



US00D707632S

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

(10) **Patent No.:** **US D707,632 S**

(45) **Date of Patent:** **** Jun. 24, 2014**

(54) **TRUNK CONNECTOR**

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5,636,998 A	6/1997	Daly et al.
5,745,356 A	4/1998	Tassitino et al.
5,823,812 A	10/1998	Bhargava et al.
5,833,495 A	11/1998	Ito
5,855,494 A	1/1999	Blaszczyk et al.
5,864,094 A	1/1999	Griffin

(Continued)

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FOREIGN PATENT DOCUMENTS

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

EP	1837985	9/2007
JP	08-264209	10/1996
JP	09-154220	6/1997
JP	2007-059259	3/2007

(21) Appl. No.: **29/424,100**

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

OTHER PUBLICATIONS

(51) **LOC (10) Cl.** **13-03**

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

USPC **D13/147**

(58) **Field of Classification Search**

USPC D13/101, 102, 110, 118, 120, 146, 147,
D13/154, 184, 199; 439/180, 246, 374, 527,
439/529, 533, 892, 894

See application file for complete search history.

Weidong Xiao, Nathan Ozog and William G. Dunford, "Topology Study of Photovoltaic Interface for Maximum Power Point Tracking," IEEE Transactions on Industrial Electronics, vol. 54, No. 3, Jun. 2007, pp. 1696-1704.

(Continued)

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(56) **References Cited**

U.S. PATENT DOCUMENTS

1,767,262 A	6/1930	Schmitz	
3,920,306 A	11/1975	Barnett et al.	
4,114,048 A	9/1978	Hull et al.	
4,217,633 A	8/1980	Evans, Jr.	
4,255,007 A	3/1981	Michaels et al.	
D295,850 S *	5/1988	Kikuta	D13/147
4,857,826 A	8/1989	Graham	
4,917,632 A	4/1990	Smith	
4,971,576 A	11/1990	Thimmesch	
5,069,634 A	12/1991	Chiarolanzio	
D324,032 S *	2/1992	Sueyoshi et al.	D13/147
5,191,519 A	3/1993	Kawakami	
5,446,241 A	8/1995	Mackaness et al.	
5,473,528 A	12/1995	Hirata et al.	
5,482,312 A	1/1996	Maurer	

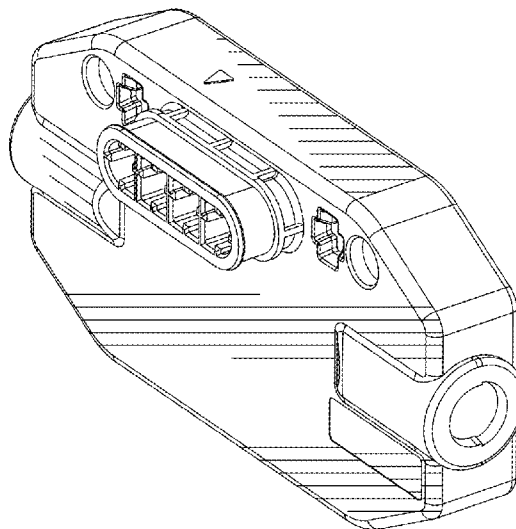
(57) **CLAIM**

The ornamental design for a trunk connector, as shown and described.

DESCRIPTION

FIG. 1 is a rear view of a trunk connector showing our new design;
FIG. 2 is a front elevation view thereof;
FIG. 3 is a top plan view thereof;
FIG. 4 is a bottom plan view thereof;
FIG. 5 is a first side elevation view thereof;
FIG. 6 is a second side elevation view thereof; and,
FIG. 7 is a front, top and side perspective view thereof.

1 Claim, 3 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

5,886,890 A 3/1999 Ishida et al.
 5,951,785 A 9/1999 Uchihashi et al.
 5,964,620 A 10/1999 Takahashi et al.
 6,046,400 A 4/2000 Drummer
 6,050,840 A 4/2000 Kowalski et al.
 6,074,238 A 6/2000 DeRoss et al.
 6,074,244 A 6/2000 Crum et al.
 6,111,189 A 8/2000 Garvison et al.
 6,163,958 A 12/2000 Suzuki
 6,180,868 B1 1/2001 Yoshino et al.
 6,201,180 B1 3/2001 Meyer et al.
 6,227,914 B1 5/2001 Lee et al.
 D445,090 S 7/2001 Payne et al.
 6,268,559 B1 7/2001 Yamawaki
 6,285,572 B1 9/2001 Onizuka et al.
 6,291,764 B1 9/2001 Ishida et al.
 6,356,471 B1 3/2002 Fang
 6,371,790 B1 4/2002 Huang
 6,381,157 B2 4/2002 Jensen
 6,396,170 B1 5/2002 Laufenberg et al.
 6,422,891 B1 7/2002 Huang
 D472,523 S 4/2003 Hansen
 6,579,114 B2 6/2003 Lord
 6,579,115 B2 6/2003 Mitsugi
 D477,285 S * 7/2003 Miyamoto et al. D13/147
 6,592,395 B2 7/2003 Brown et al.
 6,593,521 B2 7/2003 Kobayashi
 6,605,881 B2 8/2003 Takehara et al.
 D485,562 S * 1/2004 Goto D14/439
 6,713,890 B2 3/2004 Kondo et al.
 6,737,762 B2 5/2004 Koenig
 6,750,391 B2 6/2004 Bower et al.
 6,791,024 B2 9/2004 Toyomura
 6,838,611 B2 1/2005 Kondo et al.
 6,869,301 B2 3/2005 Shimizu et al.
 6,897,370 B2 5/2005 Kondo et al.
 D511,747 S 11/2005 Rey et al.
 7,018,230 B2 3/2006 Shimirak
 7,042,110 B2 5/2006 Mikhail et al.
 D524,742 S * 7/2006 Kumagai D13/147
 7,070,443 B2 7/2006 Tashiro et al.
 7,072,195 B2 7/2006 Xu
 D527,346 S 8/2006 Brodin
 7,248,490 B2 7/2007 Olsen et al.
 7,297,866 B2 11/2007 Aschenbrenner
 D557,214 S * 12/2007 Provenzano D13/154
 D559,785 S 1/2008 Tosetti
 7,342,171 B2 3/2008 Khouri et al.
 7,387,537 B1 6/2008 Daily et al.
 7,405,494 B2 7/2008 Tassitino et al.
 7,405,652 B2 7/2008 Hair, III et al.
 D579,878 S * 11/2008 Carpenter et al. D13/147
 7,456,523 B2 11/2008 Kobayashi
 D585,837 S 2/2009 Kuehne et al.
 D599,741 S 9/2009 Meldert et al.
 7,638,899 B2 12/2009 Tracy et al.
 7,646,109 B2 1/2010 Belady et al.
 7,839,022 B2 11/2010 Wolfs
 7,855,473 B2 12/2010 Fornage
 7,874,860 B2 1/2011 Starke et al.
 7,893,346 B2 2/2011 Nachamkin et al.
 7,899,632 B2 3/2011 Fornage et al.
 D644,609 S 9/2011 Marroquin
 D644,610 S 9/2011 Marroquin
 8,035,045 B2 * 10/2011 Bremicker et al. 200/43.04
 8,207,637 B2 6/2012 Marroquin et al.
 8,227,942 B2 7/2012 Marroquin et al.
 D666,974 S 9/2012 Marroquin et al.
 D673,114 S * 12/2012 Schnakenberg et al. D13/110
 2003/0111103 A1 6/2003 Bower et al.
 2005/0032416 A1 2/2005 Peress et al.
 2005/0090132 A1 4/2005 Miyazaki
 2005/0207197 A1 9/2005 Chou et al.
 2005/0213272 A1 9/2005 Kobayashi
 2005/0226164 A1 10/2005 Williams

2005/0281064 A1 12/2005 Olsen et al.
 2006/0083039 A1 4/2006 Oliveira et al.
 2007/0128920 A1 6/2007 Brown et al.
 2007/0188130 A1 8/2007 Scheucher
 2007/0221267 A1 9/2007 Fornage
 2007/0252716 A1 11/2007 Burger
 2007/0295392 A1 12/2007 Cinnamon
 2007/0295393 A1 12/2007 Cinnamon
 2008/0078436 A1 4/2008 Nachamkin et al.
 2008/0095646 A1 4/2008 Nishii et al.
 2008/0194137 A1 8/2008 Kuo
 2008/0283118 A1 11/2008 Rotzoll et al.
 2009/0000654 A1 1/2009 Rotzoll et al.
 2009/0020151 A1 1/2009 Fornage
 2009/0084426 A1 4/2009 Fornage et al.
 2009/0147554 A1 6/2009 Adest et al.
 2009/0200994 A1 8/2009 Fornage
 2009/0242272 A1 10/2009 Little et al.
 2009/0296348 A1 12/2009 Russell et al.
 2010/0138061 A1 6/2010 Walling et al.
 2010/0139945 A1 6/2010 Dargatz
 2010/0175338 A1 7/2010 Garcia Cors
 2010/0181830 A1 7/2010 Fornage et al.
 2010/0195357 A1 8/2010 Fornage et al.
 2010/0263704 A1 10/2010 Fornage et al.
 2010/0283325 A1 11/2010 Marcianesi et al.
 2010/0309695 A1 12/2010 Fornage
 2011/0012429 A1 1/2011 Fornage
 2011/0012430 A1 1/2011 Cheng et al.
 2011/0018353 A1 1/2011 Yu
 2011/0019444 A1 1/2011 Dargatz et al.
 2011/0084556 A1 4/2011 Marroquin et al.
 2011/0115301 A1 5/2011 Bhavaraju et al.
 2011/0168228 A1 7/2011 McGreevy et al.
 2011/0183537 A1 7/2011 Fornage et al.

OTHER PUBLICATIONS

“Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources,” Underwriters Laboratories Inc., UL Standard 1741.1, May 7, 1999, downloaded from web site <http://ulstandardsinfonet.ul.com/scopes/1741.html> on Jun. 11, 2008.
 “IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems,” IEEE Standard 1547TM-2003, IEEE, Jul. 28, 2003.
 Non-Final Office Action dated Mar. 15, 2010 for U.S. Appl. No. 12/075,342 entitled “Apparatus For Phase Rotation For A Three-Phase AC Circuit”, 6 pages.
 Final Office Action dated Jul. 19, 2010 for U.S. Appl. No. 12/075,342 entitled “Apparatus For Phase Rotation For A Three-Phase AC Circuit”, 9 pages.
 NEC 2008—ANSI/NFPA 70 National Electrical Code, 4 pages.
 UL 94 “Test for Flammability of Plastic Materials for Parts in Devices and Appliances”, Underwriters Laboratories, Inc. (UL), Northbrook, IL, Jul. 10, 1998, 43 pages.
 UL 1977 “Component Connectors for Use in Data, Signal, Control and Power Applications”, Underwriters Laboratories, Inc. (UL), Northbrook, IL, Oct. 18, 2002, 29 pages.
 UL 486A “Wire Connectors and Soldering Lugs for Use With Copper Conductors”, Underwriters Laboratories, Inc. (UL), Northbrook, IL, May 23, 2001, 57 pages.
 UL 498 “Attachment Plugs and Receptacles”, Underwriters Laboratories, Inc. (UL), Northbrook, IL, Dec. 26, 2001, 294 pages.
 UL 1277 “Electrical Power and Control Tray Cables with Optional Optical-Fiber Members”, Underwriters Laboratories, Inc. (UL), Northbrook, IL, Nov. 14, 2001, 48 pages.
 ANSI/IEC 60529-2004, “Degrees of Protection Provided by Enclosures (IP Code)”, National Electrical Manufacturers Association, 2004, 16 pages.
 IEC 61215, “Crystalline Silicon Terrestrial Photovoltaic (PV) Modules—Design Qualification and Type Approval”, International Standard, Second Edition, 2005, 8 pgs.

(56)

References Cited

OTHER PUBLICATIONS

IEC 61730-1, "Photovoltaic (PV) Module Safety Qualification", International Standard, Norme Internationale, Edition 1.0, 2004, 11 pages.

Non-Final Office Action dated Apr. 4, 2011 for U.S. Appl. No. 12/928,685 entitled "Apparatus For Phase Rotation For A Three-Phase AC Circuit", 8 pages.

Final Office Action dated Aug. 8, 2011 for U.S. Appl. No. 12/928,685 entitled "Apparatus For Phase Rotation For A Three-Phase AC Circuit", 10 pages.

IEC 60227-1 Ed. 3.0 B:2007, "Polyvinyl Chloride Insulated Cables Of Rated Voltages Up To And Including 450/750 V—Part 1: General requirements", Edition 3.0, Oct. 10, 2007, Abstract downloaded from website: http://www.techstreet.com/standards/iec/60227_1_ed_3_0_b_2007?product_id=1520207, 1 page.

IEC 62109-1: "Safety Of Power Converters For Use In Photovoltaic Power Systems—Part 1: General Requirements", Apr. 1, 2010, downloaded from website: <http://engineers.ihs.com/document/abstract/QDXFRCAAAAAAAAAA>, 2 pages.

IEC 62109-2: "Safety Of Power Converters For Use In Photovoltaic Power Systems—Part 2: Particular Requirements for Inverters", Edition 1.0, 2011, downloaded from website: http://webstore.iec.ch/preview/info_iec62109-2%7Bed1.0%7Db.pdf, 16 pages.

UL 514B, ISBN 0-7629-0226-4, "Fittings for Cable and Conduit", Underwriters Laboratories Inc., Northbrook, IL, Feb. 7, 2002, 129 pages.

UL 514C, "Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers", Underwriters Laboratories Inc., Northbrook, IL, Dec. 11, 2008, 129 pages.

Advisory Action dated Oct. 19, 2011 for U.S. Appl. No. 12/928,685 entitled "Apparatus For Phase Rotation For A Three-Phase AC Circuit", 3 pages.

Enphase Energy, "Application Note: Multi-Tenant Design Guidelines," rev. 1, 5 pages, 2008.

Enphase Energy, "Enphase Field Wiring Diagram—M190 & M210 Microinverters—240v, Single Phase," Drawing No. 144-00001, rev. 6, 1 page, 2009.

Enphase Energy, "Enphase Quick Install Guide," Doc. No. 140-00001, rev. 06, 1 page, 2009.

Power Cords, Hosa Technology, Inc., www.hosatech.com, Aug. 2010, 1 page.

"Power Cord, Piggyback IEC C13 to NEMA 5-15P, 2 ft", Hosa Technology, Inc., www.hosatech.com, Aug. 2010, 1 page.

"Daisy Chain Power Cord Liberator, 12in", CableOrganizer.com, Inc., www.cableorganizer.com, Aug. 2010, 1 page.

"DTCC Connector Division—Geophysical", Dynamic Technologies Co., Ltd., www.dynamictech.biz, Aug. 2010, 4 pages.

DaisyLink System, Electri-Cable Assemblies, Inc., www.electri-cable.com, Aug. 2010, 2 pages.

International Search Report and Written Opinion of the ISA, International Application No. PCT/US2010/048342, Nov. 3, 2010, 12 pages.

Hoffner, et al., "A PV Window Awning System of the University of Texas Houston Health Science Center Using AC-Modules," Photovoltaic Specialists Conference, Conference Record of the Twenty-Eight IEEE, 2000, 1545-1547, Anchorage, AK.

Strong, et al., "Development of Standardized, Low-Cost AC PV Systems—Phase I Annual Report, Sep. 7, 1995-Nov. 7, 1996," National Renewable Energy Laboratory, Jun. 1997.

Strong, S., "The Development of Standardized, Low-Cost AC PV Systems—Final Technical Report, Sep. 8, 1995-Jun. 30, 1998," National Renewable Energy Laboratory, Feb. 1999.

Rodriguez, et al., "Long-Lifetime Power Inverter for Photovoltaic AC Modules," IEEE Transactions on Industrial Electronics, Jul. 7, 2008, 2593-2601, 55-7.

Oldenkamp, et al., "AC Modules: Past, Present, and Future," Workshop Installing the Solar Solution, Jan. 22-23, 1998.

Bower, et al. "Innovative PV Micro-Inverter Topology Eliminates Electrolytic Capacitors for Longer Lifetime," Photovoltaic Energy Conversion, Conference Record of the 2006 IEEE 4th World Conference, 2006, 2038-2041, Waikoloa, HI.

Kern, G., "Sunsine 300: Manufacture of an AC Photovoltaic Module, Final Report, Phases I & II, Jul. 25, 1995-Jun. 30, 1998," National Renewable Energy Laboratory, Mar. 1999.

Russell, et al., "Sunsine 300 AC Module, Annual Report, Jul. 25, 1995-Dec. 31, 1996," National Renewable Energy Laboratory, Aug. 1997.

International Search Report and Written Opinion mailed Sep. 21, 2011 for PCT Application No. PCT/US2011/022251.

Non-Final Office Action dated Aug. 23, 2011 for U.S. Appl. No. 12/931,081 entitled "Method And Apparatus For Interconnecting Distributed Power Sources", 18 pages.

Non-Final Office Action dated Oct. 15, 2012 for U.S. Appl. No. 13/597,718 entitled "Method And Apparatus For Interconnecting Distributed Power Sources", 10 pages.

* cited by examiner

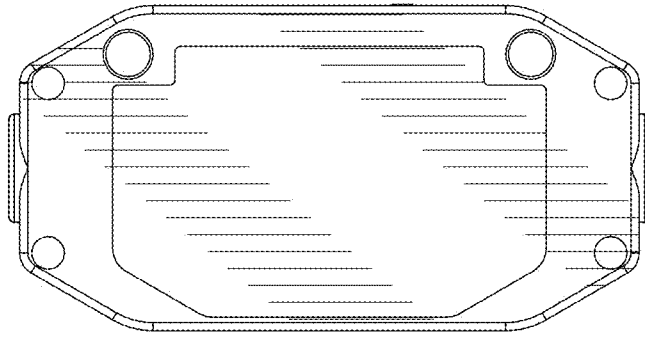


FIG. 1

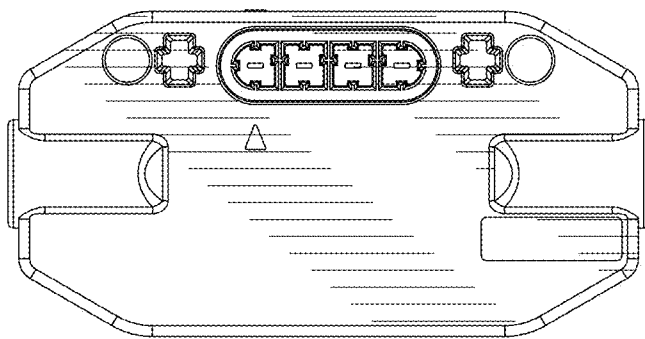


FIG. 2

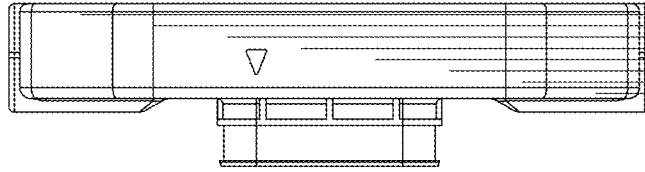


FIG. 3

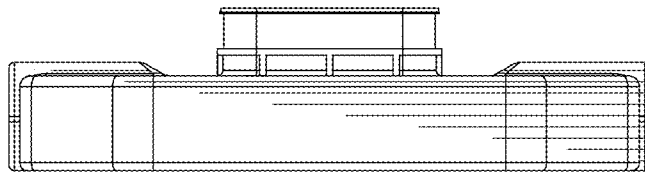


FIG. 4

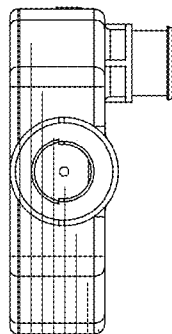


FIG. 5

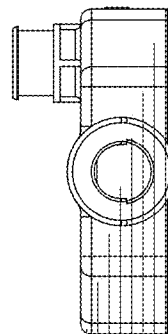


FIG. 6

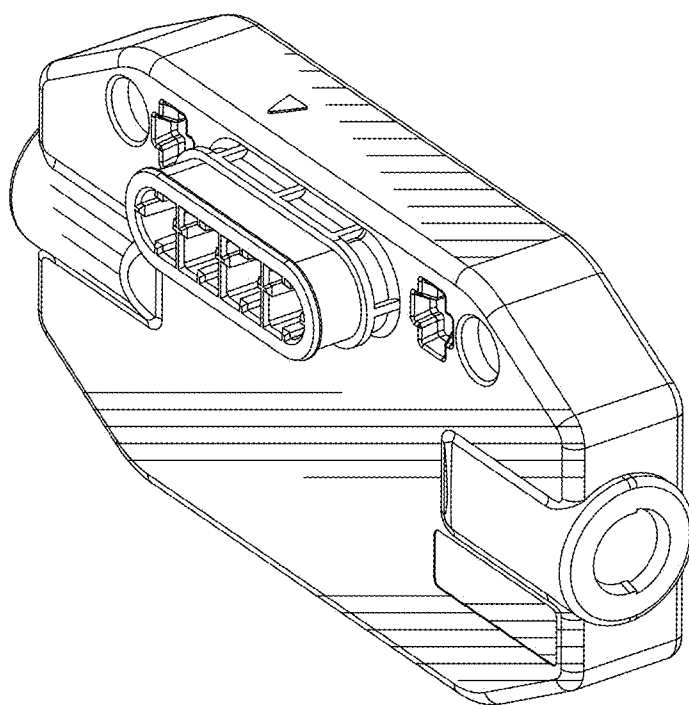


FIG. 7