US00RE44834E

(19) **United States**
(12) **Reissued Patent**
Dumbauld et al.

(10) **Patent Number: US RE44,834 E**
(45) **Date of Reissued Patent: Apr. 8, 2014**

(54) **INSULATING BOOT FOR ELECTROSURGICAL FORCEPS**

(71) Applicant: **Covidien AG**, Neuhausen AM Rheinfall (CH)

(72) Inventors: **Patrick L. Dumbauld**, Lyons, CO (US); **Paul Guerra**, Los Gatos, CA (US); **Roger F. Smith**, Boulder, CO (US); **Scott DePierro**, Madison, CT (US)

(73) Assignee: **Covidien AG** (CH)

(21) Appl. No.: **13/708,335**

(22) Filed: **Dec. 7, 2012**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **7,846,161**
Issued: **Dec. 7, 2010**
Appl. No.: **11/529,798**
Filed: **Sep. 29, 2006**

U.S. Applications:

(60) Provisional application No. 60/722,213, filed on Sep. 30, 2005, provisional application No. 60/722,186, filed on Sep. 30, 2005, provisional application No. 60/722,359, filed on Sep. 30, 2005.

(51) **Int. Cl.**
A61B 18/18 (2006.01)

(52) **U.S. Cl.**
USPC **606/51**; 606/45; 606/52

(58) **Field of Classification Search**
USPC 606/50–52
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

371,664	A	10/1887	Brannan et al.
702,472	A	6/1902	Pignolet
728,883	A	5/1903	Downes
1,586,645	A	6/1926	Bierman
1,813,902	A	7/1931	Bovie
1,822,330	A	9/1931	Ainslie
1,852,542	A	4/1932	Sovatkin
2,002,594	A	5/1935	Wappler et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2104423	2/1994
DE	2415263	10/1975

(Continued)

OTHER PUBLICATIONS

Australian Examiner's first report on Patent Application No. 2006225175 dated Nov. 4, 2011 (4 pages).

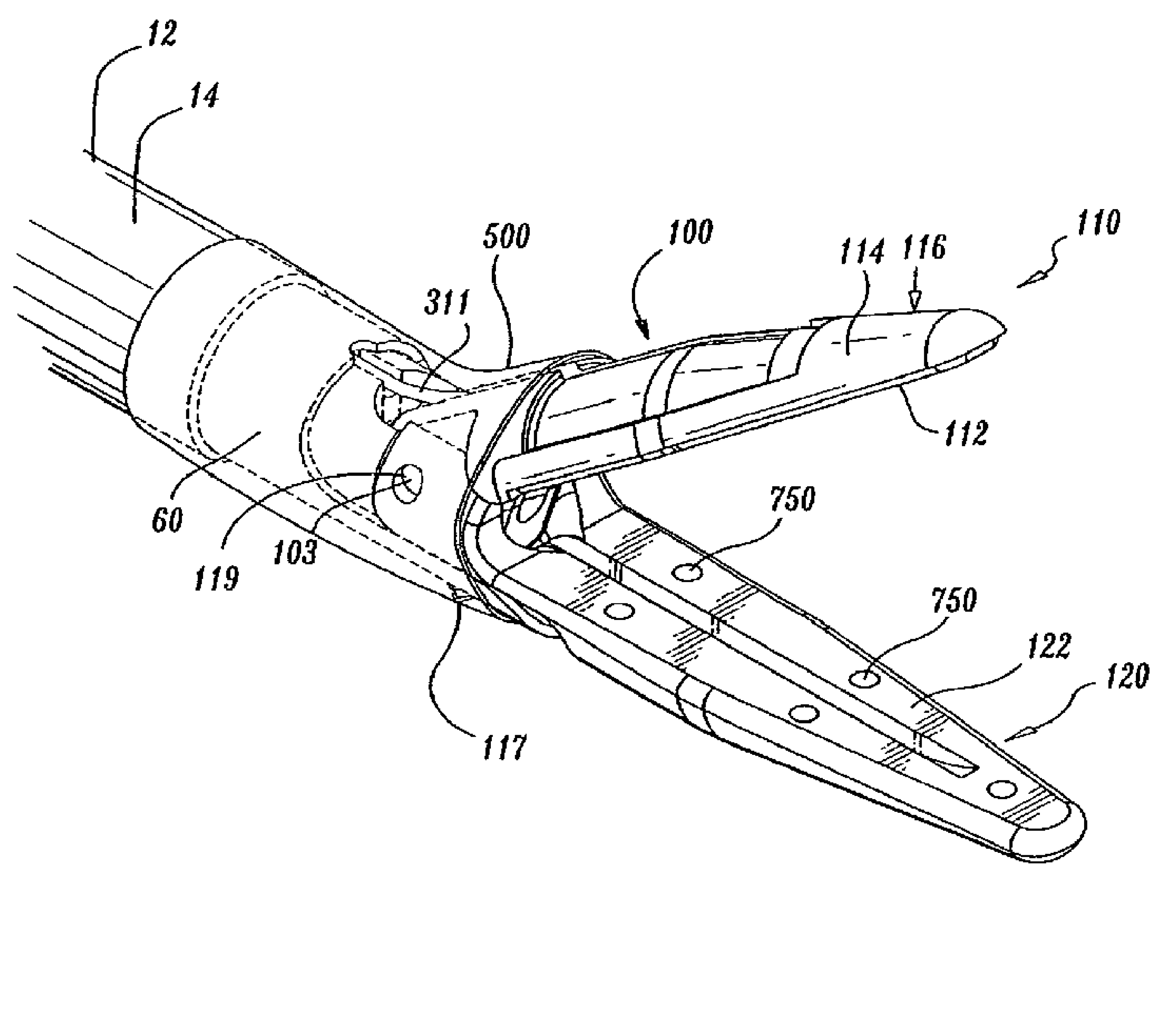
(Continued)

Primary Examiner — Linda Dvorak
Assistant Examiner — Amanda Scott

(57) **ABSTRACT**

Either an endoscopic or open bipolar forceps includes a flexible, generally tubular insulating boot for insulating patient tissue, while not impeding motion of the jaw members. The jaw members are movable from an open to a closed position and the jaw members are connected to a source of electrosurgical energy such that the jaw members are capable of conducting energy through tissue held therebetween to effect a tissue seal. A knife assembly may be included that allows a user to selectively divide tissue upon actuation thereof. The insulating boot may be made from a viscoelastic, elastomeric or flexible material suitable for use with a sterilization process including ethylene oxide.

16 Claims, 28 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2,011,169 A 8/1935 Wappler
2,031,682 A 2/1936 Wappler et al.
2,054,149 A 9/1936 Wappler
2,176,479 A 10/1939 Willis
2,279,753 A 4/1942 Knopp
2,305,156 A 12/1942 Grubel
2,327,353 A 8/1943 Karle
2,632,661 A 3/1953 Cristofv
2,668,538 A 2/1954 Baker
2,796,065 A 6/1957 Kapp
3,073,311 A 1/1963 Tibbs et al.
3,372,288 A 3/1968 Wigington
3,459,187 A 8/1969 Pallotta
3,643,663 A 2/1972 Sutter
3,648,001 A 3/1972 Anderson et al.
3,651,811 A 3/1972 Hildebrandt et al.
3,678,229 A 7/1972 Osika
3,720,896 A 3/1973 Beierlein
3,763,726 A 10/1973 Hildebrand
3,779,918 A 12/1973 Ikeda et al.
3,801,766 A 4/1974 Morrison, Jr.
3,862,630 A 1/1975 Balamuth
3,863,339 A 2/1975 Reaney et al.
3,866,610 A 2/1975 Kletschka
3,897,786 A * 8/1975 Garnett et al. 606/109
3,911,766 A 10/1975 Fridolph et al.
3,920,021 A 11/1975 Hiltebrandt
3,921,641 A 11/1975 Hulka
3,938,527 A 2/1976 Rioux et al.
3,952,749 A 4/1976 Fridolph et al.
3,970,088 A 7/1976 Morrison
3,987,795 A 10/1976 Morrison
4,005,714 A 2/1977 Hiltebrandt
4,016,881 A 4/1977 Rioux et al.
4,041,952 A 8/1977 Morrison, Jr. et al.
4,043,342 A 8/1977 Morrison, Jr.
4,074,718 A 2/1978 Morrison, Jr.
4,076,028 A 2/1978 Simmons
4,080,820 A 3/1978 Allen
4,088,134 A 5/1978 Mazzariello
4,112,950 A 9/1978 Pike
4,127,222 A 11/1978 Adams
4,128,099 A 12/1978 Bauer
4,165,746 A 8/1979 Burgin
4,187,420 A 2/1980 Piber
4,233,734 A 11/1980 Bies
4,236,470 A 12/1980 Stenson
4,300,564 A 11/1981 Furihata
4,311,145 A 1/1982 Esty et al.
D263,020 S 2/1982 Rau, III
4,370,980 A 2/1983 Lottick
4,375,218 A 3/1983 DiGeronimo
4,416,276 A 11/1983 Newton et al.
4,418,692 A 12/1983 Guay
4,443,935 A 4/1984 Zamba et al.
4,452,246 A 6/1984 Bader et al.
4,470,786 A 9/1984 Sano et al.
4,492,231 A 1/1985 Auth
4,493,320 A 1/1985 Treat
4,503,855 A 3/1985 Maslanka
4,506,669 A 3/1985 Blake, III
4,509,518 A 4/1985 McGarry et al.
4,552,143 A 11/1985 Lottick
4,574,804 A 3/1986 Kurwa
4,597,379 A 7/1986 Kihn et al.
4,600,007 A 7/1986 Lahodny et al.
4,624,254 A 11/1986 McGarry et al.
4,655,215 A 4/1987 Pike
4,655,216 A 4/1987 Tischer
4,657,016 A 4/1987 Garito et al.
4,662,372 A 5/1987 Sharkany et al.
4,671,274 A 6/1987 Sorochenko
4,685,459 A 8/1987 Koch et al.
4,733,662 A 3/1988 DeSatnick et al.
D295,893 S 5/1988 Sharkany et al.
D295,894 S 5/1988 Sharkany et al.
4,754,892 A 7/1988 Retief
4,763,669 A 8/1988 Jaeger
4,827,929 A 5/1989 Hodge
4,829,313 A 5/1989 Taggart
4,846,171 A 7/1989 Kauphusman et al.
4,887,612 A 12/1989 Esser et al.
4,938,761 A 7/1990 Ensslin
4,947,009 A 8/1990 Osika et al.
4,985,030 A 1/1991 Melzer et al.
5,007,908 A 4/1991 Rydell
5,026,370 A 6/1991 Lottick
5,026,371 A 6/1991 Rydell et al.
5,035,695 A 7/1991 Weber, Jr. et al.
5,037,433 A 8/1991 Wilk et al.
5,042,707 A 8/1991 Taheri
5,047,046 A 9/1991 Bodoia
5,078,716 A 1/1992 Doll
5,084,057 A 1/1992 Green et al.
5,085,659 A 2/1992 Rydell
5,099,840 A 3/1992 Goble et al.
5,100,430 A 3/1992 Avellanet et al.
5,108,392 A 4/1992 Spingler
5,112,343 A 5/1992 Thornton
5,116,332 A 5/1992 Lottick
5,147,357 A 9/1992 Rose et al.
5,151,102 A 9/1992 Xamiyama et al.
5,151,978 A 9/1992 Bronikowski et al.
5,176,695 A 1/1993 Dulebohn
5,190,541 A 3/1993 Abele et al.
5,196,009 A 3/1993 Kirwan, Jr.
5,197,964 A 3/1993 Parins
5,209,747 A 5/1993 Knoepfler
5,211,655 A 5/1993 Hasson
5,215,101 A 6/1993 Jacobs et al.
5,217,457 A 6/1993 Delahuerga et al.
5,217,458 A 6/1993 Parins
5,217,460 A 6/1993 Knoepfler
5,219,354 A 6/1993 Choudhury et al.
5,244,462 A 9/1993 Delahuerga et al.
5,250,047 A 10/1993 Rydell
5,250,063 A 10/1993 Abidin et al.
5,258,001 A 11/1993 Corman
5,258,006 A 11/1993 Rydell et al.
5,261,918 A 11/1993 Phillips et al.
5,275,615 A 1/1994 Rose
5,277,201 A 1/1994 Stern
5,282,799 A 2/1994 Rydell
5,282,800 A 2/1994 Foshee et al.
5,282,826 A 2/1994 Quadri
5,290,286 A 3/1994 Parins
5,300,082 A 4/1994 Sharpe et al.
5,304,203 A 4/1994 El-Mallawany et al.
5,308,353 A 5/1994 Beurrier
5,308,357 A 5/1994 Lichtman
5,313,027 A 5/1994 Inoue et al.
5,314,445 A 5/1994 Degwitz et al.
5,314,463 A 5/1994 Camps et al.
5,318,589 A 6/1994 Lichtman
5,324,289 A 6/1994 Eggers
D348,930 S 7/1994 Olson
5,326,806 A 7/1994 Yokoshima et al.
5,330,471 A 7/1994 Eggers
5,330,502 A 7/1994 Hassler et al.
5,334,166 A 8/1994 Palestrant
5,334,183 A 8/1994 Wuchinich
5,334,215 A 8/1994 Chen
5,336,220 A 8/1994 Ryan et al.
5,336,221 A 8/1994 Anderson
5,342,359 A 8/1994 Rydell
5,342,381 A 8/1994 Tidemand
5,342,393 A 8/1994 Stack
5,344,424 A 9/1994 Roberts et al.
5,350,391 A 9/1994 Iacovelli
5,352,222 A 10/1994 Rydell
5,354,271 A 10/1994 Voda
5,356,408 A 10/1994 Rydell
5,366,477 A 11/1994 LeMarie, III et al.
5,367,250 A * 11/1994 Whisenand 324/133

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,368,600	A	11/1994	Failla et al.
5,374,277	A	12/1994	Hassler
5,376,089	A	12/1994	Smith
5,383,875	A	1/1995	Bays et al.
5,383,897	A	1/1995	Wholey
5,389,098	A	2/1995	Tsuruta et al.
5,389,103	A	2/1995	Melzer et al.
5,389,104	A	2/1995	Hahnen et al.
5,391,166	A	2/1995	Eggers
5,391,183	A	2/1995	Janzen et al.
5,396,900	A	3/1995	Slater et al.
5,403,312	A	4/1995	Yates et al.
5,403,342	A	4/1995	Tovey et al.
5,405,344	A	4/1995	Williamson et al.
5,409,763	A	4/1995	Serizawa et al.
5,411,519	A	5/1995	Tovey et al.
5,411,520	A	5/1995	Nash et al.
5,413,571	A	5/1995	Katsaros et al.
5,415,656	A	5/1995	Tihon et al.
5,415,657	A	5/1995	Taymor-Luria
5,422,567	A	6/1995	Matsunaga
5,423,810	A	6/1995	Goble et al.
5,425,690	A	6/1995	Chang
5,425,739	A	6/1995	Jessen
5,429,616	A	7/1995	Schaffer
5,431,672	A	7/1995	Cote et al.
5,431,674	A	7/1995	Basile et al.
5,437,292	A	8/1995	Kipshidze et al.
5,438,302	A	8/1995	Goble
5,439,478	A	8/1995	Palmer
5,441,517	A	8/1995	Kensey et al.
5,443,463	A	8/1995	Stern et al.
5,443,464	A	8/1995	Russell et al.
5,443,480	A	8/1995	Jacobs et al.
5,445,638	A	8/1995	Rydell et al.
5,445,658	A	8/1995	Durrfeld et al.
5,449,480	A	9/1995	Kuriya et al.
5,451,224	A	9/1995	Goble et al.
5,454,823	A	10/1995	Richardson et al.
5,454,827	A	10/1995	Aust et al.
5,456,684	A	10/1995	Schmidt et al.
5,458,598	A	10/1995	Feinberg et al.
5,460,629	A	10/1995	Shlain et al.
5,461,765	A	10/1995	Linden et al.
5,462,546	A	10/1995	Rydell
5,472,442	A	12/1995	Klicek
5,472,443	A	12/1995	Cordis et al.
5,478,351	A	12/1995	Meade et al.
5,480,406	A	1/1996	Nolan et al.
5,480,409	A	1/1996	Riza
5,484,436	A	1/1996	Eggers et al.
5,496,312	A	3/1996	Klicek
5,496,317	A	3/1996	Goble et al.
5,496,347	A	3/1996	Hashiguchi et al.
5,499,997	A	3/1996	Sharpe et al.
5,509,922	A	4/1996	Aranyi et al.
5,514,134	A	5/1996	Rydell et al.
5,527,313	A	6/1996	Scott et al.
5,528,833	A	6/1996	Sakuma
5,529,067	A	6/1996	Larsen et al.
5,531,744	A	7/1996	Nardella et al.
5,536,251	A	7/1996	Evard et al.
5,540,684	A	7/1996	Hassler, Jr.
5,540,685	A	7/1996	Parins et al.
5,540,706	A	7/1996	Aust et al.
5,540,715	A	7/1996	Katsaros et al.
5,542,945	A	8/1996	Fritzsch
5,558,671	A	9/1996	Yates
5,558,672	A	9/1996	Edwards et al.
5,562,619	A	10/1996	Mirarchi et al.
5,562,699	A	10/1996	Heimberger et al.
5,562,720	A	10/1996	Stern et al.
5,564,615	A	10/1996	Bishop et al.
5,569,241	A	10/1996	Edwardds
5,569,243	A	10/1996	Kortenbach et al.
5,571,100	A	11/1996	Goble et al.
5,573,424	A	11/1996	Poppe
5,573,534	A	11/1996	Stone
5,573,535	A	11/1996	Viklund
5,575,799	A	11/1996	Bolanos et al.
5,575,805	A	11/1996	Li
5,578,052	A	11/1996	Koros et al.
5,579,781	A	12/1996	Cooke
5,582,611	A	12/1996	Tsukagoshi et al.
5,582,617	A	12/1996	Klieman et al.
5,585,896	A	12/1996	Yamazaki et al.
5,590,570	A	1/1997	LeMaire, III et al.
5,591,181	A	1/1997	Stone et al.
5,597,107	A	1/1997	Knodel et al.
5,601,224	A	2/1997	Bishop et al.
5,601,601	A	2/1997	Tal et al.
5,601,641	A	2/1997	Stephens
5,603,711	A	2/1997	Parins et al.
5,603,723	A	2/1997	Aranyi et al.
5,611,798	A	3/1997	Eggers
5,611,808	A	3/1997	Hossain et al.
5,611,813	A	3/1997	Lichtman
5,620,415	A	4/1997	Lucey et al.
5,620,453	A	4/1997	Nallakrishnan
5,620,459	A	4/1997	Lichtman
5,624,452	A	4/1997	Yates
5,626,578	A	5/1997	Tihon
5,626,609	A	5/1997	Zvenyatsky et al.
5,630,833	A	5/1997	Katsaros et al.
5,637,110	A	6/1997	Pennybacker et al.
5,638,003	A	6/1997	Hall
5,643,294	A	7/1997	Tovey et al.
5,647,869	A	7/1997	Goble et al.
5,647,871	A	7/1997	Levine et al.
5,649,959	A	7/1997	Hannam et al.
5,655,650	A	8/1997	Naitou
5,658,281	A	8/1997	Heard
D384,413	S	9/1997	Zlock et al.
5,662,667	A	9/1997	Knodel
5,665,100	A	9/1997	Yoon
5,667,526	A	9/1997	Levin
5,674,220	A	10/1997	Fox et al.
5,674,229	A	10/1997	Tovey et al.
5,681,282	A	10/1997	Eggers et al.
5,688,270	A	11/1997	Yates et al.
5,690,652	A	11/1997	Wurster et al.
5,690,653	A	11/1997	Richardson et al.
5,693,051	A	12/1997	Schulze et al.
5,693,920	A	12/1997	Maeda
5,695,522	A	12/1997	LeMaire, III et al.
5,700,261	A	12/1997	Brinkerhoff
5,700,270	A	12/1997	Peyser et al.
5,702,390	A	12/1997	Austin et al.
5,707,369	A	1/1998	Vaitekunas et al.
5,709,680	A	1/1998	Yates et al.
5,716,366	A	2/1998	Yates
5,720,744	A	2/1998	Eggleston et al.
5,722,421	A	3/1998	Francese et al.
5,725,536	A	3/1998	Oberlin et al.
5,727,428	A	3/1998	LeMaire, III et al.
5,735,848	A	4/1998	Yates et al.
5,743,906	A	4/1998	Parins et al.
5,752,973	A	5/1998	Kieturakis
5,755,717	A	5/1998	Yates et al.
5,759,188	A	6/1998	Yoon
5,766,130	A	6/1998	Selmonosky
5,766,166	A	6/1998	Hooven
5,766,170	A	6/1998	Eggers
5,766,196	A	6/1998	Griffiths
5,769,849	A	6/1998	Eggers
5,772,655	A	6/1998	Bauer et al.
5,772,670	A	6/1998	Brosa
5,776,128	A	7/1998	Eggers
5,776,130	A	7/1998	Buysse et al.
5,779,646	A	7/1998	Koblish et al.
5,779,701	A	7/1998	McBrayer et al.
H1745	H	8/1998	Paraschac
5,792,137	A	8/1998	Carr et al.
5,792,165	A	8/1998	Klieman et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,792,177	A	8/1998	Kaseda
5,797,537	A	8/1998	Oberlin et al.
5,797,927	A	8/1998	Yoon
5,797,938	A	8/1998	Paraschac et al.
5,797,941	A	8/1998	Schulze et al.
5,797,958	A	8/1998	Yoon
5,800,449	A	9/1998	Wales
5,807,393	A	9/1998	Williamson, IV et al.
5,810,764	A	9/1998	Eggers et al.
5,810,805	A	9/1998	Sutcu et al.
5,810,808	A	9/1998	Eggers
5,810,811	A	9/1998	Yates et al.
5,810,877	A	9/1998	Roth et al.
5,814,043	A	9/1998	Shapeton
5,814,054	A	9/1998	Kortenbach et al.
5,817,083	A	10/1998	Williamson, IV et al.
5,817,119	A	10/1998	Klieman et al.
5,820,630	A	10/1998	Lind
5,824,978	A	10/1998	Karasik et al.
5,827,271	A	10/1998	Buysse et al.
5,827,279	A	10/1998	Hughett et al.
5,827,281	A	10/1998	Levin
5,827,323	A	10/1998	Klieman et al.
5,827,548	A	10/1998	Lavallee et al.
5,833,690	A	11/1998	Yates et al.
5,843,080	A	12/1998	Fleenor et al.
5,849,022	A	12/1998	Sakashita et al.
5,853,412	A	12/1998	Mayenberger
5,859,527	A	1/1999	Cook
5,860,976	A	1/1999	Billings et al.
5,876,401	A	3/1999	Schulze et al.
5,876,412	A	3/1999	Piraka
5,882,567	A	3/1999	Cavallaro et al.
5,891,141	A	4/1999	Rydell
5,891,142	A	4/1999	Eggers et al.
5,893,863	A	4/1999	Yoon
5,893,875	A	4/1999	O'Connor et al.
5,893,877	A	4/1999	Gampp, Jr. et al.
5,897,563	A	4/1999	Yoon et al.
5,902,301	A	5/1999	Olig
5,906,630	A	5/1999	Anderhub et al.
5,908,420	A	6/1999	Parins et al.
5,908,432	A	6/1999	Pan
5,911,719	A	6/1999	Eggers
5,913,874	A	6/1999	Berns et al.
5,921,916	A	7/1999	Aeikens et al.
5,921,984	A	7/1999	Sutcu et al.
5,925,043	A	7/1999	Kumar et al.
5,928,136	A	7/1999	Barry
5,935,126	A	8/1999	Riza
5,941,869	A	8/1999	Patterson et al.
5,944,718	A	8/1999	Dafforn et al.
5,951,546	A	9/1999	Lorentzen
5,951,549	A	9/1999	Richardson et al.
5,954,720	A	9/1999	Wilson et al.
5,954,731	A	9/1999	Yoon
5,954,733	A	9/1999	Yoon
5,957,923	A	9/1999	Hahnen et al.
5,957,937	A	9/1999	Yoon
5,960,544	A	10/1999	Beyers
5,961,514	A	10/1999	Long et al.
5,964,758	A	10/1999	Dresden
5,976,132	A	11/1999	Morris
5,984,932	A	11/1999	Yoon
5,984,938	A	11/1999	Yoon
5,984,939	A	11/1999	Yoon
5,989,277	A	11/1999	LeMaire, III et al.
5,993,466	A	11/1999	Yoon
5,993,467	A	11/1999	Yoon
5,997,565	A	12/1999	Inoue
6,004,332	A	12/1999	Yoon et al.
6,004,335	A	12/1999	Vaitekunas et al.
6,010,516	A	1/2000	Hulka et al.
6,017,358	A	1/2000	Yoon et al.
6,021,693	A	2/2000	Feng-Sing
6,024,741	A	2/2000	Williamson et al.
6,024,743	A	2/2000	Edwards
6,024,744	A	2/2000	Kese et al.
6,027,522	A	2/2000	Palmer
6,030,384	A	2/2000	Nezhat
6,033,399	A	3/2000	Gines
6,039,733	A	3/2000	Buysse et al.
6,041,679	A	3/2000	Slater et al.
6,050,996	A	4/2000	Schmaltz et al.
6,053,914	A	4/2000	Eggers et al.
6,053,933	A	4/2000	Balazs et al.
D424,694	S	5/2000	Tetzlaff et al.
D425,201	S	5/2000	Tetzlaff et al.
6,059,782	A	5/2000	Novak et al.
6,066,139	A	5/2000	Ryan et al.
6,074,386	A	6/2000	Goble et al.
6,077,287	A	6/2000	Taylor et al.
6,080,180	A	6/2000	Yoon et al.
RE36,795	E	7/2000	Rydell
6,083,223	A	7/2000	Baker
6,086,586	A	7/2000	Hooven
6,086,601	A	7/2000	Yoon
6,090,107	A	7/2000	Borgmeier et al.
6,096,037	A	8/2000	Mulier et al.
6,099,550	A	8/2000	Yoon
6,102,909	A	8/2000	Chen et al.
6,106,542	A	8/2000	Toybin et al.
6,110,171	A	8/2000	Rydell
6,113,596	A	9/2000	Hooven et al.
6,113,598	A	9/2000	Baker
6,117,158	A	9/2000	Measamer et al.
6,122,549	A	9/2000	Sharkey et al.
6,123,701	A	9/2000	Nezhat
H1904	H	10/2000	Yates et al.
6,126,658	A	10/2000	Baker
6,126,665	A	10/2000	Yoon
6,139,563	A	10/2000	Cosgrove, III et al.
6,143,005	A	11/2000	Yoon et al.
6,152,923	A	11/2000	Ryan
6,162,220	A	12/2000	Nezhat
6,171,316	B1	1/2001	Kovac et al.
6,174,309	B1	1/2001	Wrublewski et al.
6,178,628	B1	1/2001	Clemens et al.
6,179,834	B1	1/2001	Buysse et al.
6,179,837	B1	1/2001	Hooven
6,183,467	B1	2/2001	Shapeton et al.
6,187,003	B1	2/2001	Buysse et al.
6,190,386	B1	2/2001	Rydell
6,190,400	B1	2/2001	Vandemoer et al.
6,193,718	B1	2/2001	Kortenbach et al.
6,206,876	B1	3/2001	Levine et al.
6,206,877	B1	3/2001	Kese et al.
6,206,893	B1	3/2001	Klein et al.
6,214,028	B1	4/2001	Yoon et al.
6,217,602	B1	4/2001	Redmon
6,217,615	B1	4/2001	Sioshansi et al.
6,221,039	B1	4/2001	Durgin et al.
6,223,100	B1	4/2001	Green
6,224,593	B1	5/2001	Ryan et al.
6,224,614	B1	5/2001	Yoon
6,228,080	B1	5/2001	Gines
6,228,083	B1	5/2001	Lands et al.
6,248,124	B1	6/2001	Pedros et al.
6,248,944	B1	6/2001	Ito
6,261,307	B1	7/2001	Yoon et al.
6,267,761	B1	7/2001	Ryan
6,270,497	B1	8/2001	Sekino et al.
6,270,508	B1	8/2001	Klieman et al.
6,273,887	B1	8/2001	Yamauchi et al.
6,277,117	B1	8/2001	Tetzlaff et al.
6,280,458	B1	8/2001	Boche et al.
6,283,961	B1	9/2001	Underwood et al.
D449,886	S	10/2001	Tetzlaff et al.
6,298,550	B1	10/2001	Kirwan
6,302,424	B1	10/2001	Gisinger et al.
6,319,262	B1	11/2001	Bates et al.
6,319,451	B1	11/2001	Brune
6,322,561	B1	11/2001	Eggers et al.
6,322,580	B1	11/2001	Kanner

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,325,795	B1	12/2001	Lindemann et al.
6,334,860	B1	1/2002	Dorn
6,334,861	B1	1/2002	Chandler et al.
6,345,532	B1	2/2002	Coudray et al.
6,350,264	B1	2/2002	Hooven
6,352,536	B1	3/2002	Buysse et al.
6,358,249	B1	3/2002	Chen et al.
6,358,259	B1	3/2002	Swain et al.
6,358,268	B1	3/2002	Hunt et al.
6,364,879	B1	4/2002	Chen et al.
D457,958	S	5/2002	Dycus et al.
D457,959	S	5/2002	Tetzlaff et al.
6,387,094	B1	5/2002	Eitenmuller
6,391,035	B1	5/2002	Appleby et al.
6,398,779	B1	6/2002	Buysse et al.
6,402,747	B1	6/2002	Lindemann et al.
6,409,728	B1	6/2002	Ehr et al.
H2037	H	7/2002	Yates et al.
6,419,675	B1	7/2002	Gallo, Sr.
6,425,896	B1	7/2002	Baltschun et al.
6,432,112	B2	8/2002	Brock et al.
6,440,144	B1	8/2002	Bacher
6,443,952	B1	9/2002	Mulier et al.
6,443,970	B1	9/2002	Schulze et al.
6,451,018	B1	9/2002	Lands et al.
6,458,125	B1	10/2002	Cosmescu
6,458,128	B1	10/2002	Schulze
6,458,130	B1	10/2002	Frazier et al.
6,461,352	B2	10/2002	Morgan et al.
6,461,368	B2	10/2002	Fogarty et al.
6,464,701	B1	10/2002	Hooven et al.
6,464,702	B2	10/2002	Schulze et al.
6,464,704	B2	10/2002	Schmaltz et al.
6,485,489	B2	11/2002	Teirstein et al.
6,494,888	B1	12/2002	Laufer et al.
6,500,176	B1	12/2002	Truckai et al.
6,506,196	B1	1/2003	Laufer
6,508,815	B1	1/2003	Strul et al.
6,511,480	B1	1/2003	Tetzlaff et al.
6,514,215	B1	2/2003	Ouchi
6,514,252	B2	2/2003	Nezhat et al.
6,517,539	B1	2/2003	Smith et al.
6,527,771	B1	3/2003	Weadock et al.
6,533,784	B2	3/2003	Truckai et al.
6,545,239	B2	4/2003	Spedale et al.
6,558,385	B1	5/2003	McClurken et al.
6,562,037	B2	5/2003	Paton et al.
6,569,105	B1	5/2003	Kortenbach et al.
6,582,450	B2	6/2003	Ouchi
6,585,735	B1	7/2003	Frazier et al.
6,602,252	B2	8/2003	Mollenauer
6,605,790	B2	8/2003	Yoshida
6,616,658	B2	9/2003	Ineson
6,616,661	B2	9/2003	Wellman et al.
6,620,161	B2	9/2003	Schulze et al.
6,620,184	B2	9/2003	De Laforcade et al.
6,626,901	B1	9/2003	Treat et al.
6,638,287	B2	10/2003	Danitz et al.
6,641,595	B1	11/2003	Moran et al.
6,652,514	B2	11/2003	Ellman et al.
6,652,521	B2	11/2003	Schulze
6,656,175	B2	12/2003	Francischelli et al.
6,656,177	B2	12/2003	Truckai et al.
6,660,072	B2	12/2003	Chatterjee
6,663,639	B1	12/2003	Laufer et al.
6,663,641	B1	12/2003	Kovac et al.
6,666,854	B1	12/2003	Lange
6,669,696	B2	12/2003	Bacher et al.
6,673,092	B1	1/2004	Bacher
6,676,660	B2	1/2004	Wampler et al.
6,676,676	B2	1/2004	Danitz et al.
6,679,882	B1	1/2004	Kornerup
6,682,527	B2	1/2004	Strul
6,682,528	B2	1/2004	Frazier et al.
6,685,724	B1	2/2004	Haluck
6,689,131	B2	2/2004	McClurken
6,692,445	B2	2/2004	Roberts et al.
6,693,246	B1	2/2004	Rudolph et al.
6,695,840	B2	2/2004	Schulze
6,702,810	B2	3/2004	McClurken et al.
6,723,092	B2	4/2004	Brown et al.
6,726,068	B2	4/2004	Miller
6,726,686	B2	4/2004	Buysse et al.
6,726,694	B2	4/2004	Blatter et al.
6,733,498	B2	5/2004	Paton et al.
6,736,813	B2	5/2004	Yamauchi et al.
6,743,229	B2	6/2004	Buysse et al.
6,743,230	B2	6/2004	Lutze et al.
6,743,239	B1	6/2004	Kuehn et al.
6,743,240	B2	6/2004	Smith et al.
6,755,843	B2	6/2004	Chung et al.
6,756,553	B1	6/2004	Yamaguchi et al.
6,757,977	B2	7/2004	Dambal et al.
D493,888	S	8/2004	Reschke
6,770,072	B1	8/2004	Truckai et al.
6,773,409	B2	8/2004	Truckai et al.
6,773,432	B1	8/2004	Clayman et al.
6,773,434	B2	8/2004	Ciarrocca
6,773,441	B1	8/2004	Laufer et al.
6,775,575	B2	8/2004	Bommannan et al.
6,776,780	B2	8/2004	Mulier et al.
6,786,905	B2	9/2004	Swanson et al.
6,790,217	B2	9/2004	Schulze et al.
6,796,981	B2	9/2004	Wham et al.
D496,997	S	10/2004	Dycus et al.
6,800,825	B1	10/2004	Sasaki et al.
6,802,843	B2	10/2004	Truckai et al.
6,808,525	B2	10/2004	Latterell et al.
D499,181	S	11/2004	Dycus et al.
6,818,000	B2	11/2004	Muller et al.
6,821,285	B2	11/2004	Laufer et al.
6,835,200	B2	12/2004	Laufer et al.
6,857,357	B2	2/2005	Fujii
6,860,880	B2	3/2005	Treat et al.
6,887,240	B1	5/2005	Lands et al.
6,889,116	B2	5/2005	Jinno
6,914,201	B2	7/2005	Van Vooren et al.
6,926,716	B2	8/2005	Baker et al.
6,929,644	B2	8/2005	Truckai et al.
6,932,810	B2	8/2005	Ryan
6,932,816	B2	8/2005	Phan
6,934,134	B2	8/2005	Mori et al.
6,936,061	B2	8/2005	Sasaki
8,926,716		8/2005	Baker et al.
D509,297	S	9/2005	Wells
6,942,662	B2	9/2005	Goble et al.
6,943,311	B2	9/2005	Miyako
6,953,430	B2	10/2005	Kidooka
6,953,461	B2	10/2005	McClurken et al.
6,958,070	B2	10/2005	Witt et al.
6,960,210	B2	11/2005	Lands et al.
6,964,662	B2	11/2005	Kidooka
6,966,907	B2	11/2005	Goble
6,972,017	B2	12/2005	Smith et al.
6,977,495	B2	12/2005	Donofrio
6,979,786	B2	12/2005	Aukland et al.
6,981,628	B2	1/2006	Wales
6,987,244	B2	1/2006	Bauer
6,994,707	B2	2/2006	Ellman et al.
6,994,709	B2	2/2006	Iida
6,997,931	B2	2/2006	Sauer et al.
7,001,381	B2	2/2006	Harano et al.
7,011,657	B2	3/2006	Truckai et al.
7,033,354	B2	4/2006	Keppel
7,033,356	B2	4/2006	Latterell et al.
7,041,102	B2	5/2006	Truckai et al.
7,044,948	B2	5/2006	Keppel
7,052,489	B2	5/2006	Griego et al.
7,052,496	B2	5/2006	Yamauchi
7,063,715	B2	6/2006	Onuki et al.
D525,361	S	7/2006	Hushka
7,070,597	B2	7/2006	Truckai et al.
7,083,618	B2	8/2006	Couture et al.
7,083,619	B2	8/2006	Truckai et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,083,620	B2	8/2006	Jahns et al.	
7,087,051	B2	8/2006	Bourne et al.	
7,087,054	B2	8/2006	Truckai et al.	
7,090,673	B2	8/2006	Dycus et al.	
7,090,689	B2	8/2006	Nagase et al.	
7,101,371	B2	9/2006	Dycus et al.	
7,101,372	B2	9/2006	Dycus et al.	
7,101,373	B2	9/2006	Dycus et al.	
7,103,947	B2	9/2006	Sartor et al.	
7,107,124	B2	9/2006	Green	
7,112,199	B2	9/2006	Cosmescu	
D531,311	S	10/2006	Guerra et al.	
7,115,123	B2	10/2006	Knowlton et al.	
7,118,570	B2	10/2006	Tetzlaff et al.	
7,118,587	B2	10/2006	Dycus et al.	
7,131,860	B2	11/2006	Sartor et al.	
7,131,970	B2	11/2006	Moses et al.	
7,131,971	B2	11/2006	Dycus et al.	
7,135,020	B2	11/2006	Lawes et al.	
D533,942	S	12/2006	Kerr et al.	
7,145,757	B2	12/2006	Shea et al.	
7,147,638	B2	12/2006	Chapman et al.	
7,150,097	B2	12/2006	Sremcich et al.	
7,150,749	B2	12/2006	Dycus et al.	
7,153,314	B2	12/2006	Laufer et al.	
D535,027	S	1/2007	James et al.	
7,156,842	B2	1/2007	Sartor et al.	
7,156,846	B2	1/2007	Dycus et al.	
7,160,298	B2	1/2007	Lawes et al.	
7,160,299	B2	1/2007	Baily	
7,169,146	B2	1/2007	Truckai et al.	
7,179,255	B2	2/2007	Lettice et al.	
7,179,258	B2	2/2007	Buysse et al.	
7,195,631	B2	3/2007	Dumbauld	
D541,418	S	4/2007	Schechter et al.	
7,207,990	B2	4/2007	Lands et al.	
D541,938	S	5/2007	Kerr et al.	
7,223,264	B2	5/2007	Daniel et al.	
7,223,265	B2	5/2007	Keppel	
7,232,440	B2	6/2007	Dumbauld et al.	
7,241,288	B2	7/2007	Braun	
7,241,296	B2	7/2007	Buysse et al.	
7,244,257	B2	7/2007	Podhajsky et al.	
7,246,734	B2	7/2007	Shelton, IV	
7,248,944	B2	7/2007	Green	
7,252,667	B2	8/2007	Moses et al.	
7,255,697	B2	8/2007	Dycus et al.	
7,267,677	B2	9/2007	Johnson et al.	
7,270,660	B2	9/2007	Ryan	
7,270,664	B2	9/2007	Johnson et al.	
7,276,068	B2	10/2007	Johnson et al.	
7,300,435	B2	11/2007	Wham et al.	
7,303,557	B2	12/2007	Wham et al.	
7,311,709	B2	12/2007	Truckai et al.	
7,314,471	B2	1/2008	Holman	
7,318,823	B2	1/2008	Sharps et al.	
7,329,256	B2	2/2008	Johnson et al.	
7,329,257	B2	2/2008	Kanehira et al.	
D564,662	S	3/2008	Moses et al.	
7,338,526	B2	3/2008	Steinberg	
7,342,754	B2	3/2008	Fitzgerald et al.	
7,344,268	B2	3/2008	Jigamian	
D567,943	S	4/2008	Moses et al.	
7,367,976	B2	5/2008	Lawes et al.	
7,377,920	B2	5/2008	Buysse et al.	
7,384,420	B2	6/2008	Dycus et al.	
7,384,421	B2	6/2008	Hushka	
7,396,336	B2	7/2008	Orszulak et al.	
D575,395	S	8/2008	Hushka	
D575,401	S	8/2008	Hixson et al.	
7,435,249	B2	10/2008	Buysse et al.	
7,442,193	B2	10/2008	Shields et al.	
7,442,194	B2	10/2008	Dumbauld et al.	
7,445,621	B2	11/2008	Dumbauld et al.	
7,458,972	B2	12/2008	Keppel	
7,473,253	B2	1/2009	Dycus et al.	
7,481,810	B2	1/2009	Dumbauld et al.	
7,487,780	B2	2/2009	Hooven	
7,491,201	B2	2/2009	Shields et al.	
7,491,202	B2 *	2/2009	Odom et al.	606/51
7,500,975	B2	3/2009	Cunningham et al.	
7,510,556	B2	3/2009	Nguyen et al.	
7,513,898	B2	4/2009	Johnson et al.	
7,540,872	B2	6/2009	Schechter et al.	
7,549,995	B2	6/2009	Schultz	
7,553,312	B2	6/2009	Tetzlaff et al.	
7,879,035	B2	2/2011	Garrison et al.	
8,235,993	B2	8/2012	Hushka et al.	
2002/0013583	A1	1/2002	Camran et al.	
2002/0049442	A1	4/2002	Roberts et al.	
2002/0099372	A1	7/2002	Schulze et al.	
2002/0107517	A1	8/2002	Witt et al.	
2002/0111624	A1	8/2002	Witt et al.	
2002/0188294	A1	12/2002	Couture et al.	
2003/0014052	A1	1/2003	Buysse et al.	
2003/0014053	A1	1/2003	Nguyen et al.	
2003/0018331	A1	1/2003	Dycus et al.	
2003/0018332	A1	1/2003	Schmaltz et al.	
2003/0032956	A1	2/2003	Lands et al.	
2003/0069570	A1	4/2003	Witzel et al.	
2003/0069571	A1	4/2003	Treat et al.	
2003/0078578	A1	4/2003	Truckai et al.	
2003/0109875	A1	6/2003	Tetzlaff et al.	
2003/0114851	A1	6/2003	Truckai et al.	
2003/0139741	A1	7/2003	Goble et al.	
2003/0139742	A1	7/2003	Wampler et al.	
2003/0158548	A1	8/2003	Phan et al.	
2003/0158549	A1	8/2003	Swanson	
2003/0171747	A1	9/2003	Kanehira et al.	
2003/0181910	A1	9/2003	Dycus et al.	
2003/0199869	A1	10/2003	Johnson et al.	
2003/0216732	A1	11/2003	Truckai et al.	
2003/0220637	A1	11/2003	Truckai et al.	
2003/0229344	A1	12/2003	Dycus et al.	
2003/0236325	A1	12/2003	Bonora	
2003/0236518	A1	12/2003	Marchitto et al.	
2004/0030330	A1	2/2004	Brassell et al.	
2004/0030332	A1	2/2004	Knowlton et al.	
2004/0049185	A1	3/2004	Latterell et al.	
2004/0064151	A1	4/2004	Mollenauer	
2004/0073238	A1	4/2004	Makower	
2004/0073256	A1	4/2004	Marchitto et al.	
2004/0078035	A1	4/2004	Kanehira et al.	
2004/0082952	A1	4/2004	Dycus et al.	
2004/0087943	A1	5/2004	Dycus et al.	
2004/0115296	A1	6/2004	Duffin	
2004/0116924	A1	6/2004	Dycus et al.	
2004/0116979	A1	6/2004	Truckai et al.	
2004/0122423	A1	6/2004	Dycus et al.	
2004/0143263	A1	7/2004	Schechter et al.	
2004/0147925	A1	7/2004	Buysse et al.	
2004/0148035	A1	7/2004	Barrett et al.	
2004/0162557	A1	8/2004	Tetzlaff et al.	
2004/0176762	A1	9/2004	Lawes et al.	
2004/0193153	A1	9/2004	Sarter et al.	
2004/0199181	A1	10/2004	Knodel et al.	
2004/0210282	A1	10/2004	Flock et al.	
2004/0224590	A1	11/2004	Rawa et al.	
2004/0225288	A1	11/2004	Buysse et al.	
2004/0230189	A1	11/2004	Keppel	
2004/0236326	A1	11/2004	Schulze et al.	
2004/0243125	A1	12/2004	Dycus et al.	
2004/0247849	A1	12/2004	Truckai	
2004/0249371	A1	12/2004	Dycus et al.	
2004/0249374	A1	12/2004	Tetzlaff et al.	
2004/0250419	A1	12/2004	Sremcich et al.	
2004/0254573	A1	12/2004	Dycus et al.	
2004/0260281	A1	12/2004	Baxter, III et al.	
2005/0004564	A1	1/2005	Wham et al.	
2005/0004568	A1	1/2005	Lawes et al.	
2005/0004569	A1	1/2005	Witt et al.	
2005/0004570	A1	1/2005	Chapman et al.	
2005/0021025	A1	1/2005	Buysse et al.	
2005/0021026	A1	1/2005	Baily	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0021027	A1	1/2005	Shields et al.
2005/0033278	A1	2/2005	McClurken et al.
2005/0059934	A1	3/2005	Wenchell et al.
2005/0096645	A1	5/2005	Wellman et al.
2005/0101951	A1	5/2005	Wham et al.
2005/0101952	A1	5/2005	Lands et al.
2005/0107784	A1	5/2005	Moses et al.
2005/0107785	A1*	5/2005	Dycus et al. 606/51
2005/0113818	A1	5/2005	Sartor et al.
2005/0113819	A1	5/2005	Wham et al.
2005/0113826	A1	5/2005	Johnson et al.
2005/0113827	A1	5/2005	Dumbauld et al.
2005/0113828	A1	5/2005	Shields et al.
2005/0119655	A1	6/2005	Moses et al.
2005/0149017	A1	7/2005	Dycus
2005/0149151	A1	7/2005	Orszulak et al.
2005/0154387	A1	7/2005	Moses et al.
2005/0187547	A1	8/2005	Sugi
2005/0197659	A1	9/2005	Bahney
2005/0203504	A1	9/2005	Wham et al.
2005/0240179	A1	10/2005	Buysse et al.
2006/0052778	A1	3/2006	Chapman et al.
2006/0052779	A1	3/2006	Hammill
2006/0064085	A1	3/2006	Schechter et al.
2006/0064086	A1	3/2006	Odom
2006/0074417	A1	4/2006	Cunningham et al.
2006/0079888	A1	4/2006	Mulier et al.
2006/0079890	A1	4/2006	Guerra
2006/0079891	A1	4/2006	Arts et al.
2006/0079933	A1	4/2006	Hushka et al.
2006/0084973	A1	4/2006	Hushka
2006/0089670	A1	4/2006	Hushka
2006/0116675	A1	6/2006	McClurken et al.
2006/0129146	A1	6/2006	Dycus et al.
2006/0161150	A1	7/2006	Keppel
2006/0167450	A1	7/2006	Johnson et al.
2006/0167452	A1	7/2006	Moses et al.
2006/0173452	A1	8/2006	Buysse et al.
2006/0189980	A1	8/2006	Johnson et al.
2006/0189981	A1	8/2006	Dycus et al.
2006/0190035	A1	8/2006	Hushka et al.
2006/0217709	A1	9/2006	Couture et al.
2006/0224158	A1	10/2006	Odom et al.
2006/0229666	A1	10/2006	Suzuki et al.
2006/0253126	A1	11/2006	Bjerken et al.
2006/0259036	A1	11/2006	Tetzlaff et al.
2006/0264922	A1	11/2006	Sartor et al.
2006/0264931	A1	11/2006	Chapman et al.
2006/0271030	A1	11/2006	Francis et al.
2006/0271038	A1	11/2006	Johnson et al.
2006/0283093	A1	12/2006	Petrovic et al.
2006/0287641	A1	12/2006	Perlin
2007/0016182	A1	1/2007	Lipson et al.
2007/0016187	A1	1/2007	Weinberg et al.
2007/0027447	A1	2/2007	Theroux et al.
2007/0043352	A1	2/2007	Garrison et al.
2007/0043353	A1	2/2007	Dycus et al.
2007/0055231	A1	3/2007	Dycus et al.
2007/0060919	A1	3/2007	Isaacson et al.
2007/0062017	A1	3/2007	Dycus et al.
2007/0074807	A1	4/2007	Guerra
2007/0078456	A1	4/2007	Dumbauld et al.
2007/0078458	A1	4/2007	Dumbauld et al.
2007/0078459	A1	4/2007	Johnson et al.
2007/0088356	A1	4/2007	Moses et al.
2007/0106292	A1	5/2007	Kaplan et al.
2007/0106295	A1	5/2007	Garrison et al.
2007/0106297	A1	5/2007	Dumbauld et al.
2007/0118111	A1	5/2007	Weinberg
2007/0118115	A1	5/2007	Artale et al.
2007/0142833	A1	6/2007	Dycus et al.
2007/0142834	A1	6/2007	Dumbauld
2007/0156139	A1	7/2007	Schechter et al.
2007/0156140	A1	7/2007	Baily
2007/0173811	A1	7/2007	Couture et al.
2007/0173814	A1	7/2007	Hixson et al.
2007/0179499	A1	8/2007	Garrison
2007/0198011	A1	8/2007	Sugita
2007/0203485	A1	8/2007	Keppel
2007/0213706	A1	9/2007	Dumbauld et al.
2007/0213707	A1	9/2007	Dumbauld et al.
2007/0213708	A1	9/2007	Dumbauld et al.
2007/0213712	A1	9/2007	Buysse et al.
2007/0255279	A1	11/2007	Buysse et al.
2007/0260235	A1	11/2007	Podhajsky
2007/0260238	A1	11/2007	Guerra
2007/0260241	A1	11/2007	Dalla Betta et al.
2007/0260242	A1	11/2007	Dycus et al.
2007/0265616	A1	11/2007	Couture et al.
2008/0004616	A1	1/2008	Patrick
2008/0009860	A1	1/2008	Odom
2008/0015575	A1	1/2008	Odom et al.
2008/0021450	A1	1/2008	Couture
2008/0033428	A1	2/2008	Artale et al.
2008/0039835	A1	2/2008	Johnson et al.
2008/0039836	A1	2/2008	Odom et al.
2008/0045947	A1	2/2008	Johnson et al.
2008/0058802	A1	3/2008	Couture et al.
2008/0082100	A1	4/2008	Orton et al.
2008/0091189	A1	4/2008	Carlton
2008/0114356	A1	5/2008	Johnson et al.
2008/0167651	A1	7/2008	Tetzlaff et al.
2008/0195093	A1	8/2008	Couture et al.
2008/0215051	A1	9/2008	Buysse et al.
2008/0243120	A1	10/2008	Lawes et al.
2008/0249527	A1	10/2008	Couture
2008/0312653	A1	12/2008	Arts et al.
2008/0319442	A1	12/2008	Unger et al.
2009/0012520	A1	1/2009	Hixson et al.
2009/0018535	A1	1/2009	Schechter et al.
2009/0024126	A1	1/2009	Artale et al.
2009/0043304	A1	2/2009	Tetzlaff et al.
2009/0048596	A1	2/2009	Shields et al.
2009/0062794	A1	3/2009	Buysse et al.
2009/0082766	A1	3/2009	Unger et al.
2009/0082767	A1	3/2009	Unger et al.
2009/0082769	A1	3/2009	Unger et al.
2009/0088738	A1	4/2009	Guerra et al.
2009/0088739	A1	4/2009	Hushka et al.
2009/0088740	A1	4/2009	Guerra et al.
2009/0088741	A1	4/2009	Hushka et al.
2009/0088744	A1	4/2009	Townsend
2009/0088745	A1	4/2009	Hushka et al.
2009/0088746	A1	4/2009	Hushka et al.
2009/0088747	A1	4/2009	Hushka et al.
2009/0088748	A1	4/2009	Guerra et al.
2009/0088749	A1	4/2009	Hushka et al.
2009/0088750	A1	4/2009	Hushka et al.
2009/0112206	A1	4/2009	Dumbauld et al.
2009/0131934	A1	5/2009	Odom et al.
2009/0149853	A1	6/2009	Shields et al.
2009/0149854	A1	6/2009	Cunningham et al.
2009/0171350	A1	7/2009	Dycus et al.
2009/0171353	A1	7/2009	Johnson et al.
2009/0182327	A1	7/2009	Unger
2009/0187188	A1	7/2009	Guerra et al.

FOREIGN PATENT DOCUMENTS

DE	2514501		10/1976
DE	2627679		1/1977
DE	3612646		4/1987
DE	8712328		3/1988
DE	4303882		8/1994
DE	4403252		8/1995
DE	19515914		7/1996
DE	29616210		1/1997
DE	19608716		4/1997
DE	19751106		5/1998
DE	19751108		5/1999
DE	19738457		1/2009
EP	0364216	A1	4/1990
EP	0467501		1/1992
EP	0518230	A1	12/1992

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

EP	0 541 930	B1	5/1993
EP	0572 131		12/1993
EP	0584787	A1	3/1994
EP	0589453	A2	3/1994
EP	0589555		3/1994
EP	0623316	A1	11/1994
EP	0624348	A2	11/1994
EP	0650701	A1	5/1995
EP	0694290	A3	3/1996
EP	0717966	A1	6/1996
EP	0754437	A3	3/1997
EP	0517243		9/1997
EP	0853922	A1	7/1998
EP	0875209	A1	11/1998
EP	0878169	A1	11/1998
EP	0887046	A3	1/1999
EP	0923907	A1	6/1999
EP	0986990	A1	3/2000
EP	1034747	A1	9/2000
EP	1034748	A1	9/2000
EP	1025807	A3	10/2000
EP	1034746	A3	10/2000
EP	1050278	A1	11/2000
EP	1053719	A1	11/2000
EP	1053720	A1	11/2000
EP	1055399	A1	11/2000
EP	1055400	A1	11/2000
EP	1080694	A1	3/2001
EP	1082944	A1	3/2001
EP	1159926	A2	12/2001
EP	1177771		2/2002
EP	1301135	A	4/2003
EP	1330991	A1	7/2003
EP	1486177	A2	6/2004
EP	1472984	A1	11/2004
EP	1 486 177		12/2004
EP	0774232		1/2005
EP	1527747	A2	5/2005
EP	1530952	A1	5/2005
EP	1532932	A1	5/2005
EP	1535581	A2	6/2005
EP	1609430	A1	12/2005
EP	1632192	A1	3/2006
EP	1 642 543		4/2006
EP	1645238	A1	4/2006
EP	1645240	A2	4/2006
EP	1649821		4/2006
EP	1707143	A1	10/2006
EP	1 769 765		4/2007
EP	1769766		4/2007
EP	1929970		6/2008
EP	1683496		12/2008
GB	623316		5/1949
GB	1490585		11/1977
GB	2214430	A	6/1989
GB	2213416		8/1989
JP	501068		9/1984
JP	502328		3/1992
JP	5-5106		1/1993
JP	5-40112		2/1993
JP	06343644	A2	12/1994
JP	07265328	A2	10/1995
JP	08056955	A2	3/1996
JP	08252263	A2	10/1996
JP	09010223	A2	1/1997
JP	H09-538		1/1997
JP	11244298	A2	9/1999
JP	2000342599	A2	12/2000
JP	2000350732	A2	12/2000
JP	2001008944	A2	1/2001
JP	2001029356	A2	2/2001
JP	2001128990	A2	5/2001
SU	SU401367		11/1974
WO	WO89/00757		1/1989
WO	WO 92/04873		4/1992
WO	WO 92/06642		4/1992
WO	WO 93/21845		11/1993
WO	WO 94/08524	A	4/1994
WO	WO94/20025		9/1994
WO	WO 95/02369		1/1995
WO	WO 95/07662		3/1995
WO	WO95/15124		6/1995
WO	WO96/05776		2/1996
WO	WO 96/22056		7/1996
WO	WO 96/13218		9/1996
WO	WO 97/00646		1/1997
WO	WO 97/00647		1/1997
WO	WO 97/10764		3/1997
WO	WO 97/24073		7/1997
WO	WO 97/24993		7/1997
WO	WO 98/27880		7/1998
WO	WO 99/03407		1/1999
WO	WO 99/03408		1/1999
WO	WO 99/03409		1/1999
WO	WO 99/12488		3/1999
WO	WO 99/23933		5/1999
WO	WO 99/40857		8/1999
WO	WO 99/40861		8/1999
WO	WO 99/51158		10/1999
WO	WO 99/66850	A	12/1999
WO	WO 00/24330		5/2000
WO	WO 00/24331		5/2000
WO	WO 00/36986		6/2000
WO	WO 00/41638		7/2000
WO	WO00/47124		8/2000
WO	WO 00/53112		9/2000
WO	WO 01/17448	A	3/2001
WO	WO 01/54604		8/2001
WO	WO 02/07627		1/2002
WO	WO 02/067798	A1	9/2002
WO	WO 02/080783		10/2002
WO	WO 02/080784		10/2002
WO	WO 02/080785		10/2002
WO	WO02/080786		10/2002
WO	WO 02/080786		10/2002
WO	WO02/080793		10/2002
WO	WO 02/080794		10/2002
WO	WO 02/080795		10/2002
WO	WO 02/080796		10/2002
WO	WO 02/080797		10/2002
WO	WO 02/080798		10/2002
WO	WO 02/080799		10/2002
WO	WO 02/081170		10/2002
WO	WO 03/061500		7/2003
WO	WO 03/090630	A3	11/2003
WO	WO 03/101311		12/2003
WO	WO 2004/032776	A1	4/2004
WO	WO 2004/032777		4/2004
WO	WO 2004/052221		6/2004
WO	WO 2004/073488	A2	9/2004
WO	WO 2004/073490		9/2004
WO	WO2004/073753		9/2004
WO	WO 2004/082495		9/2004
WO	WO 2004/098383		11/2004
WO	WO 2004/103156		12/2004
WO	WO 2005/004734	A1	1/2005
WO	WO2005/004735		1/2005
WO	WO 2005/110264		11/2005
WO	WO 2008/045348		4/2008
WO	WO 2008/045350		4/2008

OTHER PUBLICATIONS

Australian Examiner's first report on Patent Application No. 2007231794 dated May 11, 2012 (3 pages).

European Search Report for Application No. 10 18 1575.1 dated May 5, 2011 (7 pages).

European Search Report for Application No. 06 02 0583.8 dated Feb. 7, 2007 (9 pages).

EPO Communication of a Notice of Opposition Application No. 06020583.8 dated Oct. 29, 2012 (1page) and Opposition Against EP 1 769 765 B1. EP Application No. 06020583.8—Opponent—Dr. Hans Wegner dated Oct. 16, 2012 (27 pages).

(56) **References Cited**

OTHER PUBLICATIONS

Japanese Office Action for Patent Application No. 2006-269885, (2 pages dated May 28, 2012 with English translation 3 pages).
Int'l Search Report EP 05016399 dated Jan. 5, 2006.
Int'l Search Report EP 06005185.1 dated Apr. 18, 2006.
Int'l Search Report EP 06008779.8 dated Jun. 13, 2006.
Int'l Search Report EP 1683496 dated Jun. 13, 2006.
Int'l Search Report EP 04013772 dated Apr. 1, 2005.
Int'l Search Report EP 05013895 dated Oct. 14, 2005.
Int'l Search Report EP 05017281 dated Nov. 16, 2005.
Int'l Search Report EP 06006716 dated Aug. 4, 2006.
Int'l Search Report PCT/US01/11224 dated Nov. 13, 2001.
Int'l Search Report EP 06014461.5 dated Oct. 20, 2006.
Int'l Search Report EP 06020584.6 dated Jan. 12, 2007.
Int'l Search Report EP 06020583.8 dated Jan. 30, 2007.
Int'l Search Report EP 06020756.0 dated Feb. 5, 2007.
Int'l Search Report EP 06024123.9 dated Feb. 26, 2007.
Int'l Search Report EP 06 020574.7 dated Sep. 21, 2007.
Int'l Search Report EP 07 010672.9 dated Oct. 1, 2007.
Int'l Search Report EP 07 013779.9 dated Oct. 18, 2007.
Int'l Search Report EP 07 009026.1 dated Sep. 12, 2007.
Int'l Search Report EP 07 015601.3 dated Dec. 6, 2007.
Int'l Search Report EP 07 015191.5 dated Dec. 19, 2007.
Int'l Search Report EP 07 020283.3 dated Jan. 16, 2008.
International Search Report EP 07021647.8 dated May 2, 2008.
Sigel et al "The Mechanism of Blood Vessel Closure by High Frequency Electrocoagulation" Surgery Gynecology & Obstetrics, Oct. 1965 pp. 823-831.
Bergdahl et al. "Studies on Coagulation and the Development of an Automatic Computerized Bipolar Coagulator" J.Neurosurg, vol. 75, Jul. 1991, pp. 148-151.
Kennedy et al. "High-burst-strength, feedback-controlled bipolar vessel sealing" Surgical Endoscopy (1998) 12: 876-878.
Peterson et al. "Comparison of Healing Process Following Ligation with Sutures and Bipolar Vessel Sealing" Surgical Technology International (2001).
Linehan et al. "A Phase I Study of the LigaSure Vessel Sealing System in Hepatic Surgery" Section of HPB Surger, Washington University School of Medicine, St. Louis MO, Presented at AHPBA, Feb. 2001.
Johnson et al. "Evaluation of the LigaSure Vessel Sealing System in Hemorrhoidectormy" American College of Surgeons (ACS) Clinicla Congress Poster (2000).
Sayfan et al. "Sutureless Closed Hemorrhoidectomy: A New Technique" Annals of Surgery vol. 234 No. 1 Jul. 2001 pp. 21-24.
Heniford et al. "Initial Results with an Electrothermal Bipolar Vessel Sealer" Surgical Endoscopy (2000) 15:799-801.
Heniford et al. "Initial Research and Clinical Results with an Electrothermal Bipolar Vessel Sealer" Oct. 1999.
McLellan et al. "Vessel Sealing for Hemostasis During Pelvic Surgery" Int'l Federation of Gynecology and Obstetrics FIGO World Congress 2000, Washington, D.C.
Levy et al. "Use of a New Energy-based Vessel Ligation Device During Vaginal Hysterectomy" Int'l Federation of Gynecology and Obstetrics (FIGO) World Congress 1999.
Crawford et al. "Use of the LigaSure Vessel Sealing System in Urologic Cancer Surger" Grand Rounds In Urology 1999 vol. 1 Issue 4 pp. 10-17.
Rothenberg et al. "Use of the LigaSure Vesssel Sealing System in Minimally Invasive Surgery in Children" Int'l Pediatric Endosurgery Group (IPEG) 2000.
Palazzo et al. "Randomized clinical trial of Ligasure versus open haemorrhoidectomy" British Journal of Surgery 2002, 89, 154-157.
"Innovations in Electrosurgery" Sales/Product Literature; Dec. 31, 2000.
LigaSure Vessel Sealing System, the Seal of Confidence in Genral, Gynecologic, Urologic, and Laparaoscopic Surgery Sales/Product Literature; Jan. 2004.
Carbonell et al., "Comparison of theGyrus PlasmaKinetic Sealer and the Valleylab LigaSure Device in the Hemostasis of Small, Medium, and Large-Sized Arteries" Carolinas Laparoscopic and Advanced Surgery Program, Carolinas Medical Center, Charlotte, NC 2003.
"Reducing Needlestick Injuries in the Operating Room" Sales/Product Literature 2001.
Chung et al., "Clinical Experience of Sutureless Closed Hemorrhoidectomy with LigaSure" Diseases of the Colon & Rectum vol. 46, No. 1 Jan. 2003.
Strasberg et al., "Use of a Bipolar Vessel-Sealing Device for Parenchymal Transection During Liver Surgery" Journal of Gastrointestinal Surgery, vol. 6, No. 4, Jul./Aug. 2002 pp. 569-574.
Paul G. Horgan, "A Novel Technique for Parenchymal Division During Hepatectomy" The American Journal of Surgery, vol. 181, No. 3, Apr. 2001 pp. 236-237.
W. Scott Helton, "LigaSure Vessel Sealing System: Revolutionary Hemostasis Product for General Surgery" Sales/Product Literature 1999.
Michael Choti, "Abdominoperineal Resection with the LigaSure Vessel Sealing System and LigaSure Atlas 20 cm Open Instrument" Innovations That Work, Jun. 2003.
Craig Johnson, "Use of the LigaSure Vessel Sealing System in Bloodless Hemorrhoidectomy" Innovations That Work, Mar. 2000.
Muller et al., "Extended Left Hemicolectomy Using the LigaSure Vessel Sealing System" Innovations That Work, Sep. 1999.
Herman et al., "Laparoscopic Intestinal Resection With the LigaSure Vessel Sealing System: A Case Report" Innovations That Work, Feb. 2002.
Carus et al., "Initial Experience With the LigaSure Vessel Sealing System in Abdominal Surgery" Innovations That Work, Jun. 2002.
Levy et al. "Randomized Trial of Suture Versus Electrosurgical Bipolar Vessel Sealing in Vaginal Hysterectomy" Obstetrics & Gynecology, vol. 102, No. 1, Jul. 2003.
Levy et al., "Update on Hysterectomy—New Technologies and Techniques" OBG Management, Feb. 2003.
Barbara Levy, "Use of a New Vessel Ligation Device During Vaginal Hysterectomy" FIGO 2000, Washington, D.C.
McLellan et al. "Vessel Sealing for Hemostasis During Gynecologic Surgery" Sales/Product Literature 1999.
Sengupta et al., "Use of a Computer-Controlled Bipolar Diathermy System in Radical Prostatectomies and Other Open Urological Surgery" ANZ Journal of Surgery (2001) 71.9 pp. 538-540.
Olsson et al. "Radical Cystectomy in Females" Current Surgical Techniques in Urology, vol. 14, Issue 3, 2001.
E. David Crawford "Use of a Novel Vessel Sealing Technology in Management of the Dorsal Veinous Complex" Sales/Product Literature 2000.
Jarrett et al., "Use of the LigaSure Vessel Sealing System for Peri-Hilar Vessels in Laparoscopic Nephrectomy" Sales/Product Literature 2000.
E. David Crawford "Evaluation of a New Vessel Sealing Device in Urologic Cancer Surgery" Sales/Product Literature 2000.
Joseph Ortenberg "LigaSure System Used in Laparoscopic 1st and 2nd Stage Orchiopexy" Innovations That Work, Nov. 2002.
Koyle et al., "Laparoscopic Palomo Varicocele Ligation in Children and Adolescents" Pediatric Endosurgery & Innovative Techniques, vol. 6, No. 1, 2002.
Dulemba et al. "Use of a Bipolar Electrothermal Vessel Sealer in Laparoscopically Assisted Vaginal Hysterectomy" Sales/Product Literature; Jan. 2004.
Johnson et al. "Evaluation of a Bipolar electrothermal Vessel Sealing Device in Hemorrhoidectomy" Sales/Product Literature; Jan. 2004.
Int'l Search Report PCT/US98/18640 dated Dec. 17, 1998.
Int'l Search Report PCT/US98/23950 dated Dec. 29, 1998.
Int'l Search Report PCT/US99/24869 dated Feb. 3, 2000.
Int'l Search Reprot PCT/US01/11218 dated Aug. 3, 2001.
International Search Report PCT/US01/11224 dated Nov. 13, 2001.
Int'l Search Report PCT/US01/11340 dated Aug. 7, 2001.
Int'l Search Report PCT/US01/11420 dated Oct. 8, 2001.
Int'l Search Report PCT/US02/01890 dated Jul. 17, 2002.
Int'l Search Report PCT/US02/11100 dated Jul. 9, 2002.
Int'l Search Report PCT/US04/03436 dated Oct. 5, 2004.
Int'l Search Report PCT/US04/13273 dated Nov. 22, 2004.
Int'l Search Report PCT/US04/15311 dated Nov. 18, 2004.
Int'l Search Report EP 98944778 dated Oct. 31, 2000.

(56) **References Cited**

OTHER PUBLICATIONS

Int'l Search Report EP 98958575.7. dated Sep. 20, 2002.
Int'l Search Report EP 04027314 dated Mar. 10, 2005.
Int'l Search Report EP 04027479 dated Mar. 8, 2005.
Int'l Search Report EP 04027705 dated Feb. 3, 2005.
Int'l Search Report EP 05013463.4 dated Sep. 28, 2005.
Int'l Search Report EP 05019130.3 dated Oct. 18, 2005.
Int'l Search Report EP 05020665.5 dated Feb. 16, 2006.
Int'l Search Report EP 05020666.3 dated Feb. 17, 2006.
Int'l Search Report EP 05021779.3 dated Jan. 18, 2006.
Int'l Search Report EP 05021197.8 dated Jan. 31, 2006.
Int'l Search Report EP 05021937.7 dated Jan. 13, 2006.
Int'l Search Report—extended—EP 05021937.7 dated Mar. 6, 2006.
Int'l Search Report EP 05023017.6 dated Feb. 16, 2006.
Int'l Search Report EP 05021780.1 dated Feb. 9, 2006.
Int'l Search Report EP 06002279.5 dated Mar. 22, 2006.
Int'l Search Report EP 04 752343.6 dated Jul. 20, 2007.
Int'l Search Report EP 06 024122.1 dated Mar. 19, 2007.
Int'l Search Report EP 07 001480.8 dated Apr. 12, 2007.
Int'l Search Report EP 07 001488.1 dated May 29, 2007.
Int'l Search Report—Extended EP 07 009029.5 dated Jul. 12, 2007.
Int'l Search Report EP 07 009321.6 dated Aug. 17, 2007.
Sampayan et al, "Multilayer Ultra-High Gradient Insulator Technology" Discharges and Electrical Insulation in Vacuum, 1998. Netherlands Aug. 17-21, 1998; vol. 2, pp. 740-743.
Crouch et al. "A Velocity-Dependent Model for Needle Insertion in Soft Tissue" MICCAI 2005; LNCS 3750 pp. 624-632, Dated: 2005.
Int'l Search Report EP 98957771 dated Aug. 9, 2001.
Int'l Search Report EP 05002671.5 dated Dec. 22, 2008.
Int'l Search Report EP 05002674.5 dated Jan. 16, 2009.
Int'l Search Report EP 05019429.9 dated May 6, 2008.
Int'l Search Report EP 06008515.6 dated Jan. 8, 2009.
Int'l Search Report EP 07 014016 dated Jan. 28, 2008.
Int'l Search Report EP 07 021646.0 dated Jul. 9, 2008.
Int'l Search Report EP 07 021647.8 dated May 2, 2008.
Int'l Search Report EP 08 02692.5 dated Dec. 12, 2008.
Int'l Search Report EP 08 004655.0 dated Jun. 24, 2008.
Int'l Search Report EP 08 006732.5 dated Jul. 29, 2008.
Int'l Search Report EP 08 006917.2 dated Jul. 3, 2008.
Int'l Search Report EP 08 016539.2 dated Jan. 8, 2009.
Int'l Search Report EP 09 152267.2 Dated Jun. 15, 2009.
Int'l Search Report EP 09 152898.4 Dated Jun. 10, 2009.
Int'l Search Report PCT/US98/24281 dated Feb. 22, 1999.
Int'l Search Report PCT/US03/28534 dated Dec. 19, 2003.
Int'l Search Report PCT/US07/021438 dated Apr. 1, 2008.
Int'l Search Report PCT/US07/021440 dated Apr. 8, 2008.
Int'l Search Report PCT/US08/61498 dated Sep. 22, 2008.
Int'l Search Report PCT/US09/032690 dated Jun. 16, 2009.

* cited by examiner

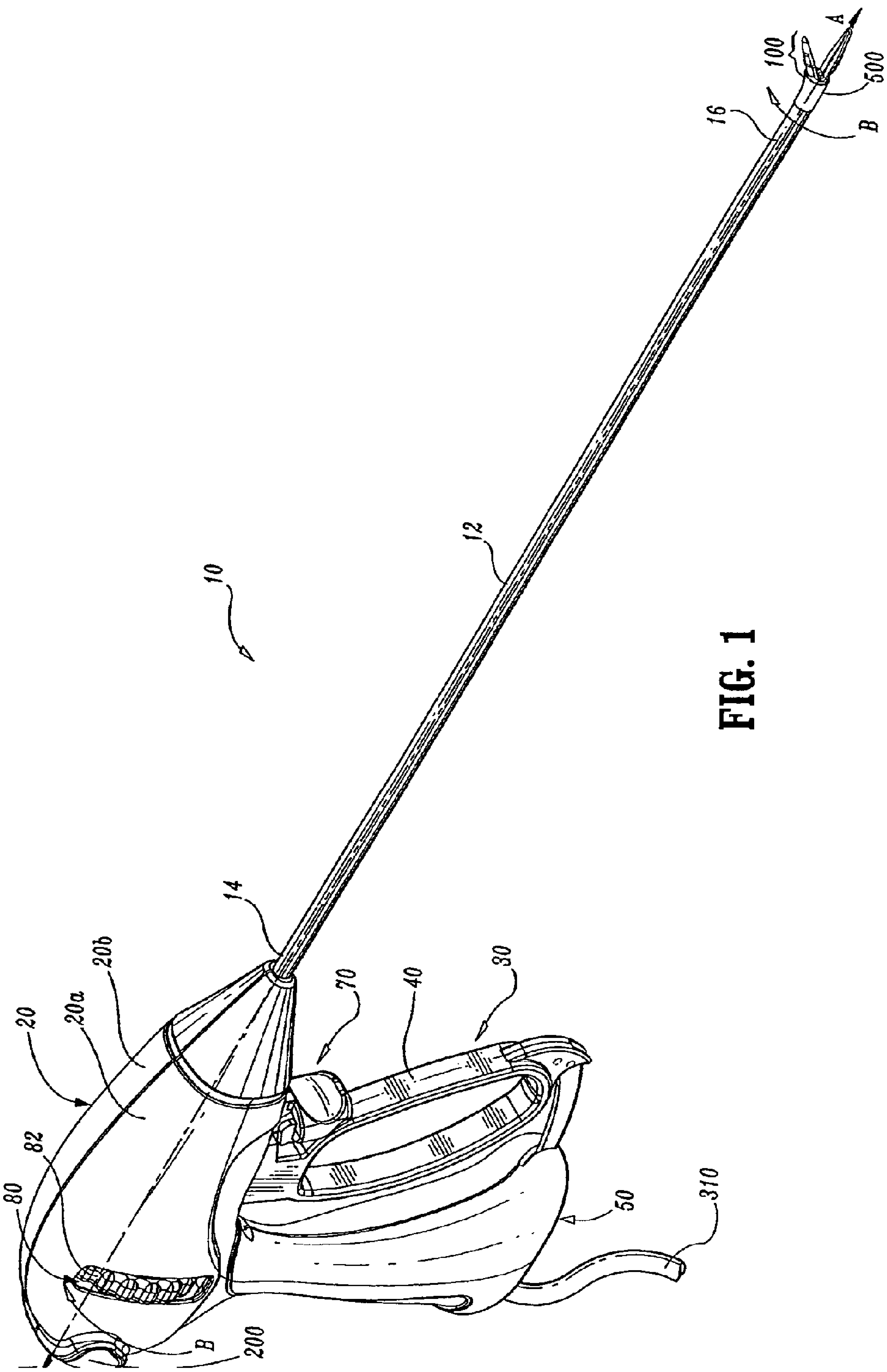


FIG. 1

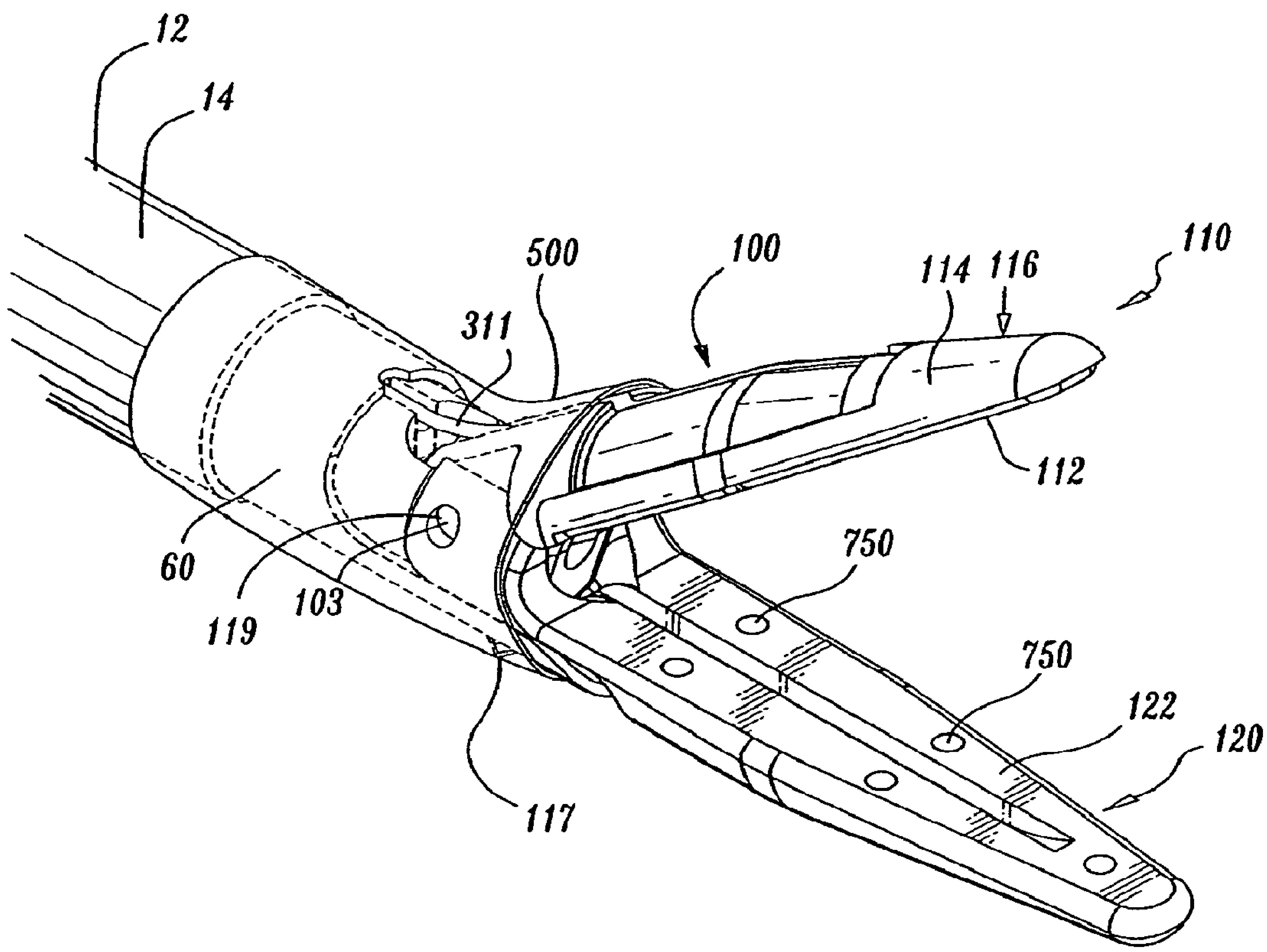


FIG. 2

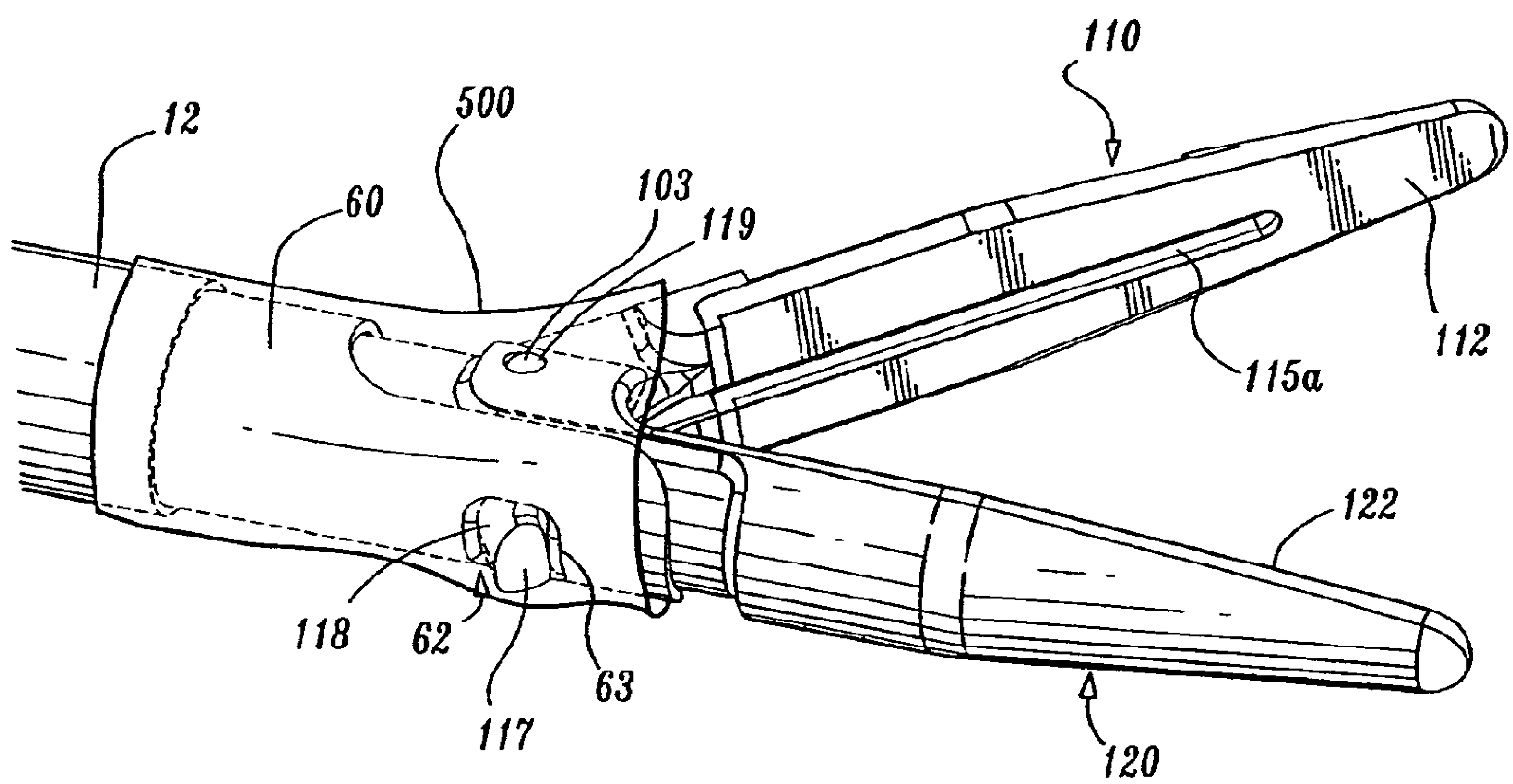


FIG. 3

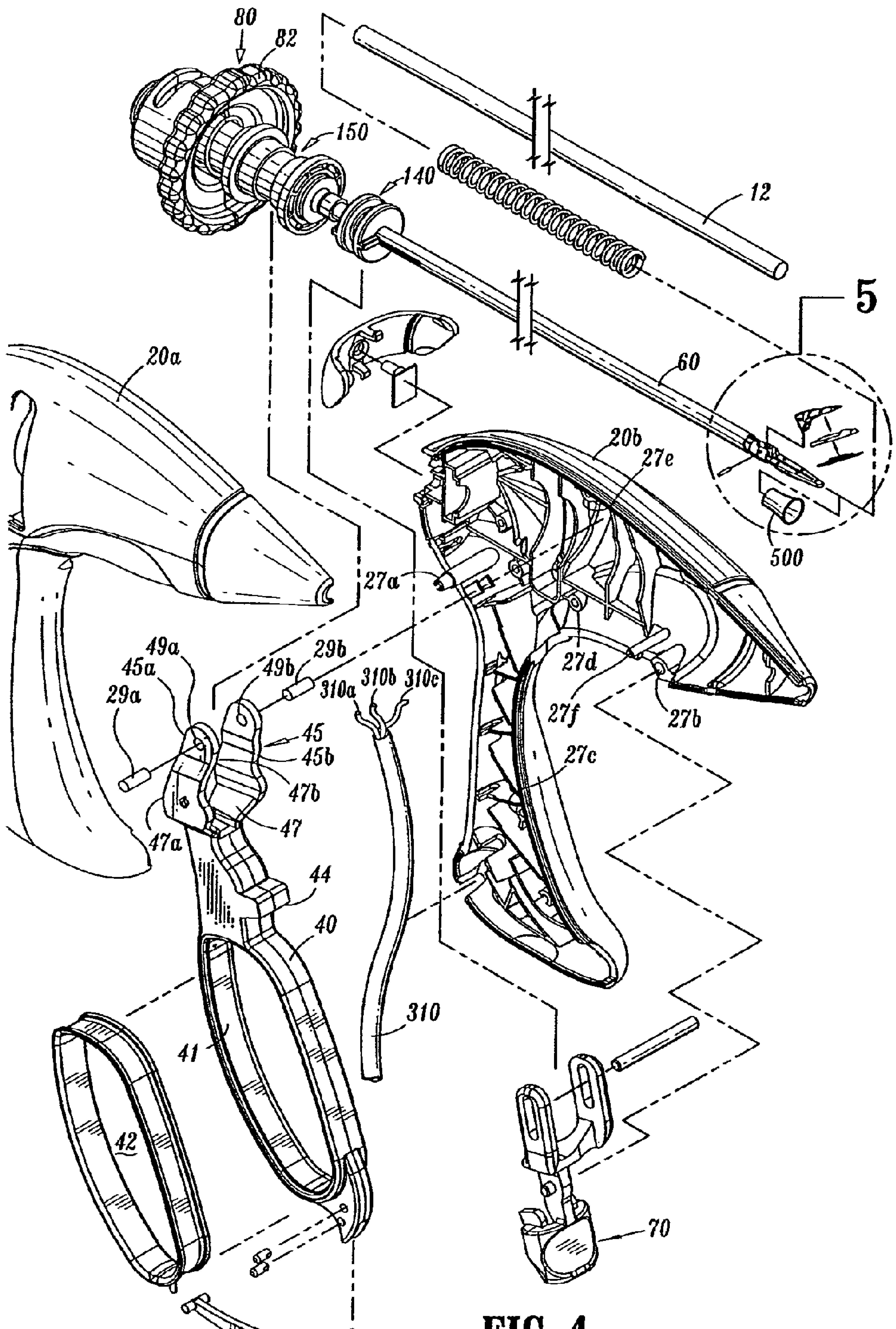

80
82
150
140
12
5
60
20a
20b
27e
500
27a
29b
49a
45a
49b
29a
310a
310b
310c
27d
27b
27f
45
45b
47b
47
47a
27c
44
40
310
41
42
70

FIG. 4

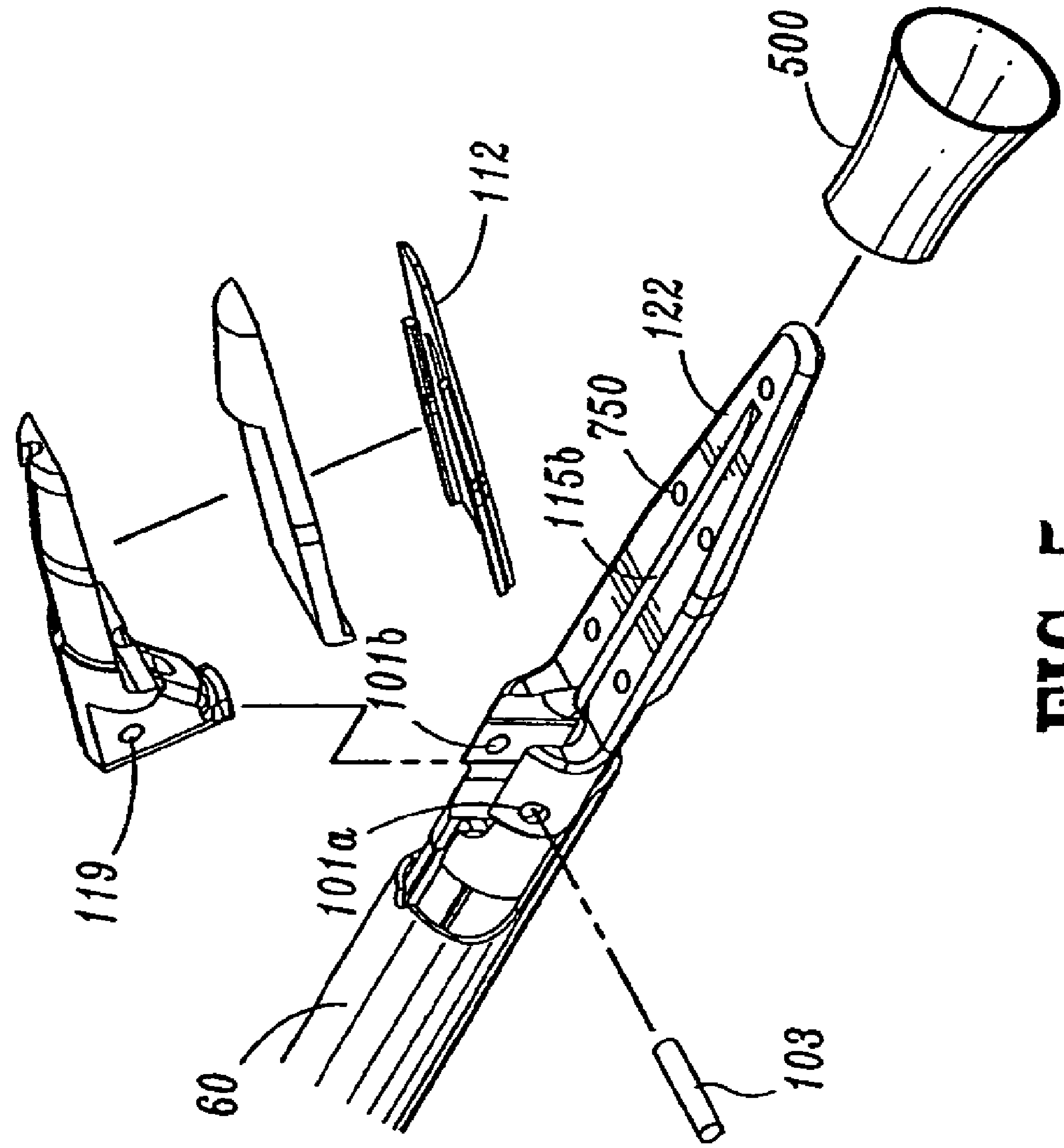


FIG. 5

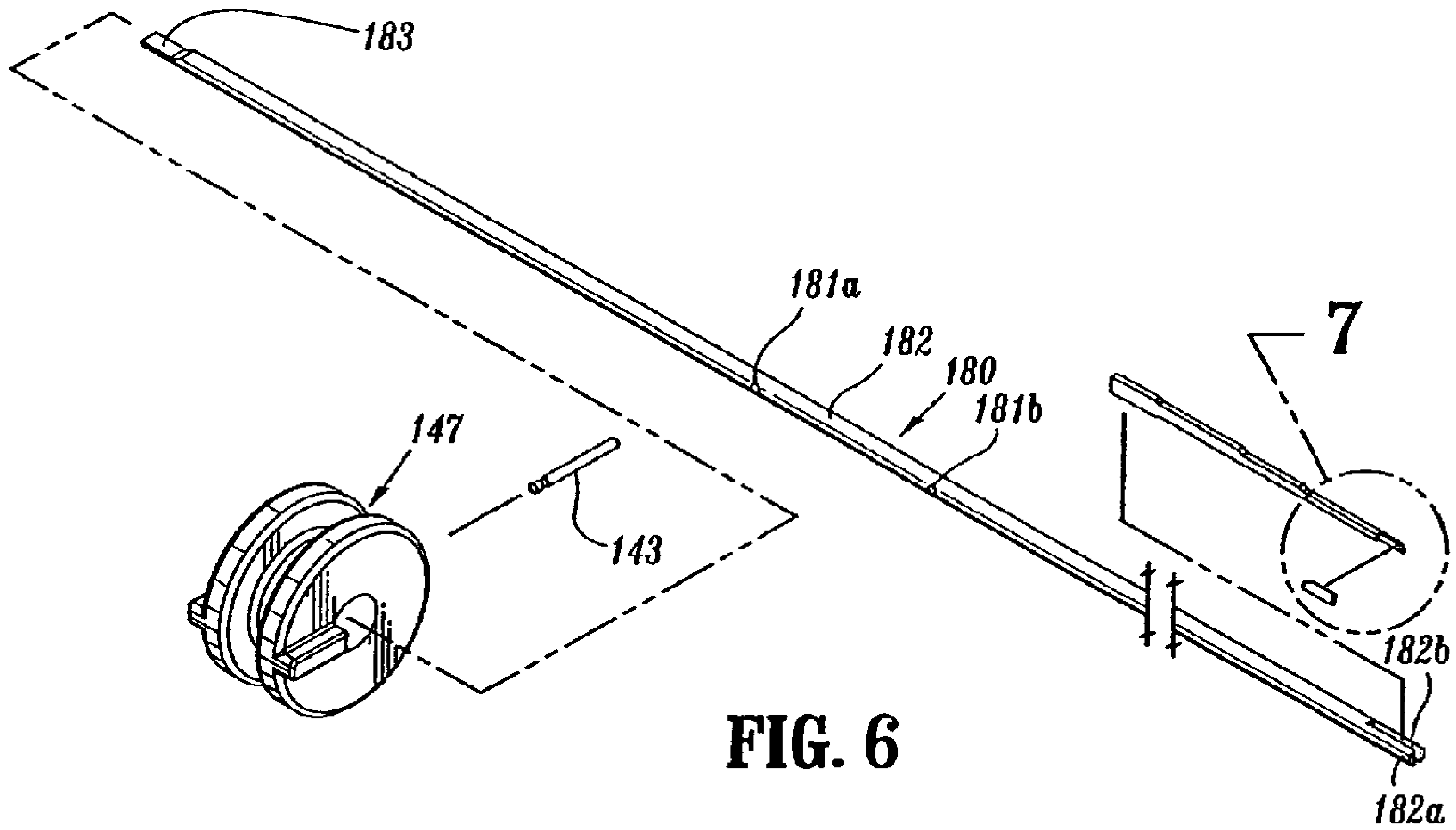


FIG. 6

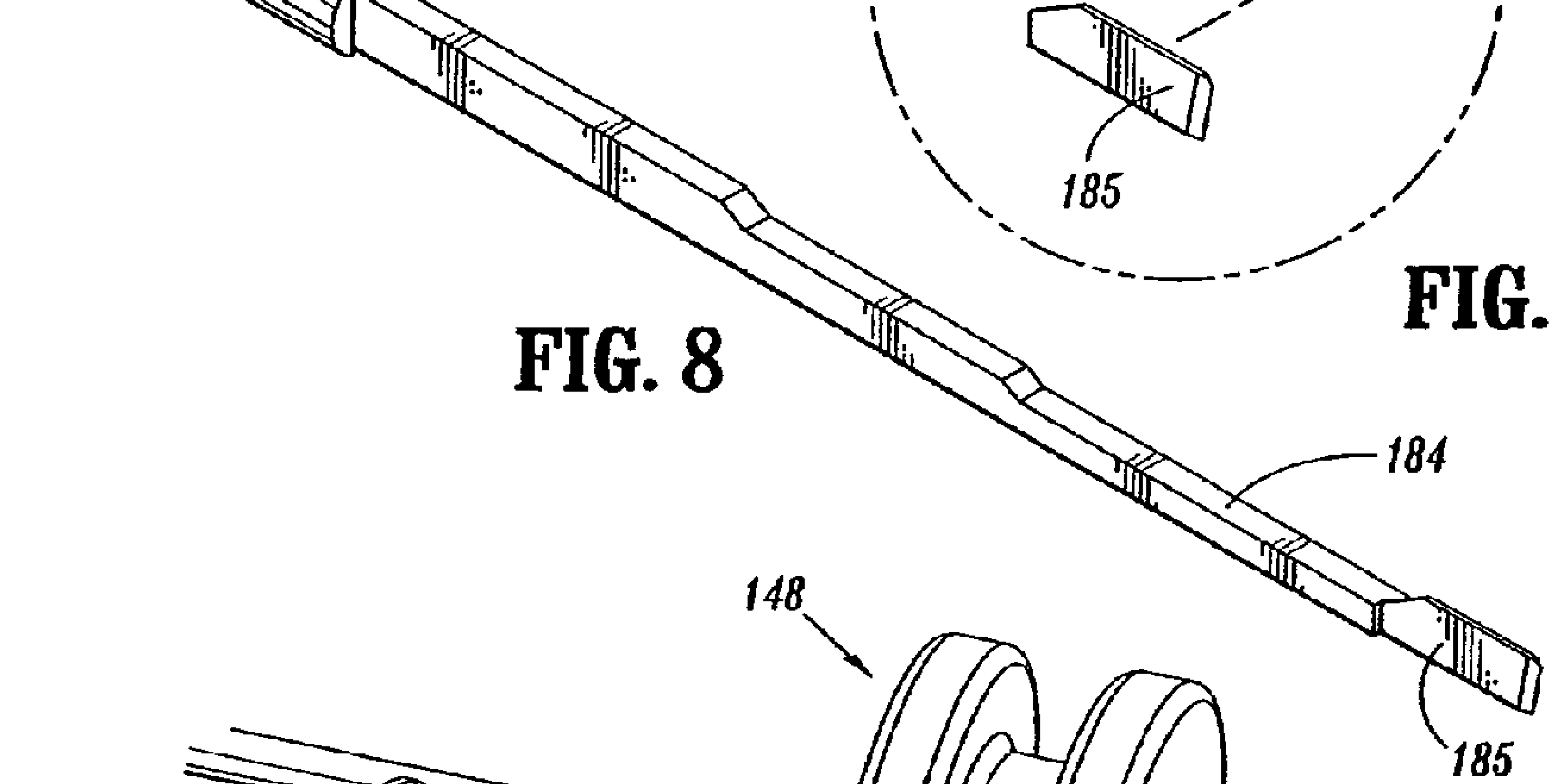


FIG. 8

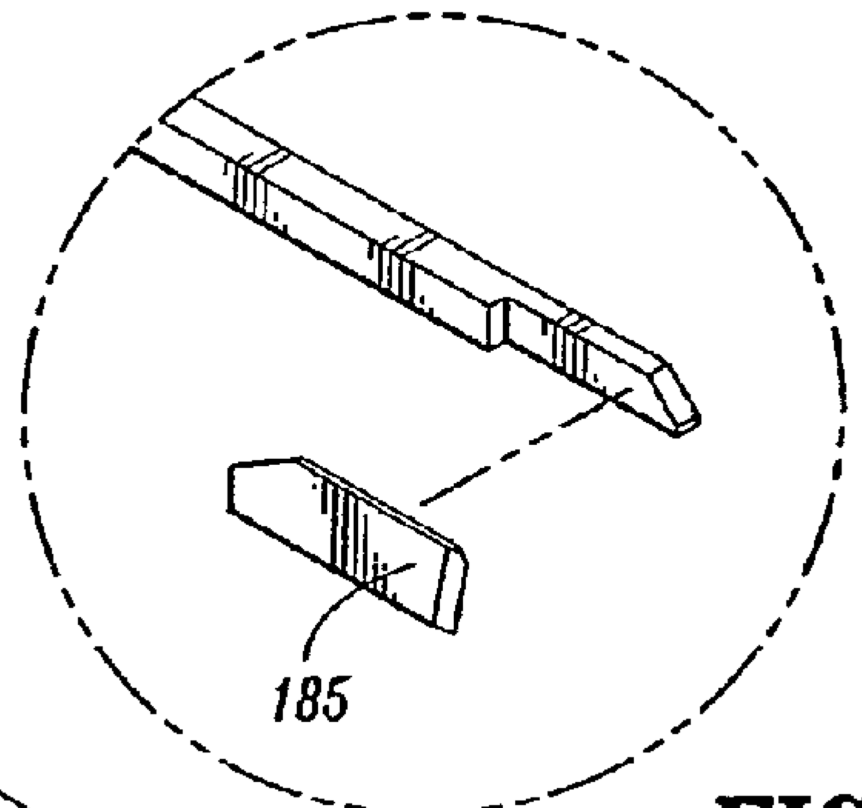


FIG. 7

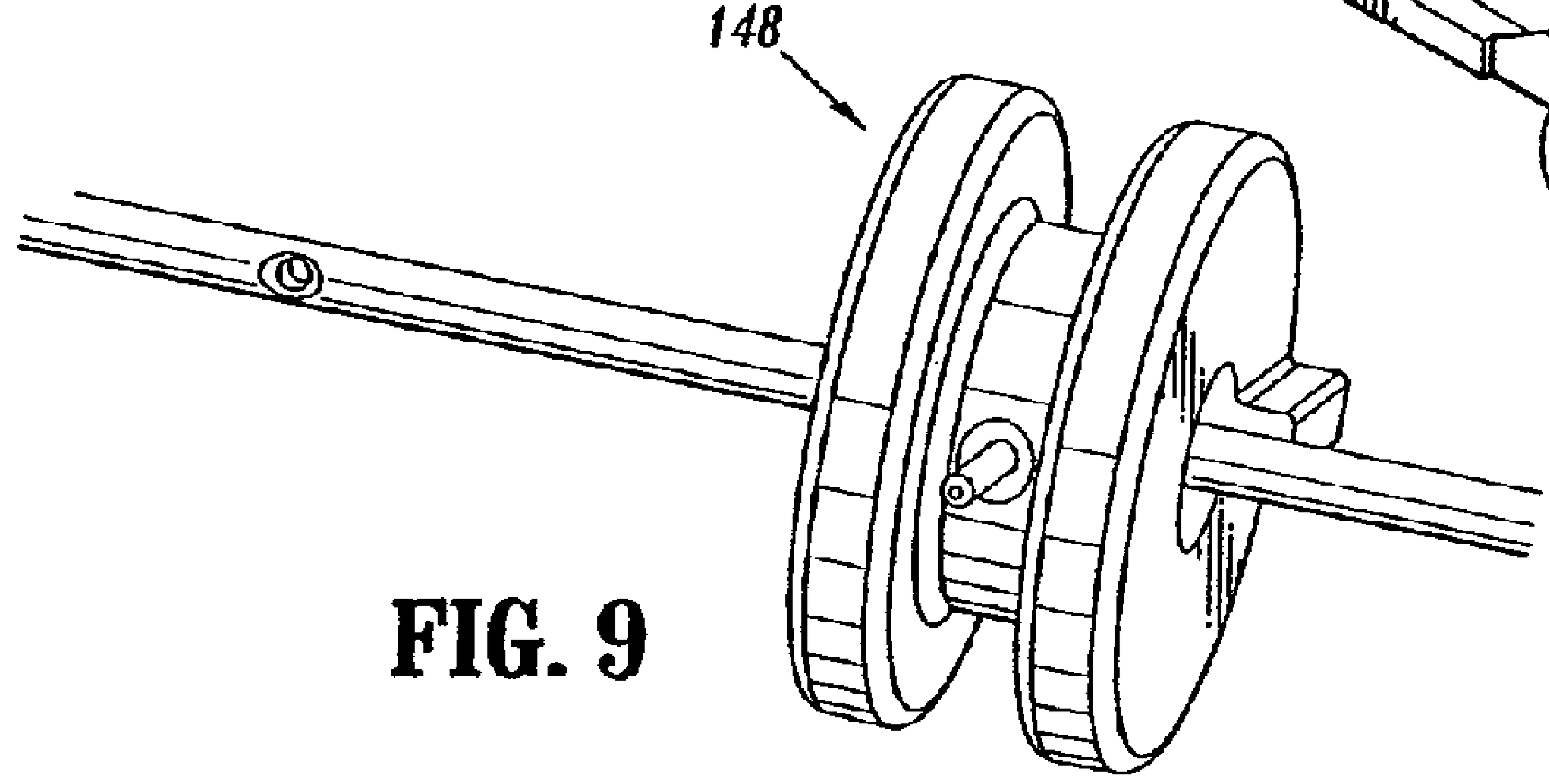


FIG. 9

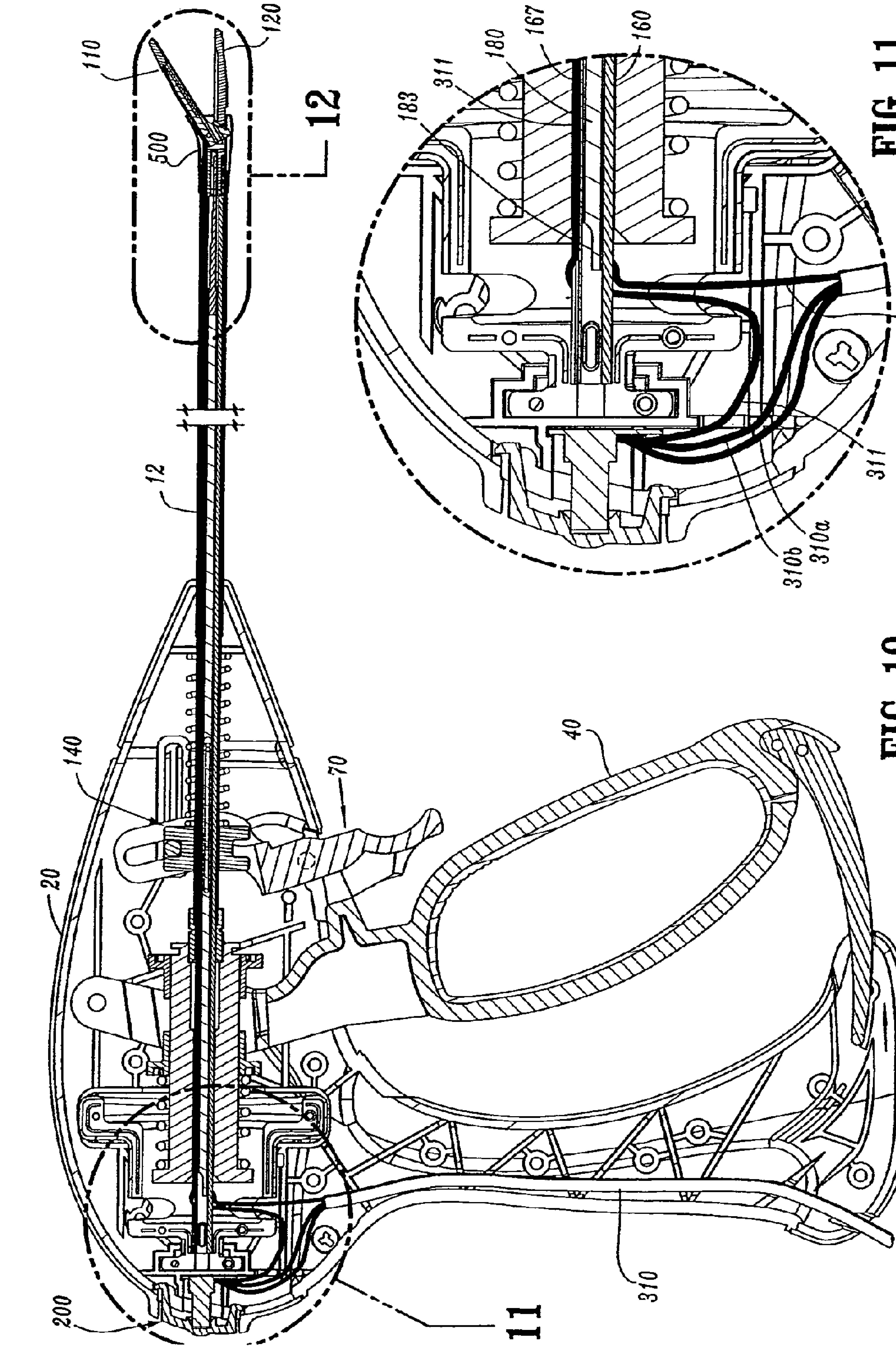

110
120
500
12
12
140
70
20
40
200
11
310
183
311
180
167
160
310c
311
310a
310b

FIG. 10

FIG. 11

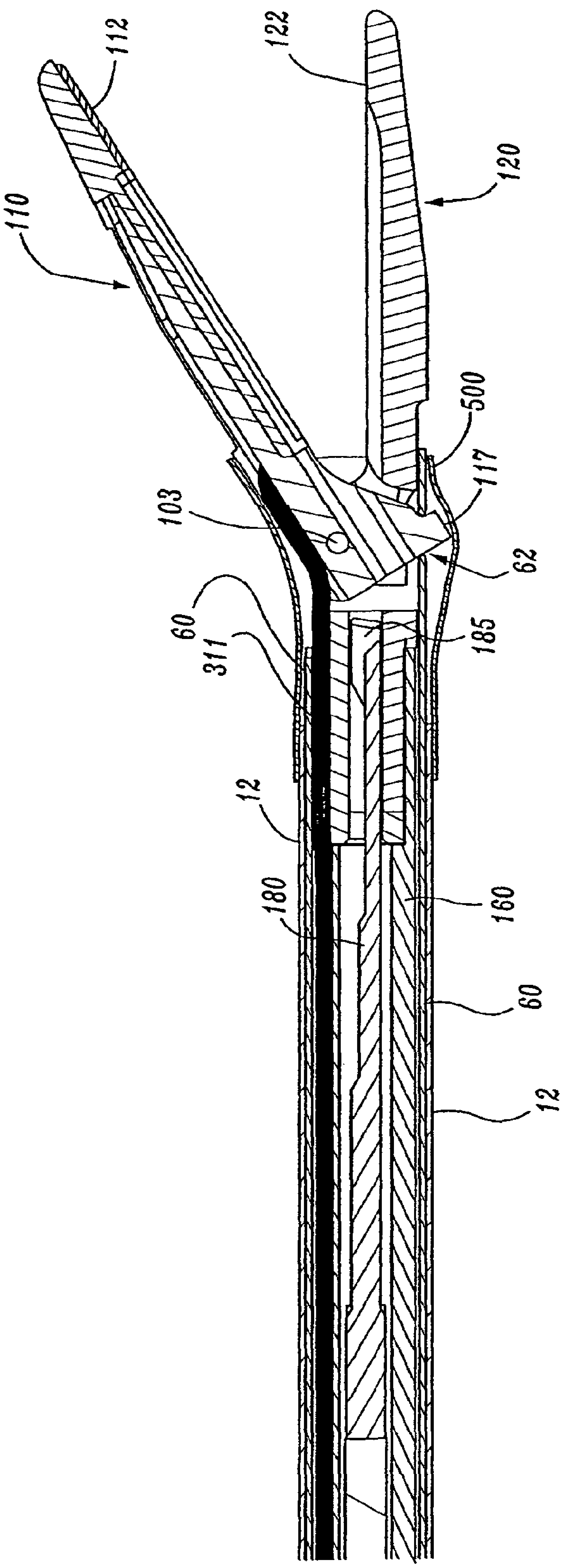


FIG. 12

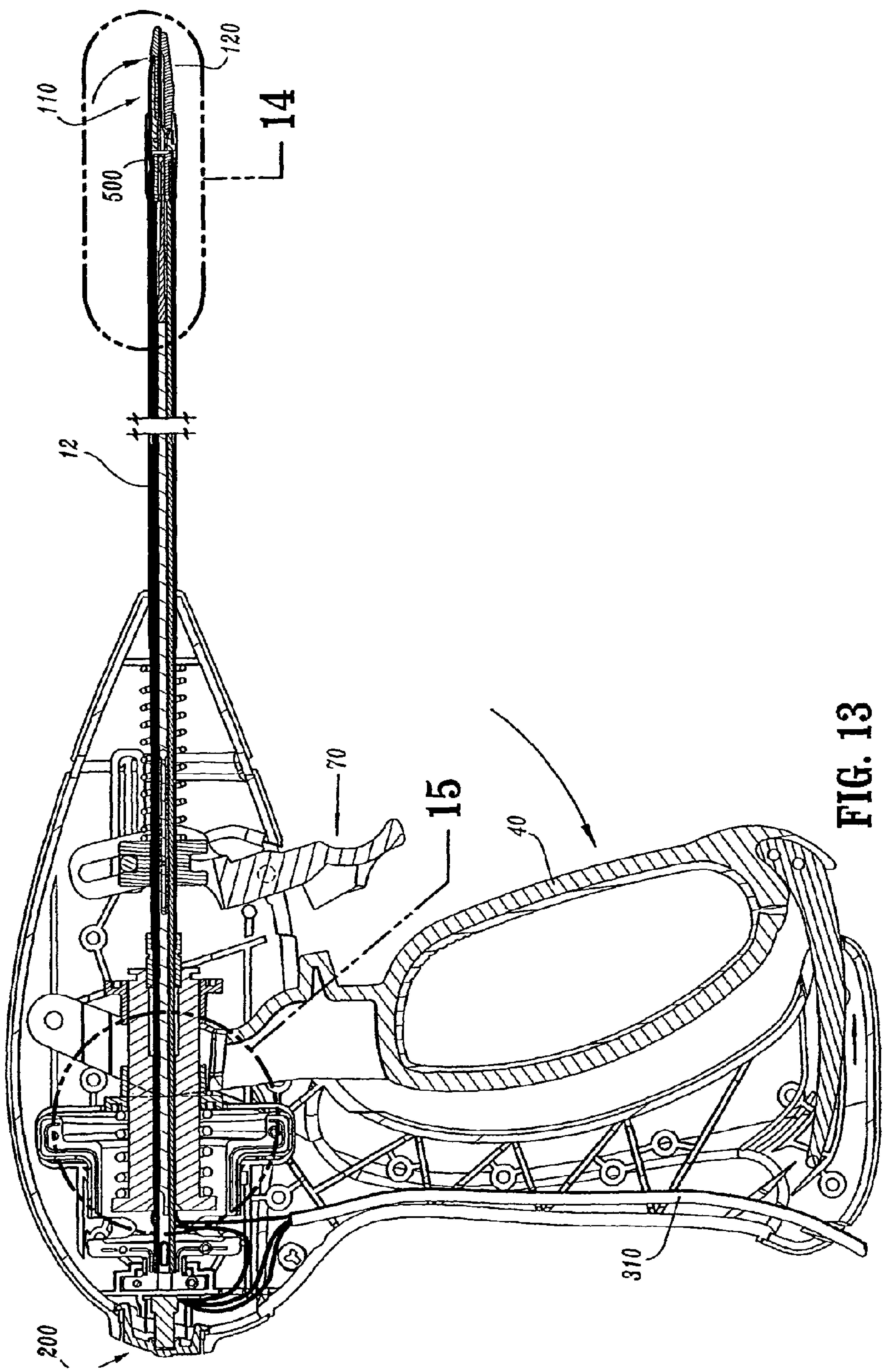


FIG. 13

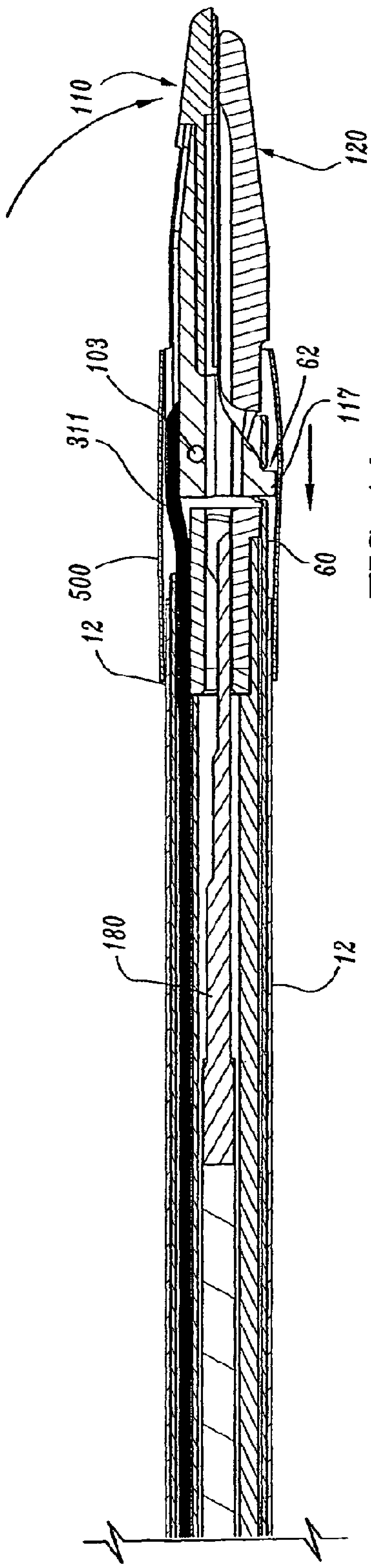


FIG. 14

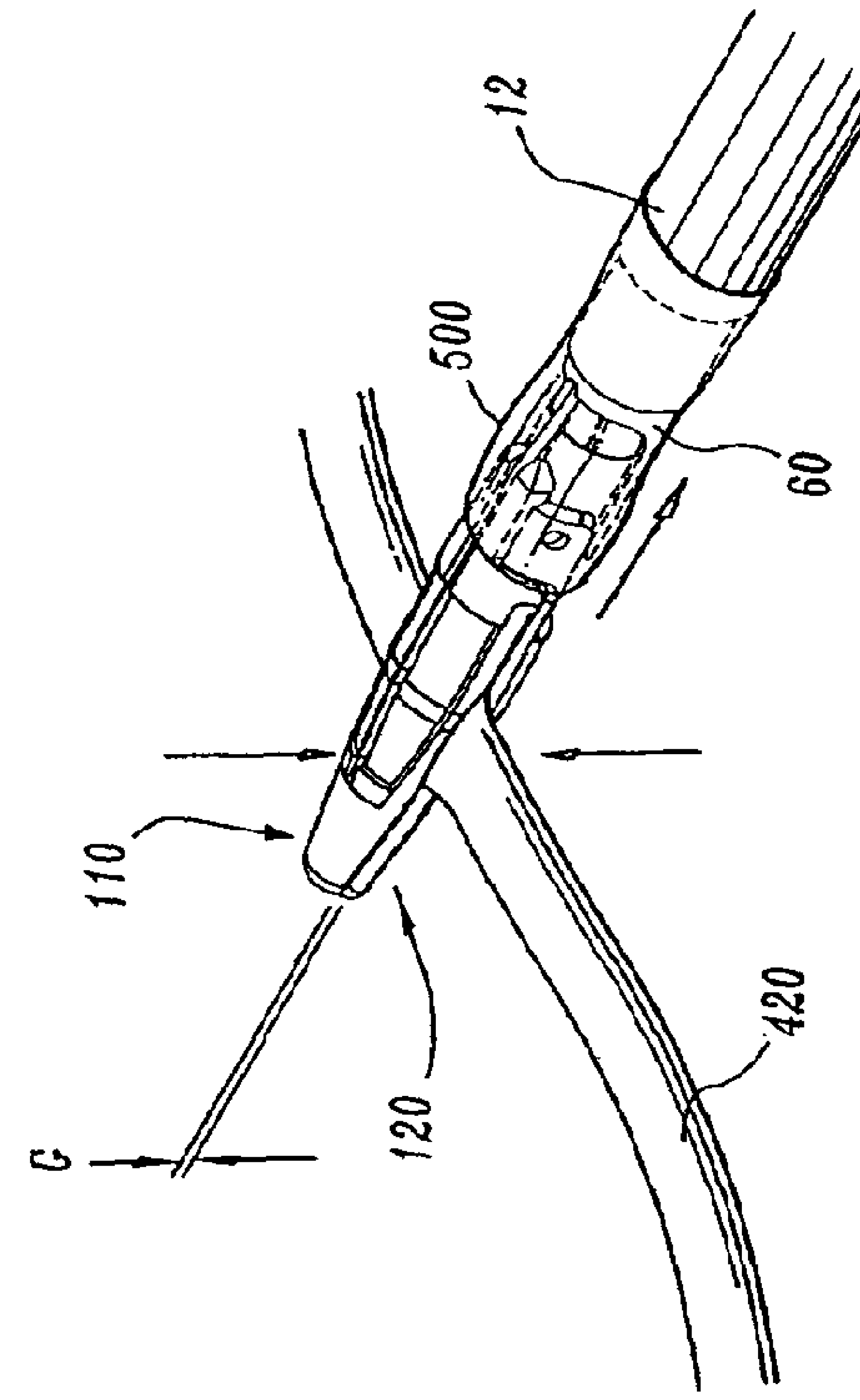


FIG. 18

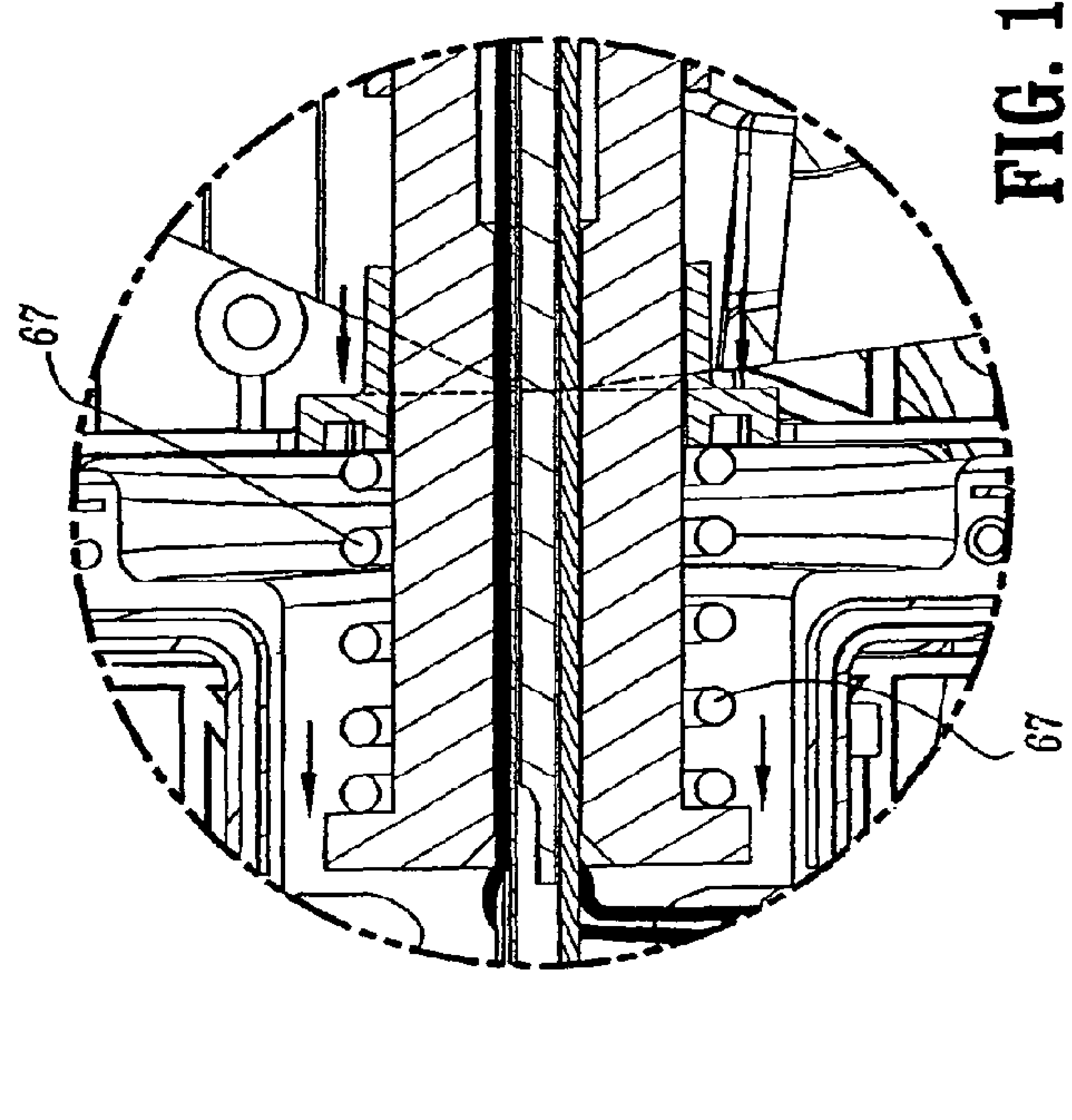


FIG. 15

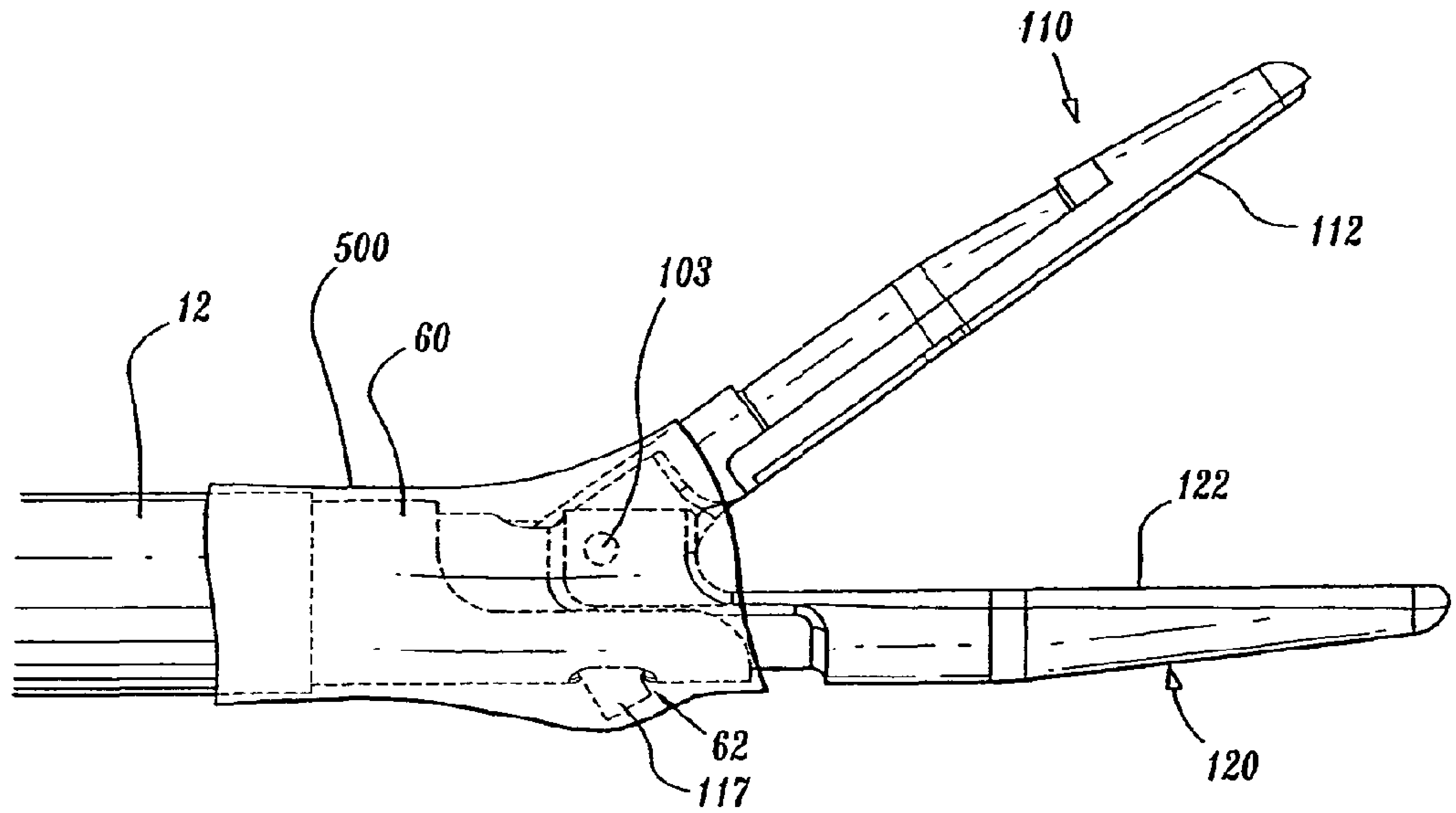


FIG. 16

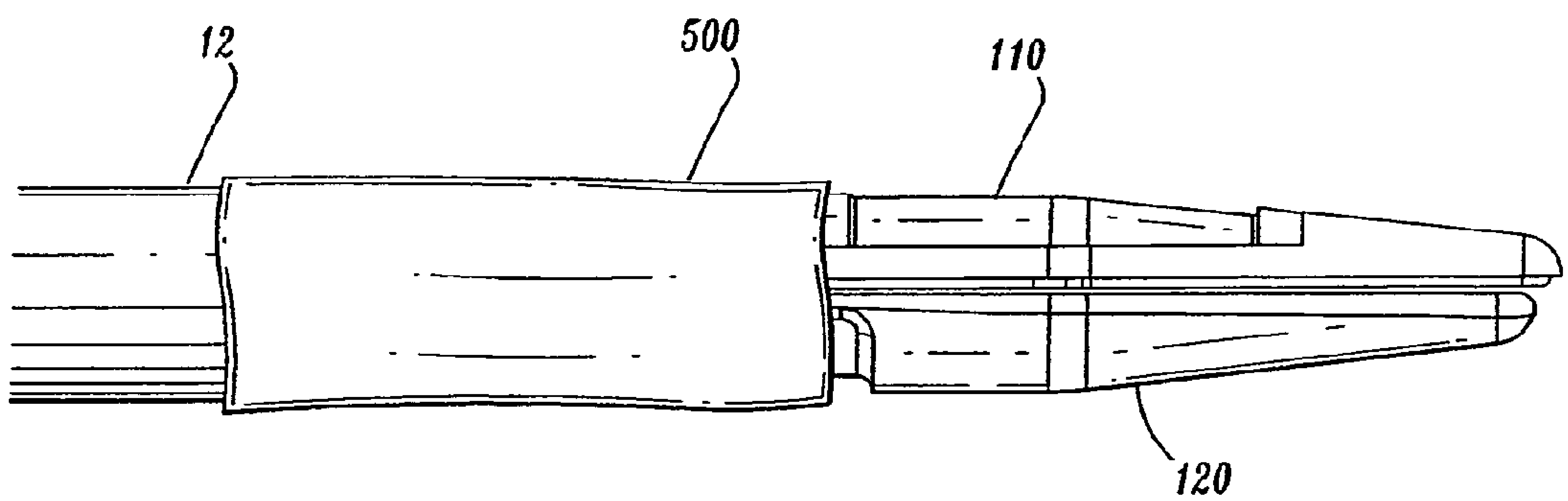


FIG. 17

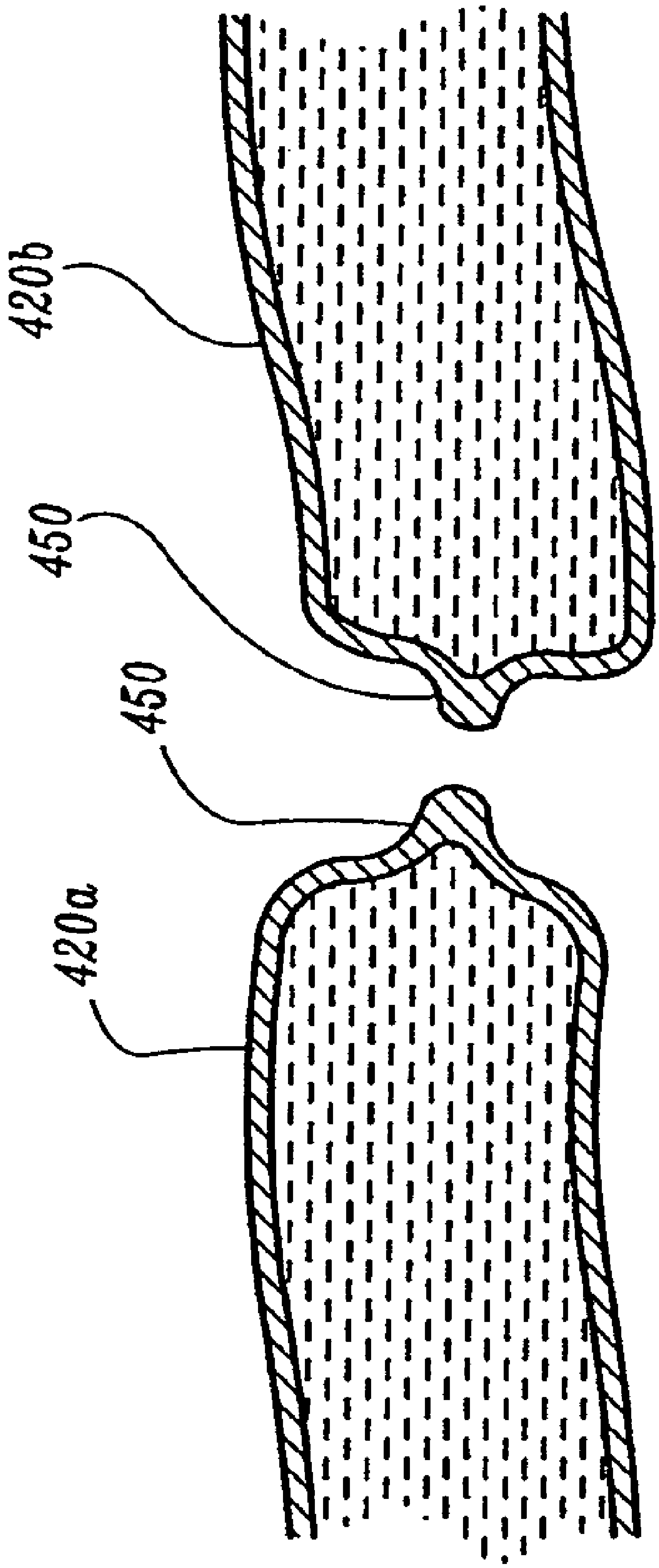


FIG. 19

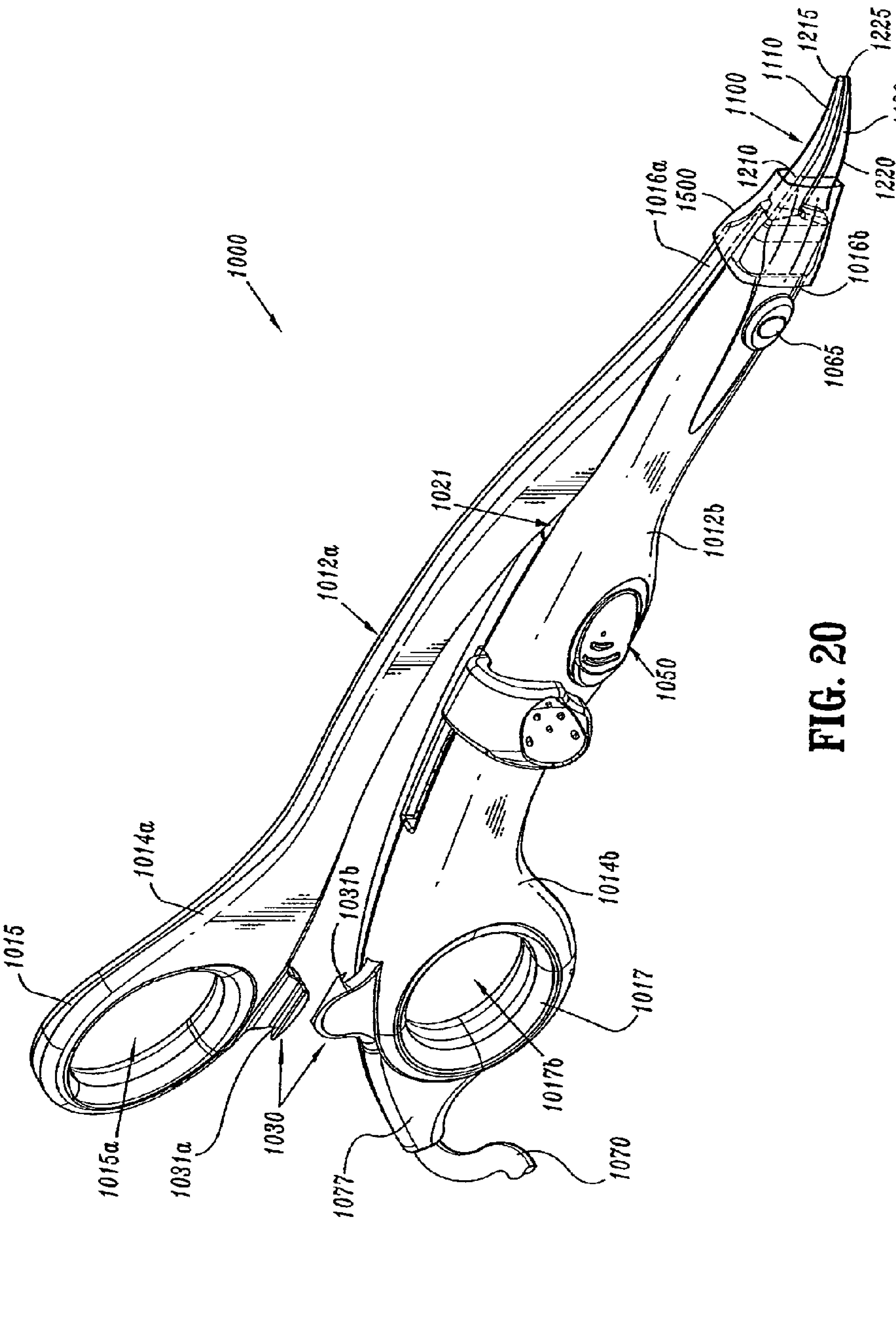

1000
1225
1215
1110
1100
1120
1220
1210
1016a
1500
1016b
1065
1021
1012a
1012b
1050
1014a
1015
1031b
1014b
1017
1017b
1015a
1031a
1030
1077
1070

FIG. 20

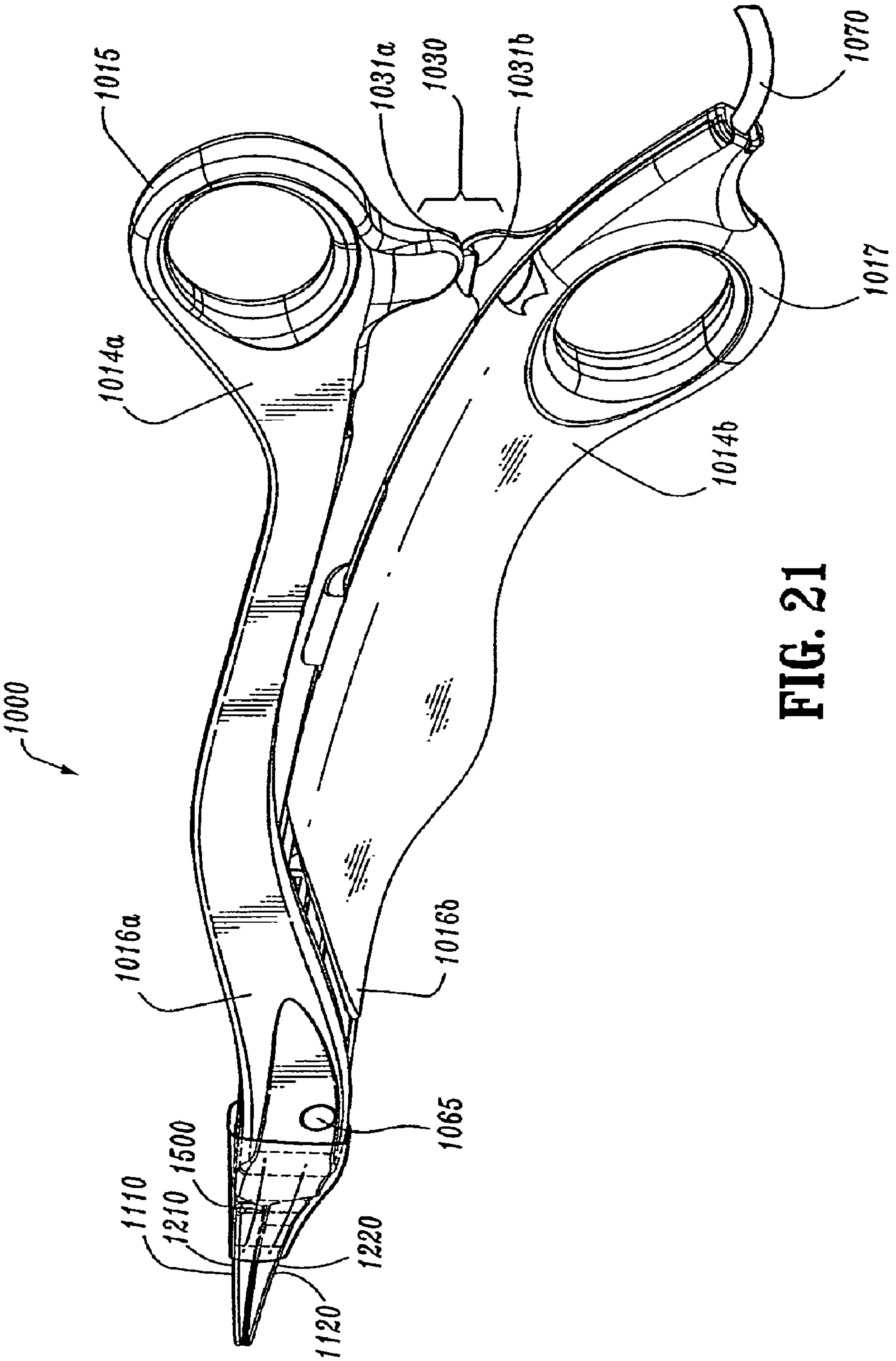

1000
1015
1031a
1030
1031b
1070
1014a
1017
1014b
1016a
1016b
1065
1500
1110
1210
1220
1120

FIG. 21

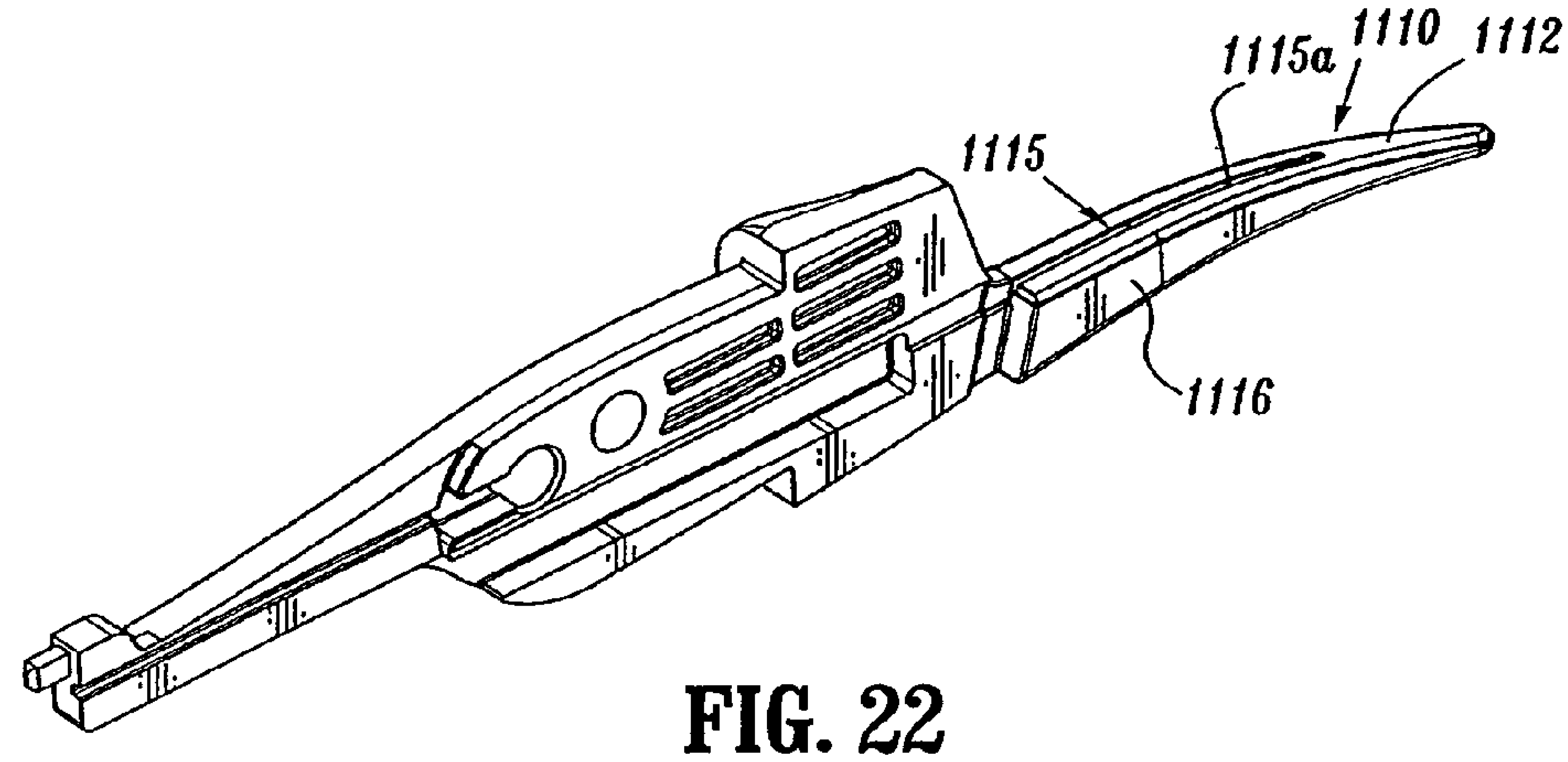

1115a
1110
1112
1115
1116

FIG. 22

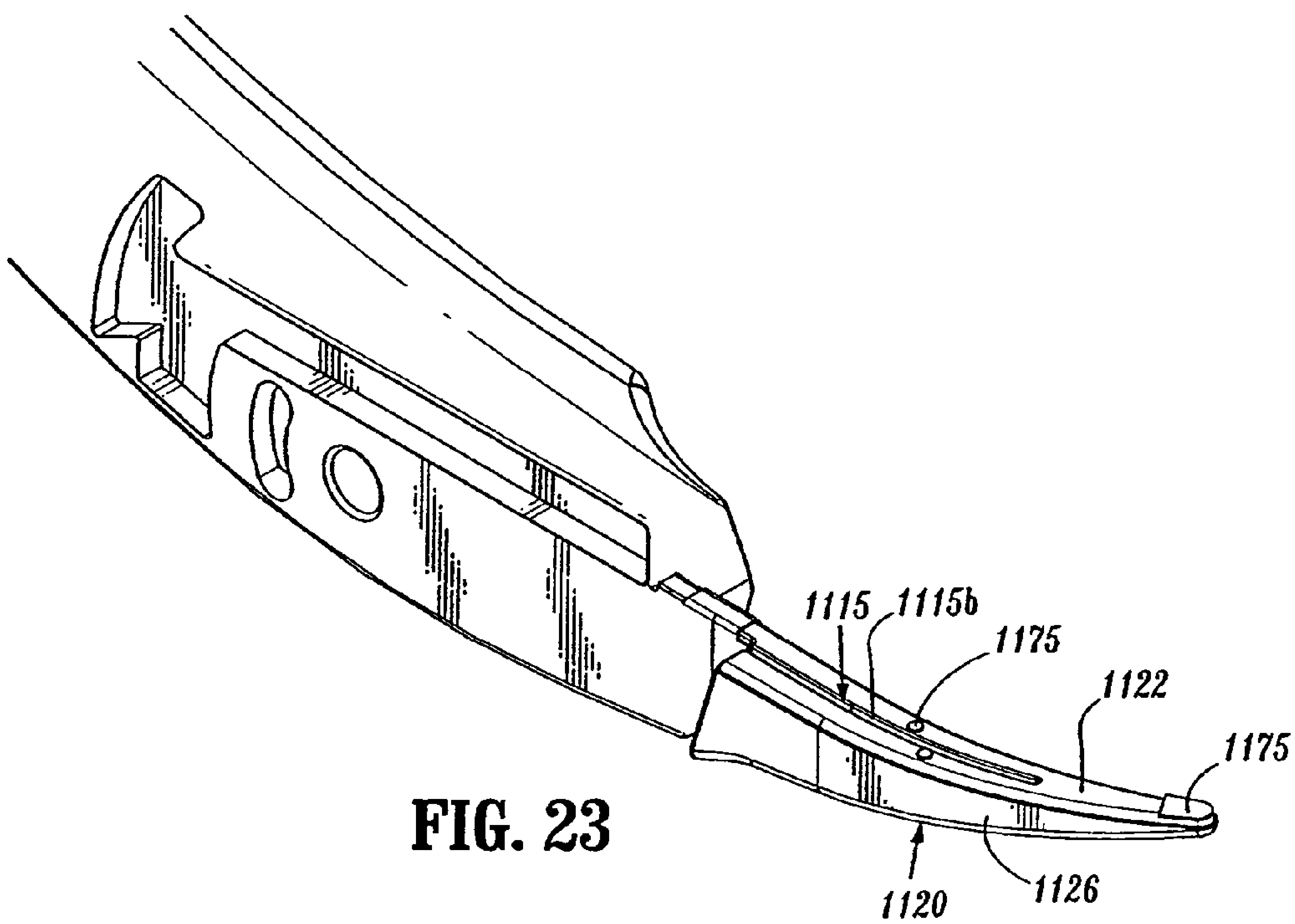

1115
1115b
1175
1122
1175
1120
1126

FIG. 23

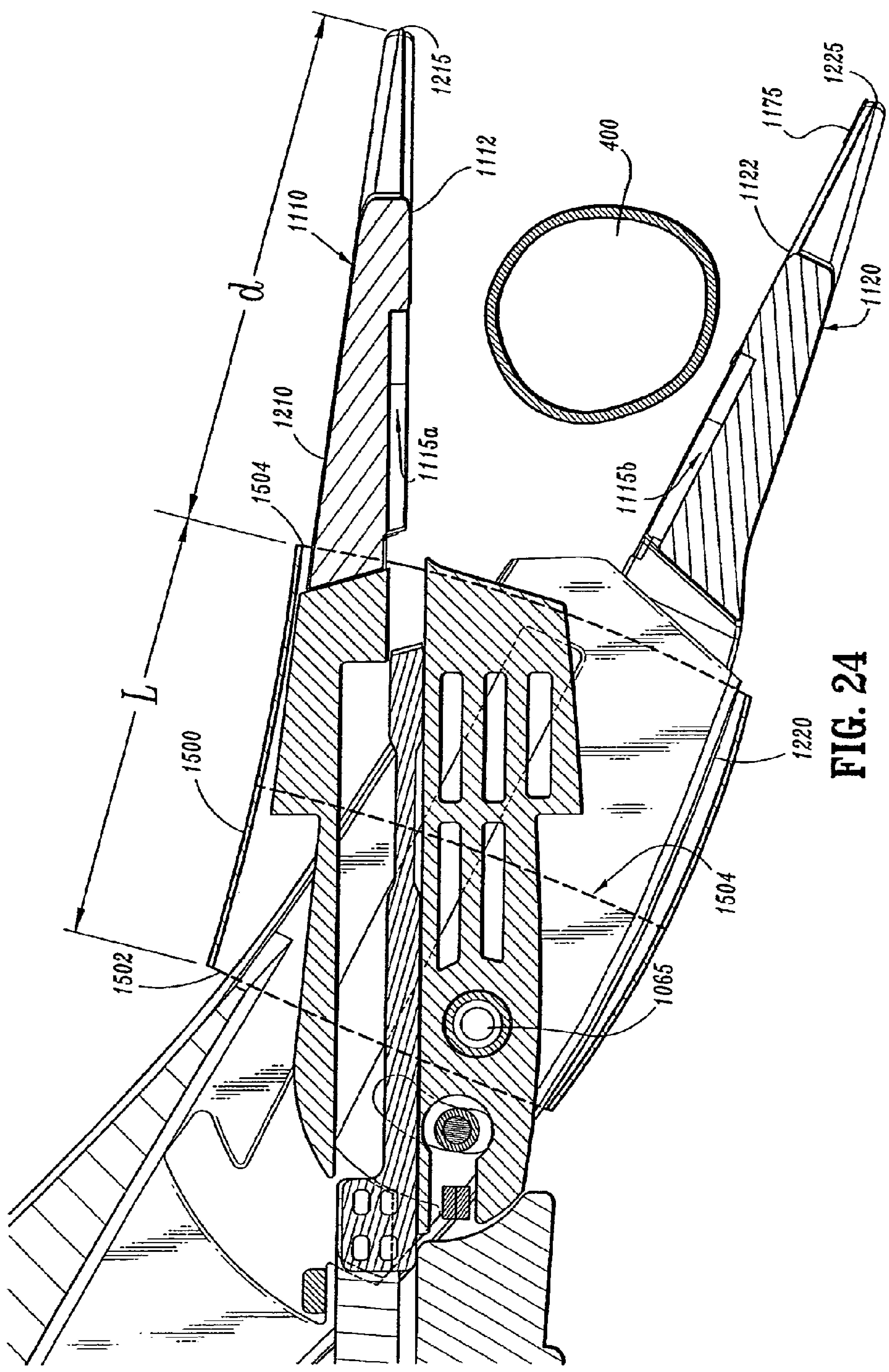

1215
1225
1175
1112
400
1110
1122
d
1120
1210
1115a
1504
1115b
L
1500
1220
1504
1502
1065

FIG. 24

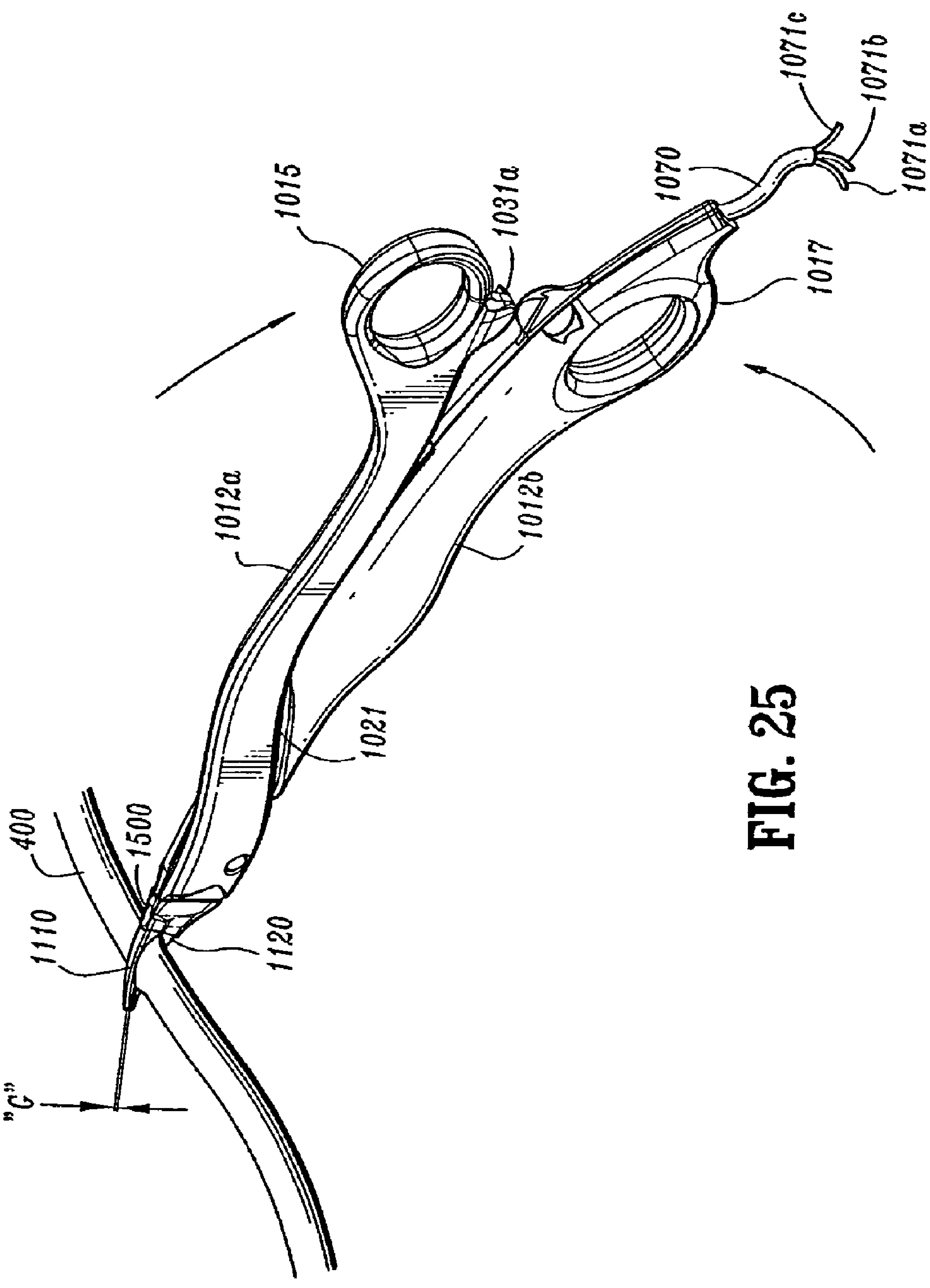

1071c
1071b
1071a
1070
1015
1031a
1017
1012a
1012b
1021
400
1500
1110
1120
"G"

FIG. 25

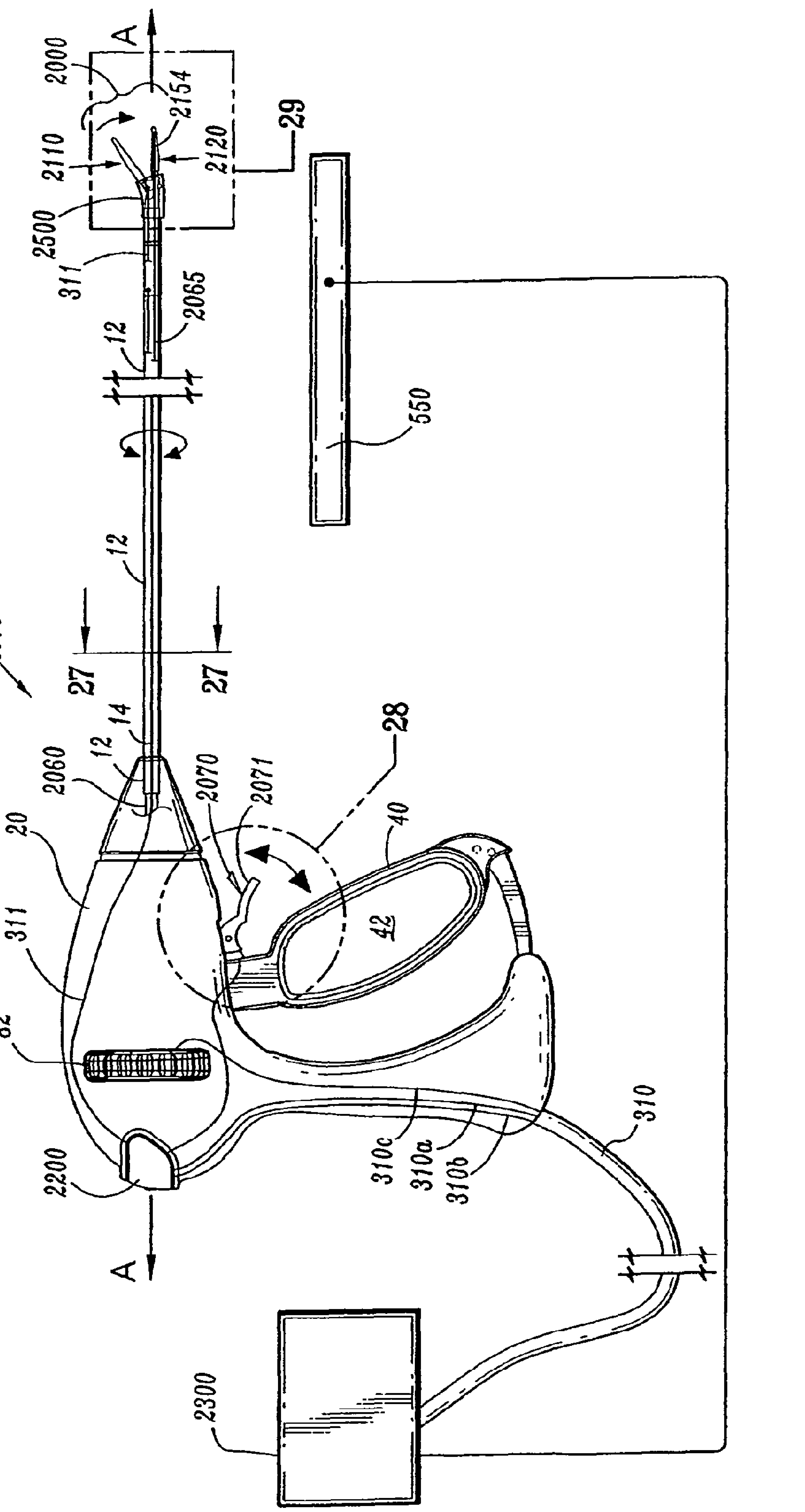

A
2000
2110
2154
2120
29
2500
311
2065
12
550
12
2010
27
27
14
12
2060
2070
2071
28
20
40
42
311
82
310
310c
310a
310b
2200
A
2300

FIG. 26

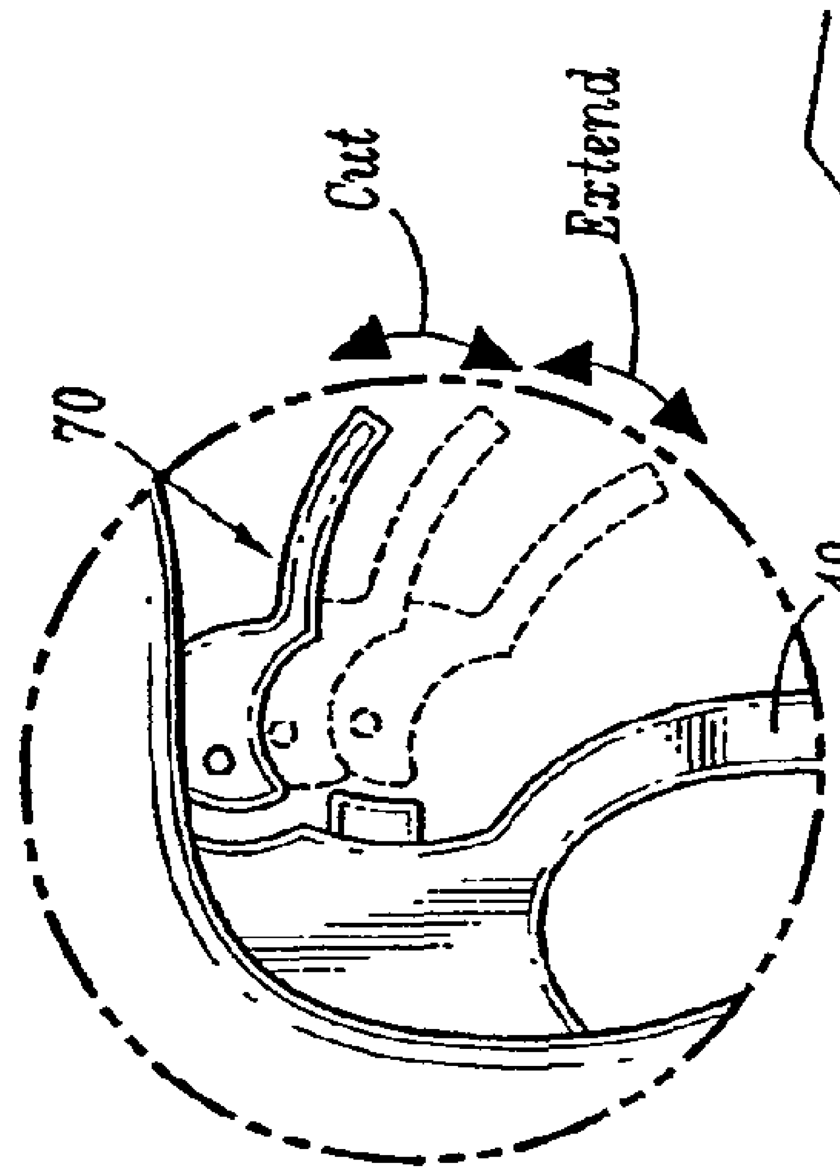


FIG. 28

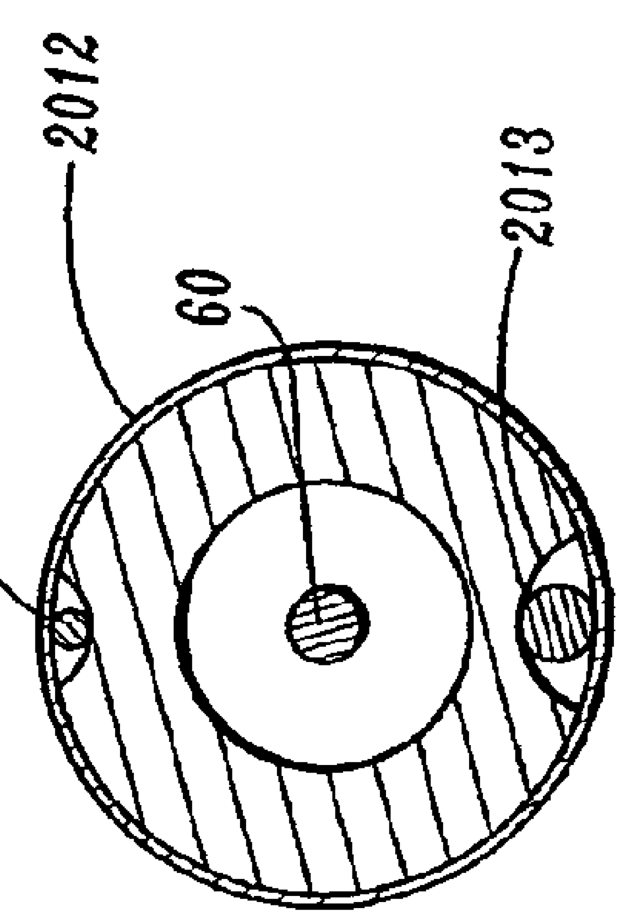


FIG. 27

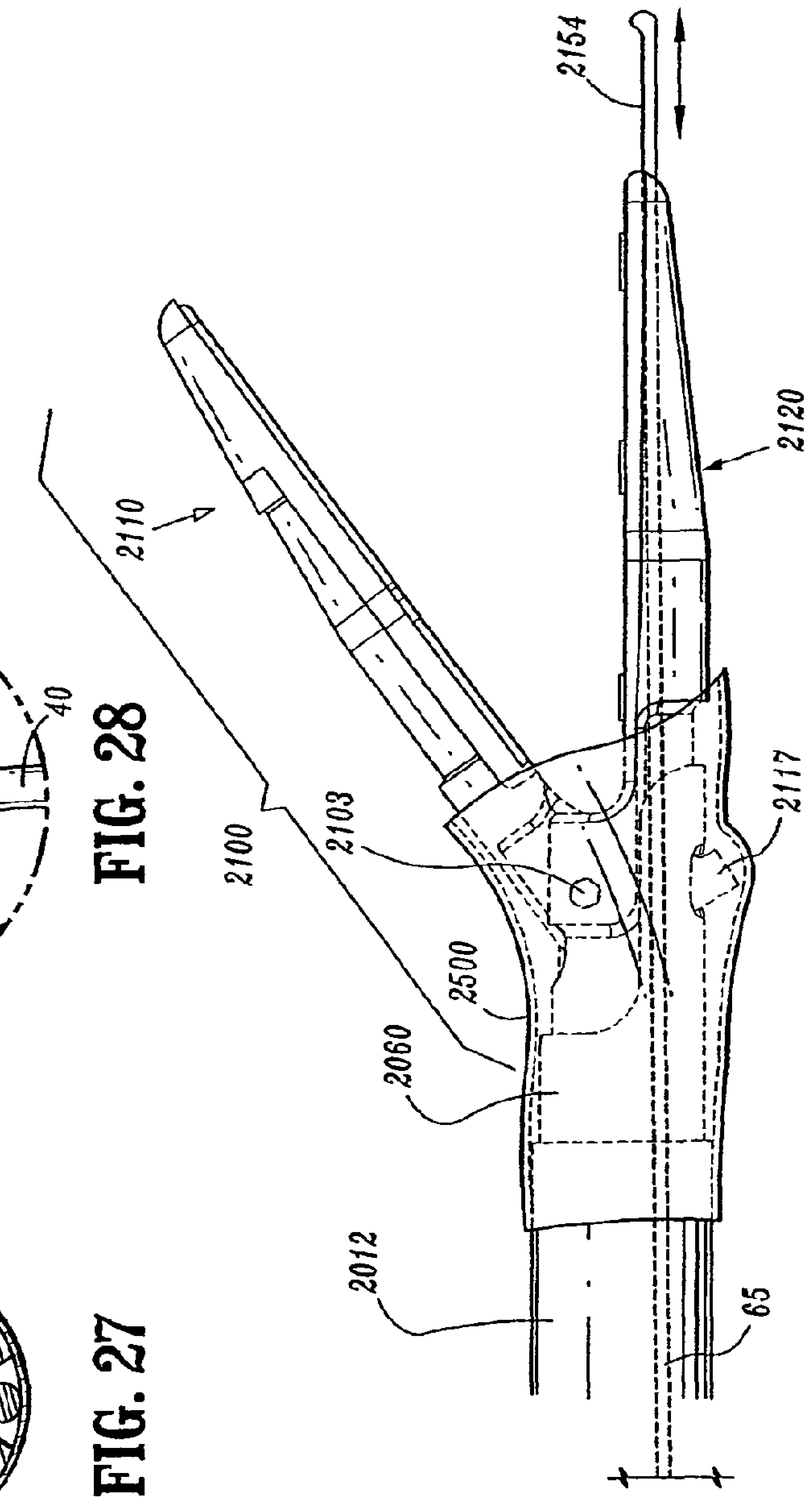


FIG. 29

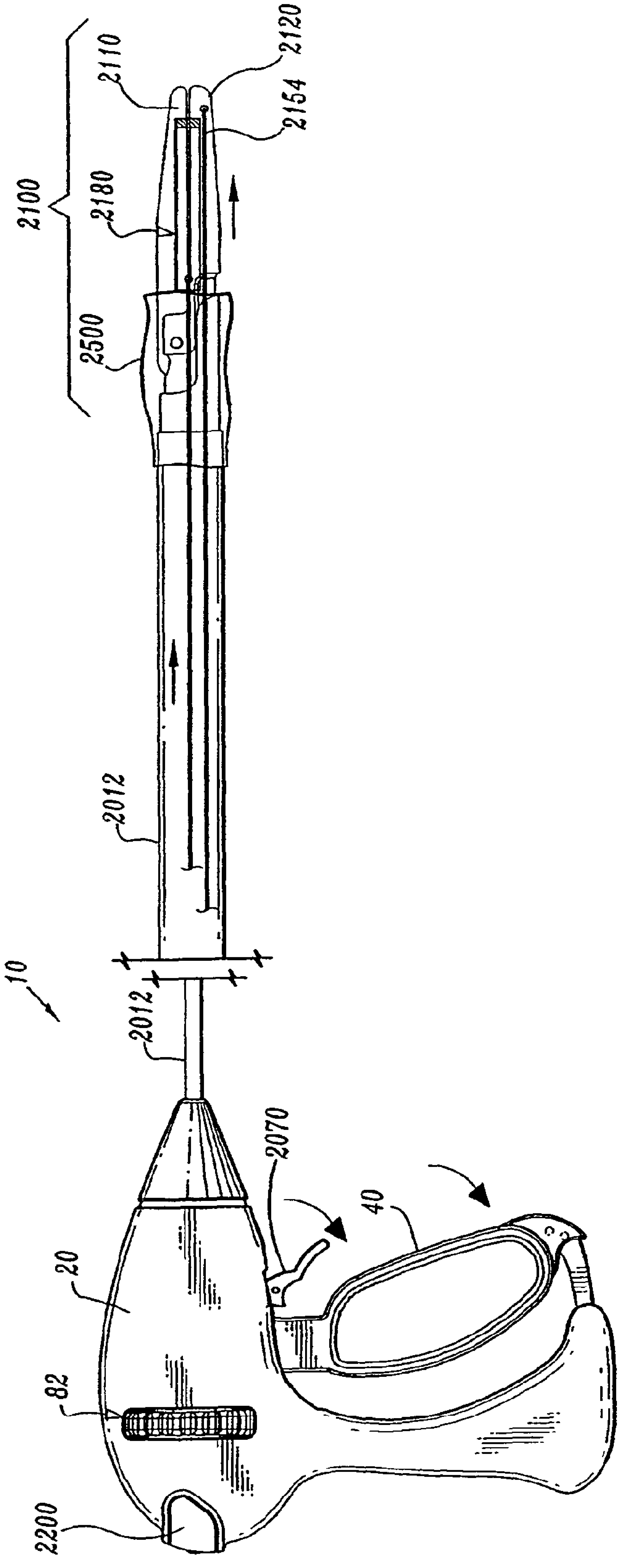


FIG. 30

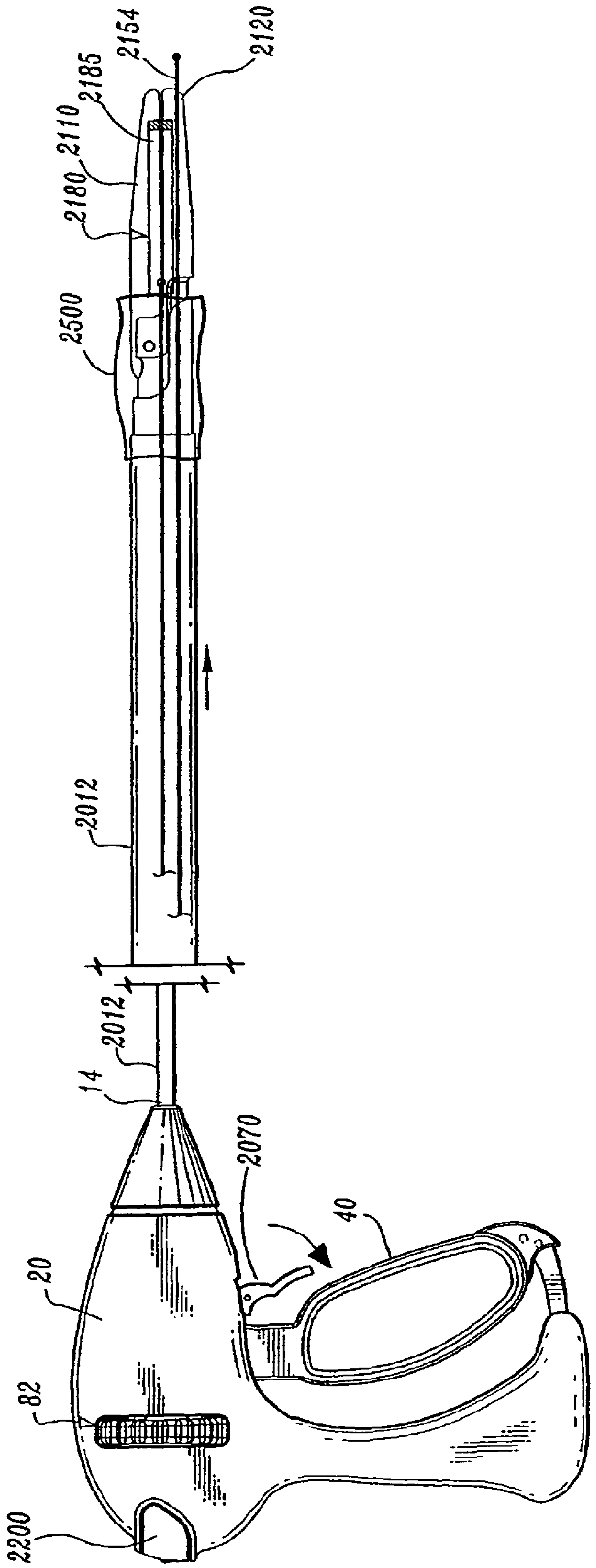


FIG. 31

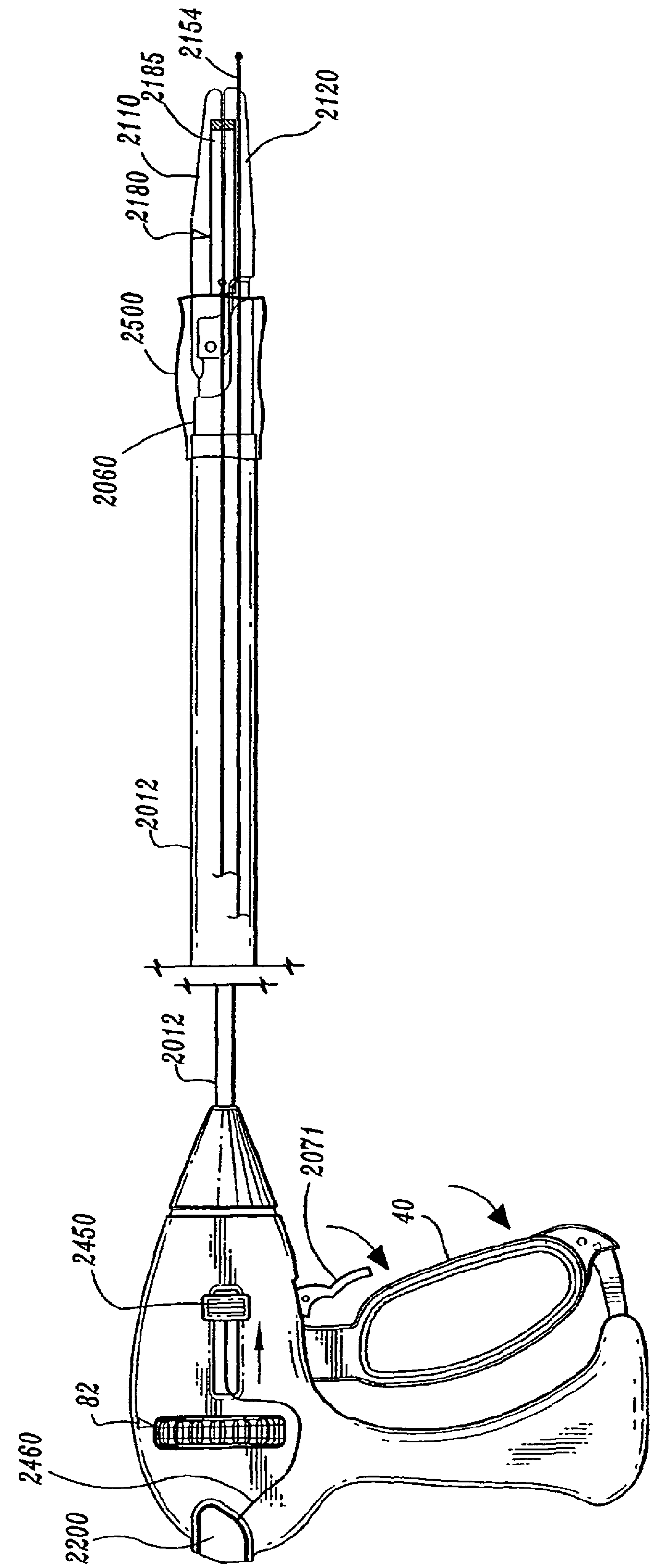

2154
2185
2110
2120
2180
2500
2060
2012
2012
2071
40
2450
82
2460
2200

FIG. 32

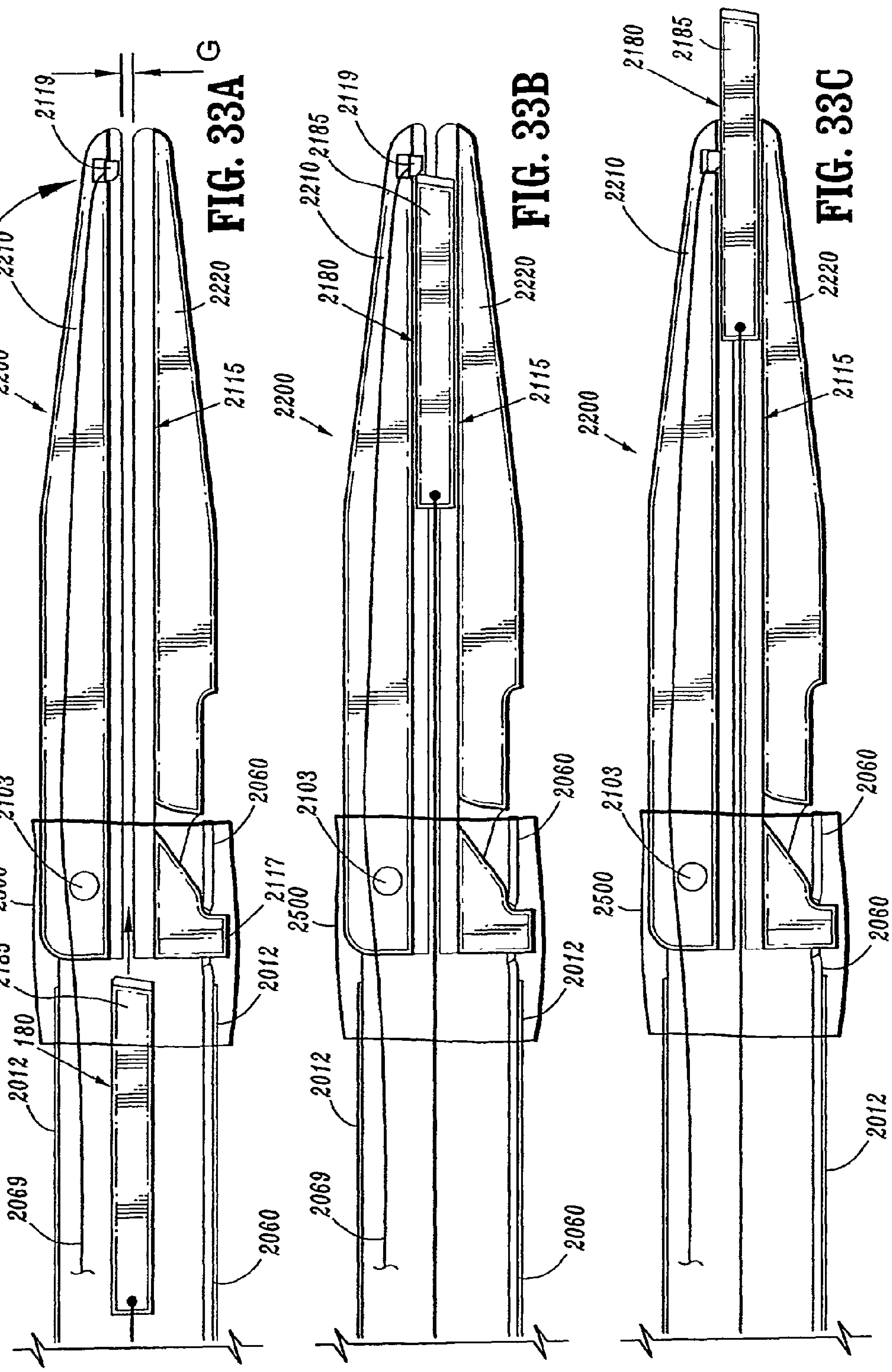


FIG. 33A

FIG. 33B

FIG. 33C

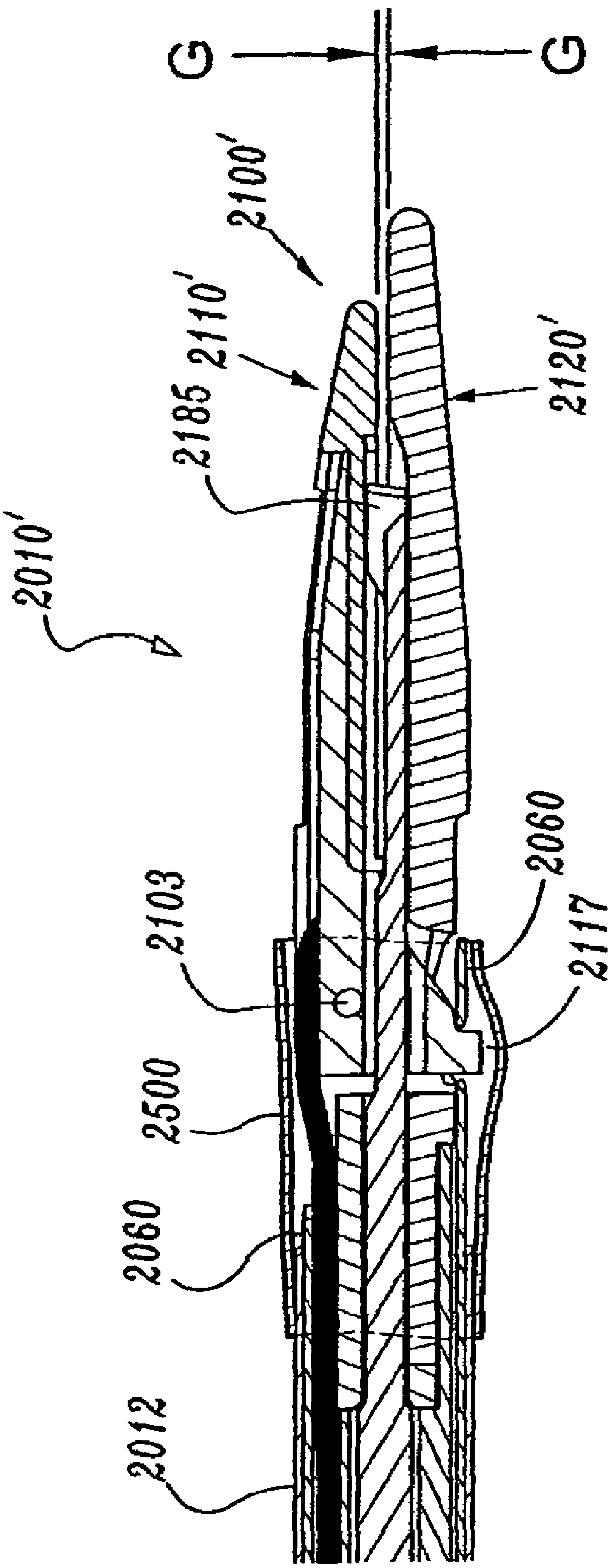


FIG. 34A

Mode	A	B	C
Off	Off	Off	Off
Bi Polar	Off	-	+
Mono Polar	-	+	+

FIG. 34C

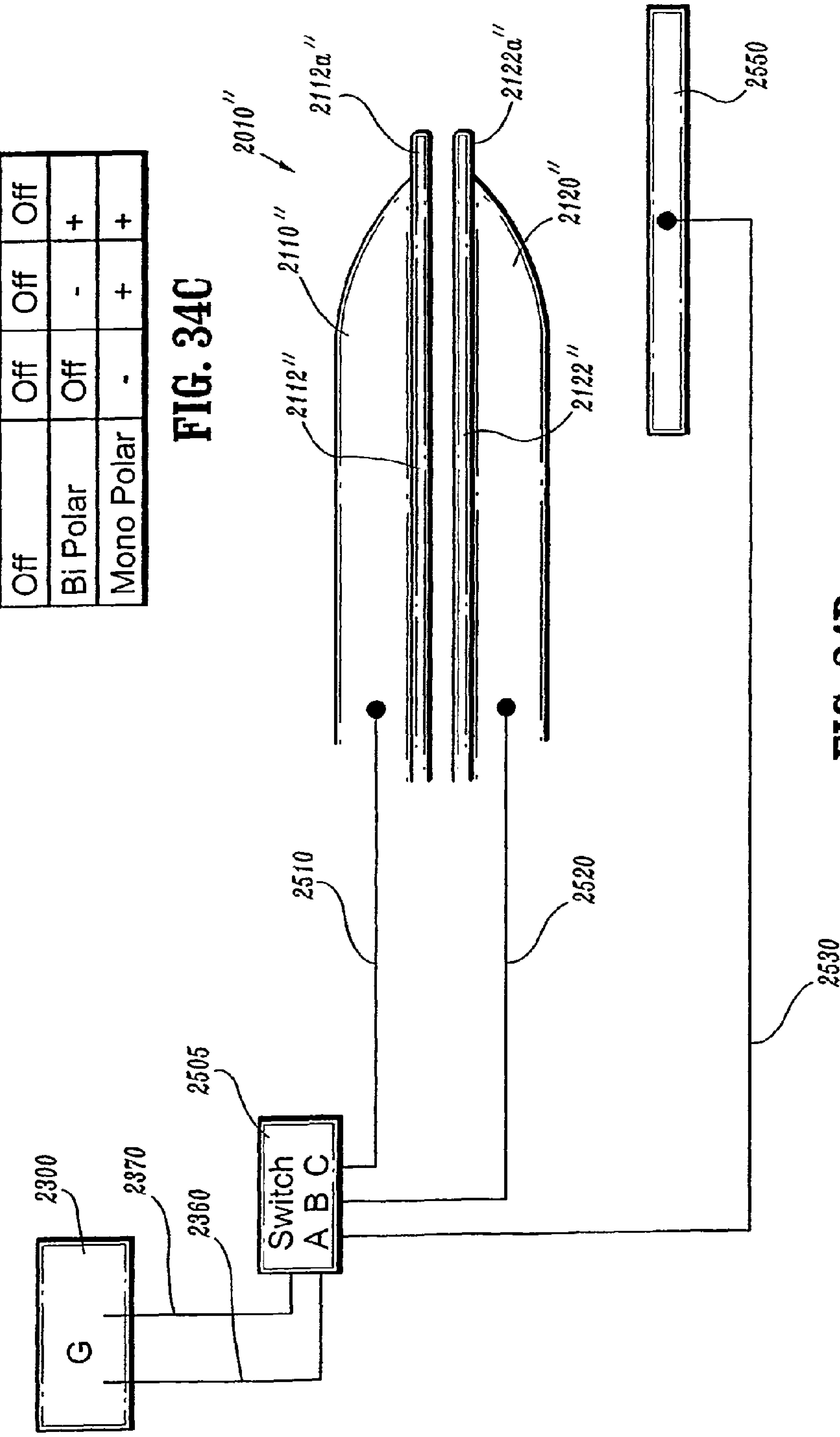


FIG. 34B

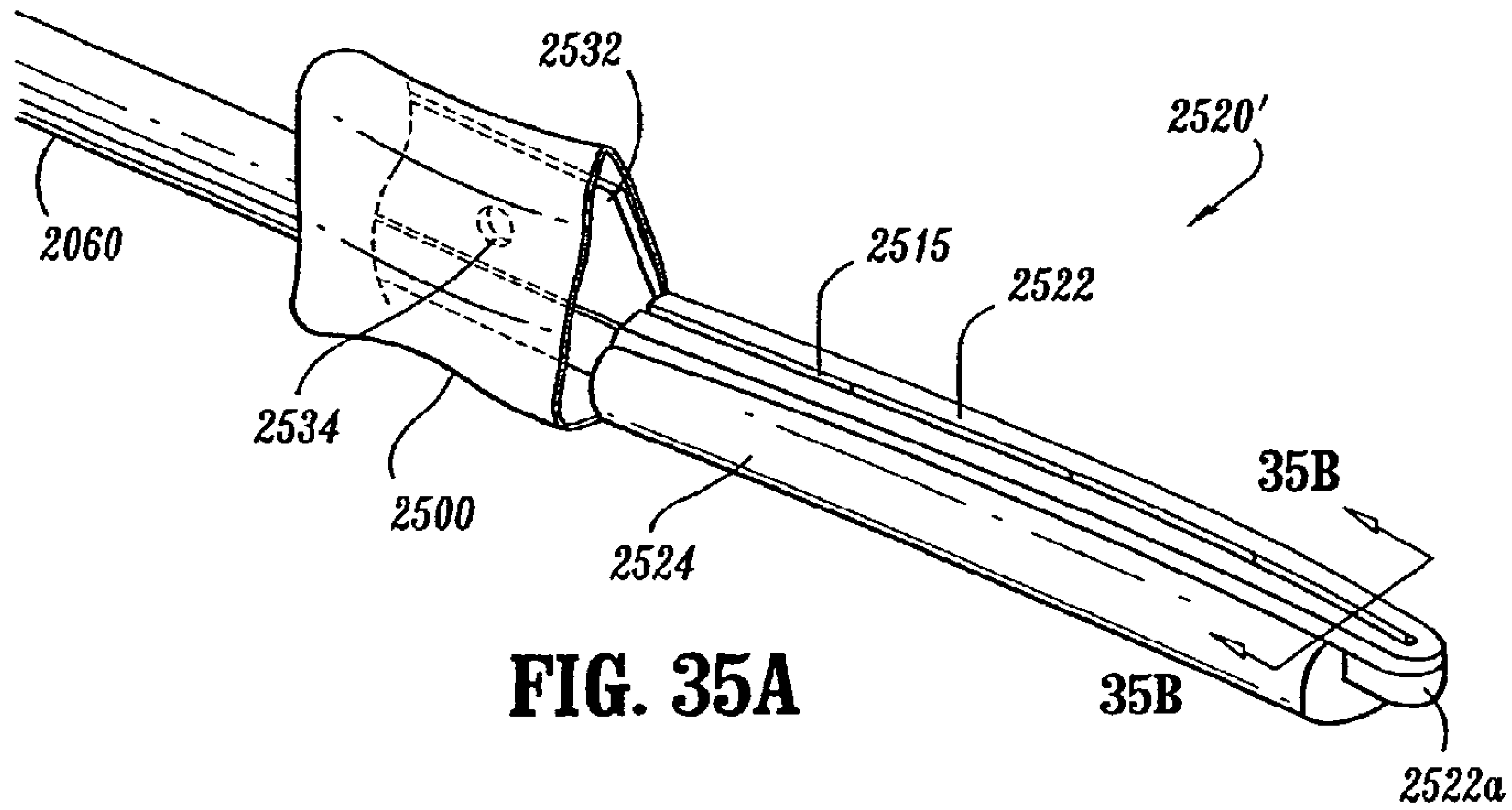


FIG. 35A

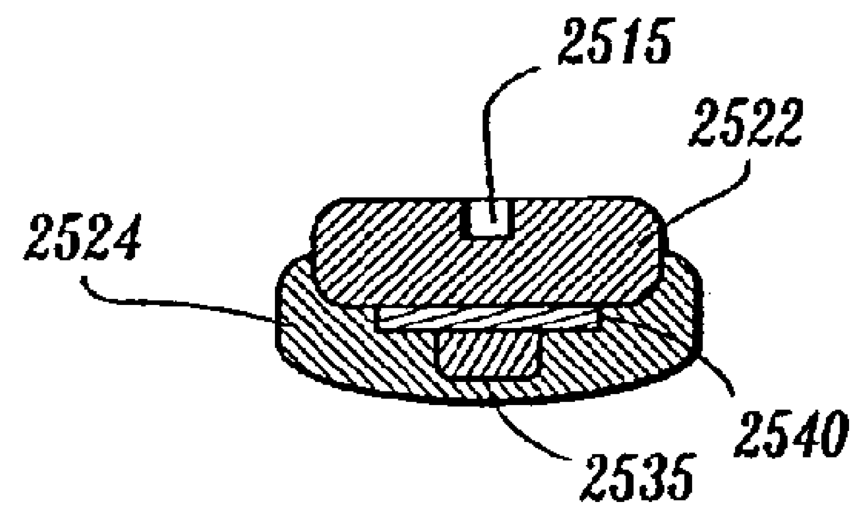


FIG. 35B

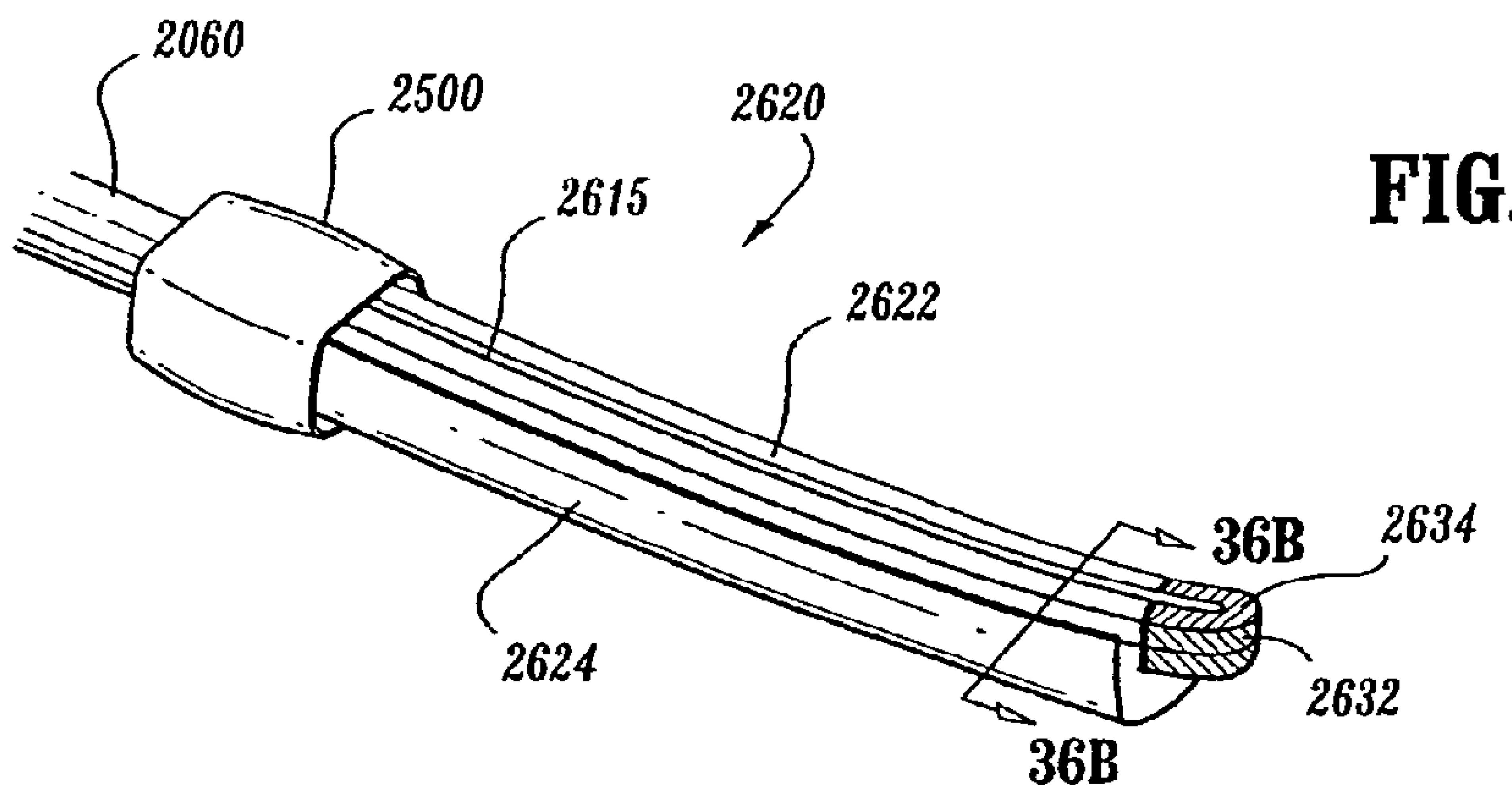


FIG. 36A

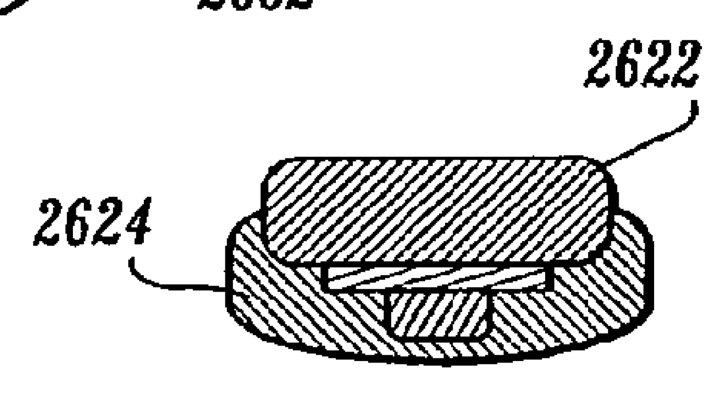


FIG. 36B

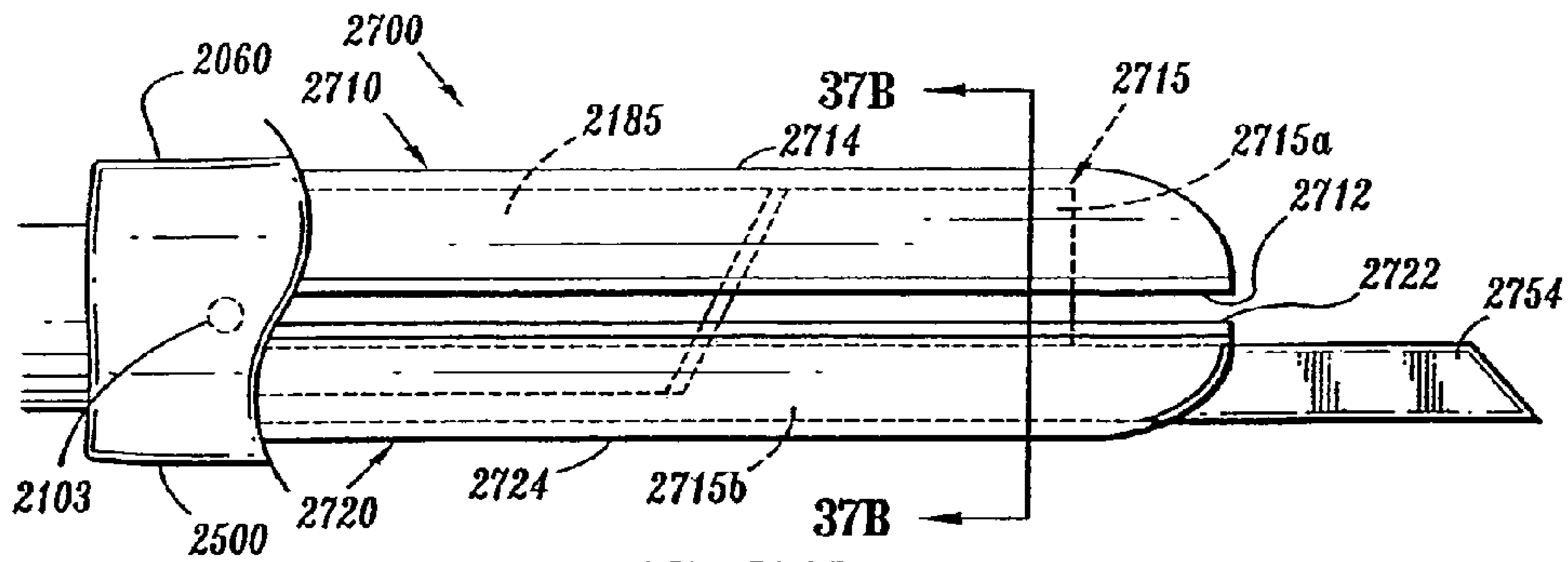


FIG. 37A

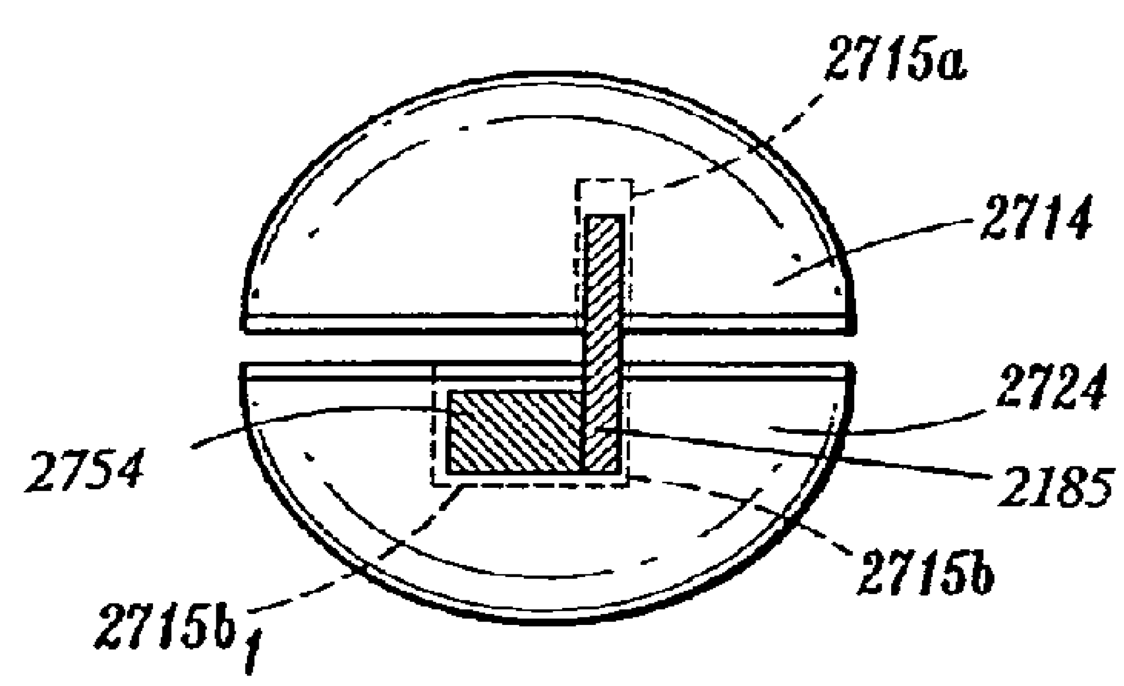


FIG. 37B

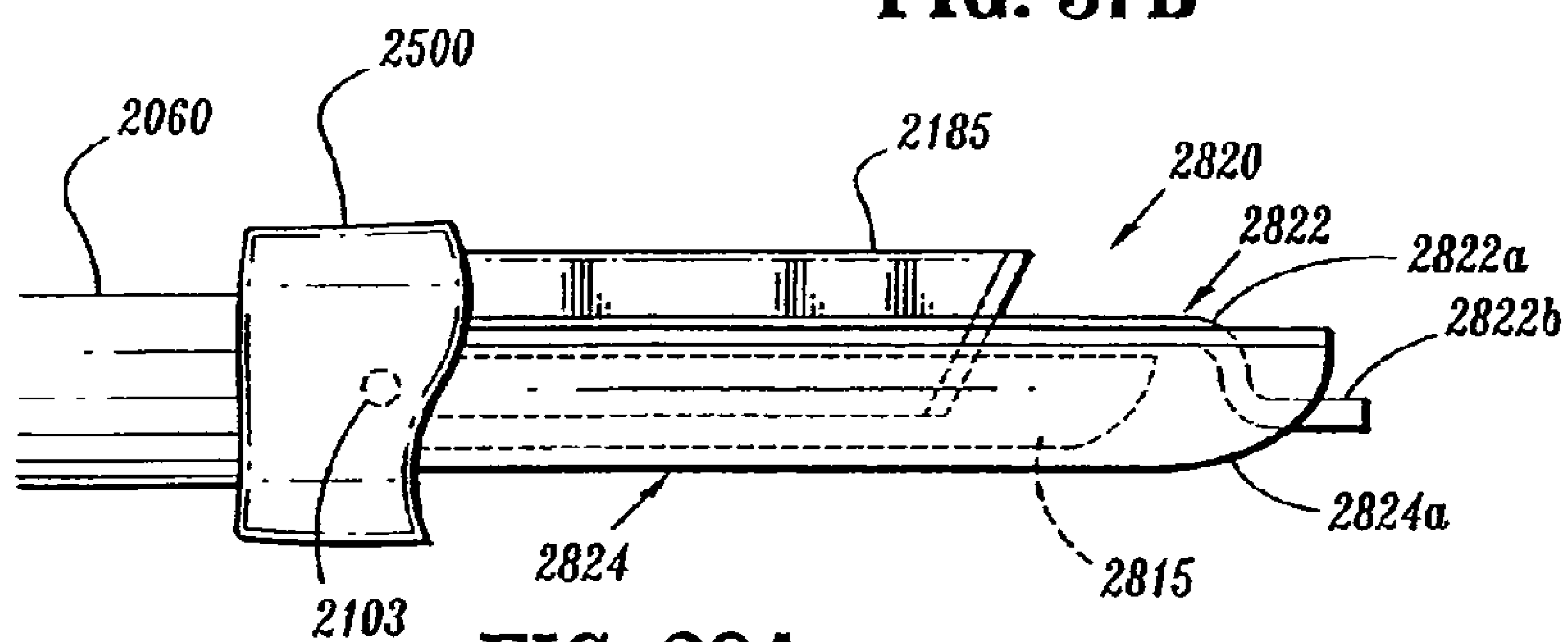


FIG. 38A

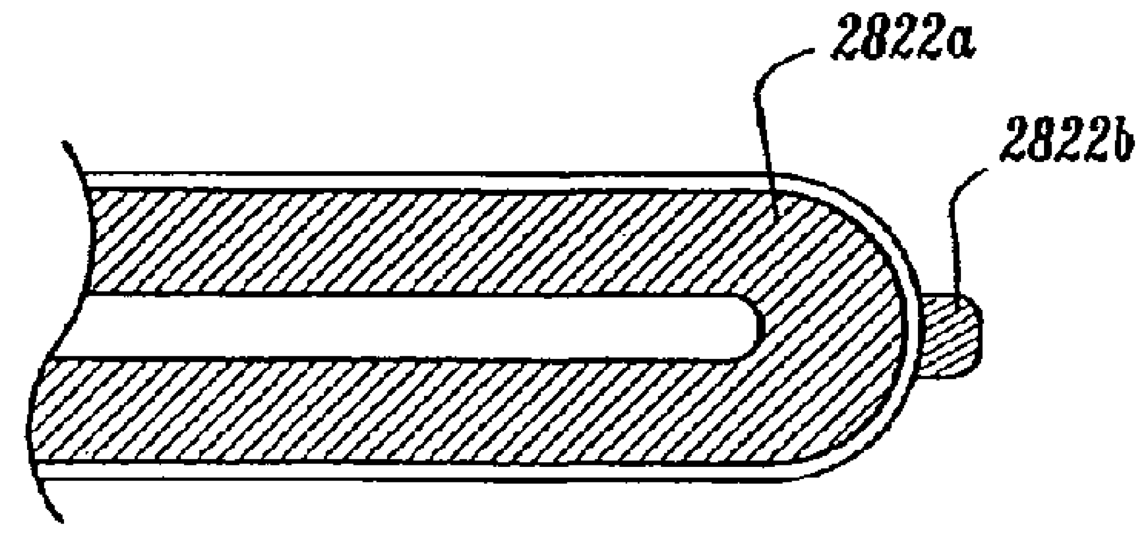


FIG. 38B

INSULATING BOOT FOR ELECTROSURGICAL FORCEPS

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of priority of U.S. Provisional Patent Application Ser. No. 60/722,213 by Scott DePierro et al., entitled "INSULATING BOOT FOR ELECTROSURGICAL FORCEPS" filed on Sep. 30, 2005, now U.S. patent application Ser. No. 11/529,798 published as U.S. Patent Application Publication No. US2007/0078458 A1, the entire contents of which is incorporated by reference herein. This application cross-references U.S. Provisional Patent Application Ser. No. 60/722,186 by Paul Guerra, entitled "METHOD FOR MANUFACTURING AN END EFFECTOR ASSEMBLY," filed on Sep. 30, 2005, now U.S. patent application Ser. No. 11/529,414 published as U.S. Patent Application Publication No. US2007/0074807 A1 and U.S. Provisional Patent Application Ser. No. 60/722,359 by Kristin Johnson et al, entitled "FLEXIBLE ENDOSCOPIC CATHETER WITH LIGASURE," [[both]] filed on Sep. 30, 2005, now U.S. patent application Ser. No. 11/540,779 published as U.S. Patent Application Publication No. US2007/0078559A1, the entire contents of both applications being incorporated by reference herein.

BACKGROUND

1. Technical Field

The present disclosure relates to an insulated electrosurgical forceps and more particularly, the present disclosure relates to an insulating boot for use with either an endoscopic or open bipolar and/or monopolar electrosurgical forceps for sealing, cutting, and/or coagulating tissue.

2. Background of Related Art

Electrosurgical forceps utilize both mechanical clamping action and electrical energy to effect hemostasis by heating the tissue and blood vessels to coagulate, cauterize and/or seal tissue. As an alternative to open forceps for use with open surgical procedures, many modern surgeons use endoscopes and endoscopic instruments for remotely accessing organs through smaller, puncture-like incisions. As a direct result thereof, patients tend to benefit from less scarring and reduced healing time.

Endoscopic instruments are inserted into the patient through a cannula, or port, which has been made with a trocar. Typical sizes for cannulas range from three millimeters to twelve millimeters. Smaller cannulas are usually preferred, which, as can be appreciated, ultimately presents a design challenge to instrument manufacturers who must find ways to make endoscopic instruments that fit through the smaller cannulas.

Many endoscopic surgical procedures require cutting or ligating blood vessels or vascular tissue. Due to the inherent spatial considerations of the surgical cavity, surgeons often have difficulty suturing vessels or performing other traditional methods of controlling bleeding, e.g., clamping and/or tying-off transected blood vessels. By utilizing an endoscopic electrosurgical forceps, a surgeon can either cauterize, coagulate/desiccate and/or simply reduce or slow bleeding simply

by controlling the intensity, frequency and duration of the electrosurgical energy applied through the jaw members to the tissue. Most small blood vessels, i.e., in the range below two millimeters in diameter, can often be closed using standard electrosurgical instruments and techniques. However, if a larger vessel is ligated, it may be necessary for the surgeon to convert the endoscopic procedure into an open-surgical procedure and thereby abandon the benefits of endoscopic surgery. Alternatively, the surgeon can seal the larger vessel or tissue.

It is thought that the process of coagulating vessels is fundamentally different than electrosurgical vessel sealing. For the purposes herein, "coagulation" is defined as a process of desiccating tissue wherein the tissue cells are ruptured and dried. "Vessel sealing" or "tissue sealing" is defined as the process of liquefying the collagen in the tissue so that it reforms into a fused mass. Coagulation of small vessels is sufficient to permanently close them, while larger vessels need to be sealed to assure permanent closure.

In order to effectively seal larger vessels (or tissue) two predominant mechanical parameters must be accurately controlled—the pressure applied to the vessel (tissue) and the gap distance between the electrodes—both of which are affected by the thickness of the sealed vessel. More particularly, accurate application of pressure is important to oppose the walls of the vessel; to reduce the tissue impedance to a low enough value that allows enough electrosurgical energy through the tissue; to overcome the forces of expansion during tissue heating; and to contribute to the end tissue thickness which is an indication of a good seal. It has been determined that a typical fused vessel wall is optimum between 0.001 and 0.006 inches (about 0.03 mm to about 0.15 mm). Below this range, the seal may shred or tear and above this range the lumens may not be properly or effectively sealed.

With respect to smaller vessels, the pressure applied to the tissue tends to become less relevant whereas the gap distance between the electrically conductive surfaces becomes more significant for effective sealing. In other words, the chances of the two electrically conductive surfaces touching during activation increases as vessels become smaller.

Many known instruments include blade members or shearing members which simply cut tissue in a mechanical and/or electromechanical manner and are relatively ineffective for vessel sealing purposes. Other instruments rely on clamping pressure alone to procure proper sealing thickness and are not designed to take into account gap tolerances and/or parallelism and flatness requirements which are parameters which, if properly controlled, can assure a consistent and effective tissue seal. For example, it is known that it is difficult to adequately control thickness of the resulting sealed tissue by controlling clamping pressure alone for either of two reasons: 1) if too much force is applied, there is a possibility that the two poles will touch and energy will not be transferred through the tissue resulting in an ineffective seal; or 2) if too low a force is applied the tissue may pre-maturely move prior to activation and sealing and/or a thicker, less reliable seal may be created.

As mentioned above, in order to properly and effectively seal larger vessels or tissue, a greater closure force between opposing jaw members is required. It is known that a large closure force between the jaws typically requires a large moment about the pivot for each jaw. This presents a design challenge because the jaw members are typically affixed with pins which are positioned to have small moment arms with respect to the pivot of each jaw member. A large force, coupled with a small moment arm, is undesirable because the large forces may shear the pins. As a result, designers must compensate for these large closure forces by either designing instruments with metal pins and/or by designing instruments which at least partially offload these closure forces to reduce the chances of mechanical failure. As can be appreciated, if metal pivot pins are employed, the metal pins must be insulated to avoid the pin acting as an alternate current path between the jaw members which may prove detrimental to effective sealing.

Increasing the closure forces between electrodes may have other undesirable effects, e.g., it may cause the opposing electrodes to come into close contact with one another which may result in a short circuit and a small closure force may cause pre-mature movement of the tissue during compression and prior to activation. As a result thereof, providing an instrument which consistently provides the appropriate closure force between opposing electrode within a preferred pressure range will enhance the chances of a successful seal. As can be appreciated, relying on a surgeon to manually provide the appropriate closure force within the appropriate range on a consistent basis would be difficult and the resultant effectiveness and quality of the seal may vary. Moreover, the overall success of creating an effective tissue seal is greatly reliant upon the user's expertise, vision, dexterity, and experience in judging the appropriate closure force to uniformly, consistently and effectively seal the vessel. In other words, the success of the seal would greatly depend upon the ultimate skill of the surgeon rather than the efficiency of the instrument.

It has been found that the pressure range for assuring a consistent and effective seal is between about 3 kg/cm^2 to about 16 kg/cm^2 and, preferably, within a working range of 7 kg/cm^2 to 13 kg/cm^2. Manufacturing an instrument which is capable of providing a closure pressure within this working range has been shown to be effective for sealing arteries, tissues and other vascular bundles.

Various force-actuating assemblies have been developed in the past for providing the appropriate closure forces to effect vessel sealing. For example, one such actuating assembly has been developed by Valleylab Inc., a division of Tyco Healthcare LP, for use with Valleylab's vessel sealing and dividing instrument commonly sold under the trademark LIGASURE ATLAS®. This assembly includes a four-bar mechanical linkage, a spring and a drive assembly which cooperate to consistently provide and maintain tissue pressures within the above working ranges. The LIGASURE ATLAS® is presently designed to fit through a 10 mm cannula and includes a bi-lateral jaw closure mechanism which is activated by a foot switch. A trigger assembly extends a knife distally to separate the tissue along the tissue seal. A rotating mechanism is associated with distal end of the handle to allow a surgeon to selectively rotate the jaw members to facilitate grasping tissue. U.S. Pat. Nos. 7,101,371 and 7,083,618 and PCT Application Ser. Nos. PCT/US01/01890 PCT/US02/01890, now WO 2002/080799, and PCT/US01/11340, now WO 2002/080795, describe in detail the operating features of the LIGASURE ATLAS® and various methods relating thereto. Copending U.S. application Ser. No. 10/970,307, now U.S. Pat. No. 7,232,440, relates to another version of an endoscopic forceps sold under the trademark LIGASURE V® by Valleylab, Inc., a division of Tyco Healthcare, LP. In addition, commonly owned, U.S. patent application Ser. No. 10/873,860, filed on Jun. 22, 2004 and entitled "Open Vessel Sealing Instrument with Cutting Mechanism and Distal Lockout", now U.S. Pat. No. 7,252,667, and incorporated by reference in its entirety herein discloses an open forceps which is configured to seal and cut tissue which can be configured to include one or more of the presently disclosed embodiments described herein. The entire contents of all of these applications are hereby incorporated by reference herein.

For example, the commonly owned U.S. patent application Ser. No. 10/970,307 filed on Oct. 21, 2004 and entitled "Bipolar Forceps Having Monopolar Extension", now U.S. Pat. No. 7,232,440, discloses an electrosurgical forceps for coagulating, sealing, and/or cutting tissue having a selectively energizable and/or extendable monopolar extension for enhanced electrosurgical effect. The instrument includes a monopolar element which may be selectively extended and selectively activated to treat tissue. Various different designs are envisioned which allow a user to selectively energize tissue in a bipolar or monopolar mode to seal or coagulate tissue depending upon a particular purpose. Some of the various designs include: (1) a selectively extendable and energizable knife design which acts as a monopolar element; (2) a bottom jaw which is electrically and selectively configured to act as a monopolar element; (3) tapered jaw members having distal ends which are selectively energized with a single electrical potential to treat tissue in a monopolar fashion; and (4) other configurations of the end effector assembly and/or bottom or second jaw member which are configured to suit a particular purpose or to achieve a desired surgical result.

However, a general issue with existing electrosurgical forceps is that the jaw members rotate about a common pivot at the distal end of a metal or otherwise conductive shaft such that there is potential for both the jaws, a portion of the shaft, and the related mechanism components to conduct electrosurgical energy (either monopolar or as part of a bipolar path) to the patient tissue. Existing electrosurgical instruments with jaws either cover the pivot elements with an inflexible shrink-tube or do not cover the pivot elements and connection areas and leave these portions exposed.

SUMMARY

It would be desirous to provide electrosurgical instruments with a flexible insulating boot that both permits pivoting and other associated movements of the jaw members and also reduces the potential for stray or miscellaneous currents affecting surrounding tissue.

The present disclosure relates to an electrosurgical forceps having a shaft with jaw members at a distal end thereof. The jaw members are movable about a pivot by actuation of a drive assembly that moves the jaw members from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members are closer to one another for grasping and treating tissue. The forceps also includes a movable handle that actuates the drive assembly to move the jaw members relative to one another.

At least one jaw member is adapted to connect to a source of electrical energy such that at least one of the jaw members is capable of conducting energy to tissue held therebetween to treat tissue. A flexible insulating boot is disposed on at least a portion of an exterior surface of at least one jaw member. The insulating boot is configured and made from a material that insulates tissue from various exposed areas of the shaft and the jaw members.

In one particularly useful embodiment, one end of the insulating boot is disposed on at least a portion of an exterior surface of the shaft and another end of the insulating boot is disposed on at least a portion of an exterior surface of at least one jaw member proximate the pivot such that movement of the jaw members is substantially unimpeded. In another embodiment according to the present disclosure, the insulating boot is made of at least one of a viscoelastic, elastomeric, and flexible material suitable for use with a sterilization process that does not substantially impair structural integrity of the boot. In particular, the sterilization process may include ethylene oxide.

The jaw members (or jaw member) may also include a series of stop members disposed thereon for regulating distance between the jaw members such that a gap is created between the jaw members during the sealing process.

The forceps may also include a knife that is selectively deployable to cut tissue disposed between the jaw members.

In one embodiment, the jaw members are configured to treat tissue in a monopolar fashion, while in another embodiment, the jaw members are configured to treat tissue in a bipolar fashion.

In one embodiment of the present disclosure, the present disclosure is directed to an electrosurgical forceps for sealing tissue having a pair of first and second shaft members each with a jaw member disposed at a distal end thereof. The jaw members are movable about a pivot from a first position in spaced relation relative to one another to at least one subsequent position wherein the jaw members cooperate to grasp tissue therebetween. At least one of the jaw members includes an electrically conductive sealing plate adapted to communicate electrosurgical energy to tissue held therebetween and a flexible insulating boot disposed on at least a portion of an exterior surface of at least one jaw member.

In yet another useful embodiment, the present disclosure relates to an electrosurgical forceps having a housing with a shaft affixed thereto. The shaft includes first and second jaw members attached to a distal end thereof. The forceps includes an actuator for moving jaw members relative to one another from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members cooperate to grasp tissue therebetween. Each jaw member is adapted to connect to a source of electrosurgical energy such that the jaw members are selectively capable of conducting energy to tissue held therebetween to treat tissue.

The forceps also includes a knife that is selectively moveable within a knife channel defined within at least one of the jaw members to cut tissue disposed therebetween. A monopolar element is housed within at least one jaw member and is selectively movable from a first proximal position within the jaw members to a second distal position within the jaw member(s). The monopolar element may be connected to the source of electrosurgical energy and may be selectively activatable independently of the jaw members. The forceps includes a flexible insulating boot disposed on at least a portion of at least one jaw member.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of the subject instrument are described herein with reference to the drawings wherein:

FIG. **1** is a left, perspective view of one version of the present disclosure that includes an endoscopic bipolar forceps showing a housing, a shaft and an end effector assembly having an insulating boot according to the present disclosure;

FIG. **2** is an enlarged, left perspective view of the end effector assembly with the jaw members shown in open configuration having the insulating boot according to the present disclosure;

FIG. **3** is a full perspective view of the end effector assembly of FIG. **1** having the insulating boot according to the present disclosure;

FIG. **4** is an exploded top, perspective view of the housing and internal working components thereof of the endoscopic bipolar forceps of FIG. **1** with parts separated;

FIG. **5** is an enlarged, top, perspective view of the end effector assembly having the insulating boot of the present disclosure with parts separated;

FIG. **6** is an enlarged, perspective view of the knife assembly with parts separated;

FIG. **7** is an enlarged view of the indicated area of detail of FIG. **6** showing a knife blade of the knife assembly;

FIG. **8** is a greatly-enlarged, perspective view of a distal end of the knife assembly;

FIG. **9** is a greatly-enlarged, perspective view of a knife drive of the knife assembly;

FIG. **10** is a cross-section of the housing with the end effector shown in open configuration having the insulating boot of the present disclosure and showing the internal, electrical routing of an electrosurgical cable and electrical leads;

FIG. **11** is a greatly-enlarged view of the indicated area of detail of FIG. **10**;

FIG. **12** is a side, cross section of the shaft and end effector assembly with the end effector assembly having the insulating boot of the present disclosure;

FIG. **13** is a side, cross section of the housing showing the moving components of the drive assembly during actuation and the end effector assembly;

FIG. **14** is a greatly-enlarged view of the indicated area of detail in FIG. **13**;

FIG. **15** is a greatly-enlarged view of the indicated area of detail in FIG. **13**;

FIG. **16** is an enlarged, side view of the end effector assembly shown in an open configuration and having the insulating boot of the present disclosure;

FIG. **17** is a side view of the end effector assembly shown in a closed configuration and having the insulating boot of the present disclosure with the jaw members in the closed position;

FIG. **18** is an enlarged, rear, perspective view of the end effectors shown grasping tissue;

FIG. **19** is a side, cross section of a tissue seal after separation by the knife assembly;

FIG. **20** is a left, front perspective view of an open forceps with a cutting mechanism having an insulating boot according to the present disclosure;

FIG. **21** is a right, rear perspective view of the forceps of FIG. **20**;

FIG. **22** is an enlarged, left perspective view of one of the jaw members of the forceps of FIG. **20**;

FIG. **23** is an enlarged, perspective view of the other jaw member of the forceps of FIG. **20**;

FIG. **24** is a side cross sectional view showing the forceps of FIG. **20** in open configuration for grasping tissue;

FIG. **25** is a rear, perspective view of the forceps of FIG. **20** shown grasping tissue with a ratchet mechanism shown prior to engagement;

FIG. **26** is a side view of an endoscopic forceps showing a housing, a shaft, an end effector assembly having an insulating boot according to the present disclosure and a trigger assembly in a first position;

FIG. **27** is an enlarged, cross section taken along line **27-27** of FIG. **26**;

FIG. **28** is an enlarged, side view of the trigger assembly of FIG. **26**;

FIG. **29** is an enlarged, side view of the embodiment of an end effector assembly of FIG. **26** having the insulating boot according to the present disclosure and showing relative extension of a monopolar element from a distal end of the end effector assembly;

FIG. **30** is a side view of the trigger assembly in a second position for advancing a knife within the end effector assembly and having the insulating boot according to the present disclosure;

FIG. **31** is a side view of the trigger assembly in a third position for extending a monopolar element from a distal end of the end effector assembly;

FIG. **32** is a side view of an alternate embodiment of the present invention showing a second actuator advancing the monopolar element relative to the distal end of the end effector;

FIG. **33**A is an enlarged, side schematic view of one embodiment of an end effector assembly having the insulating boot according to the present disclosure and showing relative movement of a first jaw member relative to a second jaw member prior to advancement of the knife through the end effector assembly;

FIG. **33**B is an enlarged, side schematic view of the end effector assembly showing relative movement of the knife through the end effector assembly to divide tissue;

FIG. **33**C is an enlarged, side schematic view of the end effector assembly showing relative movement of the knife extending from the distal end of the end effector assembly;

FIG. **34**A is an enlarged, side schematic view of another embodiment of an end effector assembly having the insulating boot according to the present disclosure;

FIG. **34**B is schematic view of another embodiment of an end effector assembly capable of being configured with the insulating boot according to the present disclosure and showing a series of electrical connections to a control switch and a generator to enable both bipolar activation and monopolar activation;

FIG. **34**C is a table showing the various modes of operation of the forceps utilizing the end effector configuration of FIG. **34**B;

FIGS. **35**A and **35**B are enlarged views of an alternate embodiment of the second jaw member configured with an insulating boot according to the present disclosure;

FIGS. **36**A and **36**B are enlarged views of another alternate embodiment of the second jaw member configured with an insulating boot according to the present disclosure;

FIGS. **37**A and **37**B are enlarged views of another alternate embodiment of the end effector assembly configured with an insulating boot according to the present disclosure showing the monopolar element in an extended configuration; and

FIGS. **38**A and **38**B are enlarged views of yet another alternate embodiment of the second jaw member configured with an insulating boot according to the present disclosure.

DETAILED DESCRIPTION

Referring initially to FIGS. **1-3**, one particularly useful endoscopic forceps **10** is shown for use with various surgical procedures and generally includes a housing **20**, a handle assembly **30**, a rotating assembly **80**, a trigger assembly **70**, a knife assembly and an end effector assembly **100** that mutually cooperate to grasp, seal and divide tubular vessels and vascular tissue **420** (see FIGS. **18-19**). For the purposes herein, forceps **10** will be described generally. However, the various particular aspects of this particular forceps are detailed in commonly owned U.S. patent application Ser. No. 10/460,926, filed on Jun. 13, 2003, and entitled "VESSEL SEALER AND DIVIDER FOR USE WITH SMALL TROCARS AND CANNULAS," now U.S. Pat. No. 7,156,846, and previously mentioned U.S. patent application Ser. No. 10/970,307, now U.S. Pat. No. 7,232,440, the entire contents of each of which are incorporated by reference herein. Forceps **10** includes a shaft **12** that has a distal end **16** dimensioned to mechanically engage the end effector assembly **100** and a proximal end **14** that mechanically engages the housing **20**. As will be discussed in more detail below, the end effector assembly **100** includes a flexible insulating boot **500** configured to cover at least a portion of the exterior surfaces of the end effector assembly **100**.

Forceps **10** also includes an electrosurgical cable **310** that connects the forceps **10** to a source of electrosurgical energy, e.g., a generator (not shown). The generator includes various safety and performance features including isolated output, independent activation of accessories, and Instant Response™ technology (a proprietary technology of Valleylab, Inc., a division of Tyco Healthcare, LP) that provides an advanced feedback system to sense changes in tissue many times per second and adjust voltage and current to maintain appropriate power. Cable **310** is internally divided into cable lead **310**a, **310**b and **310**c that each transmit electrosurgical energy through their respective feed paths through the forceps **10** to the end effector assembly **100**. (See FIG. **11**).

Handle assembly **30** includes a fixed handle **50** and a movable handle **40**. Fixed handle **50** is integrally associated with housing **20** and handle **40** is movable relative to fixed handle **50**. Rotating assembly **80** is integrally associated with the housing **20** and is rotatable approximately 180 degrees in either direction about a longitudinal axis "A" (See FIG. **1**). Details of the rotating assembly **80** are described in more detail below.

As best seen in FIGS. **1** and **4**, housing **20** is formed from two (2) housing halves **20**a and **20**b that each include a plurality of interfaces **27**a-**27**f that are dimensioned to mechanically align and engage one another to form housing **20** and enclose the internal working components of forceps **10**. Fixed handle **50** that, as mentioned above, is integrally associated with housing **20**, takes shape upon the assembly of the housing halves **20**a and **20**b. Movable handle **40** and trigger assembly **70** are of unitary construction and are operatively connected to the housing **20** and the fixed handle **50** during the assembly process. Rotating assembly **80** includes two halves that, when assembled, form a knurled wheel **82** that, in turn, houses a drive assembly **150** and a knife assembly **140**.

As mentioned above, end effector assembly **100** is attached at the distal end **14** of shaft **12** and includes a pair of opposing jaw members **110** and **120**. Movable handle **40** of handle assembly **30** is ultimately connected to the drive assembly **150** that, together, mechanically cooperate to impart movement of the jaw members **110** and **120** from an open position wherein the jaw members **110** and **120** are disposed in spaced relation relative to one another, to a clamping or closed position wherein the jaw members **110** and **120** cooperate to grasp tissue therebetween. All of these components and features are best explained in detail in the above-identified commonly owned U.S. application Ser. No. 10/460,926, now U.S. Pat. No. 7,156,846.

Turning now to the more detailed features of the present disclosure as described with respect to FIGS. **1-4**, movable handle **40** includes a finger loop **41** that has an aperture **42** defined therethrough that enables a user to grasp and move the handle **40** relative to the fixed handle **50**. As best seen in FIG. **4**, movable handle **40** is selectively moveable about a pair of pivot pins **29**a and **29**b from a first position relative to fixed handle **50** to a second position in closer proximity to the fixed handle **50** that, as explained below, imparts movement of the jaw members **110** and **120** relative to one another. The movable handle include a clevis **45** that forms a pair of upper flanges **45**a and **45**b each having an aperture **49**a and **49**b, respectively, at an upper end thereof for receiving the pivot pins **29**a and **29**b therethrough and mounting the upper end of the handle **40** to the housing **20**. In turn, each pin **29**a and **29**b mounts to a respective housing half **20**a and **20**b.

Each upper flange **45**a and **45**b also includes a force-actuating flange or drive flange **47**a and **47**b, respectively, each of which is aligned along longitudinal axis "A" and which abut the drive assembly **150** such that pivotal movement of the handle **40** forces actuating flange against the drive assembly **150** that, in turn, closes the jaw members **110** and **120**.

Movable handle **40** is designed to provide a distinct mechanical advantage over conventional handle assemblies due to the unique position of the pivot pins **29**a and **29**b (i.e., pivot point) relative to the longitudinal axis "A" of the shaft **12** and the disposition of the driving flange **47** along longitudinal axis "A". In other words, by positioning the pivot pins **29**a and **29**b above the driving flange **47**, the user gains lever-like mechanical advantage to actuate the jaw members **110** and **120** enabling the user to close the jaw members **110** and **120** with lesser force while still generating the required forces necessary to effect a proper and effective tissue seal.

In addition, the unilateral closure design of the end effector assembly **100** will also increase mechanical advantage. More particularly, as best shown in FIGS. **3** and **5**, the unilateral end effector assembly **100** includes one stationary or fixed jaw member **120** that is mounted in fixed relation to the shaft **12** and a pivoting jaw member **110** mounted about a pivot pin **103** attached to the stationary jaw member **120**. A reciprocating sleeve **60** is slidingly disposed within the shaft **12** and is remotely operable by the drive assembly **150** to move jaw member **110** relative to jaw member **120**. The pivoting jaw member **110** includes a detent or protrusion **117** that extends from jaw member **110** through an aperture **62** disposed within the reciprocating sleeve **60** (FIG. **3**). The pivoting jaw member **110** is actuated by sliding the sleeve **60** axially within the shaft **12** such that a distal end **63** of the aperture **62** abuts against the detent **117** on the pivoting jaw member **110** (See FIG. **3**). Pulling the sleeve **60** proximally closes the jaw members **110** and **120** about tissue grasped therebetween and pushing the sleeve **60** distally opens the jaw members **110** and **120** for grasping purposes.

As best illustrated in FIGS. **3-9** and **18**, a knife channel **115**a and **115**b runs through the center of the jaw members **110** and **120**, respectively, such that a blade **185** from the knife assembly **140** can cut the tissue **420** grasped between the jaw members **110** and **120** when the jaw members **110** and **120** are in a closed position. More particularly, the blade **185** can only be advanced through the tissue **420** when the jaw members **110** and **120** are closed, thus preventing accidental or premature activation of the blade **185** through the tissue **420**. The unilateral end effector assembly **100** is structured such that electrical energy can be routed through the sleeve **60** at the protrusion **117** contact point with the sleeve **60** or using a "brush" or lever (not shown) to contact the back of the moving jaw member **110** when the jaw member **110** closes. In this instance, the electrical energy would be routed through the protrusion **117** to the stationary jaw member **120**.

As best illustrated in FIG. **2**, jaw member **110** also includes a jaw housing **116** that has an insulative substrate or insulator **114** and an electrically conductive surface **112**. Details relating to the specific structure of the jaw members **110** and **120** are disclosed in previously mentioned commonly owned U.S. patent application Ser. No. 10/460,926.

As best shown in FIGS. **3** and **16**, jaw member **110** includes a pivot flange **118** that, in turn, includes protrusion **117** that extends from pivot flange **118** and has an arcuately-shaped inner surface **111** dimensioned to matingly engage the aperture **62** of sleeve **60** upon retraction thereof. Pivot flange **118** also includes a pin slot **119** that is dimensioned to engage pivot pin **103** to allow jaw member **110** to rotate relative to jaw member **120** upon retraction of the reciprocating sleeve **60**. As explained in more detail below, pivot pin **103** mounts to the stationary jaw member **120** through a pair of apertures **101**a and **101**b disposed within a proximal portion of the jaw member **120**. The pivot pin **103** serves as a common joint between the jaw members **110** and **120**.

Jaw member **120** is designed to be fixed to the end of a rotating tube **160** that is part of the rotating assembly **80** such that rotation of the tube **160** around axis "B" of FIG. **1** will impart rotation to the end effector assembly **100** (See FIGS. **1**, **2** and **15**). Details relating to the rotation of the jaw members **110** and **120** are described in the previously mentioned commonly owned U.S. patent application Ser. No. 10/460,926, now U.S. Pat. No. 7,156,846, that is incorporated by reference herein in its entirety.

Fixed jaw member **120** is connected to a second electrical potential through tube **160** that is connected at its proximal end to lead **310**c. More particularly, as best shown in FIGS. **2**, **4**, **10** and **11**, fixed jaw **120** is welded to the rotating tube **160** and includes a fuse clip, spring clip or other electro-mechanical connection that provides electrical continuity to the fixed jaw member **120** from lead **310**c. The rotating tube **160** includes an elongated guide slot **167** disposed in an upper portion thereof that is dimensioned to carry lead **311** therealong. Lead **311** carries a first electrical potential to movable jaw **110**. A second electrical connection from lead **310**c is conducted through the tube **160** to the fixed jaw member **120**. Details relating to the electrical connections are described in the aforementioned U.S. patent application Ser. No. 10/460,926, now U.S. Pat. No. 7,156,846.

A tubular insulating boot **500** is included that is configured to mount over the pivot **103** and at least a portion of the end effector assembly **100**. The tubular insulating boot **500** is flexible to permit opening and closing of the jaw members **110** and **120** about pivot **103**. The flexible insulating boot **500** is made typically of any type of visco-elastic, elastomeric or flexible material that is biocompatible. Such a visco-elastic, elastomeric or flexible material is preferably durable and is configured to minimally impede movement of the jaw members **110** and **120** from the open to the closed positions. The particularly selected material of the flexible insulating boot **500** has a dielectric strength sufficient to withstand the voltages encountered during electrosurgery, and is suitable for use with a sterilization process that does not substantially impair structural integrity of the boot, such as an ethylene oxide process that does not melt or otherwise impair the structural integrity of the insulating boot **500**. The insulating boot **500** is dimensioned to further reduce stray electrical potentials so as to reduce the possibility of subjecting the patient tissue to unintentional electrosurgical RF energy.

As best shown in FIGS. **2**, **3**, **12**, **16** and **17**, one end of the tubular insulating boot **500** is disposed on at least a portion of the exterior surface of shaft **12** while the other end of the tubular insulating boot **500** is disposed on at least a portion of the exterior surfaces of jaw members **110** and **120**. Operability of the jaw members **110** and **120** is substantially unimpeded and not affected significantly by the flexible insulating boot **500**. More particularly, the tubular insulating boot **500** is maintained on the shaft **12** such that boot **500** remains in a substantially stationary position axially with respect to reciprocating sleeve **60** and the jaw members **110** and **120**. The flexible insulating boot **500** expands and contracts both radially and axially to cover the pivot pin **103** and to accommodate motion of the protrusion **117** and the movable jaw member **110**.

Again, as previously mentioned, since one end of the tubular insulating boot **500** is disposed on at least a portion of the shaft **12** while the other end of the tubular insulating boot **500** is disposed on at least a portion of the exterior surfaces of fixed jaw member **120** and pivoting jaw member **110**, operability of the pivoting jaw member **110** and the fixed jaw member **120**, either with respect to reciprocation of the reciprocating sleeve **60** or rotation of the rotating tube **160**, is not significantly limited by or impeded by the flexible insulating boot **500**. The tubular insulating boot **500** does not interface with the shaft **12** but rather remains in a substantially stationary position axially with respect to reciprocating sleeve **60** and the jaw members **110** and **120**.

As best shown in FIGS. **1**, **4** and **10**, once actuated, handle moves in a generally arcuate fashion towards fixed handle **50** about the pivot pins **29**a and **29**b that forces driving flange **47** proximally against the drive assembly **150** that, in turn, pulls reciprocating sleeve **60** in a generally proximal direction to close jaw member **110** relative to jaw member **120**. Moreover, proximal rotation of the handle **40** causes the locking flange **44** to release, i.e., "unlock", the trigger assembly **70** for selective actuation.

The operating features and relative movements of the internal working components of the forceps **10** and the trigger assembly **70** are shown by phantom representation in the various figures and explained in more detail with respect to the aforementioned U.S. patent application Ser. No. 10/460,926, now U.S. Pat. No. 7,156,846, and also in U.S. patent application Ser. No. 10/970,307, now U.S. Pat. No. 7,232,440, the contents of both of which are incorporated herein in their entirety.

As can be appreciated, as illustrated in FIG. **15**, the utilization of an over-the-center pivoting mechanism will enable the user to selectively compress the coil spring **67** a specific distance that, in turn, imparts a specific pulling load on the reciprocating sleeve **60** that is converted to a rotational torque about the jaw pivot pin **103**. As a result, a specific closure force can be transmitted to the opposing jaw members **110** and **120**. The combination of the mechanical advantage of the over-the-center pivot along with the compressive force associated with the compression spring **67** facilitate and assure consistent, uniform and accurate closure pressure about tissue within a desired working pressure range of about 3 kg/cm^2 to about 16 kg/cm^2 and, preferably, about 7 kg/cm^2 to about 13 kg/cm^2. By controlling the intensity, frequency and duration of the electrosurgical energy applied to the tissue, the user can seal tissue.

As best shown in FIGS. **4**, **6-9** and **18**, the knife assembly **140** includes an elongated rod **182** having a bifurcated distal end comprising prongs **182**a and **182**b that cooperate to receive a knife bar **184** therein. The knife assembly **180** also includes a proximal end **183** that is keyed to facilitate insertion into tube **160** of the rotating assembly **80**. A knife wheel **148** is secured to the knife bar **182** by a pin **143**. More particularly, the elongated knife rod **182** includes apertures **181**a and **181**b that are dimensioned to receive and secure the knife wheel **148** to the knife rod **182** such that longitudinal reciprocation of the knife wheel **148**, in turn, moves the elongated knife rod **182** to sever tissue **420**. More details relating to the operational features of the knife assembly **180** are discussed in the previously mentioned U.S. patent application Ser. No. 10/460,926, *now U.S. Pat. No. 7,232,440,* which is incorporated herein by reference in its entirety.

As best shown in the exploded view of FIG. **4** and in FIGS. **14-15**, the electrical leads **310**a, **310**b, **310**c and **311** are fed through the housing **20** by electrosurgical cable **310**. More particularly, the electrosurgical cable **310** is fed into the bottom of the housing **20** through fixed handle **50**. Lead **310**c extends directly from cable **310** into the rotating assembly **80** and connects (via a fused clip or spring clip or the like) to tube **60** to conduct the second electrical potential to fixed jaw member **120**. Leads **310**a and **310**b extend from cable **310** and connect to the hand switch or joy-stick-like toggle switch **200**. Details relating to the switch **200** are disclosed in the aforementioned U.S. patent application Ser. Nos. 10/460,926 and 10/970,307, now U.S. Pat. Nos. 7,156,846 and 7,232,440, respectively.

The jaw members **110** and **120** are electrically isolated from one another such that electrosurgical energy can be effectively transferred through the tissue to form seal **450**, as shown in FIGS. **18** and **19**. The two electrical potentials are isolated from one another by virtue of the insulative sheathing surrounding cable lead **311**. At least one of the jaw members **110** and **120** is adapted to connect to a source of electrosurgical energy (a generator (not shown)) such that at least one of the jaw members **110** and **120** is capable of conducting electrosurgical energy to tissue held therebetween.

In addition, by virtue of the flexible insulating boot **500** of the present disclosure, desired motion of and force between the jaw members **110** and **120** is maintained and substantially unimpeded while at the same time insulating boot **500** further insulates the patient tissue from possible stray energy from the exterior surfaces of the jaw members **110** and **120** and the associated elements, e.g., pivot **103** (See FIG. **2**). Details relating to various forceps that may be utilized with an insulating boot include the commonly-owned aforementioned instrument described in U.S. patent application Ser. Nos. 10/460,926 and 10/970,307, now U.S. Pat. Nos. 7,156,846 and 7,232,440, respectively, and commonly-owned and concurrently filed U.S. Provisional Patent Application Ser. No. 60/722,177 entitled "INLINE VESSEL SEALER AND DIVIDER", filed on Sep. 30, 2005, filed as U.S. patent application Ser. No. 11/540,335, published as U.S. Patent Application Publication No. US2007/0078456 A1, *now U.S. Pat. No. 7,789,878,* the entire contents of which is incorporated by reference herein.

As mentioned above with respect to FIG. **3**, at least one jaw member, e.g., **120**, may include a stop member **750** that limits the movement of the two opposing jaw members **110** and **120** relative to one another. The stop member **750** extends from the sealing surface **122** a predetermined distance according to the specific material properties (e.g., compressive strength, thermal expansion, etc.) to yield a consistent and accurate gap distance "G" (preferably between about 0.001 inches to about 0.006 inches, i.e., between about 0.03 mm to about 0.15 mm) during sealing (FIG. **18**). The non-conductive stop members **750** are sprayed or otherwise deposited onto the jaw members **110** and **120** (e.g., overmolding, injection molding, etc.), stamped onto the jaw members **110** and **120** or deposited (e.g., deposition) onto the jaw members **110** and **120**. For example, one technique involves thermally spraying a ceramic material onto the surface of the jaw member **110** and **120** to form the stop members **750**.

As best shown in FIGS. **4**, **6-9**, and **18-19**, as energy is being selectively transferred to the end effector assembly **100**, across the jaw members **110** and **120** and through the tissue **420**, a tissue seal **450** forms isolating two tissue halves **420**a and **420**b. The knife assembly **140** is then activated via the trigger assembly **70**, to progressively and selectively divide the tissue **420** along an ideal tissue plane in precise manner to effectively and reliably divide the tissue **420** into two sealed halves **420**a and **420**b (See FIGS. **18**-**19**) with a tissue gap **475** therebetween. The knife assembly **140** allows the user to quickly separate the tissue **420** immediately after sealing or, if desired, without sealing, without substituting a cutting instrument through a cannula or trocar port. As can be appreciated, accurate sealing and dividing of tissue **420** is accomplished with the same forceps **10**. Again, desired motion or movement of and force between the jaw members **110** and **120** is maintained and substantially unimpeded in the presence of the flexible insulating boot **500** of the present disclosure. For example, FIG. **16** is a side view of the end effector assembly **100** having the flexible insulating boot **500** of the present disclosure illustrating the jaw members **110** and **120** in the open position. FIG. **17** is a side view of the end effector assembly **100** having the flexible insulating boot **500** of the present disclosure illustrating the jaw members **110** and **120** in the closed position.

FIGS. **20** and **21** show an open forceps **1000** for use with an insulating boot **1500** of the present disclosure. Forceps **1000** includes elongated shaft portions **1012**a and **1012**b each having a proximal end **1014**a, **1014**b and a distal end **1016**a and **1016**b, respectively. The forceps **1000** includes an end effector assembly **1100** that attaches to the distal ends **1016**a and **1016**b of shafts **1012**a and **1012**b, respectively. The end effector assembly **1100** includes pair of opposing jaw members **1110** and **1120** that are pivotably connected about a pivot pin **1065** and that are movable relative to one another to grasp vessels and/or tissue.

Each shaft **1012**a and **1012**b includes a handle **1015** and **1017**, respectively, disposed at the proximal end **1014**a and **1014**b thereof that each define a finger hole **1015**a and **1017**b, respectively, therethrough for receiving a finger of the user. Finger holes **1015**a and **1017**b facilitate movement of the shafts **1012**a and **1012**b relative to one another that, in turn, pivot the jaw members **1110** and **1120** from an open position wherein the jaw members **1110** and **1120** are disposed in spaced relation relative to one another to a clamping or closed position wherein the jaw members **1110** and **1120** cooperate to grasp tissue or vessels therebetween.

Shaft **1012**a is secured about pivot **1065** and positioned within a cut-out or relief **1021** such that shaft **1012**a is movable relative to shaft **1012**b. More particularly, when the user moves the shaft **1012**a relative to shaft **1012**b to close or open the jaw members **1110** and **1120**, the distal portion of shaft **1012**a moves within cutout **1021**. One of the shafts, e.g., **1012**b, includes a proximal shaft connector **1077** that is designed to connect the forceps **1000** to a source of electrosurgical energy such as an electrosurgical generator (not shown).

The distal end of the cable **1070** connects to a handswitch **1050** to permit the user to selectively apply electrosurgical energy as needed to seal tissue or vessels grasped between jaw members **1110** and **1120** (See FIGS. **20**, **21** and **25**). As best shown in FIGS. **22**-**23**, jaw members **1110** and **1120** include outer insulative coatings or layers **1116** and **1126** that are dimensioned to surround the outer periphery of jaw member **1110** and **1120** and expose electrically conductive sealing surfaces **1112** and **1122**, respectively on an inner facing surface thereof. The electrically conducive sealing surfaces **1112** and **1122** conduct electrosurgical energy to the tissue upon activation of the handswitch **1050** such that the two opposing electrically conductive sealing surfaces **1112** and **1122** conduct bipolar energy to seal tissue disposed between the sealing surfaces **1112** and **1122** upon activation. At least one of the jaw members **1110** and **1120** is adapted to connect to the source of electrosurgical energy (not shown) such that at least one of the jaw members **1110** and **1120** is capable of conducting electrosurgical energy to tissue held therebetween.

As best shown in FIG. **24**, the upper jaw member **1110** includes an exterior surface or outer edge **1210** extending from a distal end or tip **1215** of the upper jaw member **1110**. Similarly, the lower jaw member **1120** includes an exterior surface or outer edge **1220** extending from a distal end or tip **1225** of the lower jaw member **1120**. In addition, in accordance with the present disclosure, generally tubular insulating boot **1500** having a length "L" may be positioned about at least a portion of the end effector assembly **1100**. The distal end **1504** of the insulating boot **1500** is disposed on the outer edge **1210** of the upper jaw member **1110** at a distance "d" retracted away from the tip **1215** and at a corresponding position on the outer edge **1220** of the lower jaw member **1120** retracted away from the tip **1225**.

In one embodiment, the length "L" of the insulating boot **1500** is such that the proximal end **1502** of the insulating boot **1500** is disposed on the outer edges **1210** and **1220** so that the pivot pin **1065** remains exposed. In an alternate embodiment shown in phantom in FIG. **24**, the length "L" of the insulating boot **1500** is such that the proximal end **1502** of the insulating boot **1500** is disposed on the outer edges **1210** and **1220** so that the pivot pin **1065** is covered by the insulating boot **1500**. Those skilled in the art recognize that the distance "d" and the length "L" of the insulating boot **1500** are chosen so as to maximize continued operability of the jaw members **1110** and **1120** to perform their intended functions.

In either embodiment, the insulating boot **1500** limits stray current dissipation to surrounding tissue upon activation and continued use of the forceps **1000**. As mentioned above, the insulating boot **1500** is made from any type of visco-elastic, elastomeric or flexible material that is biocompatible and that is configured to minimally impede movement of the jaw members **1110** and **1120** from the open to closed positions. Moreover, in one embodiment, the material is selected to have a dielectric strength sufficient to withstand the voltages encountered during electrosurgery, and is suitable for use with a sterilization process that does not substantially impair structural integrity of the boot, such as an ethylene oxide process. More particularly, the insulating boot **1500** further reduces stray electrical potential so as to reduce the possibility of subjecting the patient tissue to unintentional electrosurgical RF energy.

As best shown in FIG. **24**, the tubular insulating boot **1500** is disposed on at least a portion of the exterior surface **1210** of jaw members **1110** and **1120** such that operability of the jaw members **1110** and **1120** is substantially unimpeded and not affected significantly by the flexible insulating boot **1500**. More particularly, the tubular insulating boot **1500** remains in a substantially stationary position axially with respect to the jaw members **1110** and **1120**, i.e., the distance "d" remains substantially constant during motion of the upper jaw member **1110** with respect to the lower jaw member **1120**. However, the flexible insulating boot **1500** expands and contracts both radially and axially to accommodate motion of the movable jaw member **1110**, and to cover the pivot pin **1103** where applicable.

Details relating to the jaw members **1110** and **1120** and various elements associated therewith are discussed in commonly-owned U.S. application Ser. No. 10/962,116, filed on Oct. 8, 2004, and entitled "Open Vessel Sealing Instrument with Hourglass Cutting Mechanism and Over-Ratchet Safety", *published as U.S. patent Application Publication No. US 2005/0154387 A1, now U.S. Pat. No. 7,811,283,* the entire contents of which are hereby incorporated by reference herein.

As best illustrated in FIG. **23**, jaw member **1120** (or jaw member **1110**) includes one or more stop members **1175** disposed on the inner facing surface of the electrically conductive sealing surface **1122**. The stop members are designed to facilitate gripping and manipulation of tissue and to define a gap "G" between opposing sealing surfaces **1112** and **1122** during sealing (See FIGS. **24** and **25**). The separation distance during sealing or the gap distance "G" is within the range of about 0.001 inches (about 0.03 millimeters) to about 0.006 inches (about 0.016 millimeters) for optimizing the vessel sealing process.

As best seen in FIGS. **22** and **23**, the jaw members **1110** and **1120** include a knife channel **1115** disposed therebetween that is configured to allow distal translation of a cutting mechanism (not shown) therewithin to sever tissue disposed between the seal surfaces **1112** and **1122**. The complete knife channel **1115** is formed when two opposing channel halves **1115**a and **1115**b associated with respective jaw members **1110** and **1120** come together upon grasping of the tissue. Details relating to the cutting mechanism and associated actuating mechanism (not shown) are discussed in commonly-owned U.S. application Ser. No. 10/962,116, *now U.S. Pat. No. 7,811,283, as described above,* the entire contents of which are hereby incorporated by reference herein.

FIG. **21** shows the details of a ratchet **1030** for selectively locking the jaw members **1110** and **1120** relative to one another during pivoting. A first ratchet interface **1031**a extends from the proximal end **1014**a of shaft member **1012**a towards a second ratchet interface **1031**b on the proximal end **1014**b of shaft **1012**b in general vertical registration therewith such that the inner facing surfaces of each ratchet **1031**a and **1031**b abut one another upon closure of the jaw members **1110** and **1120** about the tissue **400**. The position associated with the cooperating ratchet interfaces **1031**a and **1031**b holds a specific, i.e., constant, strain energy in the shaft members **1012**a and **1012**b that, in turn, transmits a specific closing force to the jaw members **1110** and **1120** within a specified working range of about 3 kg/cm^2 to about 16 kg/cm^2 when the jaw members **1110** and **1120** are ratcheted.

In operation, the surgeon utilizes the two opposing handle members **1015** and **1017** to grasp tissue between jaw members **1110** and **1120**. The surgeon then activates the handswitch **1050** to provide electrosurgical energy to each jaw member **1110** and **1120** to communicate energy through the tissue held therebetween to effect a tissue seal. Once sealed, the surgeon activates the actuating mechanism to advance the cutting blade through the tissue to sever the tissue **400** along the tissue seal.

The jaw members **1110** and **1120** are electrically isolated from one another such that electrosurgical energy can be effectively transferred through the tissue to form a tissue seal. Each jaw member, e.g., **1110**, includes a uniquely-designed electrosurgical cable path disposed therethrough that transmits electrosurgical energy to the electrically conductive sealing surface **1112**. The two electrical potentials are isolated from one another by virtue of the insulative sheathing surrounding each cable lead **1071**a, **1071**b and **1071**c. In addition, to further enhance safety, as noted previously, insulating boot **1500** may be positioned about at least a portion of the end effector assembly **1000**, and optionally the pivot **1065**, to limit stray current dissipation to surrounding tissue upon activation and continued use of the forceps **1010**. As mentioned above, the insulating boot **1500** is made from any type of visco-elastic, elastomeric or flexible material that is biocompatible and that is configured to minimally impede movement of the jaw members **1110** and **1120** from the open to closed positions.

The presently disclosed insulating boot may also be utilized with a forceps **2010** designed for both bipolar electrosurgical treatment of tissue (either by vessel sealing as described above or coagulation or cauterization with other similar instruments) and monopolar treatment of tissue. For example, FIGS. **26-32** show one embodiment of a forceps **2010** that includes a monopolar element, e.g., element **2154** that may be selectively extended and selectively activated to treat tissue. FIGS. **33**A-**33**B show alternate embodiments of the present disclosure that show that the knife **2185** may be extended from the distal end of the end effector assembly **2100** and selectively energized to treat tissue in a monopolar fashion. FIG. **34**A shows another embodiment of a forceps **2010'** wherein the bottom jaw member **2120'** extends distally from the top jaw member **2110'** to allow the surgeon to selectively energize the bottom jaw member **2120'** and treat tissue in a monopolar fashion. FIG. **34**B shows yet another embodiment of a forceps **2010"** wherein the jaw members **2110"** and **2120"** include tapered distal ends that are selectively energized with a single electrical potential to treat tissue in a monopolar fashion. FIGS. **35**A-**38**B show other configurations of the end effector assembly and/or bottom or second jaw member that are configured to suit a particular purpose or to achieve a desired surgical result. An insulating boot **2500** may be configured to cover the various uninsulated elements of the end effector assembly **1100** of the above mentioned and below further described elements including but not limited to portions of one or both of the jaw members **2110** and **2120**, the pivot **2103** and the knife assembly **2180** etc. The insulating boot **2500** is contemplated to be particularly useful with forceps capable of monopolar activation since the boot prevents the various uninsulated elements from acting as alternative or unintended current sources or paths during activation that may result in unintended or undesirable tissue effects during a particular surgical procedure.

More particularly, FIGS. **26-31** show one embodiment wherein a monopolar element **2154** is housed for selective extension within one jaw member, e.g., jaw member **2120**, of the end effector assembly **2100**. Monopolar element **2154** is designed to move independently from knife assembly **2180** and may be extended by further proximal movement of the trigger assembly **2070** (FIGS. **26**, **30** and **31**) or by a separate actuator **2450** (FIG. **32**).

The monopolar element **2154** may be connected to a reciprocating rod **2065** that extends through an elongated notch **2013** in the outer periphery of the shaft **2012** as best seen in FIG. **27**. Drive rod **2060** that actuates the knife **2185** extends through the inner periphery of shaft **2012**. In order to extend the monopolar element **2154**, the jaw members **2110** and **2120** are initially closed and the knife **2185** is advanced distally utilizing the trigger assembly **2070** (See FIG. **30**). As best shown in FIG. **28**, the trigger **2071** is initially advanced to translate the knife **2185** distally to cut through tissue, i.e., the "cut" stage (shown in phantom). Thereafter and as shown in FIGS. **28** and **31**, the trigger **2071** may be further actuated in a proximal direction to extend the monopolar element **2154**, i.e., the "extend" stage (shown in phantom).

As best shown in FIG. **29**, a tubular insulating boot **2500** is included that is configured to mount over the pivot **2103**, connecting the upper, pivoting jaw member **2110** with the lower, fixed jaw member **2120**, and over at least a portion of the end effector assembly **2100**. The tubular insulating boot **2500** is flexible to permit opening and closing of the jaw members **2110** and **2120** about the pivot **2103**. The flexible insulating boot **2500** is made typically of any type of viscoelastic, elastomeric or flexible material that is biocompatible. More particularly, the insulating boot **2500** is configured to reduce stray electrical potential so as to reduce the possibility of subjecting the patient tissue to unintentional electrosurgical RF energy.

As best shown in FIG. **29**, one end of the tubular insulating boot **2500** is disposed on at least a portion of the exterior surface of shaft **2012** while the other end of the tubular insulating boot **2500** is disposed on at least a portion of the exterior surfaces of fixed jaw member **2120** and pivoting jaw member **2110** such that operability of the jaw members **2110** and **2120** is substantially unimpeded and not affected significantly by the flexible insulating boot **2500**. More particularly, the tubular insulating boot **2500** is maintained on the shaft **2012** such that boot **2500** remains in a substantially stationary position axially with respect to reciprocating sleeve **2060** and the jaw members **2110** and **2120**. The flexible insulating boot **2500** expands and contracts both radially and axially to cover the pivot pin **2103** and to accommodate motion of protrusion **2117** and the movable jaw member **2110**.

Details relating to this particular embodiment of a monopolar forceps is disclosed in aforementioned commonly-owned U.S. application Ser. No. 10/970,307, the entire contents of which are hereby incorporated by reference herein.

FIG. **32** shows another embodiment of the present disclosure wherein the monopolar element **2154** is selectively extendible utilizing a second actuator **2450**. As described above, the knife **2185** is advanced by actuating the trigger **2071** in a generally proximal direction. The monopolar element **2154** is selectively advanceable independently of the knife **2185** and may be extended when the jaw members **2110** and **2120** are disposed in either the open configuration or closed configuration. The actuator **2450** may be electrically configured to activate the monopolar element **2154** automatically once extended or manually by activation switch **2200** or perhaps another switch (not shown). As mentioned above, a safety circuit **2460** may be employed to deactivate jaw members **2110** and **2120** when the monopolar element **2154** is extended such that activation of the switch **2200** energizes the monopolar element **2154**. In the case of a separate activation switch for the monopolar element, the safety circuit would deactivate the switch **2200**.

In a similar manner as discussed previously with respect to FIG. **29**, and as shown in FIG. **32**, the tubular insulating boot **2500** is included that is configured to mount over the pivot **2103** and at least a portion of the end effector assembly **2100**. The tubular insulating boot **2500** is flexible to permit opening and closing of the jaw members **2110** and **2120** about pivot **2103**.

Those skilled in the art recognize that the material properties of the insulating boot **2500** and operability considerations from disposition of the insulating boot **2500** are in all respects either similar to or in some cases identical to those described in the preceding discussion with respect to FIGS. **26**-**31**.

FIGS. **33**A-**33**C show another alternate embodiment of the present disclosure of a forceps **2200** wherein the knife **2185** can be extended distally beyond the jaw members **2210** and **2220**, respectively, and separately energized to treat tissue. In this instance, when the knife is extended beyond the jaw members **2210** and **2220**, respectively, the knife **2185** becomes the monopolar element.

As illustrated in FIGS. **33**A-**33**C and partially in FIG. **34**B, once the knife **2185** extends beyond the jaw members **2110** and **2120**, a safety or switch deactivates energizing circuitry to the jaw members **2110** and **2120** and activates the energizing circuitry to the knife **285** such that activation of the switch **2200** energizes the knife **2185** and the jaw members remain neutral. For example, the stop **2119** may act as a safety switch such that upon being forced by the knife **2185** out of or away from the knife channel **2115**, the stop **2119** deactivates circuitry to the jaw members **2210** and **2220** and activates circuitry to the monopolar knife **2185** and the return electrode **2550**. A separate lead **2069** may be used to electrically communicate with the generator **2300** (See FIG. **34**B). As can be appreciated, the knife **2185** may now be used in a monopolar fashion to treat tissue.

Upon release of a trigger such as trigger **2070** (See FIG. **26**), the knife **2185** automatically retracts into the knife channel **2115** and back to the pre-actuated position as shown in FIG. **33**A. At the same time, the stop **2119** reverts to its original position to temporarily block the knife channel **2115** for subsequent actuation.

Again, in a similar manner as discussed previously with respect to FIG. **29**, the tubular insulating boot **2500** is included that is configured to mount over the pivot **2103** and at least a portion of the end effector assembly **2200**. The tubular insulating boot **2500** is flexible to permit opening and closing of the jaw members **2210** and **2220** about pivot **2103**.

Again, those skilled in the art recognize that the material properties of the insulating boot **2500** and operability considerations from disposition of the insulating boot **2500** are similar to those described in the preceding discussions.

As shown in FIG. **34**A and partially in the schematic FIG. **34**B, another embodiment of a forceps **2010'** according to the present disclosure wherein the lower jaw member **2120'** is designed to extend beyond the distal end of jaw member **2110'**. In order to switch from a bipolar mode of the operation to a monopolar mode, the surgeon activates a switch or control that energizes jaw member **2120'** to a first potential and activates a return pad **2550** to a second potential. Energy is transferred from jaw member **2120**, through tissue, and to the return pad **2550** to treat tissue. The distal end of jaw member **2120'** acts as the monopolar element for treating the tissue and may be shaped accordingly to enhance electrosurgical effect.

FIG. **34**B shows yet another schematic embodiment of a forceps **2010"** according to the present disclosure wherein the distal ends of both jaw members **2110"** and **2120"** are shaped to treat tissue when disposed in a monopolar mode. More particularly, the distal tips **2112**a" and **2122**a" are preferably elongated or tapered to enhance energy delivery when the forceps **2010"** is disposed in the monopolar mode. When disposed in the bipolar mode, the tapered ends **2112**a" and **2122**a" do not effect treating tissue between electrically conductive plates **2112"** and **2122"**.

A control switch **2505** is preferably included that regulates the transition between bipolar mode and monopolar mode. Control switch **2505** is connected to generator **2300** via cables **2360** and **2370**. A series of leads **2510**, **2520** and **2530** are connected to the jaw members **2110"**, **2120"** and the return electrode **2550**, respectively. As best shown in the table depicted in FIG. **34**B, each lead **2510**, **220**, and **2530** is provided with an electrical potential or remains neutral depending upon the particular "mode" of the forceps **2010"**. For example, in the bipolar mode, lead **2510** (and, in turn, jaw member **2110"**) is energized with a first electrical potential and lead **2520** (and, in turn, jaw member **2120"**) is energized with second electrical potential. As a result thereof, electrosurgical energy is transferred from jaw member **2110"** through the tissue and to jaw member **2120"**. The return electrode **2550** remains off or neutral.

In a monopolar mode, jaw member **2110"** and **2120"** are both energized with the same electrical potential and the return pad **2550** is energized with a second electrical potential forcing the electrical current to travel from the jaw members **2110"** and **2120"**, through the tissue and to the return electrode **2550**. This enables the jaw members **2110"** and **2120"** to treat tissue in a monopolar fashion that, as mentioned above, advantageously treats a vascular tissue structures and/or allows quick dissection of narrow tissue planes. As can be appreciated, all of the leads **2510**, **2520** and **2530** may be deactivated when the forceps **2010"** is turned off or idle.

Yet again, as discussed previously with respect to FIG. **29**, the tubular insulating boot **2500** is included that is configured to mount over the pivot **2103** and at least a portion of the end effector assembly **2100'**.

FIGS. **35**A and **35**B show an alternate embodiment of the forceps **2010** according to the present disclosure that includes a second or bottom jaw member **2520'** that is manufactured such that the distal end **2522**a of the tissue sealing surface **2522** extends beyond the bottom jaw housing **2524**. More particularly, in this particular embodiment, the tissue sealing surface **2522** is made from a stamped sheet metal that is formed atop a stamped sheet metal skeleton **2532**. The proximal end of the sheet metal skeleton **2532** may be configured with various pivot points (or apertures **2534**), cam slots or grooves depending upon the particular type of pivot action associated with the forceps **2010**. As can be appreciated, the sealing surface **2522** may be supported atop a hem or spine **2535** that extends along the skeleton **2532** by many ways known in the art.

An insulating layer **2540** is disposed between the skeleton **2532** and the tissue sealing surface **2522** to isolate the electrically conductive sealing surface **2522'** from hem **2535** during activation. The stamped tissue sealing surface **2522'** is formed of a double layer of sheet metal material separated by a slot or knife channel **2515** that allows selective reciprocation of a knife, such as knife **2185** disclosed in FIGS. **33**A-**33**C, therein. The distal end **2522**a of the tissue sealing surface **2522** may be bent 180° to provide a larger conductive surface area that extends beyond the jaw housing **2524**.

It is envisioned that the tissue sealing surface **2522** may be curved or straight depending upon a particular surgical purpose. The jaw housing **2524** may be overmolded to encapsulate the hem **2535** of the skeleton **2532** and sealing plate **2522** that serves to insulate surrounding tissue from the conductive surfaces of the sealing plate **2522** as well as to give the jaw member **2520'** a desired shape at assembly.

In a similar manner as discussed previously with respect to FIG. **29**, and as shown in FIG. **32**, the tubular insulating boot **2500** is included of which one end is configured to mount over the sheet metal skeleton **2532** and pivot pin aperture **2534** and another end of the insulating boot **2500** configured to mount over at least a portion of an exterior surface of reciprocating sleeve **2060**. The tubular insulating boot **2500** is flexible to permit opening and closing of the jaw members **2110** and **2520'** about pivot **2103**.

Details relating to the forceps **2010'**, which is manufactured such that the distal end **2522**a' of the tissue sealing surface **2522** extends beyond the bottom jaw housing **2524**, are disclosed in previously mentioned commonly owned U.S. patent application Ser. No. 10/970,307 that is incorporated by reference herein.

FIGS. **36**A and **36**B show another embodiment of the bottom or second jaw member **2620** that includes both an electrically conductive sealing surface **2622** for sealing purposes as well as an electrically conductive surface **2632** that is designed for monopolar activation. More particularly, the bottom jaw member **2620** includes a jaw housing **2624** that supports (or encapsulates) a tissue sealing surface **2622**. A knife channel **2615** is disposed along the length of the tissue sealing surface **2622** and allows reciprocation of a knife therein. An insulating layer **2634** is positioned at or proximal to the distal end of the tissue sealing surface **2622** distal to the knife channel **2615**. A second conductive material **2632** (that may or may not be the same material as tissue sealing surface **2622**) is disposed on the opposite side of the insulating layer **2634**.

It is envisioned that the insulating material **2634** will isolate the monopolar portion **2632** during electrical activation of tissue surface **2622** and isolate the tissue surface **2622** during electrical activation of monopolar element **2632**. As can be appreciated, the two different electrically conductive elements **2622** and **2632** are connected to electrical generator **2300** by different electrical connections and may be selectively activated by the user. Various switches or electrical control elements or the like (not shown) may be employed to accomplish this purpose.

Still yet again, to further enhance safety, as discussed previously with respect to FIG. **29**, the tubular insulating boot **2500** is included that is configured to mount over the pivot (not shown) and at least a portion of the end effector assembly. The tubular insulating boot **2500** is flexible to permit opening and closing of the jaw members **2110** and **2620**.

Bottom or second jaw member **2620** includes both an electrically conductive sealing surface **2622** for sealing purposes as well as an electrically conductive surface **2632** that is designed for monopolar activation are disclosed in previously mentioned commonly owned U.S. patent application Ser. No. 10/970,307 which is incorporated by reference herein.

FIGS. **37**A and **37**B show another embodiment of an end effector assembly **2700** according to the present disclosure that includes top and bottom jaw members **2710** and **2720**, respectively each including similar jaw elements as described above, i.e., tissue sealing surfaces **2712** and **2722**, respectively and insulative housings **2714** and **2724**, respectively. In a similar manner as mentioned above with respect to tissue sealing surface **2622** and knife channel **2615**, the tissue sealing surfaces **2712** and **2722** of jaw members **2710** and **2720** mutually cooperate to form a knife channel **2715** that allows knife **2185** to be selectively reciprocated therethrough. More particularly, jaw member **2710** includes a first part of knife channel **2715**a and jaw member **2720** includes a second part of the knife channel **2715**b that align to form knife channel **2715**.

As best shown in FIG. **37**B, knife channels **2715**a and **2715**b are aligned in vertical registration along one side of the jaw members **2710** and **2720** to allow reciprocation of knife **2185** therethrough. Knife channel **2715**b of jaw member **2720** is wider (i.e., as measured transversally across the length of the jaw member **2720**) and includes a separate channel **2715**b1 that is dimensioned to slidingly receive a monopolar element **2754** therethrough. A trigger **70** (or the like) may be utilized as described above with respect to FIGS. **26-31** to extend the monopolar element **2754** for treatment of tissue. In addition, the monopolar element **2754** and the knife **2185** may be made of separate components, as shown, or the monopolar element **2754** and the knife **2185** may be integral with one another.

As can be appreciated various switching algorithms may be employed to activate both the bipolar mode for vessel sealing and the monopolar mode for additional tissue treatments (e.g., dissection). Also, a safety or lockout may be employed either electrically, mechanically or electromechanically to "lock out" one electrical mode during activation of the other electrical mode. In addition, a toggle switch (or the like) may be employed to activate one mode at a time for safety reasons. The monopolar element **2754** may also include a safety (either mechanical, electrical or electro-mechanical—not shown) that only allows electrical activation of the monopolar element **2754** when the monopolar element **2754** is extended from the distal end of jaw member **2720**. Insulating boot **2500** is included that is configured to mount over the pivot **2103** and at least a portion of the end effector assembly **2100**.

FIGS. **38**A and **38**B show yet another embodiment of bottom jaw member **2820** that may be utilized for both bipolar vessel sealing and monopolar tissue dissection or other monopolar tissue treatments. More particularly, jaw member **2820** includes an outer jaw housing **2824** that is overmolded to encapsulate a tissue sealing plate **2822** therein. Tissue sealing plate **2822** includes a knife channel **2815** for reciprocating a knife as described in detail above. Tissue sealing plate **2822** also includes a sealing surface **2822**a that is disposed in opposing relation to a corresponding sealing surface (not shown) on the opposite upper jaw member (not shown).

Tissue sealing surface **2822** also includes a sealing surface extension **2822**b that extends through a distal end **824**a of the overmolded jaw housing **2824**. As can be appreciated, sealing surface extension **2822**b is designed for monopolar tissue dissection, enterotomies or other surgical functions and may be separately electrically energized by the user by a hand switch, footswitch or at the generator **2300** in a similar manner as described above (See FIG. **34**B). As can be appreciated, the extension **2822**b also serves to further anchor the sealing plate **2822** in the jaw housing **2824** during the overmolding process. Insulating boot **2500** is included that is configured to mount over the pivot **2103** and at least a portion of the end effector assembly.

From the foregoing and with reference to the various figure drawings, those skilled in the art will appreciate that certain modifications can also be made to the present disclosure without departing from the scope of the same. For example and although the general operating components and intercooperating relationships among these components have been generally described with respect to a vessel sealing forceps, other instruments may also be utilized that can be configured to allow a surgeon to selectively treat tissue in both a bipolar and monopolar fashion. Such instruments include, for example, bipolar grasping and coagulating instruments, cauterizing instruments, bipolar scissors, etc.

Furthermore, those skilled in the art recognize that while the insulating boots **500**, **1500**, or **2500** are disclosed as having a generally tubular configuration, the cross-section of the generally tubular configuration can assume substantially any shape such as, but not limited to, an oval, a circle, a square, or a rectangle, and also include irregular shapes necessary to cover at least a portion of the jaw members and the associated elements such as the pivot pins and jaw protrusions, etc.

In addition, while several of the disclosed embodiments show endoscopic forceps that are designed to close in a unilateral fashion, forceps that close in a bilateral fashion may also be utilized with the insulating boot described herein. The presently disclosed insulating boot may be configured to fit atop or encapsulate pivot or hinge members of other known devices such as jawed monopolar devices, standard laparoscopic "Maryland" dissectors and/or bipolar scissors.

While several embodiments of the disclosure have been shown in the drawings, it is not intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. Therefore, the above description should not be construed as limiting, but merely as exemplifications of preferred embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

What is claimed is:

1. An electrosurgical forceps, comprising:

a shaft having a pair of jaw members at a distal end thereof, the jaw members being movable about a pivot from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members are closer to one another for grasping tissue, the shaft defining a longitudinal axis therethrough;

a movable handle that actuates a drive assembly to move the jaw members relative to one another;

at least one of the jaw members including a tissue-engaging surface adapted to connect to a source of electrical energy such that the at least one jaw member is capable of conducting energy to tissue held therebetween; and

a flexible insulating boot mounted over the pivot, the flexible insulating boot having a proximal portion disposed on a portion of the shaft and a distal portion disposed on a portion of an exterior surface of the pair of jaw members proximal to the tissue-engaging surface of the at least one jaw member, the proximal portion and the distal portion of the flexible insulating boot disposed such that the flexible insulating boot remains in a substantially stationary position relative to the longitudinal axis and with respect to a reciprocating sleeve of the drive assembly and the jaw members when the drive assembly mechanically advances the reciprocating sleeve to apply a predetermined closure force between the jaw members.

2. An electrosurgical forceps according to claim **1**, wherein at least one of the jaw members includes a series of stop members disposed thereon for regulating distance between the jaw members such that a gap is created between the jaw members during the sealing process.

3. An electrosurgical forceps according to claim **1**, wherein the forceps includes a knife that is selectively deployable to cut tissue disposed between the jaw members.

4. An electrosurgical forceps according to claim **1**, wherein the insulating boot is made of at least one of a viscoelastic, elastomeric, and flexible material suitable for use with a sterilization process that does not substantially impair structural integrity of the boot.

5. An electrosurgical forceps according to claim **4**, wherein the sterilization process includes ethylene oxide.

6. An electrosurgical forceps according to claim **1**, wherein the flexible insulating boot has a generally tubular configuration.

7. An electrosurgical forceps according to claim **1**, wherein two jaw members are adapted to connect to the source of electrical energy such that the jaw members are capable of treating tissue in a bipolar manner upon selective activation of the forceps.

8. An electrosurgical forceps according to claim **1**, wherein at least one jaw member is adapted to connect to the source of electrical energy such that the at least one jaw members is capable of treating tissue in a monopolar manner upon selective actuation of the forceps.

9. An electrosurgical forceps, comprising:

a shaft having a pair of jaw members at a distal end thereof, the jaw members being movable about a pivot from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members are closer to one another for grasping tissue, the shaft defining a longitudinal axis therethrough;

a drive assembly that includes a reciprocating sleeve and a movable handle that actuates the reciprocating sleeve and the drive assembly to move the jaw members relative to one another;

at least one of the jaw members including a tissue-engaging surface adapted to connect to a source of electrical energy such that the at least one jaw member is capable of conducting energy to tissue held therebetween; and

a flexible insulating boot defining an internal surface, the flexible insulating boot mounted over the pivot such that at least a portion of the internal surface is in direct contact with the pivot, the flexible insulating boot having a proximal portion disposed on a portion of the shaft and a distal portion disposed on a portion of an exterior surface of the pair of jaw members proximal to the tissue-engaging surface of the at least one jaw member such that at least a portion of the internal surface defined by the flexible insulating boot is in direct contact with the portion of the exterior surface of the pair of jaw members proximal to the tissue-engaging surface of the at least one jaw member, the proximal portion and the distal portion of the flexible insulating boot disposed such that the flexible insulating boot remains in a substantially stationary position relative to the longitudinal axis and with respect to the reciprocating sleeve and the jaw members when the drive assembly mechanically advances the reciprocating sleeve of the drive assembly to apply a predetermined closure force between the jaw members.

10. An electrosurgical forceps according to claim 9, wherein at least one of the jaw members includes a series of stop members disposed thereon for regulating distance between the jaw members such that a gap is created between the jaw members during the sealing process.

11. An electrosurgical forceps according to claim 9, wherein the forceps includes a knife that is selectively deployable to cut tissue disposed between the jaw members.

12. An electrosurgical forceps according to claim 9, wherein the insulating boot is made of at least one of a viscoelastic, elastomeric, and flexible material suitable for use with a sterilization process that does not substantially impair structural integrity of the boot.

13. An electrosurgical forceps according to claim 12, wherein the sterilization process includes ethylene oxide.

14. An electrosurgical forceps according to claim 9, wherein the flexible insulating boot has a generally tubular configuration.

15. An electrosurgical forceps according to claim 9, wherein two jaw members are adapted to connect to the source of electrical energy such that the jaw members are capable of treating tissue in a bipolar manner upon selective activation of the forceps.

16. An electrosurgical forceps according to claim 9, wherein at least one jaw member is adapted to connect to the source of electrical energy such that the at least one jaw members is capable of treating tissue in a monopolar manner upon selective actuation of the forceps.

* * * * *