



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.02.2010 Bulletin 2010/08

(51) Int Cl.:
H01R 9/03 (2006.01) H01R 9/05 (2006.01)

(21) Application number: **08305462.7**

(22) Date of filing: **12.08.2008**

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

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(54) **Method for supplying power over a coaxial cable and corresponding connector**

(57) The present invention relates to a method for supplying power over a coaxial cable, said power being transported by a power supply cable comprising 2 wires.

According to the present invention, the method comprises the steps of:

- fixing each of said two wires of said power supply cable in a contact bush of a connector;
- fixing and connecting electrically one of said bush to said inner conductor of the coaxial cable;
- fixing and connecting electrically the other bush to said outer conductor of the coaxial cable.

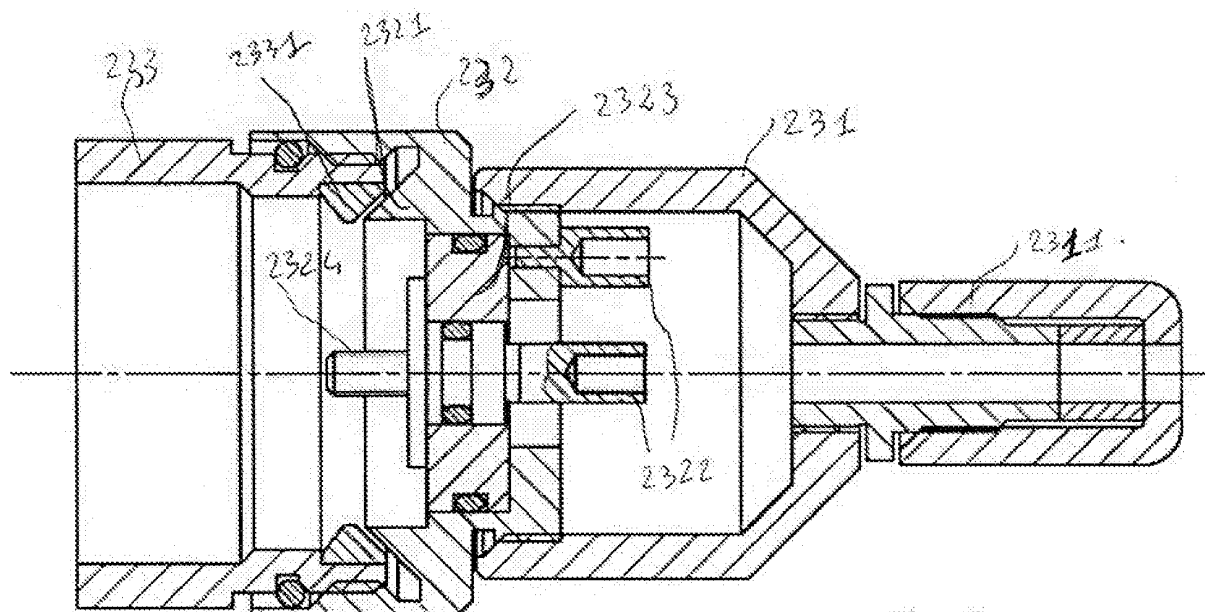


Fig. 3

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a method for supplying power supply over a coaxial cable.

[0002] Methods for supplying power over a coaxial cable are usually used for supplying power up through a coaxial cable to power an antenna mounted preamplifier, the DC power source being located at the bottom of the antenna mast. In addition to power supply, the coaxial cable is used for transmitting the signal to be sent through the antenna.

[0003] A specific Bias T arrangement is necessary for feeding simultaneously DC power and RF signal through the coaxial cable. A bias T is shown on figure 1.

[0004] The bias T shows 2 inputs +DC, RF signal and one output ANT. Input +DC is connected to one wire of the power supply cable, preferably the non ground wire. Input RF signal is a coaxial cable end connector adapted to be connected to a RF signal. Output ANT is also a coaxial cable end connector to which the coaxial cable leading to the antenna can be connected. The function of the Bias T consist in avoiding the DC power supplied to input +DC from looping back to input RF signal and reciprocally to avoid the RF signal from looping back to the DC power input. For this purpose, 2 inductors are connected between input +DC and output ANT which block the 900 1200 MHz RF signal while passing the DC power. Similarly a capacitor is connected between the RF signal input and the antenna output to block the DC power while passing the RF signal.

[0005] The second DC power wire, as well as the outer conductors of all coaxial cable end connectors are put to the ground on the Bias T housing.

[0006] This solution is advantageous since no extra wires are needed to be run toward the antennas for supplying power. One single coaxial cable combines the functionality of power supply and RF supply.

[0007] Since recently remote radio heads where developed where the whole or at least part of the base station hardware needs to be installed close to the antenna making the transport of RF signal through a coaxial cable obsolete. The remote radio heads have to be connected to power supply and to an optical fibre for the digital data transmission which have to run up to the tower. The DC power to be supplied in this configuration has a voltage is in the range of 48 V and a current is in the range of 25 A. The required cable for the power supply may have wires with a cross section of 16 mm².

[0008] The Bias T arrangements presented above have nevertheless the disadvantage not to be able to handle DC current of 25A and more. They are also not designed to connect a 2 wire shielded cable with wire cross sections of 16mm² and more.

[0009] It is a particular object of the present invention to provide a solution for supplying power over a coaxial cable mitigating the drawbacks mentioned above.

[0010] Another object of the invention is to provide a corresponding connector for connecting a power supply cable to coaxial cable.

SUMMARY OF THE INVENTION

[0011] These objects, and others that appear below, are achieved by a connector for connecting a 2 wire power supply cable to a coaxial cable according to claim 1, and a method for supplying power over a coaxial cable according to claim 10.

[0012] According to the present invention, the method consists in connecting the one wire of the power cable to the inner conductor of the coaxial cable and connecting the second wire of the power cable to the outer conductor of the coaxial cable.

[0013] This invention presents the advantage that when existing base stations sites of traditional system approach shall be replaced by a remote radio head system, the already installed coaxial cables can be reused for the power supply. Consequently, coaxial cables are reused even if no RF signal is transported any more through the coaxial cable for supplying power to antennas and their associated remote radio heads. Additionally, the coaxial cable can be reused as protection tube of the optical fibre in case the coaxial cable has a hollow inner conductor.

[0014] This invention further presents the advantage that a quite solid connection can be established between both wires of the power cable and both conductors of the coaxial cable so that moisture and dust sealing can be reached easily. This is especially required for DC power with a voltage about 48 V and a current about 25A. The connector presents good contact in term of contact area and contact pressure to the coaxial cable.

[0015] Such connectors avoid the installation of additional power supply cables. At the same time the down time of a base station is reduced when installing the remote radio head system.

[0016] Further advantageous features of the invention are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Other characteristics and advantages of the invention will appear on reading the following description of a preferred embodiment given by way of non-limiting illustrations, and from the accompanying drawings, in which:

- Figure 1 shows a Bias T arrangement known from prior art;
- Figure 2 shows an arrangement power supply cable/connector/coaxial cable according to the present invention;
- Figure 3 shows the different parts of a connector for connecting a power cable to a coaxial cable in their installation position according to the present invention.

- tion;
- Figure 4a, 4b, 4c show the different parts of a connector for connecting a power cable to a coaxial cable according to the present invention;
 - Figure 5 shows another embodiment of the connector according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018] Figure 1 has already been described in relation to prior art.

[0019] Figure 2 shows an arrangement comprising a power supply cable a connector and a coaxial cable according to the present invention. The three elements are represented: the power supply cable 21, the coaxial cable 22 and connector 23.

[0020] Power supply cable 21 comprises 2 wires, 211, 212 and optionally braided shield not shown on the figure. Preferably the power supply cable transport power with a voltage of about 48 V and a current of about 25 A. The contact surface of the wire is preferably about 16 mm².

[0021] Coaxial cable 22 comprises an inner conductor 221, an outer conductor 222, a dielectric 223.

[0022] Connector 23 will be further detailed thanks to figures 3 and 4a, 4b, 4c. For the part of the description relating to the connection of the power supply cable respectively the coaxial cable, figure 2 should be preferably referred to.

[0023] Connector 23 comprises a connector front part 231, a connector middle part 232 and a connector back part 233. Connector front part 231 is the interface with the power supply cable 21 while connector back part 233 is the interface with the coaxial cable 22.

[0024] Connector front part 231 are externally preferably cylindrical or conic with an axial hole for power supply cable 21 to be lead through the hole.

[0025] Connector front part 231 further comprises fixation means to connector middle part 232. Preferably the diameters of both parts are adjusted to each other so that connector middle part 232 can be inserted into connector front part creating a fixed and sealed liaison.

[0026] Connector middle part 232 comprises contacting means preferably in the form of 2 soldered or crimped or clamped contact bushes 2322 each adapted to receive one of the wires 211, 212.

[0027] Connector middle part 232 comprises contacting means preferably in form of a conic inner surface 2321 cooperating with a conic clamping ring 2331 of the connector back part 233. These contacting means are enabling a clamped contact of outer conductor 222 to the middle connector part 232. The connector middle part 232 is arranged to establish a solid contact C1 between one contact bush 2322 and the outer conductor 222 on the one hand and a solid contact C2 between the second contact bush 2322 and the inner conductor 221 on the other hand.

[0028] Contact bushes 2322 for the wires of the power supply cables could be separated parts which could be

pressed into appropriate holes in the connector middle part 232. Alternatively, the contact bush that contacts the outer conductor of the coaxial cable and connector middle part may be manufactured as one single piece. (Both bushes have to be electrically isolated). The contact bushes 2322 can be made either such that the power supply cable wires are soldered, crimped or fixed with a screw inside them.

[0029] Both contact bushes 2322 are electrically isolated from each other preferably by an isolating material as but not restricted to a plastic ring 2323

[0030] Middle part conductor 232 is adapted to be fixed thanks to fixation means 2324 as for example spring fingers or screwed contact to coaxial cable 22. Preferably, the fixation is performed in the center of the coaxial cable 22 in the area of the inner conductor 221. Preferably, the contact to the inner conductor 221 of the coaxial cable 22 is made with a self-tapping screw type inner conductor 221. The self-tapping contact would allow using the same connector for coaxial cables made from different suppliers having certain variations of dimensions and wall thicknesses.

[0031] The connector back part 233 may comprises in addition to the clamping ring 2331, o-rings 2332 for establishing a sealed contact with the outer part of the coaxial cable 22.

[0032] Coaxial cable outer conductor 222 is pressed against conic surface 2321 when the connector back part 233 is tightened on coaxial cable 22.

[0033] In the following, the different steps of the process of realizing an arrangement as shown on figure 2 will be detailed:

1. The jacket of coaxial cable 22 is removed to a certain length. Coaxial cable 22 is cut perpendicular to the cable axis.
2. Connector back part 233 is pushed over coaxial cable 22.
3. Coaxial cable outer conductor 222 is flared.
4. fixation means 2324 of connector middle part 232 is screwed/clipped into coaxial cable 22.
5. The connector middle part 232 is pushed on the fixation means.
6. Connector back part 233 is screwed on connector middle part. Other coupling mechanisms are possible
7. Connector front part 231 including gland 2311 is pushed over power supply cable 21.
8. The gland 2311 is closed. Fixation and sealing could also be made by other means.
9. The jacket of power supply cable 21 is stripped to a certain length.
10. The braided shield of the power supply cable is cut to leave only a short section free close to the jacket.
11. The braid is clamped inside the connector front part 231 with nut and washer or similar.
12. Both wires 211, 212 of power supply cable 21

are stripped as required by the bushes 2322.

13. Both wires 211, 212 are formed to a bow to enable some movement of the connector front part 231 relative to the other parts 232, 233 of the connector. Some freedom in relative movement is required for the attachment of both connector parts.

14. The wire ends 211, 212 are attached to the bushes 2322 by either crimping, screwing, soldering or similar.

15. The connector front part 231 is attached to connector middle part 232. The coupling mechanism could be made by a kind of bayonet, thread or similar.

[0034] In another embodiment of the present invention showed on figure 5, it is foreseen to have a optical fiber cable 24 being fed through connector 23. It would be especially advantageous to have the optical fiber cable being inserted in an axial opening of the inner conductor 221 of coaxial cable 22. Coaxial cable 22 would constitute a further protection for the optical fiber cable 24 and would limit the size used for having the optical fiber cable being connected to a remote radio head. The digital signal being forwarded towards the remote radio head through this optical fiber cable. The connector middle part 232 would show an hollow finger resp screw 2324 for letting the coaxial cable go through the connector middle part. In addition, bush 2322 connected to the inner conductor 221 would no more be in the axis of the coaxial cable but ex-centred and electrically connected to finger resp. screw 2324.

Claims

1. Connector (23) adapted to be used for connecting a 2-wire power supply cable (21) to a coaxial cable (22) with an inner (221) and an outer (222) conductor, said connector comprising

- a connector middle part (232) comprising two contact bushes (2322), each of one being adapted for receiving one of the wire (211, 212) of said power cable (21), said connector middle part (232) further comprising means (2321) for connecting electrically one of said contact bushes (2322) to said outer conductor (222) of said coaxial cable (22) and means (2324) for connecting electrically the other contact bush (2322) to the inner conductor (221) of said coaxial cable (22);
- fixation means (233) for fixing said connector middle part on said coaxial cable (22), and fixation means (231) for fixing said connector middle part on said power supply cable (21).

2. Connector according to claim 1, wherein said electrical connection between said contact bush (2322) and said outer conductor (222) of said coaxial cable

(22) is obtained by the cooperation of a conic surface (2321) of said conductor middle part electrically connected to said contact bush (2322) and an clamping ring (2331), the outer conductor extremity being flared and pressed between said clamping ring (2331) and said conic surface (2321).

3. Connector according to claim 1, wherein said fixation means for fixing said connector middle part (232) on said power supply cable (21) consists in a connector front part (231) with an opening for letting said power cable being inserted in said connector front part (231), said connector front part being attached to the connector middle part (232).

4. Connector according to claim 1, wherein said fixation means for fixing said connector middle part (232) on said coaxial cable (22) consists in a connector back part (233), said connector back part showing an opening for letting said coaxial cable (22) being inserted in said connector back part, said connector back part being adapted to press said clamping ring (2331) on said outer conductor (222).

5. Connector according to claim 1, wherein said electrical connection between said contact bush (2322) and said inner conductor (221) of said coaxial cable (22) is obtained by inserting a metallic finger (2324) in an opening of the inner conductor (221) having the size of said metallic finger, said metallic finger being connected to said contact bush (2322).

6. Connector according to claim 1, wherein said electrical connection between said contact bush (2322) and said inner conductor (221) of said coaxial cable (22) is obtained by screwing a screw (2324) part of said connector middle part in an opening of the inner conductor (221).

7. Connector according to claim 1, further comprising means (2323) for isolating electrically said two contact bushes (2322) from each other.

8. Connector according to claim 1, further comprising an additional opening in said connector middle part (232) for inserting an optical fiber cable through said connector middle part.

9. Connector according to claim 8, wherein said connector middle part comprises a hollow metallic finger 2324 for inserting an optical fiber through said connector middle part.

10. Method for supplying power over a coaxial cable 22, said power being transported by a power supply cable 21 comprising 2 wires, said method comprising the steps of:

- fixing each of said two wires (211, 212) of said power supply cable (21) in a contact bush (2322) of a connector (23);
- fixing and connecting electrically one of said bush (2322) to said inner conductor (221) of the coaxial cable (22);
- fixing and connecting electrically the other bush (2322) to said outer conductor (222) of the coaxial cable (22).

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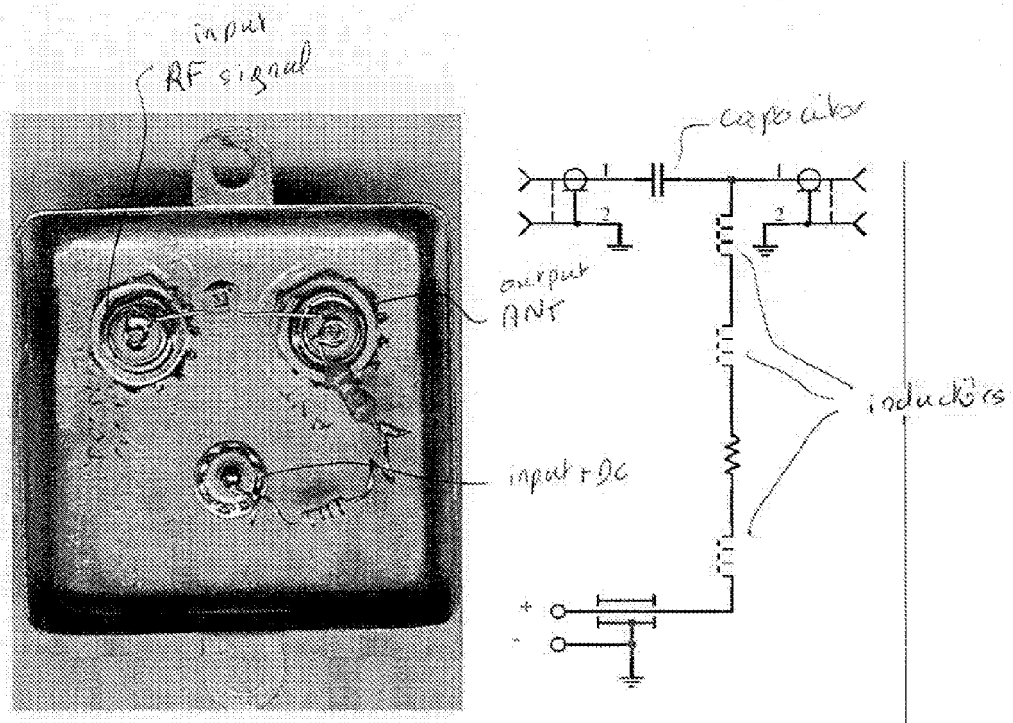


Fig. 1

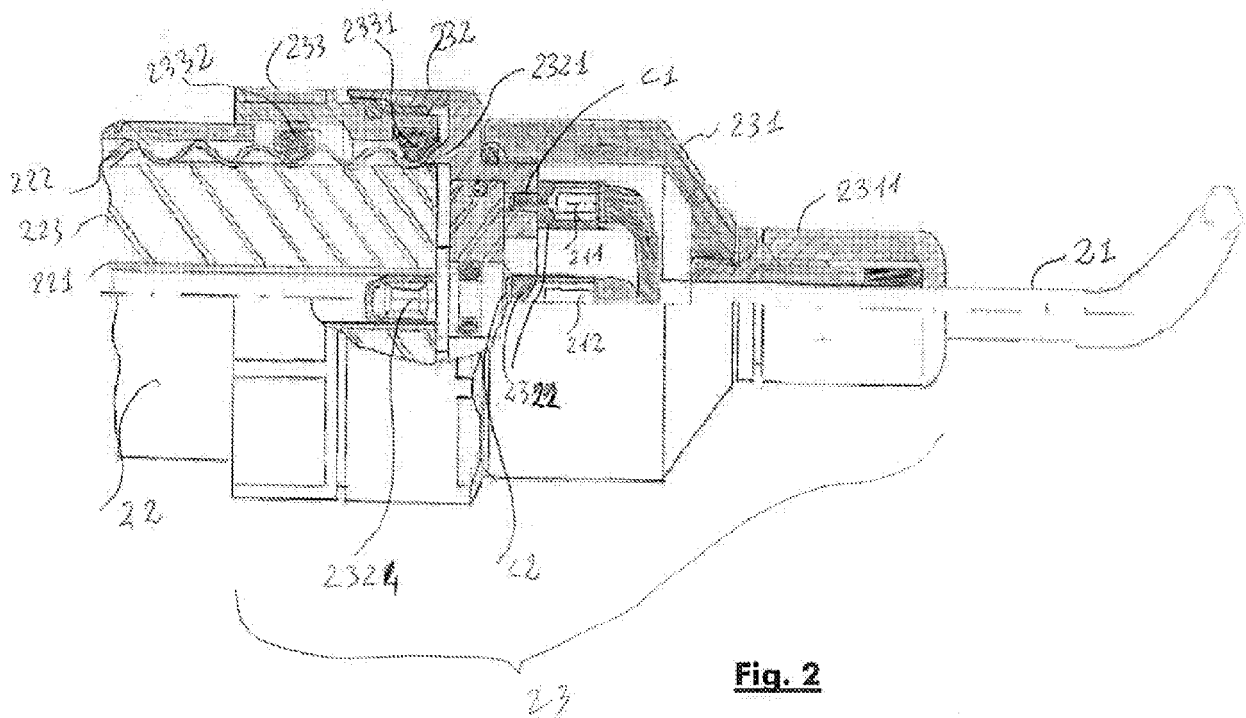
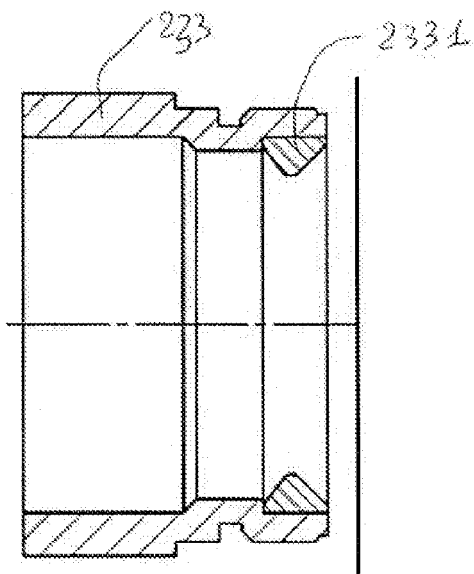
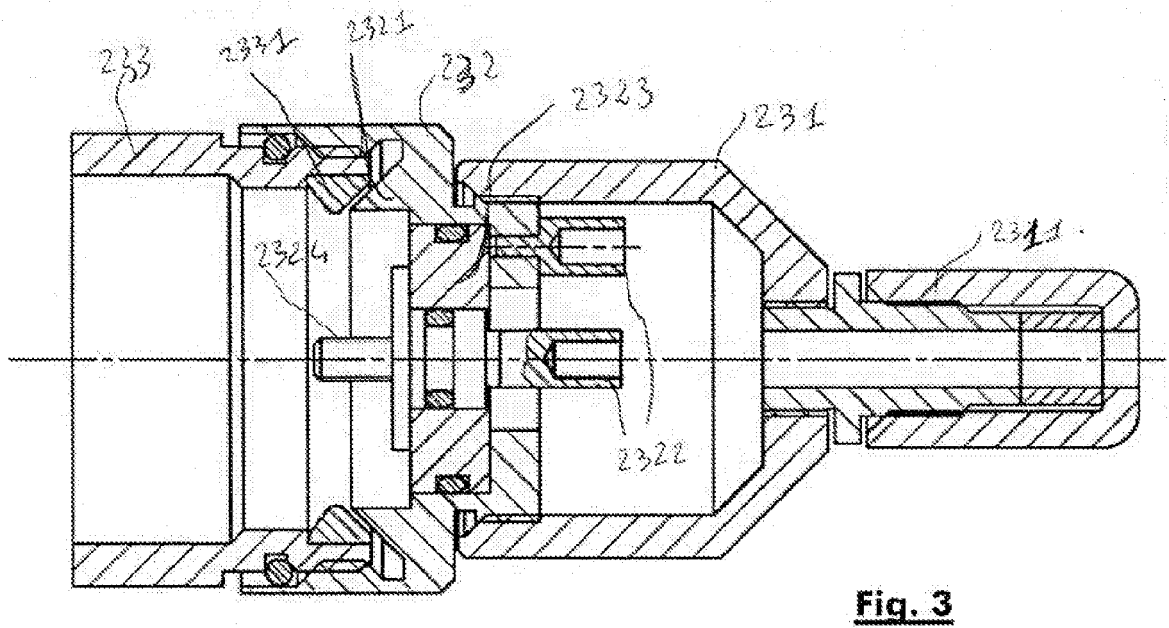


Fig. 2



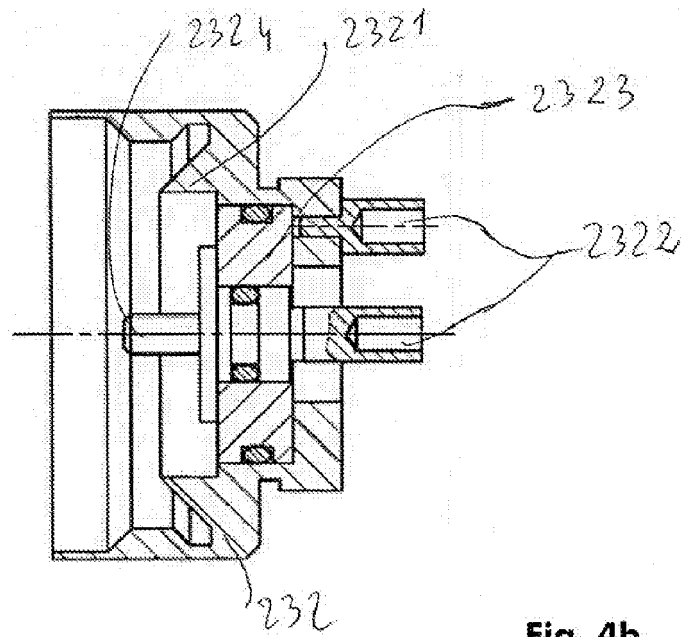


Fig. 4b

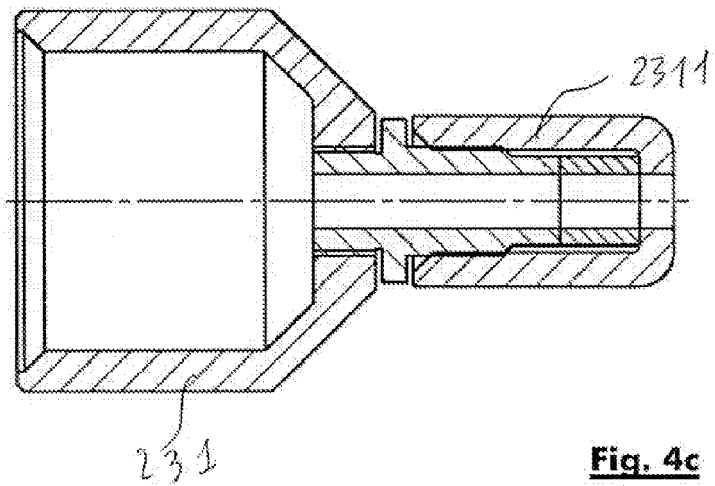


Fig. 4c

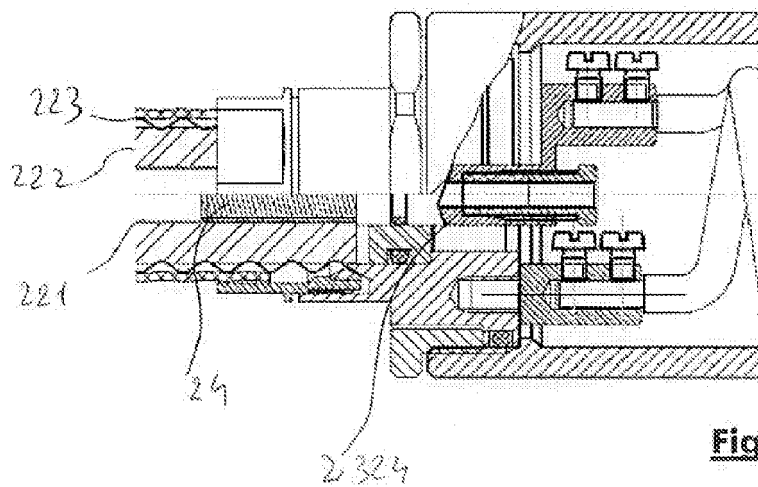


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 08 30 5462

DOCUMENTS CONSIDERED TO BE RELEVANT			
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X	US 5 928 032 A (DREESEN EMMETT RONALD [US]) 27 July 1999 (1999-07-27)	10	INV. H01R9/03 H01R9/05
Y	* abstract *	1,3,5,7	
	* column 3, line 6 - column 6, line 45 *		
	* figures 1-5,8 *		
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	* abstract *		
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A	* abstract; figures 1-3 *	2,4,6	
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	* abstract; figures 1-8 *		
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	* page 3, paragraph 55 - page 4, paragraph 61 *		
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			H01R H02G
Place of search		Date of completion of the search	Examiner
Munich		14 January 2009	Kardinal, Ingrid
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 08 30 5462

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
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14-01-2009

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