



US00D804682S

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

(10) **Patent No.:** **US D804,682 S**

(45) **Date of Patent:** **\*\* Dec. 5, 2017**

(54) **MULTI-LAYERED SAMPLE CASSETTE**

(71) Applicant: **OPKO Diagnostics, LLC**, Woburn, MA (US)

(72) Inventors: **Jason Taylor**, Windham, NH (US); **Matthew Dirckx**, Somerville, MA (US); **David Steinmiller**, Mountain View, CA (US); **Vincent Linder**, Tewksbury, MA (US)

(73) Assignee: **OPKO Diagnostics, LLC**, Woburn, MA (US)

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

(21) Appl. No.: **29/535,749**

(22) Filed: **Aug. 10, 2015**

(51) **LOC (10) Cl.** ..... **24-02**

(52) **U.S. Cl.**  
USPC ..... **D24/225**

(58) **Field of Classification Search**  
USPC ..... D24/216, 217, 223, 224, 225, 226, 227, D24/229, 232, 233; D10/81; 73/53.01;  
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS  
3,735,640 A 5/1973 Chizhov et al.  
D243,542 S 3/1977 Fadler et al.  
(Continued)

FOREIGN PATENT DOCUMENTS  
EP 0 110 771 B1 3/1988  
EP 0 643 307 A1 3/1995  
(Continued)

OTHER PUBLICATIONS

Invitation to Pay Additional Fees for PCT/US2008/005577 mailed Aug. 19, 2008.

(Continued)

*Primary Examiner* — Ian Simmons

*Assistant Examiner* — Mark Cavanna

(74) *Attorney, Agent, or Firm* — Wolf, Greenfield & Sacks, P.C.

(57) **CLAIM**

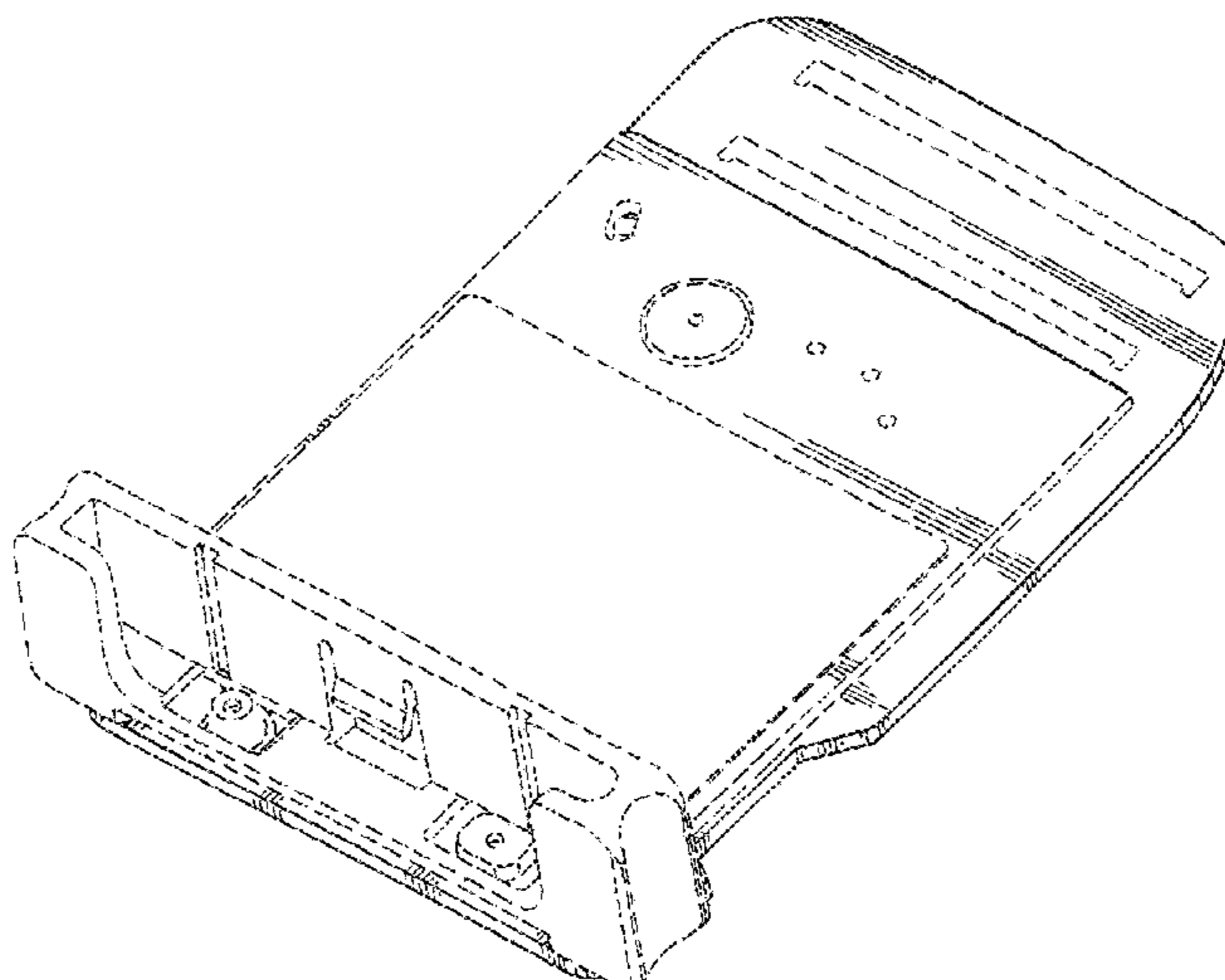
The ornamental design for multi-layered sample cassette, as shown and described.

**DESCRIPTION**

FIG. 1 is a top, front, right side perspective view of a first embodiment of the multi-layered sample cassette; FIG. 2 is a top plan view of the embodiment of FIG. 1; FIG. 3 is a bottom plan view of the embodiment of FIG. 1; FIG. 4 is a front elevational view of the embodiment of FIG. 1; FIG. 5 is a rear elevational view of the embodiment of FIG. 1; FIG. 6 is a left side elevational view of the embodiment of FIG. 1; FIG. 7 is a right side elevational view of the embodiment of FIG. 1; FIG. 8 is a top, front, right side perspective view of a fourth embodiment of the multi-layered sample cassette; FIG. 9 is a top plan view of the embodiment of FIG. 8; FIG. 10 is a bottom plan view of the embodiment of FIG. 8; FIG. 11 is a front elevational view of the embodiment of FIG. 8; FIG. 12 is a rear elevational view of the embodiment of FIG. 8; FIG. 13 is a left side elevational view of the embodiment of FIG. 8; and, FIG. 14 is a right side elevational view of the embodiment of FIG. 8.

The broken lines are included for the purpose of illustrating portions of the multi-layered sample cassette that form no part of the claimed design.

**1 Claim, 10 Drawing Sheets**



(58) **Field of Classification Search**

USPC ... 422/400-401, 412, 502-504, 63-64, 68.1,  
 422/73, 287.2, 288.7, 560; 435/287.2,  
 435/288.7, 6.12, 6.19, 7.1, 7.2, 7.21;  
 436/180, 45, 518, 69; 356/246; 425/174  
 CPC .. B01D 57/02; B01F 11/0071; B01F 13/0071;  
 B01F 15/0264; B01F 15/0646; B01J  
 19/0046; B01J 19/0093; B01L 3/502;  
 B01L 3/5023; B01L 3/5025; B01L  
 3/502715; B01L 3/502723; B01L  
 3/50273; B01L 3/502738; B01L  
 3/502776; B01L 3/5085; B01L 3/50855;  
 B01L 9/527; G01N 21/31; G01N 35/025  
 See application file for complete search history.

6,413,782 B1 7/2002 Parce et al.  
 6,416,642 B1 7/2002 Alajoki et al.  
 D462,125 S \* 8/2002 Pham ..... D24/225  
 6,429,025 B1 8/2002 Parce et al.  
 6,432,720 B2 8/2002 Chow  
 6,454,924 B2 \* 9/2002 Jedrzejewski ..... B01L 3/5085  
 422/503  
 6,479,299 B1 11/2002 Parce et al.  
 6,488,872 B1 12/2002 Beebe et al.  
 6,488,894 B1 12/2002 Miethe et al.  
 6,488,896 B2 12/2002 Weigl et al.  
 6,495,104 B1 12/2002 Unno et al.  
 6,551,841 B1 4/2003 Wilding et al.  
 6,610,499 B1 8/2003 Fulwyler et al.  
 6,613,512 B1 9/2003 Kopf-Sill et al.  
 6,613,525 B2 9/2003 Nelson et al.  
 6,620,625 B2 9/2003 Wolk et al.  
 6,632,619 B1 10/2003 Harrison et al.  
 6,638,482 B1 10/2003 Ackley et al.  
 6,656,430 B2 12/2003 Sheppard, Jr. et al.  
 6,656,431 B2 12/2003 Holl et al.  
 6,669,831 B2 12/2003 Chow et al.  
 6,705,357 B2 3/2004 Jeon et al.  
 6,709,869 B2 3/2004 Mian et al.  
 6,716,620 B2 4/2004 Bashir et al.  
 6,742,661 B1 6/2004 Schulte et al.  
 6,761,962 B2 7/2004 Bentsen et al.  
 6,780,584 B1 8/2004 Edman et al.  
 D495,805 S \* 9/2004 Lea ..... D24/225  
 6,794,197 B1 9/2004 Indermuhle et al.  
 6,818,184 B2 11/2004 Fulwyler et al.  
 6,827,095 B2 12/2004 O'Connor et al.  
 6,828,143 B1 12/2004 Bard  
 6,830,936 B2 12/2004 Anderson et al.  
 6,858,185 B1 2/2005 Kopf-Sill et al.  
 6,878,271 B2 4/2005 Gilbert et al.  
 6,878,755 B2 4/2005 Singh et al.  
 6,919,045 B1 7/2005 Berndt  
 6,937,330 B2 \* 8/2005 Dietz ..... B01L 3/5025  
 356/246

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,318,994 A 3/1982 Meyer et al.  
 4,453,807 A 6/1984 Faulkner et al.  
 4,517,302 A 5/1985 Saros  
 D292,229 S 10/1987 Knudson et al.  
 D302,294 S 7/1989 Hillman et al.  
 4,963,498 A 10/1990 Hillman et al.  
 5,051,237 A 9/1991 Grenner et al.  
 5,219,762 A 6/1993 Katamine et al.  
 5,268,147 A 12/1993 Zabetakis et al.  
 5,279,791 A 1/1994 Aldrich et al.  
 5,286,454 A 2/1994 Nilsson et al.  
 D351,913 S \* 10/1994 Hieb ..... D24/223  
 5,376,252 A 12/1994 Ekström et al.  
 5,478,751 A 12/1995 Oosta et al.  
 5,486,335 A 1/1996 Wilding et al.  
 5,571,410 A 11/1996 Swedberg et al.  
 5,627,041 A \* 5/1997 Shartle ..... B01L 3/50273  
 422/68.1  
 5,635,358 A 6/1997 Wilding et al.  
 5,637,469 A 6/1997 Wilding et al.  
 D382,647 S \* 8/1997 Staples ..... D24/216  
 5,726,026 A 3/1998 Wilding et al.  
 5,731,212 A 3/1998 Gavin et al.  
 D395,708 S \* 6/1998 Shartle ..... D24/225  
 5,866,345 A 2/1999 Wilding et al.  
 5,876,675 A 3/1999 Kennedy  
 5,932,799 A 8/1999 Moles  
 5,942,443 A 8/1999 Parce et al.  
 5,955,028 A 9/1999 Chow  
 5,957,579 A 9/1999 Kopf-Sill et al.  
 6,019,944 A 2/2000 Buechler  
 6,042,709 A 3/2000 Parce et al.  
 6,046,056 A 4/2000 Parce et al.  
 6,073,482 A 6/2000 Moles  
 6,103,199 A 8/2000 Bjornson et al.  
 6,114,122 A 9/2000 Besemer et al.  
 6,136,272 A 10/2000 Weigl et al.  
 6,146,489 A 11/2000 Wirth  
 6,146,589 A 11/2000 Chandler  
 6,168,948 B1 1/2001 Anderson et al.  
 6,175,420 B1 \* 1/2001 Barry ..... G01N 21/31  
 436/164  
 6,176,962 B1 1/2001 Soane et al.  
 6,184,029 B1 2/2001 Wilding et al.  
 6,186,660 B1 2/2001 Kopf-Sill et al.  
 6,214,560 B1 4/2001 Yguerabide et al.  
 6,238,538 B1 5/2001 Parce et al.  
 6,241,560 B1 6/2001 Furusawa et al.  
 6,251,343 B1 6/2001 Dubrow et al.  
 D445,909 S 7/2001 Pogorzelski  
 6,274,337 B1 8/2001 Parce et al.  
 6,293,012 B1 9/2001 Moles  
 6,296,020 B1 10/2001 McNeely et al.  
 6,331,439 B1 12/2001 Cherukuri et al.  
 6,333,200 B1 12/2001 Kaler et al.  
 6,353,475 B1 3/2002 Jensen et al.  
 6,361,958 B1 3/2002 Shieh et al.

6,949,377 B2 9/2005 Ho  
 6,953,550 B2 10/2005 Sheppard, Jr. et al.  
 6,987,263 B2 1/2006 Hobbs et al.  
 6,989,128 B2 1/2006 Alajoki et al.  
 7,005,292 B2 2/2006 Wilding et al.  
 7,015,046 B2 3/2006 Wohlstadter et al.  
 7,018,830 B2 3/2006 Wilding et al.  
 7,067,263 B2 6/2006 Parce et al.  
 7,087,148 B1 8/2006 Blackburn et al.  
 7,091,048 B2 8/2006 Parce et al.  
 D531,321 S \* 10/2006 Godfrey ..... D24/225  
 D540,953 S 4/2007 Ramel  
 7,235,406 B1 6/2007 Woudenberg et al.  
 7,323,660 B2 \* 1/2008 Bedingham ..... G01N 35/025  
 422/64  
 7,678,576 B2 \* 3/2010 Sasaki ..... B01F 11/0071  
 366/136  
 7,708,950 B2 \* 5/2010 Yamada ..... B01L 3/5027  
 422/504  
 D621,060 S \* 8/2010 Handique ..... D24/225  
 7,972,778 B2 \* 7/2011 Brown ..... B01L 3/5027  
 435/6.12  
 D645,971 S 9/2011 Taylor et al.  
 8,047,829 B1 \* 11/2011 Sommer ..... B01L 3/502707  
 425/174  
 D650,911 S \* 12/2011 Odeh ..... D24/225  
 8,088,616 B2 \* 1/2012 Handique ..... B01L 3/502715  
 435/287.2  
 8,202,492 B2 6/2012 Linder et al.  
 8,216,853 B2 \* 7/2012 Miller ..... B01L 3/502707  
 422/401  
 D669,594 S \* 10/2012 Cao ..... D24/216  
 8,318,439 B2 \* 11/2012 Battrell ..... B01L 3/502715  
 435/7.1  
 D672,053 S \* 12/2012 Chen ..... D24/225  
 8,394,341 B2 \* 3/2013 Reinhardt ..... B01L 9/527  
 422/502



(56)

## References Cited

## U.S. PATENT DOCUMENTS

8,420,015	B2 *	4/2013	Ganesan .....	B01L 3/502715	
					422/504
8,580,567	B2 *	11/2013	Sarofim .....	B01L 3/502738	
					422/506
8,709,787	B2 *	4/2014	Handique .....	B01L 3/502738	
					422/501
8,797,527	B2 *	8/2014	Hukari .....	B01L 3/502715	
					356/246
8,852,862	B2 *	10/2014	Wu .....	B01L 3/502738	
					422/502
2002/0001818	A1	1/2002	Brock		
2002/0019059	A1	2/2002	Chow et al.		
2002/0071788	A1	6/2002	Fujii et al.		
2002/0092767	A1	7/2002	Bjornson et al.		
2002/0142618	A1	10/2002	Parce et al.		
2002/0199094	A1	12/2002	Strand et al.		
2003/0012697	A1	1/2003	Hahn et al.		
2003/0082081	A1	5/2003	Fouillet et al.		
2003/0118486	A1	6/2003	Zhou et al.		
2003/0124623	A1	7/2003	Yager et al.		
2003/0138969	A1	7/2003	Jakobsen et al.		
2003/0180824	A1	9/2003	Mpock et al.		
2003/0207328	A1	11/2003	Yguerabide et al.		
2004/0077074	A1	4/2004	Ackley et al.		
2004/0115094	A1	6/2004	Gumbrecht et al.		
2004/0141887	A1 *	7/2004	Mainquist .....	B01L 3/50855	
					422/400
2004/0228771	A1	11/2004	Zhou et al.		
2005/0014248	A1	1/2005	Canton		
2005/0118073	A1	6/2005	Facer et al.		
2005/0161669	A1	7/2005	Jovanovich et al.		
2005/0221281	A1	10/2005	Ho		
2005/0238545	A1	10/2005	Parce et al.		
2005/0255003	A1	11/2005	Summersgill et al.		
2006/0002827	A1	1/2006	Curcio et al.		
2006/0076482	A1	4/2006	Hobbs et al.		
2006/0094119	A1	5/2006	Ismagilov et al.		
2006/0202133	A1	9/2006	Ok et al.		
2006/0257992	A1	11/2006	McDevitt et al.		
2006/0275852	A1	12/2006	Montagu		
2007/0003434	A1	1/2007	Padmanabhan et al.		
2007/0009386	A1	1/2007	Padmanabhan et al.		
2007/0031289	A1	2/2007	Cox et al.		
2007/0048189	A1	3/2007	Cox et al.		
2007/0120903	A1	5/2007	Takagi		
2007/0172388	A1	7/2007	Padmanabhan et al.		
2007/0298433	A1	12/2007	Sia et al.		
2008/0085219	A1	4/2008	Beebe et al.		
2008/0248590	A1	10/2008	Gulliksen et al.		
2009/0022625	A1	1/2009	Lee et al.		
2009/0156966	A1	6/2009	Kontschieder et al.		
2010/0002293	A1	1/2010	McLellan et al.		
2010/0027008	A1	2/2010	Bornhop et al.		
2011/0268630	A1 *	11/2011	Williams .....	B01L 3/5085	
					422/560

## FOREIGN PATENT DOCUMENTS

EP	1 054 259	A1	11/2000
EP	1 946 830	A1	7/2008
EP	2 071 026	A1	6/2009
WO	WO 91/01003	A1	1/1991
WO	WO 02/22250	A2	3/2002
WO	WO 03/054513	A2	7/2003
WO	WO 2004/087951	A3	10/2004
WO	WO 2005/056186	A1	6/2005
WO	WO 2005/072858	A1	8/2005

WO	WO 2006/018044	A1	2/2006
WO	WO 2006/056787	A1	6/2006
WO	WO 2006/103440	A2	10/2006
WO	WO 2006/113727	A2	10/2006
WO	WO 2007/082480	A1	7/2007
WO	WO 2008/028124	A1	3/2008
WO	WO 2008/118098	A1	10/2008
WO	WO 2008/123112	A1	10/2008

## OTHER PUBLICATIONS

International Search Report and Written Opinion for PCT/US2008/005577 mailed Apr. 3, 2009.

International Preliminary Report on Patentability for PCT/US2008/005577 mailed Oct. 5, 2009.

[No Author Listed] Proceedings of uTAS 2004, 8th International Conference on Miniaturized Systems in Chemistry and Life Sciences, Sep. 26-30, Malmo, Sweden, Edited by Thomas Laurell, Johan Nilsson, Klays Jensen, D. Jed Harrison, Jorg P. Kutter, The Royal Society of Chemistry, pp. 1-135 (2004).

Ahn et al., Disposable Smart Lab on a Chip for Point-of-Care Clinical Diagnostics. Proceedings of the IEEE. 2004;92(1): 154-73.

Andersson, et al., Micromachined flow-through filter-chamber for chemical reactions on beads. Sensors and Actuators B. 2000;67:203-08.

Atencia et al., Capillary inserts in microcirculatory systems. Lab Chip. 2006;6: 575-77.

Atencia et al., Steady flow generation in microcirculatory systems. Lab Chip. 2006;6:567-74.

Daridon, et al., Chemical sensing using an integrated microfluidic system based on the Berthelot reaction. Sensors and Actuators B. 2001;76:235-43.

Dodge, et al., Electrokinetically Driven Microfluidic Chips with Surface-Modified Chambers for Heterogeneous Immunoassays. Anal Chem. 2001;73:3400-9.

Fredrickson et al., Macro-to-micro interfaces for microfluidic devices. Lab Chip. 2004;4:526-33.

Grodzinski et al., A Modular Microfluidic System for Cell Pre-concentration and Genetic Sample Preparation. Biomedical Microdevices. 2003;5(4):303-10.

Juncker et al., Autonomous Microfluidic Capillary Systems. Anal Chem. 2002;74:6139-44.

Laksanasopin et al., A smartphone dongle for diagnosis of infectious diseases at the point of care. Sci Transl Med. Feb. 4, 2015;7(273):273rel. doi: 10.1126/scitranslmed.aaa0056.

Linder, et al., Reagent-Loaded Cartridges for Valveless and Automated Fluid Delivery in Microfluidic Devices. Anal Chem. 2005;77(1):64-71.

Moorthy, et al., Microfluidic tectonics platform: A colorimetric, disposable botulinum toxin enzyme-linked immunosorbent assay system. Electrophoresis. 2004;25:1705-13.

Obeid et al., Microfabricated Device for DNA and RNA Amplification by Continuous-Flow Polymerase Chain Reaction and Reverse Transcription-Polymerase Chain Reaction with Cycle Number Selection. Anal Chem. 2003;75:288-95.

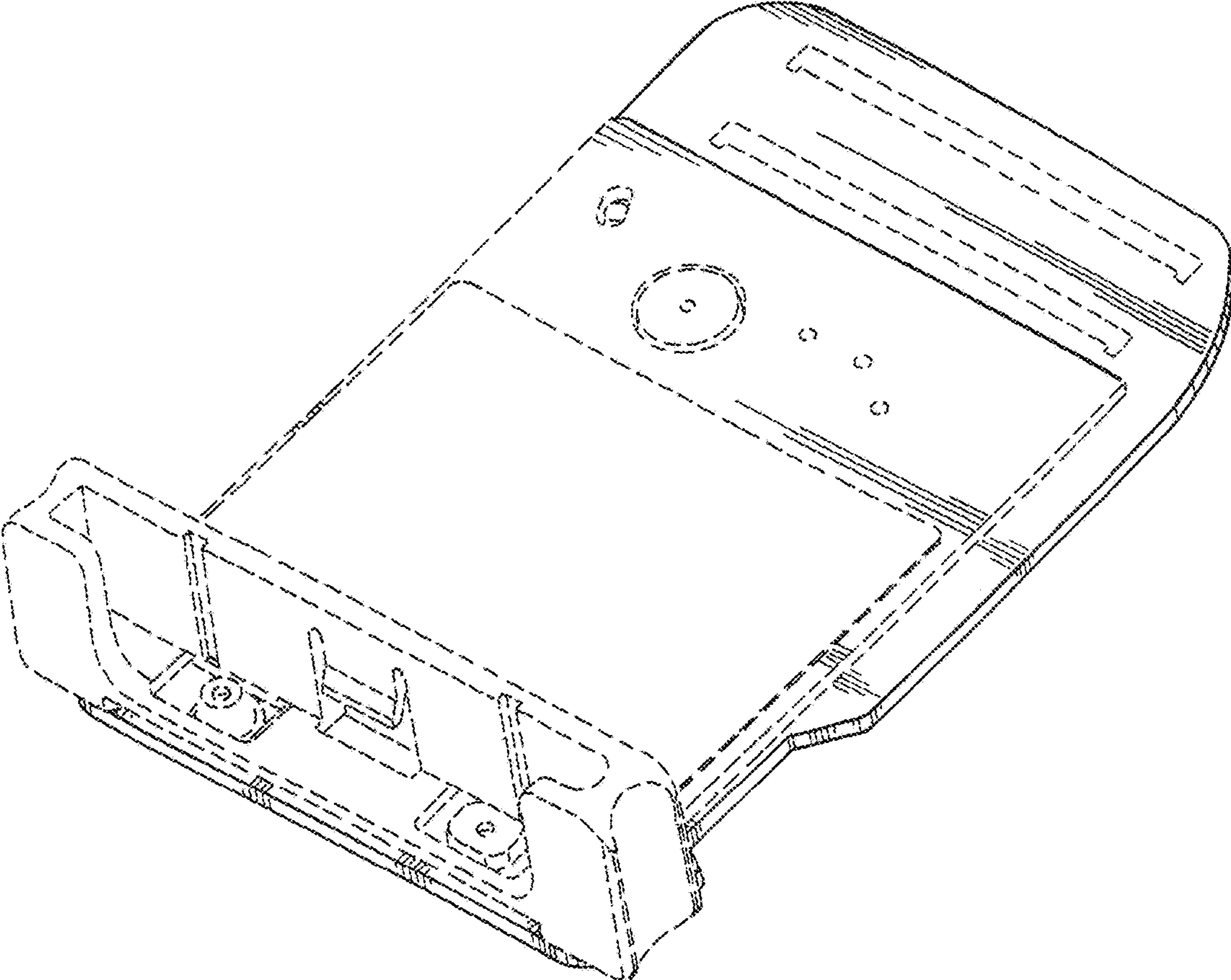
Sia et al., An Integrated Approach to a Portable and Low-Cost Immunoassay for Resource-Poor Settings. Angew Chem Int Ed. 2004;43:498-502.

Sia et al., Microfluidic devices fabricated in poly(dimethylsiloxane) for biological studies. Electrophoresis. 2003;24:3563-76.

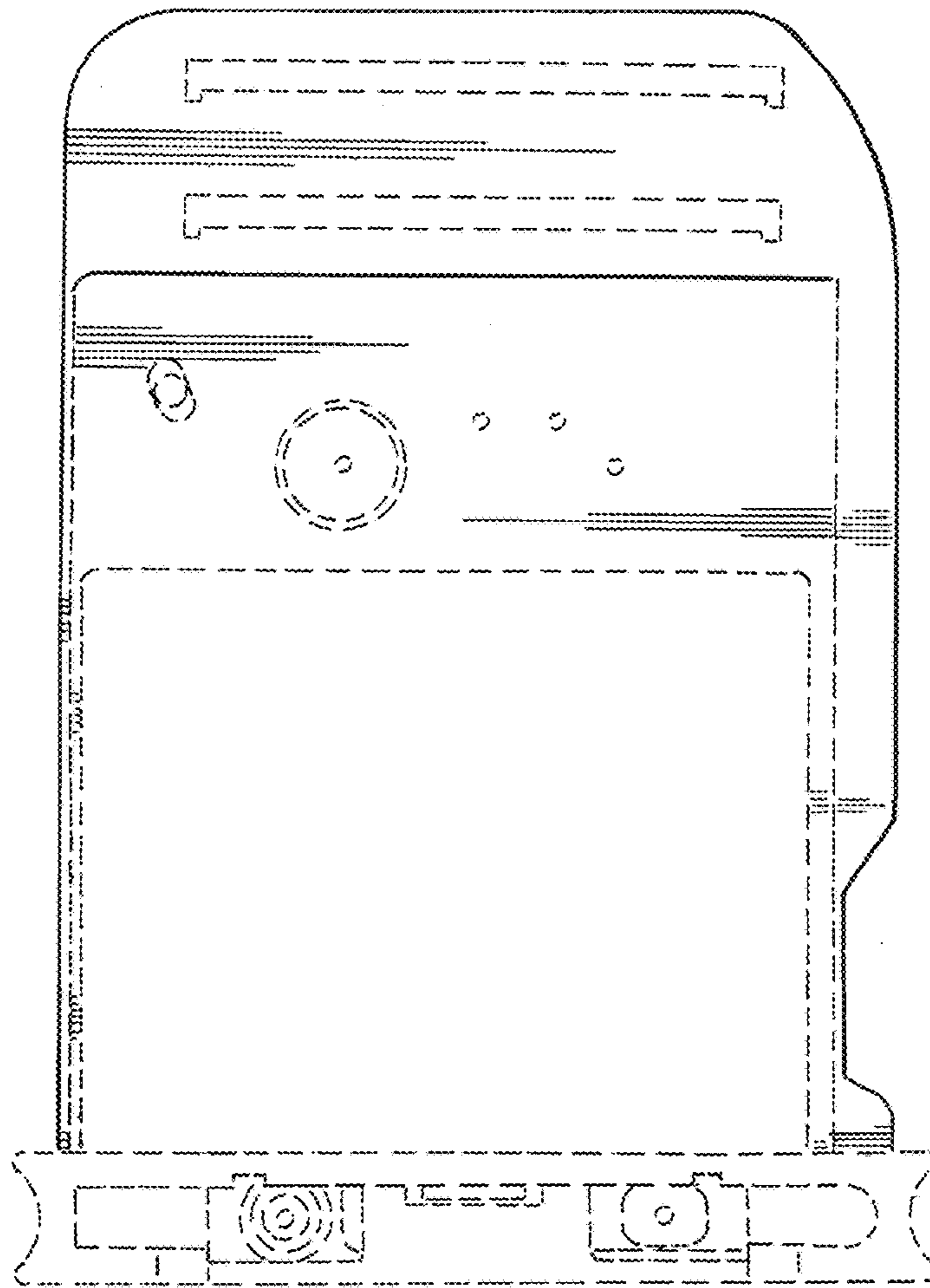
Song et al., A microfluidic system for controlling reaction networks in time. Angew Chem Int Ed. 2003;42(7):767-72.

Weigl et al., Lab-on-a-chip for drug development. Advanced Drug Delivery Reviews. 2003;55:349-77.

\* cited by examiner

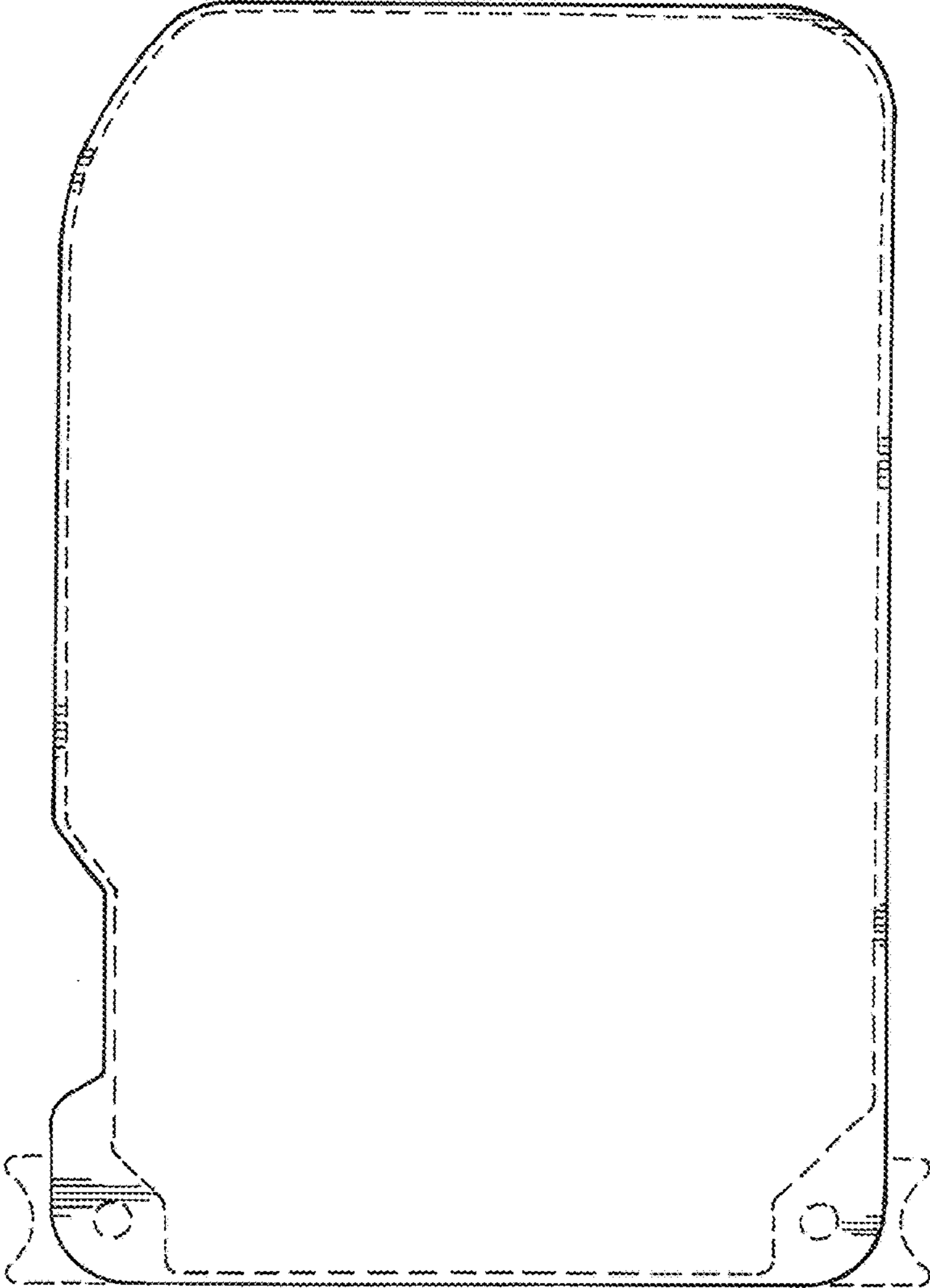


*Fig. 1*

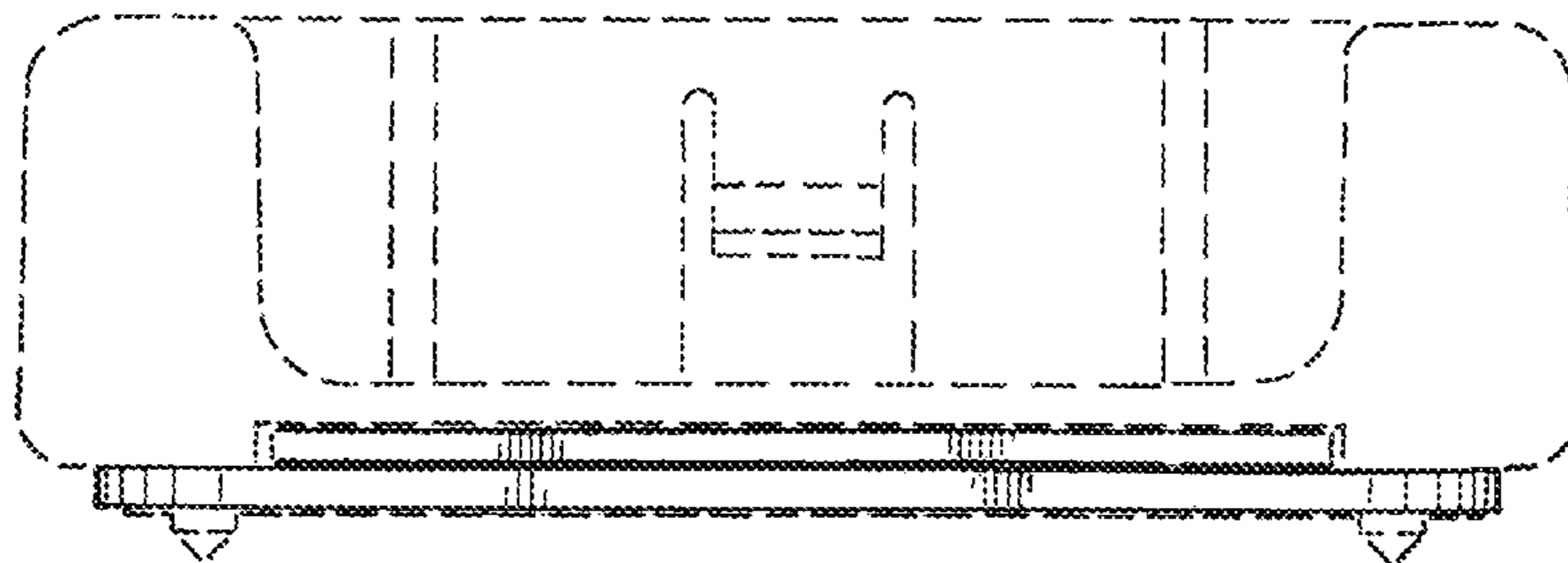


*Fig. 2*

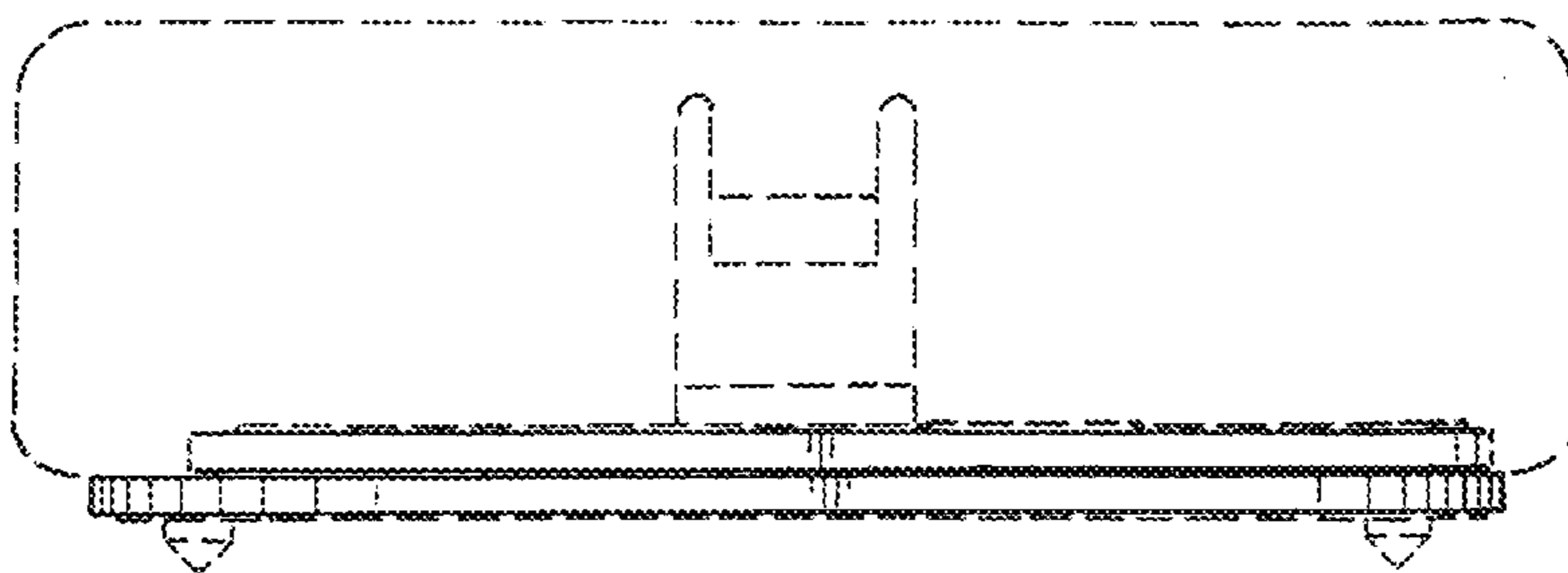




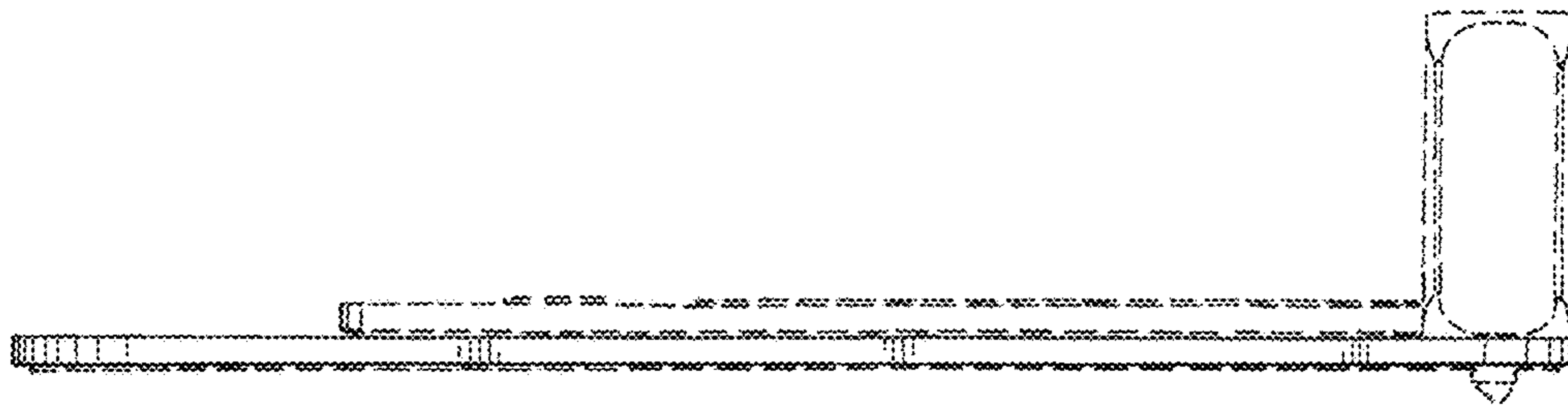
*Fig. 3*



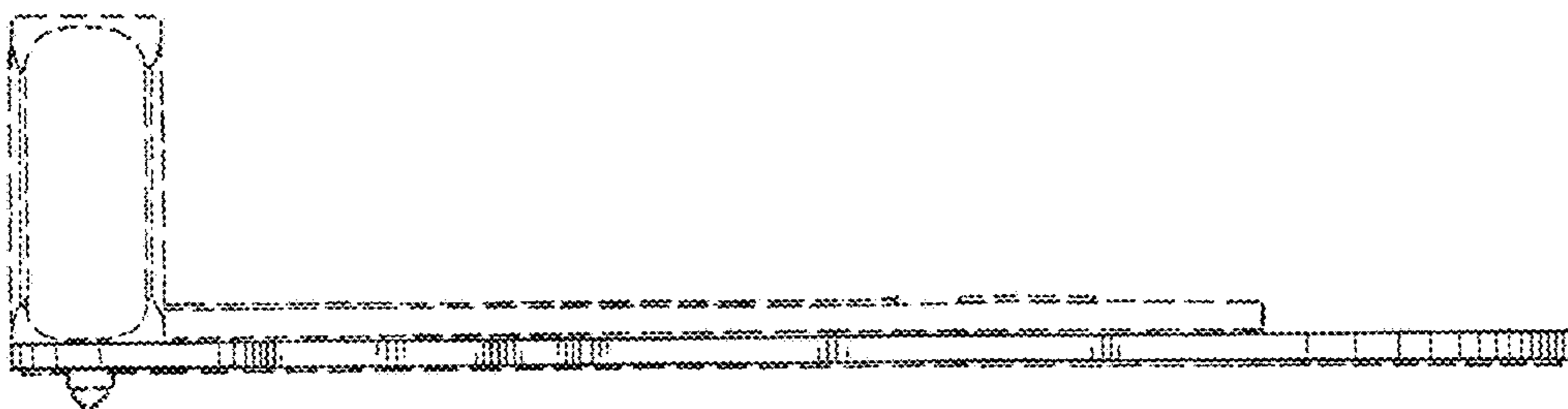
*Fig. 4*



*Fig. 5*



*Fig. 6*



*Fig. 7*



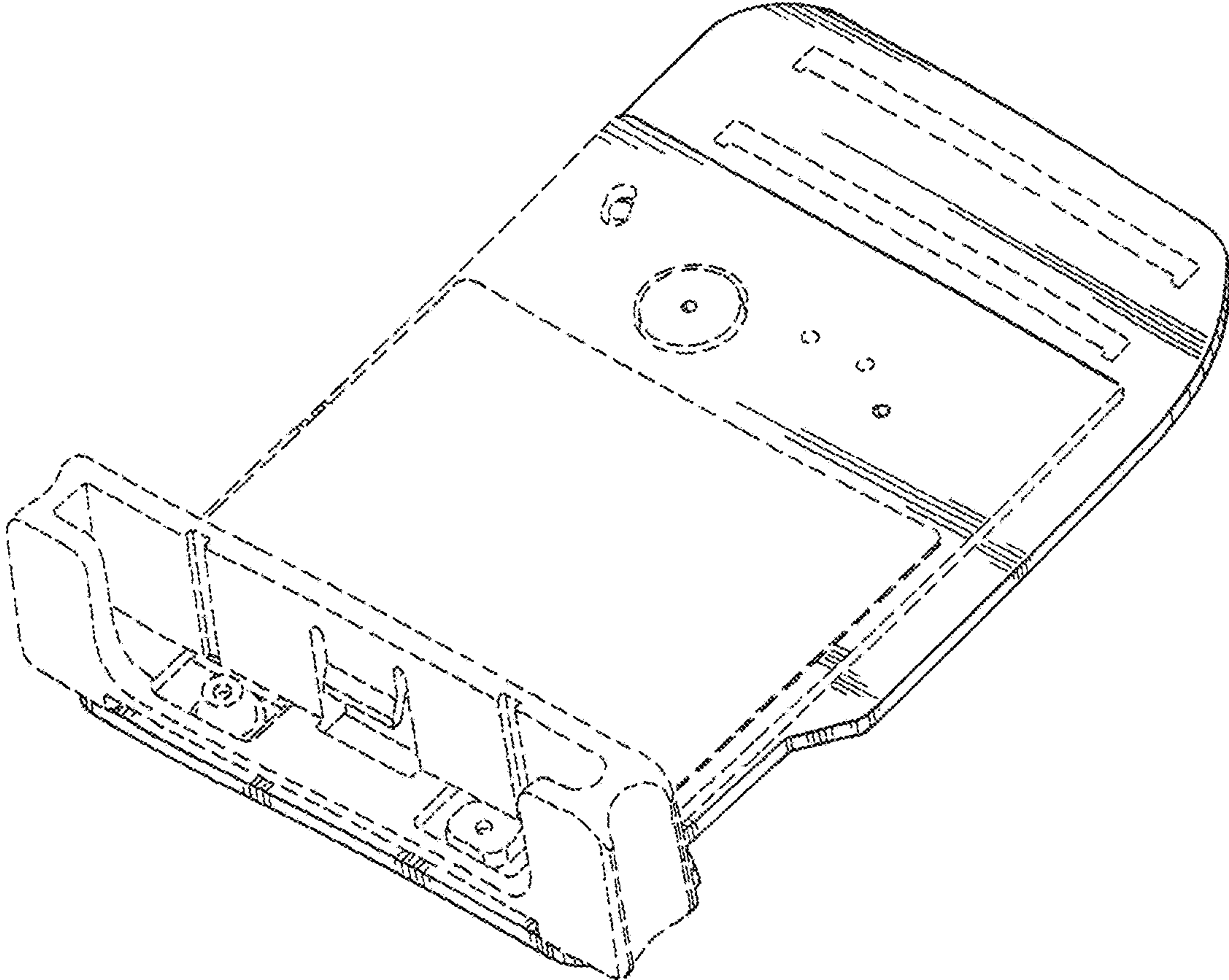


FIG. 8

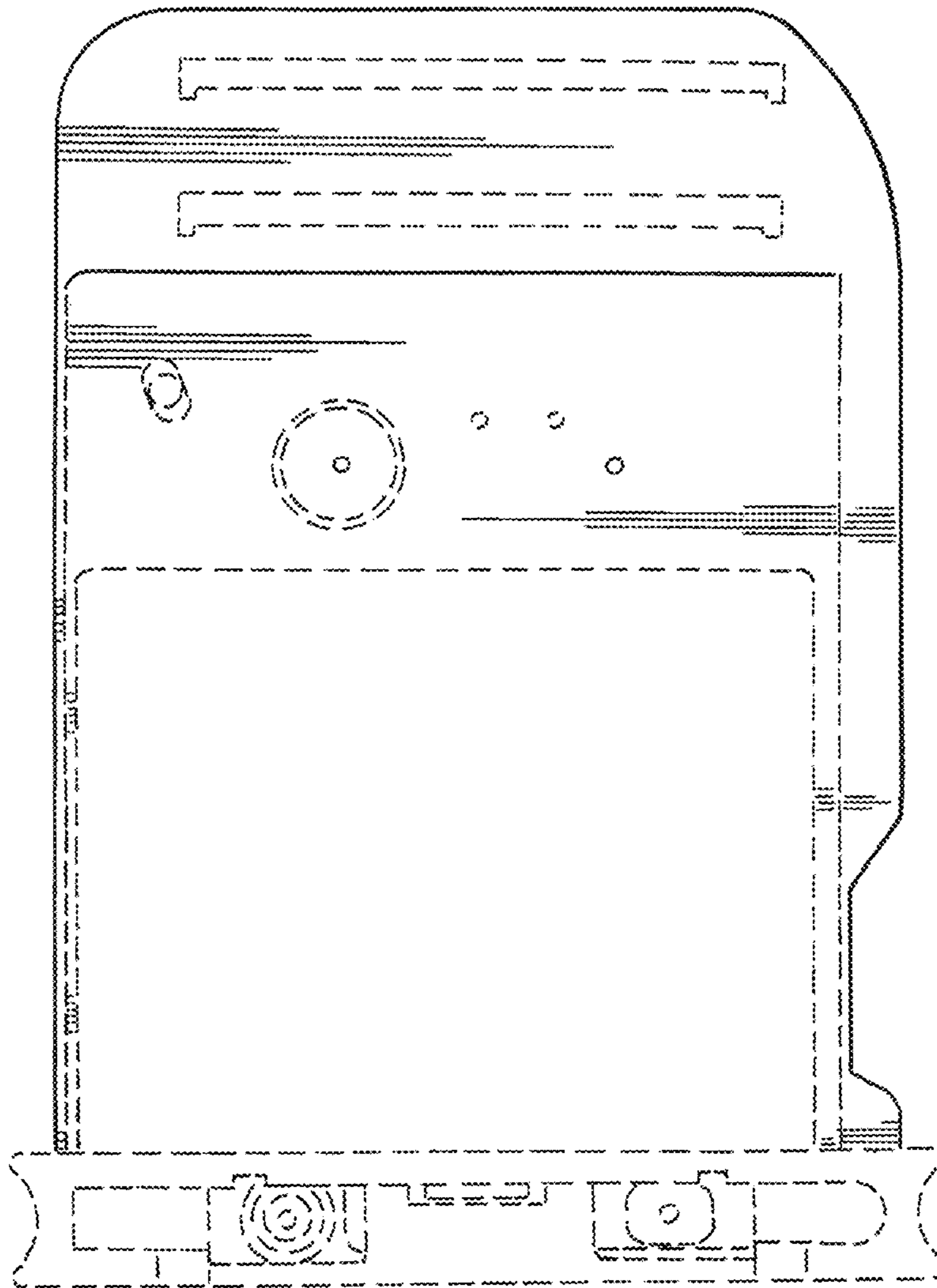


FIG. 9

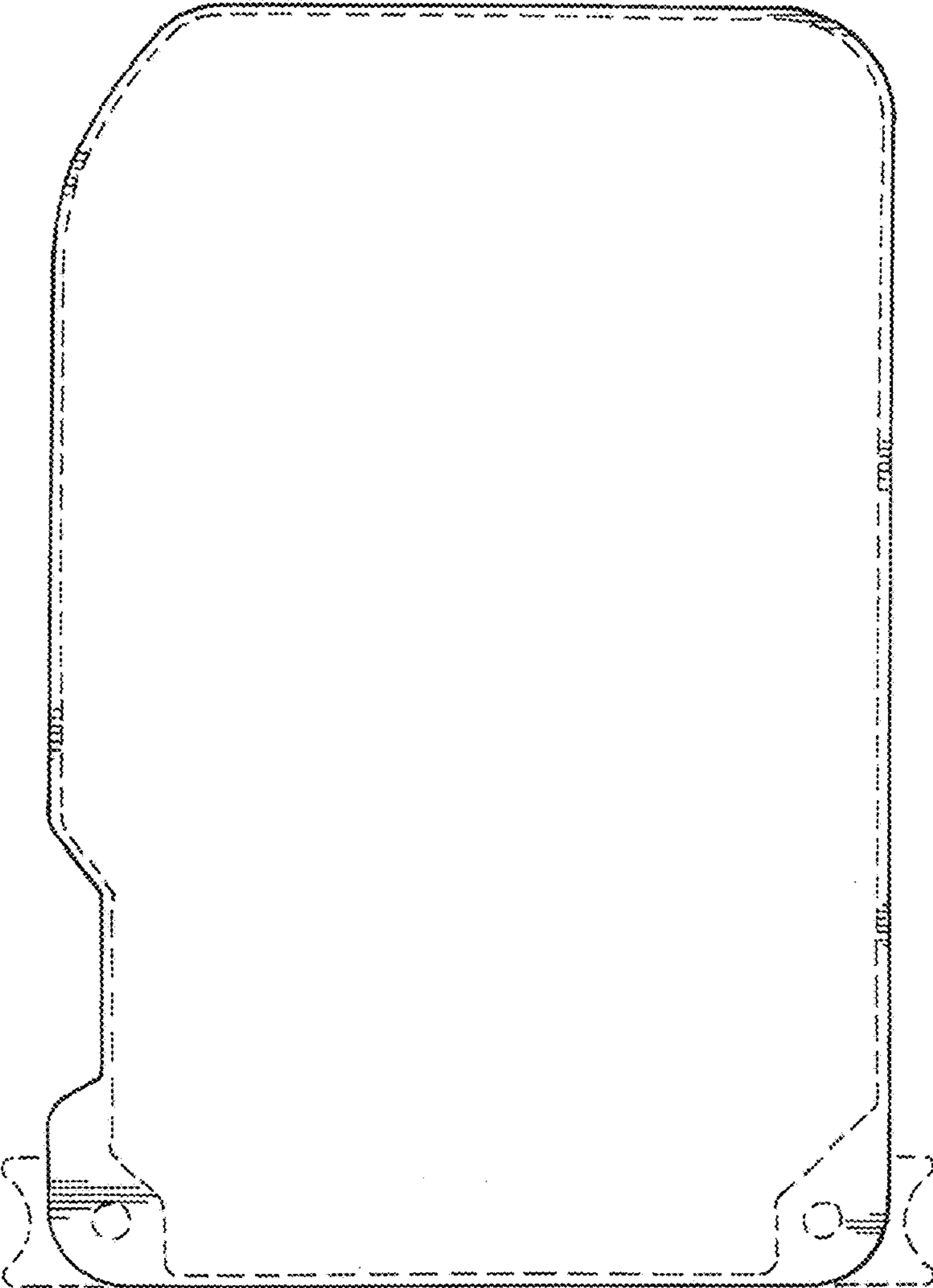


FIG. 10



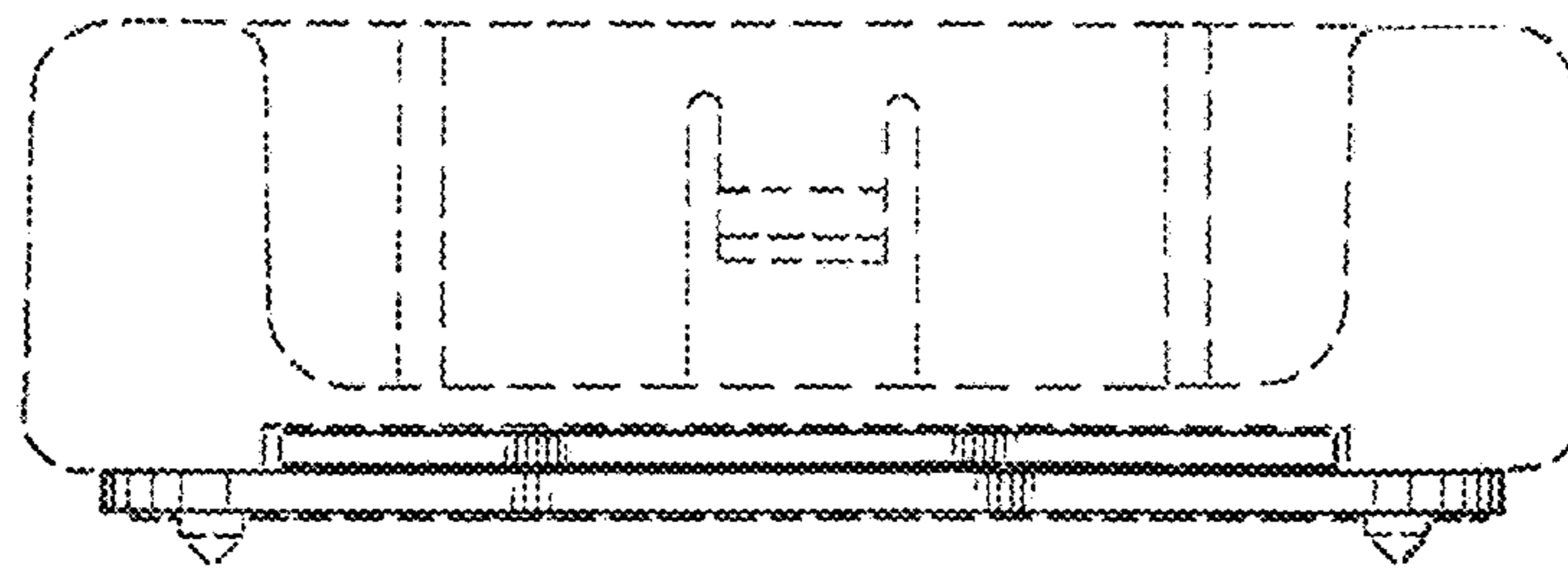


FIG. 11

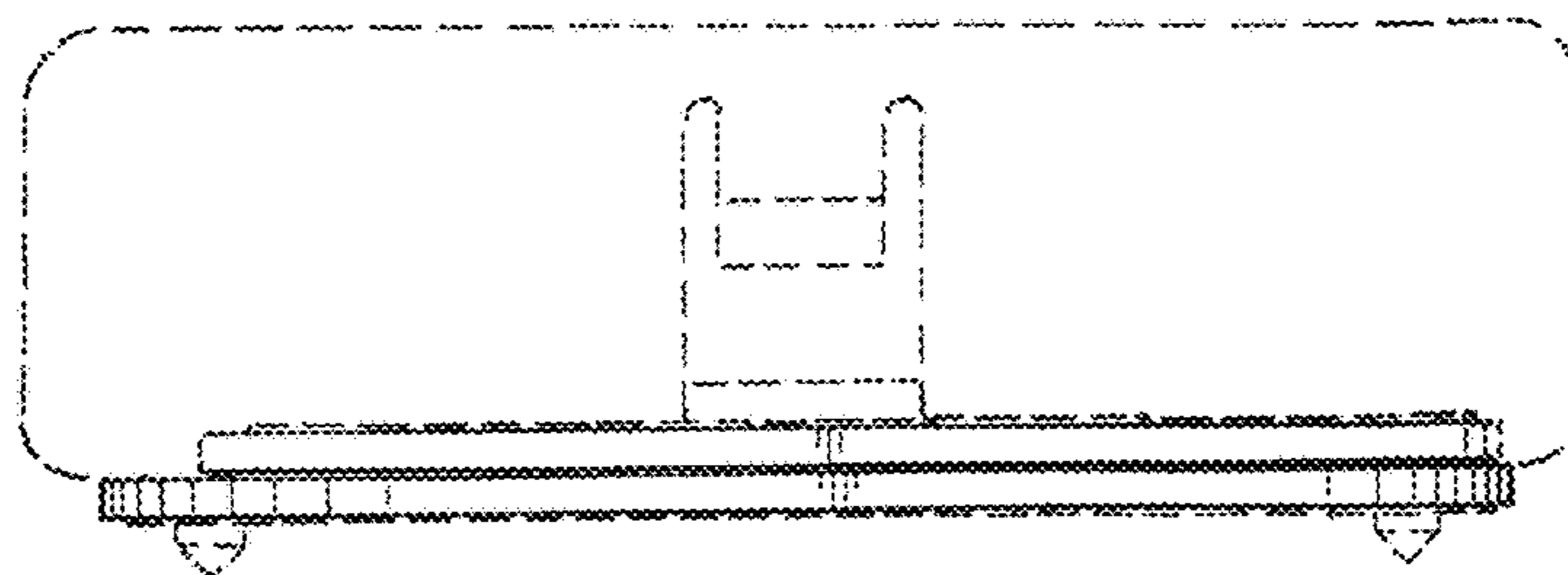


FIG. 12

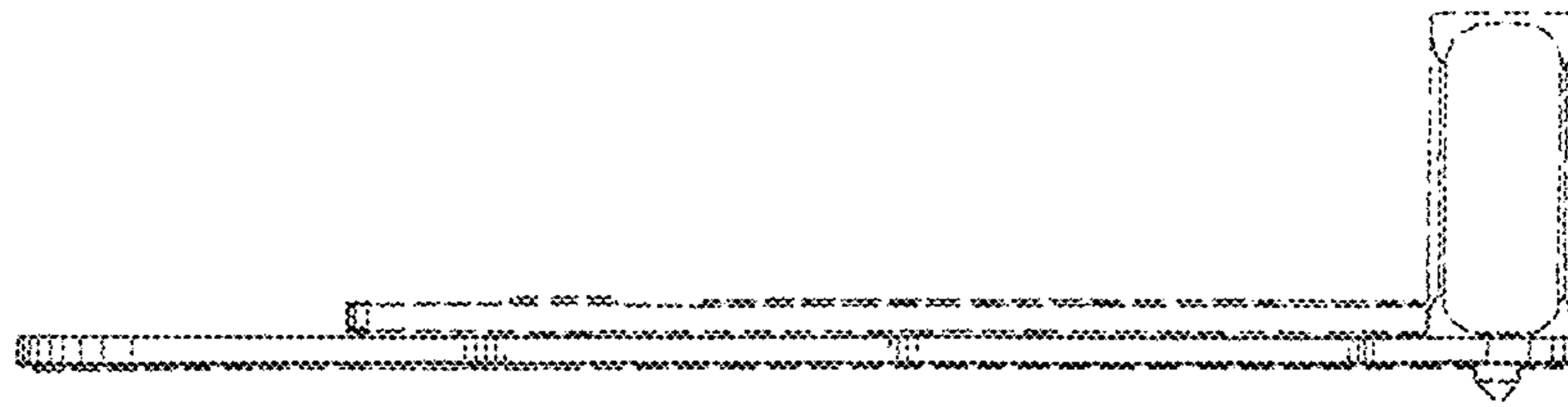


FIG. 13

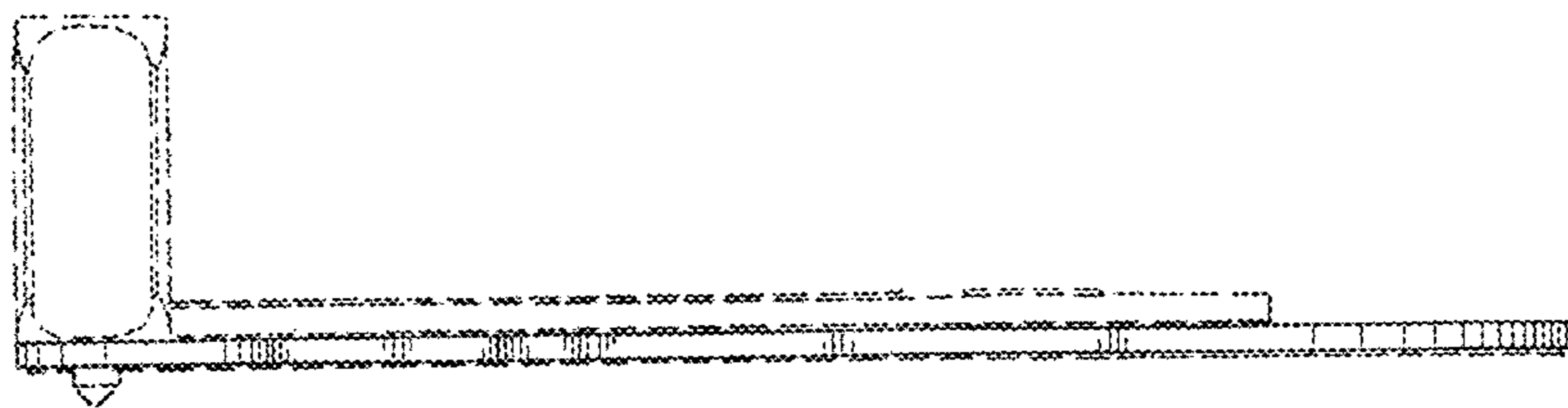


FIG. 14