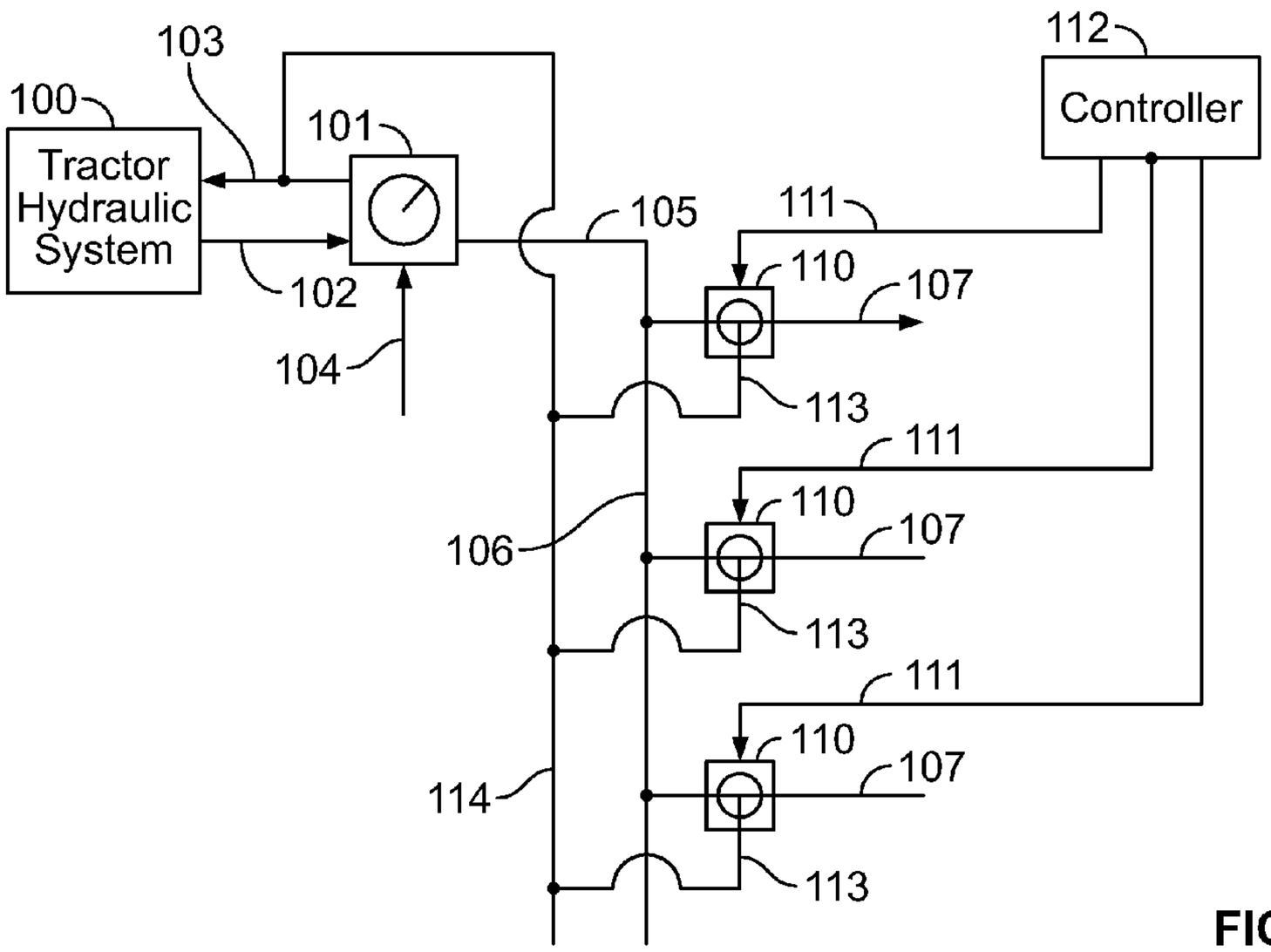
103
100
Tractor Hydraulic System
101
102
104
105
112
Controller
111
110
107
113
111
110
107
106
113
111
110
107
114
113

FIG. 11

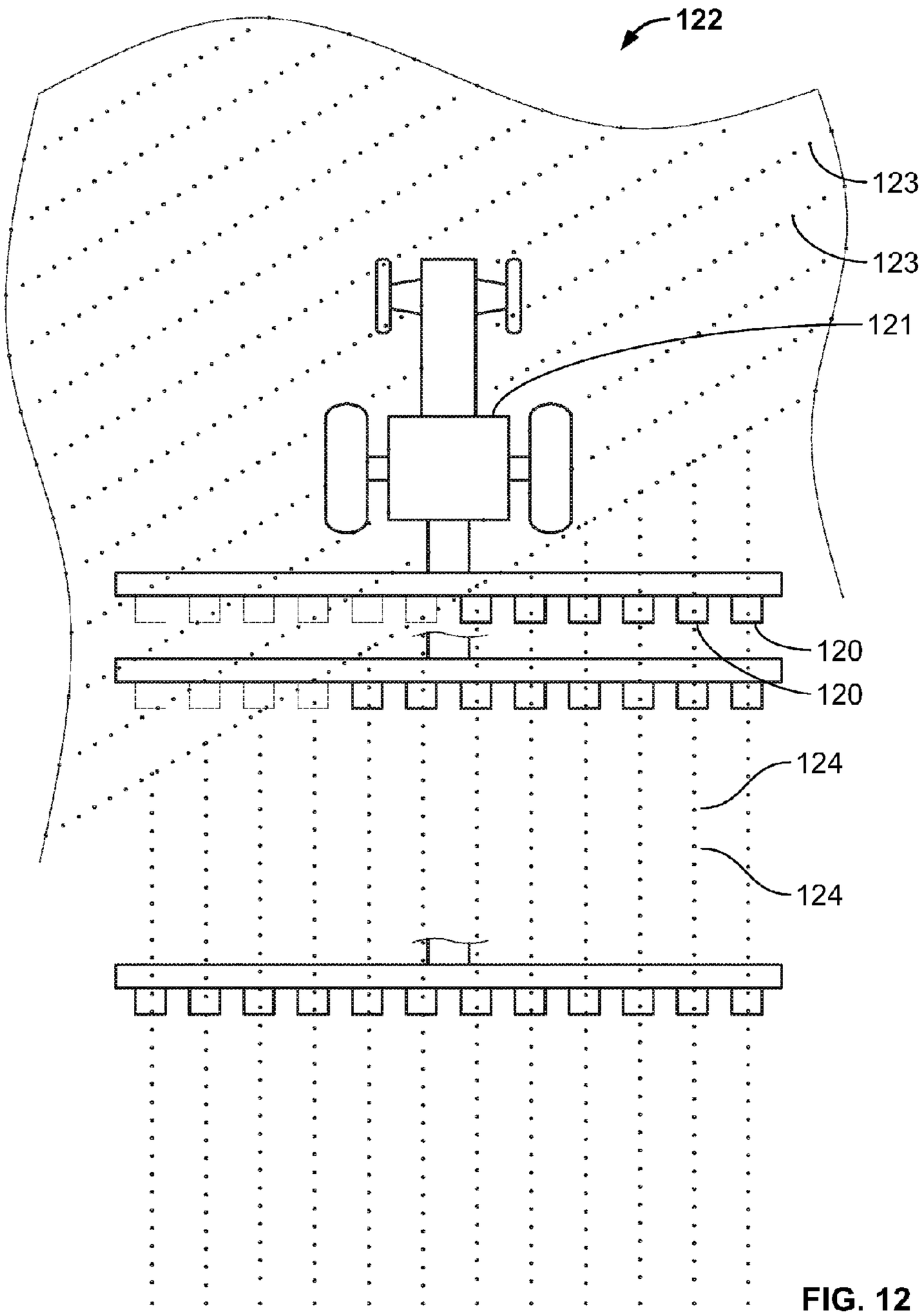

FIG. 12

ROW-CLEARING UNIT FOR AGRICULTURAL IMPLEMENT

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.

FIELD OF THE INVENTION

The present invention relates to agricultural implements and, more particularly, to an agricultural row-clearing unit for use with agricultural implements such as planting row units.

SUMMARY OF THE INVENTION

In one embodiment, an agricultural row clearing unit for use with an agricultural planter row unit attached to a towing frame hitched to a tractor comprises an attachment frame adapted to be rigidly connected to the towing frame, a support element having a leading end pivotally connected to the attachment frame for vertical pivoting movement relative to the attachment frame, at least one agricultural tool mounted on the trailing end of the support element, and a hydraulic cylinder connected between the attachment frame and the support element for pivoting the support element around the pivotal connection to the attachment frame. The hydraulic cylinder includes a movable rod coupling the cylinder to the support element, a cavity within the cylinder for receiving pressurized hydraulic fluid for advancing the rod in a direction that pivots the support element downwardly, and an energy storage device coupled to the rod and the cylinder to apply a retracting force to the rod to bias the support element in a direction that urges the agricultural tool(s) upwardly away from the soil.

One implementation also includes an accumulator having a fluid chamber containing a diaphragm. The portion of the chamber on one side of the diaphragm is connected to the hydraulic-fluid cavity in said hydraulic cylinder, and the portion of the chamber on the other side of the diaphragm contains a pressurized gas.

In one particular implementation, the energy storage device is a compressed coil spring disposed around a portion of the movable rod with one end of the spring coupled to said rod and the other end of the spring coupled to the cylinder so that the spring continuously biases the movable rod in a retracting direction relative to the cylinder.

In modified embodiments, the row-clearing wheels may be replaced with other agricultural tools, such as fertilizer openers or rollers to firm loose soil. With the row-clearing wheels or any other agricultural tools, the unit may be used without a planting row unit, or any other row unit, and the frame element may be connected directly to the towing frame.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may best be understood by reference to the following description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a side elevation of a planting row unit and a row-clearing unit, both attached to a towing frame, with the row-clearing unit in a lowered position.

FIG. **2** is the same side elevation shown in FIG. **1** with the row-clearing unit in a raised position.

FIG. **3** is an enlarged perspective of the row-clearing unit shown in FIGS. **1** and **2**.

FIGS. **4**, **5** and **6** are side elevations of the main components of the row-clearing unit shown in FIGS. **1-3** in three different vertical positions.

FIGS. **7**, **8** and **9** are side elevations of the hydraulic cylinder of the row-clearing unit shown in FIGS. **1-6** with the cylinder rod in three different positions corresponding to the positions shown in FIGS. **5**, **6** and **4**, respectively.

FIG. **10** is a schematic diagram of a first hydraulic control system for use in the row-clearing unit shown in FIGS. **1-6**.

FIG. **11** is a schematic diagram of a second hydraulic control system for use in the row-clearing unit shown in FIGS. **1-6**.

FIG. **12** is a diagram illustrating one application of the hydraulic control system of FIG. **11**.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

Although the invention will be described in connection with certain preferred embodiments, it will be understood that the invention is not limited to those particular embodiments. On the contrary, the invention is intended to cover all alternatives, modifications, and equivalent arrangements as may be included within the spirit and scope of the invention as defined by the appended claims.

Turning now to the drawings, the illustrative implement includes a row-clearing unit **10** mounted in front of a planting row unit **11**. A common elongated hollow towing frame **12** (typically hitched to a tractor by a draw bar) is rigidly attached to the front frame **13** of a four-bar linkage assembly **14** that is part of the row unit **11**. The four-bar (sometimes referred to as "parallel-bar") linkage assembly **14** is a conventional and well known linkage used in agricultural implements to permit the raising and lowering of tools attached thereto.

As the planting row unit **11** is advanced by the tractor, a coulter wheel **15** works the soil and then other portions of the row unit part the cleared soil to form a seed slot, deposit seed in the seed slot and fertilizer adjacent to the seed slot, and close the seed slot by distributing loosened soil into the seed slot with a closing wheel **18**. A gauge wheel **19** determines the planting depth for the seed and the height of introduction of fertilizer, etc. Bins **16** and **17** on the row unit carry the chemicals and seed which are directed into the soil. The planting row unit **11** is urged downwardly against the soil by its own weight. If it is desired to have the ability to increase this downward force, or to be able to adjust the force, a hydraulic or pneumatic cylinder and/or one or more springs may be added between the front frame **13** and the linkage **14** to urge the row unit downwardly with a controllable force. Such a hydraulic cylinder may also be used to lift the row unit off the ground for transport by a heavier, stronger, fixed-height frame that is also used to transport large quantities of fertilizer for application via multiple residue-clearing and tillage row units. This hydraulic or pneumatic cylinder may be controlled to adjust the downward force for different soil conditions such as is described in U.S. Pat. Nos. 5,709,271, 5,685,245 and 5,479,992.

The row-clearing unit **10** includes an attachment frame that includes a pair of rigid arms **20** and **21** adapted to be rigidly connected to the towing frame **12**. In the illustrative embodiment, the arms **20** and **21** are bolted to opposite sides of the front frame **13** of the row unit **11**, which in turn is rigidly attached to the towing frame **12**. An alternative is to attach the row-clearing unit **10** directly to the towing frame **12**. At the bottom of the row-clearing unit **10**, a pair of cooperating toothed clearing wheels **22** and **23** are positioned upstream of the coulter wheel **15** of the planting row unit **11**.

The clearing wheels **22**, **23** are arranged for rotation about transverse axes and are driven by the underlying soil as the wheels are advanced over the soil. The illustrative wheels **22**, **23** are a type currently sold by the assignee of the present invention under the trademark TRASHWHEEL. The toothed wheels **22**, **23** cooperate to produce a scissors action that breaks up compacted soil and simultaneously clears residue out of the path of planting. The wheels **21** and **22** kick residue off to opposite sides, thus clearing a row for planting. To this end, the lower edges are tilted outwardly to assist in clearing the row to be planted. This arrangement is particularly well suited for strip tilling, where the strip cleared for planting is typically only about 10 inches of the 30-inch center-to-center spacing between planting rows.

In FIGS. **1** and **2**, the clearing wheels **22** and **23** are shown in two different vertical positions. Specifically, the wheels **22**, **23** are in a lower position in FIG. **1**, where the elevation of the soil is decreasing, than in FIG. **2**, where the soil elevation is increasing.

The row-clearing unit **10** is shown in more detail in FIGS. **3-9**. The two frame arms **20**, **21** are interconnected by an arched crossbar **24** that includes a pair of journals **25** and **26** for receiving the leading ends of a pair of laterally spaced support arms **30** and **31**. The support arms **30**, **31** are thus pivotally suspended from the crossbar **24** of the attachment frame, so that the trailing ends of the support arms **30**, **31** can be pivoted in an arc around a horizontal axis **32** extending through the two journals **25**, **26**.

The row-clearing wheels **22** and **23** are mounted on the trailing ends of the support arms **30** and **31**, which are bolted or welded together. As can be seen in FIGS. **4-6**, the wheels **22**, **23** can be raised and lowered by pivoting the support arms **30**, **31** around the horizontal axis **32**. The pivoting movement of the support arms **30**, **31** is controlled by a hydraulic cylinder **70** connected between the fixed crossbar **24** and the trailing ends of the support arms **30**, **31**. FIGS. **4-6** show the support arms **30**, **31**, and thus the clearing wheels **22**, **23**, in progressively lower positions. The downward pressure applied to the support arms **30**, **31** to urge the clearing wheels **22**, **23** against the soil is also controlled by the hydraulic cylinder **70**.

The hydraulic cylinder **70** is shown in more detail in FIGS. **7-9**. Pressurized hydraulic fluid from the tractor is supplied by a hose (not shown) to a port **71** that leads into an annular cavity **72** surrounding a rod **73**, and then on into an accumulator **79**. After the internal cavities connected to the port **71** are filled with pressurized hydraulic fluid, the port is closed by a valve, as will be described in more detail below. The lower end of the annular cavity **72** is formed by a shoulder **74** on the rod **73**, so that the hydraulic pressure exerted by the hydraulic fluid on the surface of the shoulder **74** urges the rod **73** downwardly (as viewed in FIGS. **7-9**), with a force determined by the pressure of the hydraulic fluid and the area of the exposed surface of the shoulder **74**. The hydraulic fluid thus urges the rod **73** in an advancing direction (see FIG. **8**).

When the rod **73** is advanced outwardly from the cylinder **70**, the rod pivots the support arms **30**, **31** downwardly, thereby lowering the clearing wheels **22**, **23**. Conversely, retracting movement of the rod **73** pivots the support arms **30**, **31** upwardly, thereby raising the clearing wheels **22**, **23**.

The accumulator **79** includes a diaphragm that divides the interior of the accumulator into a hydraulic-fluid chamber **79**a and a gas-filled chamber **79**b, e.g., filled with pressurized nitrogen. FIG. **7** shows the rod **73** in a position where the diaphragm is not deflected in either direction, indicating that the pressures exerted on opposite sides of the diaphragm are substantially equal. In FIG. **8**, the hydraulic force has advanced the rod **73** to its most advanced position, which occurs when the resistance offered by the soil to downward movement of the clearing wheels **22**, **23** is reduced (e.g., by softer soil or a depression in the soil).

As can be seen in FIG. **8**, advancing movement of the rod **73** is limited by the "bottoming out" of a coil spring **75** located between a flange **76** attached to the inner end of the rod **73** and a flange **77** attached to the interior of the cylinder **70**. As the rod **73** is advanced, the coil spring **75** is progressively compressed until it reaches its fully compressed condition illustrated in FIG. **8**, which prevents any further advancement of the rod **73**. Advancing movement of the rod **73** also expands the size of the annular cavity **72** (see FIG. **8**), which causes the diaphragm **78** in the accumulator **79** to deflect to the position illustrated in FIG. **8** and reduce the amount of hydraulic fluid in the accumulator **80**. When the rod **73** is in this advanced position, the support arms **30**, **31** and the clearing wheels **22**, **23** are pivoted to their lowermost positions relative to the row unit **11**.

In FIG. **9**, the rod **73** has been withdrawn to its most retracted position, which can occur when the clearing wheels **22**, **23** encounter a rock or other obstruction, for example. When the rod **73** is in this retracted position, the support arms **30**, **31** and the clearing wheels **22**, **23** are pivoted to their uppermost positions relative to the row unit. As can be seen in FIG. **9**, retracting movement of the rod **73** is limited by engagement of a shoulder **80** on the rod **73** with a ring **81** on the trailing end of the cylinder **70**. As the rod **73** is retracted by forces exerted on the clearing wheels **22**, **23**, the coil spring **75** is progressively expanded, as illustrated in FIG. **9**, but still applies a retracting bias to the rod **73**.

Retracting movement of the rod **73** virtually eliminates the annular cavity **72** (see FIG. **9**), which causes a portion of the fixed volume of hydraulic fluid in the cylinder **70** to flow into the chamber **79**a of the accumulator **79**, causing the diaphragm **78** to deflect to the position illustrated in FIG. **9**. This deflection of the diaphragm **78** into the chamber **79**b compresses the gas in that chamber. To enter the chamber **79**a, the hydraulic fluid must flow through a restriction **82**, which limits the rate at which the hydraulic fluid flows into the accumulator. This controlled rate of flow of the hydraulic fluid has a damping effect on the rate at which the rod **73** retracts or advances, thereby avoiding sudden large movements of the moving parts of the row-clearing unit.

When the external obstruction causing the row cleaners to rise is removed from the clearing wheels, the combined effects of the pressurized gas in the accumulator **79** on the diaphragm **78** and the pressure of the hydraulic fluid move the rod **73** to a more advanced position. This downward force on the clearing wheels **22**, **23** holds them against the soil and prevents uncontrolled bouncing of the wheels over irregular terrain, but is not so excessive as to leave a trench in the soil. The downward force applied to the clearing wheels **22**, **23** can be adjusted by changing the pressure of the hydraulic fluid supplied to the cylinder **70**.

FIG. **10** is a schematic of a hydraulic control system for supplying pressurized hydraulic fluid to the cylinders **70** of multiple row-clearing units. A source **100** of pressurized hydraulic fluid, typically located on a tractor, supplies hydraulic fluid under pressure to a valve **101** via supply line **102** and receives returned fluid through a return line **103**. The valve **101** can be set by an electrical control signal S**1** on line **104** to deliver hydraulic fluid to an output line **105** at a desired constant pressure. The output line is connected to a manifold **106** that in turn delivers the pressurized hydraulic fluid to individual feed lines **107** connected to the ports **71** of the respective hydraulic cylinders **70** of the individual row-clear-

ing units. With this control system, the valve **101** is turned off, preferably by a manually controlled on/off valve V, after all the cylinders **70** have been filled with pressurized hydraulic fluid, to maintain a fixed volume of fluid in each cylinder.

FIG. **11** is a schematic of a modified hydraulic control system that permits individual control of the supply of hydraulic fluid to the cylinder **70** each separate row-clearing unit via feed lines **107** connected to the ports **71** of the respective cylinders **70**. Portions of this system that are common to those of the system of FIG. **10** are identified by the same reference numbers. The difference in this system is that each separate feed line **107** leading to one of the row-clearing units is provided with a separate control valve **110** that receives its own separate control signal on a line **111** from a controller **112**. This arrangement permits the supply of pressurized hydraulic fluid to each row-clearing unit to be turned off and on at different times by the separate valve **110** for each unit, with the times being controlled by the separate control signals supplied to the valves **110** by the controller **112**. The individual valves **110** receive pressurized hydraulic fluid via the manifold **106**, and return hydraulic fluid to a sump on the tractor via separate return line **113** connected to a return manifold **114** connected back to the hydraulic system **100** of the tractor.

FIG. **12** illustrates on application for the controllable hydraulic control system of FIG. **11**. Modern agricultural equipment often includes GPS systems that enable the user to know precisely where a tractor is located in real time. Thus, when a gang of planting row units **120** towed by a tractor **121** begins to cross a headland **122** in which the rows **123** are not orthogonal to the main rows **124** of a field, each planting row unit **120** can be turned off just as it enters the headland **122**, to avoid double-planting while the tractor **121** makes a turn through the headland. With the control system of FIG. **11**, the hydraulic cylinder **70** of each row unit can also be separately controlled to turn off the supply of pressurized hydraulic fluid at a different time for each row-clearing unit, so that each row-clearing unit is raised just as it enters the headland, to avoid disrupting the rows already planted in the headland.

One benefit of the system of FIG. **11** is that as agricultural planters, seeders, fertilizer applicators, tillage equipment and the like become wider with more row units on each frame, often 36 30-inch rows or 54 20-inch rows on a single 90-foot wide toolbar, is that each row-clearing unit can float vertically independently of every other row-clearing unit. Yet the following row units still have the down force remotely adjustable from the cab of the tractor or other selected location. This permits very efficient operation of a wide planter or other agricultural machine in varying terrain without having to stop to make manual adjustment to a large number of row-clearing units, resulting in a reduction in the number of acres planted in a given time period. One of the most important factors in obtaining a maximum crop yield is timely planting. By permitting remote down force adjustment of each row-clearing unit (or group of units), including the ability to quickly release all down force and let the row cleaner quickly rise, e.g., when approaching a wet spot in the field, one can significantly increase the planter productivity or acres planted per day, thereby improving yields and reducing costs of production.

On wide planters or other equipment, at times 90 feet wide or more and planting at 6 mph or more forward speed, one row-clearing unit must often rise or fall quickly to clear a rock or plant into an abrupt soil depression. Any resistance to quick movement results in either gouging of the soil or an uncleared portion of the field and reduced yield. With the row-clearing unit having its own hydraulic accumulator, the clearing wheels and the rod of the hydraulic cylinder can move quickly and with a nearly constant down force. Oil displaced by or required by quick movement of the rod and clearing wheels (or other agricultural tool) is quickly moved into or out of the closely mounted accumulator which is an integral part of each row-clearing unit. The accumulator diaphragm or piston supplies or accepts fluid as required at a relatively constant pressure and down force as selected manually or automatically by the hydraulic control system. By following the soil profile closely and leaving a more uniform surface, the toolbar-frame-mounted row-clearing unit permits the planter row unit following independently behind to use less down force for its function, resulting in more uniform seed depth control and more uniform seedling emergence. More uniform seedling stands usually result in higher yields than less uniform seedling stands produced by planters with less accurate row cleaner ground following.

Although the illustrative embodiments described above utilize clearing wheels as the agricultural tools, it should be understood that the invention is also applicable to row units that utilize other agricultural tools, such as fertilizer openers or rollers for firming loose soil.

It will be evident to those skilled in the art that the invention is not limited to the details of the foregoing illustrated embodiments and that the present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

The invention claimed is:

1. An agricultural row-clearing unit for use with an agricultural planting row unit attached to a towing frame hitched to a tractor, said row clearing unit comprising:

an attachment frame adapted to be rigidly connected to said towing frame,

a support element having a leading end pivotally connected to said attachment frame at a pivotal connection for vertical pivoting movement relative to said attachment frame,

at least one row-clearing wheel mounted on the trailing end of said support element,

a hydraulic cylinder pivotally connected between said attachment frame and said support element for pivoting said support element around said pivotal connection to said attachment frame, said hydraulic cylinder including

a movable rod coupling said cylinder to said support element,

a cavity within said cylinder for receiving pressurized hydraulic fluid for advancing said rod in a direction that pivots said support element downwardly toward the soil, and

an energy storage device coupled to said rod and said cylinder to apply a retracting force to said rod to pivotally bias said support element in a direction that urges said at least one row-clearing wheel upwardly away from the soil.

2. The row-clearing unit of claim **1** which includes an accumulator having a fluid chamber containing a diaphragm, the portion of said chamber on one side of said diaphragm connected to said hydraulic-fluid cavity in said hydraulic cylinder, and the portion of said chamber on the other side of said diaphragm containing a pressurized gas.

3. The row-clearing unit of claim 2 in which said cavity is closed so that the volume of hydraulic fluid in said cylinder and accumulator is fixed.

4. The row-clearing unit of claim 1 in which said energy storage device is a compressed coil spring disposed around a portion of said rod with one end of said spring coupled to said rod and the other end of said spring coupled to said cylinder so that said spring continuously biases said movable rod in a retracting direction relative to said cylinder.

5. The row-clearing unit of claim 1 in which said rod forms a shoulder within said cavity so that the pressure of said hydraulic fluid urges said rod in an advancing direction.

6. The row-clearing unit of claim 1 in which said agricultural row unit is a planting row unit.

7. The row-clearing unit of claim 6 which said attachment frame is adapted to be rigidly connected to said towing frame via an attachment frame of a planting row unit.

8. An agricultural implement for use with a towing frame adapted to be hitched to a tractor, said implement comprising

an attachment frame adapted to be rigidly connected to said towing frame,

a support element having a leading end pivotally connected to said attachment frame at a pivotal connection for vertical pivoting movement relative to said attachment frame,

at least one agricultural tool mounted on the trailing end of said support element,

a hydraulic cylinder pivotally connected between said attachment frame and said support element for pivoting said support element around said pivotal connection to said attachment frame, said hydraulic cylinder including

a movable rod coupling said cylinder to said support element,

a cavity within said cylinder for receiving pressurized hydraulic fluid for advancing said rod in a direction that pivots said support element downwardly toward the soil, and

an energy storage device coupled to said rod and said cylinder to apply a retracting force to said rod to pivotally bias said support element in a direction that urges said at least one agricultural tool upwardly away from the soil.

9. An agricultural implement for use with a towing frame adapted to be hitched to a tractor, said implement comprising

a planting row unit having

a frame element rigidly adapted to be rigidly attached to said towing frame, and

a planting assembly pivotally connected to said frame element, and

a row-clearing unit having

a frame element adapted to be rigidly connected to said towing frame,

a support element having a leading end pivotally connected to said frame element of said row-clearing unit at a pivotal connection for vertical pivoting movement of said support element,

at least one clearing wheel mounted on the trailing end of said support element,

a hydraulic cylinder pivotally connected between said frame element of said row-clearing unit and said support element for pivoting said support element around said pivotal connection, said hydraulic cylinder including

a movable rod coupling said cylinder to said support element,

a cavity within said cylinder for receiving pressurized hydraulic fluid for advancing said rod in a direction that pivots said support element downwardly, and

an energy storage device coupled to said rod and said cylinder to apply a retracting force to said rod to pivotally bias said support element in a direction that urges said at least one clearing wheel upwardly away from the soil to be cleared.

10. The agricultural implement of claim 9 in which said frame element of said row-clearing unit is adapted to be rigidly connected to said towing frame via said frame element of said planting row unit.

11. The agricultural implement of claim 8, in which said energy storage device is a compressed coil spring.

12. The agricultural implement of claim 11, in which a bias force of said compressed coil spring is adjustable.

13. The agricultural implement of claim 12, in which said compressed coil spring is configured to provide an upward bias force.

14. The agricultural implement of claim 11, in which said compressed coil spring is disposed around a portion of said rod with one end of said spring coupled to said rod and the other end of said spring coupled to said cylinder so that said spring continuously biases said movable rod in a retracting direction relative to said cylinder.

15. The agricultural implement of claim 11, in which said compressed spring coil is disposed between a flange attached to an inner end of said rod and a flange attached to an interior of said cylinder.

16. The agricultural implement of claim 8, in which said agricultural implement is part of a planting row unit or a row-clearing unit.

17. The agricultural implement of claim 15, in which a downward force is a function of a weight of the planting row unit.

18. The agricultural implement of claim 8, in combination with a hydraulic control system having a controller, said hydraulic cylinder including a control valve coupled via a line to the controller to control a supply of said pressurized hydraulic fluid.

19. The agricultural implement of claim 8, in which a bias force of said energy storage device is adjustable.

20. The agricultural implement of claim 8, in which said hydraulic cylinder is configured to apply said retracting force as a function of a force exerted on the at least one agricultural tool.

21. The agricultural implement of claim 8, in which said hydraulic cylinder is configured to apply a compression force as a function of a resistance offered by the soil on the at least one agricultural tool.

22. The agricultural implement of claim 8, in which the at least one agricultural tool includes a clearing wheel, a fertilizer opener, or a roller for firming loose soil.

23. The agricultural implement of claim 8, in which the agricultural implement is an agricultural planter, a seeder, a fertilizer applicator, or a tillage equipment.

24. The agricultural implement of claim 8, in which a downward force is held on the at least one agricultural tool to prevent uncontrolled bouncing of the at least one agricultural tool over the soil.

25. The agricultural implement of claim 8, in combination with a GPS system that tracks a location of the tractor.

26. The agricultural implement of claim 25, in combination with a control system that avoids double-planting of rows.

27. The agricultural implement of claim 26, wherein the control system is configured to selectively turn off the supply of the hydraulic fluid to avoid disrupting a row already planted.

28. The agricultural implement of claim 8, wherein the hydraulic fluid includes oil.

29. The agricultural implement of claim 28, wherein the oil is displaced by the energy storage device.

30. The agricultural implement of claim 29, wherein the energy storage device is configured to displace the oil.

31. The agricultural implement of claim 28, wherein the energy storage device includes an accumulator diaphragm or piston that supplies or accepts the oil.

32. The agricultural implement of claim 31, wherein the accumulator diaphragm or piston operates at a relatively constant pressure.

33. The agricultural implement of claim 31, wherein the hydraulic cylinder is pneumatic.

34. The agricultural implement of claim 8, further comprising one or more springs to urge the implement downwardly with a controllable force.

35. The agricultural implement of claim 8, wherein the energy storage device includes a piston that supplies or accepts the hydraulic fluid.

36. The agricultural implement of claim 35, wherein the energy stored by the energy storage device includes oil or a gas.

37. The agricultural implement of claim 8, wherein the cavity includes a hydraulic-fluid chamber and a gas-filled chamber.

38. The agricultural implement of claim 37, wherein a gas or fluid or both a gas and fluid is stored with the energy storage device.

39. The agricultural implement of claim 8, wherein the energy storage device is coupled to said rod, and wherein a retracting movement of said rod raises said at least one agricultural tool.

40. The agricultural implement of claim 8, in combination with a hydraulic control system and at least one other agricultural implement, wherein the hydraulic control system comprises a plurality of ports supplied by a plurality of feed lines separately controllable via separate control signals supplied by a controller.

41. The agricultural implement of claim 40, wherein a downforce on the agricultural implement is remotely adjustable and a downforce on the at least one other agricultural implement is remotely adjustable.

42. The agricultural implement of claim 41, wherein the downforce is adjustable from a cab of the tractor.

43. The agricultural implement of claim 40, wherein a downforce on the agricultural implement and the at least one other agricultural implement is releasable to allow the agricultural implement and the at least one other agricultural implement to rise quickly.

44. The agricultural implement of claim 40, wherein the controller is configured to control the supply of the hydraulic fluid at different times to selective ones of the feed lines.

45. The agricultural implement of claim 40, wherein a down force is selected manually or automatically by the hydraulic control system.

46. The agricultural implement of claim 45, wherein the down force is remotely adjustable from a cab of the tractor.

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