



US009011164B2

(12) **United States Patent**
Filman et al.

(10) **Patent No.:** **US 9,011,164 B2**
(45) **Date of Patent:** **Apr. 21, 2015**

(54) **CLIP CONTACT FOR EASY INSTALLATION OF PRINTED CIRCUIT BOARD PCB**

(71) Applicant: **MEDIMOP Medical Projects Ltd.,**
Ra'anana (IL)

(72) Inventors: **Reuven Y. Filman,** Netanya (IL); **Tomer Solomon,** Modiin (IL)

(73) Assignee: **MEDIMOP Medical Projects Ltd.,**
Ra'anana (IL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 24 days.

(21) Appl. No.: **13/873,335**

(22) Filed: **Apr. 30, 2013**

(65) **Prior Publication Data**

US 2014/0322935 A1 Oct. 30, 2014

(51) **Int. Cl.**
H01R 12/00 (2006.01)
H01R 12/70 (2011.01)
H01R 43/20 (2006.01)
H05K 3/34 (2006.01)

(52) **U.S. Cl.**
CPC **H01R 12/7076** (2013.01); **H01R 43/205** (2013.01); **H05K 3/341** (2013.01); **H05K 2201/1031** (2013.01); **H05K 2203/166** (2013.01)

(58) **Field of Classification Search**
USPC 439/74
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,795,630 A 3/1931 Wilson
3,212,685 A 10/1965 Swan et al.

3,794,028 A 2/1974 Mueller et al.
4,195,636 A 4/1980 Behnke
4,218,724 A * 8/1980 Kaufman 361/736
4,300,554 A 11/1981 Hessberg et al.
4,403,987 A 9/1983 Gottinger
4,435,173 A 3/1984 Siposs et al.
4,599,082 A 7/1986 Grimard
4,867,743 A 9/1989 Vaillancourt
4,886,499 A 12/1989 Cirelli et al.
4,929,241 A 5/1990 Kulli
5,109,850 A 5/1992 Blanco et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1747683 A 3/2006
CN 1863566 A 11/2006

(Continued)

OTHER PUBLICATIONS

Int'l Search Report and Written Opinion issued Jul. 26, 2013 in Int'l Application No. PCT/US2012/039465.

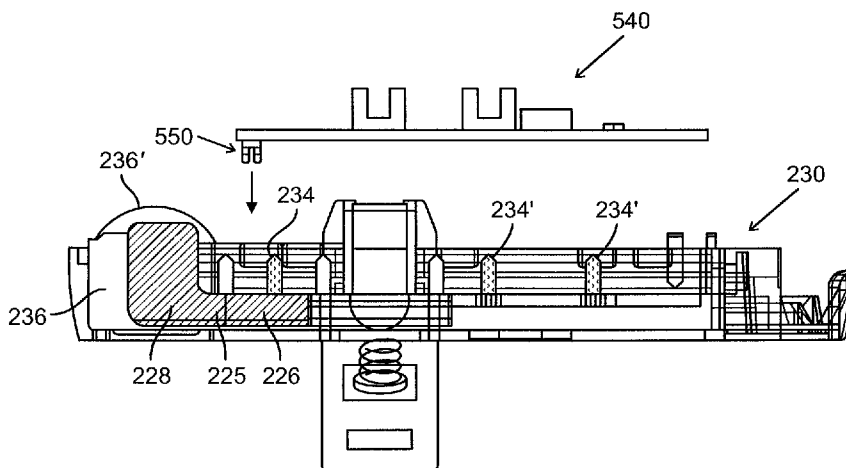
(Continued)

Primary Examiner — Gary Paumen
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

In some embodiments, a power terminal is in electrical connection to a power supply terminal, and a printed circuit board is supplied with a board to power contact. Bringing the board to power contact together with the PCB contact causes an electrical connection between the power supply and the PCB. In some embodiments the electrical connection resists disconnection from the PCB contact without requiring an external force on the PCB. In some embodiments the PCB-to-power-contact and the PCB contact are brought together in a direction perpendicular to a plane of the PCB. In some embodiments the PCB-to-power-contact includes fingers with grasp the PCB contact on two sides.

20 Claims, 11 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

5,190,521 A	3/1993	Hubbard et al.	7,144,384 B2	12/2006	Gorman et al.
5,300,045 A	4/1994	Plassche, Jr.	7,225,694 B2	6/2007	Said
5,348,544 A	9/1994	Sweeney et al.	7,247,149 B2	7/2007	Beyerlein
5,366,498 A	11/1994	Brannan et al.	7,250,037 B2	7/2007	Shermer et al.
5,383,865 A	1/1995	Michel	7,291,159 B2	11/2007	Schmelzeisen-Redeker et al.
5,478,315 A	12/1995	Brothers et al.	7,303,549 B2	12/2007	Flaherty et al.
5,482,446 A	1/1996	Williamson et al.	7,344,385 B2*	3/2008	Chen 439/74
5,496,274 A	3/1996	Graves et al.	7,364,570 B2	4/2008	Gerondale et al.
5,505,709 A	4/1996	Funderburk et al.	7,390,314 B2	6/2008	Stutz, Jr. et al.
5,562,686 A	10/1996	Sauer et al.	7,407,493 B2	8/2008	Cane'
5,593,390 A	1/1997	Castellano et al.	7,455,663 B2	11/2008	Bikovsky
5,616,132 A	4/1997	Newman	7,530,964 B2	5/2009	Lavi et al.
5,643,218 A	7/1997	Lynn et al.	7,565,208 B2	7/2009	Harris et al.
5,645,955 A	7/1997	Maglica	7,569,050 B2	8/2009	Moberg et al.
5,662,678 A	9/1997	Macklin	7,585,287 B2	9/2009	Bresina et al.
5,690,618 A	11/1997	Smith et al.	7,588,559 B2	9/2009	Aravena et al.
5,766,186 A	6/1998	Faraz et al.	7,589,974 B2*	9/2009	Grady et al. 361/735
5,795,675 A	8/1998	Maglica	7,628,770 B2	12/2009	Ethelfeld
5,800,420 A	9/1998	Gross et al.	7,637,891 B2	12/2009	Wall
5,807,375 A	9/1998	Gross et al.	7,641,649 B2	1/2010	Moberg et al.
5,814,020 A	9/1998	Gross	7,678,079 B2	3/2010	Shermer et al.
5,836,920 A	11/1998	Robertson	7,686,787 B2	3/2010	Moberg et al.
5,848,991 A	12/1998	Gross et al.	7,699,829 B2	4/2010	Harris et al.
5,851,197 A	12/1998	Marano et al.	7,704,229 B2	4/2010	Moberg et al.
5,858,001 A	1/1999	Tsals et al.	7,704,229 B2	4/2010	Moberg et al.
5,868,710 A	2/1999	Battiato et al.	7,713,238 B2	5/2010	Mernoe
5,931,814 A	8/1999	Alex et al.	7,744,589 B2	6/2010	Mounce et al.
5,941,850 A	8/1999	Shah et al.	7,749,194 B2	7/2010	Edwards et al.
5,948,392 A	9/1999	Haslwanter et al.	7,806,868 B2	10/2010	De Polo et al.
5,954,697 A	9/1999	Srisathapat et al.	7,837,659 B2	11/2010	Bush, Jr. et al.
5,957,895 A	9/1999	Sage et al.	7,854,723 B2	12/2010	Hwang et al.
5,968,011 A	10/1999	Larsen et al.	7,967,795 B1	6/2011	Cabiri
6,074,369 A	6/2000	Sage et al.	8,021,357 B2	9/2011	Tanaka et al.
6,186,982 B1	2/2001	Gross et al.	8,057,431 B2	11/2011	Woehr et al.
6,200,289 B1	3/2001	Hochman et al.	8,086,306 B2	12/2011	Katzman et al.
6,200,296 B1	3/2001	Dibiasi et al.	8,114,046 B2	2/2012	Covino et al.
6,224,569 B1	5/2001	Brimhall	8,157,769 B2	4/2012	Cabiri
6,277,095 B1	8/2001	Kriesel et al.	8,162,674 B2*	4/2012	Cho et al. 439/74
6,277,098 B1	8/2001	Klitmose et al.	8,206,351 B2	6/2012	Sugimoto et al.
6,277,099 B1	8/2001	Strowe et al.	8,292,647 B1	10/2012	McGrath et al.
6,287,283 B1	9/2001	Ljunggreen et al.	8,323,250 B2	12/2012	Chong et al.
6,293,925 B1	9/2001	Safabash et al.	8,372,039 B2	2/2013	Mernoe et al.
6,336,729 B1	1/2002	Pavelle et al.	8,409,142 B2	4/2013	Causey et al.
6,377,848 B1	4/2002	Garde et al.	8,430,847 B2	4/2013	Mernoe et al.
6,391,005 B1	5/2002	Lum et al.	8,475,408 B2	7/2013	Mernoe et al.
6,485,461 B1	11/2002	Mason et al.	8,512,287 B2	8/2013	Cindrich et al.
6,500,150 B1	12/2002	Gross et al.	8,679,060 B2	3/2014	Mernoe et al.
6,503,231 B1	1/2003	Prausnitz et al.	8,708,961 B2	4/2014	Field et al.
6,517,517 B1	2/2003	Farrugia et al.	2001/0025168 A1	9/2001	Gross et al.
6,558,351 B1	5/2003	Steil et al.	2001/0041869 A1	11/2001	Causey et al.
6,589,229 B1	7/2003	Connelly et al.	2002/0010423 A1	1/2002	Gross et al.
6,595,956 B1	7/2003	Gross et al.	2002/0029018 A1	3/2002	Jeffrey
6,645,181 B1	11/2003	Lavi et al.	2002/0040208 A1	4/2002	Flaherty et al.
6,652,482 B2	11/2003	Hochman	2002/0055711 A1	5/2002	Lavi et al.
6,656,158 B2	12/2003	Mahoney et al.	2002/0107487 A1	8/2002	Preuthun
6,656,159 B2	12/2003	Flaherty	2002/0123740 A1	9/2002	Flaherty et al.
6,689,118 B2	2/2004	Alchas et al.	2002/0169215 A1	11/2002	Meng
6,699,218 B2	3/2004	Flaherty et al.	2003/0009133 A1	1/2003	Ramey
6,743,211 B1	6/2004	Prausnitz et al.	2003/0125671 A1	7/2003	Aramata et al.
6,749,587 B2	6/2004	Flaherty	2003/0135159 A1	7/2003	Daily et al.
6,752,787 B1	6/2004	Causey, III et al.	2003/0171717 A1	9/2003	Farrugia et al.
6,768,425 B2	7/2004	Flaherty et al.	2004/0010207 A1	1/2004	Flaherty et al.
6,786,890 B2	9/2004	Preuthun et al.	2004/0092873 A1	5/2004	Moberg
6,800,071 B1	10/2004	McConnell et al.	2004/0116866 A1	6/2004	Gorman et al.
6,805,687 B2	10/2004	Dextradeur et al.	2004/0127857 A1	7/2004	Shemesh et al.
6,824,529 B2	11/2004	Gross et al.	2004/0158172 A1	8/2004	Hancock
6,843,782 B2	1/2005	Gross et al.	2004/0186419 A1	9/2004	Cho
6,854,620 B2	2/2005	Ramey	2004/0260233 A1	12/2004	Garibotto et al.
6,905,298 B1	6/2005	Haring	2005/0033234 A1	2/2005	Sadowski et al.
6,960,192 B1	11/2005	Flaherty et al.	2005/0065466 A1	3/2005	Vedrine
7,001,360 B2	2/2006	Veasey et al.	2005/0065472 A1	3/2005	Cindrich et al.
7,060,054 B2	6/2006	Nissels	2005/0071487 A1	3/2005	Lu et al.
7,060,059 B2	6/2006	Keith et al.	2005/0113761 A1	5/2005	Faust et al.
7,097,637 B2	8/2006	Triplett et al.	2005/0159706 A1	7/2005	Wilkinson et al.
7,128,727 B2	10/2006	Flaherty et al.	2005/0171476 A1	8/2005	Judson et al.
			2005/0171512 A1	8/2005	Flaherty
			2005/0177136 A1	8/2005	Miller
			2005/0197650 A1	9/2005	Sugimoto et al.
			2005/0203461 A1	9/2005	Flaherty et al.
			2005/0238507 A1	10/2005	Dilanni et al.

(56)

References Cited

U.S. PATENT DOCUMENTS

2005/0283114 A1 12/2005 Bresina et al.
 2006/0095014 A1 5/2006 Ethelfeld
 2006/0122577 A1 6/2006 Poulsen et al.
 2006/0173406 A1 8/2006 Hayes et al.
 2006/0173439 A1 8/2006 Thorne et al.
 2006/0211982 A1 9/2006 Prestrelski et al.
 2006/0229569 A1 10/2006 Lavi et al.
 2006/0264889 A1 11/2006 Moberg et al.
 2006/0264890 A1 11/2006 Moberg et al.
 2006/0264894 A1 11/2006 Moberg et al.
 2006/0270987 A1 11/2006 Peter
 2006/0283465 A1 12/2006 Nickel et al.
 2006/0293722 A1 12/2006 Slatkine et al.
 2007/0021733 A1 1/2007 Hansen et al.
 2007/0049865 A1 3/2007 Radmer et al.
 2007/0073228 A1 3/2007 Mernoe et al.
 2007/0118405 A1 5/2007 Campbell et al.
 2007/0167912 A1 7/2007 Causey et al.
 2007/0185449 A1 8/2007 Mernoe
 2007/0197968 A1 8/2007 Pongpairachana et al.
 2007/0203454 A1 8/2007 Shermer et al.
 2007/0233038 A1 10/2007 Pruiitt et al.
 2008/0021439 A1 1/2008 Brittingham et al.
 2008/0033367 A1 2/2008 Haury et al.
 2008/0033369 A1 2/2008 Kohlbrenner et al.
 2008/0033393 A1 2/2008 Edwards et al.
 2008/0051711 A1 2/2008 Mounce et al.
 2008/0051730 A1 2/2008 Bikovsky
 2008/0059133 A1 3/2008 Edwards et al.
 2008/0097381 A1 4/2008 Moberg et al.
 2008/0108951 A1 5/2008 Jerde et al.
 2008/0140006 A1 6/2008 Eskuri et al.
 2008/0140018 A1 6/2008 Enggaard et al.
 2008/0188813 A1 8/2008 Miller et al.
 2008/0208138 A1 8/2008 Lim et al.
 2008/0215006 A1 9/2008 Thorkild
 2008/0215015 A1 9/2008 Cindrich et al.
 2008/0243087 A1 10/2008 Enggaard et al.
 2008/0249473 A1 10/2008 Rutti et al.
 2008/0262436 A1 10/2008 Olson
 2008/0269687 A1 10/2008 Chong et al.
 2008/0269723 A1 10/2008 Mastrototaro et al.
 2008/0274630 A1* 11/2008 Shelton et al. 439/74
 2008/0294143 A1 11/2008 Tanaka et al.
 2008/0306449 A1 12/2008 Kristensen et al.
 2008/0312601 A1 12/2008 Cane
 2008/0319416 A1 12/2008 Yodfat et al.
 2009/0041805 A1 2/2009 Walker
 2009/0048347 A1 2/2009 Cohen et al.
 2009/0054750 A1 2/2009 Jennewine
 2009/0069784 A1 3/2009 Estes et al.
 2009/0076453 A1 3/2009 Mejlhede et al.
 2009/0088731 A1 4/2009 Campbell et al.
 2009/0093792 A1 4/2009 Gross et al.
 2009/0093793 A1 4/2009 Gross et al.
 2009/0105650 A1 4/2009 Wiegel et al.
 2009/0124977 A1 5/2009 Jensen
 2009/0143730 A1 6/2009 De Polo et al.
 2009/0143735 A1 6/2009 De Polo et al.
 2009/0149830 A1 6/2009 Spector
 2009/0182277 A1 7/2009 Carter
 2009/0209896 A1 8/2009 Selevan
 2009/0234319 A1 9/2009 Marksteiner
 2009/0240240 A1 9/2009 Hines et al.
 2009/0253973 A1 10/2009 Bashan et al.
 2009/0259176 A1 10/2009 Yairi
 2009/0326509 A1 12/2009 Muse et al.
 2010/0030198 A1 2/2010 Beebe et al.
 2010/0049128 A1 2/2010 McKenzie et al.
 2010/0057057 A1 3/2010 Hayter et al.
 2010/0076412 A1 3/2010 Rush et al.
 2010/0094255 A1 4/2010 Nycz et al.
 2010/0100076 A1 4/2010 Rush et al.
 2010/0100077 A1 4/2010 Rush et al.
 2010/0106098 A1 4/2010 Atterbury et al.

2010/0121314 A1 5/2010 Iobbi
 2010/0137831 A1 6/2010 Tsals
 2010/0145303 A1 6/2010 Yodfat et al.
 2010/0145305 A1 6/2010 Alon
 2010/0162548 A1 7/2010 Leidig
 2010/0168683 A1 7/2010 Cabiri
 2010/0198157 A1 8/2010 Gyrn et al.
 2010/0204657 A1 8/2010 Yodfat et al.
 2010/0234767 A1 9/2010 Sarstedt
 2010/0234830 A1 9/2010 Straessler et al.
 2010/0274112 A1 10/2010 Hoss et al.
 2010/0274192 A1 10/2010 Mernoe
 2010/0280499 A1 11/2010 Yodfat et al.
 2011/0125056 A1 5/2011 Merchant
 2011/0172745 A1 7/2011 Na et al.
 2011/0178472 A1 7/2011 Cabiri
 2011/0282296 A1 11/2011 Harms et al.
 2012/0035546 A1 2/2012 Cabiri
 2012/0129362 A1 5/2012 Hampo et al.
 2013/0012875 A1 1/2013 Gross et al.
 2013/0068319 A1 3/2013 Plumptre et al.
 2013/0089992 A1 4/2013 Yang
 2013/0323699 A1 12/2013 Edwards et al.
 2013/0331791 A1 12/2013 Gross et al.
 2014/0148784 A1 5/2014 Anderson et al.
 2014/0213975 A1 7/2014 Clemente et al.
 2014/0261758 A1 9/2014 Wlodarczyk et al.

FOREIGN PATENT DOCUMENTS

DE 1064693 B 9/1959
 EP 0017412 A1 10/1980
 EP 0222656 A1 5/1987
 EP 2498589 A1 9/2012
 JP H07-194701 A 8/1995
 JP H09-505758 A 6/1997
 JP 2001-512992 A 8/2001
 JP 2002-505601 A 2/2002
 JP 2002-507459 A 3/2002
 JP 2002-528676 A 9/2002
 JP 2003-501157 A 1/2003
 JP 2003-527138 A 9/2003
 JP 2003-534061 A 11/2003
 JP 2004-501721 A 1/2004
 JP 2004-512100 A 4/2004
 JP 2005-523127 A 8/2005
 JP 2005-270629 A 10/2005
 JP 2007-509661 A 4/2007
 JP 2008-534131 A 8/2008
 JP 2008-220961 A 9/2008
 JP 2009-502273 A 1/2009
 WO 9307922 A1 4/1993
 WO 9407553 A1 4/1994
 WO 9609083 A1 3/1996
 WO 9700091 A1 1/1997
 WO 9710012 A1 3/1997
 WO 9857683 A1 12/1998
 WO 9929151 A1 6/1999
 WO 9959665 A1 11/1999
 WO 0025844 A1 5/2000
 WO 0187384 A1 11/2001
 WO 0189607 A2 11/2001
 WO 0189613 A1 11/2001
 WO 0202165 A2 1/2002
 WO 0234315 A1 5/2002
 WO 03090833 A1 11/2003
 WO 2004032990 A2 4/2004
 WO 2005018703 A2 3/2005
 WO 2005037350 A2 4/2005
 WO 2006037434 A1 4/2006
 WO 06069380 A1 6/2006
 WO 2006102676 A1 9/2006
 WO 2006104806 A2 10/2006
 WO 2007051563 A1 5/2007
 WO 2007056504 A1 5/2007
 WO 2008001377 A2 1/2008
 WO 2008014908 A1 2/2008
 WO 2008057976 A2 5/2008
 WO 2008072229 A2 6/2008

(56)

References Cited

FOREIGN PATENT DOCUMENTS

WO	2008076459	A1	6/2008
WO	2008078318	A2	7/2008
WO	2009044401		4/2009
WO	2009046989	A2	4/2009
WO	2009125398	A2	10/2009
WO	2010078227	A1	7/2010
WO	2010078242	A1	7/2010
WO	2011075105	A1	6/2011
WO	2011090955	A1	7/2011
WO	2011156373	A1	12/2011
WO	2012032411	A2	3/2012
WO	2012040528	A1	3/2012
WO	2012160157	A1	11/2012

OTHER PUBLICATIONS

Int'l Search Report and Written Opinion issued Aug. 5, 2013 in Int'l Application No. PCT/US2013/033118.
 U.S. Appl. No. 13/964,651 by Gross, filed Aug. 12, 2013.
 Office Action issued Aug. 15, 2013 in CN Application No. 200880117084.X.
 Office Action issued Oct. 9, 2013 in IL Application No. 208634.
 Office Action issued Nov. 5, 2013 in JP Application No. 2010-527595.
 Office Action issued Sep. 29, 2013 in CN Application No. 201080040968.7.
 Office Action issued Nov. 4, 2013 in EP Application No. 11 709 234.6.
 U.S. Appl. No. 14/258,661 by Cabiri, filed Apr. 22, 2014.
 Int'l Search Report and Written Opinion issued Jan. 7, 2014 in Int'l Application No. PCT/US2013/065211.
 Office Action issued May 23, 2014 in U.S. Appl. No. 13/472,112 by Cabiri.
 Office Action issued Dec. 17, 2013 in JP Application No. 2012-529808.
 Office Action issued Dec. 10, 2013 in CN Application No. 201180006567.4.
 Office Action issued Jan. 8, 2014 in U.S. Appl. No. 13/521,167 by Cabiri.
 U.S. Appl. No. 29/479,307 by Norton, filed Jan. 14, 2014.
 U.S. Appl. No. 14/193,692 by Gross, filed Feb. 28, 2014.
 Office Action issued Feb. 4, 2014 in EP Application No. 11 707 942.6.
 English translation of an Office Action issued Mar. 5, 2014 in CN Application No. 200880117084.X.
 Int'l Search Report and Written Opinion issued Apr. 3, 2014 in Int'l Application No. PCT/US2013/078040.
 Extended European Search Report issued Mar. 27, 2014 in EP Application No. 14154717.4.
 Office Action issued Feb. 28, 2014 in CN Application No. 201180006571.0.
 Daikyo Crystal Zenith® polymer, Manufactured by Daikyo Seiko, Ltd.
 Copaxone®, Manufactured by Teva Pharmaceutical Industries Ltd.
 Int'l Search Report issued May 13, 2009 in Int'l Application No. PCT/IL2008/001312.
 Int'l Preliminary Report on Patentability issued Apr. 7, 2010 in Int'l Application No. PCT/IL2008/001312; Written Opinion.
 Int'l Search Report issued Apr. 26, 2010 in Int'l Application No. PCT/US2009/069552.
 Office Action issued Apr. 5, 2010 in U.S. Appl. No. 12/244,666.
 Office Action issued Sep. 21, 2010 in U.S. Appl. No. 12/244,666.
 Office Action issued Apr. 5, 2010 in U.S. Appl. No. 12/244,688.
 Office Action issued Sep. 2, 2010 in U.S. Appl. No. 12/244,688.
 Office Action issued Sep. 30, 2010 in U.S. Appl. No. 12/689,250.
 Int'l Search Report issued Jan. 12, 2011 in Int'l Application No. PCT/US2010/048556; Written Opinion.

International Preliminary Report on Patentability issued on Jul. 5, 2011 in International Application No. PCT/US2009/069552; Written Opinion.
 Office Action issued Jul. 13, 2011 in U.S. Appl. No. 12/559,563.
 Int'l Preliminary Report on Patentability issued Sep. 1, 2011 in Int'l Application No. PCT/US2010/048556.
 Office Action issued Sep. 6, 2011 in U.S. Appl. No. 12/345,818.
 Office Action issued Feb. 21, 2012 in U.S. Appl. No. 12/689,249.
 Int'l Search Report issued Jun. 17, 2011 in Int'l Application No. PCT/US2011/021604.
 Int'l Search Report issued Oct. 12, 2011 in Int'l Application No. PCT/US2011/021605.
 Office Action issued Oct. 28, 2011 in U.S. Appl. No. 12/615,828.
 Int'l Search Report issued Sep. 22, 2011 in Int'l Application No. PCT/IL11/00368; Written Opinion.
 U.S. Appl. No. 13/521,181 by Cabiri, filed Jul. 9, 2012.
 U.S. Appl. No. 13/521,167 by Cabiri, filed Jul. 9, 2012.
 Office Action issued May 16, 2012 in U.S. Appl. No. 12/615,828.
 Office Action issued Jul. 2, 2012 in U.S. Appl. No. 13/272,555.
 Office Action issued May 3, 2012 in CN Application No. 200880117084.X.
 U.S. Appl. No. 13/472,112 by Cabiri, filed May 15, 2012.
 U.S. Appl. No. 13/429,840 by Cabiri, filed Mar. 26, 2012.
 Int'l Preliminary Report on Patentability issued Aug. 2, 2012 in Int'l Application No. PCT/US2011/021604.
 U.S. Appl. No. 13/643,470 by Alon, filed Oct. 25, 2012.
 U.S. Appl. No. 13/733,516 by Cabiri, filed Jan. 3, 2013.
 Office Action issued Jan. 8, 2013 in JP Application No. 2010-527595.
 Int'l Preliminary Report on Patentability issued Feb. 7, 2013 in Int'l Application No. PCT/US2011/021604.
 Int'l Preliminary Report on Patentability issued Feb. 7, 2013 in Int'l Application No. PCT/US2011/021605.
 English translation of an Office Action issued Jan. 30, 2013 in CN Application No. 200880117084.X.
 U.S. Appl. No. 13/892,905 by Cabiri, filed May 13, 2013.
 U.S. Appl. No. 13/874,121 by Degtiar, filed Apr. 30, 2013.
 U.S. Appl. No. 13/874,085 by Cabiri, filed Apr. 30, 2013.
 U.S. Appl. No. 13/874,017 by Cabiri, filed Apr. 30, 2013.
 Extended European Search Report issued Aug. 7, 2014 in EP Application No. 1417477.4.
 Office Action issued Aug. 6, 2014 in EP Application No. 11 707 942.6.
 Office Action issued Sep. 2, 2014 in JP Application No. 2012-550069.
 Office Action issued Sep. 2, 2014 in JP Application No. 2012-550068.
 Office Action issued Aug. 26, 2014 in CN Application No. 201180006567.4.
 Int'l Preliminary Report on Patentability issued Oct. 9, 2014 in Int'l Application No. PCT/US2013/033118.
 Office Action issued Jun. 3, 2014 in JP Application No. 2010-527595.
 Office Action issued Jul. 7, 2014 in U.S. Appl. No. 12/244,666 by Gross.
 Int'l Search Report and Written Opinion issued Jul. 31, 2014 in Int'l Application No. PCT/US2014/033598.
 Office Action issued Nov. 5, 2014 in U.S. Appl. No. 13/643,470 by Alon.
 U.S. Appl. No. 14/553,399 by Cabiri, filed Nov. 25, 2014.
 Office Action issued Nov. 2, 2014 in CN Application No. 201180006571.0.
 Office Action issued Nov. 21, 2014 in U.S. Appl. No. 13/472,112 by Cabiri.
 Office Action issued Nov. 21, 2014 in U.S. Appl. No. 13/429,840 by Cabiri.
 Int'l Preliminary Report on Patentability issued Nov. 27, 2014 in Int'l Application No. PCT/US2013/039465.
 U.S. Appl. No. 14/593,051 by Gross, filed Jan. 9, 2015.

* cited by examiner

Figure 1

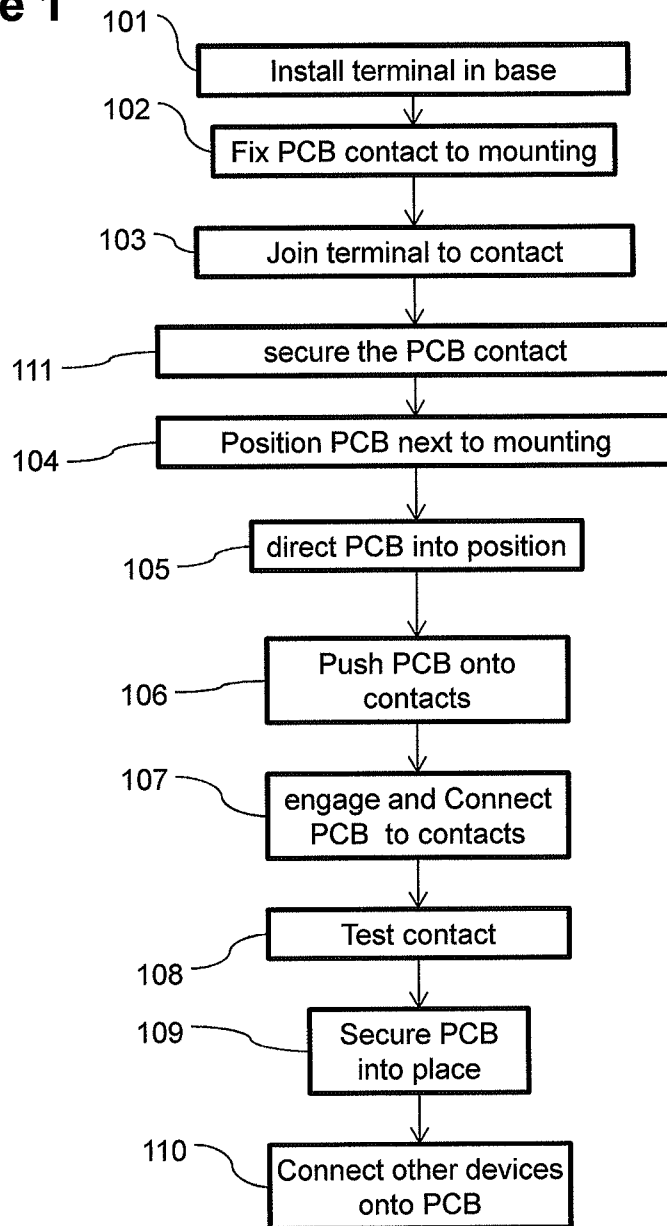


Figure 2

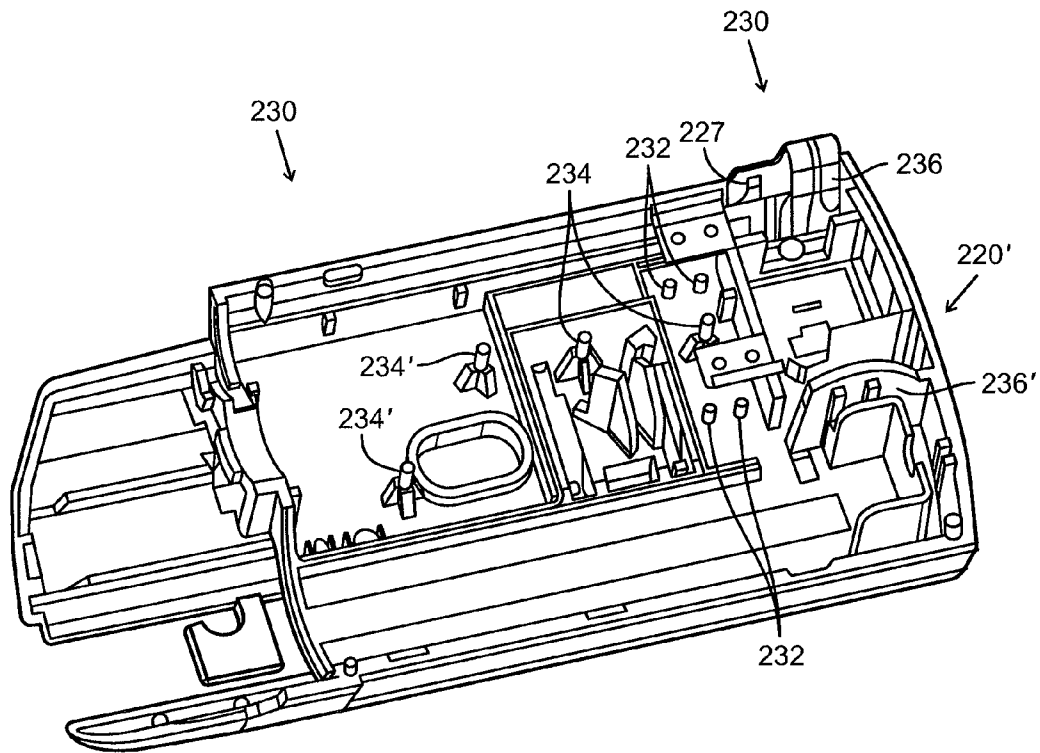


Figure 3

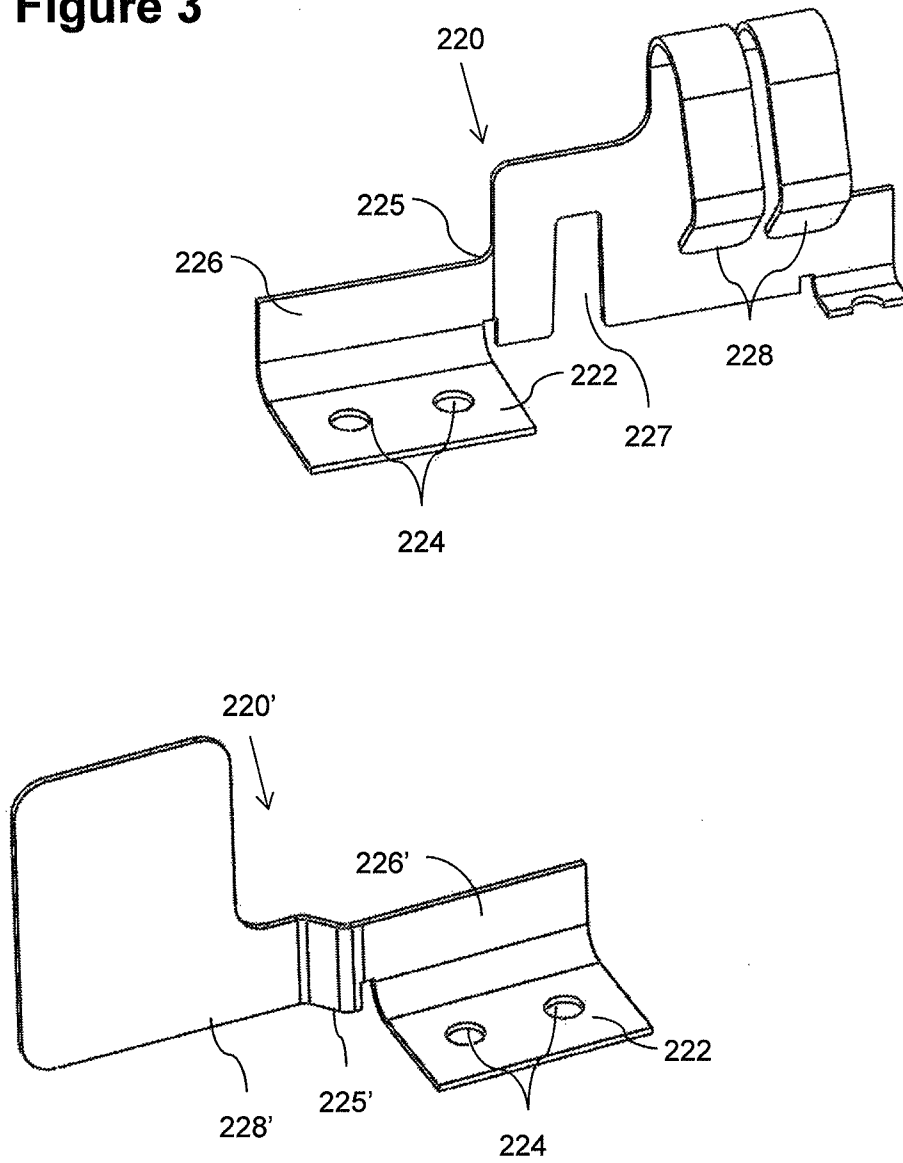


Figure 4A

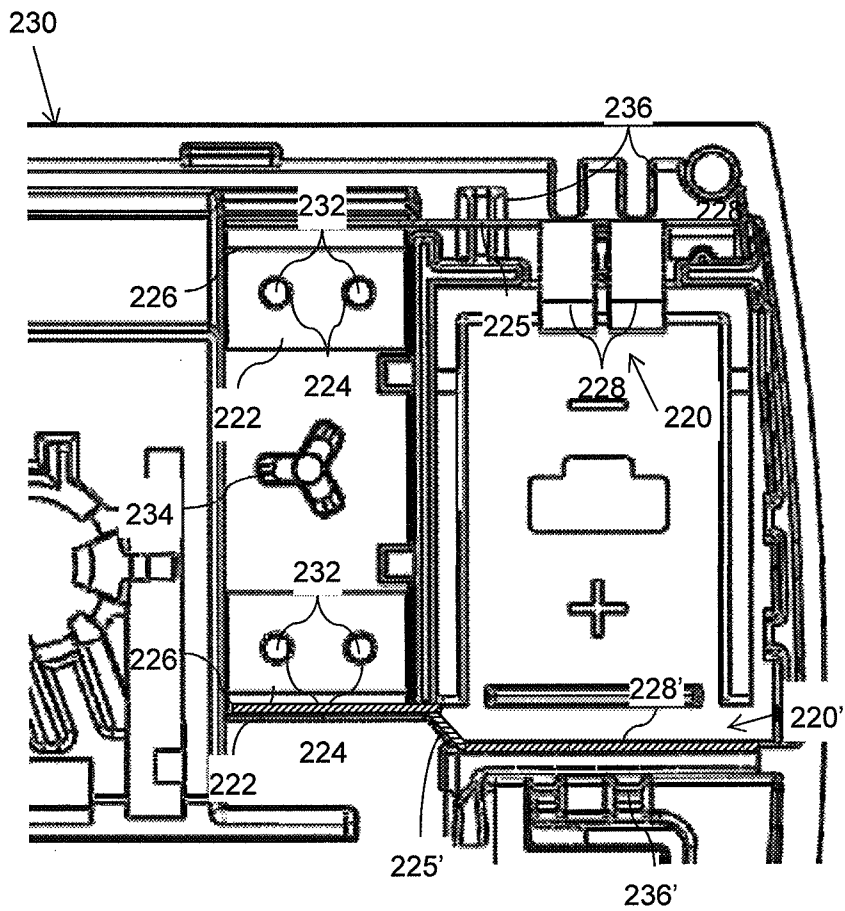


Figure 4B

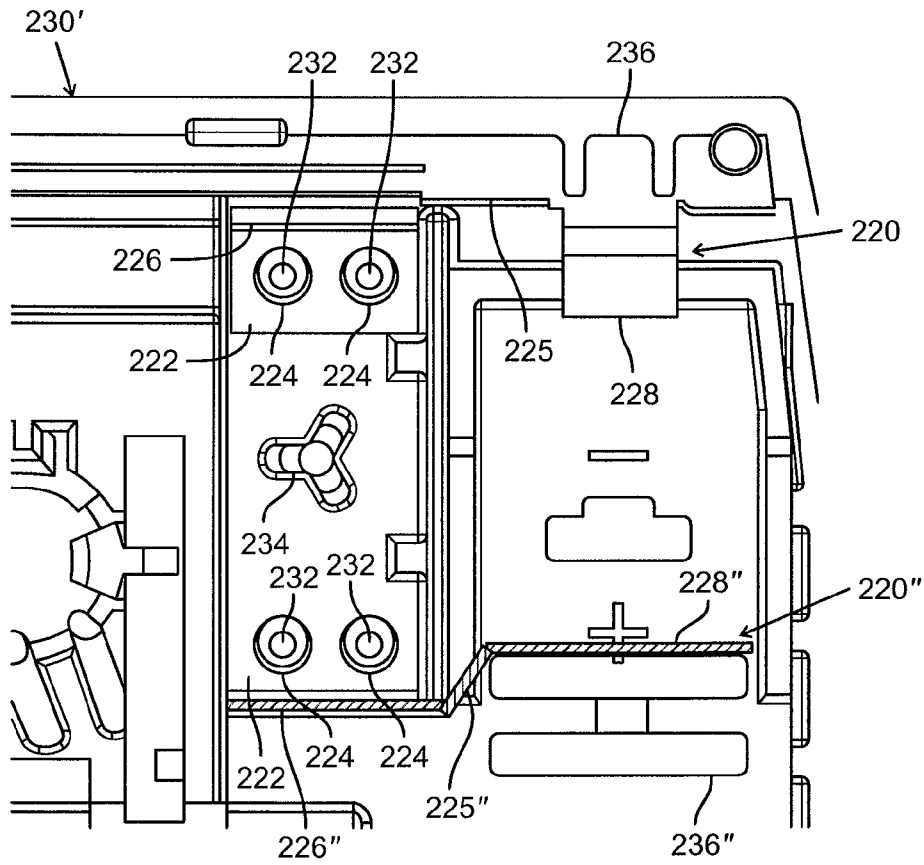


Figure 5

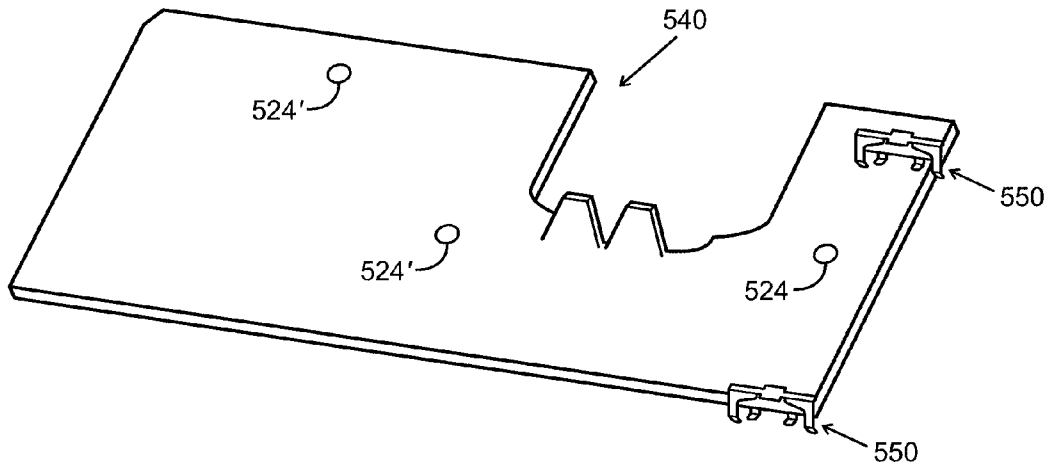


Figure 6A

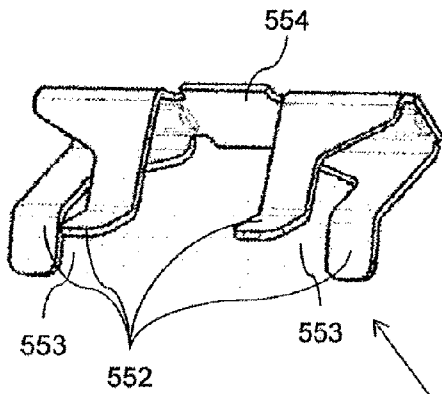


Figure 6B

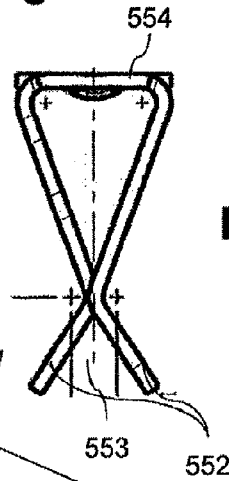


Figure 6C

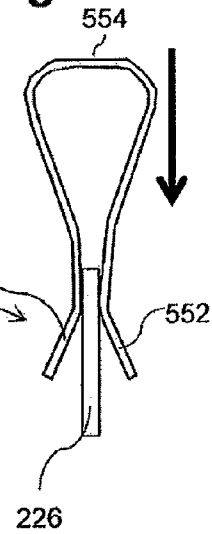


Figure 7

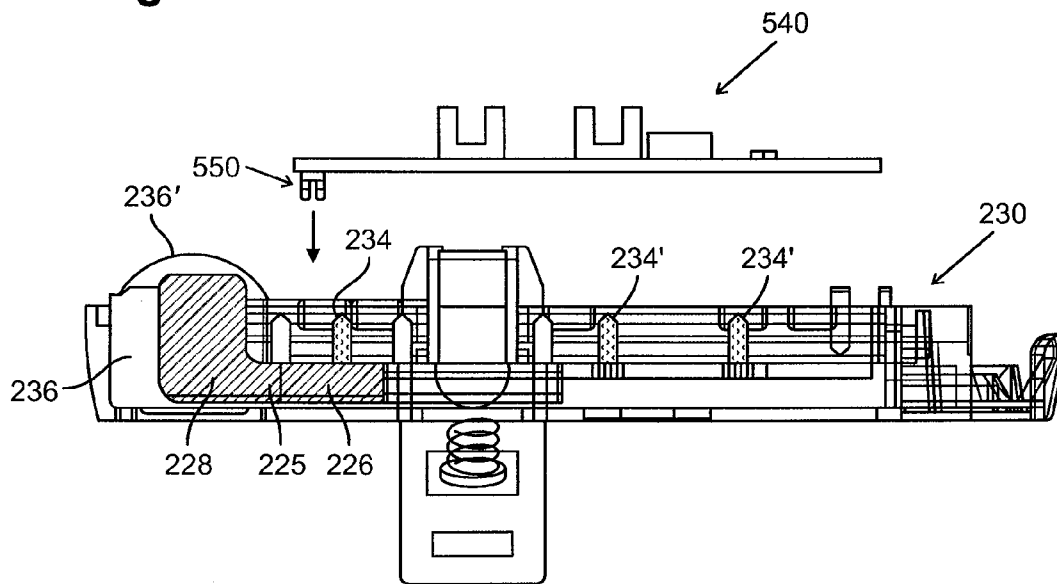


Figure 8

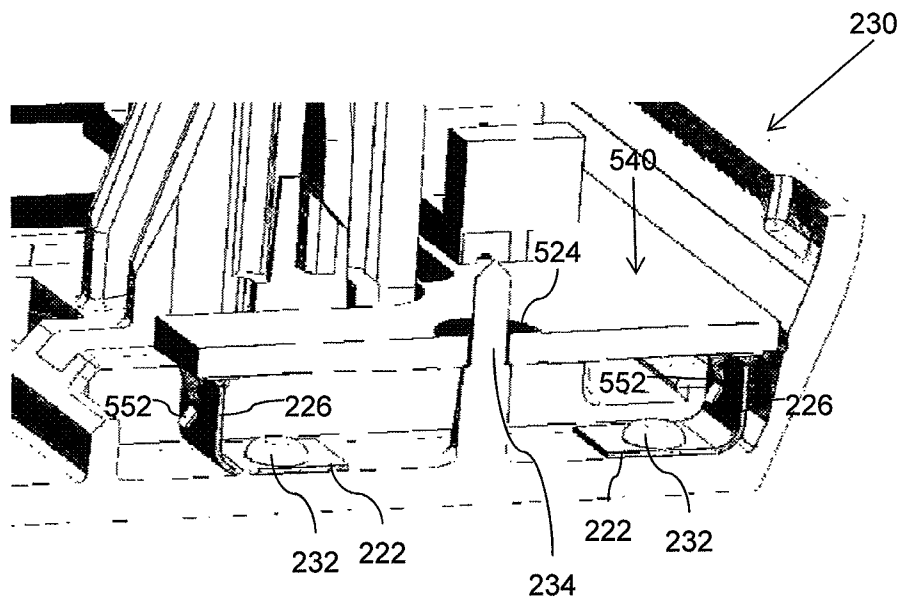


Figure 9A

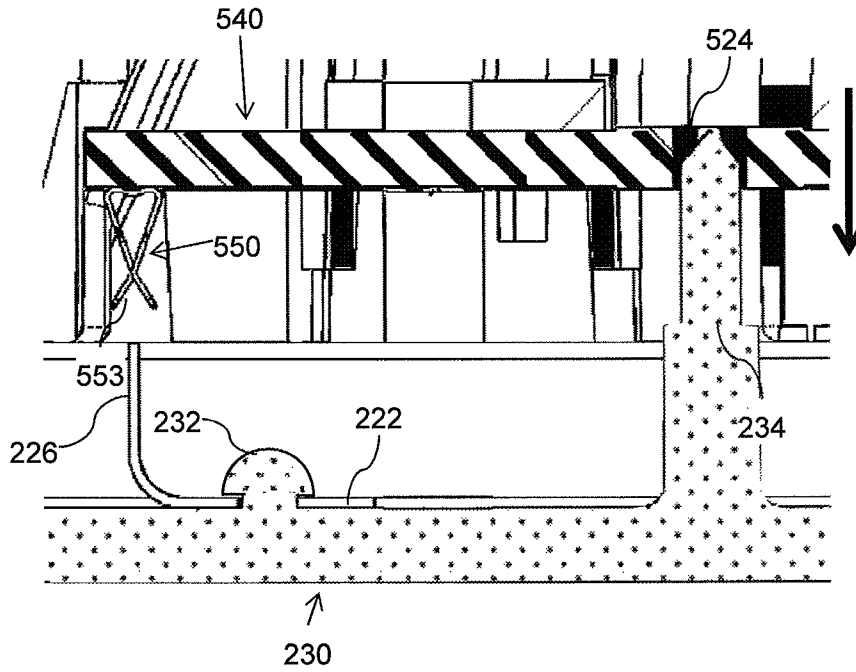


Figure 9B

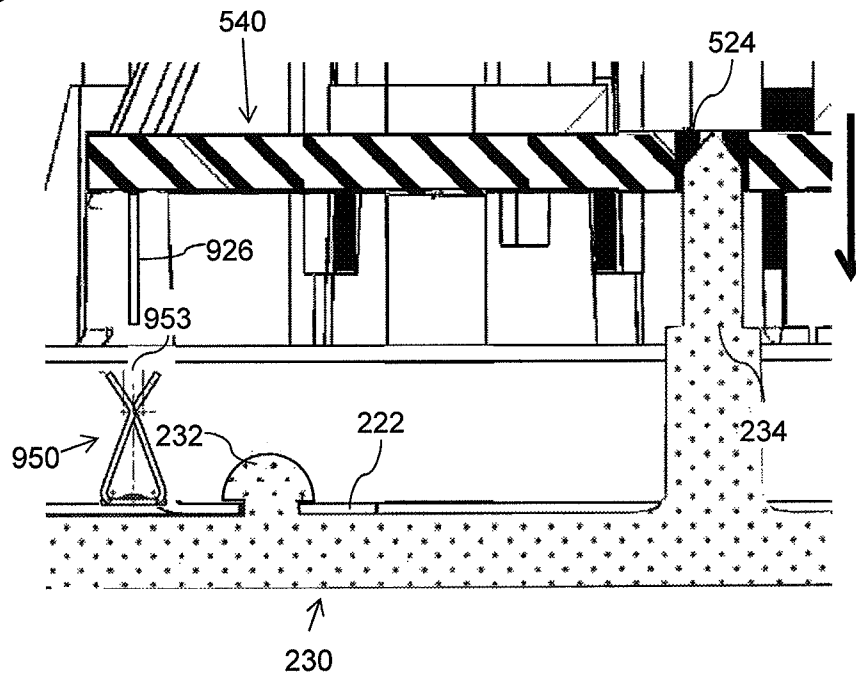


Figure 10A

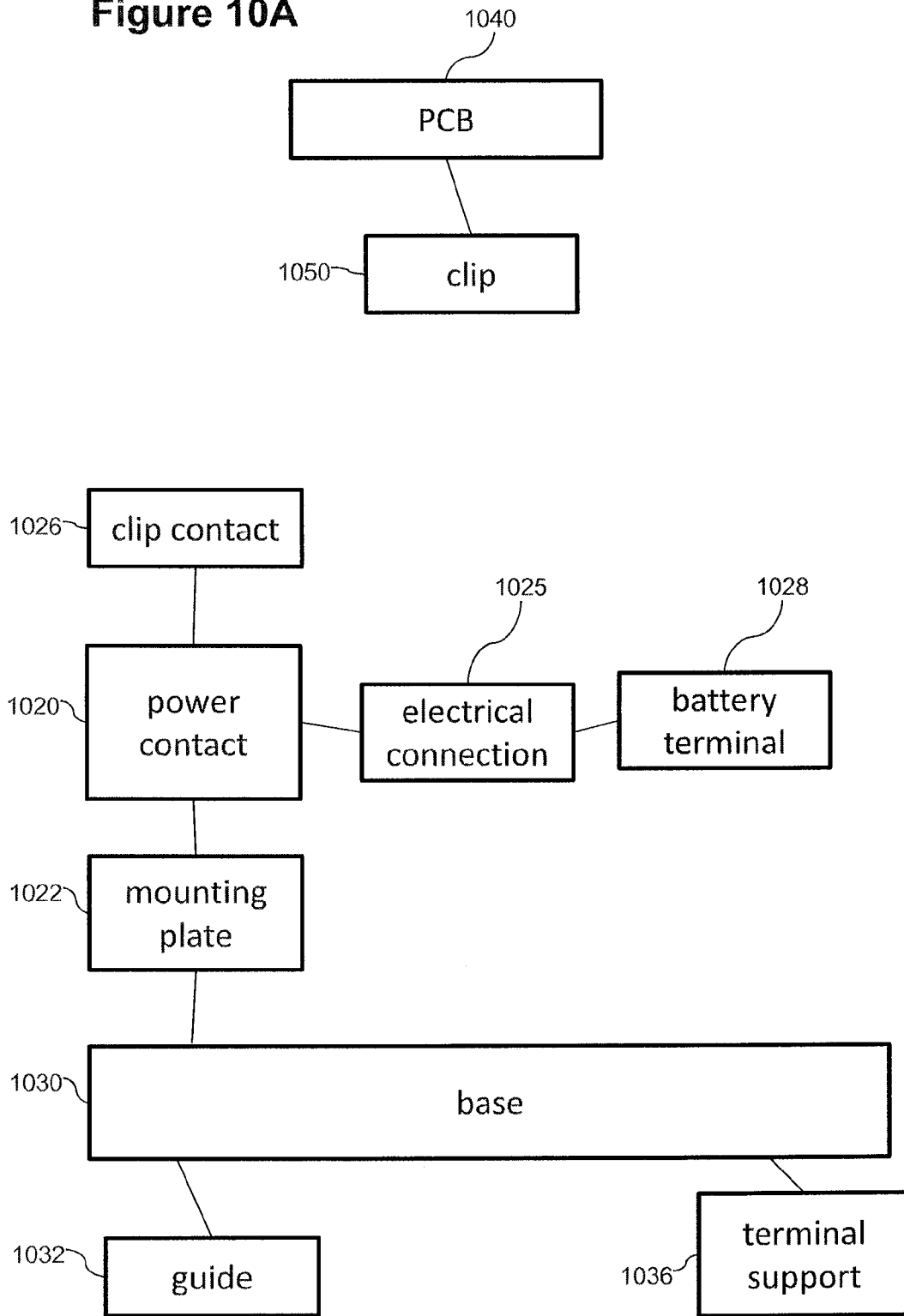
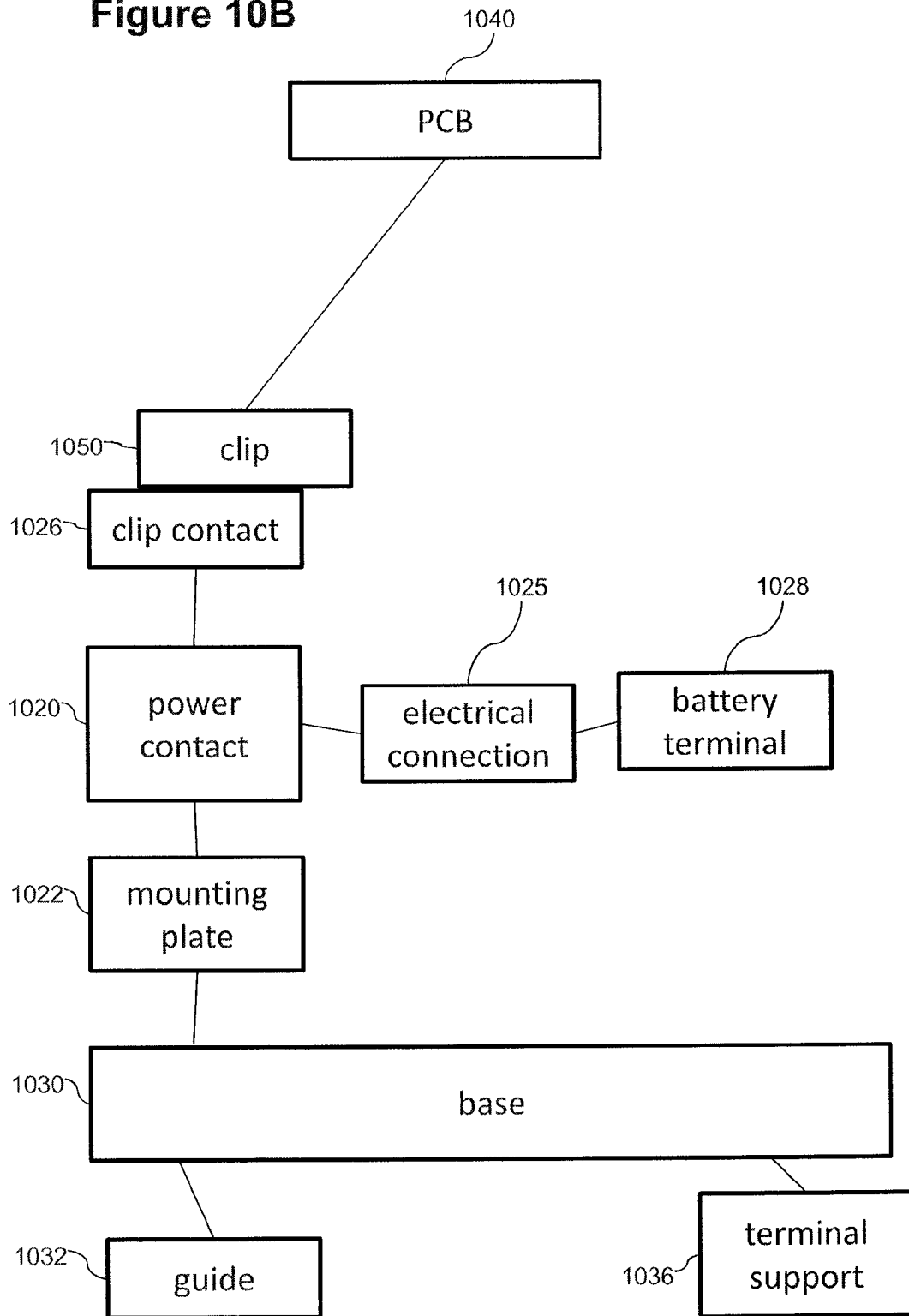


Figure 10B



CLIP CONTACT FOR EASY INSTALLATION OF PRINTED CIRCUIT BOARD PCB

BACKGROUND OF THE INVENTION

The present invention, in some embodiments thereof, relates to a contact clip for a printed circuit board and, more particularly, but not exclusively, to a contact for connection to a power supply for surface installation of a printed circuit board with reduced stress on the PCB.

U.S. Pat. No. 6,722,916 to Buccinna et al. discloses an electronic component that includes a printed circuit board having first and second battery contacts. A battery clip having a bottom portion is connected to the first battery contact. The battery clip also includes a top portion spaced from the printed circuit board with a tab extending from the top portion in a downward direction toward the printed circuit board. A coin cell battery is arranged between the battery clip and the second battery contact. The present invention battery clip biases the battery into engagement with the second battery contacts with the tab. The second battery contacts may be provided by a solder bump or a printed circuit preferably arranged in a criss-cross waffle shaped pattern. The battery clip is secured to the first battery contacts preferably by applying a solder paste that is heated to electrically join the battery clip to the first battery contacts.

U.S. Pat. No. 7,501,587 to English discloses clips that may be compatible with surface mount technology. The clips may be surface mountable to a substrate for allowing repeated releasable attachment and detachment of a shielding structure thereto. In one exemplary embodiment, a clip generally includes a base member having generally opposed first and second side edge portions. Two or more arms extend generally upwardly in a first direction from the base member. The clip also includes a generally flat pick-up surface configured to enable the clip to be picked up by a head associated with pick-and-place equipment.

U.S. Pat. No. 7,488,181 to Van Haaster discloses contacts that may be compatible with surface mount technology. The contacts may be surface mountable for establishing an electrical pathway (e.g., electrical grounding contact, etc.) from at least one electrically-conductive surface on the substrate to another electrically-conductive surface (e.g., EMI shield, battery contact, etc.). In one exemplary embodiment, a contact generally includes a resilient dielectric core member. At least one outer electrically-conductive layer is electrocoated onto the resilient dielectric core member. A solderable electrically-conductive base member may be coupled to the resilient core member and/or the outer electrically-conductive layer. The base member may be in electrical contact with the outer electrically-conductive layer.

U.S. Pat. No. 7,034,223 to Fan discloses a PCB mounting apparatus includes a supporting plate defining a number of through holes, a number of standoffs engaging in the through holes, and a number of grounding members attached to the standoffs. The standoff each includes a head having a holding portion, a flange a post, and a base. The grounding member each includes a first ring supported on the flange, a second ring supported on the base, and a band connecting therebetween. The PCB defines a number of fixing apertures. The combined standoff and grounding member is disposed in the through hole. The PCB is placed upon the supporting plate with the fixing apertures engaging the holding portions of the standoffs and contacts the first rings of the grounding members. The standoffs and the grounding members are made of conductive materials.

BRIEF SUMMARY OF THE INVENTION

According to an aspect of some embodiments of the present invention there is provided method of mounting a printed circuit board (PCB) to a power supply including pushing the PCB into position on a mounting, and simultaneously engaging mechanically a PCB-to-power-contact connected to the PCB to a PCB contact connected to the mounting and electrically connecting the PCB-to-power-contact to the PCB contact.

According to some embodiments of the invention, the engaging includes forming a friction contact between the PCB-to-power-contact and the PCB contact.

According to some embodiments of the invention, the engaging includes clasping a rail from opposite sides.

According to some embodiments of the invention, the engaging includes sliding the rail between two fingers, wherein the two fingers are mounted parallel to a direction of the pushing.

According to some embodiments of the invention, the sliding includes elastically deforming the fingers to admit the rail between the fingers.

According to some embodiments of the invention, a first force between at least one of the fingers and the rail is at least partially balanced by a second of the forces between at least a second of the fingers and the rail.

According to some embodiments of the invention, the net force on the rail is less than a tenth of the sum of the magnitudes of individual forces on the rail.

According to some embodiments of the invention, the method may further include directing the PCB to the position with a guide.

According to some embodiments of the invention, the method may further include fixing a location of the PCB contact with respect to the mounting.

According to some embodiments of the invention, the method may further include locating a power supply terminal separate from the fixing of the PCB contact.

According to some embodiments of the invention, the method may further include joining the PCB contact to the power supply terminal with an adaptor element.

According to some embodiments of the invention, the pushing is in a direction substantially perpendicular to a plane of the PCB. According to some embodiments of the invention, after the engaging, the PCB-to-power-contact resists disconnection from the PCB contact without requiring an external force.

According to some embodiments of the invention, after the engaging, the PCB-to-power-contact resists disconnection from the PCB contact.

According to some embodiments of the invention, after the engaging, the electrical connecting remains stable without stressing the PCB.

According to an aspect of some embodiments of the present invention there is provided a system for mounting a printed circuit board (PCB) to a power supply including: a PCB contact positioned on a mounting for the PCB; a PCB-to-power-contact positioned on the PCB, and a friction contact mechanically engaging and electrically connecting the PCB-to-power-contact to the PCB contact without requiring an external force from the PCB.

According to some embodiments of the invention, wherein the friction contact includes at least two fingers extending perpendicular to a plane of the PCB, the fingers configured for sliding onto opposite sides of a rail.

According to some embodiments of the invention, in an unstressed state the fingers are positioned on opposite sides of

a gap and wherein the gap is configured for sliding a rail into the gap, elastically deforming the fingers to grasp opposite sides of the rail.

According to some embodiments of the invention, during the mechanical engaging, the at least two fingers are elastically stressed by the rail in opposing directions by forces from the rail that at least partially counter balance each other, the net force being less than the sum of the magnitudes individual forces.

According to some embodiments of the invention, the stresses on the fingers are in a direction substantially parallel to a plane of the PCB.

According to some embodiments of the invention, during the mechanical engaging, the at least two fingers are elastically stressed by the rail in opposing directions by forces from the rail that at least partially counter balance each other, the net force being less than a tenth of the sum of the magnitudes individual forces.

According to some embodiments of the invention, the system may further include: a guide positioned on the mounting, the guide configured to direct the positioning prior to the engaging of the friction contact.

According to some embodiments of the invention, a position of the PCB contact is fixed with respect to the mounting.

According to some embodiments of the invention, the system may further include: a power supply terminal and wherein a position of the power supply terminal is fixed separately from the fixing of the PCB.

According to some embodiments of the invention, the system may further include: an adaptor element joining the PCB contact to the power supply terminal.

According to some embodiments of the invention, the friction contact is configured for the engaging in response to pushing in a direction substantially perpendicular to a plane of the PCB.

According to some embodiments of the invention, after the engaging, the PCB-to-power-contact resists disconnection from the PCB contact without requiring an external force.

Unless otherwise defined, all technical and/or scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention pertains. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of embodiments of the invention, exemplary methods and/or materials are described below. In case of conflict, the patent specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and are not intended to be necessarily limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

Some embodiments of the invention are herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of embodiments of the invention. In this regard, the description taken with the drawings makes apparent to those skilled in the art how embodiments of the invention may be practiced.

In the drawings:

FIG. 1 is a flowchart showing a method of connecting a PCB to a power supply in accordance with an embodiment of the present invention;

FIG. 2 is a perspective view of two battery contacts being mounted to a base in accordance with an embodiment of the present invention;

FIG. 3 is a perspective view of two battery contacts in accordance with an embodiment of the present invention;

FIGS. 4A-B are overhead schematic views of battery contacts mounted to a base in accordance with alternate exemplary embodiments of the present invention;

FIG. 5 is a perspective view of a PCB with PCB-to-power-contacts in accordance with an embodiment of the present invention;

FIGS. 6A-C are three views of a PCB-to-power-contact in accordance with an embodiment of the present invention;

FIG. 7 is schematic side view of mounting a PCB in accordance with an embodiment of the present invention;

FIG. 8 is perspective cut away view of a mounted PCB in accordance with an embodiment of the present invention;

FIGS. 9A-B are front cut away views of a mounted PCB's in accordance with alternate exemplary embodiments of the present invention, and

FIGS. 10A-B are block diagrams of a PCB before and after mounting in accordance with an embodiment of the present invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS OF THE INVENTION

The present invention, in some embodiments thereof, relates to a contact clip for a printed circuit board and, more particularly, but not exclusively, to a contact for connection to a power supply for surface installation of a printed circuit board with reduced stress on the PCB.

Overview

Quick Contact for Mounting a PCB to a Device Power Supply

An aspect of some embodiments of the current invention relates to a modular system for mounting a printed circuit board to a device. Modularity may optionally allow replacement of one or more parts without changing the PCB. In this way, it may be possible to change for example the geometry of the device and/or the type of batteries keeping the same PCB and/or PCB contact structure. This may be useful for medical devices where any minor change may require extensive testing and approval of each part that has been changed.

In some embodiments an adaptor element, for example a battery contact, may interconnect between a PCB and an interchangeable part, for example a power supply. For example, a single PCB may be used in multiple models of medical infusers. Optionally different models may include different power supplies. In some embodiments of an infuser, a power supply may be exchanged for a power supply having a different geometry by changing the geometry of the infuser housing to fit the new power supply while keeping the mounting area for the PCB unchanged. Optionally the geometry of the battery contacts may be adjusted to connect between the changed power supply and the unchanged PCB. Optionally, mounting of the PCB may by simple surface mounting without requiring an extra step for connecting the power supply (for example soldering and/or insertion of a plug in a socket). This may optionally facilitate uniform automated assembly of a device containing the PCB.

In some embodiments, a PCB may be mounted by z-assembly. For example the PCB may be mounted from a disconnected state to a connected state by a single vertical push onto a mounting. Power contacts may be optionally be connected by simple z-mounting (for example by pushing the PCB linearly into place). Optionally once connected the power contacts may resist disengagement.

In some embodiments, of a modular system, the battery cavity may be separate from the PCB contacts. For example, the power supply may include a battery cavity and battery

terminals. The battery terminals may be in electrical connection with PCB contacts. The location of the terminals may be controlled for example by the shape of the battery cavity while the location of the PCB contacts may be fixed by a PCB contact guide.

An aspect of some embodiments of the current invention relates to a quick power connector for mounting a printed circuit board to a device. The quick connector may simplify disconnection of the PCB for proper disposal and/or recycling.

Drop in Compression and/or Friction Contacts with Reduced Stress on the PCB

An aspect of some embodiments of the current invention relates to compression contacts and/or friction contacts that may connect between a PCB and a power supply when the PCB is dropped into place on a mount. For example, when a PCB is placed on a mounting metal clips may contact a mounting rail. When the PCB is pushed into place the clips may optionally slide onto the rail and/or clasp the rail from opposite sides. Optionally the contact in itself may supply an interface and/or a stable connection and/or an electrical interconnection between the PCB and a power supply. Grasping forces may optionally make a friction and/or pressure contact that remains in contact with the rail without requiring a constant force from the PCB. The grasping forces may optionally make a friction and/or pressure contact that once connected resists disconnection from the rail without requiring an external force, for example from the PCB. The forces of clamping may be balanced on opposite sides of the rail without requiring a constant counter force from the PCB or the rail. When the PCB is placed on the mounting it may be guided by guide members. For example in some embodiments the force needed to engage the clip to a rail may range between 0.01 and 10 N. The engagement force of each clip may be added to the force to push the PCB into place. For example in some embodiments once connected the clip may resist a disengagement force ranging between 0.05 and 1.0 N. The disengagement force of each clip may be added to the force required to disengage the PCB from its mount. Optionally the force to push the PCB into place and/or the disengagement force may be perpendicular to the plane and the PCB. Optionally the force to push the PCB into place and/or the disengagement force may be in the direction of insertion of the PCB. Optionally the force to push the PCB into place and/or the disengagement force may be perpendicular to a PCB mount.

For example in some embodiments as a PCB is lowered into place via z-assembly, the contacts may interconnect. For example, a clip may have fingers directed parallel to the direction of insertion of the PCB and/or perpendicular to the plane of the PCB. Optionally the fingers may have a gap into which a rail penetrates, as the PCB is pushed into place. The width of gap may range, for example, between 0.3 to 1.0 mm. For example in some embodiments the length of fingers may range between 1 and 4 mm. For example in some embodiments the length of the clip may range between 1 and 10 mm. For example in some embodiments the width of the clip may range between 0.5 and 2.0 mm. For example in some embodiments the thickness of the rail grasped by the clip may range between 0.05 and 0.5 mm.

In some embodiments, the contacts of the current invention may reduce stress on a PCB and or on mounts used to hold a PCB. For example, the current invention may avoid use of a spring contact that pushes against a contact plate requiring a counter force from the PCB mountings. In some cases, such forces from spring mounts on the PCB may cause mounting pins and/or the PCB to deform over time. Such deformations may in some cases reduce reliability.

For example the PCB contacts may include a clip and a corresponding rail. The contact between the PCB and the power supply may be made by the clip grasping the rail from two sides without stressing the PCB. Alternatively or additionally, the contact between the PCB and the power supply may use a clip that grasps the PCB locally. In some embodiments, the clip may balance stresses locally without requiring counter forces from the PCB mountings. Suitable clip contacts may include for example 51711 and/or 51721 shielding clips available from Harwin Inc., 7B Raymond Avenue, Unit 11 Salem, N.H. 03079, USA. Specifications are published as the S1711 and/or 51721 Customer Information Sheet which are incorporated herein by reference.

In some embodiment power supply clips and/or respective contacts may extend between the base and the PCB. A PCB mount may be configured to extend between the base and the PCB while the PCB is adjacent to the base. Optionally, the guide may direct the PCB into position before the power supply clips reach the contacts.

Exemplary Detailed Embodiments

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not necessarily limited in its application to the details of construction and the arrangement of the components and/or methods set forth in the following description and/or illustrated in the drawings and/or the Examples. The invention is capable of other embodiments or of being practiced or carried out in various ways.

Method of Mounting PCB

Referring now to the drawings, FIG. 1 is a flow chart illustration of an exemplary embodiment of a method of mounting a PCB into a device with a power supply contacts. In the exemplary embodiment of FIG. 1, the power supply includes batteries, a battery cavity and battery contacts. Optionally, the battery contacts are installed into the device separately from the PCB. The battery contacts may optionally include a battery terminal in electrical connection with a PCB contact. Optionally the battery terminals are supported and/or located separately from the PCB contact. The PCB may optionally be lowered onto mounts that may serve also as guides for positioning the PCB and then onto the contacts without requiring an extra step of for example soldering and/or plugging in a power cord.

In some embodiment, a power supply terminal may be installed **101** into the base of the device. Optionally, guides for directing engagement of a PCB contact may be fixed **102** in a PCB mounting (for example the PCB mounting may include a section of the base having a PCB positioning guide and/or a PCB contact guide for directing **105** placement of the PCB and/or fixing **102** a location of a PCB contact). In some embodiments, the terminal supports and/or the PCB positioning guides and/or the PCB contact locators may optionally be separate and/or independent from each other. In some embodiments, the terminal supports and/or the PCB positioning guides and/or the PCB contact locator may optionally be located in a specified relative geometry. The PCB mounts may optionally be long enough that they direct **105** positioning of the PCB while it is adjacent to the mounting base before PCB-to-power-contacts on the PCB reach the PCB contacts on the mounting.

In some embodiments an adapter element may join **103** the PCB contacts to the power supply terminals. For example, the terminals may be installed **101** into the base with a terminals support (for example a battery cavity) and/or the PCB contacts may be precisely fixed **102** in their location (for example

on the PCB mounting) by a PCB contact guide and/or the PCB contact may be joined **103** to the terminal by a flexible conductive metal ribbon.

In some embodiments installing **101** power terminals and/or fixing **102** PCB contacts and/or joining **103** the contacts to the terminals may be performed simultaneously. For example, a single piece battery contact (for example contacts **220**, **220'** of FIG. 3) may be a single piece including power terminals (for example terminals **228**, **228'** (for example see detailed view of FIG. 3A,B) and/or a joining element (for example ribbon **225**, **225'**) and/or a PCB contact (for example rail **226**). Optionally lowering contact **220**, **220'** onto a base (for example by z-assembly) may simultaneously accomplish installing **101** power terminals and/or fixing **102** PCB contacts and/or joining **103** the contacts to the terminals.

In some embodiments, the PCB contact may be secured **111** to the PCB mounting. For example, the PCB locator includes a mounting pin; the battery contacts may be secured **111** by hot melting the mounting pins.

In some embodiments, after the PCB contacts are in place, the PCB may be installed simply by positioning **104** the PCB adjacent to the mounting. When the PCB is positioned **104** next to the mounting it may optionally engage a PCB guide. The PCB guide may, for example, direct **105** the PCB into its correct position on the mounting. Optionally, gentle push **106** may engage the PCB-to-power-contact to on the PCB to the PCB contact on the PCB mounting.

In some embodiments, mounting may be simple vertical lowering of the PCB onto the base. Optionally mounting may not require complex motions and/or action (for example tilting and/or translating the PCB, and/or soldering contacts and/or plugging in cords). For example, the PCB guide may include a mounting pin. Optionally during positioning **104** the mounting pin may optionally enter holes in the PCB and direct **105** the PCB while it is being pushed **106** into position on the mounting. Optionally, pushing **106** the PCB onto the mounting may engage a PCB-to-power-contact installed on the PCB to a PCB contact on the mounting thereby electrically connecting **107** the PCB to the power supply. For example, PCB-to-power-contact may include a clip and the PCB contact may include a rail. The clip may, optionally, slide onto and/or grasp the PCB contacts. Alternatively or additionally, PCB contact may include a clip that grasps a rail on the PCB.

In some embodiments a test circuit may be included in the PCB. The test circuit may be used to test **108** whether the PCB is in good electrical connection with the PCB contacts.

In some embodiments the PCB may be secured **109** into the base. For example if the PCB mounts are mounting pins, the PCB may be secured **109** by hot melting the mounting pins.

In some embodiments, once the PCB has been mounted, various components may be connected **110** to the surface of the PCB. For example, there may be contacts for an electric motor and/or a rotation sensor for the motor and/or other sensors and/or power supply contacts.

Installing Battery Contacts

Referring now to further drawings, FIG. 2 is a perspective view of installation of battery contacts (for example contacts **220** and **220'**) into a base (for example base **230**) according to an embodiment of the invention. FIG. 3 is a detailed perspective view of exemplary battery contacts **220**, **220'**. An exemplary relationship is depicted between the battery terminal supports **236**, **236'** and the PCB contact guides **232**. FIG. 2 also illustrates other components of base **230**, for example PCB guides **234**, **234'**.

In some embodiments, positive and negative battery connectors **220**, **220'** respectively, may be lowered into place on

a plastic base **230**. For example a negative terminal **228** may be supported by a negative terminal support **236** and/or a positive terminal **228'** may be supported by a positive terminal support **236'**.

In some embodiments, battery terminal **228** may have multiple redundant fingers, each independently contacting the battery. If one of the fingers is blocked (for example by corrosion and/or dirt), the other finger may supply contact and/or electrical connection.

In some embodiments, PCB connectors may include a rail **226** and a base plate **222**. Optionally base plate **222** may be mounted to base **230** using guides **232**. Guides **232** may optionally pass through holes **224** in base plate **222** to hold rail **226** in precise locations for connecting to the PCB. Battery terminals **228**, **228'** may optionally be electrically joined to rails **226**, **226'** via a thin metal ribbons **225**, **225'**. Metal ribbons **225**, **225'** may optionally be flexible. Flexibility of ribbons **225**, **225'** may optionally facilitate guides **232** fixing of rails **226** in their proper location separately from the supporting of terminals **228**, **228'**. Flexibility may optionally facilitate fixing of rails **226** in their proper location regardless of small imprecision and/or movements in the location of terminals **228**, **228'**. Connection between terminals **228**, **228'** and PCB connecting rails **226** may optionally be formed by an adaptor element according to the particular geometry of a device, for example base **230**. For example, an adapter element may include a conducting ribbon that is adapted to the base geometry. For example, ribbon **225** is straight while ribbon **225'** is bent.

In some embodiments, ribbon **225** may have a cut out **227** portion. For example, cut out portion **227** may allow part of battery support **236** to pass through ribbon **225**. In the exemplary embodiment of FIG. 4A, the part of battery support **236** passing through cut out **227** has a triangular form. The support **236** passing through cut out **227** may, optionally, guide ribbon **225** and/or stabilize ribbon **225** in position.

In some embodiments, battery connectors **220**, **220'** are monolithic elements. For example, each connector **220**, **220'** may be made of a single piece of metal. Alternatively or additionally, each connector **220**, **220'** may be made of multiple components. Modification of the power source without changing the PCB

Referring now to further drawings, FIG. 4A and 4B illustrate an example of modifying a power source without modifying a PCB that controls a device using the power source.

FIG. 4A is an over head illustration of the embodiment of FIGS. 2 and 3. In the example of FIG. 4A the power source includes battery terminals **228**, **228'** and supports **236**, **236'** and is configured for holding three AG13 button batteries (not shown).

FIG. 4B is an over head illustration of an alternative embodiment of a device including a modified connector **220''**. In the example of FIG. 4B a base **230''** battery terminals **228**, **228''** and supports **236**, **236''** are configured for holding three AG12 button batteries (not shown). AG12 batteries may be smaller than AG13 batteries. To accommodate the smaller batteries, supports **236''** and **236'** are closer together than the corresponding supports **236**, **236'** of base **230**. Nevertheless, the PCB connectors (rails **226**) of the battery connectors remain in the same locations. In order to connect terminal **228''** to its corresponding PCB connector rail **226'** in the modified geometry of FIG. 4B, ribbon **225''** is optionally bent in an opposite direction from ribbon **225'**.

Clip Contacts

Referring now to further drawings, FIG. 5 is a perspective view illustration of an exemplary embodiment of a PCB **540**

with a PCB-to-power-contact, for example clips **550**, for connecting to a power source. FIGS. **6A-C** are detail views of an exemplary clip **550**.

FIG. **5** illustrates an exemplary embodiment clip **550** mounted on the bottom of a PCB **540**. For example, clips **550** extend downward from the bottom of PCB **540** in a direction substantially perpendicular to the plane of PCB **540**. In some embodiments, a PCB (for example PCB **540**) may include guide holes **524,524'**. Pins (for example PCB guides **234, 234'**) may line up with guides holes **524,524'** to position PCB **540** for proper mounting (for example to base **230**). In the exemplary embodiment of PCB **540** and base **230**, guide **234** fits in hole **524** located between clips **550**. The close proximity of guide **234** and guide hole **524** to clips **550** may facilitate precise locating of clips **550** as they are lowered onto rails **226**.

FIG. **6A** is a perspective view of an exemplary embodiment of clip **550**. Clip **550** optionally includes a base **554** for connecting to a contact on PCB **540**. Clip **550** optionally includes two sent of fingers **552**. Optionally, fingers **552** and base **554** are formed from a single integral piece of metal, for example of spring steel.

In alternative exemplary embodiment a clip contact may have more or less than four fingers. For example, a clip may have three fingers, for example one finger in the middle and opposing fingers on either side. Optionally, a clip may have five, six or more fingers.

FIG. **6B** and **6C** illustrate a side view of an exemplary embodiment of a contact clip (for example clip **550**). The base of fingers **552** may optionally be bent until fingers **552** close together. The end of fingers **552** may be bent back outward to produce a gap **553**. As illustrated in FIG. **6C**, clip **550** may be lowered onto a rail (for example rail **226**) having the form of a vertical metal plate. Rail **226** slides into gap **553**. As clip **550** is pushed downward, rail **226** pushes apart fingers **552** and slides between fingers **552**.

In some embodiments, as fingers **552** spread, admitting rail **226** into gap **553**, fingers **552** are elastically deformed. Fingers **552** may optionally spring back to grasp rail **226** from two sides, for example as illustrated in FIG. **6C**. Contact between fingers **552** and rail **226** may supply an electrical connection between PCB **540** and the PCB contacts.

In some embodiments, friction and/or compression forces between fingers **552** and rail **226** may resist disconnection. The forces and/or torques produced by the contact between fingers **552** and mounting plate **226** may optionally be balanced such that the clip **550** holds to rail **226** without requiring an external restraining force and/or torque for example from base **230** and/or PCB **540** and/or the guides **234** and/or the guides **232** that join them without requiring an external force to hold clip **550** to rail **226**. For example, opposite fingers **552** may apply forces to rail in opposite directions. In the example friction between fingers **552** and rail **226** may resist disconnection according to the sum of the magnitude of the force between fingers **552** and rail **226**. The net force and or torque on base **554** and or rail **226** may be the vector sum of the forces and/or torques. Opposite forces and torques may have vector forces that substantially nullify each other. For example, in some embodiments the net force may range between half and a tenth of the sum of the force magnitudes. For example, in some embodiments the net force may be less than a tenth the sum of the force magnitudes. Additionally or alternatively, other mounting clips (for example various forms of grounding clips) may be used as contacts between a PCB and a power supply.

Mounting a PCB with Power Source Connecting Contacts

Referring now to further drawings, FIG. **7** is a schematic partial cutaway side view of mounting of exemplary PCB **540** onto exemplary base **230** and FIG. **8** is a perspective front cutaway view of PCB **540** and base **230** showing fingers **552** clasp rails **226**.

As illustrated in FIG. **7**, pushing PCB **540** onto base **230** guided by guides **234,234'** may optionally bring together clip **550** and rail **226** in a desired direction. For example, clip **550** may contact with rail **226** in a direction substantially perpendicular to the plane of PCB **540**. Bringing together clip **550** and rail **226** in the desired direction may optionally mechanically engage clip **550** to rail **226** and complete a connection between clip **550** and rail **226** supplying an electrical connection between the power supply and PCB **540**. The resulting engagement is illustrated in FIG. **8**. Installing PCB **540** to the mounting of base **230** may optionally be completed by hot melting the top of guide **234,234'** to secure PCB **540** into place. Guides **232** are illustrated in FIGS. **8, 9A** and **9B** after hot melting.

FIGS. **9A** and **9B** illustrate close up schematic partial cutaway views of two alternate exemplary embodiments of PCB power connection clips **550,950**. For example, FIG. **9A** illustrates an embodiment that corresponds to FIGS. **2-8** wherein a clip **550** mounted on the bottom of PCB **540** connects to a rail **260** on battery contacts **220**. FIG. **9B** illustrates an alternative embodiment wherein a rail **926** mounted on the bottom of PCB **540** connects to a clip **950** on battery contacts **220**.

FIGS. **9A,B** also illustrate that in the exemplary embodiments of FIGS. **4A,B** guide **234** is optionally longer than the combined lengths of corresponding pairs of rails **226** or **926** and clips **550** or **950**. As PCB **540** is positioned over base **230**, guides **234** optionally enter holes **524** before clip **550,950** contacts corresponding rail **226,926**. Guide **234** may guide rails **226,926** to precisely slide into the gaps **553,953** of corresponding clips **550,950**. A system for connecting a PCB to a power supply

Referring now to further drawings, FIGS. **10A,B** are block diagrams of a system for mounting a PCB to a power supply. FIG. **10A** shows the system before mounting and FIG. **10B** shows the system after mounting.

In some embodiments, a PCB **1040** may include a clip **1050** on a face to be mounted onto a base (for example base **1030**). Clip **1050** may include for example clip **550** as described herein above or various clip contacts known in the art (for example as described in U.S. Pat. No. 7,501,587 and/or U.S. Pat. No. 7,488,181 where are incorporated in their entirety by reference into the specification).

In some embodiments, clip **1050** may form a connection to a clip contact **1026** included in a power contact **1020**. For example the connection may be formed by simple pressing clip **1050** onto clip contact **1026**. Optionally, the forces between clip **1050** and clip contact **1026** may be balanced so that they do not require a counter force and/or torque from PCB **1040** and/or power contact **1020**. An electrical connection **1025** may be supplied between clip contact **1026** and a battery terminal **1028**. In some embodiments contact **1020** may include a mounting plate **1022** for mounting to base **1030**.

In some embodiments base **1030** may include guides **1032** to position PCB **1040** and/or contact **1020** during mounting of PCB **1040** to base **1030** and power contact **1020**.

In some embodiments base **1030** may include a terminal support **1036**.

11

It is expected that during the life of a patent maturing from this application many relevant PCB connectors will be developed and the scope of the terms contacts, clips, rails and connectors is intended to include all such new technologies a priori.

As used herein the term “about” refers to $\pm 5\%$.

The terms “comprises”, “comprising”, “includes”, “including”, “having” and their conjugates mean “including but not limited to”.

The term “consisting of” means “including and limited to”.

The term “consisting essentially of” means that the composition, method or structure may include additional ingredients, steps and/or parts, but only if the additional ingredients, steps and/or parts do not materially alter the basic and novel characteristics of the claimed composition, method or structure.

As used herein, the singular form “a”, “an” and “the” include plural references unless the context clearly dictates otherwise. For example, the term “a compound” or “at least one compound” may include a plurality of compounds, including mixtures thereof.

Throughout this application, various embodiments of this invention may be presented in a range format. It should be understood that the description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the invention. Accordingly, the description of a range should be considered to have specifically disclosed all the possible subranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed subranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of the breadth of the range.

Whenever a numerical range is indicated herein, it is meant to include any cited numeral (fractional or integral) within the indicated range. The phrases “ranging/ranges between” a first indicate number and a second indicate number and “ranging/ranges from” a first indicate number “to” a second indicate number are used herein interchangeably and are meant to include the first and second indicated numbers and all the fractional and integral numerals therebetween.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable subcombination or as suitable in any other described embodiment of the invention. Certain features described in the context of various embodiments are not to be considered essential features of those embodiments, unless the embodiment is inoperative without those elements.

All publications, patents and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present invention. To the extent that section headings are used, they should not be construed as necessarily limiting.

What is claimed is:

1. A method of mounting a printed circuit board (PCB) to a power supply comprising:

12

pushing the PCB into a position on a mounting U;
simultaneously engaging mechanically a PCB-to-power-contact connected to the PCB to a PCB contact connected to said mounting and electrically connecting said PCB-to-power-contact to said PCB contact;
fixing a location of said PCB contact with respect to said mounting;
locating a power supply terminal separate from said fixing of said PCB contact; and
joining said PCB contact to said power supply terminal with an adaptor element.

2. The method of claim 1, wherein said engaging includes forming a friction contact between said PCB-to-power-contact and said PCB contact.

3. The method of claim 2, wherein said engaging includes clasp a rail from opposite sides.

4. The method of claim 3, wherein said engaging includes sliding said rail between two fingers, wherein said two fingers are mounted parallel to a direction of said pushing.

5. The method of claim 4, wherein said sliding includes elastically deforming said fingers to admit said rail between said fingers.

6. The method of claim 4, wherein a first force between at least one of said fingers and said rail is at least partially balanced by a second force between at least a second of said fingers and said rail.

7. The method of claim 4, wherein, a net force on said rail is less than a tenth of a sum of magnitudes of individual forces on said rail.

8. The method of claim 1, further comprising directing the PCB to said position with a guide.

9. The method of claim 1, wherein said pushing is in a direction substantially perpendicular to a plane of the PCB.

10. The method of claim 1, wherein after said engaging, said PCB-to-power-contact resists disconnection from said PCB contact without requiring an external force.

11. The method of claim 1, wherein after said engaging, said electrically connecting remains stable without stressing the PCB.

12. A system for mounting a printed circuit board (PCB) to a power supply comprising:

a PCB contact positioned on a mounting for the PCB in a fixed position with respect to the mounting;
a PCB-to-power-contact positioned on the PCB;
a friction contact mechanically engaging and electrically connecting the PCB-to-power-contact to said PCB contact;
a power supply terminal having a position fixed separately from the fixed position of the PCB contact; and
an adaptor element joining the PCB contact to the power supply terminal.

13. The system of claim 12, wherein said friction contact includes at least two fingers extending perpendicular to a plane of the PCB, said fingers configured for sliding onto opposite sides of a rail.

14. The system of claim 13, wherein in an unstressed state said fingers are positioned on opposite sides of a gap and wherein said gap is configured for sliding a rail into said gap, elastically deforming said fingers to grasp opposite sides of said rail.

15. The system of claim 13, wherein during said mechanical engaging, said at least two fingers are elastically stressed by said rail in opposing directions by forces from said rail that at least partially counter balance each other, a net force being less than a sum of magnitudes of individual forces.

16. The system of claim 15, wherein during said mechanical engaging, said at least two fingers are elastically stressed in a direction substantially parallel to a plane of said PCB.

17. The system of claim 13, wherein during said mechanical engaging, said at least two fingers are elastically stressed 5 by said rail in opposing directions by forces from said rail that at least partially counter balance each other, a net force being less than a tenth of a sum of magnitudes of individual forces.

18. The system of claim 12, further comprising:

a guide positioned on said mounting, said guide configured 10 to direct said positioning prior to said engaging of said friction contact.

19. The system of claim 12, wherein said friction contact is configured for said engaging in response to pushing in a 15 direction substantially perpendicular to a plane of the PCB.

20. The system of claim 12, wherein after said engaging, the PCB-to-power-contact resists disconnection from said PCB contact without requiring an external force.

* * * * *