



US00D775333S

(12) **United States Design Patent** (10) **Patent No.:** **US D775,333 S**  
**Ding et al.** (45) **Date of Patent:** **\*\* Dec. 27, 2016**

- (54) **OPEN VESSEL SEALER WITH MECHANICAL CUTTER**
- (71) Applicant: **COVIDIEN LP**, Mansfield, MA (US)
- (72) Inventors: **Weijiang Ding**, Shanghai (CN); **Pu Liu**, Shanghai (CN); **Yuanxun Li**, Shanghai (CN); **Peixiong Yi**, Shanghai (CN); **Peining Sun**, Shanghai (CN)
- (73) Assignee: **Covidien LP**, Mansfield, MA (US)
- (\*\*) Term: **15 Years**
- (21) Appl. No.: **29/537,163**
- (22) Filed: **Aug. 24, 2015**

**Related U.S. Application Data**

- (63) Continuation of application No. 29/481,407, filed on Feb. 5, 2014.

**Foreign Application Priority Data**

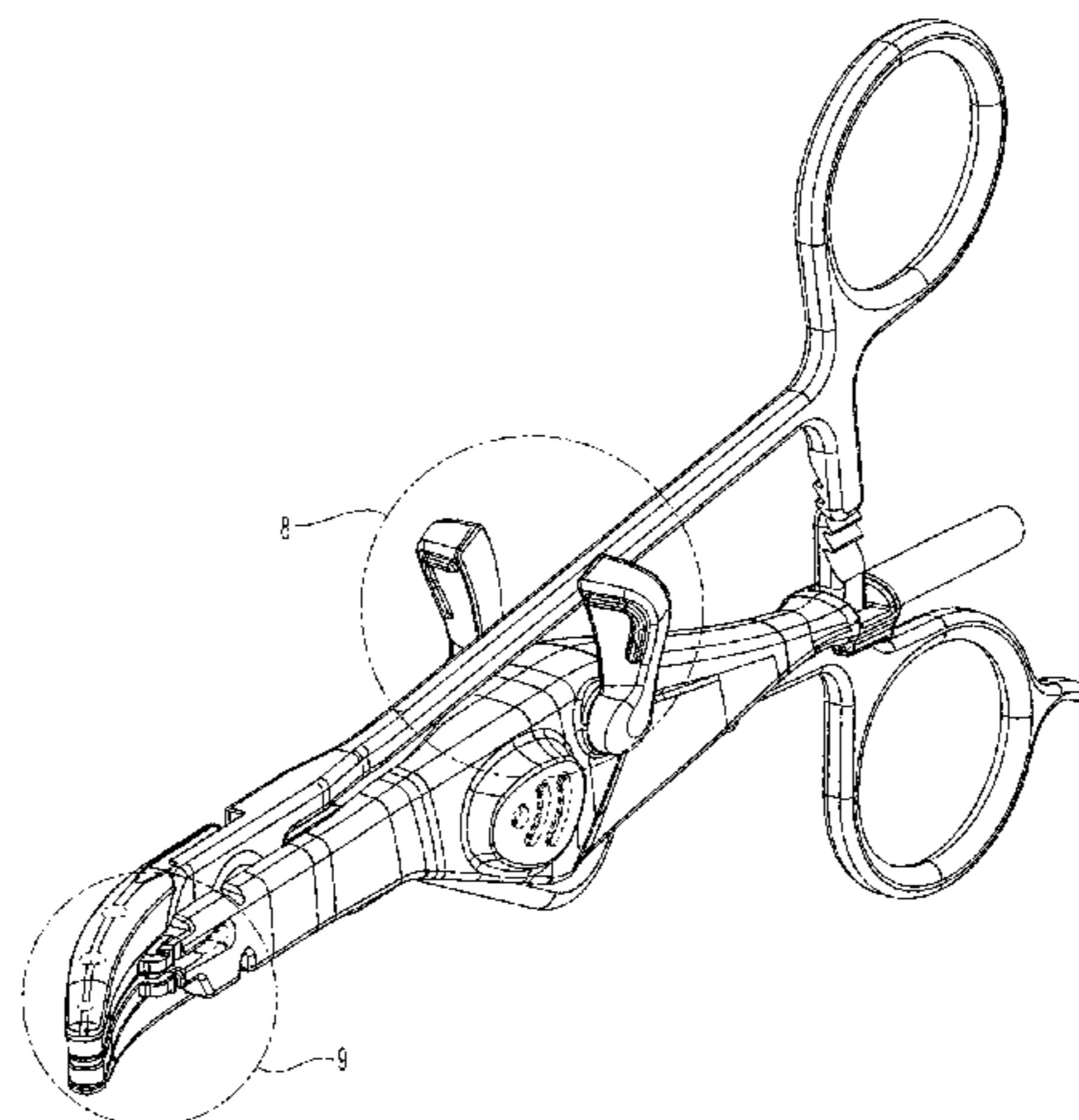
- Aug. 7, 2013 (CN) ..... 2013 3 0376262
- (51) **LOC (10) Cl.** ..... **24-02**
- (52) **U.S. Cl.**  
USPC ..... **D24/133**
- (58) **Field of Classification Search**  
USPC ..... D24/133, 153, 143, 144, 146, 147, 148;  
D8/51, 52, 54; 606/45, 51, 41, 1, 46, 40,  
606/167, 174  
CPC ..... A61B 18/1442; A61B 2017/2945; A61B  
2018/00601; A61B 18/1445; A61B  
2018/1432; A61B 17/32; A61B 2018/146;  
A61B 17/3201  
See application file for complete search history.

**References Cited**

**U.S. PATENT DOCUMENTS**

- D249,549 S 9/1978 Pike
- D263,020 S 2/1982 Rau, III
- 4,671,274 A 6/1987 Sorochenko

- D295,893 S 5/1988 Sharkany et al.
- D295,894 S 5/1988 Sharkany et al.
- D298,353 S 11/1988 Manno
- D299,413 S 1/1989 DeCarolis
- D343,453 S 1/1994 Noda
- D348,930 S 7/1994 Olson
- D349,341 S 8/1994 Lichtman et al.
- D354,564 S 1/1995 Medema
- D358,887 S 5/1995 Feinberg
- D384,413 S 9/1997 Zlock et al.
- H1745 H 8/1998 Paraschac
- D402,028 S 12/1998 Grimm et al.
- D408,018 S 4/1999 McNaughton
- D416,089 S 11/1999 Barton et al.
- D424,694 S 5/2000 Tetzlaff et al.
- D425,201 S 5/2000 Tetzlaff et al.
- H1904 H 10/2000 Yates et al.
- D449,886 S 10/2001 Tetzlaff et al.
- D453,923 S 2/2002 Olson
- D454,951 S 3/2002 Bon
- D457,958 S 5/2002 Dycus et al.
- D457,959 S 5/2002 Tetzlaff et al.
- H2037 H 7/2002 Yates et al.
- D465,281 S 11/2002 Lang
- D466,209 S 11/2002 Bon
- 6,511,480 B1 1/2003 Tetzlaff et al.
- D493,888 S 8/2004 Reschke
- D496,997 S 10/2004 Dycus et al.
- D499,181 S 11/2004 Dycus et al.
- D502,994 S 3/2005 Blake, III
- D509,297 S 9/2005 Wells
- D525,361 S 7/2006 Hushka
- D531,311 S 10/2006 Guerra et al.
- 7,131,970 B2 11/2006 Moses et al.
- D533,274 S 12/2006 Visconti et al.
- D533,942 S 12/2006 Kerr et al.
- D535,027 S 1/2007 James et al.
- 7,160,299 B2 1/2007 Bailly
- D538,932 S 3/2007 Malik
- D541,418 S 4/2007 Schechter et al.
- D541,611 S 5/2007 Aglassinger
- D541,938 S 5/2007 Kerr et al.
- D545,432 S 6/2007 Watanabe
- D547,154 S 7/2007 Lee
- D564,662 S 3/2008 Moses et al.
- D567,943 S 4/2008 Moses 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.
- D582,038 S 12/2008 Swoyer et al.
- 7,641,653 B2 1/2010 Dalla Betta et al.
- 7,655,007 B2 2/2010 Bailly
- D617,900 S 6/2010 Kingsley et al.



(56)

References Cited

U.S. PATENT DOCUMENTS

D617,901 S 6/2010 Unger et al.  
 D617,902 S 6/2010 Twomey et al.  
 D617,903 S 6/2010 Unger et al.  
 D618,798 S 6/2010 Olson et al.  
 D621,503 S 8/2010 Otten et al.  
 7,811,283 B2 10/2010 Moses et al.  
 D627,462 S 11/2010 Kingsley  
 D628,289 S 11/2010 Romero  
 D628,290 S 11/2010 Romero  
 7,846,161 B2 12/2010 Dumbauld et al.  
 D630,324 S 1/2011 Reschke  
 7,922,718 B2 4/2011 Moses et al.  
 D649,249 S 11/2011 Guerra  
 D649,643 S 11/2011 Allen, IV et al.  
 8,128,625 B2 3/2012 Odom  
 D661,394 S 6/2012 Romero et al.  
 8,211,105 B2 7/2012 Buysse et al.  
 8,216,223 B2 7/2012 Wham et al.  
 8,235,993 B2 8/2012 Hushka et al.  
 8,241,283 B2 8/2012 Guerra et al.  
 8,298,228 B2 10/2012 Buysse et al.  
 D670,808 S 11/2012 Moua et al.  
 8,357,159 B2 1/2013 Romero  
 8,394,096 B2 3/2013 Moses et al.  
 D680,220 S 4/2013 Rachlin  
 8,425,504 B2 4/2013 Orton et al.  
 8,486,107 B2 7/2013 Hinton  
 8,574,230 B2 11/2013 Romero  
 8,623,017 B2 1/2014 Moses et al.  
 RE44,834 E 4/2014 Dumbauld et al.  
 9,084,608 B2 7/2015 Larson et al.  
 D736,920 S \* 8/2015 Lee ..... D24/133  
 D737,439 S \* 8/2015 Ding ..... D24/133  
 D738,499 S \* 9/2015 Ding ..... D24/133  
 D744,644 S \* 12/2015 Lee ..... D24/133  
 2003/0109875 A1 6/2003 Tetzlaff et al.  
 2003/0181910 A1 9/2003 Dycus et al.  
 2003/0199869 A1 10/2003 Johnson et al.  
 2005/0107784 A1 5/2005 Moses et al.  
 2005/0119655 A1 6/2005 Moses et al.  
 2005/0154387 A1 7/2005 Moses et al.  
 2006/0074417 A1 4/2006 Cunningham et al.  
 2006/0167452 A1 7/2006 Moses et al.  
 2007/0088356 A1 4/2007 Moses et al.  
 2007/0118111 A1 5/2007 Weinberg  
 2007/0156140 A1 7/2007 Baily  
 2007/0260241 A1 11/2007 Dalla Betta et al.  
 2008/0039836 A1 2/2008 Odom et al.  
 2009/0062794 A1 3/2009 Buysse et al.  
 2010/0130971 A1 5/2010 Baily  
 2011/0054472 A1 3/2011 Romero  
 2011/0218530 A1 9/2011 Reschke  
 2011/0257680 A1 10/2011 Reschke et al.  
 2012/0083786 A1 4/2012 Artale et al.  
 2013/0018371 A1 1/2013 Twomey  
 2013/0041370 A1 2/2013 Unger  
 2013/0103031 A1 4/2013 Garrison  
 2013/0138101 A1 5/2013 Kerr  
 2014/0221994 A1 8/2014 Reschke  
 2014/0221995 A1 8/2014 Guerra et al.  
 2014/0221999 A1 8/2014 Cunningham et al.  
 2014/0228842 A1 8/2014 Dycus et al.  
 2014/0230243 A1 8/2014 Roy et al.  
 2014/0236149 A1 8/2014 Kharin et al.  
 2014/0243811 A1 8/2014 Reschke et al.  
 2014/0243824 A1 8/2014 Gilbert  
 2014/0249528 A1 9/2014 Hixson et al.  
 2014/0250686 A1 9/2014 Hempstead et al.  
 2014/0257274 A1 9/2014 McCullough, Jr. et al.  
 2014/0257283 A1 9/2014 Johnson et al.  
 2014/0257284 A1 9/2014 Artale  
 2014/0257285 A1 9/2014 Moua  
 2014/0276803 A1 9/2014 Hart  
 2014/0284313 A1 9/2014 Allen, IV et al.  
 2014/0284841 A1 9/2014 Ackley et al.

2014/0288549 A1 9/2014 McKenna et al.  
 2014/0288553 A1 9/2014 Johnson et al.  
 2014/0330308 A1 11/2014 Hart et al.  
 2014/0336635 A1 11/2014 Hart et al.  
 2014/0353188 A1 12/2014 Reschke et al.  
 2015/0018816 A1 1/2015 Latimer  
 2015/0025528 A1 1/2015 Arts  
 2015/0032106 A1 1/2015 Rachlin  
 2015/0051598 A1 2/2015 Orszulak et al.  
 2015/0051599 A1 2/2015 Joseph  
 2015/0051640 A1 2/2015 Twomey et al.  
 2015/0066026 A1 3/2015 Hart et al.  
 2015/0080880 A1 3/2015 Sartor et al.  
 2015/0080889 A1 3/2015 Cunningham et al.  
 2015/0082928 A1 3/2015 Kappus et al.  
 2015/0088122 A1 3/2015 Jensen  
 2015/0088126 A1 3/2015 Duffin et al.  
 2015/0088128 A1 3/2015 Couture  
 2015/0094714 A1 4/2015 Lee et al.

FOREIGN PATENT DOCUMENTS

CN 201299462 9/2009  
 DE 2415263 A1 10/1975  
 DE 02514501 A1 10/1976  
 DE 2627679 A1 1/1977  
 DE 03423356 C2 6/1986  
 DE 03612646 A1 4/1987  
 DE 3627221 A1 2/1988  
 DE 8712328 U1 2/1988  
 DE 04303882 C2 2/1995  
 DE 04403252 A1 8/1995  
 DE 19515914 C1 7/1996  
 DE 19506363 A1 8/1996  
 DE 29616210 U1 11/1996  
 DE 19608716 C1 4/1997  
 DE 19751106 A1 5/1998  
 DE 19751108 A1 5/1999  
 DE 19946527 C1 7/2001  
 DE 20121161 U1 4/2002  
 DE 10045375 C2 10/2002  
 DE 202007009165 U1 8/2007  
 DE 202007009317 U1 8/2007  
 DE 202007009318 U1 8/2007  
 DE 10031773 B4 11/2007  
 DE 202007016233 U1 1/2008  
 DE 19738457 B4 1/2009  
 DE 102004026179 B4 1/2009  
 DE 102008018406 B3 7/2009  
 EP 1281878 A1 2/2003  
 EP 1159926 A3 3/2003  
 EP 1532932 A1 5/2005  
 EP 1609430 12/2005  
 EP 1852079 A1 11/2007  
 JP 61-501068 9/1984  
 JP 10-24051 A 1/1989  
 JP 11-47150 A 6/1989  
 JP 6-502328 3/1992  
 JP 5-5106 1/1993  
 JP 05-40112 2/1993  
 JP 0006030945 A 2/1994  
 JP 6-121797 A 5/1994  
 JP 6-285078 A 10/1994  
 JP 6-511401 12/1994  
 JP 06343644 A 12/1994  
 JP 07265328 A 10/1995  
 JP 08056955 3/1996  
 JP 08252263 A 10/1996  
 JP 8-289895 A 11/1996  
 JP 8-317934 A 12/1996  
 JP 8-317936 A 12/1996  
 JP 9-10223 C 1/1997  
 JP 09000538 A 1/1997  
 JP 9-122138 A 5/1997  
 JP 0010000195 A 1/1998  
 JP 10-155798 A 6/1998  
 JP 11-47149 2/1999  
 JP 11-070124 A 3/1999  
 JP 11-169381 A 6/1999

(56)

## References Cited

## FOREIGN PATENT DOCUMENTS

JP	11-192238	A	7/1999
JP	11244298	A	9/1999
JP	2000-102545	A	4/2000
JP	2000-135222	A	5/2000
JP	2000342599	A	12/2000
JP	2000350732	A	12/2000
JP	2001008944	A	1/2001
JP	2001-29355		2/2001
JP	2001029356	A	2/2001
JP	2001-03400		4/2001
JP	2001128990	A	5/2001
JP	2001-190564	A	7/2001
JP	2002-136525	A	5/2002
JP	2002-528166	A	9/2002
JP	2003-116871	A	4/2003
JP	2003-175052	A	6/2003
JP	2003245285	A	9/2003
JP	2004-517668	A	6/2004
JP	2004-528869	A	9/2004
JP	2005-152663	A	6/2005
JP	2005-253789	A	9/2005
JP	2005312807	A	11/2005
JP	2006-015078	A	1/2006
JP	2006-501939	A	1/2006
JP	2006-095316	A	4/2006
JP	2008-054926	A	3/2008
JP	2011125195	A	6/2011
SU	401367	A1	11/1974
WO	00/24330		5/2000
WO	0036986	A1	6/2000
WO	0059392	A1	10/2000
WO	0115614	A1	3/2001
WO	0154604	A1	8/2001
WO	02/45589		6/2002
WO	02/080784		10/2002
WO	02/080785		10/2002
WO	02/080786		10/2002
WO	2006021269	A1	3/2006
WO	2005110264	A3	4/2006
WO	2008/040483	A1	4/2008
WO	2011/018154	A1	2/2011

## OTHER PUBLICATIONS

Michael Choti, "Abdominoperineal Resection with the LigaSure Vessel Sealing System and LigaSure Atlas 20 cm Open Instrument"; *Innovations That Work*, Jun. 2003.

Chung et al., "Clinical Experience of Sutureless Closed Hemorrhoidectomy with LigaSure" *Diseases of the Colon & Rectum* vol. 46, No. 1 Jan. 2003.

Tinkler L.F., "Combined Diathermy and Suction Forceps", Feb. 6, 1967 (Feb. 6, 1965), *British Medical Journal* Feb. 6, 1976, vol. 1, nr. 5431 p. 361, ISSN: 0007-1447.

Carbonell et al., "Comparison of the Gyros PlasmaKinetic Sealer and the Valleylab LigaSure Device in the Hemostasis of Small, Medium, and Large-Sized Arteries" *Carolinan Laparoscopic and Advanced Surgery Program*, Carolinas Medical Center, Charlotte, NC; Date: Aug. 2003.

Peterson et al. "Comparison of Healing Process Following Ligation with Sutures and Bipolar Vessel Sealing" *Surgical Technology International* (2001).

"Electrosurgery: A Historical Overview" *Innovations in Electrosurgery*; Sales/Product Literature; Dec. 31, 2000.

Johnson et al. "Evaluation of a Bipolar Electrothermal Vessel Sealing Device in Hemorrhoidectomy" *Sales/Product Literature*; Jan. 2004.

E. David Crawford "Evaluation of a New Vessel Sealing Device in Urologic Cancer Surgery" *Sales/Product Literature* 2000.

Johnson et al. "Evaluation of the LigaSure Vessel Sealing System in Hemorrhoidectomy" *American College of Surgeons (ACS) Clinical Congress Poster* (2000).

Muller et al., "Extended Left Hemicolectomy Using the LigaSure Vessel Sealing System" *Innovations That Work*, Sep. 1999.

Kennedy et al. "High-burst-strength, feedback-controlled bipolar vessel sealing" *Surgical Endoscopy* (1998) 12:876-878.

Burdette et al. "In Vivo Probe Measurement Technique for Determining Dielectric Properties at VHF Through Microwave Frequencies", *IEEE Transactions on Microwave Theory and Techniques*, vol. MTT-28, No. 4, Apr. 1980 pp. 414-427.

Carus et al., "Initial Experience With the LigaSure Vessel Sealing System in Abdominal Surgery" *Innovations That Work*, Jun. 2002.

Heniford et al. "Initial Results with an Electrothermal Bipolar Vessel Sealer" *Surgical Endoscopy* (2000) 15:799-801.

Herman et al., "Laparoscopic Intestinal Resection With the LigaSure Vessel Sealing System: A Case Report"; *Innovations That Work*, Feb. 2002.

Koyle et al., "Laparoscopic Palomo Varicocele Ligation in Children and Adolescents" *Pediatric Endosurgery & Innovative Techniques*, vol. 6, No. 1, 2002.

W. Scott Helton, "LigaSure Vessel Sealing System: Revolutionary Hemostasis Product for General Surgery"; *Sales/Product Literature* 1999.

LigaSure Vessel Sealing System, the Seal of Confidence in General, Gynecologic, Urologic, and Laparoscopic Surgery; *Sales/Product Literature*; Apr. 2002.

Joseph Ortenberg "LigaSure System Used in Laparoscopic 1st and 2nd Stage Orchiopexy" *Innovations That Work*, Nov. 2002.

Sigel et al. "The Mechanism of Blood Vessel Closure by High Frequency Electrocoagulation" *Surgery Gynecology & Obstetrics*, Oct. 1965 pp. 823-831.

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.

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.

Benaron et al., "Optical Time-Of-Flight and Absorbance Imaging of Biologic Media", *Science, American Association for the Advancement of Science*, Washington, DC, vol. 259, Mar. 5, 1993, pp. 1463-1466.

Olsson et al. "Radical Cystectomy in Females" *Current Surgical Techniques in Urology*, vol. 14, Issue 3, 2001.

Palazzo et al. "Randomized clinical trial of Ligasure versus open haemorrhoidectomy" *British Journal of Surgery* 2002, 89, 154-157.

Levy et al. "Randomized Trial of Suture Versus Electrosurgical Bipolar Vessel Sealing in Vaginal Hysterectomy" *Obstetrics & Gynecology*, vol. 102, No. 1, Jul. 2003.

"Reducing Needlestick Injuries in the Operating Room" *Sales/Product Literature* 2001.

Bergdahl et al. "Studies on Coagulation and the Development of an Automatic Computerized Bipolar Coagulator" *J. Neurosurg*, vol. 75, Jul. 1991, pp. 148-151.

Strasberg et al. "A Phase I Study of the LigaSure Vessel Sealing System in Hepatic Surgery" *Section of HPB Surgery*, Washington University School of Medicine, St. Louis MO, Presented at AHPBA, Feb. 2001.

Sayfan et al. "Sutureless Closed Hemorrhoidectomy: A New Technique" *Annals of Surgery* vol. 234 No. 1 Jul. 2001; pp. 21-24.

Levy et al., "Update on Hysterectomy—New Technologies and Techniques" *OBG Management*, Feb. 2003.

Dulemba et al. "Use of a Bipolar Electrothermal Vessel Sealer in Laparoscopically Assisted Vaginal Hysterectomy" *Sales/Product Literature*; Jan. 2004.

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.

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.

Rothenberg et al. "Use of the LigaSure Vessel Sealing System in Minimally Invasive Surgery in Children" *Int'l Pediatric Endosurgery Group (IPEG)* 2000.

(56)

**References Cited**

## OTHER PUBLICATIONS

- Crawford et al. "Use of the LigaSure Vessel Sealing System in Urologic Cancer Surgery" Grand Rounds in Urology 1999 vol. 1 Issue 4 pp. 10-17.
- Craig Johnson, "Use of the LigaSure Vessel Sealing System in Bloodless Hemorrhoidectomy" Innovations That Work, Mar. 2000.
- 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.
- Barbara Levy, "Use of a New Vessel Ligation Device During Vaginal Hysterectomy" FIGO 2000, Washington, D.C.
- E. David Crawford "Use of a Novel Vessel Sealing Technology in Management of the Dorsal Venous 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.
- Crouch et al. "A Velocity-Dependent Model for Needle Insertion in Soft Tissue" MICCAI 2005; LNCS 3750 pp. 624-632, Dated: 2005.
- McLellan et al. "Vessel Sealing for Hemostasis During Pelvic Surgery" Int'l Federation of Gynecology and Obstetrics FIGO World Congress 2000, Washington, D.C.
- McLellan et al. "Vessel Sealing for Hemostasis During Gynecologic Surgery" Sales/Product Literature 1999.

\* cited by examiner

*Primary Examiner* — Ian Simmons*Assistant Examiner* — Samantha Q Lawrence

(57)

**CLAIM**

The ornamental design for an open vessel sealer with mechanical cutter, as shown and described.

**DESCRIPTION**

- FIG. 1 is a front, perspective view of an open vessel sealer with mechanical cutter showing the new design;
- FIG. 2 is a front view of the open vessel sealer with mechanical cutter of FIG. 1;
- FIG. 3 is a rear view of vessel sealer with mechanical cutter of FIG. 1;
- FIG. 4 is a left side view of the open vessel sealer with mechanical cutter of FIG. 1;

FIG. 5 is a right side view of the open vessel sealer with mechanical cutter of FIG. 1;

FIG. 6 is a top view of the open vessel sealer with mechanical cutter of FIG. 1; and

FIG. 7 is a bottom view of the open vessel sealer with mechanical cutter of FIG. 1.

FIG. 8 is a front, perspective view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 1 taken along line 8 of FIG. 1.

FIG. 9 is a front, perspective view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 1 taken along line 9 of FIG. 1.

FIG. 10 is a front view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 2 taken along line 10 of FIG. 2.

FIG. 11 is a rear view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 3 taken along line 11 of FIG. 3.

FIG. 12 is a left side view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 4 taken along line 12 of FIG. 4.

FIG. 13 is a left side view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 4 taken along line 13 of FIG. 4.

FIG. 14 is a right side view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 5 taken along line 14 of FIG. 5.

FIG. 15 is a right side view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 5 taken along line 15 of FIG. 5.

FIG. 16 is a top view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 6 taken along line 16 of FIG. 6.

FIG. 17 is a bottom view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 7 taken along line 17 of FIG. 7; and,

FIG. 18 is a bottom view of an enlarged portion of the open vessel sealer with mechanical cutter of FIG. 7 taken along line 18 of FIG. 7.

The broken lines shown in FIGS. 1, 2, 4-7, 9, 10, 12, 13-18 illustrate portions of the open vessel sealer with mechanical cutter that form no part of the claimed design.

**1 Claim, 14 Drawing Sheets**

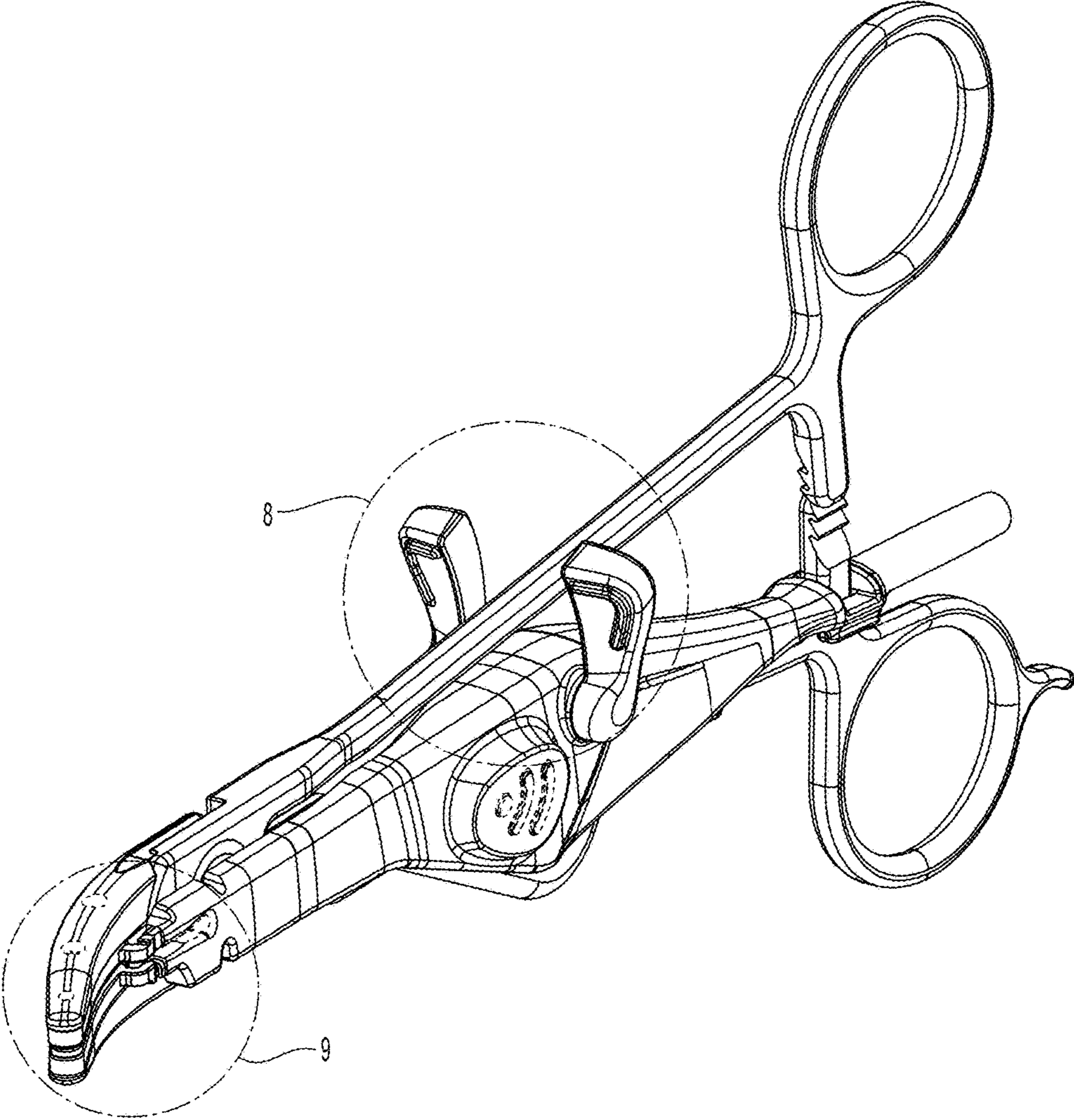
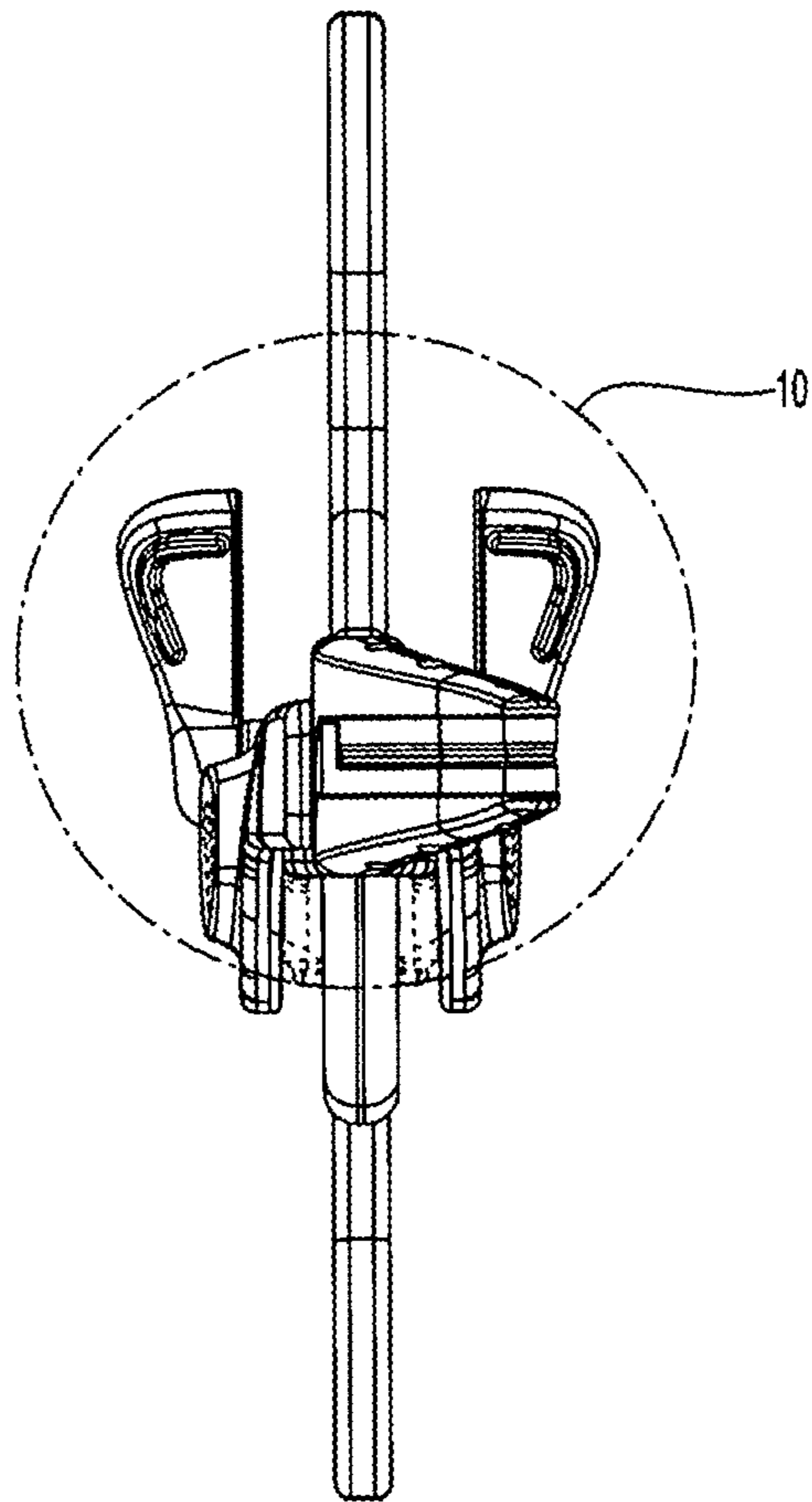
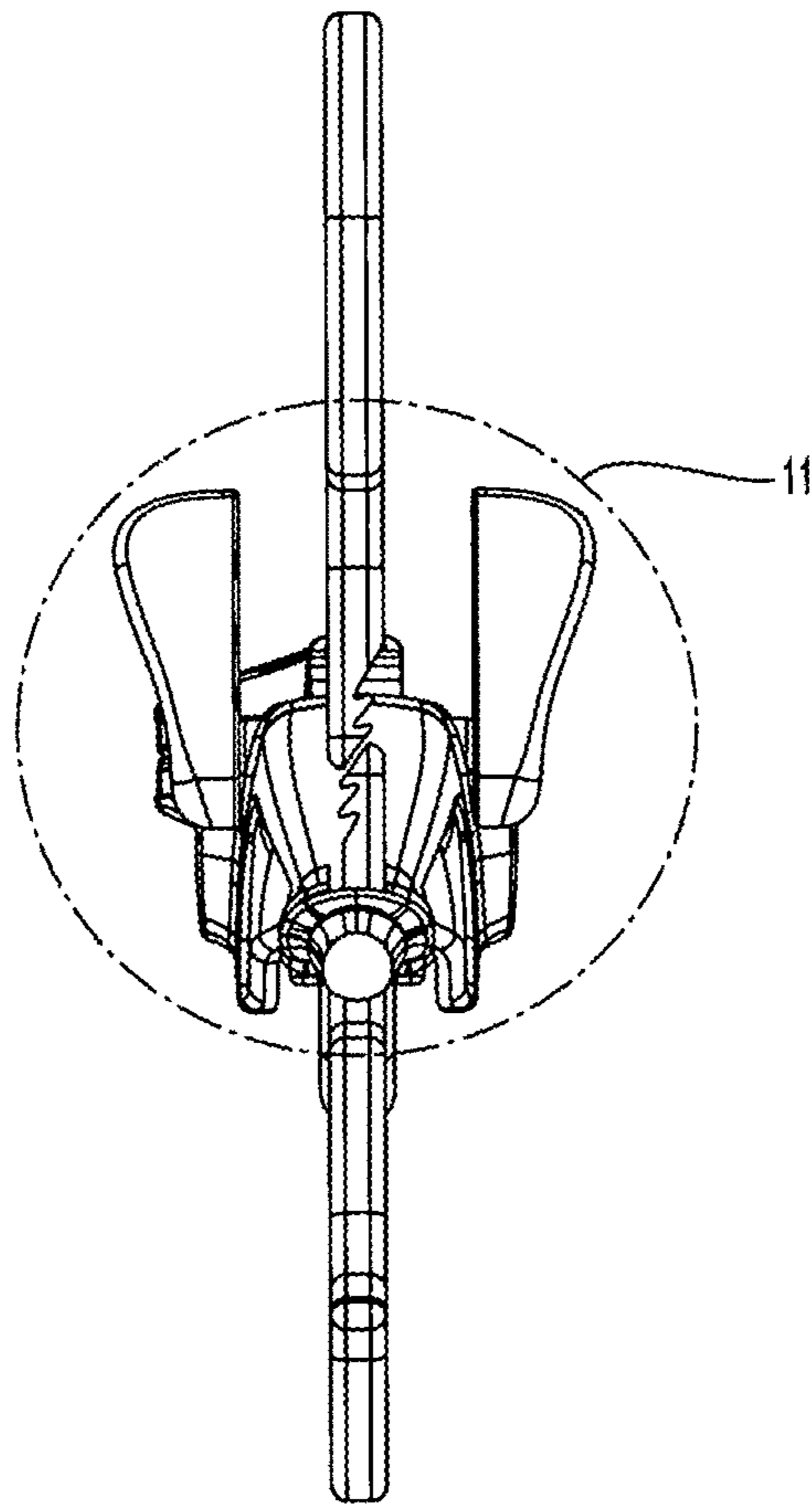


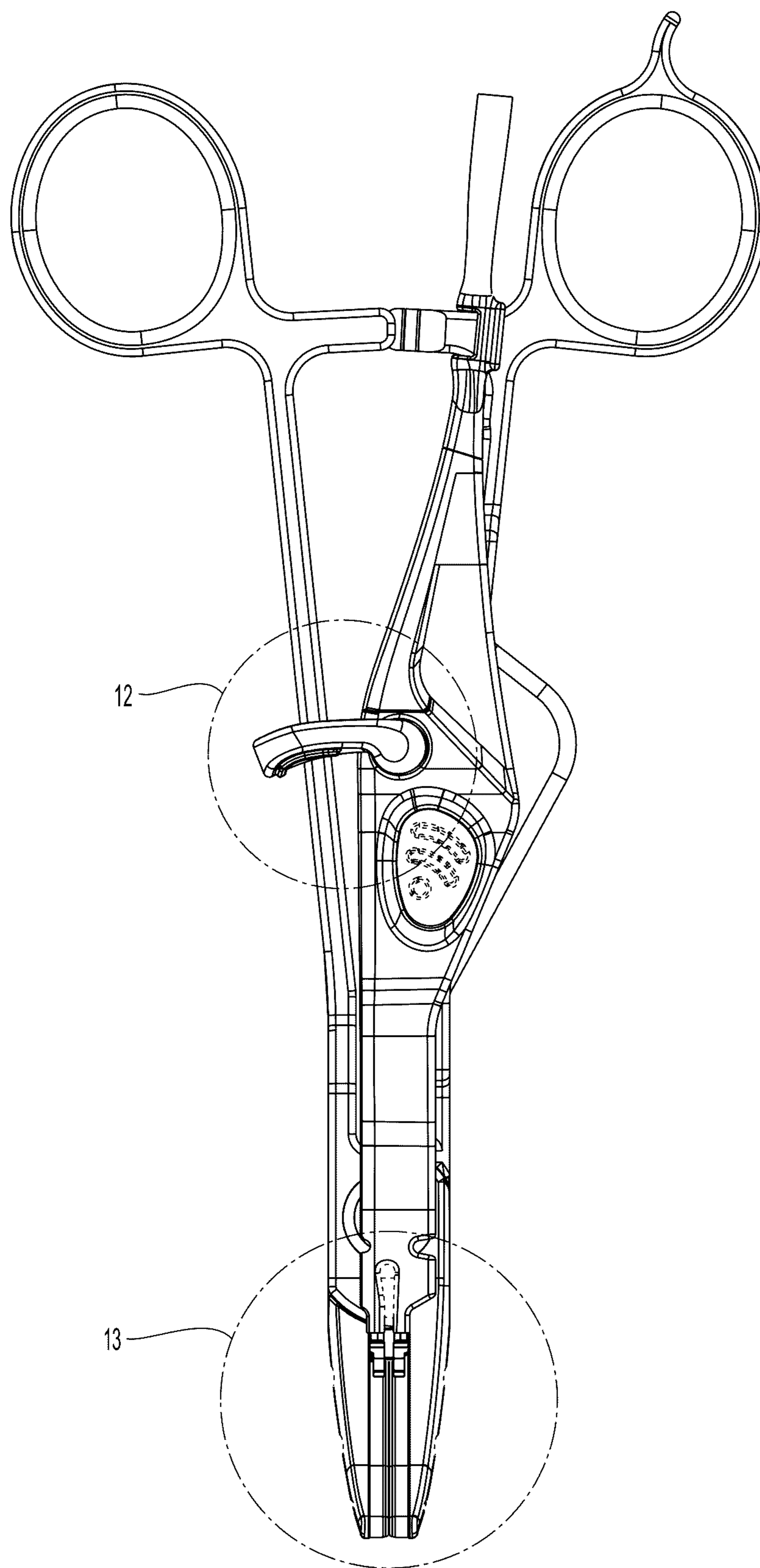
Fig. 1



**Fig. 2**

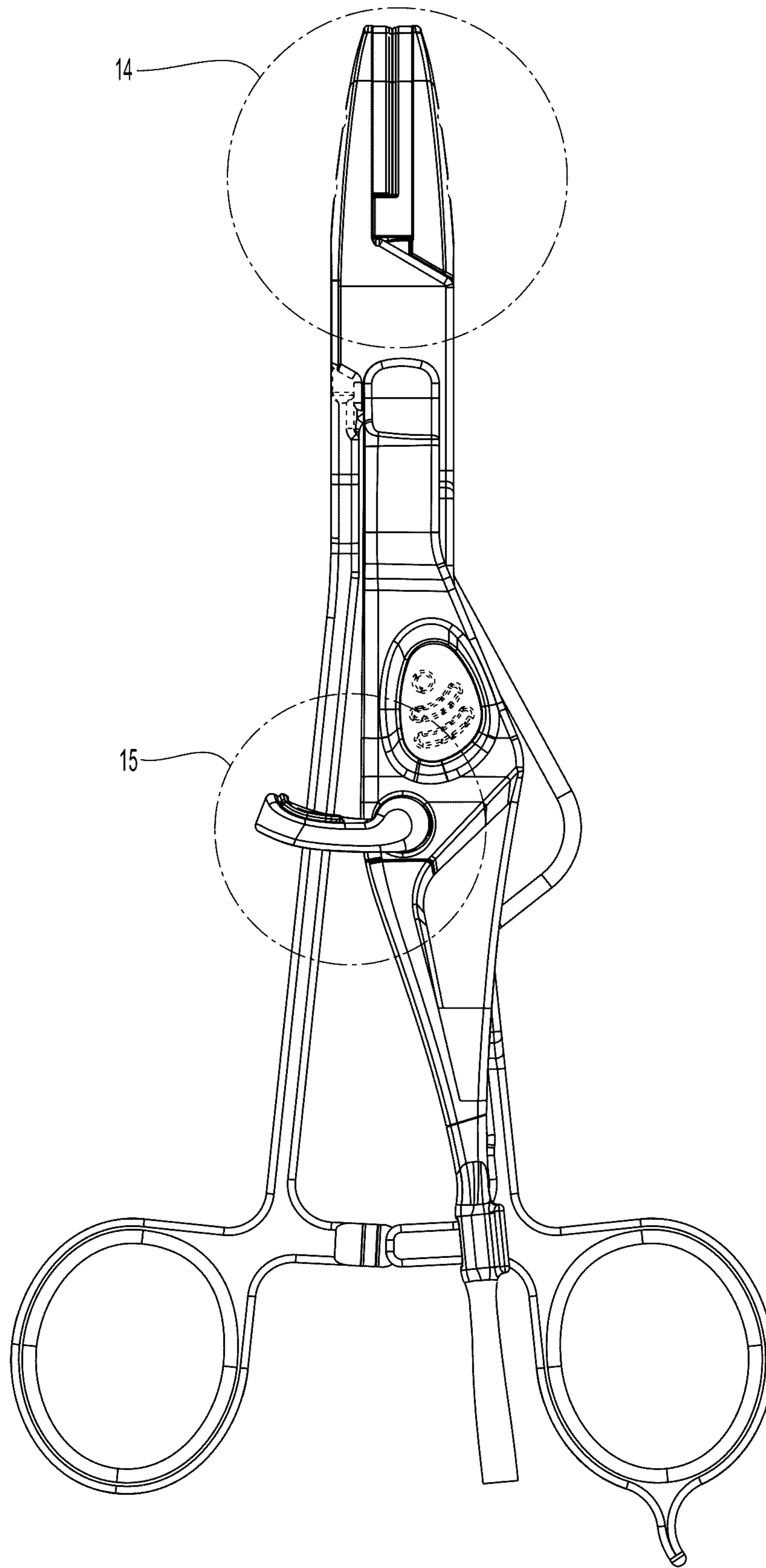


**Fig. 3**

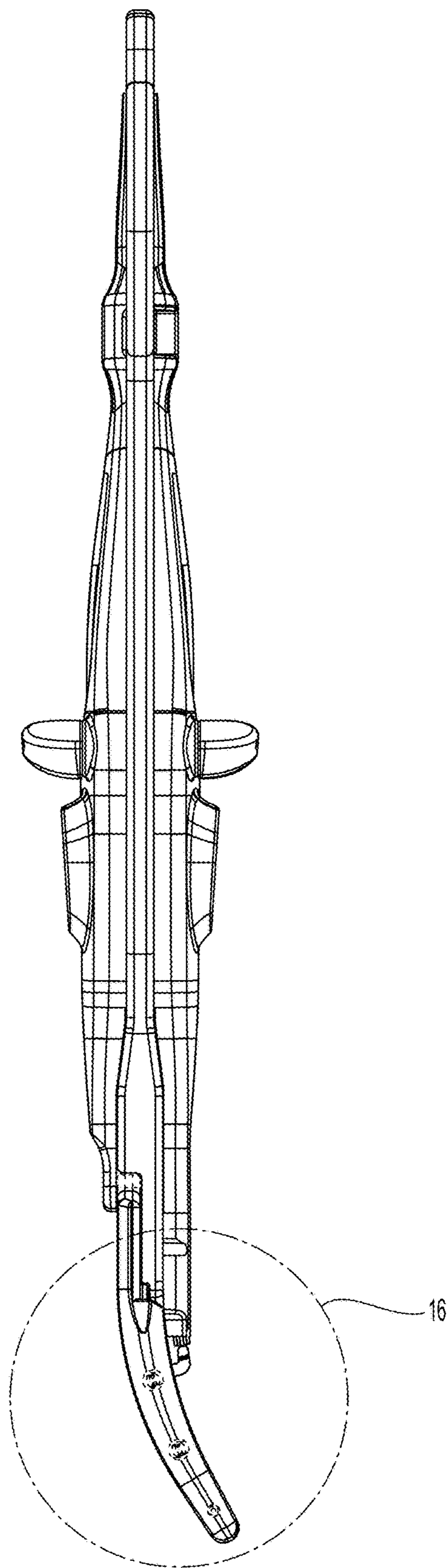


**Fig. 4**





**Fig. 5**



**Fig. 6**

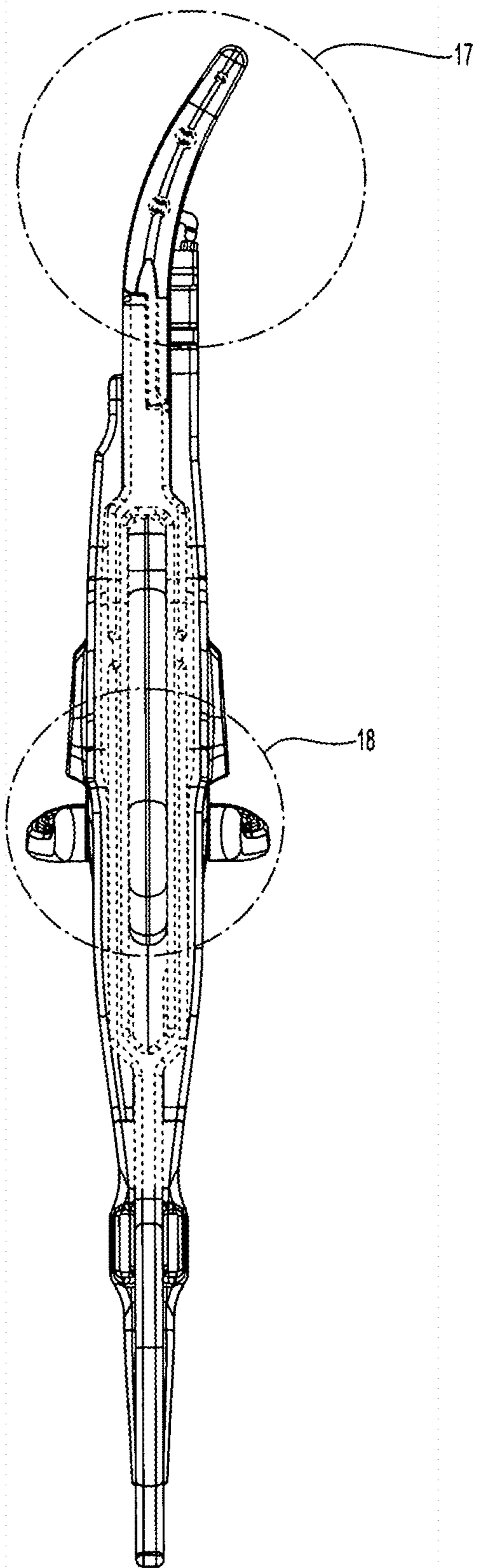
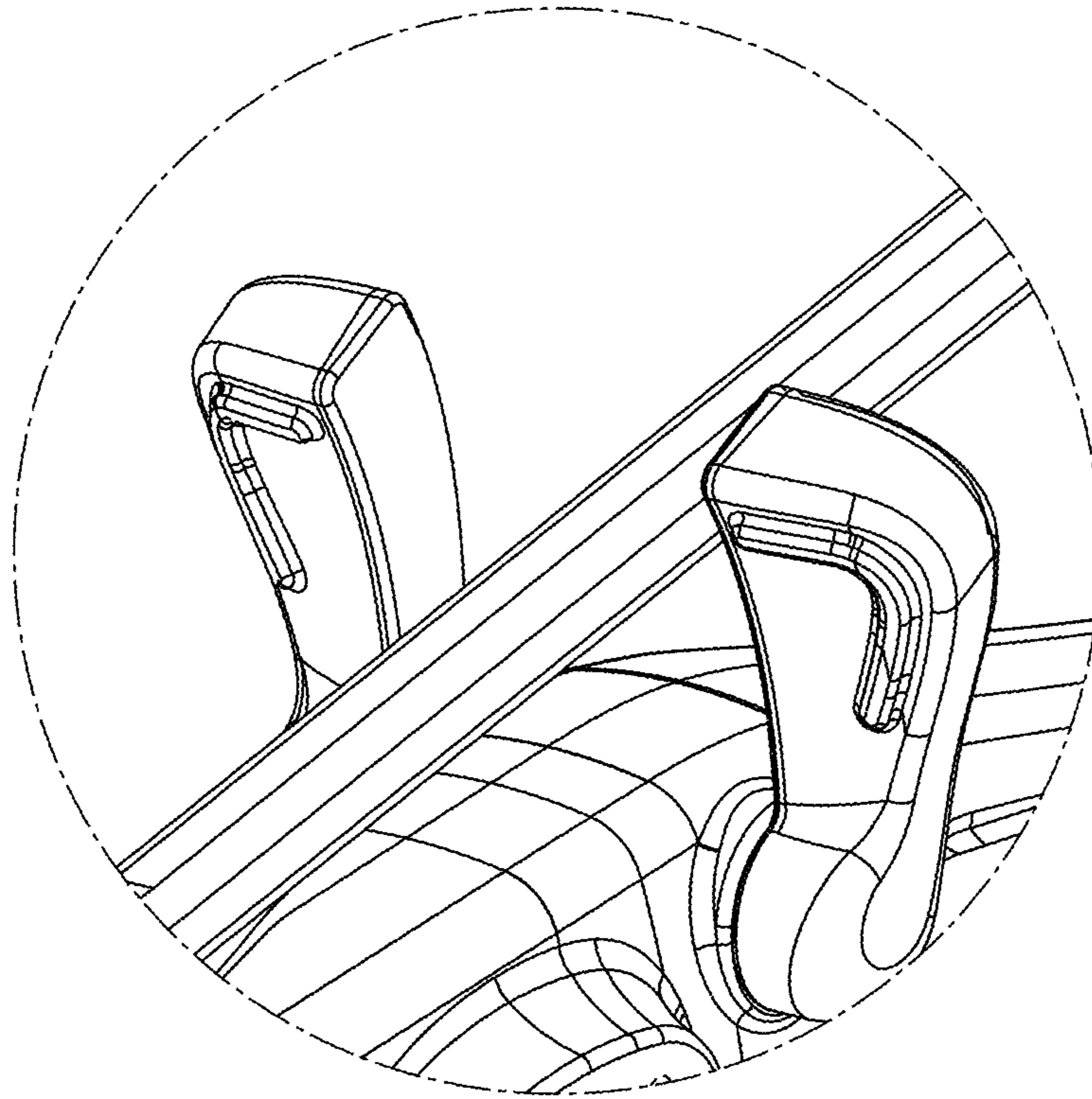
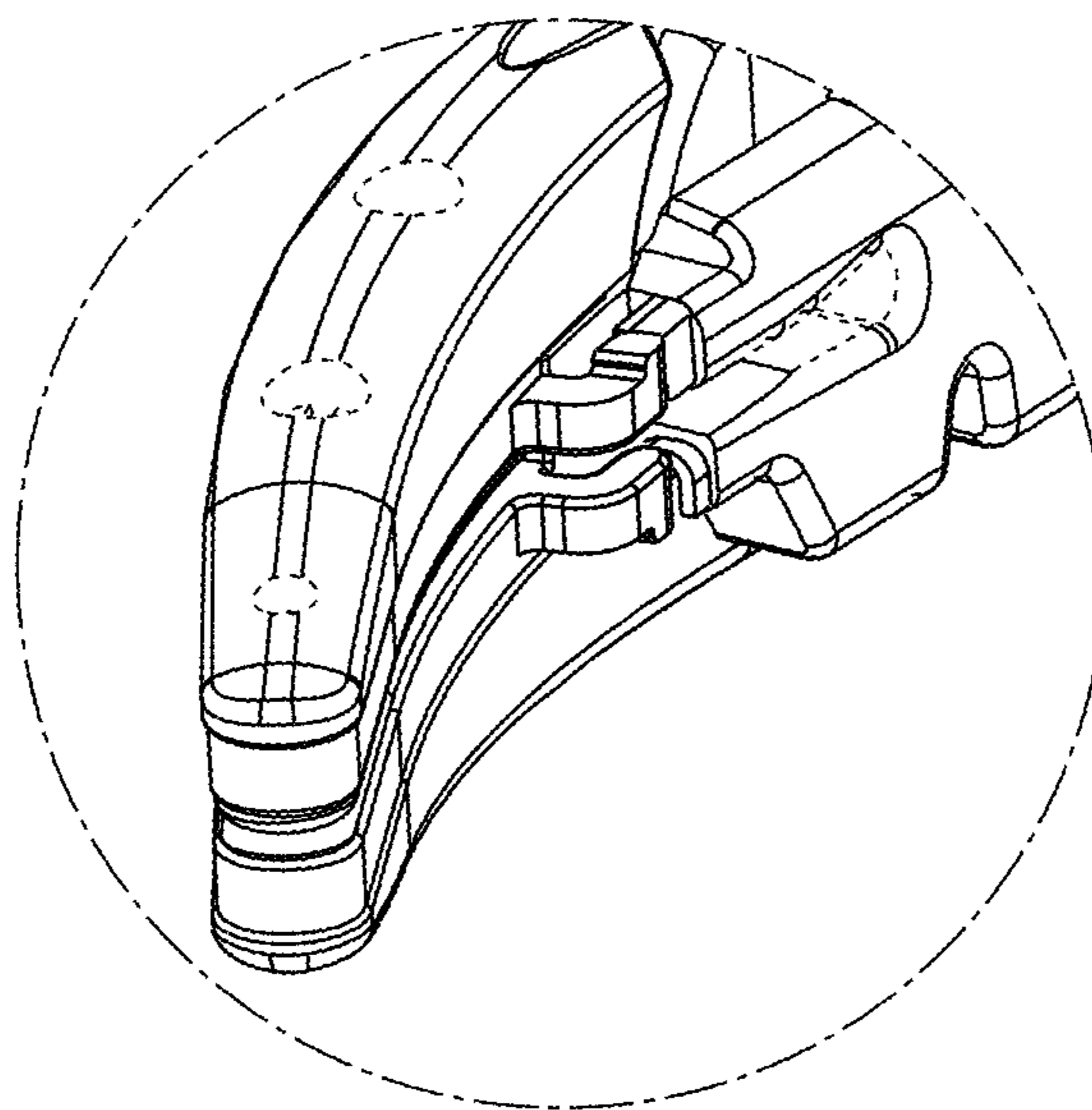


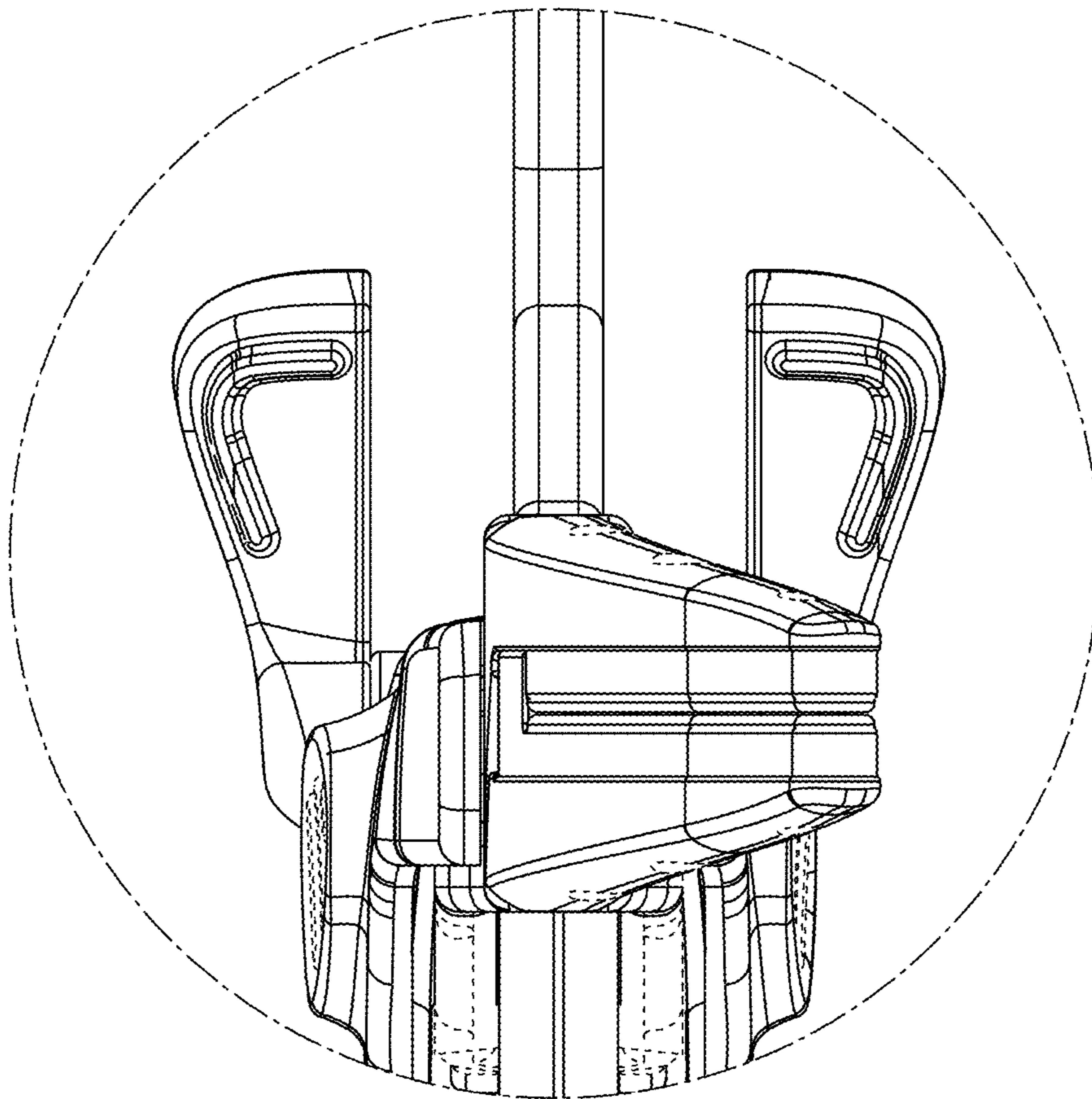
Fig. 7



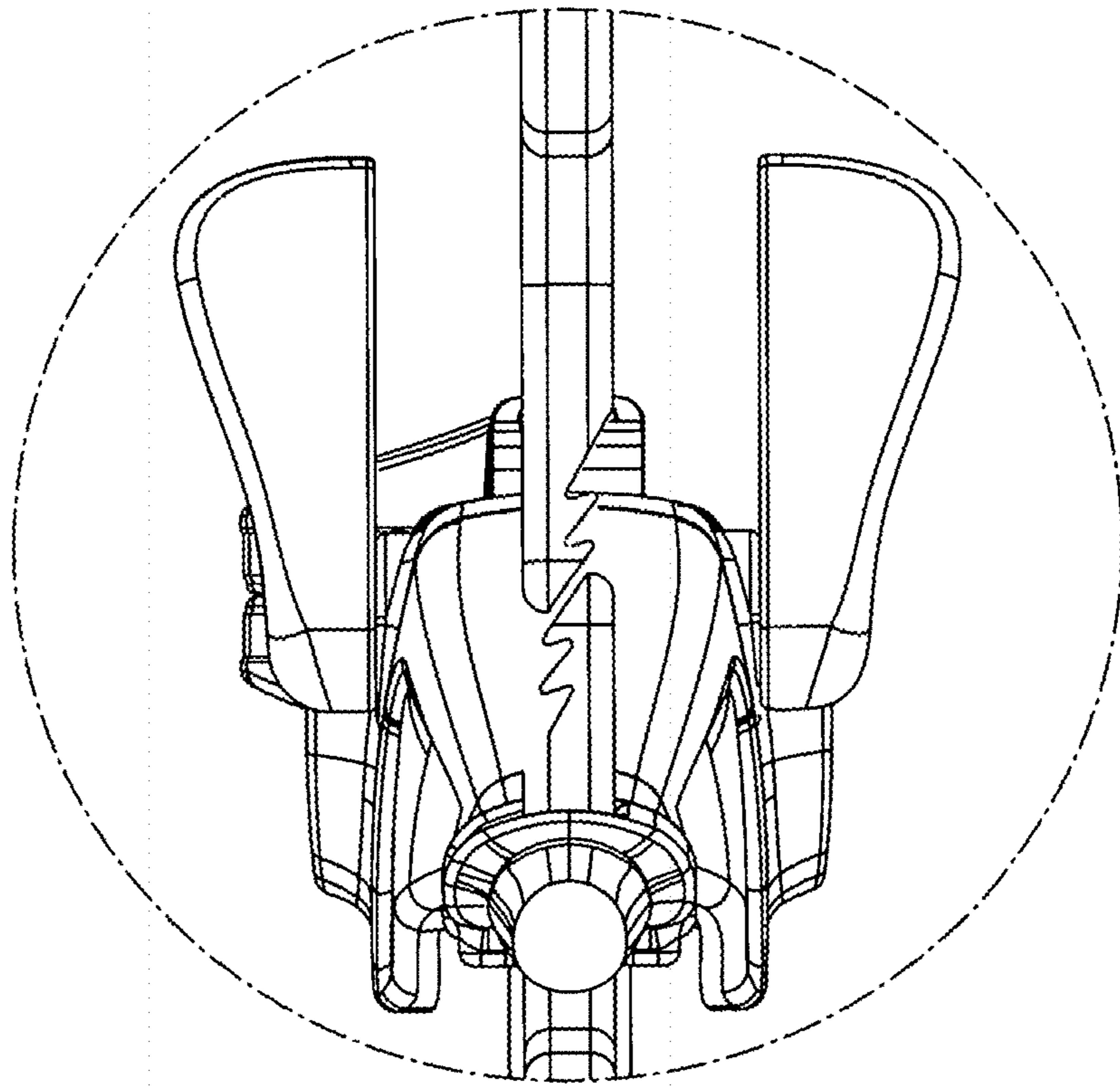
**Fig. 8**



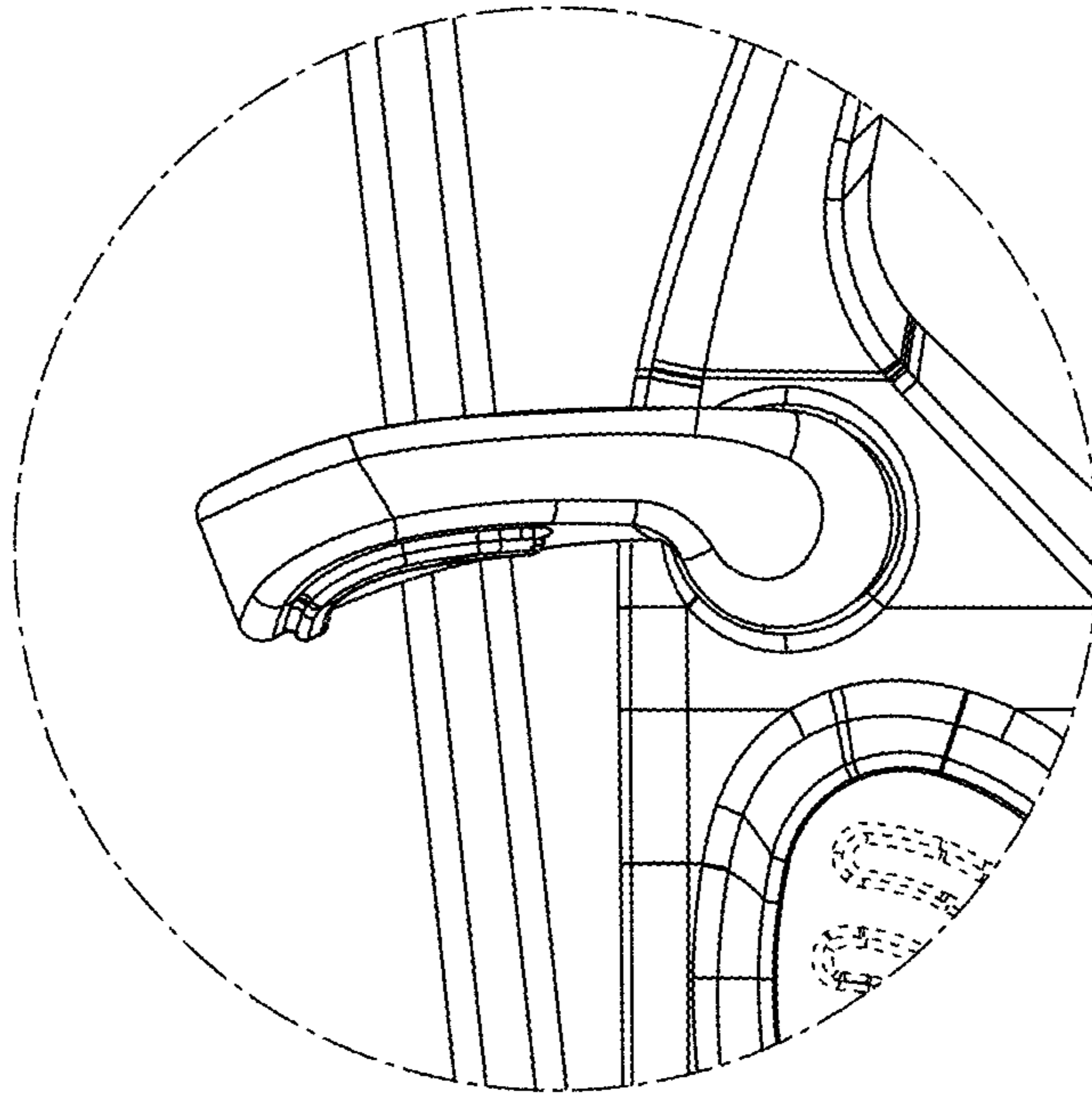
**Fig. 9**



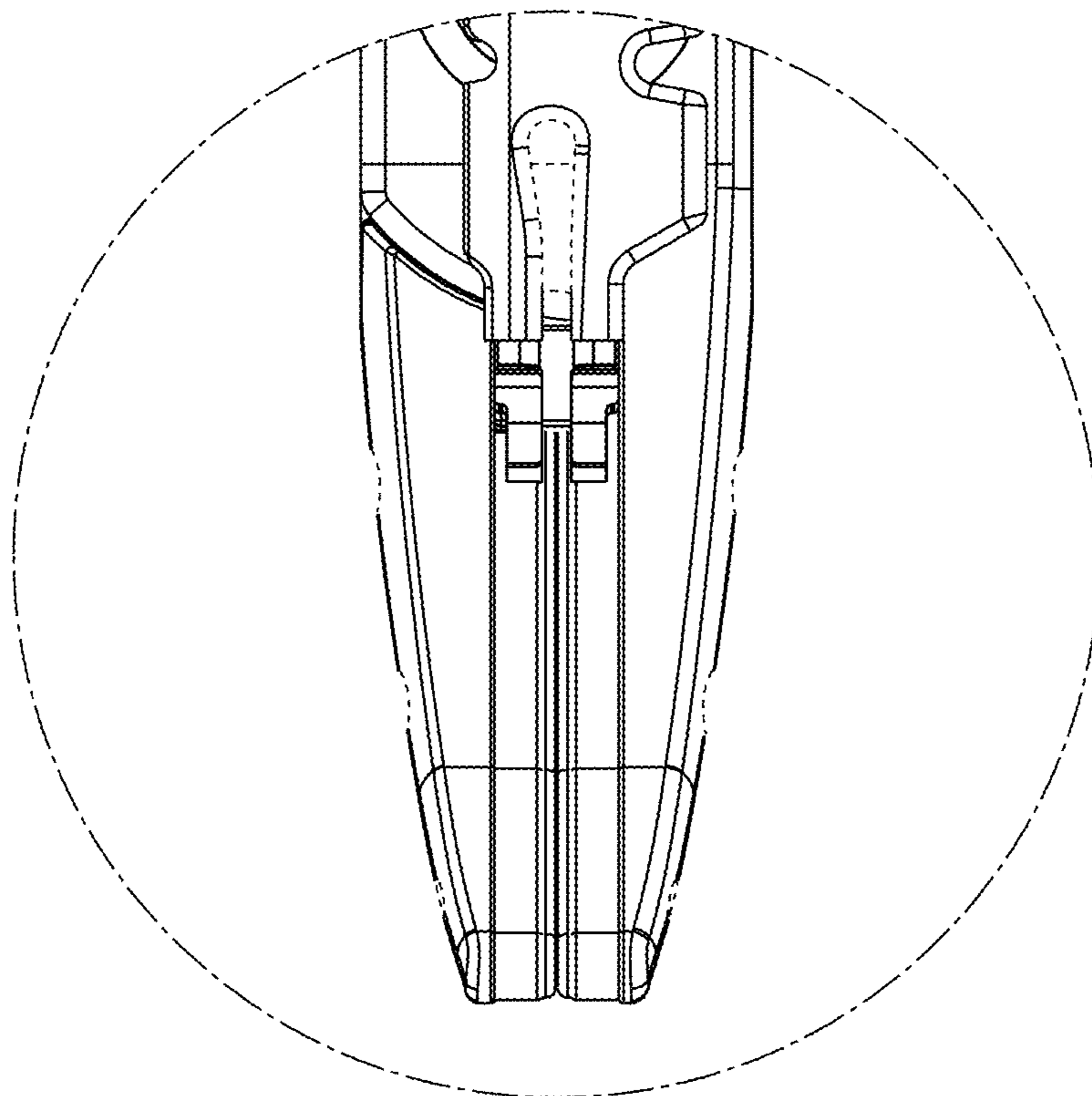
**Fig. 10**



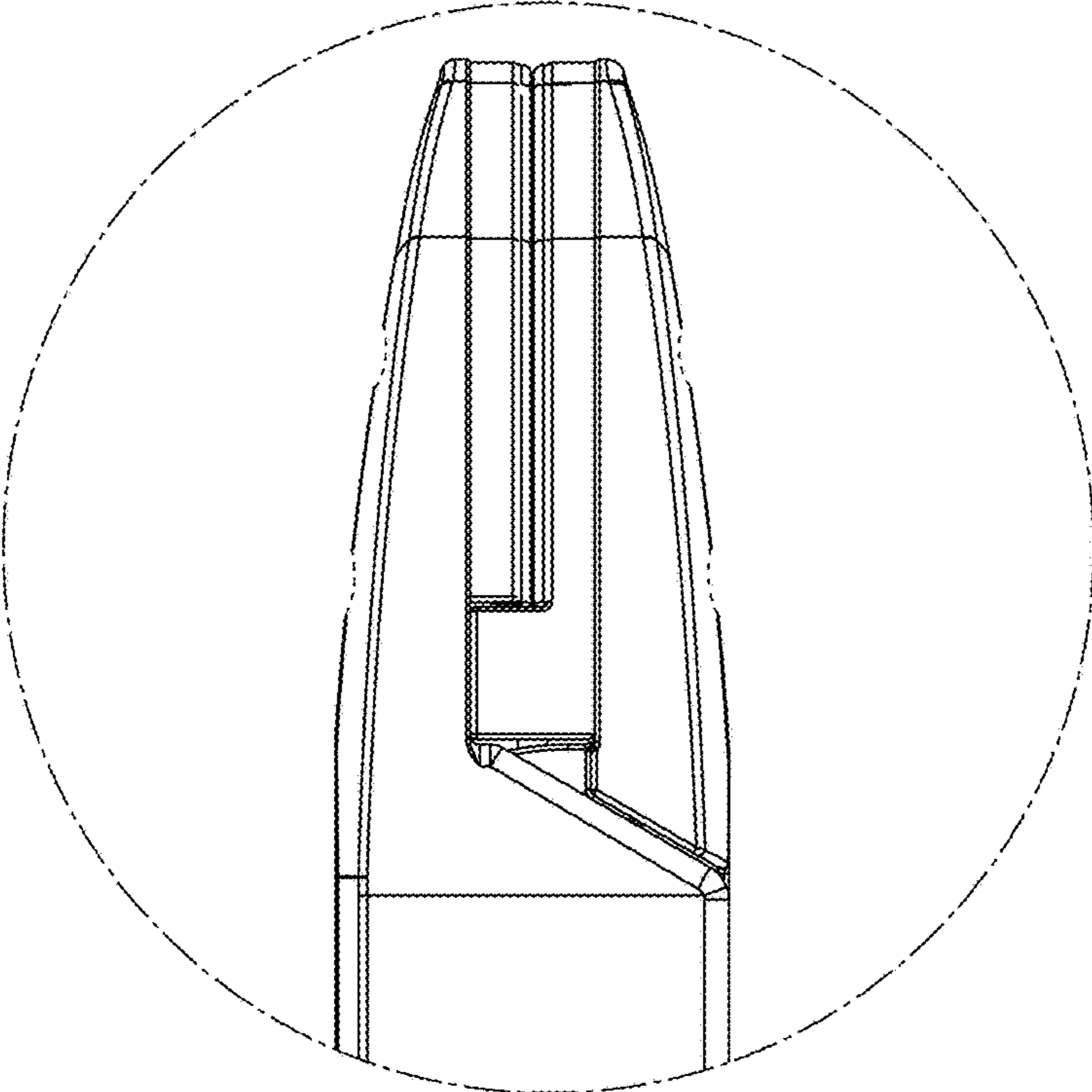
**Fig. 11**



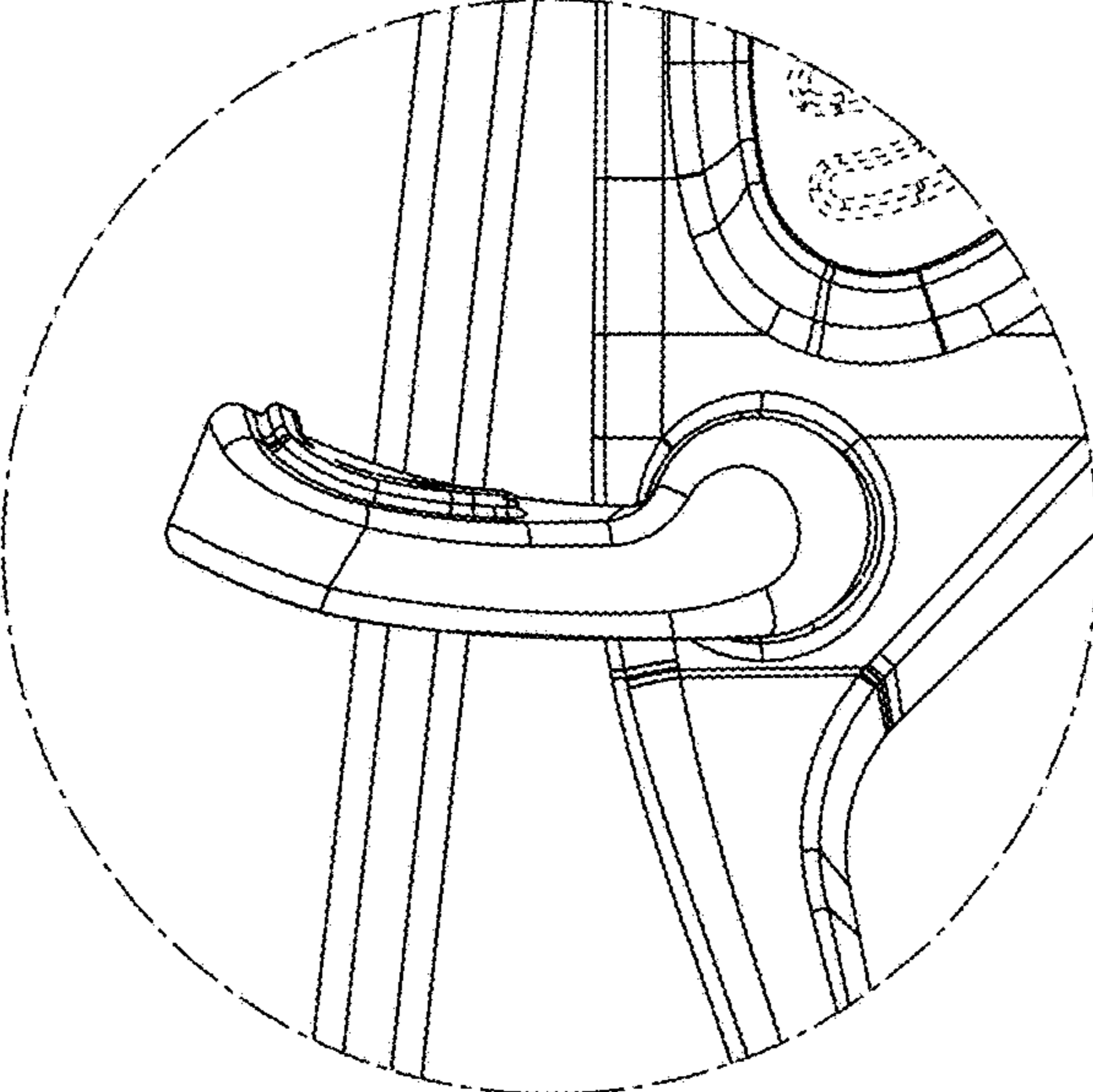
**Fig. 12**



**Fig. 13**

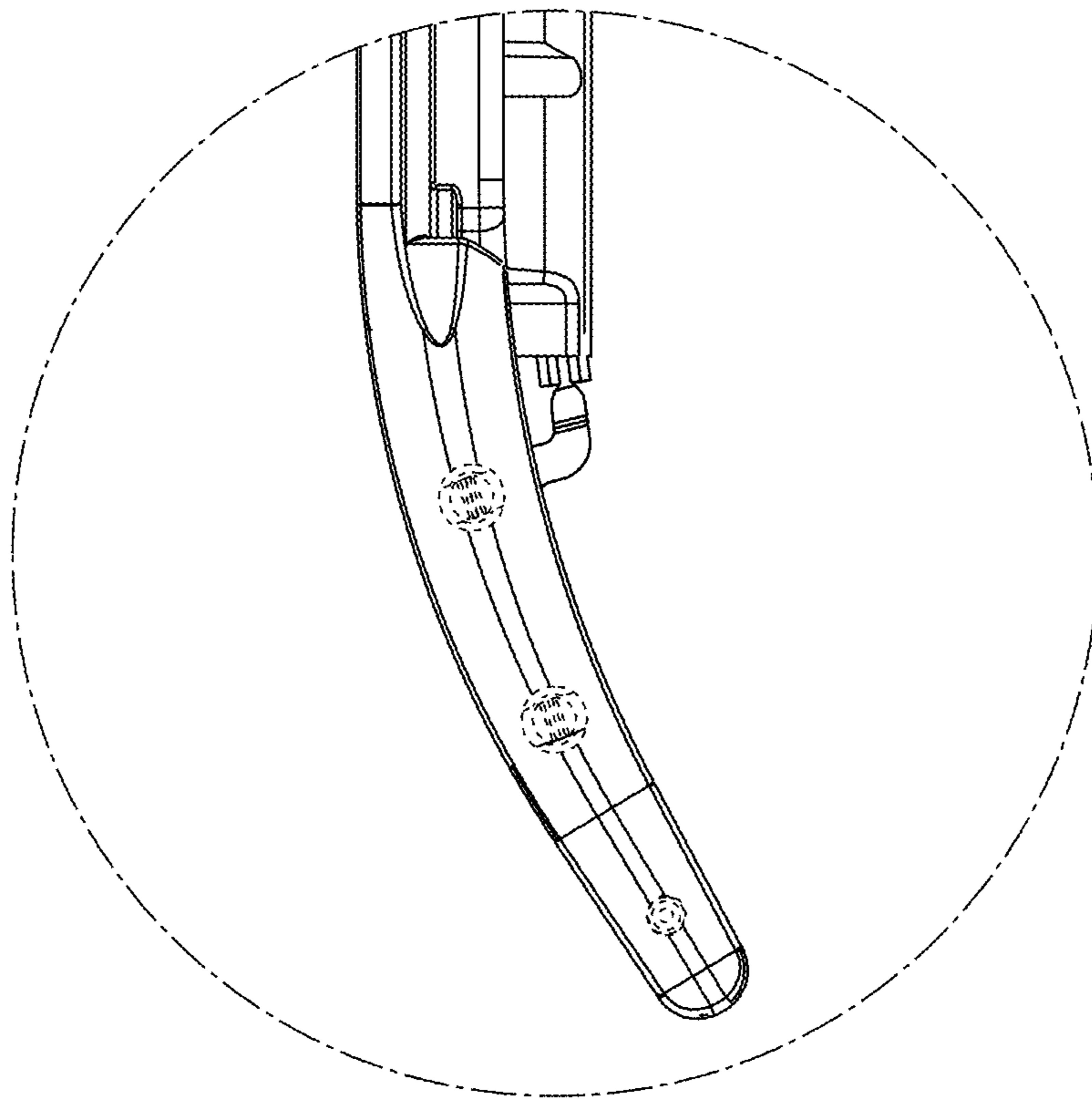


**Fig. 14**

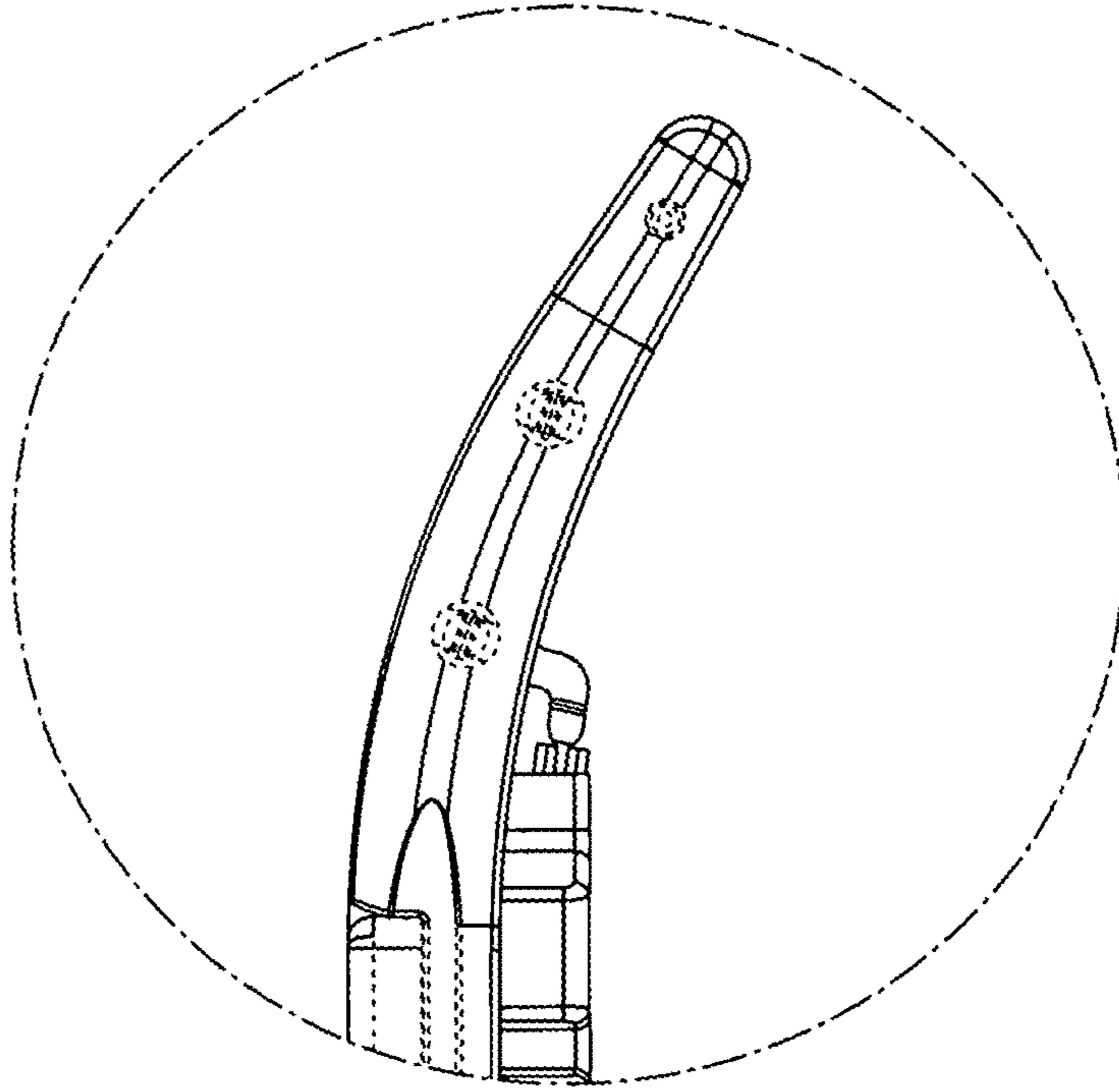


**Fig. 15**

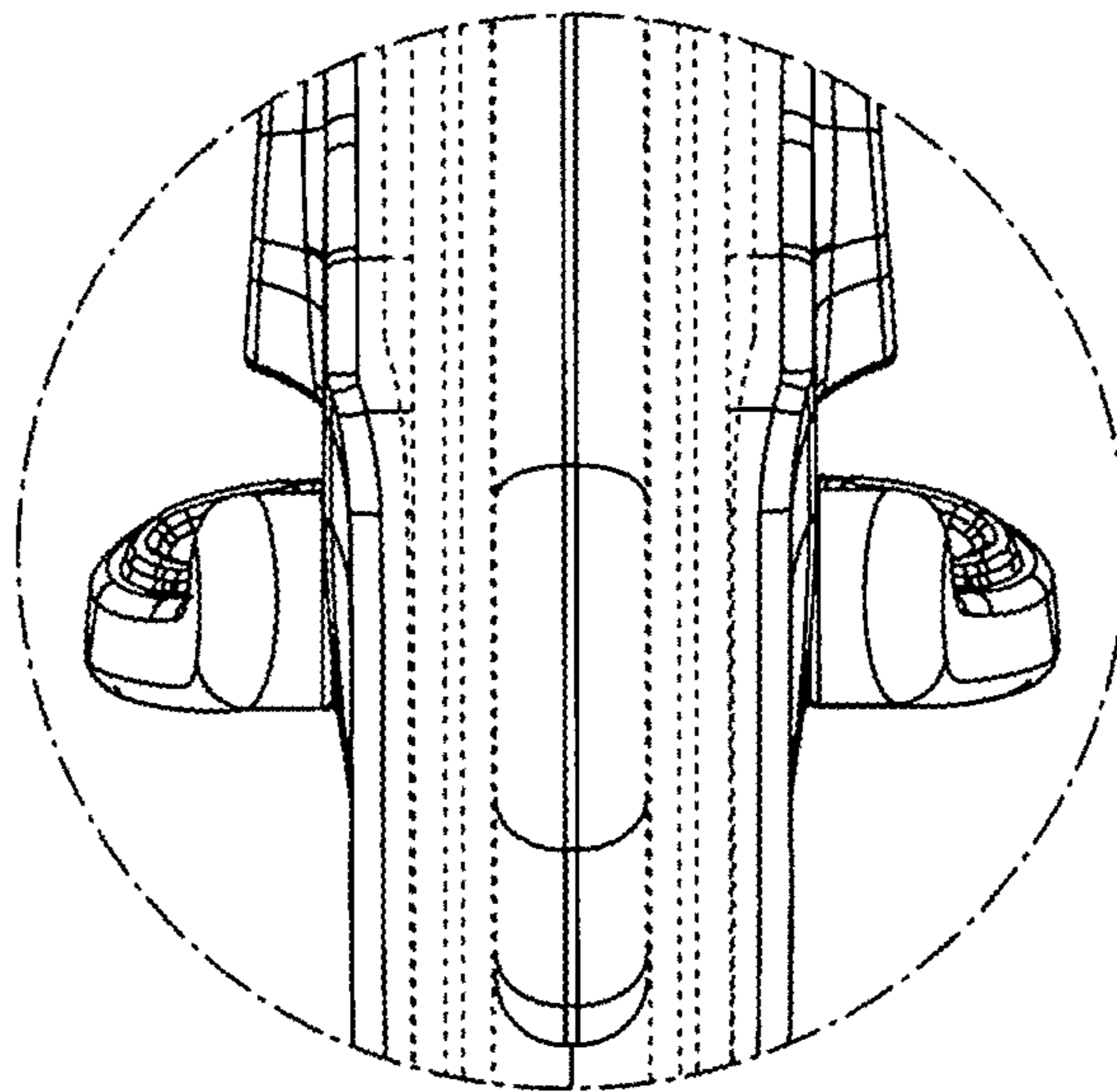




**Fig. 16**



**Fig. 17**



**Fig. 18**