



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.07.2017 Bulletin 2017/28

(51) Int Cl.:
H01R 13/04 ^(2006.01) **H01R 13/22** ^(2006.01)
H01R 13/41 ^(2006.01) **H01R 13/52** ^(2006.01)
H01R 13/24 ^(2006.01)

(21) Application number: **17150424.4**

(22) Date of filing: **05.01.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **Amphenol Limited**
Whitstable, Kent CT5 3JF (GB)

(72) Inventor: **TAYLOR, James**
Whitstable, Kent CT5 3JF (GB)

(74) Representative: **Loustalan, Paul William**
Reddie & Grose LLP
The White Chapel Building
10 Whitechapel High Street
London E1 8QS (GB)

(30) Priority: **06.01.2016 GB 201600228**

(54) **PIN FOR ADAPTING ELECTRICAL CONNECTORS, AND A KIT OF PARTS INCLUDING SAME**

(57) The present invention provides a pin (100, 400, 500) for adapting a socket contact (610) of a connector. The pin (100, 400, 500) converts the connector for use with a sprung contact type receptacle connector (700). The pin (100, 400, 500) comprises: a shaft portion (102) having a first end (104) and a second end (106), the first end (104) being tapered; an electrical contact portion (106) provided at the second end (106), having a greater

diameter than the shaft portion (102); and at least one barb (108), disposed on the shaft portion (102), configured to engage with the connector upon insertion of the pin (100, 400, 500) socket contact (610). The invention also provides a kit of parts comprising such a pin (100, 400, 500), together with a corresponding sprung contact type mating connector.

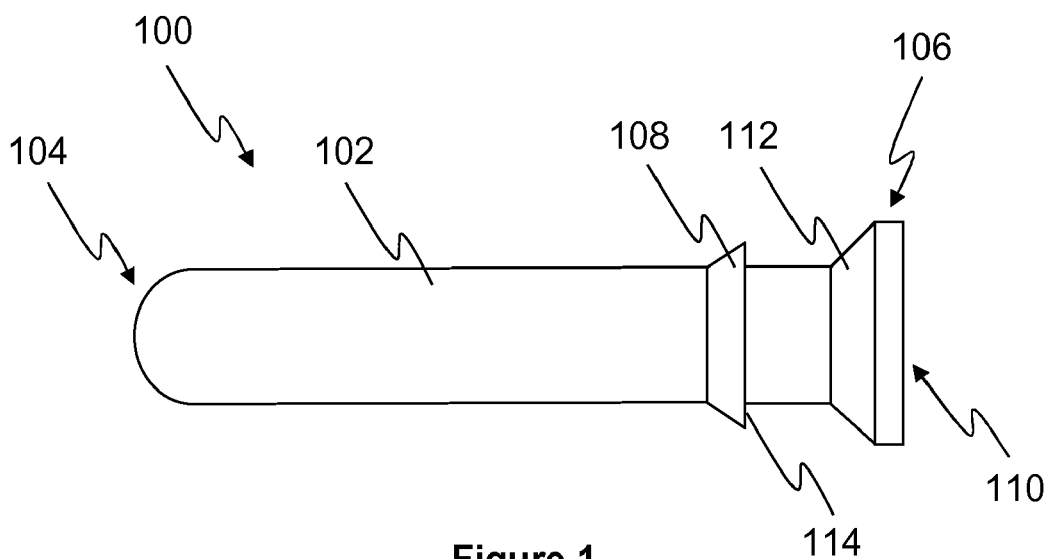


Figure 1

Description

[0001] The present invention relates to a pin for adapting electrical connectors, and in particular for adapting a socket contact within an existing connector for use with a mating connector with sprung contacts. The invention also relates to a kit of parts for adapting a socket contact, and a mating connector with sprung contacts.

[0002] Electrical connectors consisting of a mating pair, made up of a plug half and receptacle half, are well known. These types of connector pairs are often designed based on military standards.

[0003] They advantageously provide secure connections, and are used in aerospace, industrial, marine, and automotive applications. Often for this particular style of connectors the socket contacts are located in the plug connector side. These are often permanently incorporated into equipment and are difficult, costly and time consuming to replace in service. The mating receptacle half, is usually provided on a removable portion of the equipment.

[0004] When coupled together, the pin contacts are inserted into the socket contacts and the connector is sealed. However it has been found that certain environments can result in debris, dirt, dust, and/or moisture ingress into the socket cavities when the two halves are unmated which can negatively affect the electrical performance.

[0005] It is therefore an object of the present invention to provide means for enabling the use of equipment in environments where debris, dirt, dust, and/or moisture is present, without degrading the electrical connection between the mating connectors, and without replacing the portion of the mating pair permanently incorporated into equipment while in service.

[0006] According to a first aspect of the present invention, there is provided a pin for adapting a socket contact of a connector, comprising: a shaft portion having a first end and a second end, the first end being tapered; an electrical contact portion provided at the second end, having a greater diameter than the shaft portion; and at least one barb, disposed on the shaft portion, configured to engage with the connector upon insertion of the pin into the socket contact.

[0007] Advantageously, providing such a pin enables a plug and receptacle mating pair having socket contacts to be adapted for use with a sprung contacts as opposed to insertion contacts. Providing the pin with at least one barb which engages with the connector prevents the pin from being removed once it is inserted, and thus permanently adapts the connector. The pin therefore prevents the ingress of debris, dirt, dust, and/or moisture into the socket contact, and where such debris, dirt, dust and/or moisture is deposited on the connector it may be easily wiped off the contact portion of the pin before the sprung contact receptacle connector is coupled to the plug connector.

[0008] As such, use of the pins means that the existing,

difficult to replace, socket contact connectors can remain in place, but be provided with the advantages associated with a sprung contact connector mating pair.

[0009] For ease of understanding, the invention will now be described with reference to use in adapting socket contacts in a plug connector for use with a receptacle connector having sprung contacts. However, as will be appreciated, the socket contacts may be provided in a receptacle connector, the sprung contacts being provided in the plug connector.

[0010] It should also be appreciated that the present invention may be used to adapt any suitable socket contact type connector for use with sprung contacts.

[0011] Providing a tapered end, for insertion into the socket contact, enables the pins to be fitted to the plug connector more easily, and therefore reduces the probability of damaging the face of the plug connector, and reduces the time required to fit each pin. In a preferred embodiment, the tapered first end is hemispherical. Alternatively, the first end may be conical, or frustoconical.

[0012] Preferably, the pin has a substantially circular cross-section, and is preferably sized to be a locational interference fit within the socket contact. Sizing the pin in this manner ensures a good electrical connection between the pin and the socket contact.

[0013] The or each barb may comprise a tapered face, facing the first end of the shaft portion, and an engagement face, facing the second end of the shaft portion. The tapered face may enable the pin to be more easily located and inserted into the socket contact. The engagement face is configured to engage with the socket contact, and may engage with the rear face of a housing of the plug connector. That is to say, it engages with the internal face of the housing. The housing of such a plug connector may be a socket insert, the plug connector having an outer shell for receiving the insert. The pin is therefore, in effect, permanently attached to the plug connector. As described above, it will be appreciated that the socket insert may be provided in an outer shell of the receptacle connector half of the mating pair of connectors.

[0014] The radius of the barb portion preferably has a minimum tolerance of about 0.05 mm larger than the maximum tolerance value for the hole in the plug connector, for example the hole in the plug connector housing known as the socket insert which the pin passes through upon insertion into the socket contact. This means that when the barb portion passes through the hole it will temporarily cause the socket insert to deform, and when it has passed through returns to its original form preventing the contact from being removed for the plug connector.

[0015] In a preferred embodiment, the pin comprises a single barb, the tapered face extending around substantially the entire circumference of the shaft portion, and the engagement face extending around substantially the entire circumference of shaft portion.

[0016] The electrical contact portion is preferably in the

form of a disc. The disc has a contact face for electrically coupling with an electrical connector, such as a sprung contact receptacle connector, and a mating face, for mechanically mating with a portion of the plug connector. The mating face is preferably frustoconical.

[0017] Preferably, the contact face of the contact portion is planar. Alternatively, the contact face of the contact portion may be concave. The cross-sectional profile of the concave face may be curved, and may be symmetrical such that a dome shape is provided. Alternatively, the concave face of the contact portion has a cross-sectional profile that is triangular. In this way, a cone shaped indentation in the contact face may be provided.

[0018] The distance, along the length of the shaft portion, between the at least one barb and the contact portion is configured such that, upon insertion of the pin into the socket contact of the plug connector, the barb engages with an internal surface of the connector, and an outer edge of the contact portion is substantially planar with an outer surface of the connector. It is also preferable that the distance along the length of the shaft portion between the mating face of the contact portion and the engagement face of the or each barb, is configured such that, upon insertion of the pin into the socket contact of the plug connector, a housing portion of the connector, disposed between the barb and the contact portion is placed under compression by the barb and contact portion. In this way, a secure fit is provided preventing movement of the pin relative to the plug connector's mating face and also substantially preventing the ingress of debris, dust, dirt and/or moisture into the socket contact.

[0019] At least the surface of the shaft portion and the surface of the contact portion may be gold-plated. Preferably, the entire pin is gold-plated, for ease of manufacture. Alternatively, the pin may be coated with another non-corrosive, highly conductive, metal. The electrical contacts surfaces of the pin are the outer surface of the shaft portion between the first end and the barb, and the contact face of the contact portion. It is therefore advantageous that the plating extends at least along and between these surfaces. The pin may be formed of Beryllium copper (BeCu) or Phosphor bronze, and then plated with gold, or another non-corrosive, highly conductive metal.

[0020] As will now be appreciated, it is not important that the tapered portion at the first end of the shaft be plated, because it does not form part of the electrical pathway.

[0021] According to a second aspect of the present invention, there is provided a kit of parts for adapting a socket contact of a connector, comprising: at least one pin for adapting a socket contact of a connector as described herein; and a mating connector with sprung contacts for electrically coupling with the adapted connector, comprising: a housing configured to be mechanically coupled to the adapted connector; at least one sprung electrical contact, mounted to the housing, to be electrically coupled to the pin, or a respective one of the pins,

upon mechanical coupling of the mating connector and the connector.

[0022] Preferably, the kit comprises a plurality of pins, the mating connector comprising a corresponding plurality of sprung electrical contacts.

[0023] The adapted connector is preferably a plug connector, the mating connector preferably being a receptacle connector. Alternatively, the adapted connector may be a receptacle connector, the mating connector being a plug connector.

[0024] Any feature in one aspect of the invention may be applied to other aspects of the invention, in any appropriate combination. Furthermore, any, some and/or all features in one aspect can be applied to any, some and/or all features in any other aspect, in any appropriate combination.

[0025] It should also be appreciated that particular combinations of the various features described and defined in any aspects of the invention can be implemented and/or supplied and/or used independently.

[0026] The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a side view of a pin according to the present invention;

Figure 2 shows a perspective view of the pin of Figure 1;

Figure 3 shows a cross-sectional view of the pin of Figure 1, taken along the longitudinal axis of the pin; Figure 4 shows a cross-sectional view of an alternative embodiment of a pin according to the present invention, taken along the longitudinal axis of the pin; Figure 5 shows a cross-sectional view of a further alternative embodiment of a pin according to the present invention, taken along the longitudinal axis of the pin;

Figures 6(a) and (b) show the pin of Figure 1 being inserted into a socket contact of a plug connector; and

Figures 7(a) and (b) show an example of a mating pair of connectors having a receptacle connector with sprung contacts and an adapted plug connector.

[0027] Figures 1 and 2 show a pin 100 according to the present invention. The pin 100 comprises a shaft portion 102 having a first end 104 with a taper, and in this embodiment rounded taper, a second end 106 in the form of a contact portion, and a barb 108. The contact portion 106 has a contact face 110 and a mating face 112. The barb 108 has an engagement face 114. The pin is configured to adapt a plug connector, upon insertion of the pin into the or each socket contact, to enable use with a receptacle connector having sprung contacts. The shaft is substantially cylindrical in shape, and thus has a circular cross-sectional shape.

[0028] To adapt the plug connector, the pin is inserted in the existing socket contact by a user. The rounded end

104 of the pin, enables the pin to be more easily located and aligned in the socket contact. As the pin is inserted, and the barb 108 meets the outer face of the connector, the user must exert sufficient force to push the barb passed the outer housing, until it emerges on the other side of the outer housing, and engages with the rear, internal, surface of the outer housing.

[0029] The distance along the length of the shaft, between the engagement face 114 and the mating face 112 is configured such that engagement face 114 and the mating face cooperate to retain the pin within the plug connector without the pin being able to move in the axial direction of the pin 100. That is to say, the housing of the plug connector, such as a socket insert, is clamped between the barb and the contact portion. In addition, the dimensions of the pin are such that the outer edge of the contact face 110 is planar with the outer surface of the housing. That is to say, the contact face is flush with the socket insert mating face.

[0030] As can be seen, the barb 108 is of a frustoconical shape facing the first end 104 of the pin 100. The shape enables the pin 100 to be more easily inserted into the socket contact of the plug connector. The mating face 112 of the contact portion 106 is also of a frustoconical shape, and also faces the first end 104 of the pin 100. The shape of the mating face 112 is configured to correspond to the shape of the opening of the socket insert, and so may not be frustoconical.

[0031] Referring to Figure 3, which shows a cross-sectional view of the pin 100, it can be seen that the contact face 110 is substantially flat. Alternatively, as shown in Figures 4 and 5, the contact face may be concave, which may improve the electrical connection between the sprung contact and the pin. In Figure 4, the pin 400 shows the cross-sectional shape of the contact face with a smooth curve 402, and thus a dome shaped contact face is provided. In Figure 5, the pin 500 shows the cross-sectional shape of the contact face as being triangular 502, and thus a cone shaped contact face is provided.

[0032] The pin may be formed of any suitable electrically conductive material, such as Beryllium copper (BeCu) or Phosphor bronze, and may be coated with a non-corrosive, highly conductive, metal such as gold.

[0033] Figure 6(a) shows the pin 100 being inserted into a plug connector 600. As can be seen, the plug connector 600 has an outer casing, known as a shell, which in use mechanically couples with the other half of the mating pair of connectors, a socket connector housing 604, in the form of a socket insert, having an external face 606 and an internal face 608, and a socket contact 610. The diameter of the pin 100 is such that a locational interference fit is formed between the pin 100 and the socket contact 610.

[0034] As the user continues to insert the pin 100 into the plug connector 600, as shown in Figure 6(b), the barb 108 passes through the opening in the socket insert 604, and engages with the internal face 608 of the socket insert 604. The mating face of the contact portion mates

with the outer surface 606 of the socket insert 604, the contact face of the pin 100 being flush with the outer surface 606. Using such a snap-fit to locate and retain the pin 100 eliminates the need for soldering, and therefore enables the connector to be adapted quickly and easily.

[0035] Figure 7(a) shows a sprung contact receptacle connector 700, which is also known as a pogo connector, and Figure 7(b) shows the permanently adapted plug connector. The receptacle connector 700 and the plug connector 600 form the complete assembly.

[0036] As will be appreciated, the socket insert 604 may alternatively be provided in the receptacle connector 700 outer shell. In this alternative example, the sprung contacts are provided in the plug connector outer shell.

Claims

1. A pin for adapting a socket contact of a connector, comprising:
 - a shaft portion having a first end and a second end, the first end being tapered;
 - an electrical contact portion provided at the second end, having a greater diameter than the shaft portion; and
 - at least one barb, disposed on the shaft portion, configured to engage with the connector upon insertion of the pin into the socket contact.
2. A pin according to Claim 1, wherein the tapered first end is hemispherical.
3. A pin according to Claim 1 or 2, wherein the or each barb comprises a tapered face, facing the first end of the shaft portion, and an engagement face, facing the second end of the shaft portion.
4. A pin according to Claim 3, wherein the pin comprises a single barb, the tapered face extending around substantially the entire circumference of the shaft portion, and the engagement face extending around substantially the entire circumference of shaft portion.
5. A pin according to Claim 3 or 4, wherein the or each engagement face extends substantially perpendicular from the surface of the shaft portion.
6. A pin according to any of the preceding claims, wherein the electrical contact portion is in the form of a disc, having a contact face for electrically coupling with an electrical connector, and a mating face, for mechanically mating with a portion of the connector.
7. A pin according to Claim 6, wherein the mating face

is frustoconical.

8. A pin according to Claim 6 or 7, wherein the contact face is concave. 5
9. A pin according to Claim 8, wherein the cross-sectional profile of the concave face is curved.
10. A pin according to Claim 8, wherein the cross-sectional profile of the concave face is triangular. 10
11. A pin according to any of the preceding claims, wherein the distance, along the length of the shaft portion, between the at least one barb and the contact portion is configured such that, upon insertion of the pin into the connector, the barb engages with an internal surface of the connector, and an outer edge of the contact portion is substantially planar with an outer surface of the connector. 15
20
12. A pin according to any of the preceding claims, wherein at least the surface of the shaft portion and the surface of the contact portion are gold-plated.
13. A kit of parts for adapting a socket contact of a connector, comprising: 25
 - at least one pin according to any of claims 1 to 12; and
 - a mating connector for electrically coupling with the adapted connector, comprising: 30
 - a housing configured to be mechanically coupled to the adapted connector;
 - at least one sprung electrical contact, mounted to the housing, to be electrically coupled to the pin, or a respective one of the pins, upon mechanical coupling of the mating connector and the connector. 35
40
14. A kit of parts according to Claim 13, comprising a plurality of pins according to any of claims 1 to 11, wherein the connector comprises a corresponding plurality of sprung electrical contacts. 45
15. A kit of parts according to Claim 13 or 14, wherein the connector is a plug connector and the mating connector is a receptacle connector. 50

55

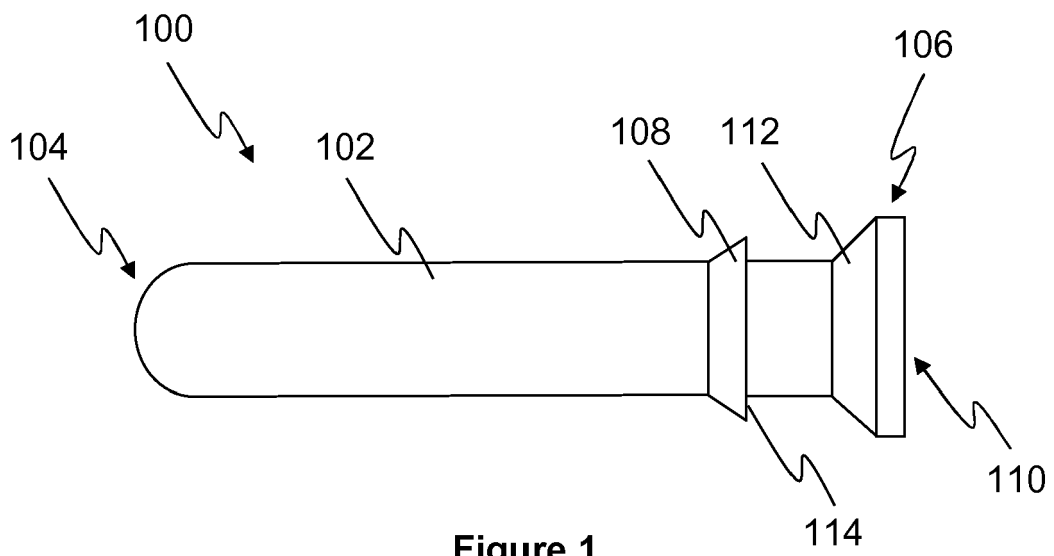


Figure 1

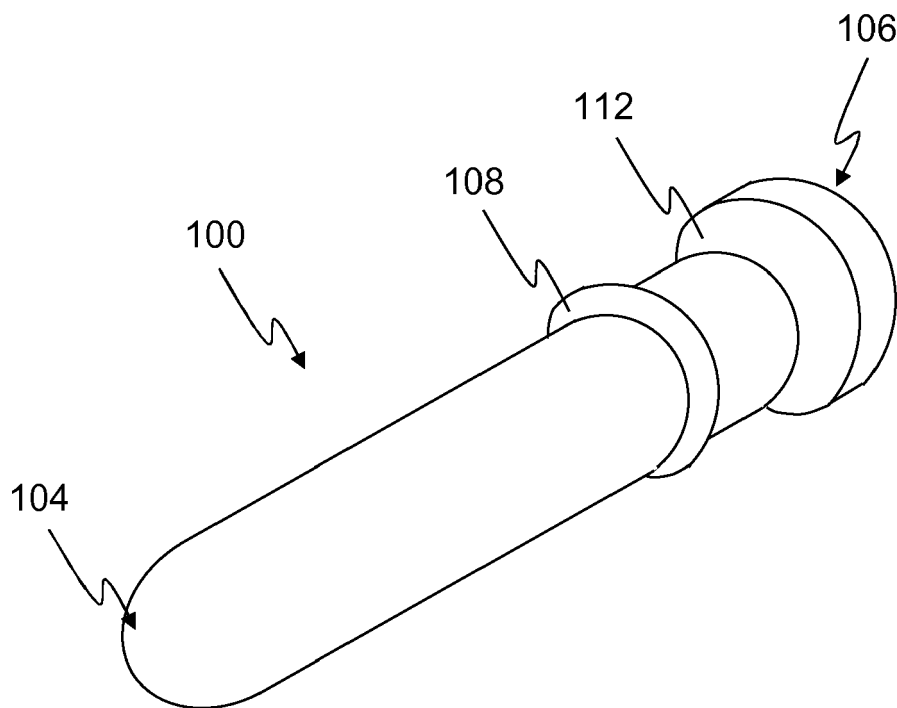


Figure 2

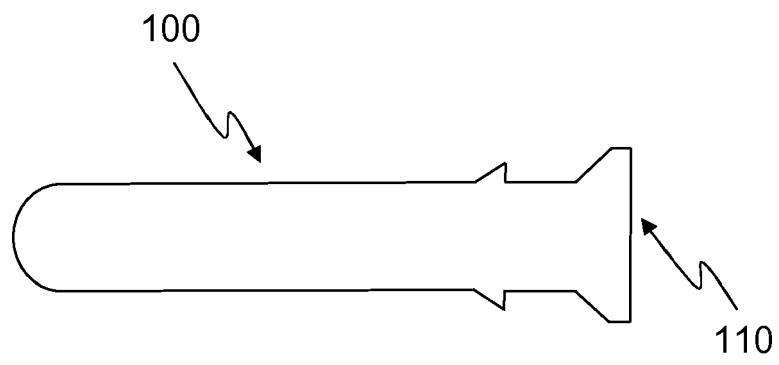


Figure 3

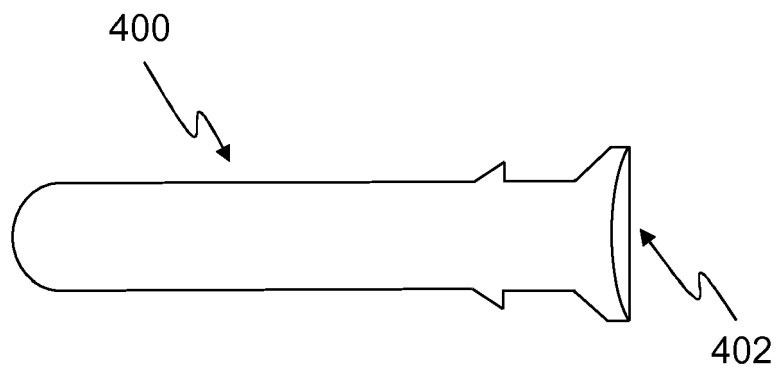


Figure 4

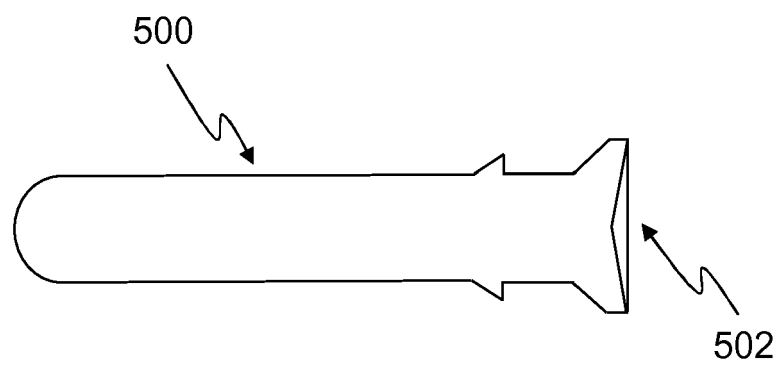


Figure 5

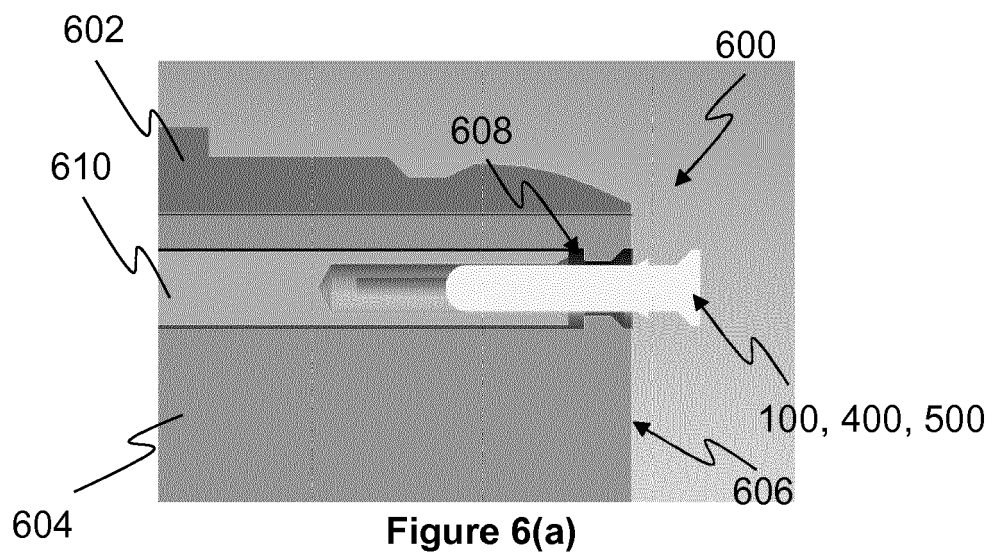


Figure 6(a)

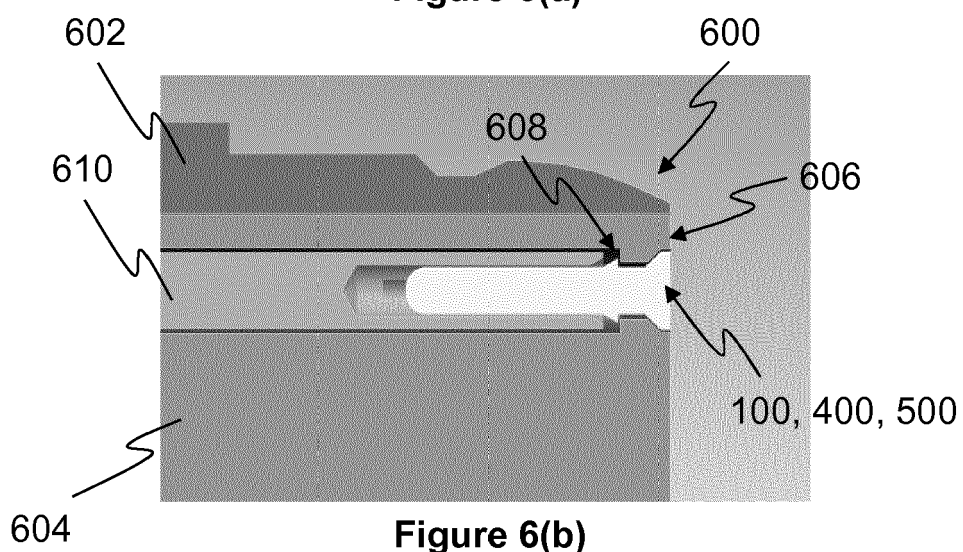


Figure 6(b)

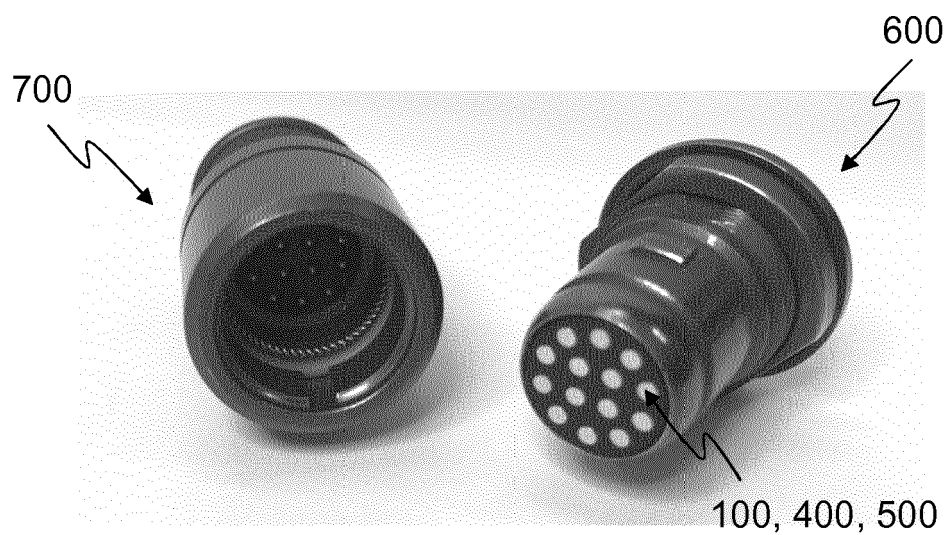


Figure 7(a)

Figure 7(b)



EUROPEAN SEARCH REPORT

Application Number
EP 17 15 0424

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2012/028489 A1 (GRAMSAMER JOSEF [DE] ET AL) 2 February 2012 (2012-02-02) * figures 1,2 * * paragraph [0044] * -----	1-15	INV. H01R13/04 H01R13/22 H01R13/41 H01R13/52
X	EP 2 209 171 A2 (DDK LTD [JP]) 21 July 2010 (2010-07-21) * figures 4, 6a * -----	1-5	ADD. H01R13/24
A		6-15	
X	US 4 652 842 A (KLING JOHN P [US] ET AL) 24 March 1987 (1987-03-24) * figures 1,2 * -----	1-5	
A		6-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01R
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 February 2017	Examiner Skaloumpakas, K
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

 1
EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 15 0424

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-02-2017

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012028489 A1	02-02-2012	CA 2751410 A1	16-09-2010
		CN 102349198 A	08-02-2012
		DE 202009003592 U1	20-05-2009
		EP 2406856 A1	18-01-2012
		HK 1166186 A1	09-05-2014
		JP 5250704 B2	31-07-2013
		JP 2012520537 A	06-09-2012
		KR 20110139203 A	28-12-2011
		US 2012028489 A1	02-02-2012
		WO 2010102738 A1	16-09-2010

EP 2209171 A2	21-07-2010	CN 101783463 A	21-07-2010
		EP 2209171 A2	21-07-2010
		JP 5341532 B2	13-11-2013
		JP 2010165624 A	29-07-2010
		US 2011275982 A1	10-11-2011

US 4652842 A	24-03-1987	NONE	
