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- (54) **BLADELESS OBTURATOR**
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(56) **References Cited**
U.S. PATENT DOCUMENTS
RE682 E 4/1859 Peale
184,573 A 11/1876 Becker
(Continued)

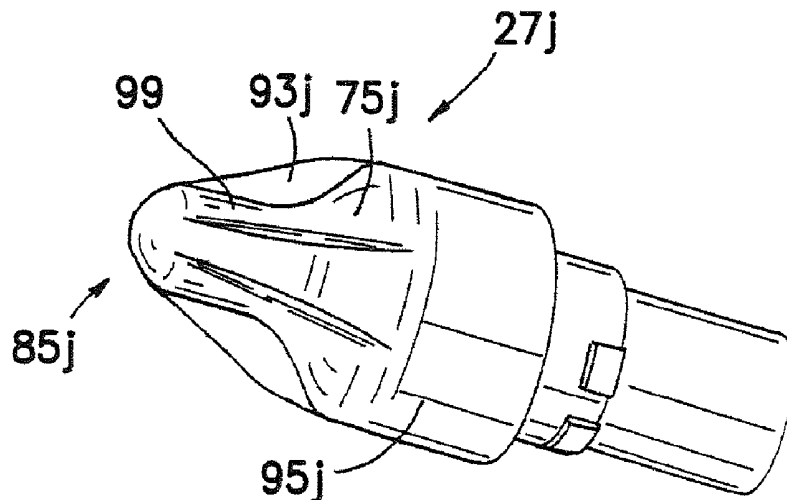
FOREIGN PATENT DOCUMENTS
BE 1 006 811 12/1994
CA 2 170 841 9/1997
(Continued)
OTHER PUBLICATIONS

U.S. Appl. No. 10/745,262, filed Dec. 23, 2003; Title: "Catheter With Conduit Traversing Tip" (abandoned).
(Continued)

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(57) **ABSTRACT**

A surgical obturator adapted to penetrate a body wall includes an elongate shaft having an axis which extends between a proximal end and a distal end. A bladeless tip, disposed at the distal end of the shaft has an outer surface which extends to a blunt point. The outer surface has a pair of side sections separated by an intermediate section. The side sections extend from the blunt point radially outwardly with progressive positions proximally along the axis. These side sections include a distal portion in proximity to the blunt point, and a proximal portion in proximity to the shaft. The distal portion of the side section is twisted radially with respect to the proximal portion of the side section. The outer surface in radial cross section has the general configuration of a geometric shape which rotates in a first direction about the axis with progressive proximal radial cross sections along the axis.

17 Claims, 13 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

207,932 A	9/1878	Alvord	4,750,877 A	6/1988	McFarlane
224,513 A	2/1880	Burdon	4,762,130 A	8/1988	Fogarty et al.
396,754 A	1/1889	Mayfield	4,779,613 A	10/1988	Hashiguchi et al.
764,322 A	7/1904	Wiegand	4,803,999 A	2/1989	Liegner
1,147,408 A	7/1915	Kelis	4,813,400 A	3/1989	Washizuka et al.
1,672,258 A	6/1928	Hippenmeyer	4,850,393 A	7/1989	Lashomb
1,727,495 A	9/1929	Wappler	4,895,431 A	1/1990	Tsujiuchi et al.
1,845,727 A	2/1932	Slaughter	4,901,142 A	2/1990	Ikuno et al.
2,024,069 A	12/1935	Sharp	4,956,143 A	9/1990	McFarlane
2,102,274 A	12/1937	Larimore	4,959,067 A	9/1990	Muller
2,189,343 A	2/1940	Fritz	4,972,827 A	11/1990	Kishi et al.
2,301,338 A	11/1942	Smith	4,978,350 A	12/1990	Wagenknecht
2,434,594 A	1/1948	Schultz	5,017,057 A	5/1991	Krueger
2,441,143 A	5/1948	Gracey	5,030,210 A	7/1991	Alchas
2,646,701 A	7/1953	Lietin	5,041,100 A	8/1991	Rowland et al.
2,699,770 A	1/1955	Fourestier et al.	5,057,082 A	10/1991	Burchette, Jr.
2,764,148 A	9/1956	Sheldon	5,066,288 A	11/1991	Deniego et al.
2,764,149 A	9/1956	Sheldon	5,098,379 A	3/1992	Conway
2,769,355 A	11/1956	Henry	5,098,388 A	3/1992	Kulkashi et al.
2,877,368 A	3/1959	Sheldon	5,104,316 A	4/1992	Mc Spadden
2,932,294 A	4/1960	Fourestier et al.	5,104,388 A	4/1992	Quackenbush
3,005,468 A	10/1961	Erwin et al.	5,104,389 A	4/1992	Deem et al.
3,021,834 A	2/1962	Sheldon	5,114,407 A	5/1992	Burbank
3,033,226 A	5/1962	Allen	5,116,547 A	5/1992	Tsukahara et al.
3,042,022 A	7/1962	Sheldon	5,144,942 A	9/1992	Decarie et al.
3,224,320 A	12/1965	Knudsen	5,147,376 A	9/1992	Pianetti
3,277,922 A	10/1966	Eisel	5,159,920 A	11/1992	Condon et al.
3,279,460 A	10/1966	Sheldon	5,163,941 A	11/1992	Garth et al.
3,357,433 A	12/1967	Fourestier et al.	5,178,186 A	1/1993	Levasseur
3,385,553 A	5/1968	Braun	5,186,972 A	2/1993	Williams et al.
3,417,745 A	12/1968	Sheldon	5,197,955 A	3/1993	Stephens et al.
3,437,747 A	4/1969	Sheldon	5,207,656 A	5/1993	Kranys
3,459,189 A	8/1969	Alley et al.	5,217,441 A	6/1993	Shichman
3,473,421 A *	10/1969	Grussner	5,221,163 A	6/1993	Nishimura
3,556,085 A	1/1971	Takahashi	5,240,397 A	8/1993	Fay et al.
3,613,684 A	10/1971	Sheridan	5,246,425 A	9/1993	Hunsberger et al.
3,653,338 A	4/1972	Sauey	5,250,068 A	10/1993	Ideguchi et al.
3,791,379 A	2/1974	Storz	5,256,149 A	10/1993	Banik et al.
3,817,251 A	6/1974	Hasson	5,258,003 A	11/1993	Ciaglia
3,821,956 A	7/1974	Gordhamer	5,269,316 A	12/1993	Spitalny
3,870,036 A	3/1975	Fiore	5,271,380 A	12/1993	Riek et al.
3,961,621 A	6/1976	Northeved	5,279,567 A	1/1994	Ciaglia et al.
3,971,385 A	7/1976	Corbett	5,288,290 A	2/1994	Brody
3,994,287 A	11/1976	Turp	5,290,276 A	3/1994	Sewell
3,994,301 A	11/1976	Agris	5,290,585 A	3/1994	Elton
4,028,987 A	6/1977	Wilson	5,300,033 A	4/1994	Miller
4,112,932 A	9/1978	Chiulli	5,334,150 A	8/1994	Kaali
4,126,291 A	11/1978	Gilbert et al.	5,342,382 A	8/1994	Brinkerhoff et al.
4,150,929 A	4/1979	Brandt	5,350,364 A	9/1994	Stephens et al.
4,168,882 A	9/1979	Hopkins	5,366,446 A	11/1994	Tal et al.
4,180,068 A	12/1979	Jacobsen et al.	5,370,624 A	12/1994	Edwards et al.
4,191,191 A	3/1980	Auburn	5,372,588 A	12/1994	Farley
4,222,375 A	9/1980	Martinez	5,374,253 A	12/1994	Burns, Sr. et al.
4,248,214 A	2/1981	Hannah et al.	5,380,291 A	1/1995	Kaali
4,254,762 A	3/1981	Yoon	5,387,197 A	2/1995	Smith
4,269,192 A	5/1981	Matsuo	5,389,077 A	2/1995	Melinyshyn et al.
4,274,771 A	6/1981	Nishimura	5,391,153 A	2/1995	Haber et al.
4,285,618 A	8/1981	Shanley	5,391,248 A	2/1995	Brain
4,299,230 A	11/1981	Kubota	5,392,766 A	2/1995	Masterson et al.
4,311,138 A	1/1982	Sugarman	5,405,328 A	4/1995	Vidal et al.
4,319,563 A	3/1982	Kubota	5,407,427 A	4/1995	Zhu et al.
4,356,826 A	11/1982	Kubota	5,431,151 A	7/1995	Riek et al.
4,386,179 A	5/1983	Sterling	5,441,041 A	8/1995	Sauer et al.
4,414,966 A	11/1983	Stednitz	5,443,484 A	8/1995	Kirsch et al.
4,429,856 A	2/1984	Jackson	5,445,615 A	8/1995	Yoon et al.
4,436,519 A	3/1984	O'Neill	5,454,791 A	10/1995	Tovey et al.
4,493,444 A	1/1985	Deli et al.	5,480,410 A	1/1996	Cuschieri et al.
4,498,902 A	2/1985	Ash et al.	5,510,065 A	4/1996	McFarlane
4,524,805 A	6/1985	Hoffman	5,540,711 A	7/1996	Kieturakis et al.
4,535,773 A	8/1985	Yoon	5,542,845 A	8/1996	Jenkins
4,535,808 A	8/1985	Johanson	5,549,546 A	8/1996	Schneider et al.
4,537,593 A	8/1985	Alchas	5,551,947 A	9/1996	Kaali
4,567,882 A	2/1986	Heller	5,562,696 A	10/1996	Nobles et al.
4,601,710 A	7/1986	Moll	5,569,291 A	10/1996	Privitera
4,607,619 A	8/1986	Seike et al.	5,569,292 A	10/1996	Schwemmerger et al.
			5,577,993 A	11/1996	Zhu et al.
			5,591,186 A	1/1997	Wurster et al.
			5,591,192 A	1/1997	Privitera et al.
			5,593,402 A	1/1997	Patrick

(56)

References Cited

U.S. PATENT DOCUMENTS

5,603,720	A	2/1997	Kieturakis	6,387,043	B1	5/2002	Yoon
5,609,562	A	3/1997	Kaali	6,462,111	B1	10/2002	Singh et al.
5,609,604	A	3/1997	Schwemberger et al.	6,468,228	B1	10/2002	Topel et al.
5,613,954	A	3/1997	Nelson et al.	6,478,806	B2	11/2002	McFarlane
5,622,462	A	4/1997	Gakhar et al.	6,508,759	B1	1/2003	Taylor et al.
5,630,805	A	5/1997	Ternamian	6,520,939	B2	2/2003	Lafontaine
5,634,908	A	6/1997	Loomas	6,579,298	B1	6/2003	Bruneau et al.
5,658,236	A	8/1997	Sauer	6,656,160	B1	12/2003	Taylor et al.
5,662,615	A	9/1997	Blake, III	6,656,198	B2	12/2003	Tsonton et al.
5,662,673	A	9/1997	Kieturakis	6,685,630	B2	2/2004	Sauer et al.
5,676,611	A	10/1997	Foster	6,764,107	B1	7/2004	Obahi et al.
5,685,820	A	11/1997	Riek et al.	6,770,731	B2	8/2004	Mason et al.
5,695,462	A	12/1997	Sutcu et al.	6,835,201	B2	12/2004	O'Heeron
5,697,947	A	12/1997	Wolf	6,884,253	B1	4/2005	McFarlane
5,720,730	A	2/1998	Blake, III	6,887,194	B2	5/2005	Hart et al.
5,720,761	A	2/1998	Kaali	6,902,541	B2	6/2005	McNally et al.
5,735,867	A	4/1998	Golser et al.	6,939,296	B2	9/2005	Ewers et al.
5,738,628	A	4/1998	Sierocuk	7,008,979	B2	3/2006	Schottman et al.
5,743,881	A	4/1998	Demco	7,037,303	B2	5/2006	Beaufore et al.
5,746,734	A	5/1998	Dormandy, Jr. et al.	7,056,294	B2	6/2006	Khairkahan et al.
5,752,970	A	5/1998	Yoon et al.	7,056,329	B2	6/2006	Kerr
5,759,185	A	6/1998	Grinberg	7,070,586	B2	7/2006	Hart et al.
5,779,697	A	7/1998	Glowa et al.	7,182,752	B2	2/2007	Stubbs
5,785,693	A	7/1998	Halninig	7,344,519	B2	3/2008	Wing et al.
5,792,112	A	8/1998	Hart et al.	7,370,709	B2	5/2008	Williamson, Jr.
5,797,888	A	8/1998	Yoon et al.	7,470,255	B2	12/2008	Sterns et al.
5,797,944	A	8/1998	Nobeles et al.	7,563,250	B2	7/2009	Wenchell
5,817,061	A	10/1998	Goodwin et al.	7,686,823	B2	3/2010	Pingleton et al.
5,817,062	A	10/1998	Flom et al.	7,708,713	B2	5/2010	Albrecht et al.
5,836,957	A	11/1998	Schulz	7,758,603	B2	7/2010	Taylor et al.
5,842,971	A	12/1998	Yoon	7,794,644	B2	9/2010	Taylor et al.
5,860,996	A	1/1999	Urban et al.	7,811,253	B2	10/2010	Hart et al.
5,865,809	A	2/1999	Moening et al.	7,942,862	B2	5/2011	Hart et al.
5,871,474	A	2/1999	Hermann et al.	7,947,058	B2	5/2011	Kahle et al.
5,876,202	A	3/1999	Berlin	8,007,477	B2	8/2011	Johnson et al.
5,882,340	A	3/1999	Yoon	8,028,395	B2	10/2011	Taylor et al.
5,884,639	A	3/1999	Chen	8,075,530	B2	12/2011	Taylor et al.
5,891,013	A	4/1999	Thompson	8,105,285	B2	1/2012	Hart et al.
5,893,865	A	4/1999	Swindle	8,128,590	B2	3/2012	Albrecht et al.
5,904,699	A	5/1999	Schwemberger et al.	8,152,828	B2	4/2012	Taylor et al.
5,913,818	A	6/1999	Co et al.	8,267,952	B2	9/2012	Kahle et al.
5,922,351	A	7/1999	Daher	8,282,663	B2	10/2012	Smith
5,924,452	A	7/1999	Szpara et al.	8,292,853	B2	10/2012	Hart et al.
5,941,852	A	8/1999	Dunlap et al.	8,317,815	B2	11/2012	Mastri et al.
5,957,884	A	9/1999	Hooven	8,377,090	B2	2/2013	Taylor et al.
5,957,888	A	9/1999	Hinchliffe	8,382,663	B2	2/2013	Taylor
5,968,060	A	10/1999	Kellogg	2002/0013597	A1	1/2002	McFarlane
5,976,079	A	11/1999	Volz et al.	2002/0026207	A1	2/2002	Stellon et al.
5,976,168	A	11/1999	Chin	2002/0133188	A1	9/2002	O'Heeron et al.
5,980,809	A	11/1999	Crain et al.	2002/0183715	A1	12/2002	Mantell et al.
5,984,941	A	11/1999	Wilson	2002/0183775	A1	12/2002	Tsonton et al.
6,001,084	A	12/1999	Riek	2003/0023201	A1	1/2003	Aboul-Hosn
6,007,481	A	12/1999	Riek et al.	2003/0032755	A1	2/2003	Gomey et al.
6,007,544	A	12/1999	Kim	2003/0059263	A1	3/2003	Chen
6,019,776	A	2/2000	Preissman	2003/0187471	A1	10/2003	Cooper
6,024,551	A	2/2000	Yamaguchi	2004/0015185	A1	1/2004	Ewers et al.
6,030,155	A*	2/2000	Scheer et al. 408/59	2004/0082969	A1	4/2004	Kerr
6,030,406	A	2/2000	Davis	2004/0093000	A1	5/2004	Kerr
6,043,310	A	3/2000	Liu et al.	2004/0093018	A1	5/2004	Johnson et al.
6,053,194	A	4/2000	Nelson et al.	2004/0106942	A1	6/2004	Taylor et al.
6,068,637	A	5/2000	Popov et al.	2004/0108623	A1	6/2004	Deeter et al.
6,077,481	A	6/2000	Ichida et al.	2004/0167559	A1	8/2004	Taylor et al.
6,092,551	A	7/2000	Bennett	2004/0199127	A1	10/2004	Jensen et al.
6,168,355	B1	1/2001	Wardell	2004/0204671	A1	10/2004	Stubbs et al.
6,179,528	B1	1/2001	Wardell	2004/0230155	A1	11/2004	Blanco et al.
6,203,559	B1	3/2001	Davis	2004/0230217	A1	11/2004	O'Heeron
6,203,745	B1	3/2001	Wachsmann et al.	2004/0254517	A1	12/2004	Quiroz-Mercado et al.
6,221,061	B1	4/2001	Engelson et al.	2005/0033237	A1	2/2005	Fentress et al.
6,228,059	B1	5/2001	Astarita	2005/0033246	A1	2/2005	Ahlberg et al.
6,228,063	B1	5/2001	Aboul-Hosn	2005/0038466	A1	2/2005	O'Heeron et al.
6,270,484	B1	8/2001	Yoon	2005/0059865	A1	3/2005	Kahle
6,302,873	B1	10/2001	Moening	2005/0065543	A1	3/2005	Kahle et al.
6,319,266	B1	11/2001	Stellon	2005/0107803	A1	5/2005	Guanche
6,346,074	B1	2/2002	Roth	2005/0107816	A1	5/2005	Pingleton et al.
6,355,014	B1	3/2002	Zadno-Azizi et al.	2005/0113533	A1	5/2005	Shaikh et al.
				2005/0149094	A1	7/2005	Kasahara et al.
				2005/0149096	A1	7/2005	Hilal et al.
				2005/0159711	A1	7/2005	Kathrani et al.
				2005/0216028	A1	9/2005	Hart et al.

(56) **References Cited**
U.S. PATENT DOCUMENTS

2005/0227610 A1 10/2005 Zukor et al.
 2005/0273133 A1 12/2005 Shluzas et al.
 2005/0283122 A1 12/2005 Nordgren
 2005/0288622 A1 12/2005 Albrecht et al.
 2006/0030755 A1 2/2006 Ewers et al.
 2006/0030870 A1 2/2006 Staudner
 2006/0041270 A1 2/2006 Lenker et al.
 2006/0047284 A1 3/2006 Gresham
 2006/0058570 A1 3/2006 Rapach et al.
 2006/0074374 A1 4/2006 Gresham
 2006/0118189 A1 6/2006 Tekulve et al.
 2006/0224174 A1 10/2006 Smith et al.
 2006/0264991 A1 11/2006 Johnson
 2007/0027453 A1 2/2007 Hart et al.
 2007/0075465 A1 4/2007 Taylor et al.
 2007/0088277 A1 4/2007 McGinley
 2007/0239108 A1 10/2007 Albrecht et al.
 2008/0065021 A1 3/2008 Jenkins et al.
 2008/0086074 A1 4/2008 Taylor et al.
 2008/0086093 A1 4/2008 Steppe et al.
 2009/0030375 A1 1/2009 Franer et al.
 2009/0137943 A1 5/2009 Steams et al.
 2009/0187079 A1 7/2009 Albrecht et al.
 2009/0281500 A1 11/2009 Acosta et al.
 2010/0025045 A1 2/2010 Lake et al.

FOREIGN PATENT DOCUMENTS

DE 0365049 12/1922
 DE 1616107 4/1971
 DE 2218901 10/1973
 DE 2538758 3/1977
 DE 2929233 1/1980
 DE 2922239 12/1980
 DE 4020956 1/1991
 DE 4133073 4/1992
 DE 4035146 5/1992
 DE 4116648 11/1992
 DE 29503750 4/1995
 DE 29521431 4/1997
 DE 19541041 5/1997
 DE 19718086 11/1998
 DE 19819432 11/1999
 EP 0135364 3/1985
 EP 0312787 4/1989
 EP 0347140 12/1989
 EP 0369936 5/1990
 EP 0369937 5/1990
 EP 0474124 3/1992
 EP 0548612 6/1993
 EP 0556056 8/1993
 EP 0664992 8/1995
 EP 0724864 8/1996
 EP 1074224 2/2001
 EP 1582158 10/2005
 EP 2229897 9/2010
 EP 2233090 9/2010
 FR 1370580 8/1964
 GB 2 124 970 2/1984
 GB 186 005 9/1992
 GB 2 313 316 11/1997
 JP 408127661 5/1996
 JP 2001-137253 5/2001
 SU 0942730 7/1982
 SU 1328658 8/1987
 SU 1329769 8/1987
 WO WO 93/25148 12/1993
 WO WO 98/33536 2/1994
 WO WO 94/11040 5/1994
 WO WO 96/01074 A2 1/1996
 WO WO 96/01132 1/1996
 WO WO 96/10361 4/1996
 WO WO 97/40758 11/1997
 WO WO 99/02089 1/1999

WO WO 99/15084 4/1999
 WO WO 00/18306 4/2000
 WO WO 00/54648 9/2000
 WO WO 01/01847 1/2001
 WO WO 01/01871 1/2001
 WO WO 01/08563 2/2001
 WO WO 02/01998 1/2002
 WO WO 02/34108 5/2002
 WO WO 02/41795 5/2002
 WO WO 03/026512 4/2003
 WO WO 03/032819 4/2003
 WO WO 03/096879 11/2003
 WO WO 2004/037097 5/2004
 WO WO 2004/093699 11/2004
 WO WO 2005/063134 7/2005
 WO WO 2007/093957 8/2007

OTHER PUBLICATIONS

Co-Pending U.S. Appl. No. 12/750,372, filed Mar. 30, 2010, title: "Bladeless Obturator".
 Co-Pending U.S. Appl. No. 11/549,872, filed Oct. 16, 2006, title: "Surgical Devices, Systems and Methods Thereof Having Gel Material, Gel Coatings, or Gel Lubricants".
 Co-Pending U.S. Appl. No. 13/565,972, filed Aug. 3, 2012, title: "Bladeless Optical Obturator".
 Co-Pending U.S. Appl. No. 13/356,260, filed Jan. 23, 2012, title: "Insufflating Optical Surgical Instrument".
 Co-Pending U.S. Appl. No. 13/078,750, filed Apr. 1, 2011 title "Surgical Access Apparatus and Method".
 Co-Pending U.S. Appl. No. 12/569,652, filed Sep. 29, 2009; title "First-Entry Trocar System".
 Co-Pending U.S. Appl. No. 12/359,964, filed Jan. 26, 2009, title: "Insufflating Access System".
 Co-Pending U.S. Appl. No. 13/462,330, filed May 2, 2012, title: "Low-Profile Surgical Universal Access Port".
 Co-Pending U.S. Appl. No. 13/411,244, filed Mar. 2, 2012, title: "Blunt Tip Obturator".
 Co-Pending U.S. Appl. No. 13/586,825, filed Aug. 15, 2012, title: "Blunt Tip Obturator".
 Co-Pending U.S. Appl. No. 11/868,883, filed Oct. 8, 2007; Title: "Visual Insufflation Port".
 International Bureau of WIPO, International Preliminary Report on Patentability for International Application No. PCT/US04/032346, dated May 20, 2008.
 International Bureau of WIPO, International Preliminary Report on Patentability for International Application No. PCT/US2005/022716 mailed Nov. 22, 2005.
 International Bureau of WIPO, International Preliminary Report on Patentability for International Application No. PCT/US2006/060013, mailed Apr. 24, 2008.
 International Bureau of WIPO, The International Preliminary Report on Patentability for International Application No. PCT/US2009/058792, titled First Entry Trocar System, dated Mar. 29, 2011.
 International Bureau of WIPO, The International Preliminary Report on Patentability for International Application No. PCT/US2007/080724, titled "Visual Insufflation Port", dated Apr. 7, 2009.
 International Bureau of WIPO, The International Preliminary Report on Patentability for International Application No. PCT/US2009/32026, titled "Insufflating Access System", dated Jul. 27, 2010.
 International Bureau of WIPO, The International Preliminary Report on Patentability for International Application No. PCT/US2004/000695, titled "Surgical Access Apparatus and Method", dated Jul. 22, 2005.
 International Bureau of WIPO, The International Preliminary Report on Patentability for International Application No. PCT/US2004/04883, titled "Surgical Access Apparatus and Method", dated Sep. 9, 2005.
 International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US2004/000695, titled "Surgical Access Apparatus and Method", mailed Jan. 12, 2005.

(56)

References Cited

OTHER PUBLICATIONS

International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US2004/04883, titled "Surgical Access Apparatus and Method", mailed Mar. 31, 2005.

International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US2002/06759, titled "Bladeless Obturator", mailed Jul. 12, 2002.

International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US2005/022716, titled "Insufflating Optical Surgical Instrument", mailed Nov. 22, 2005.

International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US04/32346, titled Bladeless Optical Obturator, mailed May 20, 2008.

International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US2009/32026, titled "Insufflating Access System", mailed Mar. 23, 2009.

International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US2007/080724, titled "Visual Insufflation Port", mailed Apr. 16, 2008.

International Searching Authority/US, International Search Report and the Written Opinion of the International Searching Authority dated May 27, 2009, for International Application No. PCT/US2009/037863, titled "Instrument Seal with Inverting Shroud", mailed May 27, 2009.

The International Searching Authority, The International Search Report and the Written Opinion for International Application No. PCT/US2009/058792, titled "First Entry Trocar System", mailed Dec. 23, 2009.

International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US2012/036119, title "Low-Profile Surgical Universal Access Port", mailed Nov. 7, 2012.

European Patent Office, Supplementary European Search Report for European Patent Application No. EP 04 70 1731 based on International Application No. PCT/US2004/000695, titled "Surgical Access Apparatus and Method", dated Apr. 11, 2007.

European Patent Office, Supplementary European Search Report for European Patent Application No. EP 02706494.8, titled "Bladeless Obturator", dated Jun. 24, 2008.

European Patent Office, Supplementary European Search Report for European Patent Application No. EP 03753017.7, titled "Blunt Tip Obturator", dated Nov. 21, 2008.

European Patent Office, Supplementary European Search Report for European Patent Application No. EP 04712378, titled "Surgical Access Apparatus and Method", dated May 19, 2008.

European Patent Office, Supplementary European Search Report for European Patent Application No. EP 07843973.4, titled "Visual Insufflation Port" dated Oct. 4, 2008.

European Patent Office, Supplementary European Search Report for European Patent Application No. EP 04793965.7, titled "Bladeless Optical Obturator", dated Apr. 16, 2010.

European Patent Office, Supplementary European Search Report for European Patent Application No. EP 11154547.1, titled "Blunt Tip Obturator", dated Mar. 22, 2011.

European Patent Office, European Search Report for European Application No. 11191191.3, titled "Bladeless Obturator" dated Feb. 29, 2012.

European Patent Office, European Search Report for European Application No. 11191179.8, titled "Bladeless Obturator", dated Feb. 21, 2012.

European Patent Office, European Search Report for European Application No. 11191193.9, titled "Bladeless Obturator", dated Mar. 5, 2012.

European Patent Office, European Search Report for European Application No. 11191187.1, titled Bladeless Obturator, dated Feb. 23, 2012.

European Patent Office, European Search Report for European Application No. 11191184.8, titled "Bladeless Obturator", dated Feb. 23, 2012.

European Patent Office, European Search Report for European Application No. 11191189.7, titled "Bladeless Obturator", dated Feb. 24, 2012.

European Patent Office, European Search Report for European Application No. 11191175.6, titled "Bladeless Obturator", dated Feb. 21, 2012.

European Patent Office, European Search Report for European Application No. 047017314, titled "Surgical Access Apparatus and Method", dated Mar. 30, 2007.

Taut, Inc., ADAPT—Asymmetrical Dilating Access Port, Geneva Illinois.

Karl Storz, The Karl Storz Ternamian EndoTIP (TM) System, date: Aug. 27, 2001.

Karl Storz, ZEROCART Trocar with eccentric tip, Recklinghausen, Germany, date Mar. 7, 2001.

Ethicon Endo-Surgery, Inc., ENDOPATH Minimally Invasive Access, date: 2001.

European Patent Office, Invitation to Pay Additional Fees for International Application No. PCT/US2012/036119, titled "Low-Profile Surgical Universal Access Port", mailed Jul. 13, 2012.

European Patent Office, European Search Report for European Application No. 12187933, titled "Insufflating Optical Surgical Instrument", dated Nov. 20, 2012.

European Patent Office, European Search Report for European Application No. 12187929, titled "Insufflating Optical Surgical Instrument", dated Nov. 20, 2012.

European Patent Office, European Search Report for European Application No. 12186716.2, titled "Bladeless Optical Obturator", dated Mar. 7, 2013.

European Patent Office, European Search Report for European Application No. 12186717.0, titled "Bladeless Optical Obturator", dated Mar. 7, 2013.

European Patent Office, European Search Report for European Application No. 12186712.1, titled "Bladeless Optical Obturator", dated Mar. 7, 2013.

European Patent Office, European Search Report for European Application No. 12186720.4, titled "Bladeless Optical Obturator", dated Mar. 7, 2013.

International Searching Authority, International Search Report and Written Opinion for International Application No. PCT/US2013/023458 titled "Adaptable Obturator for Various Sized Trocars", mailed Mar. 19, 2013.

European Patent Office, European Search Report for European Application No. 12186722.0, titled "Bladeless Optical Obturator", dated Mar. 20, 2013.

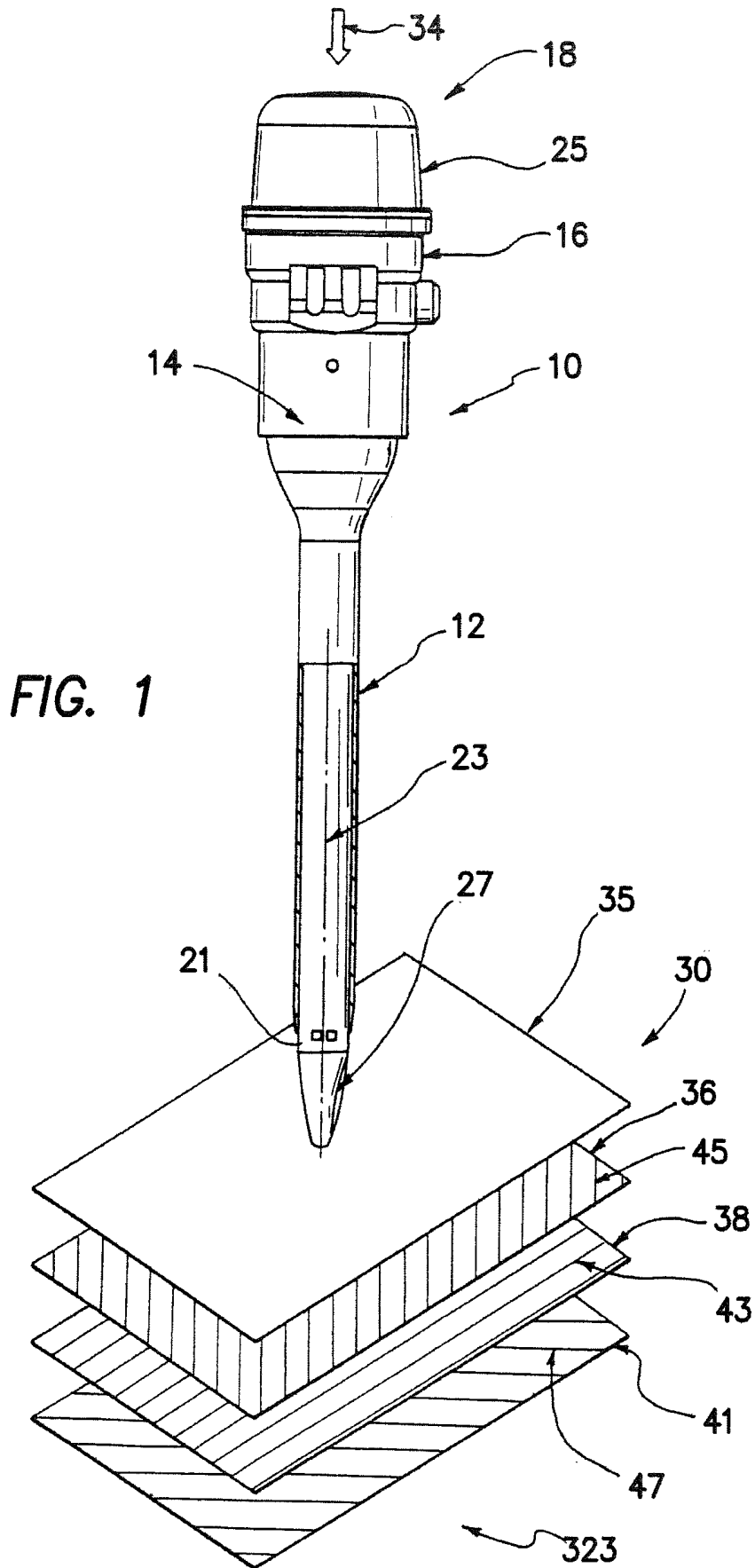
European Patent Office, European Search Report for European Application No. 12186721.2, titled "Bladeless Optical Obturator", dated Mar. 22, 2013.

European Patent Office, European Search Report for European Application No. 12186723.8, titled "Bladeless Optical Obturator", dated Mar. 22, 2013.

European Patent Office, European Communication pursuant to Article 94(3) EPC for European Patent Application No. 12186717.0, titled "Bladeless Optical Obturator", dated Mar. 26, 2013.

Yang, Guoqing, Hong Jun, Zhu, Linbo, Li Baotong, Xiong Meihua, and Wang Fei, Chinese Journal of Mechanical Engineering, (vol. 26, No. 3, 2013), Three-Dimensional Finite Element Analysis of the Mechanical Properties of Helical Threat Connection, Received Jun. 7, 2012, Revised Jan. 28, 2013, Accepted Feb. 27, 2013.

* cited by examiner



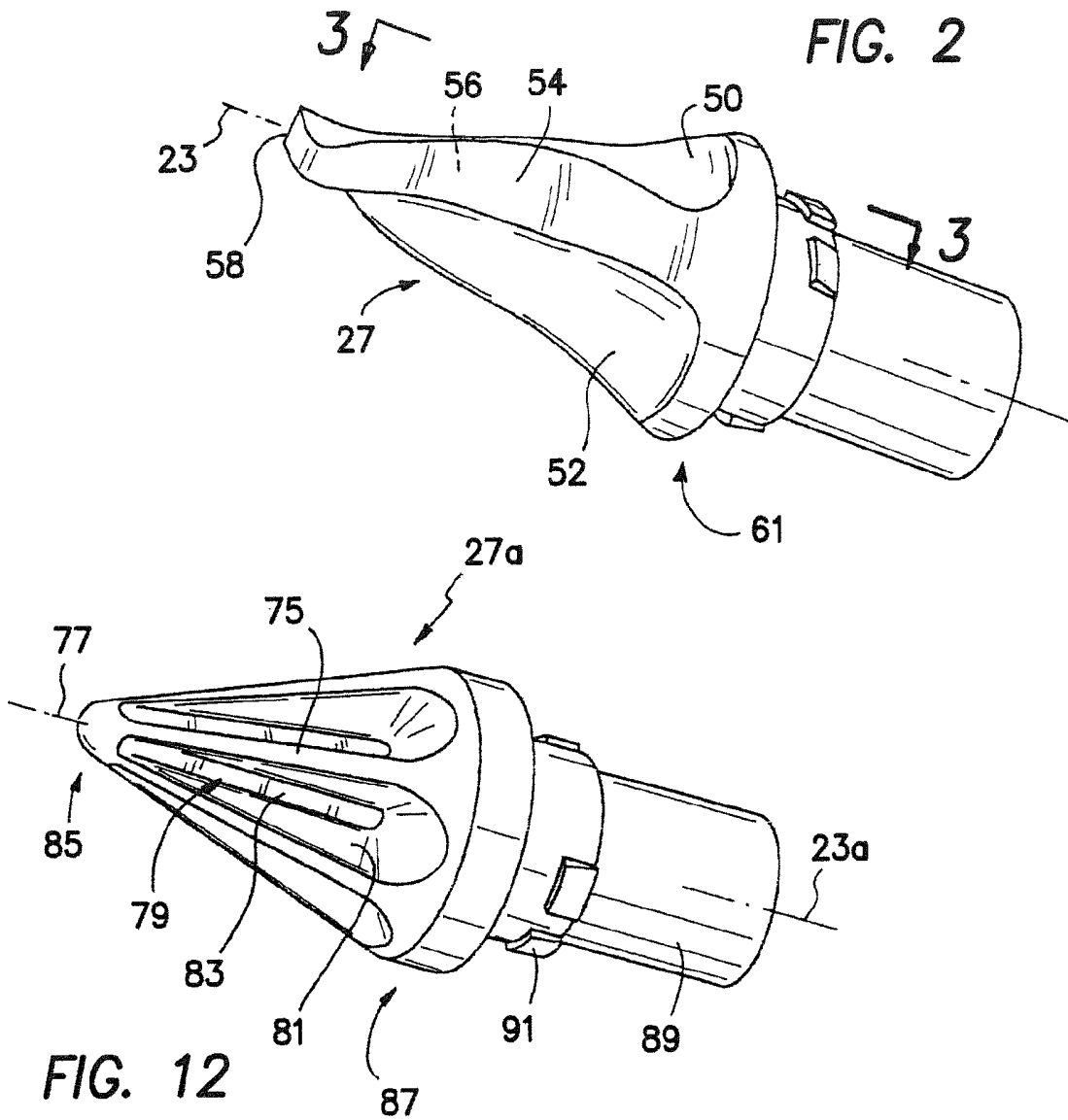


FIG. 12

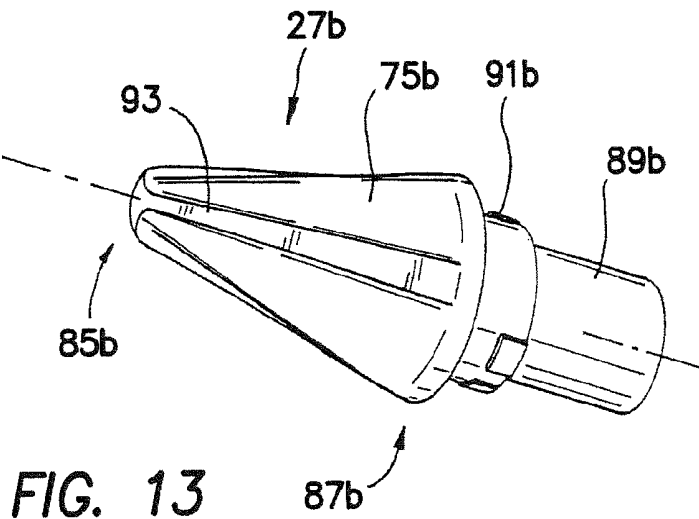


FIG. 13

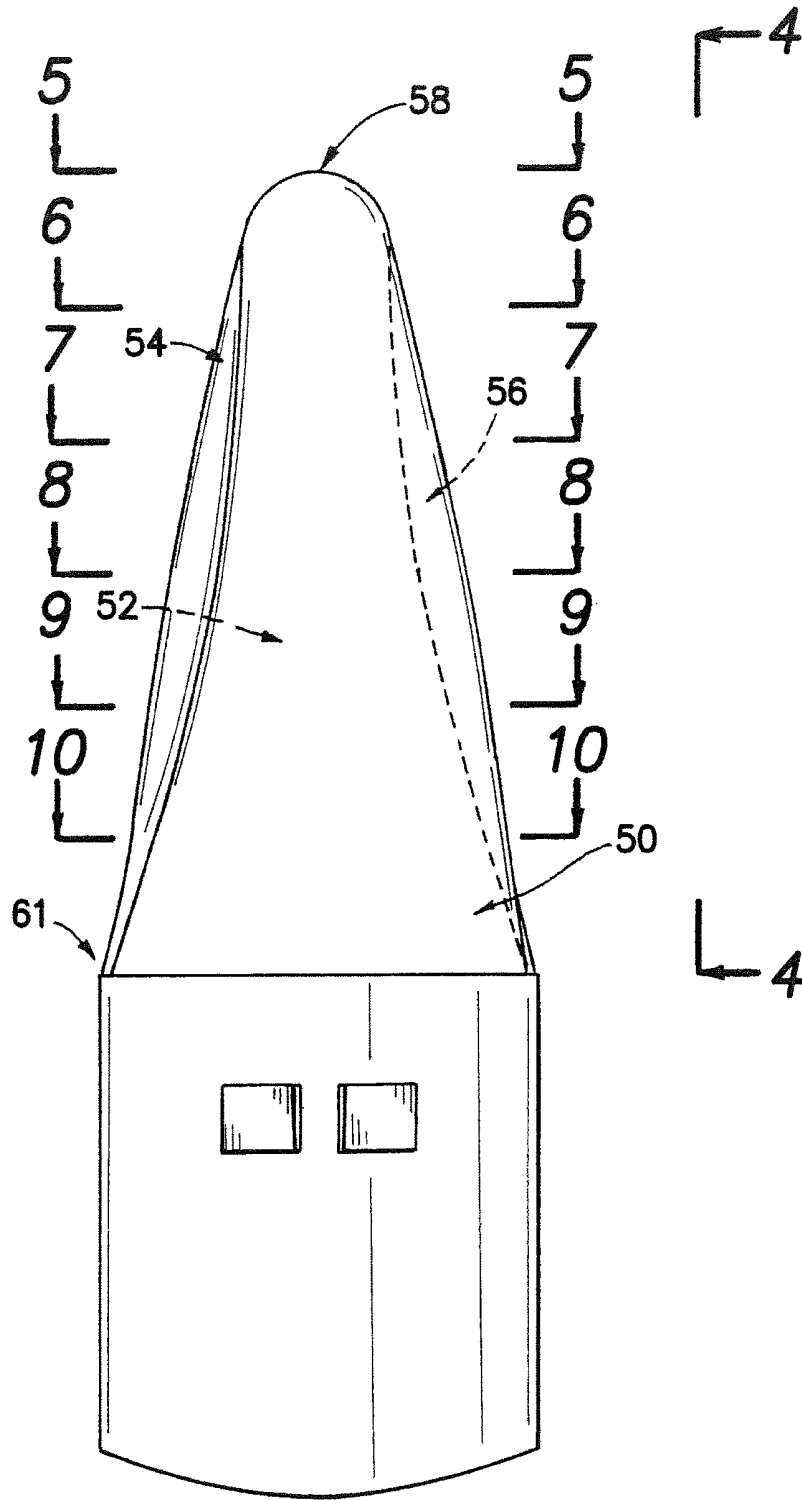
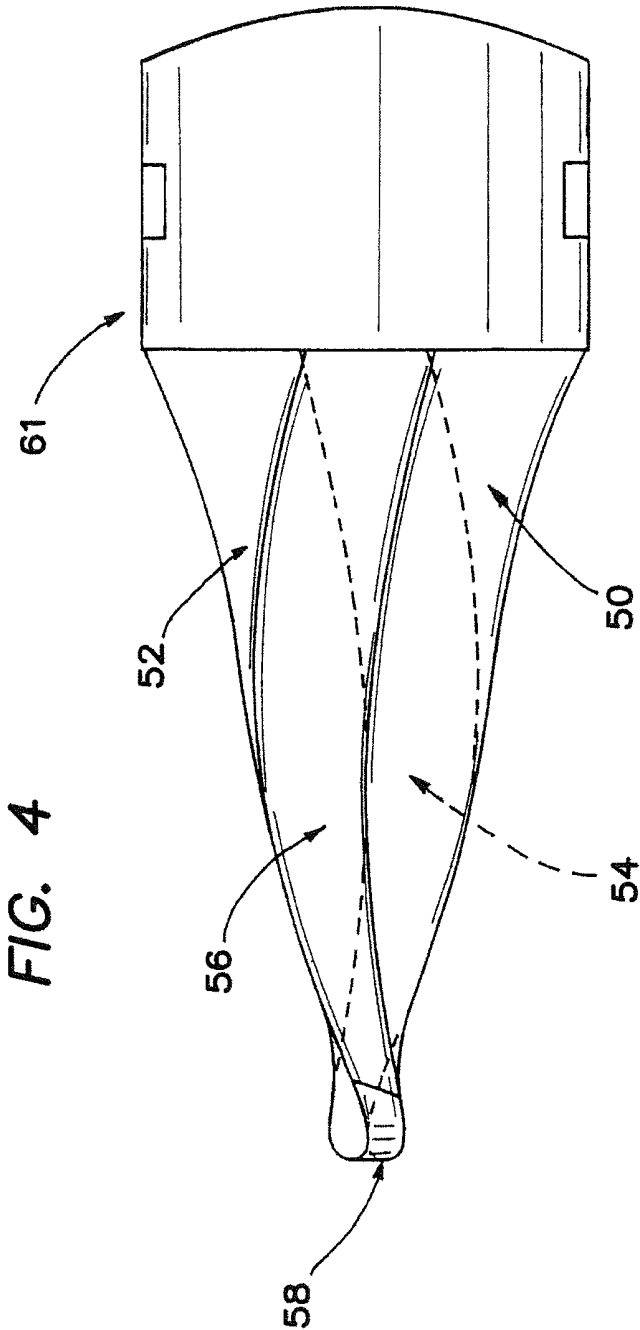


FIG. 3



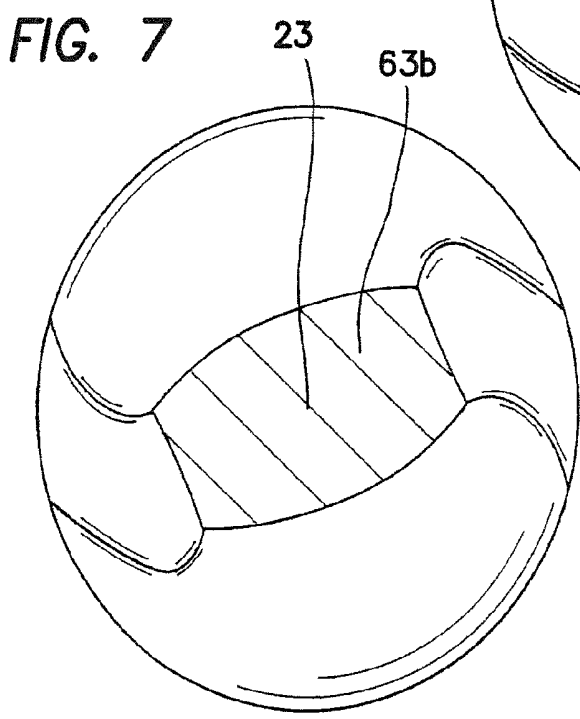
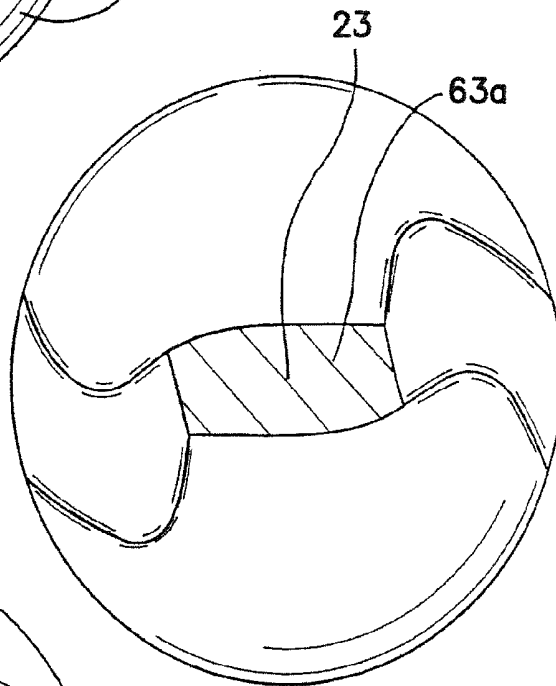
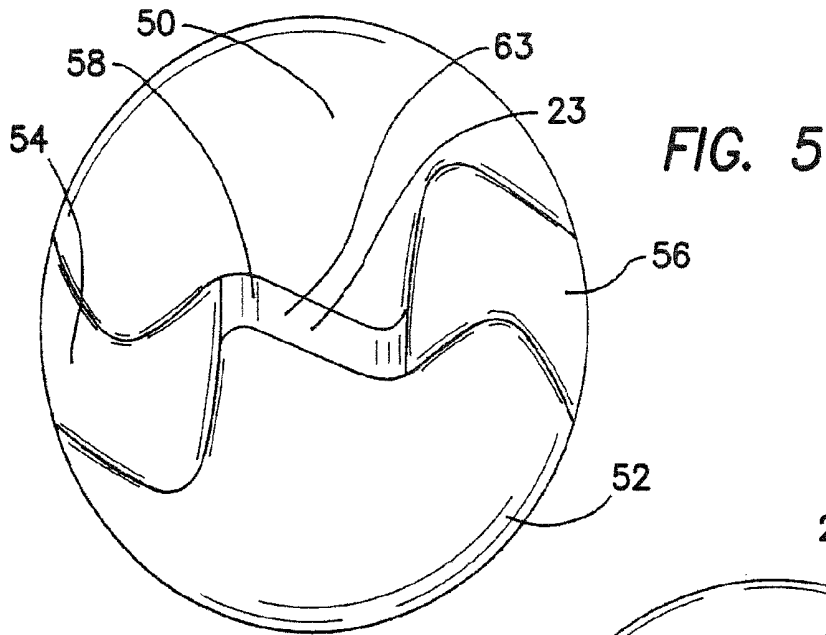
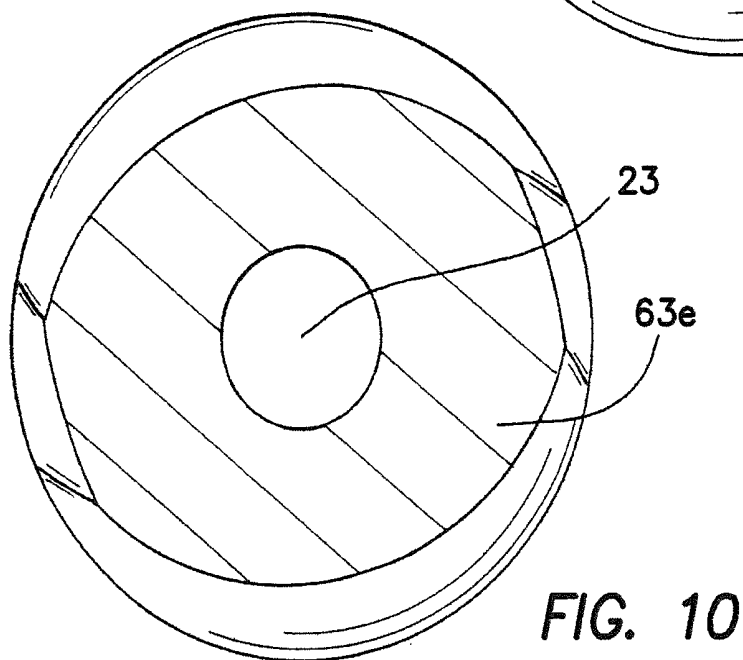
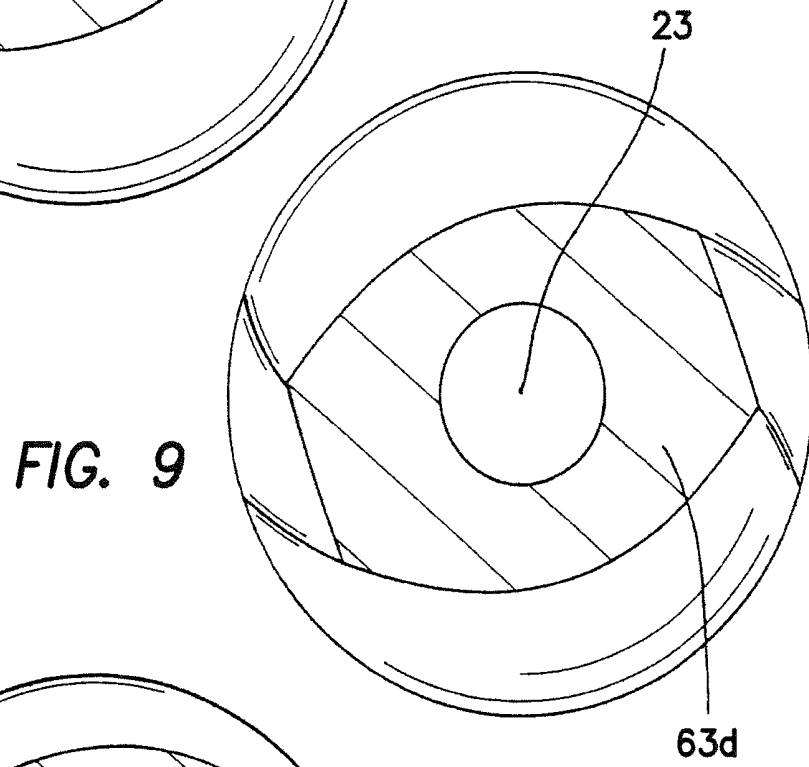
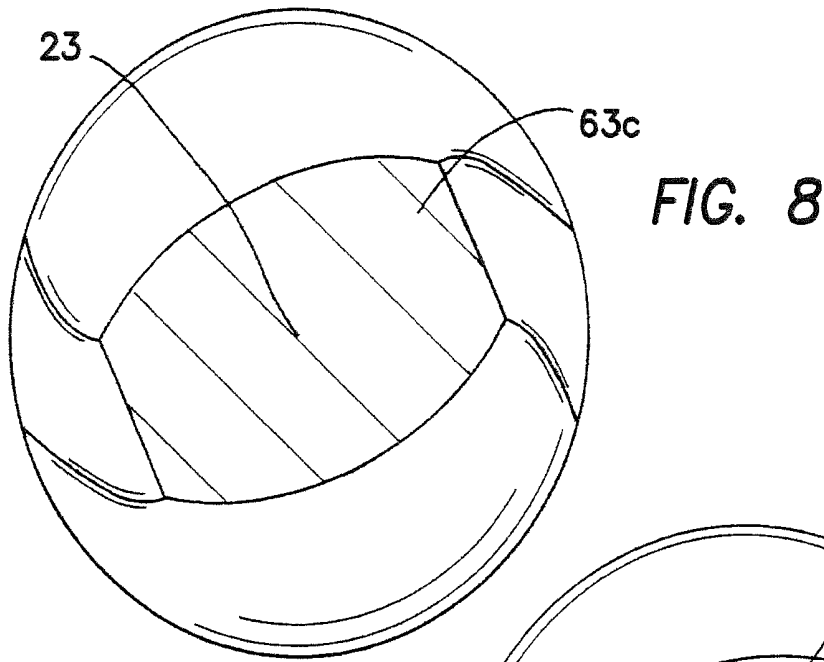


FIG. 6



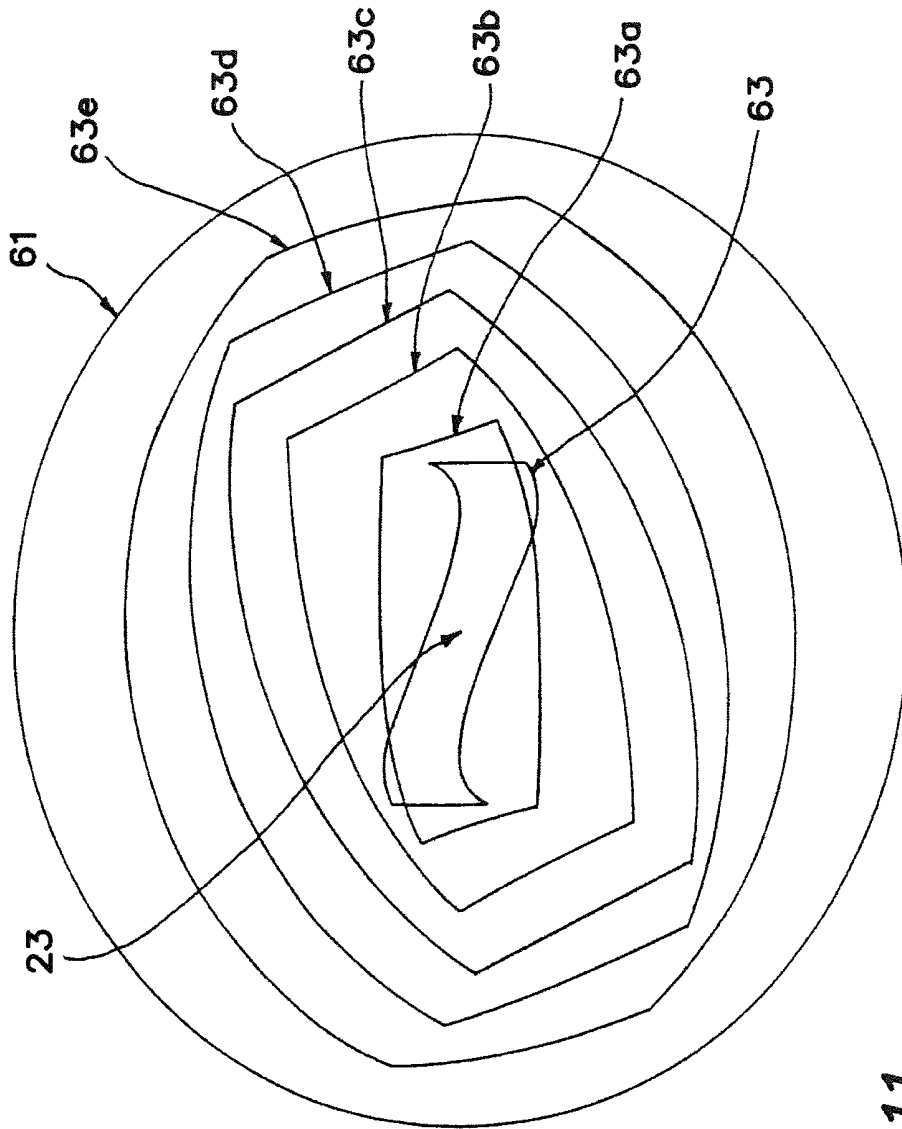


FIG. 11

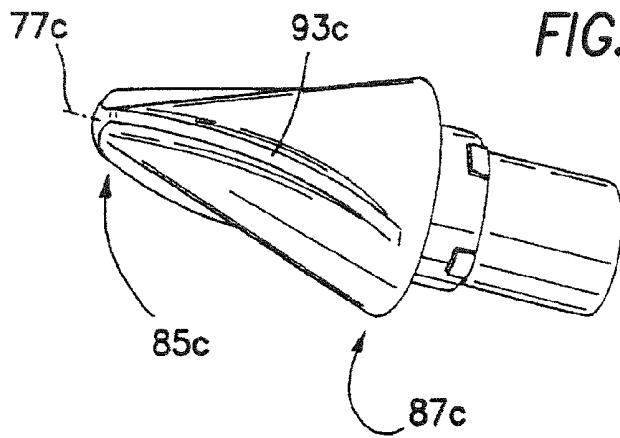


FIG. 14

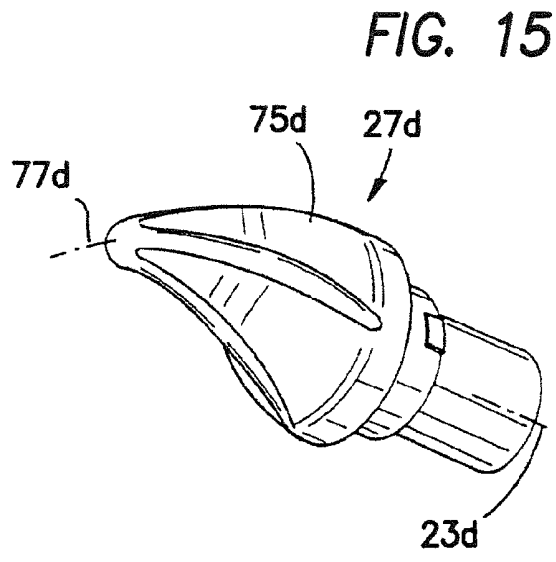


FIG. 15

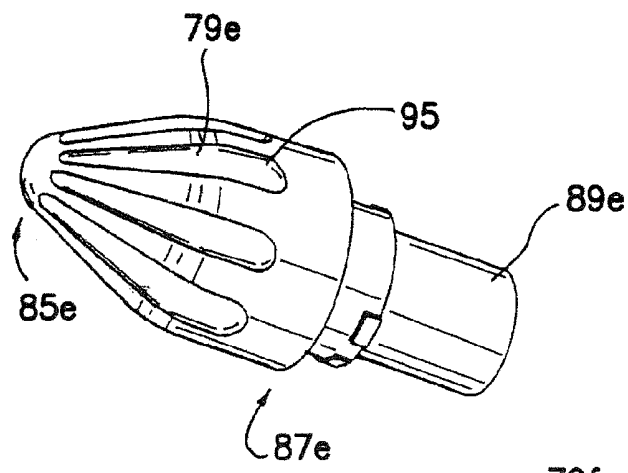


FIG. 16

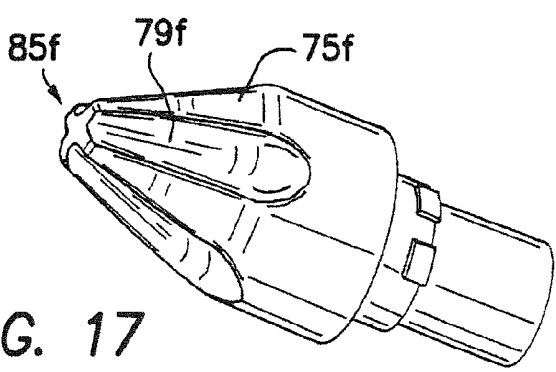


FIG. 17

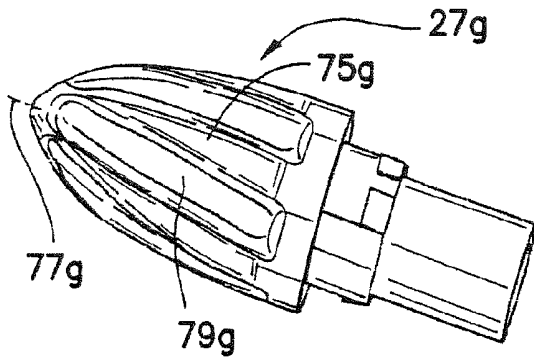


FIG. 18

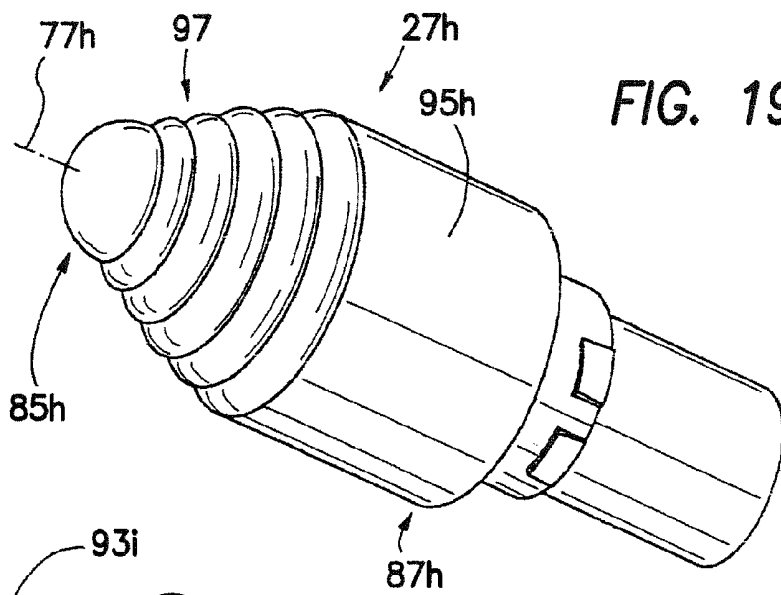


FIG. 19

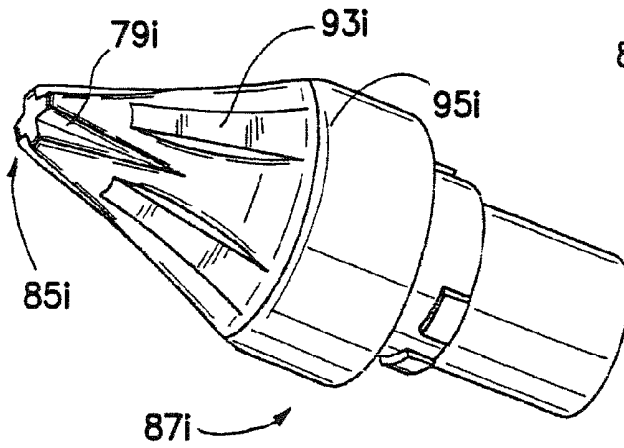


FIG. 20

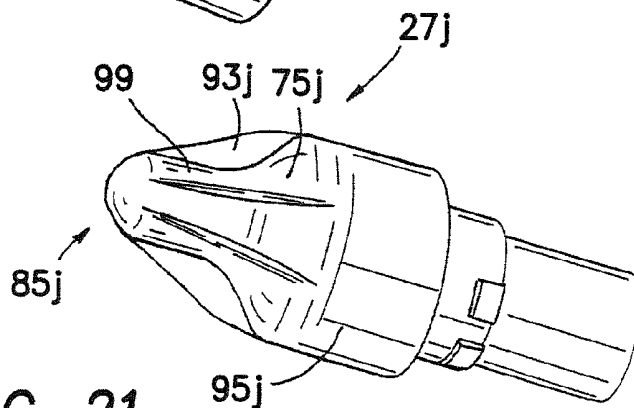


FIG. 21

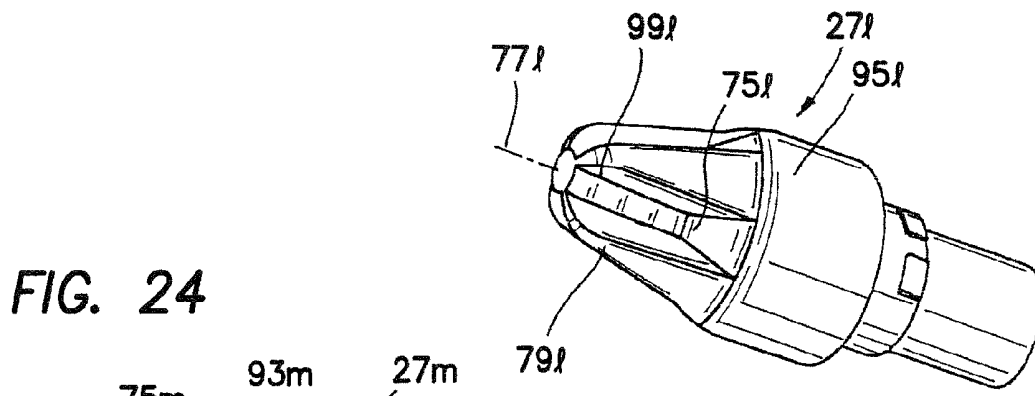
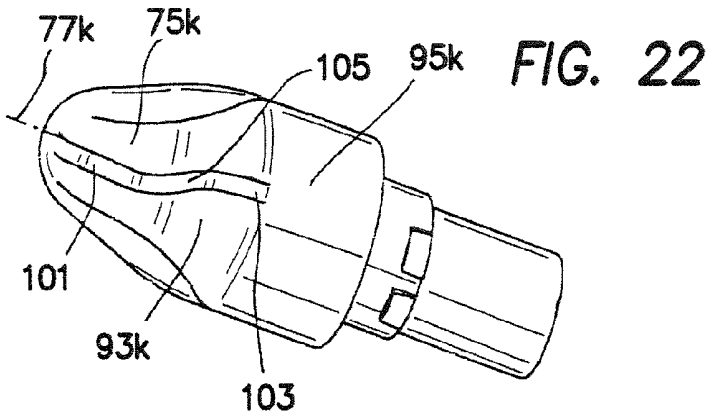


FIG. 24

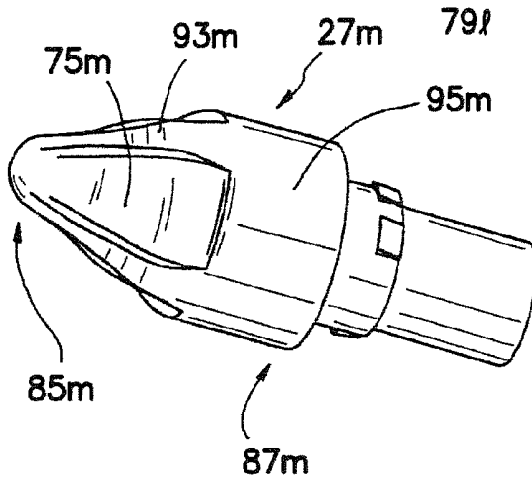
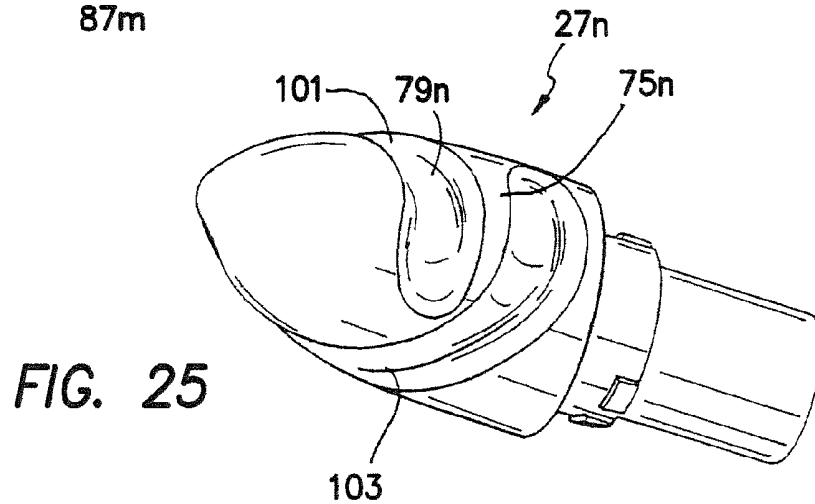


FIG. 23



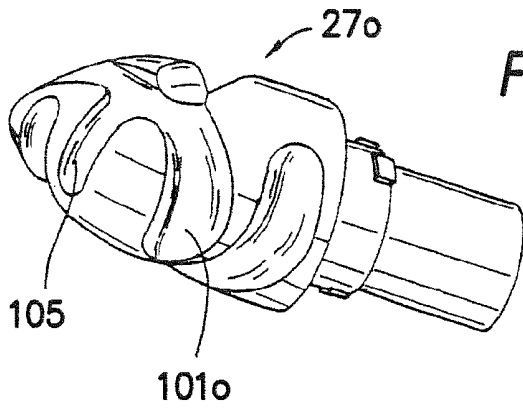


FIG. 26

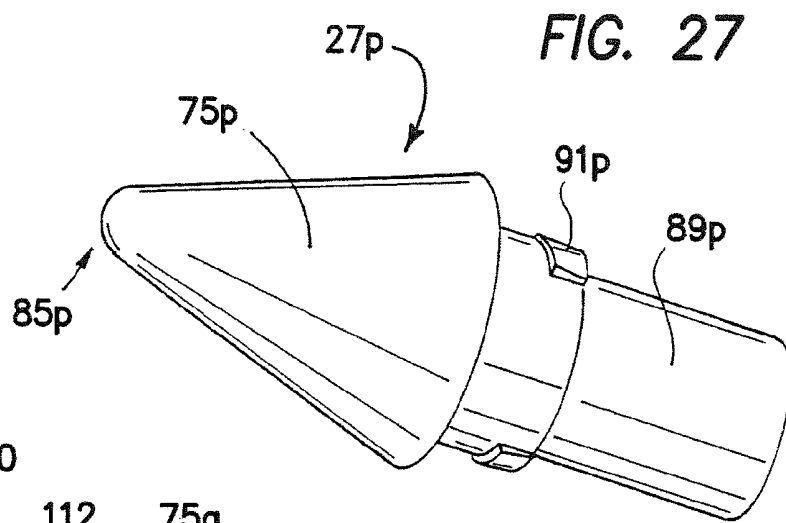


FIG. 27

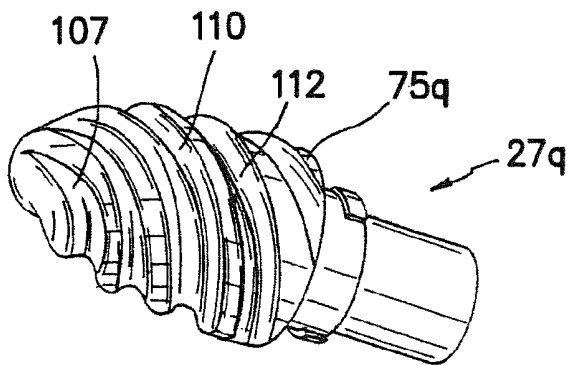


FIG. 28

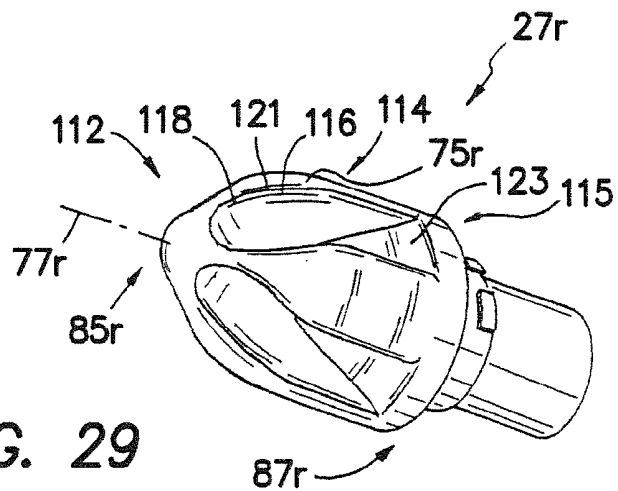
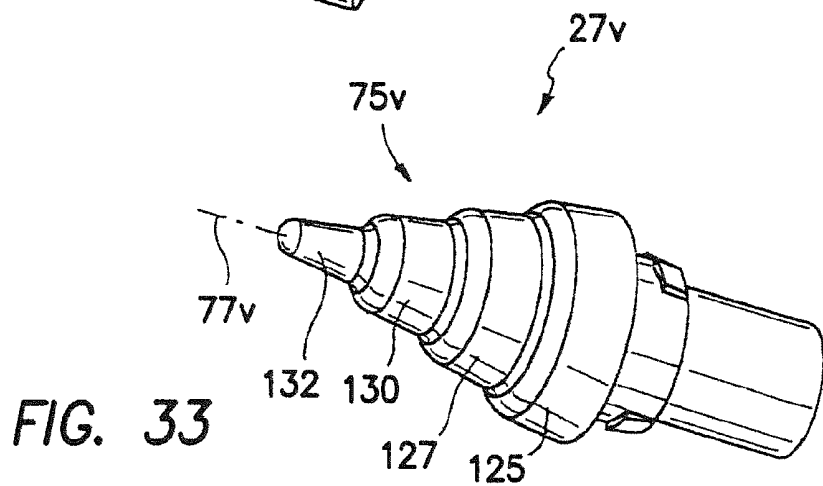
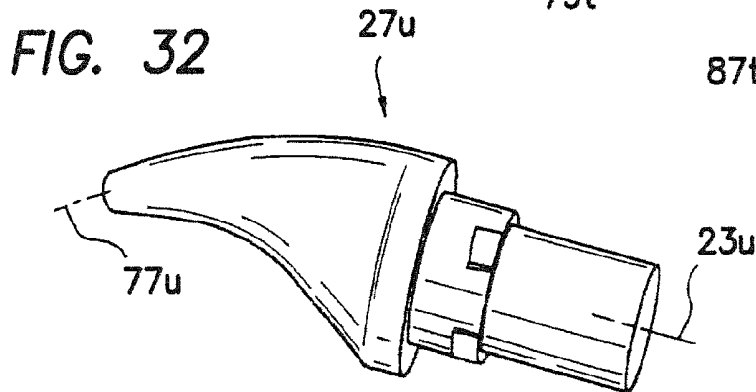
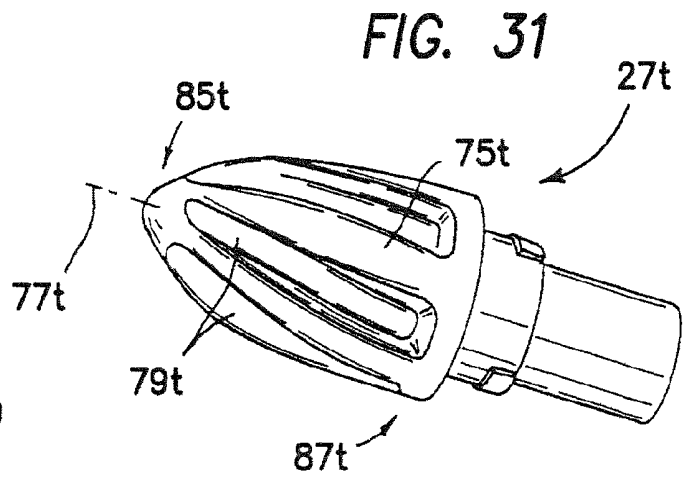
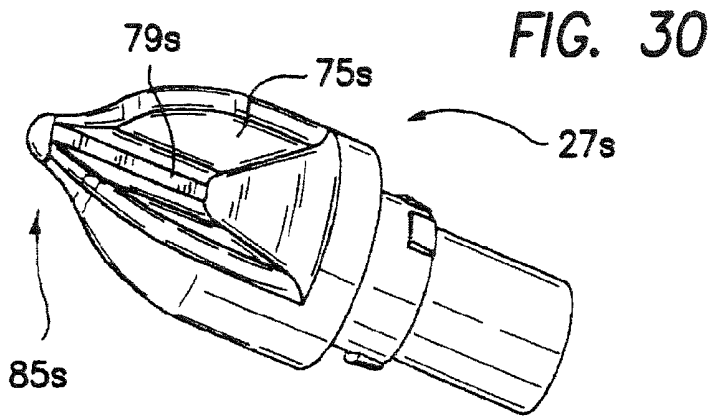


FIG. 29



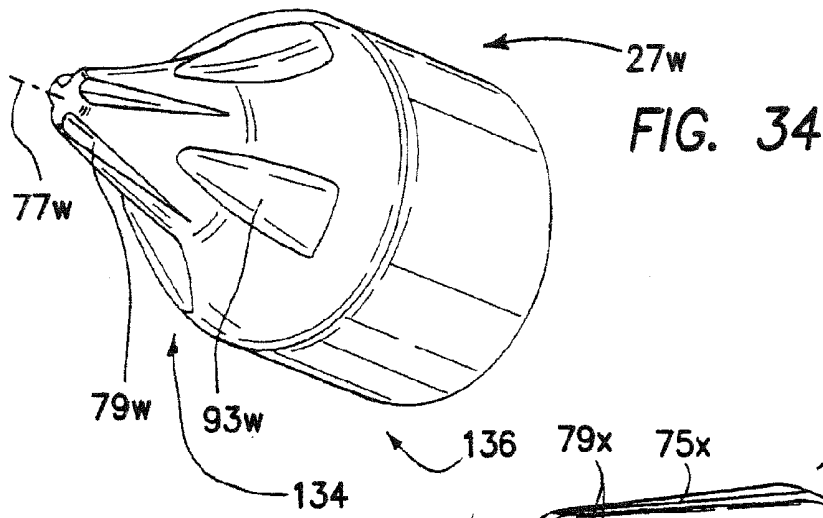


FIG. 34

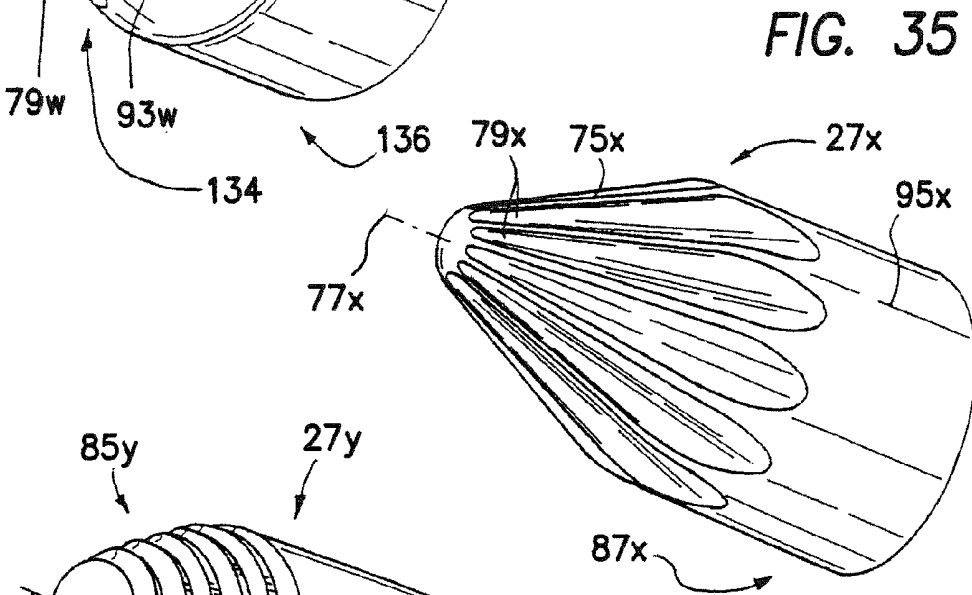


FIG. 35

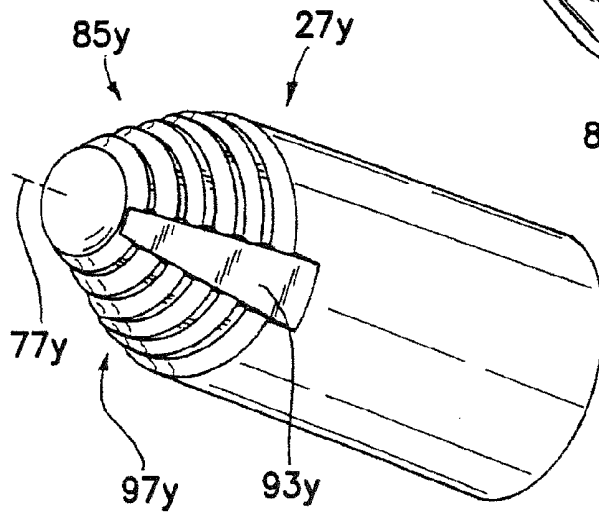


FIG. 36

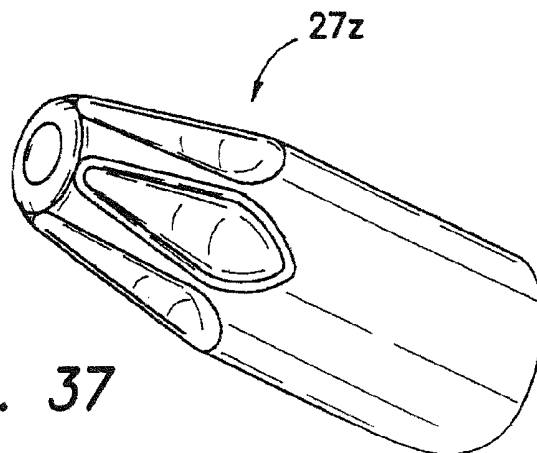


FIG. 37

BLADELESS OBTURATORCROSS REFERENCE TO RELATED
APPLICATIONS

This application is a continuation of U.S. application Ser. No. 12/750,372, filed on Sep. 2, 2010 which is a continuation of U.S. application Ser. No. 10/489,403, now U.S. Pat. No. 7,686,823, which entered the National Phase under 35 U.S.C. §371 on Mar. 11, 2004 from International Application No. PCT/US2002/06759, filed Mar. 4, 2002, which claims the benefit of U.S. Application No. 60/324,613, filed on Sep. 24, 2001, the entire disclosures of which are incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates generally to trocar systems including obturators, and more specifically, bladeless obturators.

BACKGROUND

Trocar systems have been of particular advantage in facilitating less invasive surgery across a body wall and within a body cavity. This is particularly true in the case of the abdominal surgery where trocars have provided working channels across the abdominal wall to facilitate the use of instruments within the abdominal cavity. Particularly in this form of surgery, it is advantageous to insufflate, inflate, or pressurize the abdominal cavity in order to provide an increased working volume. In the interest of maintaining this insufflation, trocars have been provided with valves which form at least two seals: across the working channel a zero seal in the absence of an instrument, and an instrument seal in the presence of an instrument.

The trocar systems of the past typically includes a cannula, which defines the working channel, and an obturator which is used to place the cannula across the abdominal wall. The obturator is inserted into the working channel of the cannula and then pushed through the abdominal wall with a penetration force of sufficient magnitude to result in penetration of the abdominal wall. Once the cannula is in place, the obturator can be removed.

In the past, obturators have been developed with an intent to provide a reduction in the force required for penetration. Sharp blades have typically been used to enable the obturator to cut its way through the abdominal wall. While the blades have facilitated a reduced penetration force, they have been of particular concern once the abdominal wall has been penetrated. Within the abdominal cavity, there are organs which need to be protected against any puncture by an obturator.

In some cases, shields have been provided with the obturators in order to sense penetration of the abdominal wall and immediately shield the sharp blades. These shielding systems have been very complex, have required a large amount of time to deploy, and have generally been ineffective in protecting the organs against the sharp blades.

Blunt-tip obturators have been contemplated with both symmetrical and asymmetrical designs. While the blunt tip tends to inhibit damage to interior organs, it also tends to increase the penetration force associated with the obturator.

In some cases, blunt tip obturators have been adjusted to take advantage of the known anatomy associated with the abdominal wall. This anatomy includes three layers of muscle, each layer having parallel fibers which extend in a particular direction that is different for each of the layers. Notwithstanding this knowledge of the anatomy, prior

attempts to develop blunt-tip obturators have not taken full advantage of this anatomical structure.

SUMMARY

In accordance with the present invention, a blunt tip obturator is disclosed with characteristics which take further advantage of the abdominal anatomy. In several embodiments, the obturator has a blunt tip with a blade configuration particularly adapted for alignment parallel to the fibers of the muscle layers. With a twisted configuration, this tip transitions through a rectangular cross section to a circular cross section as it twists radially from a distal end to a proximal end of the tip. This configuration facilitates insertion with a reduced penetration force as the user moves the tip back and forth radially while applying an axial penetration force. With the blade tip having a length to width ratio greater than one, the blade can be inserted between the fibers and then rotated to provide increased fiber separation and thereby facilitate accommodation of the larger diameter associated with the cannula.

In one aspect of the invention, a surgical obturator is adapted to penetrate a body wall. The obturator includes an elongate shaft extending along an axis between a proximal end and a distal end. A bladeless tip is disposed at the distal end of the shaft, the tip having an outer surface extending distally to a blunt point. The outer surface has a pair of side sections separated by an intermediate section. One of the side sections extends from the blunt point radially outwardly with progressive position proximally along the axis. This side section includes a distal portion in proximity to the blunt point and a proximal portion in proximity to the shaft. The distal portion of the one side section is twisted radially with respect to the proximal portion of the one side section. The intermediate section extends across the blunt point of the bladeless tip.

In another aspect of the invention, a bladeless tip is disposed at the distal end of the shaft and has an outer surface with the distal portion and a proximal portion. The outer surface of the tip in radial cross section has the general configuration of a geometric shape with a side. The side of the geometric shape in the distal portion of the tip rotates in the first direction about the axis in progressive proximal radial cross sections along the axis. The side of the geometric shape in the proximal portion of the tip rotates in a second direction opposite to the first direction with progressive proximal radial cross sections along the axis.

In an additional aspect of the invention, the bladeless tip has an outer surface including a pair of generally opposed sections. The outer surface has a geometric shape in progressive radial cross sections from a distal cross section to a proximal cross section. A pair of generally opposed sections of the outer surface appear as a pair of lines in each of the progressive radial cross sections, with at least one of the lines becoming increasingly arcuate in the progressive radial cross sections.

In a further aspect of the invention, the bladeless tip is coupled to the shaft and has an axis extending between a proximal end and a distal end, the tip having an outer surface with a generally conical configuration and a blunt tip. Portions of the outer surface define at least one recess extending relative to the axis generally between the proximal end and the distal end of the tip.

These and other features and advantageous of the invention will become more apparent with a discussion of preferred embodiments in reference to the associated drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of a trocar system including a cannula with associated valve housing, and an obturator with a blunt tip extending through the working channel of the cannula to facilitate placement across the abdominal wall;

FIG. 2 is a perspective view of a preferred embodiment of the blunt tip illustrated in FIG. 1;

FIG. 3 is a side elevation view of the blunt tip taken along lines 3-3 of FIG. 2;

FIG. 4 is a side elevation view taken along lines 4-4 of FIG. 3;

FIG. 5 is an end view taken along lines 5-5 of FIG. 4;

FIG. 6 is a radial cross-section view taken along line 6-6 of FIG. 4;

FIG. 7 is a radial cross-section view taken along line 7-7 of FIG. 4;

FIG. 8 is a radial cross section view taken along lines 8-8 of FIG. 4;

FIG. 9 is a radial cross section view taken along lines 9-9 of FIG. 4;

FIG. 10 is a radial cross section view taken along lines 10-10 of FIG. 4;

FIG. 11 is a schematic view illustrating each of the FIGS. 5-10 superimposed to facilitate an understanding of the twisted configuration of the blunt tip; and

FIG. 12-37 show perspective views of other embodiments of the blunt tip of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

A trocar system is illustrated in FIG. 1 and designated by the reference numeral 10. This system includes a cannula 12, defining a working channel 14, and a valve housing 16. The system 10 also includes an obturator 18 having a shaft 21 extending along an axis 23. A handle 25 is disposed at a proximal end of the shaft at 21 while a blunt tip 27 is disposed at a distal end of the shaft 21. The shaft 21 of the obturator 18 is sized and configured for disposition within the working channel 14 of the cannula 12. With this disposition, illustrated in FIG. 1, the obturator functions to penetrate a body wall such as the abdominal wall 30 to provide the cannula with access across the wall 30 and into a body cavity, such as the peritoneal or abdominal cavity 32. The blunt tip 27, which initially facilitates penetration of the abdominal wall 30 can be removed with the obturator 18 once the cannula 12 is operatively disposed with the working channel 14 extending into the abdominal cavity 32.

In order to facilitate penetration of the abdominal wall 30 by the trocar system 10, a penetration force, represented by an arrow 34, is typically applied along the axis 23. It can be appreciated that the force required to penetrate the abdominal wall 30 drops significantly once the wall 30 is penetrated. Further application of the force 34, even for an instant of time, can result in injury to organs within the cavity 32. Where the obturators of the past have included blades facilitating penetration of the abdominal wall, these blades have been particularly threatening and detrimental to the interior organs.

Consequently, in accordance with the present invention, the tip 27 of the obturator 18 is provided with a blunt configuration. As noted, blunt tips have been used in the past to significantly reduce any potential for damage to interior organs. Unfortunately, these blunt tips have increased significantly the amount of force 34 required for penetration of the abdominal wall 30.

The blunt tip 27 of the present invention takes into account an anatomical configuration of the abdominal wall 30 with an improved structural design and method of insertion.

In order to fully appreciate the aspects of this invention, it is helpful to initially discuss the anatomy associated with the abdominal wall 30. This wall 30 typically includes the skin or fascia 35 and a series of muscles in the form of muscle layers 36, 38 and 41. These layers are each defined by muscle fibers which extend generally parallel to each other in a direction which is different for each of the layers. For example, the layer 38 is composed of fibers 43 which extend generally parallel in a particular direction. Fibers 45 associated with the layer 36 extend generally parallel at an angle such as 45 degrees to the particular direction of the fibers 43. Fibers 47 associated with the layer 41 also extend in a parallel direction but at an angle of about 45 degrees to the fibers 43 and an angle of about 90 degrees to the fibers 45.

Having noted the directional nature of the fibers, such as the fibers 45, it can be appreciated that such a structure is most easily penetrated by a tip 27 having a narrow width which is capable of being moved generally parallel to and between the fibers associated with a particular muscle layer. This narrow width might be provided with a point configuration or in the case of a preferred embodiment, a line or rectangular configuration having the narrow width and a longer length. With the length oriented parallel to the fibers of a particular layer a reduced penetration force 34 is required to push the obturator 18 through the particular layer.

Unfortunately, with the fibers 45, 43 and 47 oriented at 45 degrees to each other, proper alignment of the tip 27 for penetration of one layer, such as the layer 36, will not necessarily result in proper alignment for penetration of the next layer, such as the layer 38. For this reason, the rectangular configuration for the tip 27 is twisted slightly so that penetration of the first layer 36 begins to rotate the distal end of the tip 27 into proper orientation for penetration of the next layer 38.

The twisted configuration of the tip 27 also causes the tip 27 to function with the mechanical advantage of a screw thread. With this configuration, a preferred method of placement requires that the user grip the handle 25 of the obturator 18, and twist it about the axis 27. This twisting motion in combination with the screw configuration of the tip 27 converts radial movement into forward movement along the axis 23. Thus, the user applies both a forwardly directed force as well as a radial force to move the trocar system 10 in a forward direction. Since all of the force supplied by the user is not directed axially along the arrow 34, this concept avoids the tendency of prior trocar systems to jump forward upon penetration of the wall 30.

The twisted and rectangular configuration of the tip 27 is most apparent in the schematic view of FIG. 2 and the side elevation views of FIGS. 3 and 4. In this embodiment, the tip is composed generally of four surfaces: two opposing major surfaces 50 and 52, separated by two side surfaces 54 and 56 which extend between an end surface 58 and a proximal base 61. A plane drawn through the axis 23 would show the tip 27 in this case, to be composed of two symmetrical halves.

The major surfaces 50 and 52 and the side surfaces 54 and 56 generally define the cross section of the tip 27 to be rectangular from the distal surface 58 to the proximal end 61. This configuration can best be appreciated with reference to the cross section views of FIGS. 5-10. In FIG. 5, the distal end of the tip 27 is shown with a rectangle having the greatest length to width ratio. This rectangle, designated by the reference numeral 63, also has a twisted, S-shaped configuration at the distal-most end of the tip 27.

As views are taken along progressive proximal cross sections, it can be seen that the rectangle 63 becomes less twisted, and the width increases relative to the length of the rectangle 63. The spiral nature of the tip 27 is also apparent as the rectangle moves counterclockwise around the axis 23 in the embodiment of FIG. 2. This is perhaps best appreciated in a comparison of the rectangle 63 in FIG. 7 relative to that in FIG. 6. With progressive proximal positions, the rectangle 63 begins to fatten with a reduction in the ratio of length to width. The long sides of the rectangle 63 also tend to become more arcuate as they approach a circular configuration most apparent in FIGS. 9 and 10. In these figures, it will also be apparent that the rotation of the rectangle 63 reaches a most counterclockwise position and then begins to move clockwise. This is best illustrated in FIGS. 8, 9 and 10. This rotation back and forth results from the configuration of the side surfaces 54 and 56, which in general, have a U-shape best illustrated in FIGS. 2 and 3.

The ratio of the length-to-width of the rectangle 63 is dependent on the configuration of the side surfaces 54 and 56, which defined the short sides of the rectangle 63 as well as the configuration of the major surfaces 50 and 52 which define the long sides of the rectangle 63. Again with reference to FIG. 3, it can be seen that the side surfaces 50 and 52 are most narrow at the distal end of the tip 27. As these surfaces extend proximally, they reach a maximum width near the point of the most counterclockwise rotation, shown generally in FIG. 8, and then reduce in width as they approach the proximal end 61. Along this same distal to proximal path, the major surfaces 50 and 52 transition from a generally flat configuration at the distal end to a generally conical configuration at the proximal end 61.

In the progressive views of FIGS. 6-10, the rectangle 63 is further designated with a lower case letter a, b, c, d, or e, respectively. In FIG. 11, the rectangles 63 and 63a-63c are superimposed on the axis 23 to show their relative sizes, shapes, and angular orientations.

A preferred method of operating the trocar system 10 benefits significantly from this preferred shape of the blunt tip 27. With a rectangular configuration at the distal surface 58, the end of the tip 27 appears much like a flathead screwdriver. The length of the surface 58 is aligned parallel with the fibers 45 of the layer 36. With this shape, the simple back and forth twisting motion tends to separate the fibers 45 along natural lines of separation, opening the muscle layer 36 to accept the larger diameter of the cannula 12. By the time the first layer 36 is substantially penetrated, the twisted configuration of the blunt tip 27 turns the rectangle at the distal surface 58 more into a parallel alignment with fibers 43 in the next layer 48. Again, a twisting or dithering motion facilitates an easy separation of these fibers requiring a significantly reduced penetration force along the arrow 34.

When the muscle layer 38 is sufficiently penetrated, the twisted configuration of the tip 27 automatically rotates the rectangular end surface 58 into generally parallel alignment with the fibers 47 of the next layer 41. Again, the natural separation of these fibers 47 together with the unique configuration of the tip 27, accommodates the further penetration of the layer 41 until the cannula 12 is operatively disposed across the wall 30. It will be noted in particular that the fibers 45, 43, and 47 are naturally separated, not cut. This has two advantageous effects: 1) the abdominal wall 30 easily closes upon removal of the trocar system 10; and 2) without cutting, very little bleeding is encountered and very little healing is required to seal the wound permanently.

Certainly, one of the primary purposes of the invention is to maintain control and facilitate entry into the body cavity 32

while inhibiting any tearing or cutting of tissue. The tip 27 is bladeless, blunt, and atraumatic to organs and bowel within the peritoneal or abdominal cavity 32. The tip 27 also minimizes tenting of the peritoneum and allows for a safe entry. The device is used in conjunction with the cannula 12 to create an initial entry way into the peritoneal cavity 32. The obturator is first inserted through the valve housing 16 and into the cannula 12. The entire trocar system 10 is then inserted through the abdominal wall 30 and into the peritoneal cavity 32. Once the cannula 12 is properly placed, the obturator 18 can be removed.

This facilitates a unique method of separating tissue and could apply to any object with a slim profile and flat sides. When inserted into the peritoneum the slim profile of the device requires very little area to move safely between tissue and muscle fibers. The device can then be rotated in alternating clockwise and counterclockwise directions while the downward penetration force is applied. When rotated in alternating directions, the tissue is moved apart and a larger opening is created for a profile of greater cross sectional area to follow. This process continues with safety and ease until the device enters the peritoneal cavity 32 and moves to its operative position.

When the cannula 12 is ultimately removed, the size of the opening left in the tissue is minimal. Importantly, this opening is left sealed due to a dilating effect caused by the mere separation of fibers. Note that there are no blades or sharp edges to cut muscle fiber, and thereby prolong the healing process.

In other embodiments, the tip 27 of the obturator can be fabricated of a translucent or clear material, and the handle provided with a passageway along the inside of the tip. With this configuration, a laparoscope can be inserted through the handle of the obturator and through the shaft to the tip. Insertion can then be monitored through the laparoscope, and the clear tip of the obturator, in order to further ensure safe entry.

The obturator 18 can be constructed as a single component or divided into two components such as the shaft 21 and the tip 27. If the obturator 18 is constructed as a single component, it may be constructed of either disposable or reusable materials. If the obturator 18 is constructed as two or more components, each component can be made either disposable or useable as desired for a particular configuration. In a preferred embodiment, the obturator shaft 21 and handle are made of a reusable material, such as a metal or an autoclavable polymer in order to facilitate re-sterilization and reuse of these components. In this embodiment, the tip 27 is made of a material that is not autoclavable and therefore is adapted to be disposable.

The blunt tip 27 can be coated or otherwise constructed from a soft elastomeric material. In such a case, the material could be a solid elastomer or composite elastomer/polymer.

The obturator could also contain a spring-biased shield to cover the tip. On entry the shield could be retracted exposing the tip and then immediately and automatically moved distally back over the tip upon full entry into the peritoneal cavity 32. The action of the shield could also serve as an indicator to the surgeon that safe entry had been achieved. The obturator could be constructed in a manner wherein the tip 27 itself is spring biased and keyed to the shaft. The tip 27 would retract during insertion but would then deploy upon entry into the peritoneal cavity 32. This deployment action could also further serve as an indicator of safe entry.

The shaft 21 of the obturator 18 could be partially or fully flexible. With this configuration, the obturator 18 could be inserted through a passageway containing one or more curves of virtually any shape. A partially or fully flexed obturator 18

could then be used with a flexible cannula 12 allowing greater access to an associated body cavity 32.

The obturator 18 could also be used as an insufflation needle and provided with a passageway and valve to administer carbon dioxide or other insufflation gas to the peritoneal cavity 32. The obturator 18 could also be used with an insufflation needle cannula, in which cases removal of the obturator 18 upon entry would allow for rapid insufflation of the peritoneal cavity 32.

The obturator 18 could also be constructed to permit free spinning of the tip about the axis 23. This would allow the tip 27 to find its own way through the abdominal wall 30 rather than relying on the user for clockwise and counterclockwise rotation.

Other embodiments of the invention are illustrated in FIG. 12-38 where elements of structure similar to those previously disclosed are designated with the same reference numeral followed by the lower case letters "a" to "z", respectively. Thus, in FIG. 12, the tip 27 is referred to with the reference numeral 27a while in FIG. 38, the tip is referred to with a reference numeral 27z.

In FIG. 12, the obturator tip 27a is formed with a conical surface 75 having an axis 77. In this embodiment, the axis 77 of the surface 75 is collinear with the axis 23a of the tip 27a. A plurality of recesses 79 are formed in the conical surface 75 around the axis 77. These recesses are formed with side walls 81 which extend radially inwardly to a valley 83. In this embodiment, the conical surface 75 has an angle with respect to the axis 77 which is greater than an angle between the valley 83 and the axis 77. As a result, the recesses 79 appear to deepen relative to the surface 75 from a distal end 85 to a proximal end 87 of the tip 27a. The sidewalls 81 have a generally constant angle with respect to the conical surface 75 and consequently have an increased area toward the proximal end 87. The valley 83 has a generally constant width as it extends towards the proximal end 87.

In this embodiment, the tip 27a also has a cylindrical mounting shaft 89 with mounting lugs 91. This mounting shaft 89 is adapted to closely fit within the obturator shaft 21 (FIG. 1). The mounting lugs 91 can engage holes or shoulders within the shaft 21 to facilitate a fixed but removable relationship between the shaft 21 and tip 27a.

In FIG. 13, the tip 27b is also characterized by the conical surface 75b, the cylindrical mounting stub 89 and the lugs 91b. In this case, the tip 27b is provided with ridges 93 which extend radially outwardly from the conical surface 75b. The ridges 93 can have a constant width or a width which increases proximally as in the illustrated embodiment. The height of the ridges above the conical surface 75b can be either constant or variable between the distal end 85b and the proximal end 87b.

The obturator tip 27c in FIG. 14 is similar to that of FIG. 13 except that the ridges 93c are not straight but rather curved as they extend between the distal end 85c and the proximal end 87c. In this case, the ridges have an angle with respect to the axis 77c which increases proximally both radially and axially.

The obturator tip 27d in FIG. 15 is similar to that of FIG. 12 except that the axis 77d of the conical surface 75d is curved rather than straight. Accordingly, the axis 77d of the conical surface 75d is curved relative to the axis 23d of the obturator shaft 21d.

The obturator tip 27e in FIG. 16 is similar to that of FIG. 12 in that it includes the recess 79e which extend from the distal end 85e to the proximal end 87e. In this case however, the tip 27e has a cylindrical surface 95 which extends proximally of the conical surface 75e between the distal tip 85e and the

mounting stub 89e. The recesses 79e in this embodiment extend along both the conical surface 75e and the cylindrical surface 95.

The obturator tip 27f of FIG. 17 is similar to that of FIG. 16 except that the recesses 79f extend through the distal end 85f. In the illustrated embodiment, four of the recesses 79f provide the distal end 85f with the shape of the letter "X."

The obturator tip 27g in FIG. 18 is similar to that of FIG. 12 except that the surface 75g is more rounded thereby providing the tip 27g with a parabolic or bullet shape. Also, the recesses 79g are disposed at an angle with respect to any plane passing through the axis 77g.

The obturator tip 27h in FIG. 19 has the cylindrical surface 95h at its proximal end 87h and a series of grooves 97 which extend circumferentially of the axis 77h with diameters which increase from the distal end 85h to the cylindrical surface 95h. Each of the recesses or ridges in the series 97h is disposed in an associated plane that is perpendicular to the axis 77h.

In the embodiment of FIG. 20, the tip 27i includes recesses 79i which are similar to those illustrated in FIG. 17 in that they extend through the distal end 85i. This embodiment also includes the ridges 93i which are disposed between the recesses 79i and extend toward the cylindrical surface 95i at the proximal end 87i. The recesses 79i in FIG. 20 have individual widths which decrease proximally.

In the embodiment of FIG. 21, the tip 27j includes the conical surface 75j which transitions proximally into the cylindrical surface 95j. Distally of the conical surface 75j a second cylindrical surface 99j is provided which extends to the distal end 85j. Ridges 93j extend radially outwardly from the second surface 99 and the conical surface 75j.

The obturator tip 27k in FIG. 22 is similar to previous embodiments having the conical surface 75k and the cylindrical surface 95k. In this embodiment, the ridges 93k include distally portions 101 and proximal portions 103 which extend in planes passing through the axis 77k. Between the proximal portions 103 and distal portions 101, the ridges 93k include intermediate portions 105 which extend in planes that do not include the axis 77k.

In FIG. 23, the tip 27l is similar to that of FIG. 17 except that the second cylindrical surface 99l is provided in this embodiment. The recesses 79l have a generally constant width along the second cylindrical surface 99l and the conical surface 75l. These recesses 79l do not extend into the cylindrical surface 95l.

The obturator tip 27m in FIG. 24 is similar to that of FIG. 21 except that it does not include the second cylindrical surface 99m. In this case, the conical surface 75m extends to the distal end 85m with a slightly concave shape. The ridges 93m transition into the surface 75m at the distal end 85m and transition into the cylindrical surface 95m at the proximal end 87m. Between these two ends, the ridges 93m have a height which is increased by the concave configuration of the surface 75m.

The tip 27n in FIG. 25 is similar to the tip 27g in FIG. 18 in that the outer surface 75n has a generally bullet-shaped configuration. The recesses 79n include a recess 101 which curves proximally in a counterclockwise direction, and a recess 103 which curves proximally in a clockwise direction.

The tip 27o in FIG. 26 is similar to that of FIG. 25 but includes a further recess 105 which spirals toward the distal end 85o in a clockwise direction. This spiral recess 105 crosses the recess 101 in this embodiment.

In FIG. 27, the tip 27p includes the conical surface 75p which extends toward the distal end 85p at its apex. The apex

of the conical surface **75p** is blunted at the distal end **85p**. This embodiment also includes the mounting stub **89p** and associated lugs **91p**.

The tip **27q** in FIG. **28** has the outer surface **75q** with a bullet-shaped configuration. The recesses **79q** in this embodiment include three recesses, **107**, **110**, and **112** which spiral in a generally parallel relationship proximally in a counter-clockwise direction.

The tip **27r** in FIG. **29** has an outer surface **75r** with a bullet-shaped configuration, and a plurality of recesses **79r** which extend generally axially from the distal end **85** as to the proximal end **87r**. The recesses **79r** are generally symmetrical and include a distal portion **114** with sidewalls **116** and **118** which define a deep valley **121** that extends generally parallel to the axis **27r**. The proximal portion **115** of the recess **112** comprises a plane **123** which extends between the sidewalls **118** and **121** from the valley **116** radially outwardly with progressive positions toward the proximal end **87r**.

The tip **27s** in FIG. **30** is similar to that of FIG. **29**, but includes fewer recesses **79s**. Also, the tip **27s** has a nose that is more pointed thereby providing the outer surface **75s** with a concave configuration near the distal end **85s**.

FIG. **31** shows a perspective view of the tip **27t** with a bullet-shaped outer surface **75t** and a plurality of the recesses **79t**. In this case the recesses are straight but nevertheless have an angular relationship with the axis **77t**. These recesses **79t** extend through the distal end **85t** but stop short of the proximal end **87t**.

The tip **27u** in FIG. **32** is similar to that of FIG. **15** in that the axis **77u** is curved relative to the axis **23u** which is straight. Also, in this embodiment, there are no ridges or recesses.

In FIG. **33**, the tip **27v** has an outer surface **75v** which is formed by individual conical portions **125**, **127**, **130**, and **132**, which have progressively smaller average diameters. These conical portions **125-132** appear to be stacked with their individual axes disposed along the common axis **77v**.

The tip **27w** in FIG. **34** is similar to that of FIG. **20** in that it includes both the recesses **79w**, as well as the ridges **93w**. In this embodiment, which includes both a distal portion **134**, as well as a proximal portion **136**. These portions **124** and **136** have a generally common dimension along the axis **77w**.

The tip **27x** in FIG. **35** includes the conical surface **75x** as well as the cylindrical surface **95x**. The recesses **79x** are oriented generally in respective radial plans. These recesses **79x** are similar in shape and have a width which increases toward the distal end **87x**.

The tip **27y** in FIG. **36** is similar to that of FIG. **19**. It includes concentric circular structures at the distal end **85y**. In this case however, the structures are a series of recesses **97y** rather than ridges. This embodiment includes at least one ridge **93y**, however, which extends radially outwardly with progressive proximal positions along the axis **77y**.

The tip **27z** in FIG. **37** is similar to that of FIG. **35** except that it includes recesses **79z** which are fewer in number but wider in size. Also, the nose of the tip **27** at the distal end **85z** is accentuated in the embodiment of FIG. **37**.

It will be understood that many modifications can be made to the various disclosed embodiments without departing from the spirit and scope of the concept. For example, various sizes of the surgical device are contemplated as well as various types of constructions and materials. It will also be apparent that many modifications can be made to the configuration of parts as well as their interaction. For these reasons, the above description should not be construed as limiting the invention, but should be interpreted as merely exemplary of preferred embodiments. Those skilled in the art will envision other

modifications within the scope and spirit of the present invention as defined by the following claims.

What is claimed is:

1. A surgical obturator adapted to penetrate a body wall, comprising:
 - an elongate shaft extending along a longitudinal axis between a proximal end and a distal end; and
 - a bladeless tip at the distal end of the shaft; the tip includes a first region defined by a first cylindrical surface, a second region defined by a conical surface and a third region defined by a second cylindrical surface; the second region is located between the first region and the third region; the second cylindrical surface is located distally of the conical surface; and the conical surface transitions distally into the second cylindrical surface; the first cylindrical surface is located proximally of the conical surface; and the conical surface transitions proximally into the first cylindrical surface; and the tip further includes ridges; the ridges extend radially outwardly in the second region and the third region; wherein the distal end is rounded.
2. The obturator of claim 1 wherein the ridges extend along the tip such that a major component of the ridges is parallel to the longitudinal axis.
3. The obturator of claim 1 wherein the obturator comprises a lumen open at a proximal end of obturator.
4. The obturator of claim 3 wherein the lumen is configured to receive a laparoscope therein.
5. The obturator of claim 1 wherein the tip is adapted to closely fit with the elongate shaft to facilitate a fixed but removable relationship between the elongate shaft and the tip.
6. A surgical obturator adapted to penetrate a body wall, comprising:
 - an elongate shaft extending along a longitudinal axis between a proximal end and a distal end; and
 - a bladeless tip at the distal end of the shaft; the tip includes a first region defined by a first cylindrical surface, a second region defined by a conical surface and a third region defined by a second cylindrical surface; the second region is located between the first region and the third region; the second cylindrical surface is located distally of the conical surface; and the conical surface transitions distally into the second cylindrical surface; the first cylindrical surface is located proximally of the conical surface; and the conical surface transitions proximally into the first cylindrical surface; and the tip further includes ridges; the ridges extend radially outwardly in the second region and the third region; and a cannula having a lumen extending between an open proximal end and an open distal end; the cannula is configured to receive the elongate shaft inside the lumen of the cannula.
7. A surgical obturator adapted to penetrate a body wall, comprising:
 - an elongate shaft extending along a longitudinal axis between a proximal end and a distal end; and
 - a bladeless tip at the distal end of the shaft; the tip includes a first region defined by a first cylindrical surface and a second region defined by a conical surface; the first region is located proximally of the second region; the conical surface transitions proximally into a first cylindrical surface; and the conical surface extends to the distal end; and the tip further includes ridges; the ridges extend radially outwardly from the conical surface; each ridge having a proximal portion, an intermediate portion and a distal portion; the intermediate portion is located between the

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proximal portion and the distal portion; the distal portion being distal to the intermediate portion; the proximal portion being proximal to the intermediate portion; the proximal portion and the distal portion of each ridge extend in planes passing through the longitudinal axis along the conical surface; and the intermediate portion of each ridge extends in planes that do not include the longitudinal axis; and

a cannula having a lumen extending between an open proximal end and an open distal end; the cannula is configured to receive the elongate shaft inside the lumen of the cannula.

8. A surgical obturator adapted to penetrate a body wall, comprising:

an elongate shaft extending along a longitudinal axis between a proximal end and a distal end; and

a bladeless tip at the distal end of the shaft; the tip includes a first region defined by a first cylindrical surface and a second region defined by a conical surface; the first region is located proximally of the second region; the conical surface transitions proximally into a first cylindrical surface; and the conical surface extends to the distal end; and

the tip further includes ridges; the ridges extend radially outwardly from the conical surface; each ridge having a proximal portion, an intermediate portion and a distal portion; the intermediate portion is located between the proximal portion and the distal portion; the distal portion being distal to the intermediate portion; the proximal portion being proximal to the intermediate portion; the proximal portion and the distal portion of each ridge extend in planes passing through the longitudinal axis along the conical surface; and the intermediate portion of each ridge extends in planes that do not include the longitudinal axis;

wherein the distal end is rounded.

9. The obturator of claim 8 wherein the obturator comprises a lumen open at a proximal end of obturator.

10. The obturator of claim 9 wherein the lumen is configured to receive a laparoscope therein.

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11. The obturator of claim 8 wherein distally of the second region, the tip includes a third region defined by a second cylindrical surface.

12. The obturator of claim 8 wherein the tip is adapted to closely fit with the elongate shaft to facilitate a fixed but removable relationship between the elongate shaft and the tip.

13. A surgical obturator adapted to penetrate a body wall, comprising:

an elongate shaft extending along a longitudinal axis between a proximal end and a distal end; and

a bladeless tip at the distal end of the shaft; the tip includes a first region defined by a first cylindrical surface and a second region defined by a generally conical outer surface; the first region is located proximally of the second region; the conical outer surface transitions proximally into a first cylindrical surface; the conical outer surface extends distally; at least a portion of the conical outer surface along the longitudinal axis has a concave configuration; and

the tip further includes ridges extending radially outwardly from the conical outer surface; each ridge having a proximal end and a distal end; the distal end of each ridge transitions into the conical outer surface at the distal end; the proximal end of each ridge transitions into the first cylindrical surface at the proximal end; between the proximal end and the distal end, the ridges have a height that is increased in the location of the concave configuration of the conical outer surface;

wherein the distal end is rounded.

14. The obturator of claim 13 wherein the ridges extend along the tip such that a major component of the ridges is parallel to the longitudinal axis.

15. The obturator of claim 13 wherein the obturator comprises a lumen open at a proximal end of obturator.

16. The obturator of claim 15 wherein the lumen is configured to receive a laparoscope therein.

17. The obturator of claim 15 wherein the tip is adapted to closely fit with the elongate shaft to facilitate a fixed but removable relationship between the elongate shaft and the tip.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 9,254,125 B2
APPLICATION NO. : 14/138498
DATED : February 9, 2016
INVENTOR(S) : Edward D. Pingleton et al.

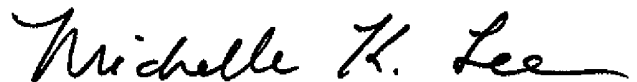
Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

IN THE SPECIFICATION

Column 8, line 65: Please delete "1010" and add --101o-- before in this embodiment

Signed and Sealed this
Third Day of May, 2016



Michelle K. Lee
Director of the United States Patent and Trademark Office

专利名称(译)	无叶闭孔器		
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当前申请(专利权)人(译)	应用医疗资源CORPORATION		
[标]发明人	PINGLETON EDWARD D WIXEY MATTHEW A KAHLE HENRY		
发明人	PINGLETON, EDWARD D. WIXEY, MATTHEW A. KAHLE, HENRY		
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外部链接	Espacenet USPTO		

摘要(译)

适于穿透体壁的外科填塞器包括细长轴，该细长轴具有在近端和远端之间延伸的轴线。设置在轴的远端的无刀片尖端具有延伸到钝点的外表面。外表面具有由中间部分分开的一对侧部。侧部从钝点径向向外延伸，并且沿着轴线向近侧渐进位置。这些侧部包括靠近钝点的远端部分和靠近轴的近端部分。侧部的远端部分相对于侧部的近端部分径向扭转。径向横截面中的外表面具有几何形状的一般构造，该几何形状围绕轴线在第一方向上旋转，沿轴线具有渐进的近端径向横截面。

