US0D1104958S

(12) United States Design Patent

Nowakowski et al.

(10) Patent No.: US D1,104,958 S
(45) Date of Patent: ** Dec. 9, 2025

(54) **BATTERY CHARGER**

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

(21) Appl. No.: **29/963,884**

(22) Filed: **Sep. 19, 2024**

Related U.S. Application Data

(62) Division of application No. 29/847,607, filed on Jul. 26, 2022, now Pat. No. Des. 1,051,824.

(51) **LOC (15) Cl.** **13-02**

(52) **U.S. Cl.**
USPC **D13/107**

(58) **Field of Classification Search**
USPC D13/103, 107, 108, 110, 118, 119, 184, D13/199
CPC .. H02J 50/00; H02J 50/10; H02J 50/12; H02J 50/80; H02J 7/025; H02J 7/005; H02J 7/02; H02J 7/0026; H02J 7/0042; H02J 7/0044; H02J 7/0045; H02J 7/0013; H02J 7/0003
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

D203,543 S 1/1966 Coe
3,938,024 A 2/1976 Clarke
(Continued)

FOREIGN PATENT DOCUMENTS

CA 2806870 A1 4/2014
EM 008213565-0001 * 11/2020
(Continued)

OTHER PUBLICATIONS

"Delta-Q Expands RQ Series With New High-Performance Charger", posted Jul. 7, 2023. OEMOffHighway.com [https://www.oemoffhighway.com/electronics/power-systems/batteries-capacitors/product/22866590] (Year: 2023).*
(Continued)

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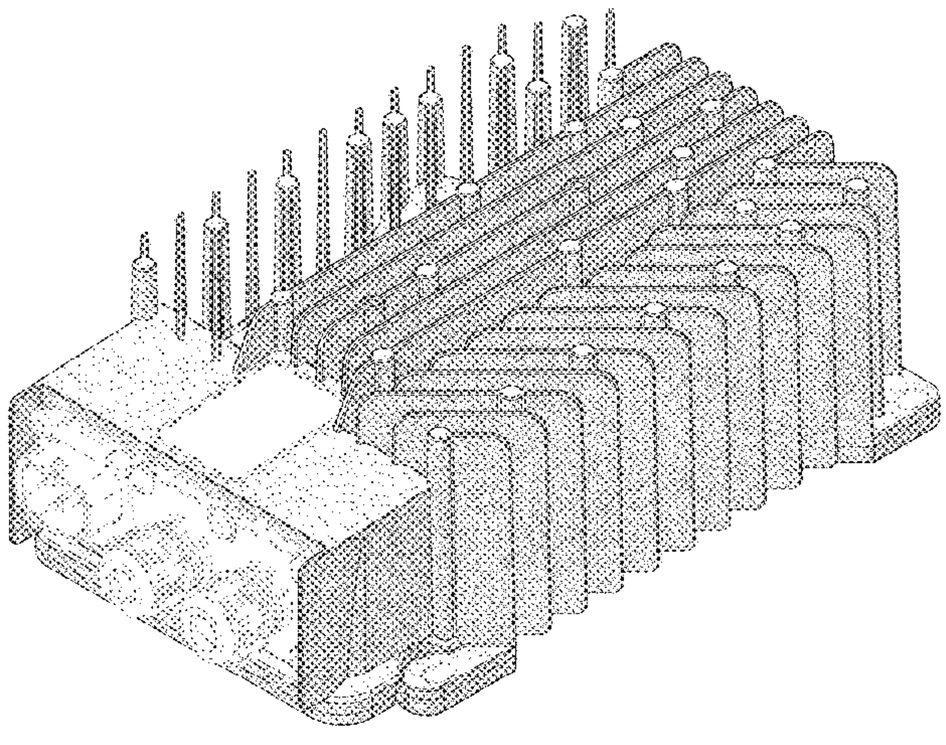
(57) **CLAIM**

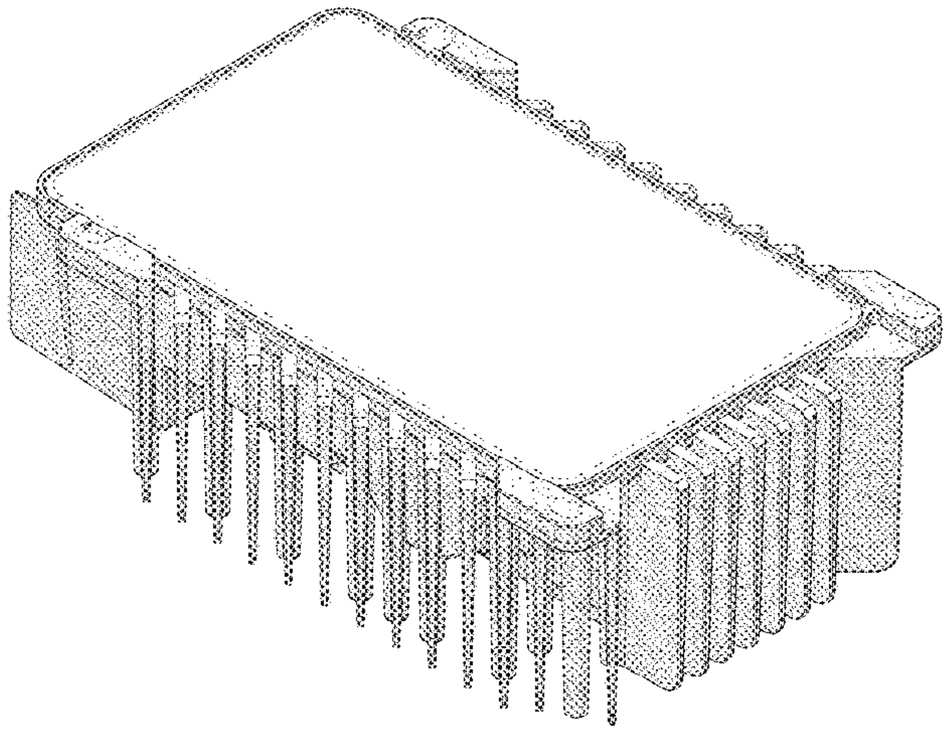
The ornamental design for a battery charger as shown and described.

DESCRIPTION

FIG. **1** is a top left-front isometric view of a battery charger showing our new design.
FIG. **2** is a top right-rear isometric view thereof.
FIG. **3** is a top rear isometric view thereof.
FIG. **4** is a top left-rear isometric view thereof.
FIG. **5** is a bottom right-rear isometric view thereof.
FIG. **6** is a bottom left-front isometric view thereof.
FIG. **7** is a top plan view thereof.
FIG. **8** is a bottom plan view thereof.
FIG. **9** is a right side elevational view thereof.
FIG. **10** is a left side elevational view thereof.
FIG. **11** is a front elevational view thereof; and,
FIG. **12** is a rear elevational view thereof.
The broken lines in the figures depict portions of the article which form no part of the claimed design.

1 Claim, 12 Drawing Sheets





(56) **References Cited**

U.S. PATENT DOCUMENTS

4,412,277	A		10/1983	Mitchell
4,559,590	A		12/1985	Davidson
D287,718	S		1/1987	Moeller
D292,914	S		11/1987	Moeller
D305,115	S		12/1989	Kondo et al.
4,885,675	A		12/1989	Henze et al.
5,001,620	A		3/1991	Smith
5,034,871	A		7/1991	Okamoto et al.
5,065,278	A		11/1991	Schultz
5,077,486	A		12/1991	Marson et al.
D328,057	S		7/1992	Prager et al.
D336,074	S		6/1993	Friend et al.
D338,653	S		8/1993	Morgan et al.
D348,869	S		7/1994	Egger et al.
D351,134	S		10/1994	Hunziker
5,355,300	A		10/1994	Zinn
D358,753	S		5/1995	Yoshida et al.
D360,186	S		7/1995	Netz et al.
5,490,057	A		2/1996	Vinciarelli et al.
D375,725	S		11/1996	Dodson
5,602,462	A		2/1997	Stich et al.
D378,915	S		4/1997	Widmayer et al.
D379,088	S		5/1997	Hopper
D379,799	S		6/1997	Widmayer et al.
D381,011	S		7/1997	Widmayer et al.
D388,399	S		12/1997	Widmayer et al.
D389,807	S		1/1998	Dodson
D398,589	S		9/1998	Dodson
D401,138	S		11/1998	Rosen et al.
D401,216	S		11/1998	Person et al.
D409,138	S		5/1999	Gammenthaler
D409,139	S		5/1999	Cornell et al.
D410,652	S		6/1999	Jones et al.
D416,873	S		11/1999	Korsunsky et al.
D426,814	S		6/2000	Lee
D427,146	S		6/2000	Wei
D427,147	S		6/2000	Wei
6,076,594	A		6/2000	Kuo
D441,724	S		5/2001	Chou et al.
D442,565	S		5/2001	Chou et al.
D442,566	S		5/2001	Chou et al.
D449,587	S		10/2001	Cronin
D449,817	S		10/2001	Takeuchi et al.
6,307,747	B1		10/2001	Farnsworth et al.
6,320,772	B1		11/2001	Doyama et al.
D458,228	S		6/2002	Jacobson
D464,939	S		10/2002	Chuang et al.
6,462,966	B1		10/2002	Leung et al.
D465,771	S		11/2002	Hsieh
D476,958	S		7/2003	Tsai
D478,876	S		8/2003	Tan et al.
6,650,559	B1		11/2003	Okamoto et al.
6,671,172	B2		12/2003	Carter et al.
D489,682	S	*	5/2004	Guillarme D13/110
D490,383	S		5/2004	Tan et al.
6,736,195	B2		5/2004	Busch et al.
D492,251	S		6/2004	Cameron et al.
6,809,678	B2		10/2004	Vera et al.
6,841,979	B2		1/2005	Berson et al.
6,847,195	B2		1/2005	Chen
6,862,201	B2		3/2005	Hodge, Jr.
D505,915	S		6/2005	Hussaini et al.
D507,528	S		7/2005	Feldman et al.
D510,320	S		10/2005	Tuomola et al.
7,116,090	B1		10/2006	Yang et al.
7,198,094	B2		4/2007	Barsun et al.
D541,743	S		5/2007	Virolainen et al.
D541,744	S		5/2007	Virolainen et al.
D541,745	S		5/2007	Virolainen et al.
D546,282	S		7/2007	Wardenburg
D551,621	S		9/2007	Iacovelli et al.
D559,778	S		1/2008	Tsuzuki et al.
D561,711	S		2/2008	Lin
D562,765	S		2/2008	Tsuzuki et al.
7,365,987	B2		4/2008	Jeong
D568,841	S		5/2008	Fischer et al.
D571,314	S		6/2008	Horng
7,535,716	B2		5/2009	Fischer et al.
D593,512	S		6/2009	Lin
D602,577	S		10/2009	Miyazawa et al.
7,616,455	B2		11/2009	Cameron et al.
D606,017	S		12/2009	Charlson et al.
D613,257	S		4/2010	Clifton
D613,258	S		4/2010	Walker et al.
D621,812	S		8/2010	Wayman
D638,376	S		5/2011	Herrmann et al.
7,983,043	B2		7/2011	Xu et al.
D642,721	S		8/2011	Li et al.
D651,200	S		12/2011	Sugime et al.
D652,156	S		1/2012	Li et al.
D661,008	S		5/2012	Yuan
D662,880	S		7/2012	Scott et al.
D664,544	S		7/2012	Yi et al.
D667,789	S		9/2012	O'Neil
D672,730	S		12/2012	Lin
D675,622	S		2/2013	Petrick et al.
D677,621	S		3/2013	Beroukas et al.
D678,852	S		3/2013	Marshall
D682,207	S		5/2013	Nakahira et al.
D682,459	S		5/2013	Gordin et al.
D684,130	S		6/2013	Vincent et al.
D691,558	S		10/2013	Helosvuori et al.
8,546,974	B2		10/2013	Foxall et al.
8,552,695	B2		10/2013	Stracquadaini
D696,764	S		12/2013	Sato et al.
8,598,737	B2		12/2013	Foxall et al.
D698,481	S		1/2014	Wasserman et al.
D702,376	S		4/2014	Su
D703,132	S	*	4/2014	Pearson D13/107
D703,181	S		4/2014	Wilson
D705,728	S		5/2014	Choi
D706,216	S		6/2014	Perin
8,803,489	B2		8/2014	Li et al.
D713,336	S		9/2014	Perin
8,861,238	B2		10/2014	Huang et al.
8,937,469	B2		1/2015	Clark et al.
D722,576	S		2/2015	Zimmer
D722,958	S		2/2015	Kotaniemi et al.
D726,141	S		4/2015	Wilson
D730,333	S		5/2015	Matsumoto
9,028,096	B2		5/2015	Verdes et al.
D734,250	S		7/2015	Rennick
D734,526	S		7/2015	Gordin et al.
D734,532	S		7/2015	Gordin et al.
D739,347	S		9/2015	Huang et al.
D751,241	S		3/2016	Aldape
D751,751	S		3/2016	Lockart et al.
D755,740	S		5/2016	Chen et al.
D761,472	S		7/2016	Zhu
D761,729	S		7/2016	Leong
D767,815	S		9/2016	Lee
D768,585	S		10/2016	Moore et al.
D770,975	S		11/2016	Nada et al.
9,490,694	B2		11/2016	Alam
D793,350	S		8/2017	Kenchappa
D796,431	S	*	9/2017	Lau D13/107
D801,921	S		11/2017	Vetu
D804,434	S		12/2017	Lu et al.
D805,473	S		12/2017	Montgomery et al.
D805,486	S		12/2017	Hochman et al.
D806,647	S	*	1/2018	Lau D13/110
D814,450	S		4/2018	Kumazawa et al.
D815,592	S	*	4/2018	Lau D13/107
D817,876	S		5/2018	Meng
D818,432	S		5/2018	Zhu
D823,796	S		7/2018	Zhang
D828,294	S	*	9/2018	Lau D13/107
D829,649	S	*	10/2018	Lau D13/107
D845,234	S		4/2019	Gao
D849,566	S		5/2019	Klintworth
D849,567	S		5/2019	Klintworth
D850,369	S		6/2019	Wang
D853,956	S	*	7/2019	Lau D13/107
D854,497	S	*	7/2019	Lau D13/108

(56) **References Cited**

U.S. PATENT DOCUMENTS

D860,132	S		9/2019	Fu	
D862,454	S		10/2019	Chun	
D870,657	S		12/2019	Liang	
D872,019	S		1/2020	Chen	
D872,020	S		1/2020	Chen	
D875,681	S		2/2020	Xu	
D879,715	S		3/2020	Brendel et al.	
D884,612	S	*	5/2020	Lau	D13/107
D887,350	S		6/2020	Yamamoto et al.	
D890,096	S		7/2020	Brendel et al.	
D891,369	S		7/2020	Wu et al.	
D913,233	S		3/2021	McGinley et al.	
D913,916	S	*	3/2021	Zaremba	D13/107
D914,595	S		3/2021	Rooyakkers et al.	
D929,321	S		8/2021	Zhu et al.	
D931,807	S		9/2021	Wu et al.	
D937,209	S		11/2021	Luo	
D943,529	S		2/2022	Carvalho et al.	
D949,788	S		4/2022	Sakamura et al.	
D962,879	S		9/2022	Kuo et al.	
D969,075	S		11/2022	Wei	
D977,481	S		2/2023	Troedson et al.	
D1,004,541	S	*	11/2023	Bos	D13/107
D1,012,844	S		1/2024	Tang	
D1,019,548	S		3/2024	Chen	
D1,019,554	S		3/2024	Chen	
D1,022,880	S	*	4/2024	Stanciu	D13/107
D1,040,093	S		8/2024	Zhu	
D1,040,094	S		8/2024	Zhang	
D1,047,906	S		10/2024	Zhang	
D1,049,033	S		10/2024	Lin	
D1,051,043	S		11/2024	Chen	
D1,051,824	S	*	11/2024	Nowakowski	D13/107
D1,055,850	S	*	12/2024	Stanciu	D13/107
2002/0149951	A1		10/2002	Leung et al.	
2004/0240182	A1		12/2004	Shah	
2005/0061480	A1		3/2005	Carter et al.	
2005/0105311	A1		5/2005	Soldano	
2007/0014089	A1		1/2007	Huang	
2007/0131387	A1		6/2007	Kawabata et al.	
2007/0133233	A1		6/2007	Cameron et al.	
2008/0002444	A1		1/2008	Shekhawat et al.	
2008/0295993	A1		12/2008	Chen et al.	
2010/0110593	A1		5/2010	Kim et al.	
2010/0165683	A1		7/2010	Sugawara	
2010/0259240	A1		10/2010	Cuk	
2011/0110127	A1		5/2011	Lee	
2011/0211377	A1		9/2011	Uno	
2011/0286216	A1		11/2011	Araman	
2011/0292703	A1		12/2011	Cuk	
2012/0069615	A1		3/2012	Tomioka	
2012/0249102	A1		10/2012	Cuk	
2012/0256606	A1		10/2012	van den Broeke	
2013/0051102	A1		2/2013	Huang et al.	
2013/0235631	A1		9/2013	Pahlevaninezhad et al.	
2014/0056045	A1		2/2014	Yan et al.	
2014/0097808	A1		4/2014	Clark et al.	
2014/0268952	A1		9/2014	Tong	
2015/0171734	A1		6/2015	Yu et al.	
2015/0263605	A1		9/2015	Alam	
2016/0056730	A1		2/2016	Yan et al.	
2016/0099660	A1		4/2016	Khaligh et al.	

FOREIGN PATENT DOCUMENTS

EM	008781967-0001		2/2022
EM	015008516-0001	*	1/2023
GB	9008213565-0002		10/2020
WO	WO 2010025596 A1		3/2010

OTHER PUBLICATIONS

"Delta-Q Technologies Launches New High-Performance Charger", first accessed Apr. 4, 2025. LiftAndAccess.com [https://www.liftandaccess.com/article/delta-q-technologies-launches-new-high-performance-charger] (Year: 2025).*

"Press Release: Delta-Q Technologies Expands RQ Series with New High- Performance Charger", posted Jun. 27, 2023. Delta-Q.com [https://delta-q.com/company-news/press-release-delta-q-technologies-expands-rq-series-with-new-high-performance-charger/] (Year: 2023).*

"Delta-Q Technologies Announces Its New RQ350 Battery Charger for Electric Vehicles and Machines", posted May 27, 2020. BusinessWire.com [https://www.businesswire.com/news/home/20200527005918/en/Delta-Q-Technologies-Announces-Its-New-RQ350-Battery-Charger-for-Electric-Vehicles-and-Machines] (Year: 202).*

Anderson, "Delta-Q launches XV3300 battery charger," Jun. 15, 2021, URL=https://www.accesslifthandlers.com/news/delta-q-launches-xv3300-battery-charger/8012935.article, download date Sep. 29, 2023. (4 pages).

Chen et al., "Digital Control for Improved Efficiency and Reduced Harmonic Distortion Over Wide Load Range in Boost PFC Rectifiers," *IEEE Transactions on Power Electronics 25*(10):2683-2692, Oct. 2010.

Cheng et al., "A Novel Single-Stage High-Power-Factor LED Street-Lighting Driver with Coupled Inductors," IEEE Power Electronics Lab. Dept. of Electrical Engineering, I-Shou University, Taiwan, R.O.C. 2013.

Clark, "Digital Control Techniques For Power Quality Improvements In Power Factor Correction Applications," Master's Thesis, University of British Columbia, Jul. 2012, 114 pages.

De Gussemé et al., "Digitally Controlled Boost Power-Factor-Correction Converts Operating in Both Continuous and Discontinuous Conduction Mode," *IEEE Transactions on Industrial Electronics 52*(1):88-97, Feb. 2005.

De Gussemé et al., "Input-Current Distortion of CCM Boost PFC Converts Operated in DCM," *IEEE Transactions on Industrial Electronics 54*(2):858-865, Apr. 2007.

De Gussemé et al., "Sample Correction for Digitally Controlled Boost PFC Converters Operating in both CCM and DCM," *Eighteenth Annual IEEE Applied Power Electronics Conference and Exposition 1*:389-395, Feb. 9-13, 2003.

De Souza et al., "A New ZVS-PWM Unity Power Factor Rectifier with Reduced Conduction Losses," *IEEE Transactions on Power Electronics 10*(6):746-752, Nov. 1995.

De Souza et al., "High Power Factor Rectifier with Reduced Conduction and Commutation Losses," 21st International Telecommunication Energy Conference, Copenhagen, Jun. 6-9, 1999, 5 pages.

Delta-Q Technologies Corp., "Delta-Q Technologies Introduces New Lithium-Specific Battery Charger at ProMAT 2017," published Mar. 27, 2017, retrieved from http://www.prnewswire.com/news-releases/delta-q-technologoes-introduces-new-lithium-specific-battery-charger-at-promat-2017-617167523.htm on Jun. 1, 2017, 3 pages.

Delta-Q Technologies, "The XV3300: A 3-in-1 Charging Solution," 2023, URL=https://connect.delta-q.com/xv3300, download date Sep. 29, 2023. (11 pages).

Deng et al., "Design Methodology of LLC Resonant Converters for Electric Vehicle Battery Chargers," *IEEE Transactions on Vehicular Technology 63*(4):1581-1592, May 2014.

Dixon, "Average Current Mode Control of Switching Power Supplies—Topic 5," Unitrode Corporation, pp. 5-1-5-14, 2001. (16 pages).

Dixon, "Average Current Mode Control of Switching Power Supplies," Unitrode Application Note U-140, pp. 3-356-3-369, 1990. (14 pages).

Electric Yacht, "Delta-Q IC1200 Battery Charger," URL=https://electricyacht.com/product/delta-q-ic1200-battery-charger/, retrieved on Jul. 25, 2024. (1 page).

Erickson et al., Fundamentals of Power Electronics, Second Edition, Kluwer Academic Publishers, Secaucus, NJ, 2001, 12 pages, Table of Contents.

EV Design & Manufacturing, "Delta-Q Technologies' 3.3kW Battery Charger," 2024, URL=https://www.evdesignandmanufacturing.com/product/delta-q-technologies-battery-charger/, retrieved on Jul. 25, 2024. (3 pages).

(56) **References Cited**

OTHER PUBLICATIONS

Fairchild Semiconductor, "FAN7930: Critical Conduction Mode PFC Controller," Apr. 2010, 22 pages.
FullRiver Battery, "Delta-Q RQ Series: Compact And Efficient Battery Chargers," URL=https://fullriverbattery.com/charger-series/delta-q-rq-series-battery-chargers/, retrieved on Jul. 26, 2024. (8 pages).
Hu et al., "Single-Stage, Universal-Input AC/DC LED Driver With Current-Controlled Variable PFC Boost Inductor", *IEEE Transactions on Power Electronics 27*(3):1579-1588, Mar. 2012.
Huber et al., "Performance Evaluation of Bridgeless PFC Boost Rectifiers," *IEEE Transactions on Power Electronics 23*(3):1381-1390, May 2008.
Hwang et al., "Seamless Boost Converter Control in Critical Boundary Condition for Fuel Cell Power Conditioning System," *IEEE Energy Conversion Congress and Exposition*, Sep. 17-22, 2011, pp. 3641-3648.
Hwang et al., "Seamless Boost Converter Control Under the Critical Boundary Condition for a Fuel Cell Power Conditioning System," *IEEE Transactions on Power Electronics 27*(8):3616-3626, Aug. 2012.
Jason's Golf Carts, "Delta-Q IC1200 Battery Charger 36V 33A," URL=https://jasonsgolfcarts.com/product/delta-q-ic1200-battery-charger-36v-33a/, download date Sep. 29, 2023. (6 pages).
Lau et al., "Battery Charger," U.S. Appl. No. 29/530,060, filed Jun. 12, 2015, 18 pages.
Lau et al., "Battery Charger," U.S. Appl. No. 29/535,892, filed Aug. 11, 2015, 22 pages.
Lau et al., "Battery Charger," U.S. Appl. No. 29/565,135, filed May 18, 2016, 26 pages.
Lau et al., "Battery Charger," U.S. Appl. No. 29/586,567, filed Dec. 5, 2016, 18 pages.
Liou et al., "Design and Implementation of a Boost Power Factor Correction Stage Operated in Mixed-Condition Mode," International Conference of Electric Information and Control Engineering (ICEICE), Apr. 15-17, 2011, pp. 2069-2072.
Lombardo, "Delta-Q launches three-in-one charging solution," Jun. 11, 2021, URL=https://chargedevs.com/newswire/delta-q-launches-three-in-one-charging-solution/, retrieved on Jul. 26, 2024. (2 pages).
Maksimovic et al., "Impact of Digital Control in Power Electronics," Proceedings of 2004 International Symposium on Power Semiconductor Devices & ICs, Kitakyushu, pp. 13-22, 2004.
Martinez et al., "A High-Performance Single-Phase Rectifier with Input Power Factor Correction," *IEEE Transactions on Power Electronics 11*(2):311-317, Mar. 1996.
Marvi et al., "A Fully ZVS Critical Conduction Mode Boost PFC," *IEEE Transactions on Power Electronics 27*(4):1958-1965, Apr. 2012.
Moon et al., "Accurate Mode Boundary Detection in Digitally Controlled Boost Power Factor Correction Rectifiers," *IEEE Energy Conversion Congress and Exposition* (*ECCE*), Sep. 12-16, 2010, pp. 1212-1217.
Moon et al., "Autotuning of Digitally Controlled Boost Power Factor Correction Rectifiers," *IEEE Transactions on Power Electronics 26*(10):3006-3018, Oct. 2011.
Musavi et al., "A Phase-Shifted Gating Technique With Simplified Current Sensing for the Semi-Bridgeless AC-DC Converter," *IEEE Transactions on Vehicular Technology 62*(4):1568-1576, May 2013.
OEM Off-Highway, "Delta-Q Expands RQ Series With New High-Performers Charger," Jul. 7, 2023, URL=https://www.oemoffhighway.com/electronics/power-systems/batteries-capacitors/product/22866590/deltaq-technologies-deltaq-expands-rq-series-with-new-highperformance-charger, retrieved on Jul. 26, 2024. (2 pages).
OEM Off-Highway, "Delta-Q Technologies Launches Battery Compatibility Program," May 24, 2021, URL=https://www.oemoffhighway.com/electronics/power-systems/batteries-capacitors/press-release/21440192/deltaq-technologies-deltaq- technologies-launches-battery-compatibility-program, retrieved on Jul. 25, 2024. (2 pages).
OEM Off-Highway, "Delta-Q XV3300 Battery Charger," Jun. 10, 2021, URL=https://www.oemoffhighway.com/electronics/power-systems/batteries-capacitors/product/21497293/deltaq-technologies-deltaq-xv3300-battery-charger, retrieved on Jul. 26, 2024. (1 page).
Park et al., "Design on Topologies for High Efficiency Two-Stage AC-DC Converter," *IEEE 7th International Power Electronics and Motion Control Conference*—ECCE Asia Jun. 2-5, 2012, Harbin, China.
Roggia et al., "Digital Control System Applied to a PFC Boost Converter Operating in Mixed Conduction Mode," Brazilian Power Electronics Conference (COBEP), Sep. 2-Oct. 1, 2009, pp. 698-704.
Salmon, "Circuit topologies for pwm boost rectifiers operated from 1-phase and 3-phase ac supplies and using either single or split dc rail voltage outputs," 10th Annual Applied Power Electronics Conference and Exposition, Dallas, TX, Mar. 5-9, 1995, vol. 1, pp. 473-479.
Salmon, "Circuit Topologies for Single-Phase Voltage-Doubler Boost Rectifiers," *IEEE Transactions on Power Electronics 8*(4):521-529, Oct. 1993.
Sebastián et al., "The Determination of the Boundaries Between Continuous and Discontinuous Conduction Modes in PWM DC-to-DC Converters Used as Power Factor Preregulators," *IEEE Transactions on Power Electronics 10*(5):574-582, Sep. 1995.
Su et al., "An Interleaved Totem-Pole Boost Bridgeless Rectifier With Reduced Reverse Recovery Problems For Power Factor Correction," *IEEE Transactions on Power Electronics 25*(6): 1406-1415, Jun. 2010.
The Fabricator, "Delta-Q Technologies' RQ350 battery charger designed for electric vehicles," Jun. 12, 2020, URL=https://www.thefabricator.com/thefabricator/product/testingmeasuring/delta-q-technologies-rq350-battery-charger-designed-for-electric-vehicles, retrieved on Jul. 25, 2024. (1 page).
Tollik et al., "Comparative Analysis of 1-Phase Active Power Factor Correction Topologies," 14th International Telecommunications Energy Conference, Washington, DC, Oct. 4-8, 1992, pp. 517-523.
Tsai et al., "A Family of Zero-Voltage-Transition Bridgeless Power-Factor-Correction Circuits With a Zero-Current-Switching Auxiliary Switch," *IEEE Transactions on Industrial Electronics 58*(5): 1848-1855, May 2011.
Van de Sype et al., "Duty-Ratio Feedforward for Digitally Controlled Boost PFC Converters," *IEEE Transactions on Industrial Electronics 52*(1):108-115, Feb. 2005.
Wang, "A New Single-Phase ZCS-PWM Boost Rectifier With High Power Factor and Low Conduction Losses," *IEEE Transactions on Industrial Electronics 53*(2):500-510, Apr. 2006.

* cited by examiner

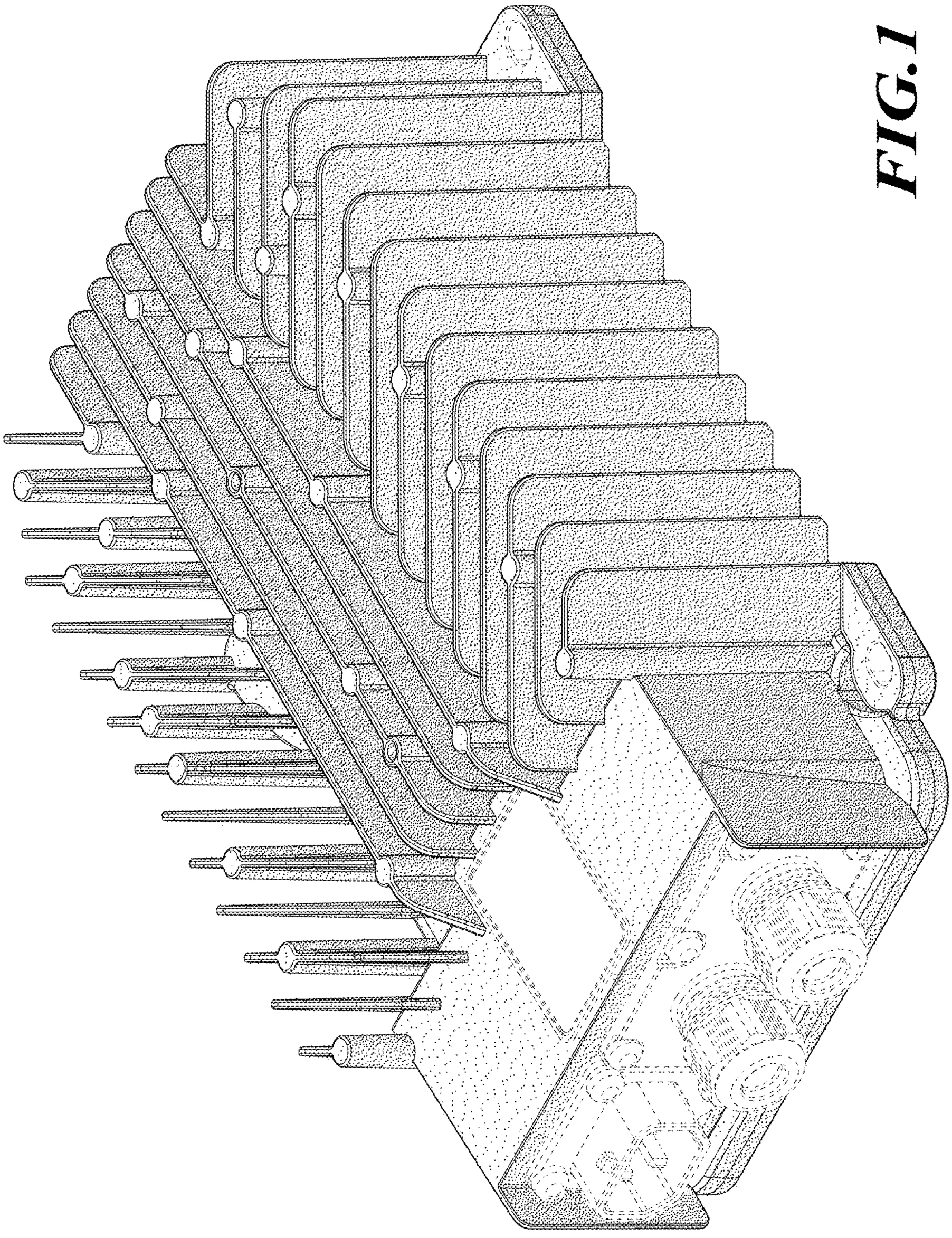


FIG. 1

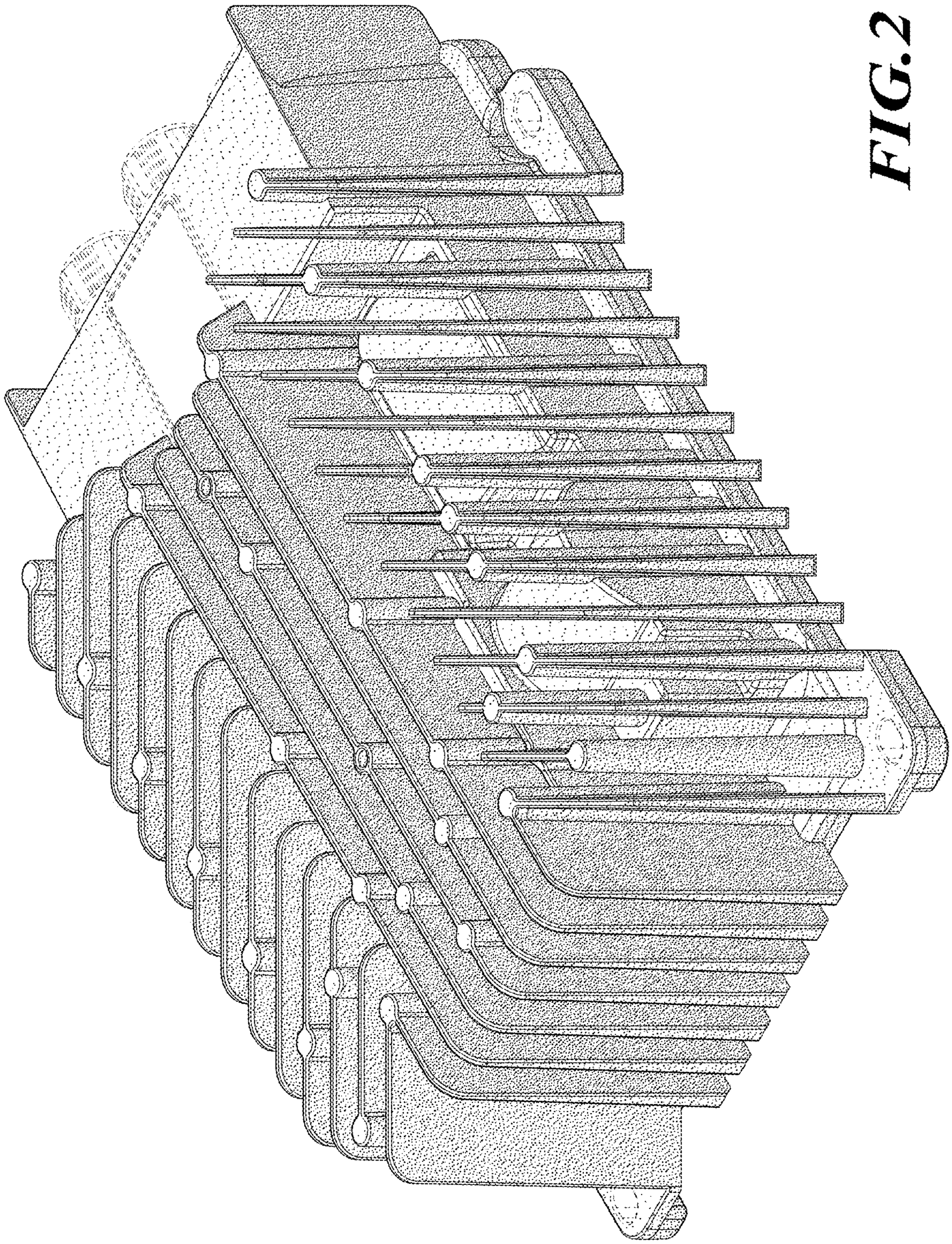
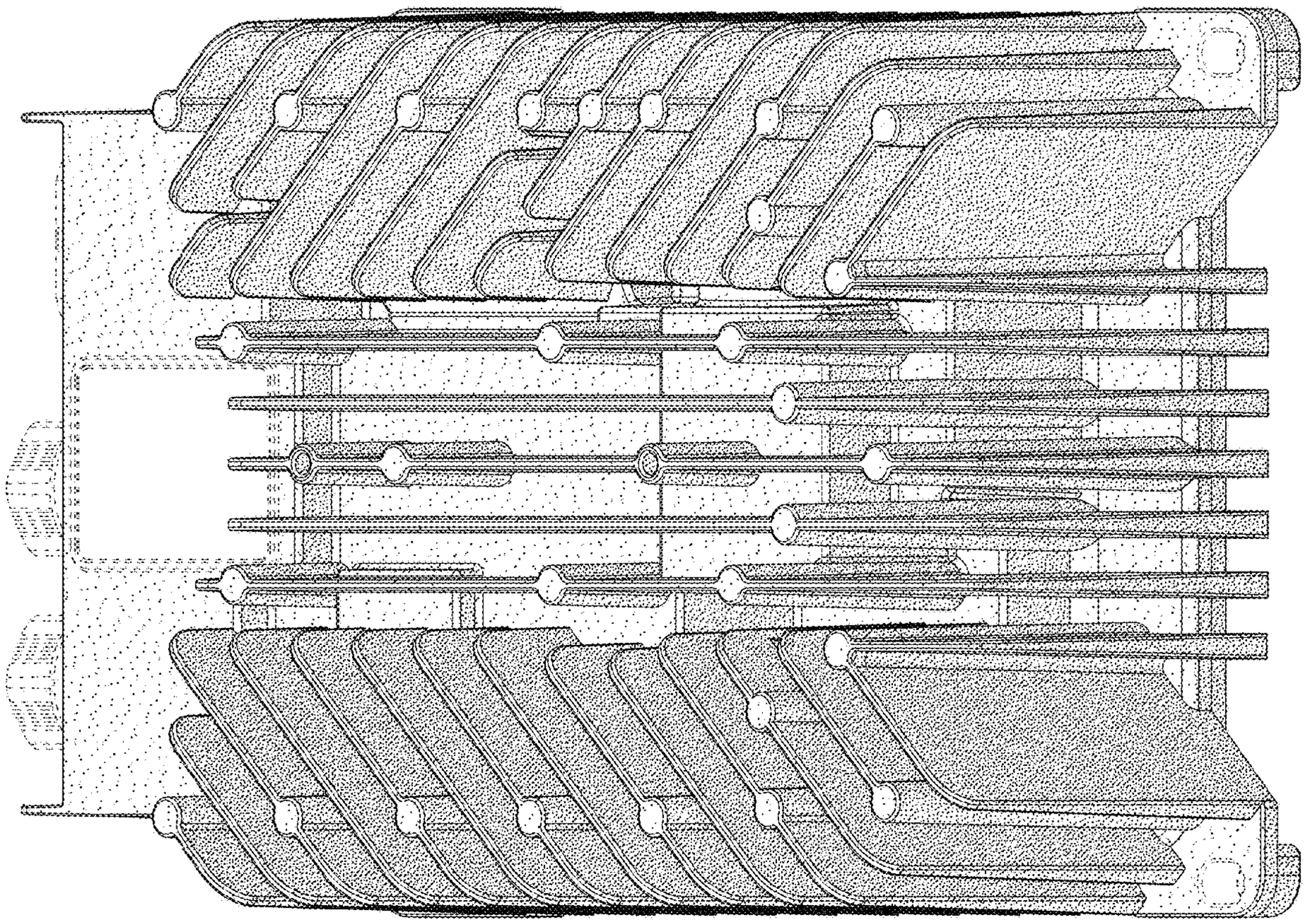


FIG.2

FIG.3



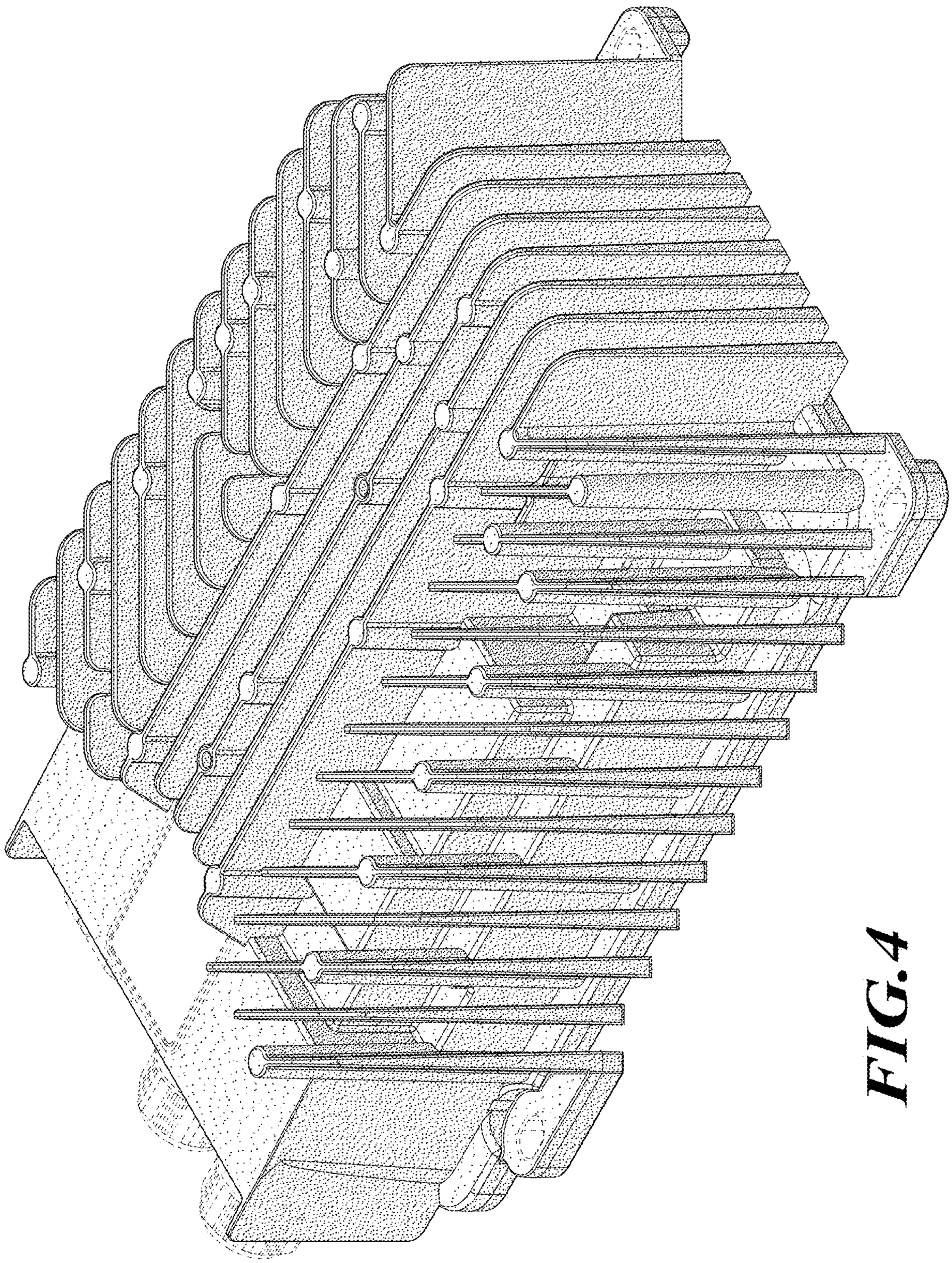


FIG.4

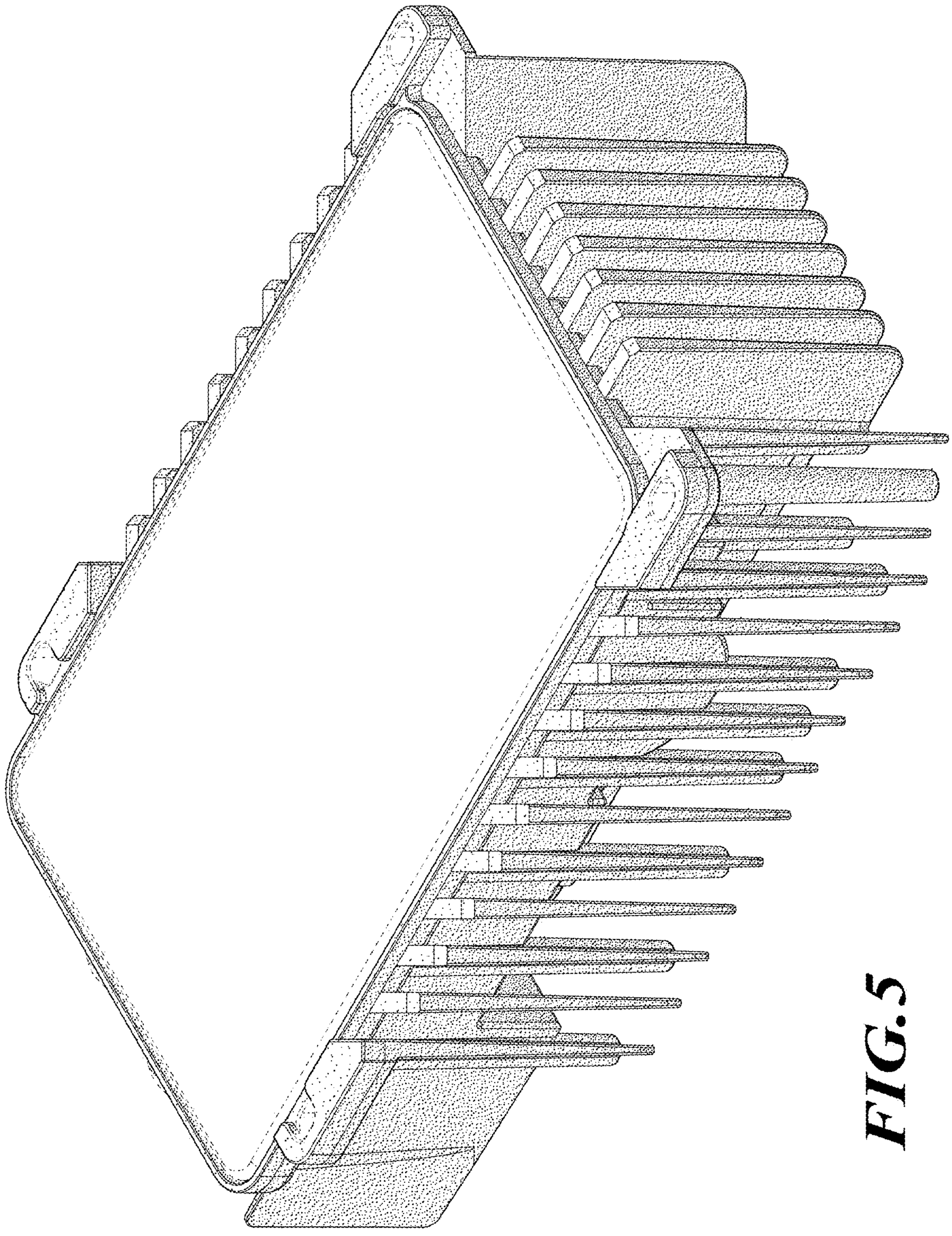


FIG.5

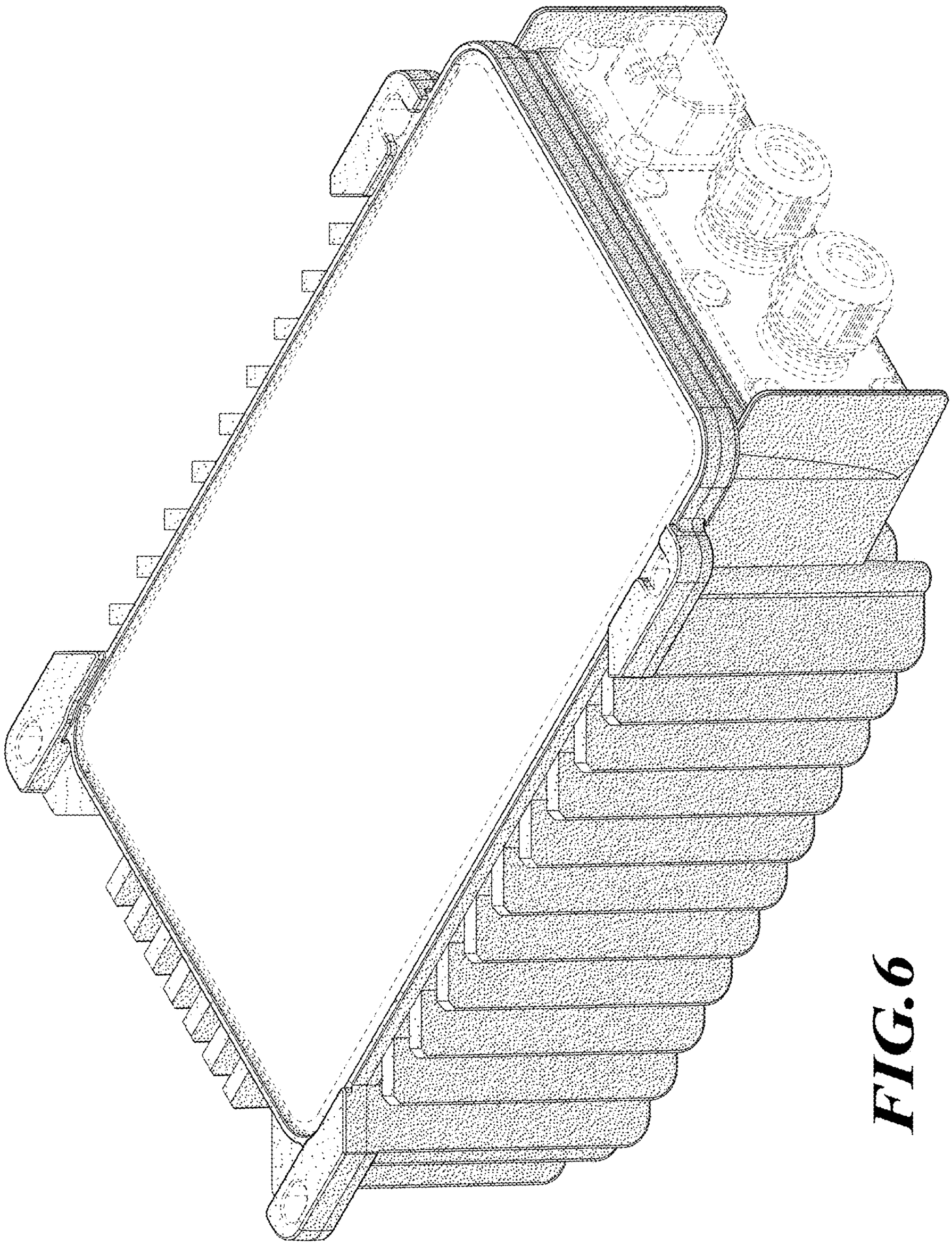


FIG.6

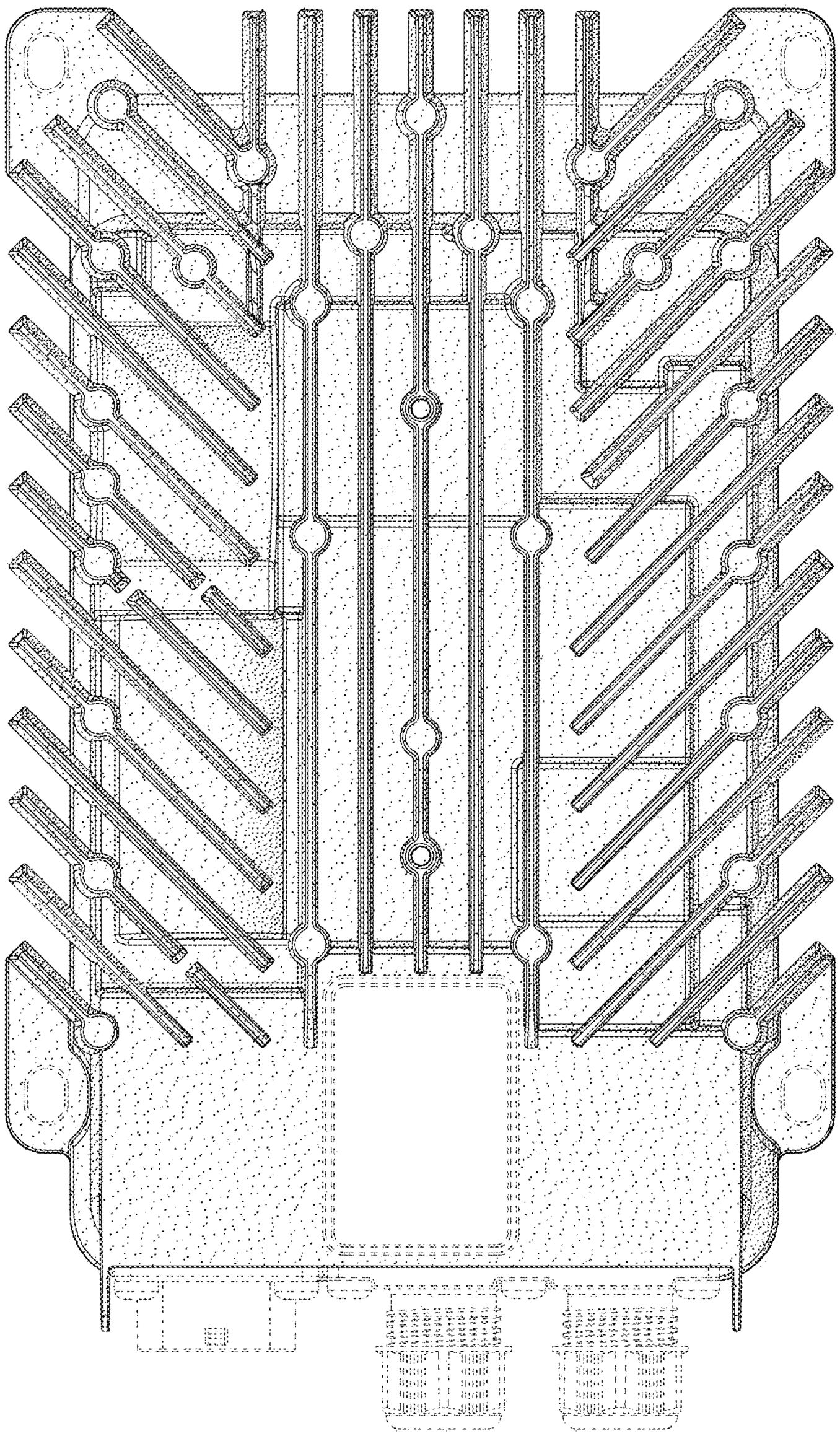


FIG. 7

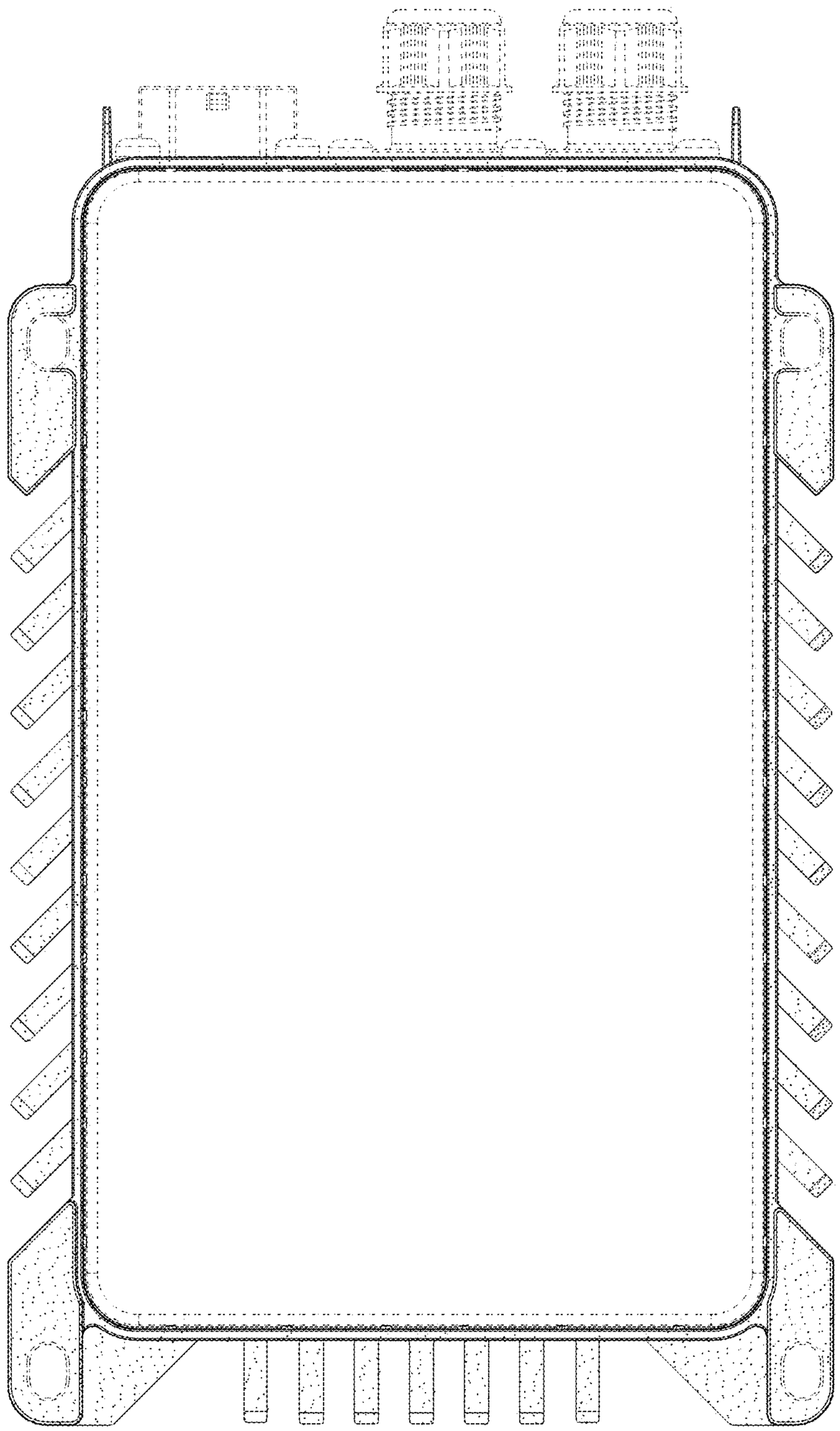


FIG.8

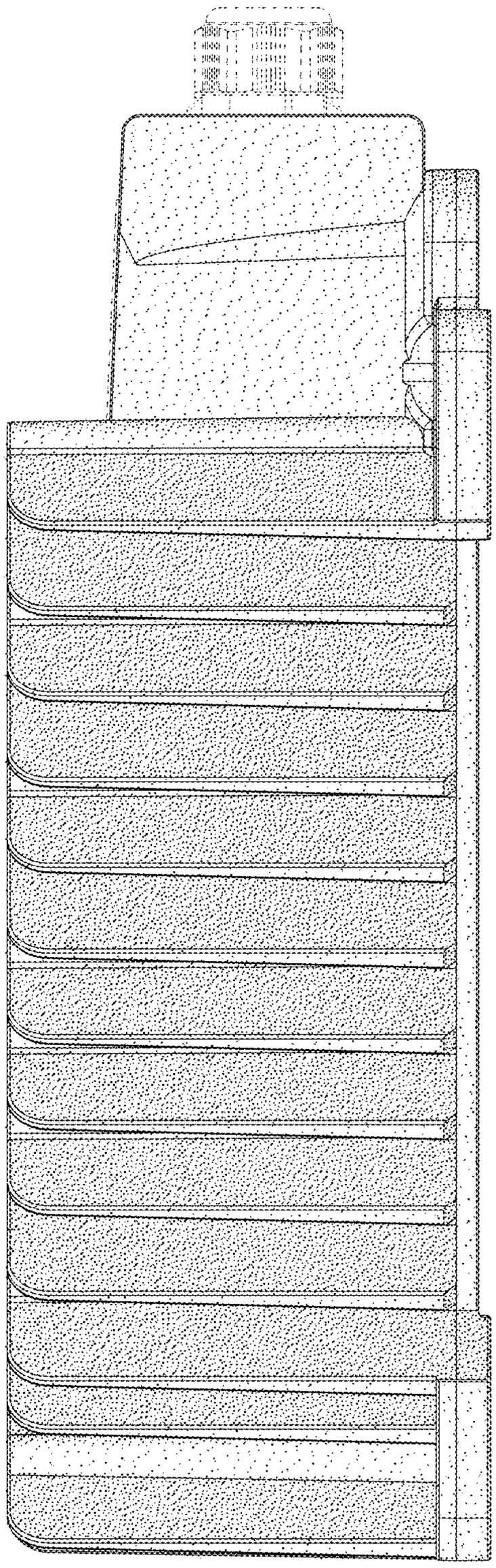


FIG. 9

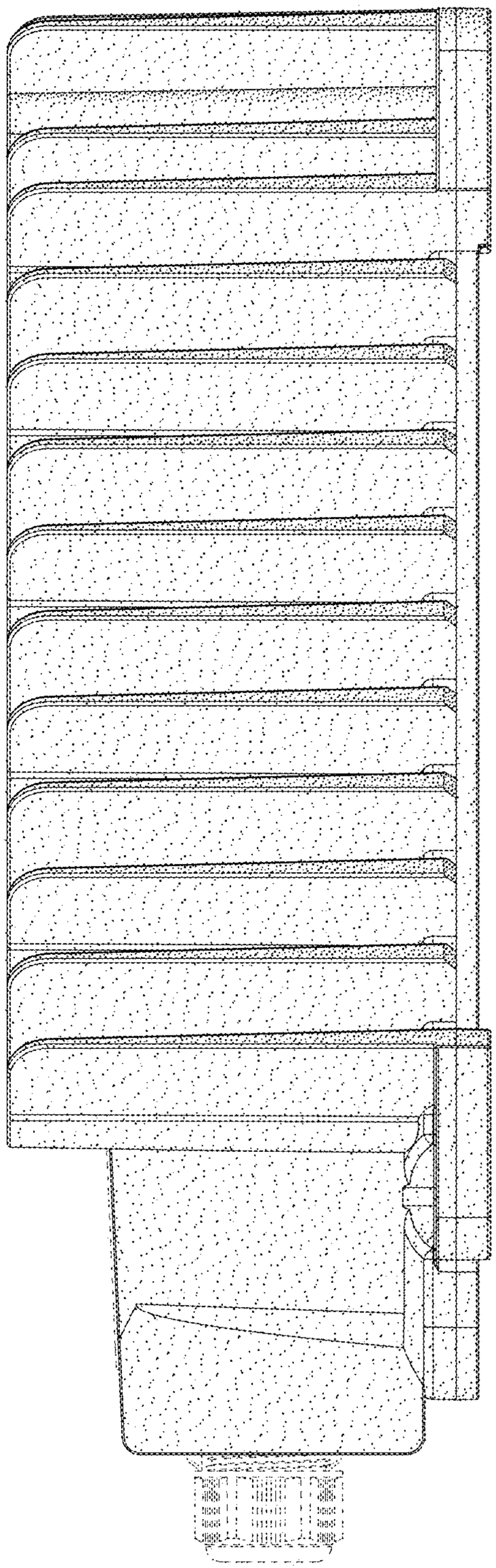


FIG. 10

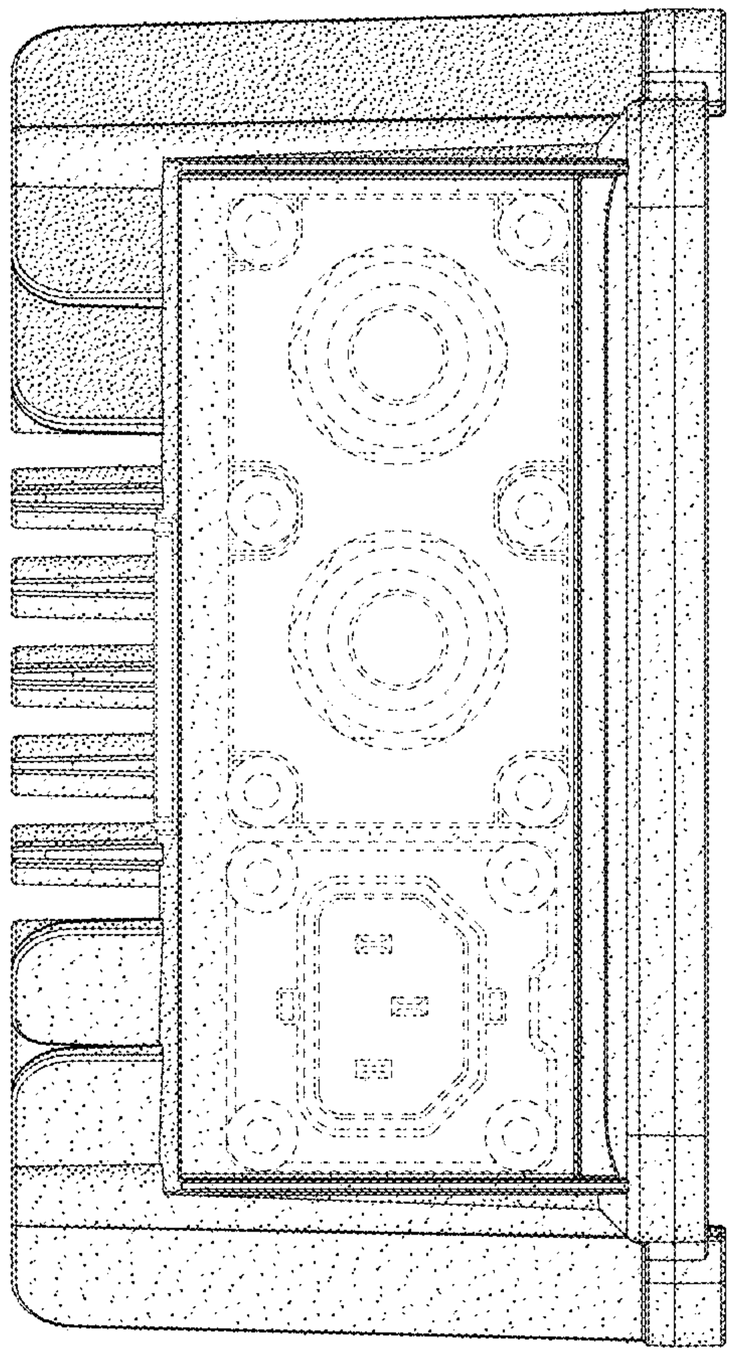


FIG.11

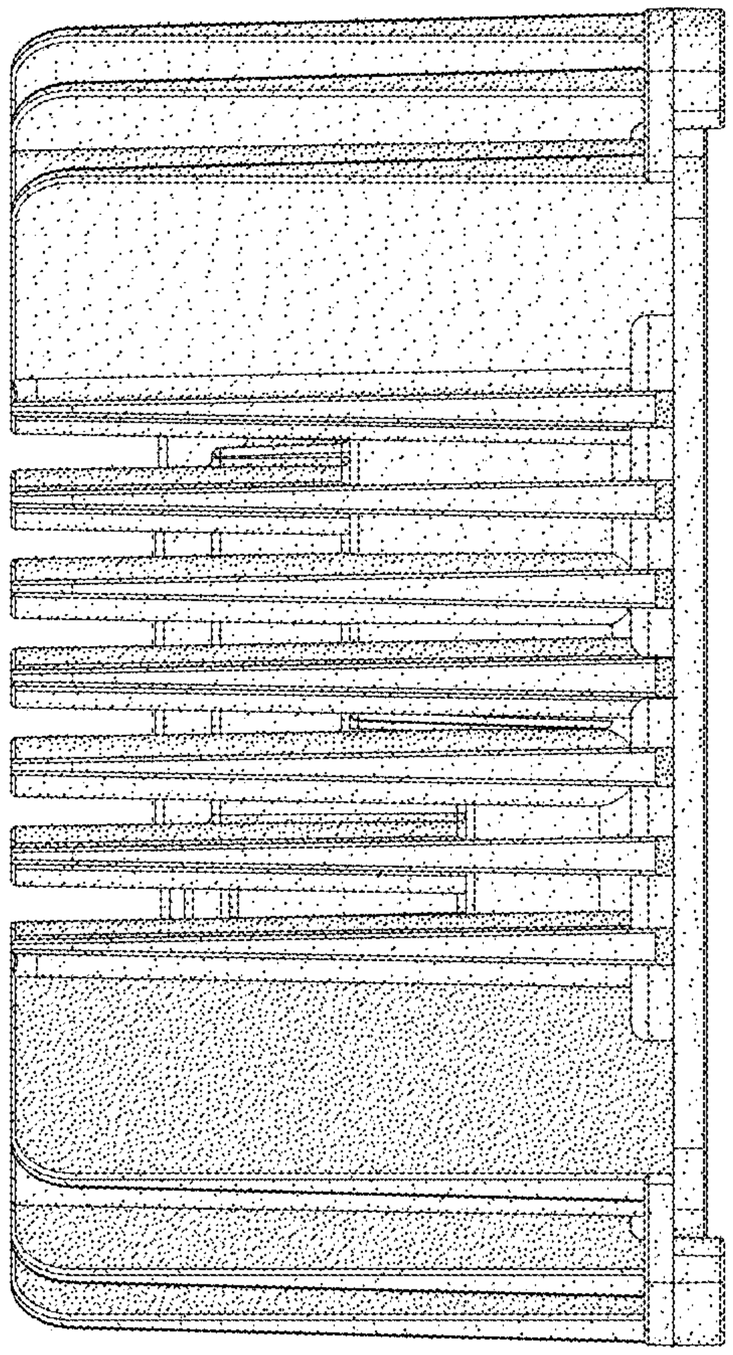


FIG. 12