



US00D699359S

(12) **United States Design Patent**  
**Lindekugel et al.**

(10) **Patent No.:** **US D699,359 S**  
(45) **Date of Patent:** **\*\* Feb. 11, 2014**

(54) **ULTRASOUND PROBE HEAD**

FOREIGN PATENT DOCUMENTS

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AU 642647 11/1990  
AU 1860597 B2 6/1999

(Continued)

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PCT/US2011/052793 filed Sep. 22, 2011 Written Opinion dated Jan. 6, 2012.

(\*\*) Term: **14 Years**

(Continued)

(21) Appl. No.: **29/428,649**

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(22) Filed: **Aug. 1, 2012**

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OTHER PUBLICATIONS

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 13/206,396, filed on Aug. 9, 2011.

(51) **LOC (10) Cl.** ..... **24-01**

(52) **U.S. Cl.**

USPC ..... **D24/186**

(58) **Field of Classification Search**

USPC ..... D24/107, 141, 158, 164, 165, 167, 170,  
D24/186–187, 231; D10/57, 60, 78, 80;  
600/407, 461, 459; 378/98.7, 98.8,  
378/189; D8/356

See application file for complete search history.

(57) **CLAIM**

The ornamental design for an ultrasound probe head, as shown and described.

**DESCRIPTION**

FIG. 1 is a front perspective view of an ultrasound probe head showing my new design;

FIG. 2 is a rear perspective view of the ultrasound probe head illustrated in FIG. 1;

FIG. 3 is a front elevation view of the ultrasound probe head illustrated in FIG. 1;

FIG. 4 is a first side elevation view of the ultrasound probe head illustrated in FIG. 1;

FIG. 5 is a bottom view of the ultrasound probe head illustrated in FIG. 1;

FIG. 6 is a rear elevation view of the ultrasound probe head illustrated in FIG. 1;

FIG. 7 is a second side elevation view of the ultrasound probe head illustrated in FIG. 1; and,

FIG. 8 is a top view of the ultrasound probe head illustrated in FIG. 1.

The broken lines are included for the purpose of illustrating portions of the ultrasound probe head that forms no part of the claimed design.

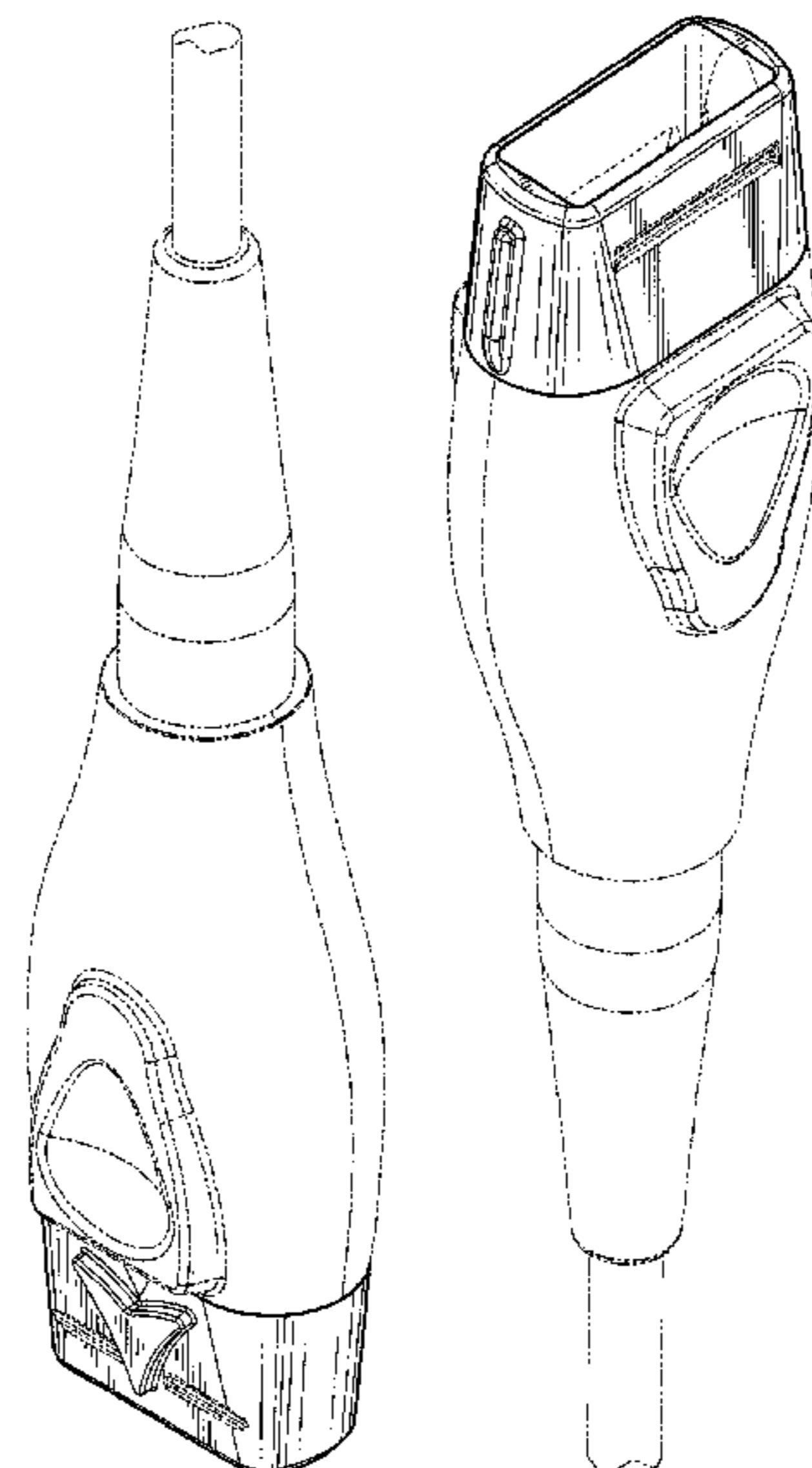
(56) **References Cited**

U.S. PATENT DOCUMENTS

3,133,244	A	5/1964	Wojtulewicz
3,297,020	A	1/1967	Mathiesen
3,625,200	A	12/1971	Muller
3,674,014	A	7/1972	Tillander et al.
3,817,241	A	6/1974	Grausz
3,847,157	A	11/1974	Caillouette et al.
3,868,565	A	2/1975	Kuipers

(Continued)

**1 Claim, 3 Drawing Sheets**













(56)

References Cited

U.S. PATENT DOCUMENTS

2007/0167738 A1 7/2007 Timinger et al.  
 2007/0167801 A1 7/2007 Webler et al.  
 2007/0167997 A1 7/2007 Forsberg et al.  
 2007/0197905 A1 8/2007 Timinger et al.  
 2007/0208255 A1 9/2007 Ridley et al.  
 2007/0225589 A1 9/2007 Viswanathan  
 2007/0225610 A1 9/2007 Mickley et al.  
 2007/0232882 A1 10/2007 Glossop et al.  
 2007/0239018 A1 10/2007 Fetzer et al.  
 2007/0244413 A1 10/2007 Biggins  
 2007/0265526 A1 11/2007 Govari et al.  
 2007/0280974 A1 12/2007 Son et al.  
 2007/0282196 A1 12/2007 Birk et al.  
 2007/0282197 A1 12/2007 Bill et al.  
 2007/0299352 A1 12/2007 Harlev et al.  
 2008/0008745 A1 1/2008 Stinchcomb et al.  
 2008/0015442 A1 1/2008 Watson et al.  
 2008/0027320 A1 1/2008 Bolorforosh et al.  
 2008/0045908 A1 2/2008 Gould et al.  
 2008/0081958 A1 4/2008 Denison et al.  
 2008/0082136 A1 4/2008 Gaudiani  
 2008/0097232 A1 4/2008 Rothenberg  
 2008/0108949 A1 5/2008 Beasley et al.  
 2008/0114095 A1 5/2008 Peppmoller et al.  
 2008/0125772 A1 5/2008 Stone et al.  
 2008/0139944 A1 6/2008 Weymer et al.  
 2008/0146939 A1 6/2008 McMorrow et al.  
 2008/0146940 A1 6/2008 Jenkins et al.  
 2008/0154100 A1 6/2008 Thalmeier et al.  
 2008/0166453 A1 7/2008 Steele et al.  
 2008/0171934 A1 7/2008 Greenan et al.  
 2008/0183075 A1 7/2008 Govari et al.  
 2008/0200754 A1 8/2008 Buchalter  
 2008/0228082 A1 9/2008 Scheirer et al.  
 2008/0255475 A1 10/2008 Kondrosky et al.  
 2008/0275765 A1 11/2008 Kuchar  
 2009/0005675 A1 1/2009 Grunwald et al.  
 2009/0043205 A1 2/2009 Pelissier et al.  
 2009/0084382 A1 4/2009 Jalde et al.  
 2009/0101577 A1 4/2009 Fulkerson et al.  
 2009/0118612 A1 5/2009 Grunwald et al.  
 2009/0118706 A1 5/2009 Schweikert et al.  
 2009/0143736 A1 6/2009 Mittermeyer et al.  
 2009/0156926 A1 6/2009 Messerly et al.  
 2009/0163810 A1 6/2009 Kanade et al.  
 2009/0171217 A1 7/2009 Kim et al.  
 2009/0177083 A1 7/2009 Matsumura  
 2009/0177090 A1 7/2009 Grunwald et al.  
 2009/0203989 A1 8/2009 Burnside et al.  
 2009/0204113 A1 8/2009 MacAdam et al.  
 2009/0209950 A1 8/2009 Starksen  
 2009/0227952 A1 9/2009 Blakstvedt et al.  
 2009/0234328 A1 9/2009 Cox et al.  
 2009/0258171 A1 10/2009 Uang  
 2009/0259124 A1 10/2009 Rothenberg  
 2009/0262982 A1 10/2009 Markowitz et al.  
 2009/0275828 A1 11/2009 Shachar et al.  
 2009/0297441 A1 12/2009 Canham et al.  
 2010/0004543 A1 1/2010 Ahlund et al.  
 2010/0004547 A1 1/2010 Scholz et al.  
 2010/0016726 A1 1/2010 Meier  
 2010/0036227 A1 2/2010 Cox et al.  
 2010/0049062 A1 2/2010 Ziv  
 2010/0055153 A1 3/2010 Majmudar  
 2010/0055184 A1 3/2010 Zeitels et al.  
 2010/0057157 A1 3/2010 Govari et al.  
 2010/0060472 A1 3/2010 Kimura et al.  
 2010/0083719 A1 4/2010 Peppmoller et al.  
 2010/0094116 A1 4/2010 Silverstein  
 2010/0106011 A1 4/2010 Byrd et al.  
 2010/0114573 A1 5/2010 Huang et al.  
 2010/0143119 A1 6/2010 Kooijman et al.  
 2010/0185097 A1 7/2010 Hall  
 2010/0204569 A1 8/2010 Burnside et al.  
 2010/0217116 A1 8/2010 Eck et al.

2010/0222664 A1 9/2010 Lemon et al.  
 2010/0234733 A1 9/2010 Wahlheim  
 2010/0249598 A1 9/2010 Smith et al.  
 2010/0258033 A1 10/2010 Yang et al.  
 2010/0273895 A1 10/2010 Stinchcomb et al.  
 2010/0298702 A1 11/2010 Rogers et al.  
 2010/0317981 A1 12/2010 Grunwald  
 2010/0318026 A1 12/2010 Grunwald  
 2010/0331712 A1 12/2010 Rothenberg  
 2011/0015527 A1 1/2011 Heasty et al.  
 2011/0015533 A1 1/2011 Cox et al.  
 2011/0040212 A1 2/2011 Dietz et al.  
 2011/0052694 A1 3/2011 Stinchcomb et al.  
 2011/0087107 A1 4/2011 Lindekugel et al.  
 2011/0196248 A1 8/2011 Grunwald  
 2011/0282188 A1 11/2011 Burnside et al.  
 2011/0295108 A1 12/2011 Cox et al.  
 2011/0313293 A1 12/2011 Lindekugel et al.  
 2012/0046562 A1 2/2012 Powers et al.  
 2012/0059270 A1 3/2012 Grunwald  
 2012/0095319 A1 4/2012 Kondrosky et al.  
 2012/0108950 A1 5/2012 He et al.  
 2012/0143029 A1 6/2012 Silverstein et al.

FOREIGN PATENT DOCUMENTS

AU 20009592 9/2000  
 AU 20015250 6/2001  
 AU 768362 B2 12/2003  
 AU 2001229024 B2 9/2005  
 AU 2001283703 B2 5/2006  
 AU 2006202149 6/2006  
 AU 2006904933 9/2006  
 CA 2420676 2/2002  
 CN 102209490 A 10/2011  
 DE 4319033 C1 6/1994  
 EP 0359697 3/1990  
 EP 0362821 4/1990  
 EP 0399536 A1 11/1990  
 EP 0823261 A2 2/1998  
 EP 1311226 A1 5/2003  
 EP 1504713 A1 2/2005  
 EP 2313143 A1 4/2011  
 EP 2440122 A1 4/2012  
 FR 2545349 11/1984  
 JP 01097440 4/1989  
 JP 03173542 A 7/1991  
 JP 4090741 8/1992  
 JP 09-094298 A 4/1997  
 JP 10043310 2/1998  
 JP 10290839 A 11/1998  
 JP 11128237 A 5/1999  
 JP 2001161683 6/2001  
 JP 2001340334 12/2001  
 JP 2003501127 A 1/2003  
 JP 2003061752 A 3/2003  
 JP 2003299654 10/2003  
 JP 2003334191 11/2003  
 JP 2002520893 2/2004  
 JP 2004505748 T 2/2004  
 JP 2004515298 A 5/2004  
 JP 2006508744 A 3/2006  
 JP 5010604 6/2012  
 WO 9112836 A1 9/1991  
 WO 9203090 3/1992  
 WO 9403159 A1 2/1994  
 WO 9404938 3/1994  
 WO 9605768 A1 2/1996  
 WO 9607352 A1 3/1996  
 WO 9641119 12/1996  
 WO 9729683 A1 8/1997  
 WO 9743989 A1 11/1997  
 WO 9916495 A1 4/1999  
 WO 9949407 A1 9/1999  
 WO 0019906 4/2000  
 WO 0040155 7/2000  
 WO 0074775 A1 12/2000  
 WO 0176479 A1 10/2001  
 WO 0215973 A1 2/2002





(56)

**References Cited**

## OTHER PUBLICATIONS

- Starr, David S et al, EKG Guided Placement of Subclavian CVP Catheters Using J-Wire, pp. 673-676, *Ann. Surg.*, Dec. 1986.
- Stas, M et al, Peroperative Intravascular Electrographic Control of Catheter Tip Position in Access Ports Placed by Venous Cut-Down Technique, *EJSO*, pp. 316-320, vol. 27, 2001.
- Stereotaxis Magnetic Navigation System with Navigant™ User Interface, 2005 Brochure.
- Stereotaxis, Expanding the Possibilities of Interventional Medicine: Remote Navigation and Automation, pp. 1-8, Apr. 2011.
- Tepa® Health Innovation PC based ECG System Introduction and Technical Specifications, EKG Master USB, 2 pages, Nov. 2003.
- The FloWire Doppler Guide Wire located <<http://www.volcanocorp.com/products/flowwire-doppler-guide-wire.php>>, 2011.
- Traxal Technologies, Tracking Technology website overview: [www.traxal.com/rd/rd\\_classroom\\_trackingtechnology.htm](http://www.traxal.com/rd/rd_classroom_trackingtechnology.htm), last accessed Dec. 1, 2006.
- UAB Health Systems, Arrhythmias, retrieved from <http://www.health.uab.edu/14564/> on Nov. 15, 2007, 12 pages.
- U.S. Appl. No. 11/466,602, filed Aug. 23, 2006 Advisory Action dated Jun. 22, 2009.
- U.S. Appl. No. 11/466,602, filed Aug. 23, 2006 Final Office Action dated Apr. 8, 2010.
- U.S. Appl. No. 11/466,602, filed Aug. 23, 2006 Final Office Action dated Jan. 30, 2009.
- U.S. Appl. No. 11/466,602, filed Aug. 23, 2006 Non-Final Office Action dated Sep. 25, 2009.
- U.S. Appl. No. 11/552,094 filed Oct. 23, 2006 Notice of Allowability dated Apr. 2, 2010.
- U.S. Appl. No. 11/552,094, filed Oct. 23, 2006 Non-Final Office Action dated Apr. 27, 2009.
- U.S. Appl. No. 11/552,094, filed Oct. 23, 2006 Notice of Allowance dated May 20, 2010.
- U.S. Appl. No. 12/104,253, filed Apr. 16, 2008 Final Office Action dated Jul. 27, 2011.
- U.S. Appl. No. 12/104,253, filed Apr. 16, 2008 Non-Final Office Action dated Nov. 29, 2010.
- U.S. Appl. No. 12/323,273, filed Nov. 25, 2008 Non-Final Office Action dated Jun. 8, 2012.
- U.S. Appl. No. 12/369,625, filed Feb. 11, 2009 Final Office Action dated Feb. 23, 2012.
- U.S. Appl. No. 12/369,625, filed Feb. 11, 2009 Non-Final Office Action dated Jul. 20, 2011.
- U.S. Appl. No. 12/427,244, filed Apr. 21, 2009 Non-Final Office Action dated Jan. 19, 2012.
- "Ascension to Launch New 3D Guidance™ Tracker at TCT 2006." Press Releases from Ascension website: [www.ascension-tech.com/news/press\\_101106.php](http://www.ascension-tech.com/news/press_101106.php), last accessed Dec. 1, 2006.
- Acuson—The Value of Vision, AcuNav Diagnostic Ultrasound Catheter, 2000.
- Advertising flyer for Gavecelt—The Italian Group for Long Term Venous Access Devices, for program on International Meeting on PICC's, Midline Catheters and Long Term Venous Access Devices in Catholic University, Rome, Italy on Dec. 3, 4, 5, 2008.
- Alexander, GD et al, The Role of Nitrous Oxide in Postoperative Nausea and Vomiting, Collection of Abstracts Presented at the International Anesthesia Research Society by various speakers, 58th Congress, Mar. 12-14, 1984, *Anesthesia and Analgesia*, pp. 175-284, vol. 63, 1984.
- Allan, P.L. et al, Role of Ultrasound in the Assessment of Chronic Venous Insufficiency, *Ultrasound Quarterly*, vol. 17, No. 1, pp. 3-10, 2001.
- Andropoulos, et al. "A Controlled Study of the Transesophageal Echocardiography to Guide Central Venous Catheter Placement in Congenital Heart Surgery Patients." *The International Anesthesia Research Society*, vol. 89, pp. 65-70, 1999.
- Anonymous author, Correct Catheter Placement with a low-impact, reliable and economical method, <<http://www.cvc-partner.com/index.cfm?103A955CC6844BF58ACFE3C9C1471959>>, last accessed Dec. 22, 2011.
- Arai, J et al, Detection of Peripherally Inserted Central Catheter Occlusion by in-line Pressure Monitoring, *Paediatr Anaesth*, pp. 621-624, vol. 12 No. 7, Sep. 2002.
- Arrow International, Inc., The Arrow-Johans RAECG Adapter-Making Proper Central Venous Catheter Placement More Reliable, Technical Report 1987, USA.
- Aslamy, et al. "MRI of Central Venous Anatomy: Implications for Central Venous Catheter Insertion." *American College of Chest Physicians*, Jun. 8, 2009.
- AU 2006283022 filed Aug. 24, 2006 Office Action dated Dec. 22, 2010.
- Aurora® System Technical Specifications, Oct. 2003.
- B. Braun Website, "The Optimal Position of the Central Venous Catheter." <http://www.cvcpartner.com/index.cfm?18F1BDEA1310466194960A39F4E90968> (2009).
- B. Braun, Certofix Central Venous Catheter for Placement Using the Seldinger Technique with Simultaneous ECG Lead Option, Feb. 2010.
- Bailey, SH et al, Is Immediate Chest Radiograph Necessary after Central Venous Catheter Placement in a Surgical Intensive Care Unit?, *Am J Surg*, pp. 517-522, vol. 180 No. 6, Dec. 2000.
- Bankier, Alexander A., Azygos Arch Cannulation by Central Venous Catheters: Radiographic Detection of Malposition and Subsequent Complications, *Journal of Thoracic Imaging* 12:64-69 (1997).
- Barber, JM et al, A Nurse led Peripherally Inserted Central Catheter Line Insertion Service is Effective with Radiological Support, *Clin Radiol*, pp. 352-354, vol. 57 No. 5, May 2002.
- Bard Access Systems, Sherlock Tip Location System, 5 pages, 2006.
- Bard Access Systems, Site Rite Vascular Access Ultrasound System, 4 pages, 2005.
- Benchimol, Alberto et al, Right Atrium and Superior Vena Cava Flow Velocity in Man Measured with the Doppler-Catheter Flowmeter-Telemetry System, *The Amer Journal of Medicine*, pp. 303-309, vol. 48, Mar. 1970.
- BioAdvance Lumen Vu, Greenhouse Fund Feb. 2004 Recipient, [www.bioadvance.com](http://www.bioadvance.com) <<http://www.bioadvance.com>>, 2005.
- Borgobello, Bridget, App allows users to view electrocardiograms on smartphones dated Oct. 15, 2010; printed from <http://www.gizmag.com/app-to-view-electrocardiograms-on-smartphones/16664/> on Feb. 4, 2011.
- Buehrle, Douglas, PICC Placement in Humans using Electromagnetic Detection, <[http://www.corpakmedsystems.com/supplement\\_material/supplementpages/navigator/navarticle.html](http://www.corpakmedsystems.com/supplement_material/supplementpages/navigator/navarticle.html)>, 2008.
- C.R. Bard, CathTrack™ Catheter Location System at [www.bardaccess.com](http://www.bardaccess.com) <<http://www.bardaccess.com>>, last accessed Apr. 28, 2011.
- C.R. Bard, Inc., Bard Electrophysiology Product Catalogue, Bard Catheters, pp. 74-75 (2002), USA.
- Cadman, A et al, To Clot or Not to Clot? That is the question in Central Venous Catheters, *Clinical Radiology*, pp. 349-355, vol. 59 No. 4, Apr. 2004.
- Calvert, N. et al, The Effectiveness and Cost-effectiveness of Ultrasound Locating Devices for Central Venous Access: A Systematic Review and Economic Evaluation, *Health Technology Assessment*, vol. 7, No. 12, 2003.
- Cardella, John F. et al., Interventinal Radiologic Placement of Peripherally Inserted Central Catheters, *Journal of Vascular and Interventional Radiology* 1993; 4:653-660.
- Carlson, R et al, Secondary Migration of a Central Venous Catheter—A Case Report, *Minerva Anesthesiol*, pp. 927-931, vol. 69 No. 12, Dec. 2003.
- Caruso, LJ et al, A Better Landmark for Positioning a Central Venous Catheter, *J Clinical Monitoring and Computing*, pp. 331-334, vol. 17 No. 6, Aug. 2002.
- Cavatorta, et al., "Central Venous Catheter Placement in Hemodialysis: Evaluation of Electrocardiography Using a Guidewire." *The Journal of Vascular Access*, vol. 2, pp. 45-50, 2001.
- Chalkiadis, Ga et al, Depth of Central Venous Catheter Insertion in Adults: An Audit and Assessment of a Technique to Improve Tip Position, *Anaesth Intensive Care*, pp. 61-66, vol. 26 No. 1, Feb. 1998.
- Chamsi-Pasha, Hassan et al, Cardiac Complications of Total Parenteral Nutrition: The Role of Two-Dimensional

(56)

## References Cited

## OTHER PUBLICATIONS

- Echocardiography in Diagnosis, *Annals of the Royal College of Surgeons of England*, pp. 120-123, vol. 71, 1989.
- Chang, Thomas C. et al., Are Routine Ch Ladiographs Necessary After Image-Guided Placement of Internal Jugular Central Venous Access Devices?, *AJR* Feb. 1998;170:335-337.
- Chaturvedi et al., "Catheter Malplacement During Central Venous Cannulation Through Arm Veins in Pediatric Patients." *Journal of Neurosurgical Anesthesiology*, vol. 15, No. 3 pp. 170-175, Jan. 2003.
- Chen, Zhongping et al, Optical Doppler Tomography: Imaging in vivo Blood Flow Dynamics Following Pharmacological Intervention and Photodynamic Therapy, 7 pages, vol. 67, *Photochemistry and Photobiology*, 1998.
- Cheng, KI et al, A Novel Approach of Intravenous Electrocardiograph Technique in Correct Position the Long-Term Central Venous Catheter, *Kaohsiung J Med Sci*, pp. 241-247, vol. 16 No. 5, May 2000 (Abstract only).
- Cheung, P., et al., The Effect of a Disposable Probe Cover on Pulse Oximetry, *Anaesth Intensive Care* 2002; 30: 211-214.
- Chu, et al., "Accurate Central Venous Port-A Catheter Placement: Intravenous Electrocardiography and Surface Landmark Techniques Compared by Using Transesophageal Echocardiography." *The International Anesthesia Research Society*, vol. 98, pp. 910-914, 2004.
- Claasz, Antonia et al, A Study of the Relationship of the Superior Vena Cava to the Bony Landmarks of the Sternum in the Supine Adult: Implications for Magnetic Guidance Systems, *Journal*, vol. 12 No. 3, *JAVA*, Jul. 24, 2007.
- Clifford, et al. "Assessment of Hepatic Motion Secondary to Respiration for Computer Assisted Interventions." *Computer Aided Surgery*, vol. 7, pp. 291-299, 2002.
- CN 200880012117.4 filed Apr. 16, 2008 First Office Action dated Dec. 23, 2011.
- Colley, Peter S et al, ECG-Guided Placement of Sorenson CVP Catheters via Arm Veins, *Anesthesia and Analgesia*, pp. 953-956, vol. 63, 1984.
- Collier, Pe et al, Cardiac Tamponade from Central Venous Catheters, *Am J Surg*, pp. 212-214, vol. 176 No. 2, Aug. 1998.
- ComboWire® Pressure/Flow Guide Wire Ref 9500 Series, Instructions for Use, Apr. 2011.
- Corsten, et al., "Central Placement Catheter Placement Using the ECG-Guided Cavafix-Certodyn SD Catheter." *Journal of Clinical Anesthesiology*, vol. 6, Nov./Dec. 1994.
- Cucchiara, Roy et al, Time Required and Success Rate of Percutaneous Right Atrial Catherization: Description of a Technique, *Canad. Anaesth. Soc. J.*, pp. 572-573, vol. 27, No. 6, Nov. 1980.
- Cullinane, DC et al, the Futility of Chest Roentgenograms Following Routine Central Venous Line Changes, *Am J Surg*, pp. 283-285, vol. 176 No. 3, Sep. 1998.
- Curet, Myriam J. et al., University and Practice-based Physicians' Input on the Content of a Surgical Curriculum, *The American Journal of Surgery*® vol. 178 Jul. 1999, 78-84.
- David, et al., "Is ECG-Guidance a Helpful Method to Correctly Position a Central Venous Catheter During Prehospital Emergency Care?" *ACTA Anaesthesiologica Scandinavica*, vol. 49, pp. 1010-1014, 2005.
- DELTEC Cath-Finder® Tracking System Operation Manual, 1994.
- Egelhof, Petra, Effects of Somatostatin on Portal Blood Flow and Portal Vein Pressure in Patients with Portal Hypertension due to Liver Cirrhosis Invasive Monitoring during TIPSS Procedures, Dissertation submitted to: Technical University of Munich, Faculty of Medicine, May 13, 2002; Date of examination: Feb. 26, 2003.
- Engelhardt, W et al, ECG-Controlled Placement of Central Venous Catheters in Patients with Atrial Fibrillation, *Anaesthesist*, pp. 476-479, vol. 38 No. 9, Sep. 1989 (Abstract only).
- EP 09808901.4 filed Aug. 21, 2009 European Search Report dated May 23, 2012.
- EP 09813632.8 filed Apr. 5, 2011 European Search Report dated Jul. 4, 2012.
- Fearon, William F et al, Evaluating Intermediate Coronary Lesions in the Cardiac Catheterization Laboratory, vol. 4, No. 1, 7 pages, *Reviews in Cardiovascular Medicine*, 2003.
- Felleiter P et al, Use of Electrocardiographic Placement Control of Central Venous Catheters in Austria, *Acta Med Austriaca*, pp. 109-113, vol. 26 No. 3, 1999 (Abstract only).
- Forauer, AR et al, Change in Peripherally Inserted Central Catheter Tip Location with Abduction and Adduction of the Upper Extremity, *J Vasc Intery Radiol*, pp. 1315-1318, vol. 11 No. 10, Nov-Dec 2000.
- Frassinelli, P et al, Utility of Chest Radiographs after Guidewire Exchanges of Central Venous Catheters, *Crit Care Med*, pp. 611-615, vol. 26 No. 3, Mar. 1998.
- Frazin L et al, A Doppler Guided Retrograde Catheterization System, *Cathet. Cardiovasc Diagn*, pp. 41-50, May 1992.
- French, PJ et al, Sensors for Catheter Applications, *Sensors Update*, vol. 13 Issue 1 pp. 107-153, Dec. 2003.
- GB Application 0800474.9 filed Aug. 24, 2006 Office Action dated Aug. 9, 2010.
- GB Application 0800474.9 filed Aug. 24, 2006 Office Action dated Mar. 17, 2010.
- Gebauer, B et al, Ultrasound and Fluoroscopy-guided Implantation of Peripherally Inserted Central Venous Catheters (PICCs), *ROFO*, pp. 386-391, vol. 176 No. 3, Mar. 2004 (Abstract only).
- Gebhard, et al., "The accuracy of Electrocardiogram-Controlled Central Line Placement." *The International Anesthesia Research Society*, vol. 104, No. 1 Jan. 2007.
- Gjendemsjo, Anders, et al., Energy and Power, The Connexions Project, Version 1.2, Feb. 20, 2004.
- Gladwin, MT et al, Cannulation of the Internal Jugular Vein: is postprocedural chest radiography always necessary?, *Crit Care Med*, 33 pages, Oct 2000.
- Gonzales, et al. "Peripherally Inserted Central Catheter Placement in Swine Using Magnet Detection." *Journal of Intravenous Nursing*, vol. 22, No. 3, May/June. 1999.
- Greenall, M.J. et al, Cardiac Tamponade and Central Venous Catheters, *British Medical Journal*, pp. 595-597, Jun. 14, 1975.
- Guillory, "Basic Principles of Technologies for Catheter Localization." C.R. Bard internal paper, Oct. 20, 2004.
- Guth, AA, Routine Chest X-rays after Insertion of Implantable Long-Term Venous Catheters: Necessary or Not?, *Am Surg*, pp. 26-29, vol. 67 No. 1, Jan. 2001 (Abstract only).
- Hill, Bradley et al, Abstract of article discussing Vasallova VPS as guide for placement of PICCs. 2009.
- Hill, Bradley, Identifying the Caval-Atrial Junction Using Smart-Catheter Technology presentation, 22nd Annual Scientific Meeting of the AVA in Savannah, Georgia, Sep. 13, 2008.
- Hoffman, Thomas et al, Simultaneous Measurement of Pulmonary Venous Flow by Intravascular Catheter Doppler Velocimetry and Transesophageal Doppler Echocardiography: Relation to Left Atrial Pressure and Left Atrial and Left Ventricular Function, pp. 239-249, *J Am Coll Cardiol*, Jul. 1995.
- Hoffmann, et al. "New Procedure in Transesophageal Echocardiography: Multiplane Transesophageal Echocardiography and Transesophageal Stress Echocardiography." *Herz*, vol. 18, No. 5, pp. 269-277, Oct. 1993.
- Iacopino, Domenico Gerardo et al, Intraoperative Microvascular Doppler Monitoring of Blood Flow within a Spinal Dural Arteriovenous Fistula: A Precious Surgical Tool, vol. 10, 5 pp., *Neurosurg. Focus*, Feb. 2001.
- Joosting, Jean-Pierre, "Dual-interface RFID-compatible EEPROM enables remote access to electronic device parameters," *EE Times*, Mar. 8, 2010.
- JP 2008-528151 filed Aug 24, 2006 Notice of Grant dated May 6, 2012.
- JP 2010-504220 filed Sep. 3, 2009 Office Action dated May 21, 2012.
- Kim, Ko et al, Positioning Internal Jugular Venous Catheters using the Right Third Intercostal Space in Children, *Acta Anaesthesiol Scand*, pp. 1284-1286, vol. 47 No. 10, Nov. 2003.
- Kjelstrup T et al, Positioning of Central Venous Catheters using ECG, *Tidssk nor Laegeforen*, pp. 599-601, vol. 111 No. 5, Feb. 1999 (Abstract only).

(56)

**References Cited**

## OTHER PUBLICATIONS

- Kofler, Julia, et al., Epinephrine application via an endotracheal airway and via the Combitube in esophageal position, *Critical Care Medicine*: May 2000, vol. 28: Issue 5, pp. 1445-1449.
- Kowalski, CM et al, Migration of Central Venous Catheters: Implications for Initial Catheter Tip Positioning, *J Vasc Intery Radiol*, pp. 443-447, vol. 8 No. 3, May-Jun. 1997.
- Leowenthal, MR et al, The Peripherally Inserted Central Catheter (PICC): a Prospective Study of its Natural History after Fossa Insertion, *Anaesth Intensive Care*, pp. 21-24; vol. 30 No. 1, Feb. 2002.
- Lepage Ronan et al. ECG Segmentation and P-wave Feature Extraction: Application to Patients Prone to Atrial Fibrillation, *IEEE/EMBS Proceedings, 23rd Annual Conference, Istanbul, Turkey, Oct. 25-28, 2001*.
- Liu , Ji-Bin et al, Catheter-Based Intraluminal Sonography, *J Ultrasound Med*, pp. 145-160, vol. 23, 2004.
- Lucey, B et al, Routine Chest Radiographs after Central Line Insertion: Mandatory Postprocedural Evaluation or Unnecessary Waste of Resources?, *Cardiovasc Intervent Radiol*, pp. 381-384, vol. 22 No. 5, Sep.-Oct. 1999.
- Lum, Phillip, A New Formula-Based Measurement Guide for Optimal Positioning of Central Venous Catheters, *Java*, vol. 9, No. 2, pp. 80-85, 2004.
- Lynch, RE et al, A Procedure for Placing Pediatric Femoral Venous Catheter Tips near the Right Atrium, *Pediatr Emerg Care*, pp. 130-132, vol. 18 No. 2, Apr. 2002.
- Madan, et al. "Right Atrial Electrocardiography: A Technique for the Placement of Central Venous Catheters for Chemotherapy or Intravenous Nutrition." *British Journal of Surgery*, vol. B1, pp. 1604-1605, 1994.
- Madias, John E, Intracardiac (Superior Vena Cava/Right Atrial) ECGs using Saline Solution as the Conductive Medium for the Proper Positioning of the Shiley Hemodialysis Catheter: Is it Not Time to Forego the Postinsertion Chest Radiograph?, pp. 2363-2367, *CHEST*, 2003.
- Markovich, Mary B., Central Venous Catheter Tip Placement: Determination of Posterior Malposition—A Case Study, *JAVA*, vol. 11, No. 2, pp. 85-89, 2006.
- Martin, Roy W, An Ultrasound Catheter for Intravascular Measurement of Blood Flow: Technical Details, *IEEE Transactions on Sonics and Ultrasonics*, vol. SU-27, No. 6, pp. 277-286, Nov. 1980.
- McDonnall, "Intra-Atrial Electrocardiography (ECG) for Catheter Placement." Literature review prepared for Bard Access Systems, Oct. 2007.
- McGee et al., "Accurate Placement of Central Venous Catheters: A Prospective, Randomize, Multicenter Trail." *Critical Care Medicine*, vol. 21 No. 8, Aug. 1993.
- MedGraphics, CardioPerfect® Resting/Stress ECG System, 3 pages, 2001.
- Michenfelder, John et al, Air Embolism During Neurosurgery—An Evaluation of Right-Atrial Catheters for Diagnosis and Treatment, *JAMA*, pp. 1353-1358, vol. 208, No. 8, May 26, 1969.
- Michenfelder, John et al, Air Embolism During Neurosurgery. A New Method of Treatment, *Anesthesia and Analgesia. Current Researches*, pp. 390-395, vol. 45, No. 4, Jul.-Aug. 1966.
- Microbird™ Miniaturized DC Magnetic Sensors for Intra-body Navigation and Localization, Specifications, 2005.
- Micronix CathRite™ Cardiac Access Device Brochure. Jun. 2004.
- Micronix Pty Ltd "CathRite" Guiding Styled Core Manufacturing, Jun. 15, 2006.
- Murthy, Vrudhula et al, Analysis of Power Spectral Densities of Electrocardiograms, *Mathematical Biosciences*, pp. 41-51, vol. 12 No. 1-2, Oct. 1971.
- Nadroo, AM et al, Changes in Upper Extremity Position Cause Migration of Peripherally Inserted Central Catheters in Neonates, *Pediatrics*, pp. 131-136, vol. 110, Jul. 2002.
- Nakatani, K et al, Accurate Placement of Central Venous Catheters—ECG-guided method vs Patient Height Method, *Masui*, pp. 34-38, vol. 51 No. 1, Jan. 2002.
- Nazarian, GK et al, Changes in Tunneled Catheter Tip Position when a patient is Upright, *J Vasc Intery Radiol*, pp. 437-441, vol. 8 No. 3, May-Jun. 1997.
- Neurometer® CPT, Clinical Applications. Neurotron, Inc. website: [www.neurotron.com/CLINAPS.html](http://www.neurotron.com/CLINAPS.html), last accessed Oct. 23, 2006.
- Neurometer® CPT, Frequently Asked Questions. Neurotron, Inc. website: [www.neurotron.com/CPTFAQ/html](http://www.neurotron.com/CPTFAQ/html), last accessed Oct. 23, 2006.
- Neurometer® CPT, Products p.. Neurotron , Inc. website: [www.neurotron.com/products.html](http://www.neurotron.com/products.html), last accessed Oct. 23, 2006.
- Neurometer® Electrodiagnostic Neuroselective Sensory Nerve Evaluation: Charts, Tables, Documents & Downloads. Neurotron, Inc. website: [www.neurotron.com/downloads.html](http://www.neurotron.com/downloads.html), last accessed Oct. 23, 2006.
- Odd, De et al, Does Radio-opaque Contrast Improve Radiographic localisation of Percutaneous Central Venous Lines?, *Arch Dis Child Fetal Neonatal Ed*, pp. 41-43, vol. 89 No. 1, Jan. 2004.
- Palesty, JA et al, Routine Chest Radiographs Following Central Venous Recatheterization over a Wire are not Justified, *Am J Surg*, pp. 618-621, vol. 176 No. 6, Dec. 1998.
- Paliotti, Roberta P. et al, Intravascular Doppler Technique for Monitoring Renal Venous Blood Flow in Man, *J Nephrol*, pp. 57-62, 2003.
- Parker, K.H. et al, Cardiovascular Fluid Dynamics, Department of Bioengineering, National Heart and Lung Institute, Imperial College of Science, Technology and Medicine, Cardiovascular Haemodynamics, pp. 1-28, Sep. 26, 2005.
- Pawlik, et al., "Central Venous Catheter Placement: Comparison of the Intravascular Guidewire and the Fluid Column Electrocardiograms." *European Journal of Anaesthesiology*, vol. 41, pp. 594-599, 2004.
- PCT/US2006/033079 filed Aug. 24, 2006 International Preliminary Report on Patentability dated Feb. 26, 2008.
- PCT/US2006/033079 filed Aug. 24, 2006 Search Report dated Dec. 19, 2006.
- PCT/US2006/033079 filed Aug. 24, 2006 Written Opinion dated Dec. 19, 2006.
- PCT/US2008/060502 filed Apr. 16, 2008 International Search Report and Written Opinion dated Oct. 16, 2008.
- PCT/US2008/084751 filed Nov. 25, 2008 International Preliminary Report on Patentability dated Jun. 1, 2010.
- PCT/US2008/084751 filed Nov. 25, 2008 Search Report dated May 20, 2009.
- PCT/US2008/084751 filed Nov. 25, 2008 Written Opinion dated May 20, 2009.
- PCT/US2009/033116 filed Feb. 4, 2009 International Preliminary Report on Patentability dated Aug. 10, 2010.
- PCT/US2009/033116 filed Feb. 4, 2009 Search Report dated Mar. 13, 2009.
- PCT/US2009/033116 filed Feb. 4, 2009 Written Opinion dated Mar. 13, 2009.
- PCT/US2009/041051 filed Apr. 17, 2009 Search Report dated Jul. 28, 2009.
- PCT/US2009/041051 filed Apr. 17, 2009 Written Opinion dated Jul. 28, 2009.
- PCT/US2009/054687 filed Aug. 21, 2009 International Preliminary Report on Patentability dated Feb. 22, 2011.
- PCT/US2009/054687 filed Aug. 21, 2009 Search Report dated Oct. 6, 2009.
- PCT/US2009/054687 filed Aug. 21, 2009 Written Opinion dated Oct. 6, 2009.
- PCT/US2009/056567 filed Sep. 10, 2009 International Preliminary Report on Patentability dated Mar. 15, 2011.
- PCT/US2009/056567 filed Sep. 10, 2009 Search Report dated Nov. 6, 2009.
- PCT/US2009/056567 filed Sep. 10, 2009 Written Opinion dated Nov. 6, 2009.
- PCT/US2010/038555 filed Jun. 14, 2010 Search Report dated Oct. 5, 2010.
- PCT/US2010/038555 filed Jun. 14, 2010 Written Opinion dated Oct. 5, 2010.
- PCT/US2010/045084 filed Aug. 10, 2010 International Preliminary Report on Patentability dated Feb. 23, 2012.

(56)

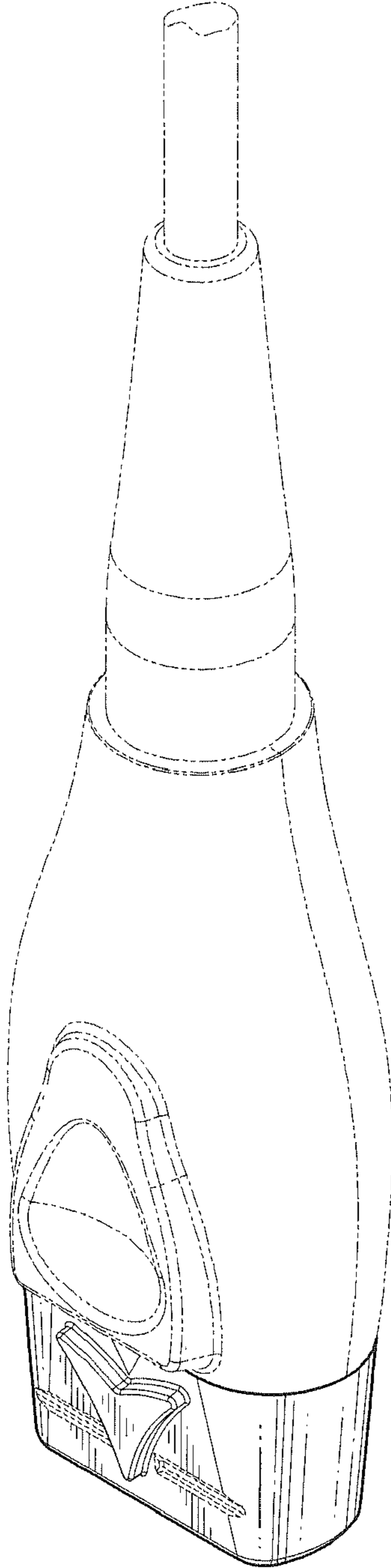
**References Cited**

## OTHER PUBLICATIONS

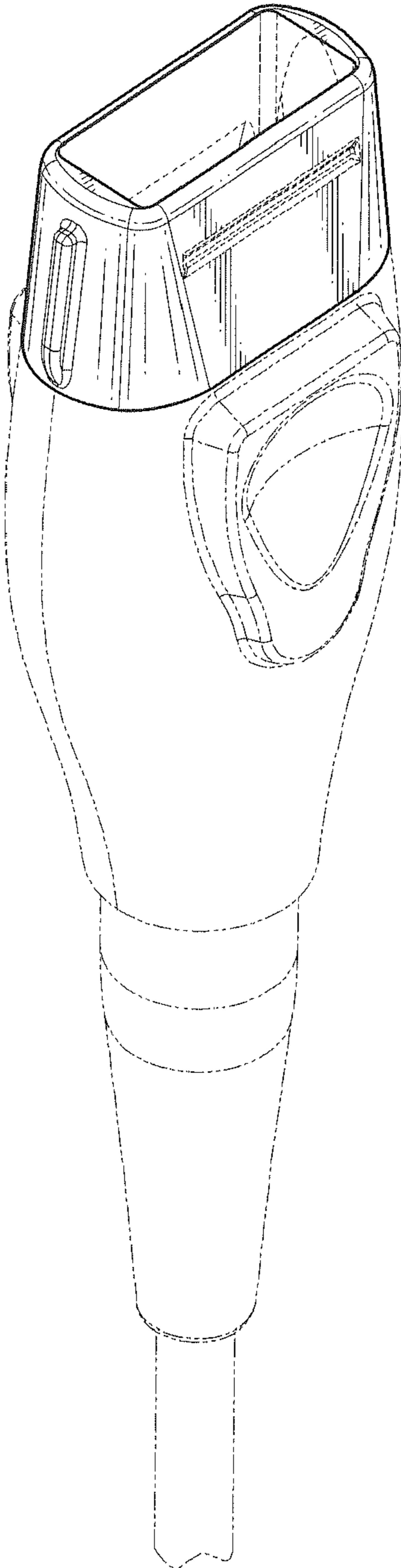
PCT/US2010/045084 filed Aug. 10, 2010 Search Report dated Apr. 14, 2011.  
 PCT/US2010/045084 filed Aug. 10, 2010 Written Opinion dated Apr. 14, 2011.  
 PCT/US2010/050773 filed Sep. 29, 2010 Search Report dated Jan. 24, 2011.  
 PCT/US2010/050773 filed Sep. 29, 2010 Written Opinion dated Jan. 24, 2011.  
 PCT/US2010/051917 filed Oct. 8, 2010 Search Report dated Nov. 29, 2010.  
 PCT/US2010/051917 filed Oct. 8, 2010 Written Opinion dated Nov. 29, 2010.  
 PCT/US2011/023497 filed Feb. 2, 2011 Search Report dated Jun. 6, 2011.  
 PCT/US2011/023497 filed Feb. 2, 2011 Written Opinion dated Jun. 6, 2011.  
 PCT/US2011/038415 filed May 27, 2011 International Search Report dated Sep. 28, 2011.  
 PCT/US2011/038415 filed May 27, 2011 Written Opinion dated Sep. 28, 2011.  
 PCT/US2011/047127 filed Aug. 9, 2011 International Search Report dated Feb. 29, 2012.  
 PCT/US2011/047127 filed Aug. 9, 2011 Written Opinion dated Feb. 29, 2012.  
 PCT/US2011/048403 filed Aug. 19, 2011 International Search Report dated Dec. 15, 2011.  
 PCT/US2011/048403 filed Aug. 19, 2011 Written Opinion dated Dec. 15, 2011.  
 PCT/US2011/052793 filed Sep. 22, 2011 International Search Report dated Jan. 6, 2012.  
 U.S. Appl. No. 12/557,401, filed Sep. 10, 2009 Non-Final Office Action dated Apr. 24, 2012.  
 U.S. Appl. No. 12/878,915, filed Sep. 9, 2010 Non-Final Office Action dated Mar. 15, 2012.  
 Valdivieso, J.R. Perez, et al., Evaluation of a formula for optimal positioning of a central venous catheter inserted through the right internal jugular vein, *Rev. Esp. Anesthesiol. Reanim.* 2003; 50:77-79.

VasoNova Inc, Vascular navigation system for accurate placement of PICCs, *Start-Up Emerging Medical Ventures*, pp. 44-45, vol. 14 No. 7, Jul.-Aug. 2009.  
 Vesely, Thomas M. et al., Central Venous Catheter Tip Position: A Continuing Controversy, *J Vasc Interv Radiol* 2003; 14:527-534.  
 VIASYS Health Care Inc. Cortrak© Fact Sheet, 2005.  
 VIASYS Healthcare MedSystems, Navigator® Benefits, 2008.  
 VIASYS Healthcare MedSystems, Navigator® Research in Cost Justification, 2008.  
 VIASYS MedSystems, Cortrak™ Systems Brochure, 2005.  
 Volcano ComboMap Features and Benefits/Technical Specifications, 2 pages, 2011.  
 Watters, et al. "Use of Electrocardiogram to Position Right Atrial Catheters During Surgery." *Annals of Surgery*, vol. 225, No. 2, pp. 165-171, 1997.  
 Welch Allyn Cardioperfect® PC-Based Resting ECG, 2003.  
 Wilson, R. G. et al, Right Atrial Electrocardiography in Placement of Central Venous Catheters, *The Lancet*, pp. 462-463, Feb. 27, 1988.  
 Wong, Jeffrey J. et al., Azygos Tip Placement for Hemodialysis Catheters in Patients with Superior Vena Cava Occlusion, *Cardiovasc Intervent Radiol* (2006) 29:143-146.  
 Worley, Seth J. "Use of a Real-Time Three-Dimensional Magnetic Navigation System for Radiofrequency Ablation of Accessory Pathways." *Pace*, vol. 21 pp. 1636-1643, Aug. 1998.  
 Yilmazlar A et al, Complications of 1303 Central Venous Cannulations, *J R Soc Med*, pp. 319-321, vol. 90 No. 6, Jun. 1997 (Abstract only).  
 Yoon, SZ et al, Usefulness of the Carina as a Radiographic Landmark for Central Venous Catheter Placement in Paediatric Patients, *Br J Anaesth*, Jul. 2005.  
 Yoshida, Teruhisa et al, Detection of Concealed Left Sided Accessory Atrioventricular Pathway by P Wave Signal Averaged Electrocardiogram, *J Am Coll Cardiol*, pp. 55-62, 1999.  
 Zaaroor, et al. "Novel Magnetic Technology for Intraoperative Intracranial Frameless Navigation: In Vivo and in Vitro Results." *Neurosurgery*, vol. 48, No. 5. pp. 1100-1107, May 2001.  
 Zachariou, Zacharias et al., Intra-atrial ECG recording: a new and safe method for implantation of Broviac catheters in children, *Pediatr Surg Int* (1994) 9: 457-458.

\* cited by examiner



**FIG. 1**



**FIG. 2**

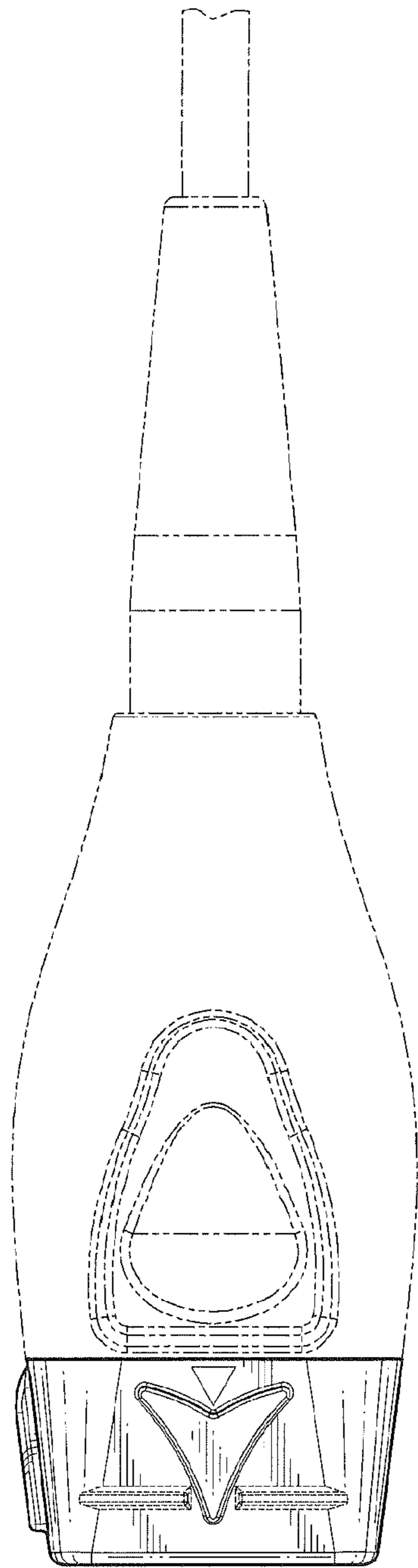


FIG. 3

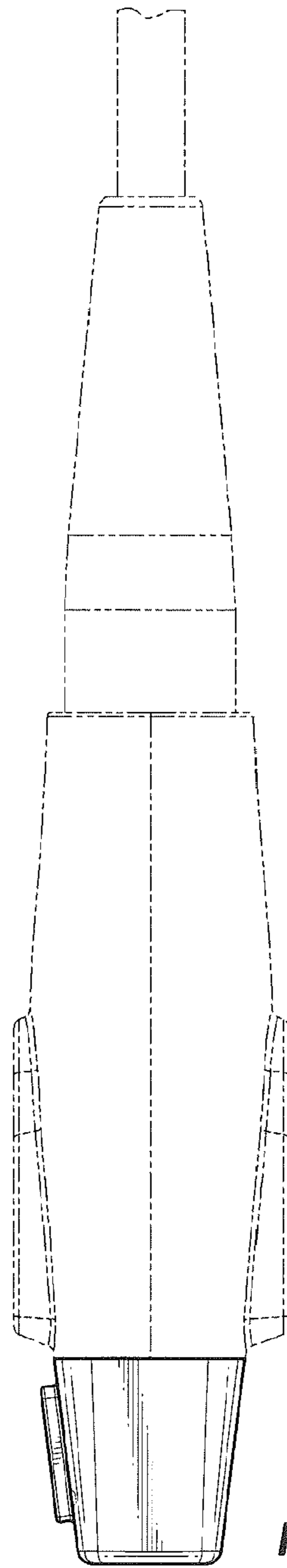


FIG. 4

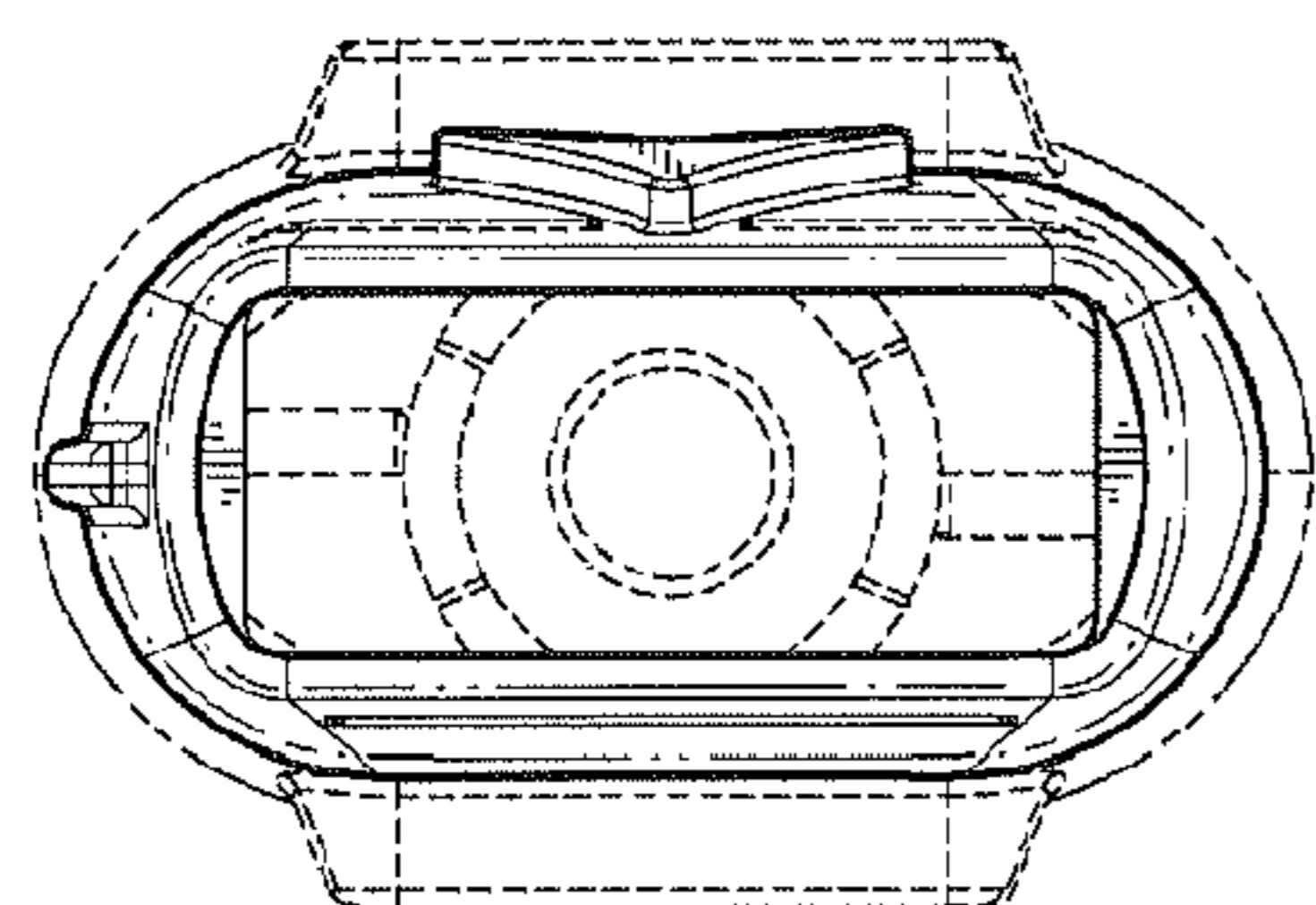
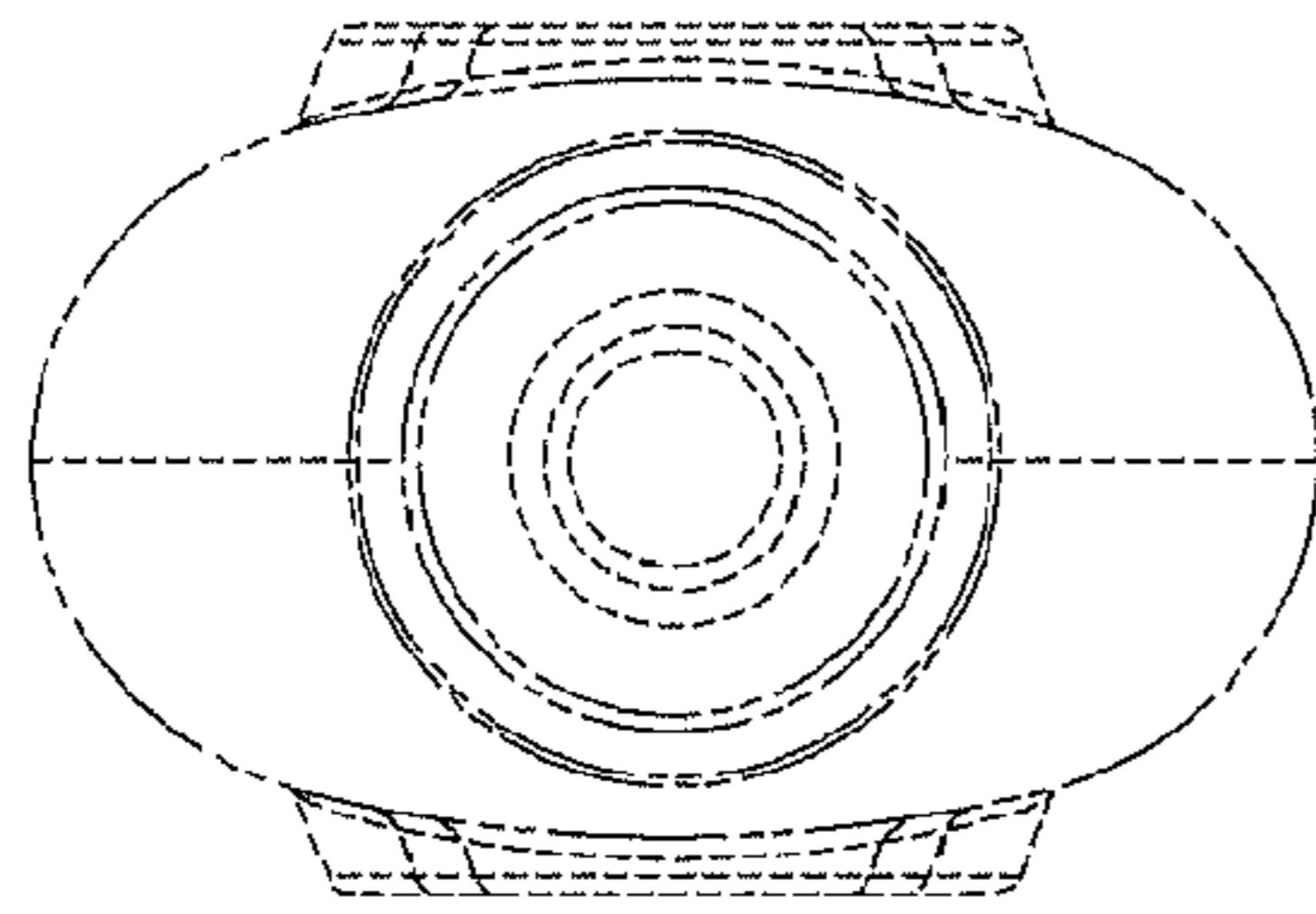
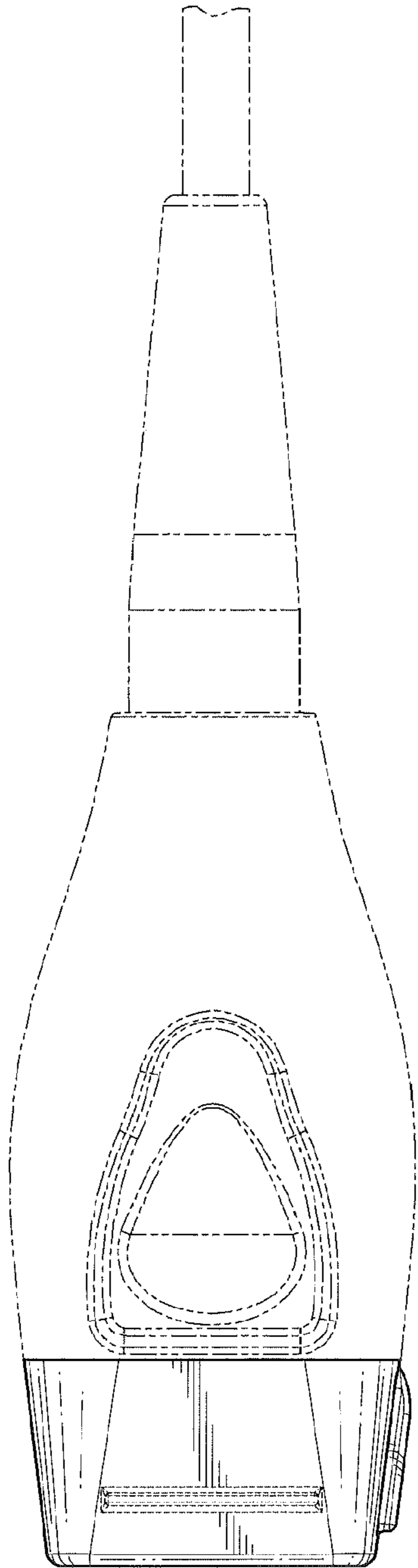


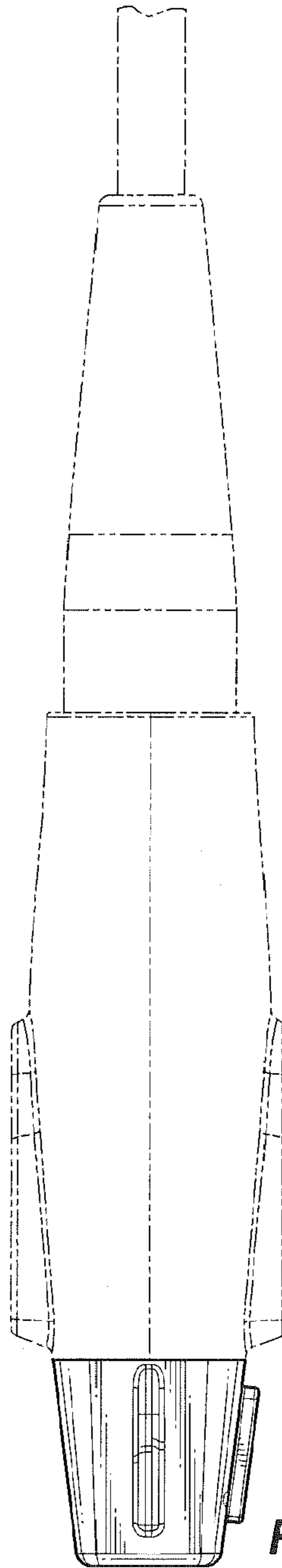
FIG. 5



**FIG. 8**



**FIG. 6**



**FIG. 7**