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(12) **United States Design Patent** (10) **Patent No.:** **US D932,580 S**  
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(54) **LOCK FOR AN ADJUSTABLE LOCKING LEG ASSEMBLY**

574,235 A 12/1896 Bennitt  
900,572 A 10/1908 Morton  
914,774 A 3/1909 Zimmerman  
1,024,176 A 4/1912 Boyens  
1,075,372 A 10/1913 Overshiner  
(Continued)

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FOREIGN PATENT DOCUMENTS

AU A 15170/92 12/1993  
CH 635 393 3/1983  
(Continued)

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OTHER PUBLICATIONS

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

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USPC ..... **D21/839**

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CPC ..... E04H 15/32; E04H 15/44; E04H 15/46; E04H 15/50; A45B 3/12; A45B 9/00; F16B 7/14; F16B 7/1454; F16L 23/06  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

33,398 A 10/1861 Miller  
292,941 A 2/1884 Nunnelley

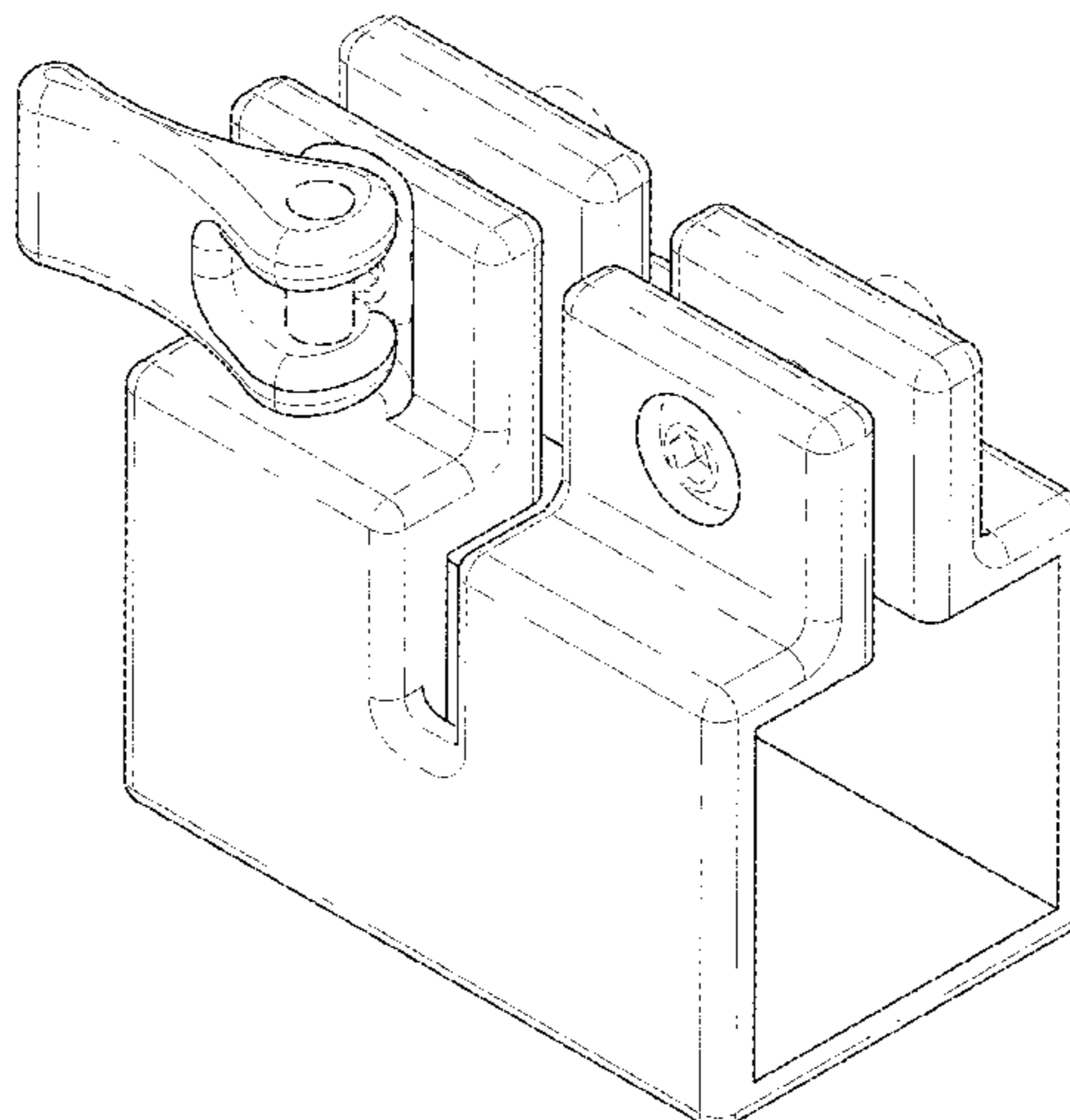
(57) **CLAIM**

The ornamental design for a lock for an adjustable locking leg assembly, as shown and described.

**DESCRIPTION**

FIG. 1 is a perspective view showing a first side of a lock for an adjustable locking leg assembly.  
FIG. 2 is a perspective view showing a second side of the lock of FIG. 1.  
FIG. 3 is a front view of the lock of FIG. 1.  
FIG. 4 is a rear view of the lock of FIG. 1.  
FIG. 5 is a top view of the lock of FIG. 1.  
FIG. 6 is a bottom view of the lock of FIG. 1.  
FIG. 7 is a left side view of the lock of FIG. 1; and, FIG. 8 is a right side view of the lock of FIG. 1.  
The broken lines are for the purpose of illustrating portions of the article that form no part of the claim.

**1 Claim, 7 Drawing Sheets**



(56)

References Cited

U.S. PATENT DOCUMENTS

1,238,646 A	8/1917	Dennis	4,251,106 A	2/1981	Gilbert
1,256,902 A	2/1918	Howe	D261,332 S	10/1981	Rohr
1,334,048 A	3/1920	Powers	4,293,162 A	10/1981	Pap et al.
1,341,689 A	6/1920	Walmsley	4,295,481 A	10/1981	Gee
1,429,043 A	9/1922	Martin	4,300,798 A	11/1981	Musgrove et al.
1,443,921 A	1/1923	Mackenzie	4,445,590 A	5/1984	Ihrman
1,575,902 A	3/1926	Dial	4,487,345 A	12/1984	Pierce et al.
1,593,431 A	7/1926	Buie	4,497,092 A	2/1985	Hoshino
1,605,679 A	11/1926	McGrail	4,528,998 A	7/1985	Gamm
1,639,074 A	8/1927	Blackwood	4,530,451 A	7/1985	Hamilton
1,666,757 A	4/1928	Snyder	4,536,026 A	8/1985	Cornell
1,763,455 A	6/1930	Bruijn	4,573,717 A *	3/1986	Peacock ..... F16B 2/185 24/270
1,789,090 A	1/1931	Wawrunek	4,596,484 A	6/1986	Nakatani
1,846,011 A	2/1932	Adams	4,635,667 A	1/1987	Harn
1,915,504 A	6/1933	Stokby	4,639,036 A	1/1987	Nichols
2,001,252 A	5/1935	Johnson	4,639,958 A	2/1987	Lerner
2,070,484 A	2/1937	Jones	4,641,676 A	2/1987	Lynch
2,137,427 A	11/1938	Thomson	4,641,883 A	2/1987	Kato
2,151,908 A	3/1939	Gottlieb	D289,473 S	4/1987	Myers
2,166,832 A	7/1939	Wenker	4,687,248 A	8/1987	Ross et al.
2,243,984 A	6/1941	Singewald	4,687,249 A	8/1987	Mills
2,265,479 A	12/1941	Goodman	4,736,825 A	4/1988	Belfi
2,429,763 A	10/1947	Lindabury	4,744,690 A	5/1988	Hsieh
2,490,367 A	12/1949	Maddocks	4,761,092 A	8/1988	Nakatani
2,545,968 A	3/1951	Newstead	4,773,574 A	9/1988	Burgard
2,561,886 A	7/1951	Rikelman	4,779,635 A	10/1988	Lynch
2,571,382 A	10/1951	Raven	4,795,068 A	1/1989	Blean
2,658,562 A	11/1953	Androsiglio	4,796,734 A	1/1989	Distasic
D171,176 S	12/1953	Yellen	4,809,724 A	3/1989	Fuser
2,689,603 A	9/1954	Smith	4,810,029 A	3/1989	Kaladis et al.
2,712,349 A	7/1955	Voir	4,824,171 A	4/1989	Hollingsworth
2,719,688 A	10/1955	Seifert	4,858,990 A	8/1989	Combs-Rose et al.
2,729,276 A	1/1956	Volney	4,865,381 A	9/1989	Van Rogue
2,747,653 A	5/1956	Obradovich	4,870,984 A	10/1989	Roth
2,752,929 A	7/1956	Berger	4,885,812 A	12/1989	Linder
D180,210 S	4/1957	Uretsky	4,889,383 A	12/1989	Jones
2,819,776 A	1/1958	Balsam	4,915,120 A	4/1990	Ziolkowski
2,849,249 A	8/1958	Fridolph	4,924,896 A	5/1990	Carter
2,926,724 A	3/1960	Rittenberg	4,932,622 A	6/1990	Hayakawa
2,932,047 A	4/1960	Johnston	4,949,929 A	8/1990	Kesselman et al.
2,989,968 A	6/1961	Gunter	D310,605 S	9/1990	Kwon
3,007,735 A	11/1961	Cohn	4,971,089 A	11/1990	Braman
3,034,523 A	5/1962	De Shano	4,972,981 A	11/1990	Gex
3,085,586 A	4/1963	McDonough	5,000,210 A	3/1991	Worthington, Jr.
3,092,224 A	6/1963	O'Neil	5,013,085 A	5/1991	Craig
3,151,909 A	10/1964	Gerdetz	5,022,420 A	6/1991	Brim
3,179,465 A	4/1965	Roberts	5,035,253 A	7/1991	Bortles
3,214,217 A	10/1965	Jente	5,042,874 A	8/1991	Williams
3,243,230 A	3/1966	Otto	5,054,848 A	10/1991	Liu
3,307,758 A	3/1967	Platt	5,080,432 A	1/1992	Connell
3,309,134 A	3/1967	Roberts	5,096,257 A	3/1992	Clark
3,333,595 A	8/1967	Bannister	5,102,190 A	4/1992	Akin et al.
3,339,566 A	9/1967	Bowden	5,135,281 A	8/1992	Pappalardo
3,371,671 A	3/1968	Kirkham	5,139,308 A	8/1992	Ziman
3,404,915 A	10/1968	Filho	5,154,449 A	10/1992	Suei-Long
3,450,432 A	6/1969	Minsker	5,154,473 A	10/1992	Joranco
3,544,157 A	12/1970	Muller	5,203,363 A	4/1993	Kidwell et al.
3,580,633 A	5/1971	Du Priest	5,205,308 A	4/1993	Kendall et al.
3,621,857 A	11/1971	May et al.	5,209,381 A	5/1993	Jay
3,637,086 A	1/1972	Klein	5,240,020 A	8/1993	Byers
3,879,086 A	4/1975	Moceri	5,244,001 A	9/1993	Lynch
3,918,109 A	11/1975	Barraclough	5,244,250 A	9/1993	Nordmeyer
3,931,918 A	1/1976	Smith et al.	D339,937 S	10/1993	Ryan
3,935,874 A	2/1976	Cohen	5,289,958 A	3/1994	Jay
3,947,903 A	4/1976	Menke	5,299,337 A	4/1994	Venza
4,029,279 A	6/1977	Nakatani	5,303,975 A	4/1994	Asato
4,030,748 A	6/1977	Brock	5,320,405 A	6/1994	Foster et al.
4,047,752 A	9/1977	Rohr	5,350,215 A	9/1994	DeMars
4,063,318 A	12/1977	Nicholson	5,362,130 A	11/1994	Hoffman
4,082,102 A	4/1978	Heuer	5,387,048 A	2/1995	Kuo
4,123,095 A *	10/1978	Stehlin ..... F16L 23/06 24/270	5,388,821 A	2/1995	Blackburn
4,174,900 A	11/1979	Ina	5,395,157 A	3/1995	Rollo et al.
4,201,416 A	5/1980	Vanderminden	5,421,356 A	6/1995	Lynch
4,248,255 A	2/1981	Arrowsmith	D360,535 S	7/1995	Sjoberg
			5,433,502 A	7/1995	Condorodis et al.
			5,433,552 A	7/1995	Thyu
			5,441,067 A	8/1995	James et al.
			5,449,014 A	9/1995	Yan-Ho

(56)

References Cited

U.S. PATENT DOCUMENTS

5,485,863 A	1/1996	Carter	6,405,742 B1	6/2002	Driscoll	
5,490,533 A	2/1996	Carter	6,412,507 B1	7/2002	Carter	
5,511,572 A	4/1996	Carter	6,418,949 B1	7/2002	Lin et al.	
5,516,193 A	5/1996	Simpson	6,450,569 B1	9/2002	Liu	
5,533,654 A	7/1996	Holty et al.	6,471,289 B2	10/2002	Aguilar	
5,538,318 A	7/1996	MacLean	6,478,039 B2	11/2002	Suh	
5,538,319 A	7/1996	DiMurro	6,508,262 B1	1/2003	Takayama	
5,544,793 A	8/1996	Harrop	6,516,821 B1	2/2003	Uemura	
5,547,246 A	8/1996	Lambert	6,520,196 B2	2/2003	Carter	
5,551,110 A	9/1996	Armstrong et al.	6,520,574 B1	2/2003	Huang	
5,551,669 A	9/1996	Reinklou	6,536,723 B1	3/2003	Nakatani	
5,564,452 A	10/1996	Kitchen	6,547,324 B1	4/2003	Ammann, Jr.	
5,579,797 A	12/1996	Rogers	6,551,226 B1	4/2003	Webber et al.	
5,582,458 A	12/1996	Wildt	6,575,656 B2	6/2003	Suh	
5,593,205 A	1/1997	Vanderminden, Sr. et al.	6,591,849 B1	7/2003	Swetish et al.	
5,593,239 A	1/1997	Sallee	6,655,736 B1	12/2003	Arenas	
5,597,101 A	1/1997	Barber et al.	6,672,631 B1 *	1/2004	Weinhold .....	F16L 23/06 24/285
5,626,271 A	5/1997	Messey et al.	6,676,092 B2	1/2004	Tsai	
5,632,292 A	5/1997	Carter	D487,297 S	3/2004	Tyler et al.	
5,634,483 A	6/1997	Gwin	6,698,827 B2	3/2004	Le Gette et al.	
5,638,851 A	6/1997	Baldwin	6,712,083 B2	3/2004	Carter	
D380,306 S	7/1997	Lin	6,718,995 B2	4/2004	Dotterweich	
D382,126 S	8/1997	Lee	D494,769 S	8/2004	Vigneaud	
D382,414 S	8/1997	Lee	6,779,538 B2	8/2004	Morgante et al.	
5,695,100 A	12/1997	O'Brien	6,789,557 B1	9/2004	Wahl, Jr.	
5,695,296 A	12/1997	Miura	6,823,883 B1	11/2004	Sears	
5,718,473 A	2/1998	Lynch, Jr.	6,824,210 B2	11/2004	Zheng	
5,722,717 A	3/1998	Rittenberger	6,837,642 B1	1/2005	Lin	
5,735,570 A	4/1998	Tseng	6,845,780 B2	1/2005	Bishirjian	
5,794,640 A	8/1998	Jang	6,899,383 B2	5/2005	Hwang	
5,797,650 A	8/1998	Gonzalez, Jr. et al.	6,908,249 B2	6/2005	Tomm	
5,813,425 A	9/1998	Carter	6,913,231 B2	7/2005	Speggiorin	
5,819,999 A	10/1998	Tennant	6,926,355 B2	8/2005	Le Gette et al.	
5,833,310 A	11/1998	Labelle	6,929,017 B2	8/2005	Byun	
5,873,625 A	2/1999	Uchtman	6,979,056 B1	12/2005	Goldszer	
5,921,258 A	7/1999	Francois	6,981,510 B2	1/2006	Carter	
5,934,301 A	8/1999	Carter	7,040,832 B2	5/2006	Hsieh	
5,934,631 A	8/1999	Becker	7,044,145 B2	5/2006	Bouchard	
5,951,103 A	9/1999	Barnhill	7,044,146 B2	5/2006	Losi, Jr.	
5,961,178 A	10/1999	Hodson	7,048,333 B2	5/2006	Martinez	
5,967,601 A	10/1999	Gillins	D522,605 S	6/2006	Bishirjian	
5,975,626 A	11/1999	Aycock	7,066,676 B2	6/2006	Tsai	
5,984,406 A	11/1999	Lee	7,097,380 B2	8/2006	Lee	
6,000,175 A	12/1999	Gale et al.	7,118,172 B1	10/2006	Pattison-Sheets	
6,006,477 A	12/1999	Ko	7,168,759 B2	1/2007	Gallegos Geier	
6,035,877 A	3/2000	Losi, Jr. et al.	7,172,532 B2	2/2007	Baker	
6,036,262 A	3/2000	Shahid	7,198,324 B2	4/2007	Le Gette et al.	
6,045,177 A	4/2000	Grace	7,231,954 B2	6/2007	Green	
6,070,604 A	6/2000	Carter	7,240,685 B2	7/2007	Seo	
6,082,813 A	7/2000	Chen	7,240,687 B2	7/2007	Carter	
6,089,247 A	7/2000	Price	7,243,990 B1	7/2007	Wahl	
6,095,172 A	8/2000	Trapp et al.	7,252,108 B2	8/2007	Carter	
6,095,596 A	8/2000	Chen	7,261,263 B2 *	8/2007	Baker .....	A47F 5/04 24/24
6,102,479 A	8/2000	Wallace	7,293,934 B1	11/2007	Huang	
6,112,757 A	9/2000	Tseng	7,296,584 B2	11/2007	Goldwitz	
6,129,102 A	10/2000	Carter	7,299,812 B2	11/2007	Carter	
6,131,593 A	10/2000	Greene et al.	7,299,813 B2	11/2007	Ochi	
6,142,699 A	11/2000	Pao	7,302,745 B2	12/2007	Stahle	
6,148,835 A	11/2000	Rhee	7,302,957 B2	12/2007	Ross	
6,152,156 A	11/2000	Tung	7,311,355 B2	12/2007	Fargason, III	
6,164,726 A	12/2000	Reeves et al.	7,316,450 B2	1/2008	Ayers et al.	
6,179,514 B1	1/2001	Cheng	7,350,532 B2	4/2008	Wu	
6,206,463 B1	3/2001	Whigham	7,373,708 B2	5/2008	Stahle et al.	
6,230,729 B1	5/2001	Carter	7,374,238 B2	5/2008	Lingwall	
6,241,311 B1	6/2001	Zheng	7,380,563 B2	6/2008	Seo	
6,250,712 B1	6/2001	Livington et al.	7,395,830 B2	7/2008	Seo	
6,263,895 B1	7/2001	Bang	7,396,073 B2	7/2008	Zheng	
6,264,271 B1	7/2001	Munn et al.	7,409,963 B2	8/2008	Mallookis et al.	
6,276,382 B1	8/2001	Bindschatel et al.	7,422,009 B2	9/2008	Rummel et al.	
6,283,136 B1	9/2001	Chen	7,422,026 B2	9/2008	Kim	
6,292,002 B1	10/2001	Tashchyan	7,427,101 B1	9/2008	Zernov	
6,328,131 B1	12/2001	Backus	7,428,908 B2	9/2008	Seo	
6,354,044 B1	3/2002	Lagace, Jr.	7,431,389 B2	10/2008	Reeb et al.	
6,363,956 B2	4/2002	Carter	7,481,236 B2	1/2009	Carter	
6,371,553 B1	4/2002	Tang	7,494,296 B2	2/2009	Stahle	
			RE40,657 E	3/2009	Suh	
			7,527,331 B2	5/2009	Fargason, III	

(56)

References Cited

U.S. PATENT DOCUMENTS

7,566,095 B2 7/2009 Reeb et al.  
 7,568,307 B1 8/2009 Zimhoni et al.  
 7,637,276 B2 12/2009 Mallookis et al.  
 D612,624 S 3/2010 Lovley et al.  
 7,673,643 B2 3/2010 Seo  
 7,703,469 B2 4/2010 Danzinger  
 7,735,504 B2 6/2010 Carter  
 7,753,063 B1 7/2010 Laws  
 7,753,064 B2 7/2010 Sy-Facunda  
 7,757,916 B1 7/2010 Petrie et al.  
 7,775,229 B2 8/2010 Sy-Facunda  
 7,784,480 B2 8/2010 Sy-Facunda  
 7,789,099 B2 9/2010 Mallookis et al.  
 D625,507 S 10/2010 Quinn  
 7,806,381 B2 10/2010 Sisk Horne et al.  
 7,836,907 B2 11/2010 Carter  
 7,849,867 B2 12/2010 Takayama  
 7,874,303 B2 1/2011 Xie  
 7,921,864 B2 4/2011 Carter  
 7,922,416 B2 4/2011 Davis et al.  
 7,954,272 B2 6/2011 Potterfield et al.  
 7,967,259 B2 6/2011 Nakatani  
 7,975,712 B2 7/2011 Beacco  
 7,980,519 B2 7/2011 Chen  
 7,997,291 B2 8/2011 Gressette et al.  
 8,006,711 B2\* 8/2011 Pietrzak ..... A45B 9/00  
 135/65  
 8,025,455 B2 9/2011 Huang et al.  
 D648,148 S 11/2011 Henry  
 8,074,669 B2 12/2011 Collins et al.  
 8,075,217 B2 12/2011 Eason  
 8,079,380 B2 12/2011 Engstrom et al.  
 8,091,962 B2 1/2012 Quinn  
 8,128,306 B2 3/2012 Gorza  
 8,162,280 B2 4/2012 Yu et al.  
 8,185,979 B2 5/2012 Hentschel  
 8,186,755 B2 5/2012 Lovley  
 8,191,744 B2 6/2012 Petrie et al.  
 8,220,477 B2 7/2012 Park  
 8,376,646 B2\* 2/2013 Melino, Sr. .... F16B 7/1454  
 403/109.3  
 8,408,225 B2 4/2013 Mallookis et al.  
 8,418,711 B2 4/2013 Park  
 8,454,093 B2 6/2013 Smith  
 8,464,379 B1 6/2013 Zajac  
 8,590,553 B2\* 11/2013 Lovley, II ..... E04H 15/46  
 135/120.2  
 8,608,118 B2\* 12/2013 Lai ..... F16B 7/1454  
 248/74.1  
 8,616,226 B2 12/2013 Ma et al.  
 8,746,267 B2\* 6/2014 Lovley, II ..... E04H 15/50  
 135/114  
 8,776,810 B2\* 7/2014 Lah ..... A45B 9/00  
 135/65  
 D712,730 S\* 9/2014 Gridley ..... D8/396  
 9,033,410 B2 5/2015 Roani  
 9,072,290 B1 7/2015 McCauley  
 D736,884 S 8/2015 Lovley, II et al.  
 D737,066 S 8/2015 Lovley, II et al.  
 9,101,222 B2 8/2015 Minkoff  
 9,103,138 B2 8/2015 Lovley, II  
 9,175,496 B2 11/2015 Darquea  
 9,220,347 B2 12/2015 Lovley, II et al.  
 9,279,269 B2 3/2016 Lovley, II et al.  
 D774,815 S 12/2016 Lovley, II et al.  
 9,528,292 B1 12/2016 Lovley, II et al.  
 2002/0030146 A1 3/2002 Akaike  
 2002/0112752 A1 8/2002 Blakney  
 2003/0090904 A1 5/2003 Ching  
 2003/0164185 A1 9/2003 Price  
 2004/0084074 A1 5/2004 Chiu et al.  
 2004/0101351 A1 5/2004 Pitcher  
 2004/0178665 A1 9/2004 May  
 2004/0182430 A1 9/2004 Seo

2004/0222678 A1 11/2004 Hansen  
 2004/0238021 A1 12/2004 Holub et al.  
 2004/0255997 A1 12/2004 Seo  
 2004/0261828 A1 12/2004 Jang  
 2005/0028856 A1 2/2005 Seo  
 2005/0081904 A1 4/2005 Suzuki et al.  
 2005/0155637 A1 7/2005 Kim  
 2005/0178419 A1 8/2005 Tseng  
 2005/0178422 A1 8/2005 Wu  
 2005/0194030 A1 9/2005 Goldwitz  
 2005/0205124 A1 9/2005 Goldwitz  
 2005/0249545 A1 11/2005 Tsai  
 2006/0051159 A1 3/2006 Tsai  
 2006/0054207 A1 3/2006 Wootliff  
 2006/0062632 A1 3/2006 Jang  
 2006/0096631 A1 5/2006 Mallookis  
 2006/0144434 A1 7/2006 Chen  
 2006/0169311 A1 8/2006 Hwang  
 2006/0174929 A1 8/2006 Tseng  
 2006/0249192 A1 11/2006 Tsai et al.  
 2006/0260666 A1 11/2006 Choi  
 2007/0012346 A1 1/2007 Choi  
 2007/0018486 A1 1/2007 Ayers et al.  
 2007/0040422 A1 2/2007 Reeb et al.  
 2007/0051397 A1 3/2007 Choi  
 2007/0145792 A1 6/2007 Miller  
 2007/0181172 A1 8/2007 Harrison  
 2007/0204897 A1 9/2007 Habib et al.  
 2007/0221263 A1 9/2007 Tai  
 2007/0236058 A1 10/2007 Yeider  
 2007/0240748 A1 10/2007 Bae  
 2008/0035194 A1 2/2008 Goldwitz  
 2008/0087313 A1 4/2008 Jang  
 2008/0121260 A1\* 5/2008 Stephens ..... A45B 9/00  
 135/75  
 2009/0071521 A1 3/2009 Sy-Facunda  
 2009/0087251 A1 4/2009 Chen  
 2009/0218856 A1 9/2009 Sykes et al.  
 2009/0309394 A1 12/2009 Chen  
 2010/0064739 A1 3/2010 Lu  
 2010/0101617 A1 4/2010 Stehly  
 2010/0269877 A1 10/2010 Sy-Facunda  
 2010/0275962 A1 11/2010 Park et al.  
 2011/0023924 A1 2/2011 Park  
 2011/0023925 A1 2/2011 Johnson et al.  
 2011/0073148 A1 3/2011 Choi  
 2011/0181078 A1 7/2011 Kelly  
 2011/0192436 A1 8/2011 Gridley  
 2011/0240078 A1\* 10/2011 Lenhart ..... A45B 9/00  
 135/75  
 2011/0259381 A1 10/2011 Adams  
 2011/0274481 A1 11/2011 Chen  
 2011/0284045 A1 11/2011 Reeb  
 2011/0308559 A1 12/2011 Ma et al.  
 2012/0006373 A1 1/2012 Stehly  
 2012/0034023 A1 2/2012 Wang et al.  
 2012/0107037 A1 5/2012 Huang  
 2012/0146354 A1 6/2012 Lofley, Sr. et al.  
 2012/0175917 A1 7/2012 Chen  
 2012/0305042 A1 12/2012 Lorbiecki  
 2013/0069400 A1 3/2013 Nikolic  
 2013/0247948 A1 9/2013 Lovley, II et al.  
 2013/0284225 A1 10/2013 Holland et al.  
 2014/0021749 A1 1/2014 Roani  
 2014/0158176 A1 6/2014 Lovley, II  
 2014/0174491 A1 6/2014 Yang  
 2014/0203619 A1 7/2014 Dapra  
 2014/0306494 A1 10/2014 Frankel et al.  
 2015/0252587 A1 9/2015 Lovley, II  
 2015/0345172 A1 12/2015 Lovley, II  
 2016/0166062 A1 6/2016 Lovley, II

FOREIGN PATENT DOCUMENTS

CN 1104546 4/2003  
 CN 2705649 6/2005  
 CN 2880991 3/2007  
 CN 201216348 Y 4/2009  
 CN 102022609 A 4/2011

(56)

References Cited

FOREIGN PATENT DOCUMENTS

CN	202055611	U	11/2011
CN	202706662	U	1/2013
CN	2545298		4/2013
DE	26 55 028	A1	6/1978
DE	31 31 166	A1	2/1983
DE	35 360 49	A1	4/1987
DE	42 01 743	A1	10/1992
DE	10 2010 049 941		5/2012
EP	0 564 326		10/1993
FR	532 496	A	2/1922
FR	2 691 619		12/1993
FR	2 805 559		8/2001
GB	2 052 960	A	2/1981
GB	2 091 648		8/1982
GB	2 216 850		10/1989
JP	58-129855		9/1983
JP	61-7351		1/1986

JP	7 207 962	8/1995
JP	3059720	7/2000
JP	2001-003604	1/2001
JP	2001-254535	9/2001
JP	2002-209663	7/2002
JP	2005-290837	10/2005
JP	2011-144606	7/2011
KR	10-2002-0048191	6/2002
KR	10-2004-0023115	3/2004
KR	20060001341	1/2006
KR	10-0886118	2/2009
KR	10-2011-0054253	5/2011
KR	10-2014-0135004	11/2014
SU	1174551	8/1985
WO	WO 82/01984	6/1982
WO	WO 91/14386	10/1991
WO	WO 94/023162	10/1994
WO	WO 96/39066	12/1996
WO	WO 2005/024158	3/2005
WO	WO 2007/018926	2/2007

\* cited by examiner

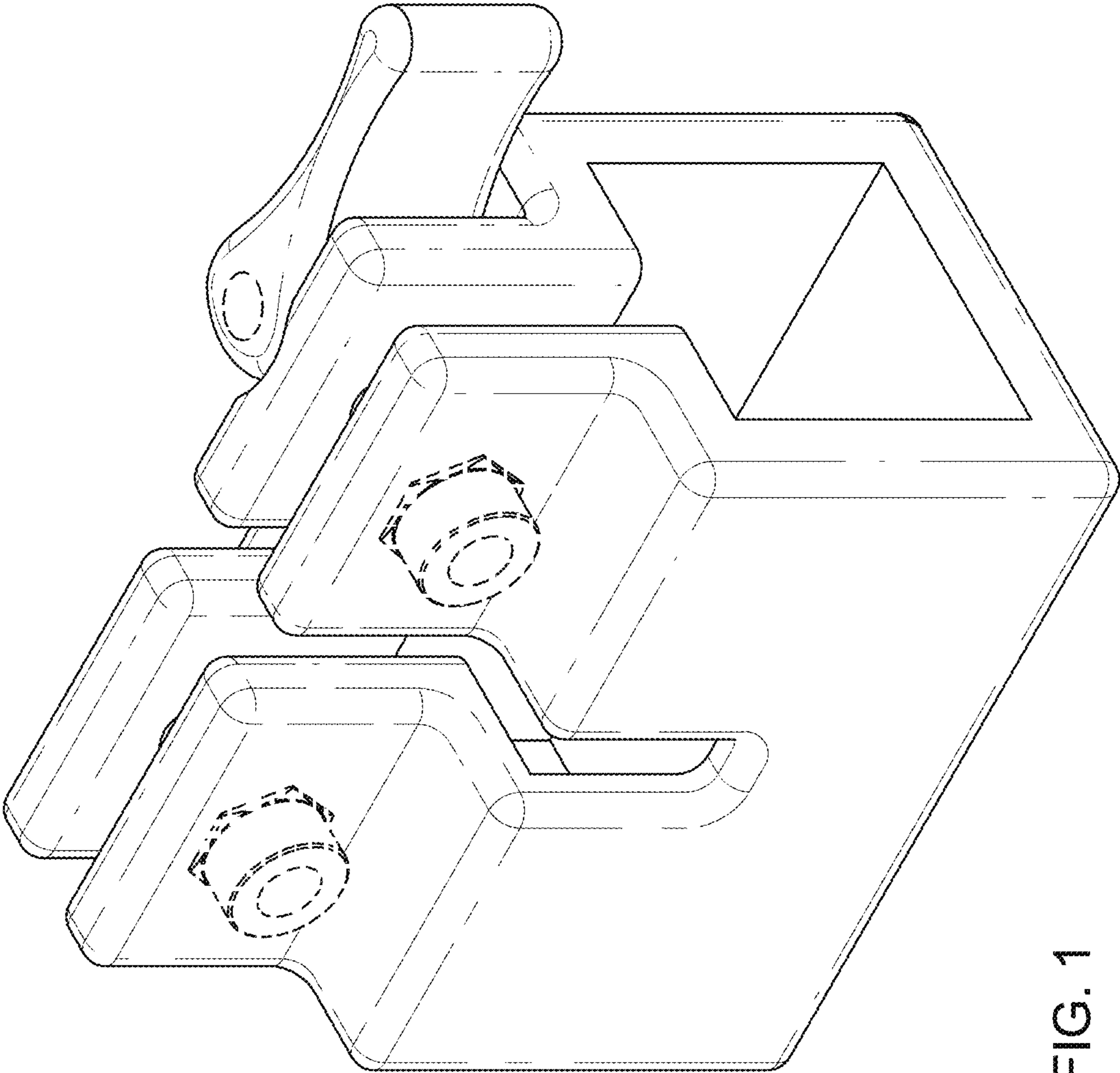


FIG. 1

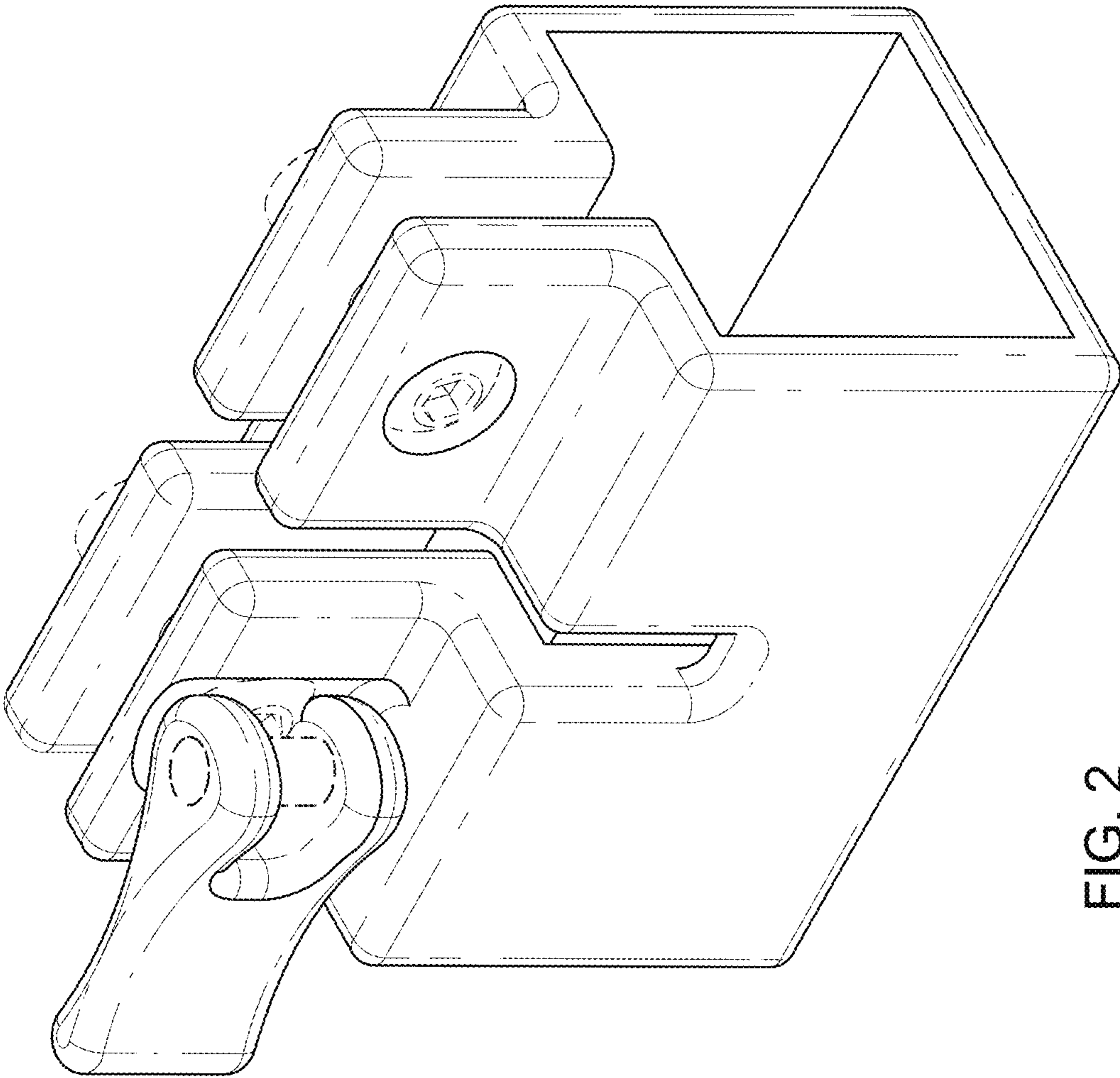


FIG. 2

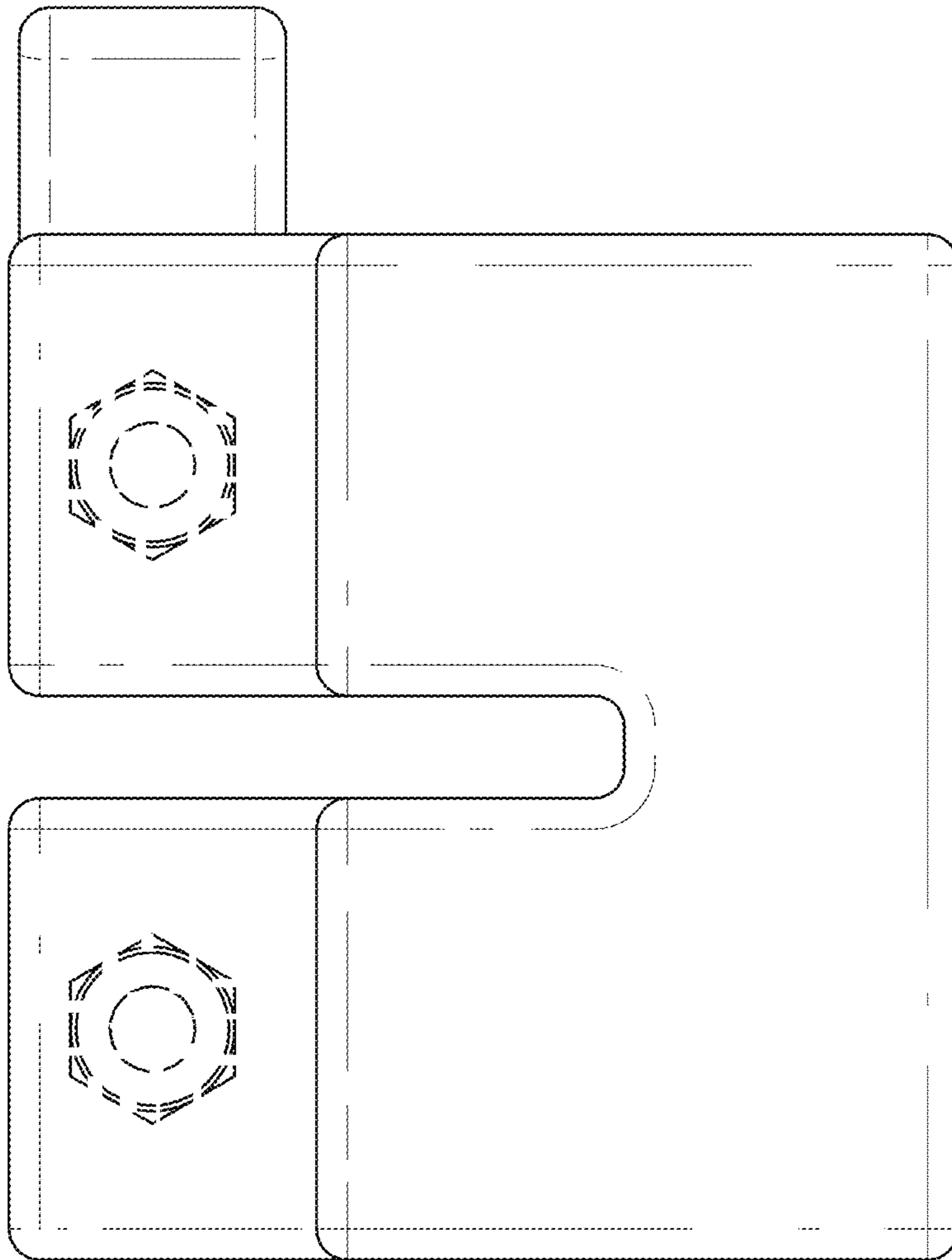


FIG. 3



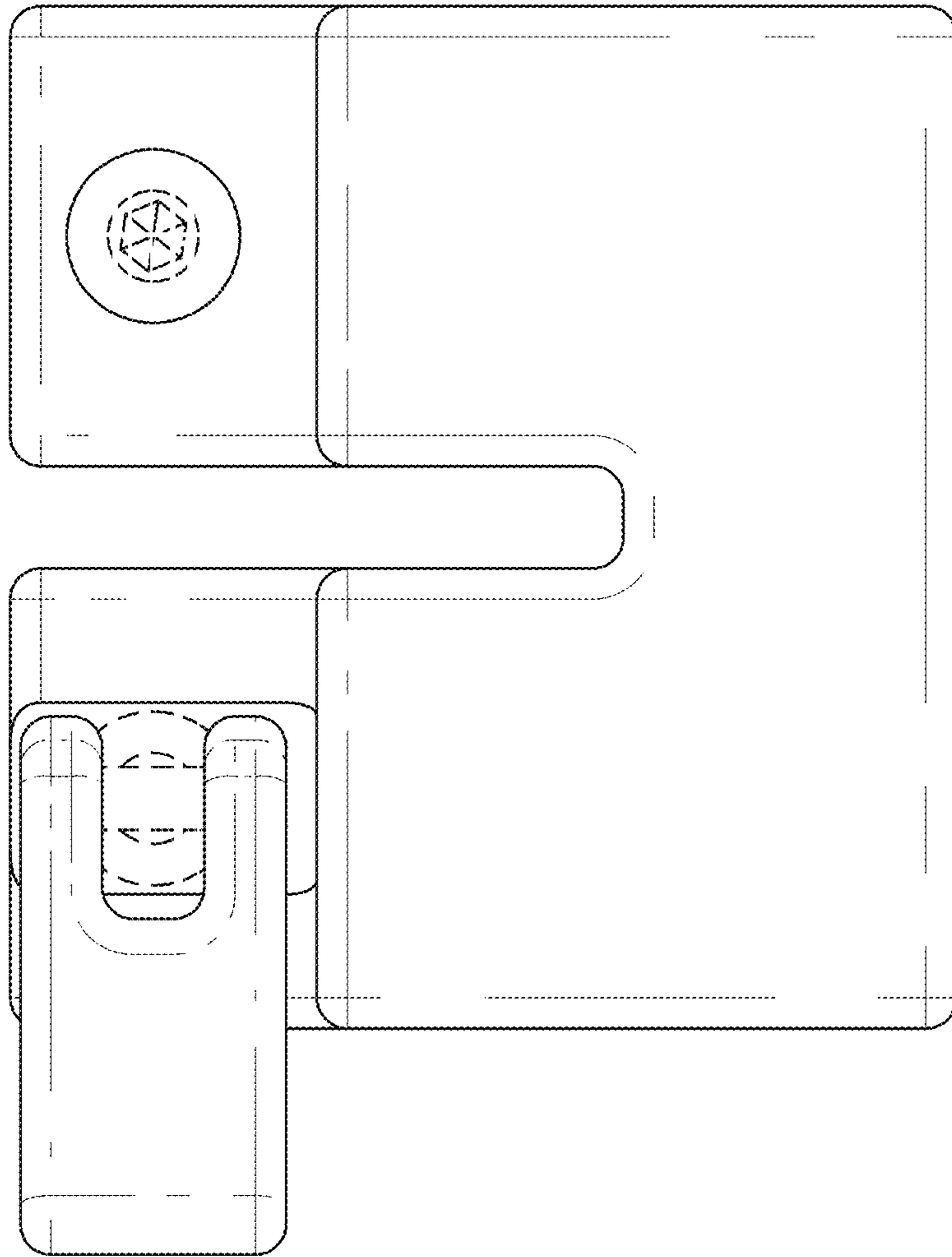


FIG. 4

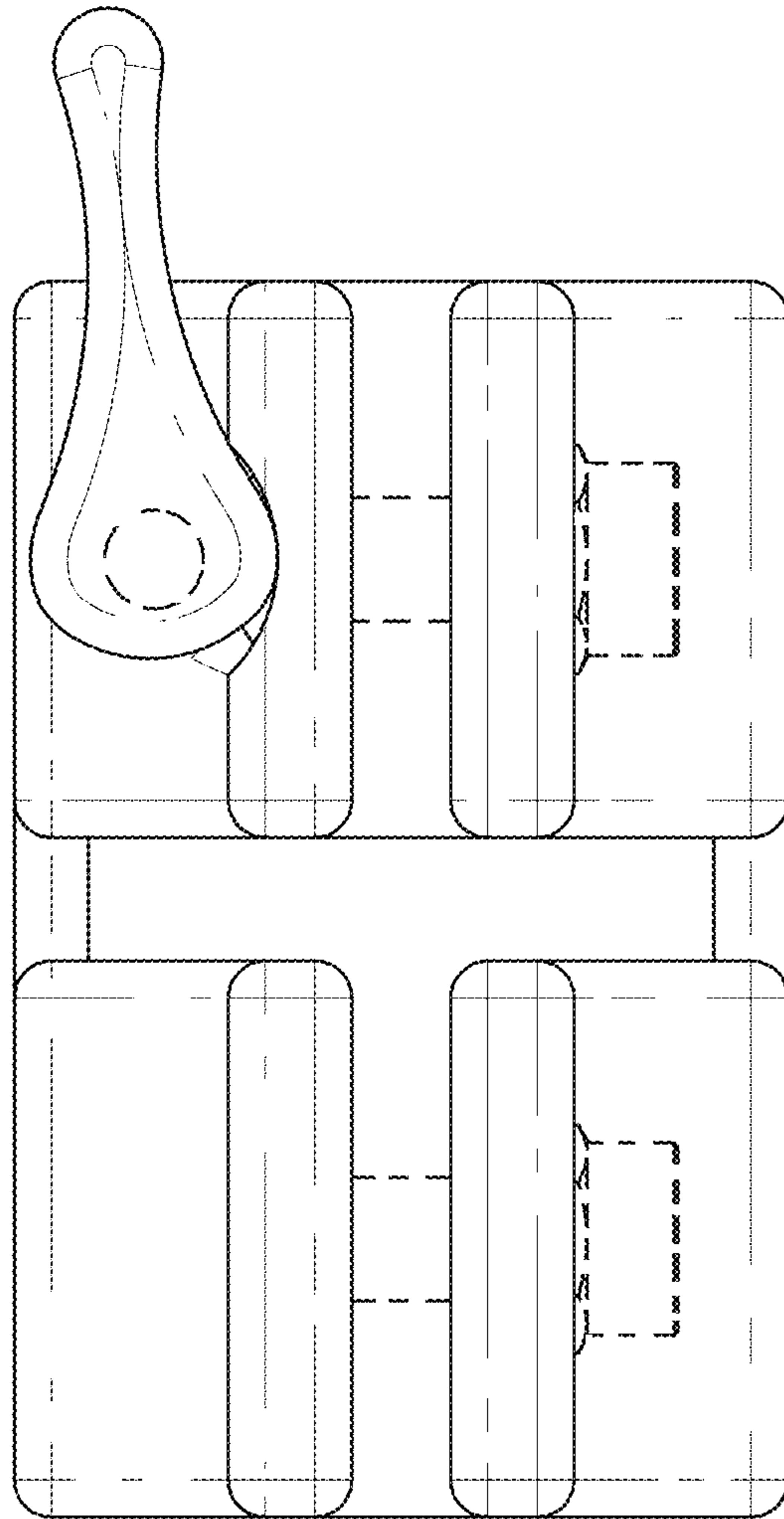


FIG. 5

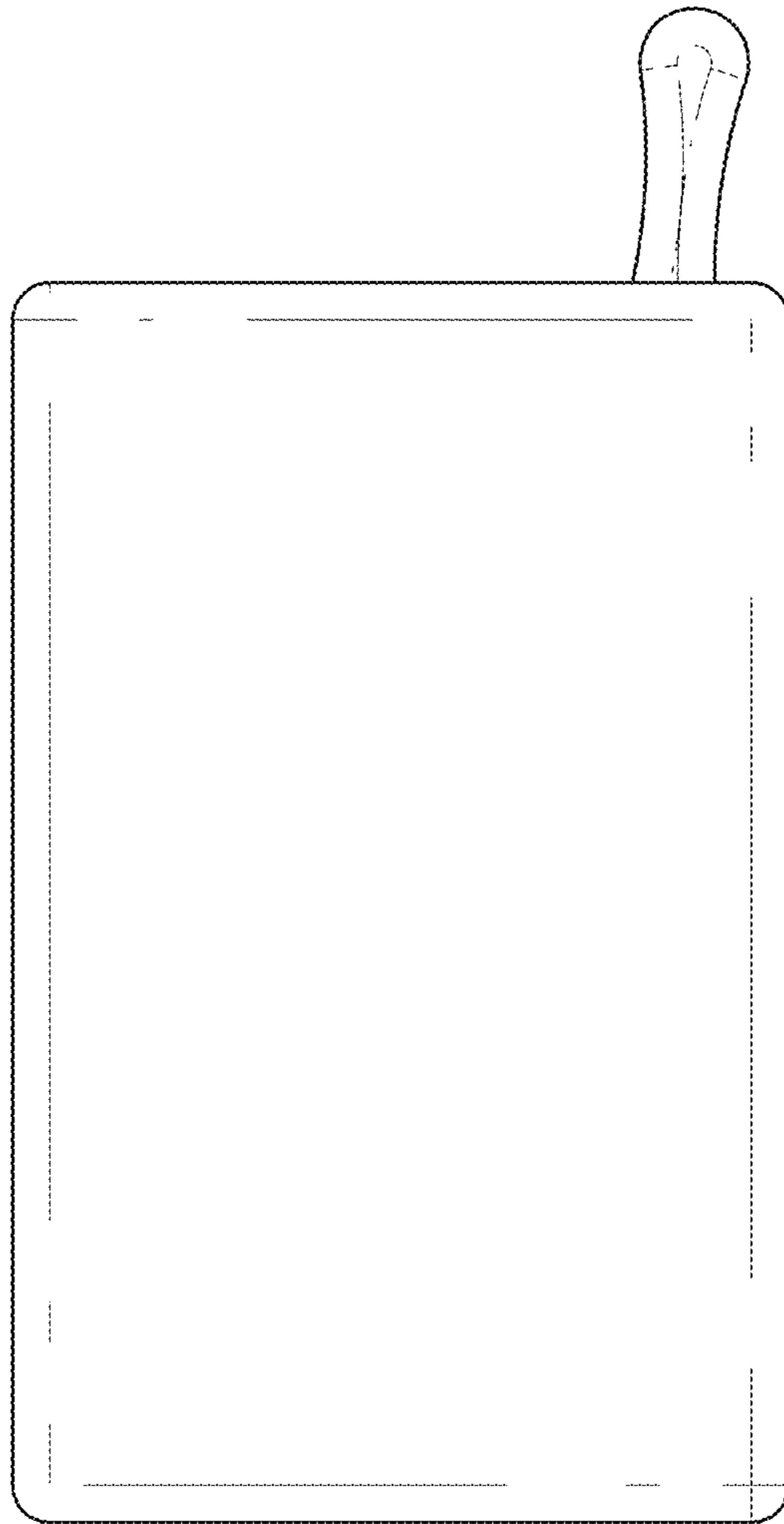


FIG. 6

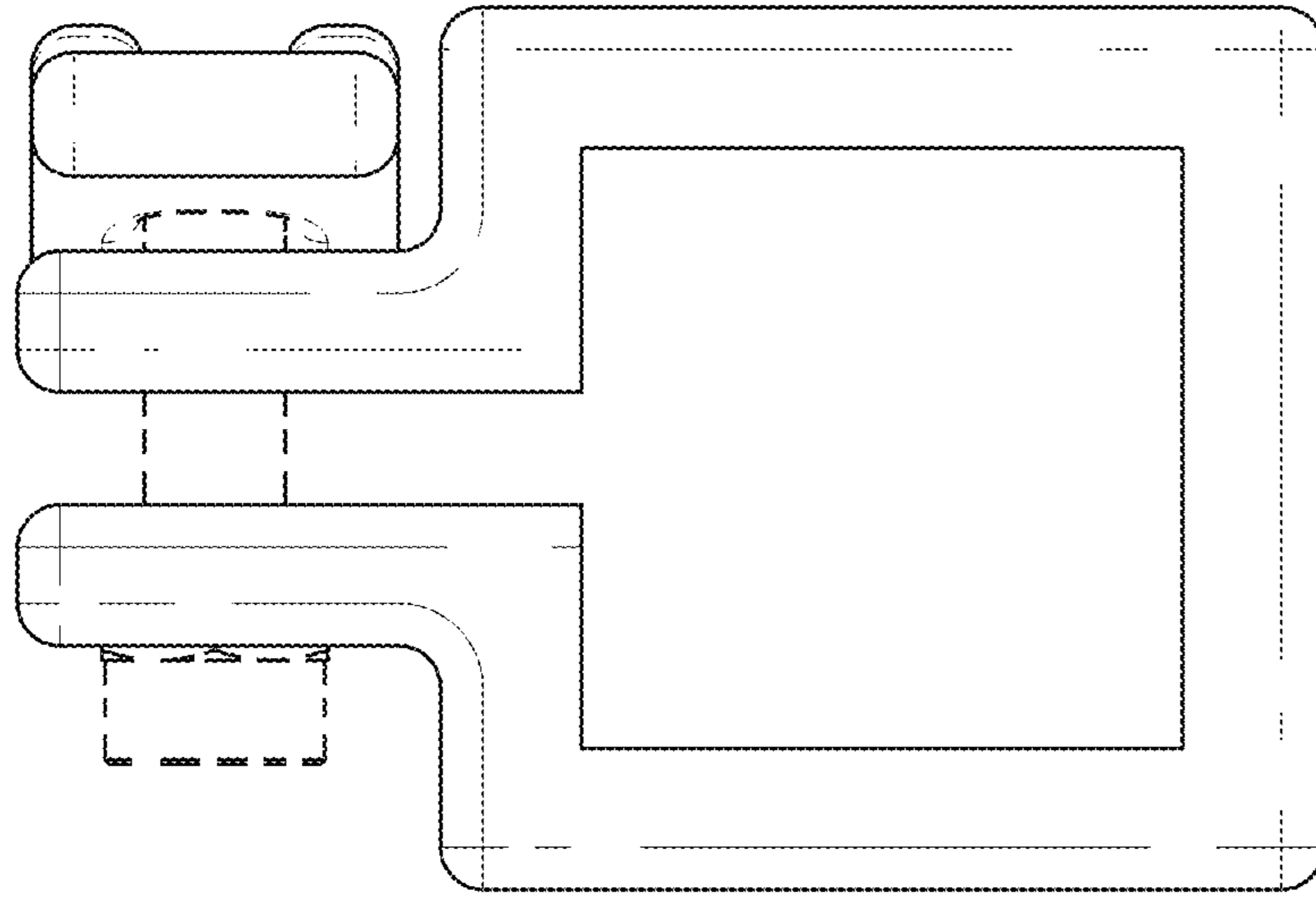


FIG. 8

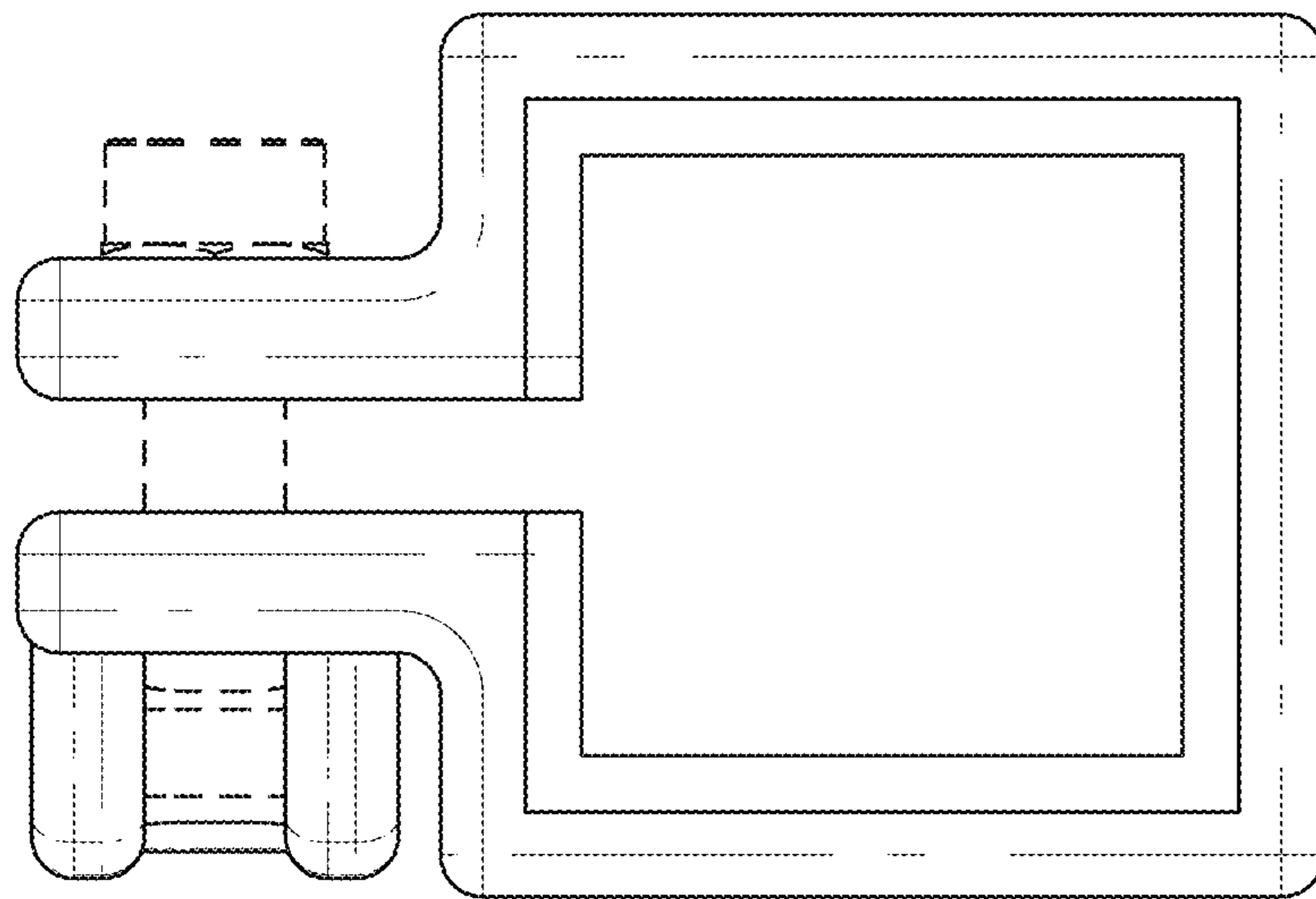


FIG. 7