



US010381767B1

(12) **United States Patent**
Milbrand, Jr. et al.(10) **Patent No.:** US 10,381,767 B1
(45) **Date of Patent:** Aug. 13, 2019(54) **HIGH PERFORMANCE CABLE CONNECTOR**(71) Applicant: **Amphenol Corporation**, Wallingford Center, CT (US)(72) Inventors: **Donald W. Milbrand, Jr.**, Bristol, NH (US); **Prescott B. Atkinson**, Nottingham, NH (US); **Brian Kirk**, Amherst, NH (US)(73) Assignee: **Amphenol Corporation**, Wallingford, CT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/065,683**(22) Filed: **Mar. 9, 2016****Related U.S. Application Data**

(63) Continuation of application No. 13/683,295, filed on Nov. 21, 2012, now Pat. No. 10,122,129, which is a (Continued)

(51) **Int. Cl.**
H01R 13/658 (2011.01)
H01R 13/26 (2006.01)
(Continued)(52) **U.S. Cl.**
CPC **H01R 13/26** (2013.01); **H01R 12/75** (2013.01); **H01R 13/6585** (2013.01); **H01R 13/6587** (2013.01)(58) **Field of Classification Search**
CPC H01R 13/65807; H01R 13/6587; H01R 13/6586; H01R 13/6585; H01R 13/658; H01R 13/646; H01R 13/6471
(Continued)(56) **References Cited**

U.S. PATENT DOCUMENTS

2,996,710 A 8/1961 Pratt
3,002,162 A 9/1961 Garstang
(Continued)

FOREIGN PATENT DOCUMENTS

CN 1179448 C 12/2004
CN 1799290 A 7/2006
(Continued)

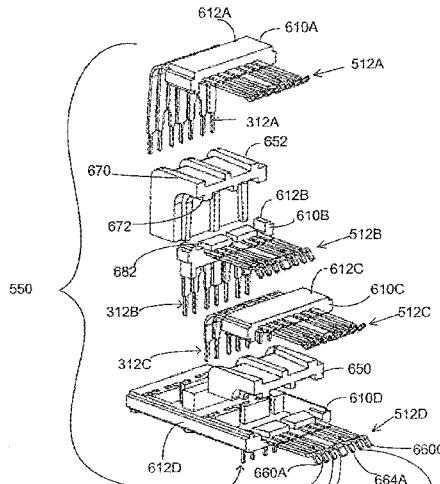
OTHER PUBLICATIONS

Extended European Search Report dated Jan. 24, 2012 for Application No. EP 11166820.8.

(Continued)

Primary Examiner — Felix O Figueroa(74) *Attorney, Agent, or Firm* — Wolf, Greenfield & Sacks, P.C.(57) **ABSTRACT**

A cable connector with improved performance and ease of use. The connector has staggered ports to reduce crosstalk and to prevent incorrect insertion of a plug into a receptacle. The plug may be constructed with subassemblies, each of which has a lossy central portion. Conductive members embedded within an insulative housing of the subassemblies may be used to electrically connect ground conductors within the subassemblies. Further, the connector may have a quick connect locking screw that can be engaged by pressing on the screw, but requires rotation of the screw to remove. Additionally, a ferrule may be used in making a mechanical connection between a cable bundle and a plug and making an electrical connection between a braid of the cable bundle and a conductive shell of the plug. The ferrule may be in multiple pieces for easy attachment while precluding deformation of the cable, which disrupts electrical performance.

32 Claims, 12 Drawing Sheets

Related U.S. Application Data

continuation of application No. 13/671,096, filed on Nov. 7, 2012, now Pat. No. 10,211,577, which is a continuation of application No. PCT/US2011/035515, filed on May 6, 2011.

- (60) Provisional application No. 61/332,366, filed on May 7, 2010.

(51) Int. Cl.

H01R 12/75 (2011.01)
H01R 13/6587 (2011.01)
H01R 13/6585 (2011.01)

(58) Field of Classification Search

USPC 439/607.02, 607.03, 607.05, 607.06,
 439/607.08, 607.1

See application file for complete search history.

(56) References Cited**U.S. PATENT DOCUMENTS**

3,134,950 A	5/1964	Cook	5,496,183 A	3/1996	Soes et al.
3,322,885 A	5/1967	May et al.	5,499,935 A	3/1996	Powell
3,786,372 A	1/1974	Epis et al.	5,551,893 A	9/1996	Johnson
3,825,874 A	7/1974	Peverill	5,562,497 A	10/1996	Yagi et al.
3,863,181 A	1/1975	Glance et al.	5,597,328 A	1/1997	Mouissie
4,155,613 A	5/1979	Brandeau	5,651,702 A	7/1997	Hanning et al.
4,195,272 A	3/1980	Boutros	5,669,789 A	9/1997	Law
4,276,523 A	6/1981	Boutros et al.	5,796,323 A	8/1998	Uchikoba et al.
4,371,742 A	2/1983	Manly	5,831,491 A	11/1998	Buer et al.
4,408,255 A	10/1983	Adkins	5,924,899 A	7/1999	Paagman
4,447,105 A	5/1984	Ruehl	5,981,869 A	11/1999	Kroger
4,471,015 A	9/1984	Ebneth et al.	5,982,253 A	11/1999	Perrin et al.
4,484,159 A	11/1984	Whitley	6,019,616 A	2/2000	Yagi et al.
4,490,283 A	12/1984	Kleiner	6,152,747 A	11/2000	McNamara
4,518,651 A	5/1985	Wolfe, Jr.	6,168,469 B1	1/2001	Lu
4,519,664 A	5/1985	Tillotson	6,174,203 B1	1/2001	Asao
4,519,665 A	5/1985	Althouse et al.	6,174,944 B1	1/2001	Chiba et al.
4,632,476 A	12/1986	Schell	6,217,372 B1	4/2001	Reed
4,636,752 A	1/1987	Saito	6,293,827 B1	9/2001	Stokoe
4,682,129 A	7/1987	Bakermans et al.	6,296,496 B1 *	10/2001	Trammel H01R 12/725 439/79
4,751,479 A	6/1988	Parr	6,299,438 B1	10/2001	Shagian et al.
4,761,147 A	8/1988	Gauthier	6,299,483 B1	10/2001	Cohen et al.
4,806,107 A	2/1989	Arnold et al.	6,328,601 B1	12/2001	Yip et al.
4,846,724 A	7/1989	Sasaki et al.	6,347,962 B1	2/2002	Kline
4,846,727 A	7/1989	Glover et al.	6,350,134 B1	2/2002	Fogg et al.
4,878,155 A	10/1989	Conley	6,364,711 B1	4/2002	Berg et al.
4,948,922 A	8/1990	Varadan et al.	6,375,510 B2	4/2002	Asao
4,970,354 A	11/1990	Iwasa et al.	6,379,188 B1	4/2002	Cohen et al.
4,975,084 A	12/1990	Fedder et al.	6,398,588 B1	6/2002	Bickford
4,992,060 A	2/1991	Meyer	6,409,543 B1	6/2002	Astbury, Jr. et al.
5,000,700 A	3/1991	Masubuchi et al.	6,482,017 B1	11/2002	Van Doorn
5,066,236 A	11/1991	Broeksteeg	6,503,103 B1	1/2003	Cohen et al.
5,141,454 A	8/1992	Garrett et al.	6,506,076 B2	1/2003	Cohen et al.
5,150,086 A	9/1992	Ito	6,517,360 B1	2/2003	Cohen
5,166,527 A	11/1992	Solymar	6,530,790 B1	3/2003	McNamara et al.
5,168,252 A	12/1992	Naito	6,537,087 B2	3/2003	McNamara et al.
5,168,432 A	12/1992	Murphy et al.	6,554,647 B1	4/2003	Cohen et al.
5,176,538 A	1/1993	Hansell, III et al.	6,565,387 B2	5/2003	Cohen
5,266,055 A	11/1993	Naito et al.	6,579,116 B2	6/2003	Brennan et al.
5,280,257 A	1/1994	Cravens et al.	6,582,244 B2	6/2003	Fogg et al.
5,287,076 A	2/1994	Johnescu et al.	6,595,802 B1	7/2003	Watanabe et al.
5,334,050 A	8/1994	Andrews	6,602,095 B2	8/2003	Astbury, Jr. et al.
5,340,334 A	8/1994	Nguyen	6,616,864 B1	9/2003	Jiang et al.
5,346,410 A	9/1994	Moore, Jr.	6,652,318 B1	11/2003	Winings et al.
5,429,520 A	7/1995	Morlion et al.	6,655,966 B2	12/2003	Rothermel et al.
5,429,521 A	7/1995	Morlion et al.	6,709,294 B1	3/2004	Cohen et al.
5,433,617 A	7/1995	Morlion et al.	6,713,672 B1	3/2004	Stickney
5,433,618 A	7/1995	Morlion et al.	6,743,057 B2	6/2004	Davis et al.
5,456,619 A	10/1995	Belopolsky et al.	6,776,659 B1	8/2004	Stokoe et al.
5,461,392 A	10/1995	Mott et al.	6,786,771 B2	9/2004	Gailus
5,474,472 A *	12/1995	Niwa H01R 13/6585	6,814,619 B1	11/2004	Stokoe et al.
			6,830,489 B2	12/2004	Aoyama
			6,872,085 B1	3/2005	Cohen et al.
			6,979,226 B2	12/2005	Otsu et al.
			7,044,794 B2	5/2006	Consoli et al.
			7,057,570 B2	6/2006	Irion, II et al.
			7,074,086 B2	7/2006	Cohen et al.
			7,094,102 B2	8/2006	Cohen et al.
			7,108,556 B2	9/2006	Cohen et al.
			7,163,421 B1	1/2007	Cohen et al.
			7,285,018 B2	10/2007	Kenny et al.
			7,335,063 B2	2/2008	Cohen et al.
			7,371,117 B2	5/2008	Gailus
			7,494,383 B2	2/2009	Cohen et al.
			7,540,781 B2	6/2009	Kenny et al.
			7,581,990 B2	9/2009	Kirk et al.
			7,588,464 B2	9/2009	Kim
			7,722,401 B2	5/2010	Kirk et al.
			7,731,537 B2	6/2010	Amleshi et al.
			7,753,731 B2	7/2010	Cohen et al.
			7,771,233 B2	8/2010	Gailus
			7,794,240 B2	9/2010	Cohen et al.
			7,794,278 B2	9/2010	Cohen et al.
			7,806,729 B2	10/2010	Nguyen et al.
			7,874,873 B2	1/2011	Do et al.
			7,887,371 B2	2/2011	Kenny et al.

(56)	References Cited					
U.S. PATENT DOCUMENTS						
7,914,304 B2	3/2011	Cartier et al.	2011/0212650 A1	9/2011	Amleshi et al.	
7,985,097 B2	7/2011	Gulla	2011/0230095 A1	9/2011	Atkinson et al.	
8,083,553 B2	12/2011	Manter et al.	2011/0230096 A1	9/2011	Atkinson et al.	
8,182,289 B2	5/2012	Stokoe et al.	2011/0256739 A1	10/2011	Toshiyuki et al.	
8,215,968 B2	7/2012	Cartier et al.	2011/0287663 A1	11/2011	Gailus et al.	
8,216,001 B2	7/2012	Kirk	2012/0077380 A1	3/2012	Minich et al.	
8,272,877 B2	9/2012	Stokoe et al.	2012/0094536 A1	4/2012	Khilchenko et al.	
8,371,875 B2	2/2013	Gailus	2012/0156929 A1	6/2012	Manter et al.	
8,382,524 B2	2/2013	Khilchenko et al.	2012/0184154 A1	7/2012	Frank et al.	
8,657,627 B2	2/2014	McNamara et al.	2012/0202363 A1	8/2012	McNamara et al.	
8,715,003 B2	5/2014	Buck et al.	2012/0202386 A1	8/2012	McNamara et al.	
8,771,016 B2	7/2014	Atkinson et al.	2012/0214344 A1	8/2012	Cohen et al.	
8,864,521 B2	10/2014	Atkinson et al.	2013/0012038 A1	1/2013	Kirk et al.	
8,926,377 B2	1/2015	Kirk et al.	2013/0017733 A1	1/2013	Kirk et al.	
8,944,831 B2	2/2015	Stoner et al.	2013/0078870 A1	3/2013	Milbrand, Jr.	
8,998,642 B2	4/2015	Manter et al.	2013/0109232 A1	5/2013	Paniaqua	
9,004,942 B2	4/2015	Paniaqua	2013/0196553 A1	8/2013	Gailus	
9,022,806 B2	5/2015	Cartier, Jr. et al.	2013/0217263 A1	8/2013	Pan	
9,028,201 B2	5/2015	Kirk et al.	2013/0225006 A1	8/2013	Khilchenko et al.	
9,124,009 B2	9/2015	Atkinson et al.	2013/0273781 A1	10/2013	Buck et al.	
9,219,335 B2	12/2015	Atkinson et al.	2013/0316590 A1	11/2013	Hon	
9,225,085 B2	12/2015	Cartier, Jr. et al.	2014/0004724 A1	1/2014	Cartier, Jr. et al.	
9,300,074 B2	3/2016	Gailus	2014/0004726 A1	1/2014	Cartier, Jr. et al.	
9,450,344 B2	9/2016	Cartier, Jr. et al.	2014/0004746 A1	1/2014	Cartier, Jr. et al.	
10,122,129 B2	11/2018	Milbrand, Jr. et al.	2014/0057498 A1	2/2014	Cohen	
10,243,304 B2	3/2019	Kirk et al.	2014/0273557 A1	9/2014	Cartier, Jr. et al.	
2001/0042632 A1	11/2001	Manov et al.	2014/0273627 A1	9/2014	Cartier, Jr. et al.	
2002/0042223 A1	4/2002	Belopolsky et al.	2015/0056856 A1	2/2015	Atkinson et al.	
2002/0089464 A1	7/2002	Joshi	2015/0111427 A1	4/2015	Foxconn	
2002/0098738 A1	7/2002	Astbury et al.	2015/0236451 A1	8/2015	Cartier, Jr. et al.	
2002/0111068 A1	8/2002	Cohen et al.	2015/0236452 A1	8/2015	Cartier, Jr. et al.	
2002/0111069 A1	8/2002	Astbury et al.	2015/0255926 A1	9/2015	Paniaqua	
2004/0005815 A1	1/2004	Mizumura et al.	2016/0149343 A1	5/2016	Atkinson et al.	
2004/0020674 A1	2/2004	McFadden et al.	2018/0062323 A1	3/2018	Kirk et al.	
2004/0115968 A1	6/2004	Cohen	2018/0145438 A1	5/2018	Cohen	
2004/0121652 A1	6/2004	Gailus	2018/0219331 A1	8/2018	Cartier et al.	
2004/0196112 A1	10/2004	Welbon et al.	FOREIGN PATENT DOCUMENTS			
2004/0259419 A1	12/2004	Payne et al.	CN	101176389 A	5/2008	
2005/0070160 A1	3/2005	Cohen et al.	CN	101600293 A	12/2009	
2005/0133245 A1	6/2005	Katsuyama et al.	CN	101790818 A	7/2010	
2005/0176835 A1	8/2005	Kobayashi et al.	CN	101120490 B	11/2010	
2005/0233610 A1	10/2005	Tutu et al.	CN	201846527 U	5/2011	
2005/0283974 A1	12/2005	Richard et al.	CN	102239605 A	11/2011	
2005/0287869 A1	12/2005	Kenny et al.	CN	101600293 B	5/2012	
2006/0068640 A1	3/2006	Gailus	CN	102598430 A	7/2012	
2006/0255876 A1	11/2006	Kushita et al.	DE	60216728 T2	11/2007	
2007/0004282 A1	1/2007	Cohen et al.	EP	1018784 A1	7/2000	
2007/0021001 A1	1/2007	Laurx et al.	EP	1 779 472 A1	5/2007	
2007/0037419 A1	2/2007	Sparrowhawk	EP	2 169 770 A2	3/2010	
2007/0042639 A1	2/2007	Manter et al.	EP	2405537 A1	1/2012	
2007/0054554 A1	3/2007	Do et al.	GB	11166820.8	1/2012	
2007/0059961 A1	3/2007	Cartier et al.	JP	1272347 A	4/1972	
2007/0218765 A1	9/2007	Cohen et al.	JP	07302649 A	11/1995	
2008/0194146 A1	8/2008	Gailus	JP	2001-510627 A	7/2001	
2008/0246555 A1	10/2008	Kirk et al.	JP	2006-344524 A	12/2006	
2008/0248658 A1	10/2008	Cohen et al.	MX	9907324 A	8/2000	
2008/0248659 A1	10/2008	Cohen et al.	WO	WO 88/05218 A1	7/1988	
2008/0248660 A1	10/2008	Kirk et al.	WO	WO 98/35409 A1	8/1998	
2009/0011641 A1	1/2009	Cohen et al.	WO	WO 2004/059794 A2	7/2004	
2009/0011645 A1	1/2009	Laurx et al.	WO	WO 2004/059801 A1	7/2004	
2009/0035955 A1	2/2009	McNamara	WO	WO 2006/039277 A1	4/2006	
2009/0061661 A1	3/2009	Shuey et al.	WO	WO 2007/005597 A2	1/2007	
2009/0117386 A1	5/2009	Vacanti et al.	WO	WO 2007/005599 A1	1/2007	
2009/0239395 A1	9/2009	Cohen et al.	WO	WO 2008/124057 A1	10/2008	
2009/0258516 A1	10/2009	Hiew et al.	WO	WO 2010/030622 A1	3/2010	
2009/0291593 A1	11/2009	Atkinson et al.	WO	WO 2010/039188 A1	4/2010	
2009/0305533 A1	12/2009	Feldman et al.	OTHER PUBLICATIONS			
2010/0048058 A1	2/2010	Morgan et al.				
2010/0081302 A1	4/2010	Atkinson et al.				
2010/0099299 A1	4/2010	Moriyama et al.				
2010/0273359 A1	10/2010	Walker et al.				
2010/0294530 A1	11/2010	Atkinson et al.				
2011/0003509 A1	1/2011	Gailus				

International Search Report and Written Opinion dated Jan. 26, 2006 for Application No. PCT/US2005/034605.

International Search Report with Written Opinion dated Oct. 31, 2007 for Application No. PCT/US2006/025562.

(56)

References Cited**OTHER PUBLICATIONS**

- International Preliminary Report on Patentability dated May 24, 2012 for Application No. PCT/US2010/056482.
- International Search Report and Written Opinion dated Nov. 22, 2011 for Application No. PCT/US2011/026139.
- International Preliminary Report on Patentability dated Sep. 7, 2012 for Application No. PCT/US2011/026139.
- International Search Report and Written Opinion dated Jul. 28, 2011 for Application No. PCT/US2011/034747.
- International Search Report and Written Opinion dated Sep. 12, 2012 for Application No. PCT/US2012/023689.
- International Preliminary Report on Patentability dated Aug. 15, 2013 for Application No. PCT/US2012/023689.
- International Search Report and Written Opinion dated Mar. 29, 2013 for Application No. PCT/US2012/060610.
- International Search Report and Written Opinion dated May 13, 2015 for Application No. PCT/US2015/012463.
- [No Author Listed], Carbon Nanotubes for Electromagnetic Interference Shielding. SBIR/STTR. Award Information. Program Year 2001. Fiscal Year 2001. Materials Research Institute, LLC. Chu et al. Available at <http://sbir.gov/sbirsearch/detail/225895>. Last accessed Sep. 19, 2013.
- Beaman, High Performance Mainframe Computer Cables. 1997 Electronic Components and Technology Conference. 1997;911-7.
- Shi et al, Improving Signal Integrity in Circuit Boards by Incorporating Absorbing Materials. 2001 Proceedings. 51st Electronic Components and Technology Conference, Orlando FL. 2001:1451-56.
- International Search Report and Written Opinion for International Application No. PCT/US2017/047905 dated Dec. 4, 2017.
- U.S. Appl. No. 13/752,534, filed Jan. 29, 2013, Gailus et al.
- U.S. Appl. No. 13/775,808, filed Feb. 25, 2013, Khilchenko et al.
- U.S. Appl. No. 14/948,171, filed Nov. 20, 2015, Atkinson et al.
- U.S. Appl. No. 13/683,295, filed Nov. 21, 2012, Milbrand, Jr. et al.
- U.S. Appl. No. 13/973,921, filed Aug. 22, 2013, Cohen.
- U.S. Appl. No. 13/930,447, filed Jun. 28, 2013, Cartier, Jr. et al.
- U.S. Appl. No. 14/640,114, filed Mar. 6, 2015, Paniagua.
- U.S. Appl. No. 14/209,240, filed Mar. 13, 2014, Cartier, Jr. et al.
- U.S. Appl. No. 14/209,079, filed Mar. 13, 2014, Cartier, Jr. et al.
- U.S. Appl. No. 14/603,300, filed Jan. 22, 2015, Cartier, Jr. et al.
- U.S. Appl. No. 14/603,294, filed Jan. 22, 2015, Cartier, Jr. et al.
- PCT/US2005/034605, Jan. 26, 2006, International Search Report and Written Opinion.
- PCT/US2006/025562, Oct. 31, 2007, International Search Report with Written Opinion.
- PCT/US2010/056482, Mar. 14, 2011, International Search Report and Written Opinion.
- PCT/US2010/056482, May 24, 2012, International Preliminary Report on Patentability.
- PCT/US2011/026139, Nov. 22, 2011, International Search Report and Written Opinion.
- PCT/US2011/026139, Sep. 7, 2012, International Preliminary Report on Patentability.
- PCT/US2011/034747, Jul. 28, 2011, International Search Report and Written Opinion.
- PCT/US2012/023689, Sep. 12, 2012, International Search Report and Written Opinion.
- PCT/US2012/023689, Aug. 15, 2013, International Preliminary Report on Patentability.
- PCT/US2012/060610, Mar. 29, 2013, International Search Report and Written Opinion.
- PCT/US2015/012463, May 13, 2015, International Search Report and Written Opinion.
- U.S. Appl. No. 15/645,931, filed Jul. 10, 2017, Atkinson et al.
- U.S. Appl. No. 15/823,494, filed Nov. 27, 2017, Cohen.
- U.S. Appl. No. 15/713,887, filed Sep. 25, 2017, Cartier et al.
- PCT/US2017/0478905, Dec. 4, 2017, International Search Report and Written Opinion.
- U.S. Appl. No. 15/683,199, filed Aug. 22, 2017, Kirk et al.
- U.S. Appl. No. 15/742,244, filed Jan. 5, 2018, Sasame et al.

* cited by examiner

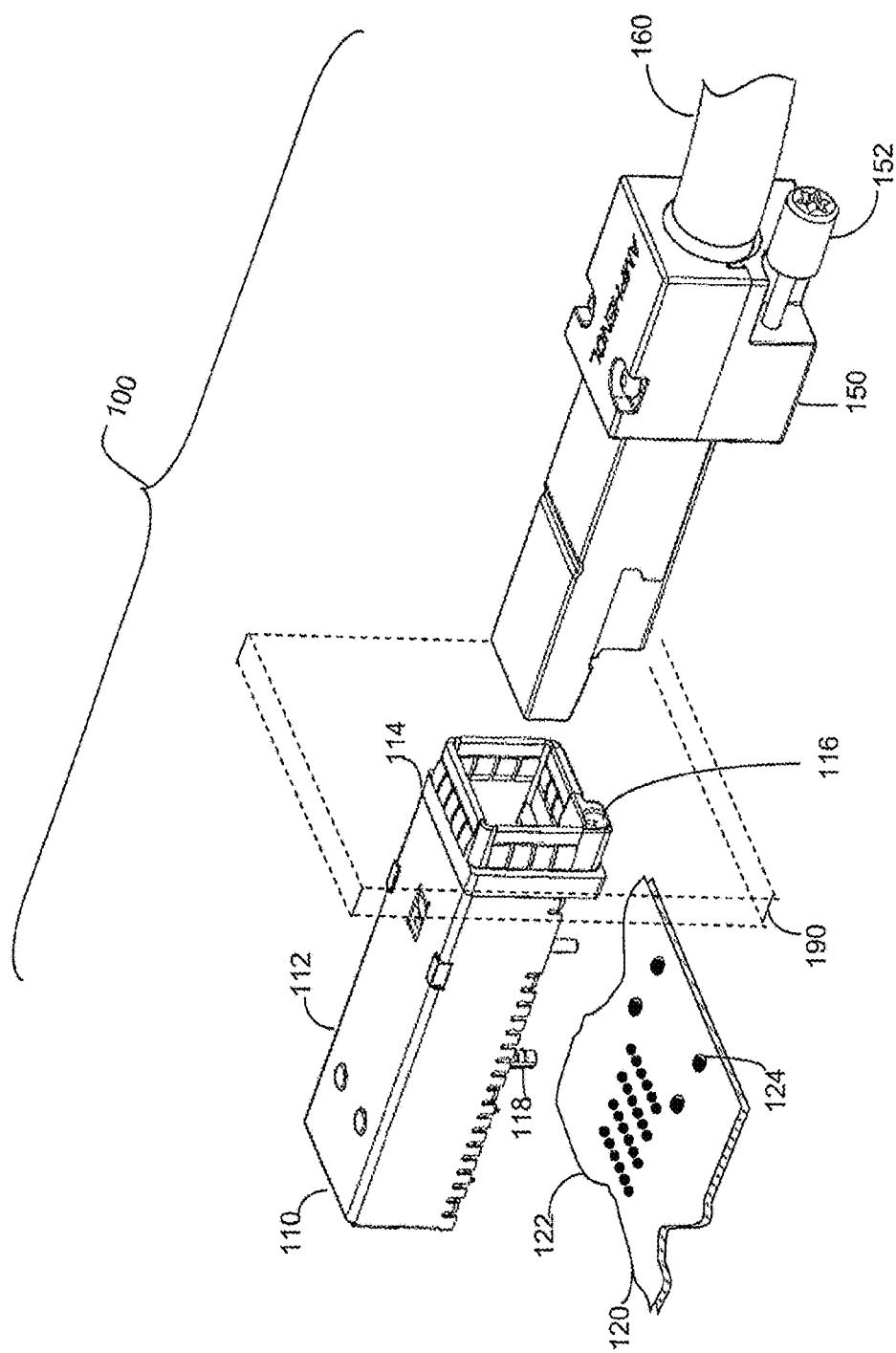


FIG. 1

Explore Litigation Insights



Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.