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(54) Title: ANGLED RADIO FREQUENCY COAXIAL CONNECTOR WITH TWO-PIECE TYPE INNER CONDUCTOR

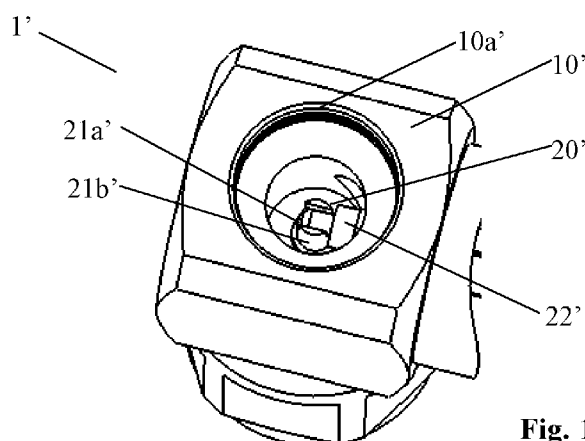


Fig. 1a

(57) Abstract: The present disclosure discloses an angled RF coaxial connector with a two-piece type inner conductor, comprising an outer body and an inner conductor disposed in the outer body. The inner conductor comprises a first inner conductor section and a second inner conductor section that are perpendicular to each other. The first inner conductor section is provided at one end thereof with a first weld segment welded to the second inner conductor section, and the second inner conductor section is provided at one end thereof with a second weld segment welded to the first inner conductor section. The first weld segment is cylindrical and includes a central recess and a closed outer peripheral wall portion surrounding the central recess.



ANGLED RADIO FREQUENCY COAXIAL CONNECTOR WITH TWO-PIECE TYPE INNER CONDUCTOR

RELATED APPLICATION

[0001] The present application claims priority from and the benefit of Chinese Patent Application No. 2018101603292, filed February 27, 2018, the disclosure of which is hereby incorporated herein by reference in full.

FIELD OF THE INVENTION

[0002] The present disclosure generally relates to coaxial cable assemblies. In particular, the present disclosure relates to an angled radio frequency (RF) coaxial connector with a two-piece type inner conductor.

DESCRIPTION OF RELATED ART

[0003] Coaxial cable assemblies are commonly used for transmitting electrical signals over a length of coaxial cable. Coaxial cable includes a center conductor and an outer conductor that are electrically isolated from one another by a dielectric layer. The

outer conductor is grounded so that it operates as an electrical shield around the center conductor to prevent a degradation of the electrical signal carried by the center conductor. A coaxial cable assembly further includes a coaxial connector having an outer connector body and an inner conductor. The outer body is coupled electrically with the outer conductor of the coaxial cable, the inner conductor is coupled electrically with the center conductor of the coaxial cable, and the outer body and inner conductor of the coaxial connector are also electrically isolated from each other by a dielectric layer.

[0004] Under certain circumstances in which a straight-line or linear connection is impossible or difficult, the coaxial connector may be in the form of an angle connector. The outer body of the angle connector comprises a first outer body section and a second outer body section that are perpendicular to each other. Correspondingly, the inner conductor of the angle connector comprises a first inner conductor section and a second inner conductor section that are perpendicular to each other. The first inner conductor section and the second inner conductor section are disposed within the first outer body section and the second outer body section, respectively.

[0005] The first inner conductor section and the second inner conductor section can be one piece, or can be separately formed and then connected together by certain connecting means. In the case where the inner conductor is of one-piece type, it is difficult to control the angle and the size of the right-angled inner conductor in the forming process. The processing cost can be high, and sufficient space is required for the outer body to install the inner conductor, resulting in high overall cost of the angle connector. In the case where the inner conductor is of two-piece type, the first inner conductor section and the second inner conductor section can be fixed together by threading, plugging, crimping, welding connection or the like. In the case of a threaded connection, it can be

time-consuming to screw between the first and the second inner conductor sections, and the connected portion is prone to loosening. In the case of plugged and crimped connections, the connection between the first and the second inner conductor sections is often unreliable, which tends to result in poor contact and further affect the stability of the electrical performance. Therefore, in order to obtain a reliable connection, the first and the second inner conductor sections are usually fixed together by welding.

[0006] As shown in Figs.1a and 1b, the angle connector 1' includes an inner conductor 20' disposed in the outer body 10'. The inner conductor 20' includes a first inner conductor section 21' in a vertical direction and a second inner conductor section 22' in a horizontal direction, and the first inner conductor section 21' and the second inner conductor section 22' are connected together by welding at the joint. The top end of the first inner conductor section 21' is notched in the middle along the axial direction thereof (i.e., the vertical direction in Fig. 1b), so as to form a recess 21a' that extends in a direction perpendicular to the axial direction (i.e., the horizontal direction in Fig. 1b) and projections 21b' located on both sides of the recess 21a'. The end portion of the second inner conductor section 22' can be inserted into the recess 21a' and located between the two projections 21b'. Through the opening 10a' of the outer body 10' above the joint, an operator can access the joint and weld the end of the second inner conductor section 22' to the recess 21a' and projections 21b' of the first inner conductor section 21' with a welding device so as to connect the first inner conductor section 21' and the second inner conductor section 22' together. After welding, an end cap 10b' will be used to close the opening 10a'.

[0007] However, for such a welding structure of a two-piece type inner conductor, solder tends to flow out from the recess of the first inner conductor, so that it is not easy

to control the amount of the solder required and the final shape of the welded portion, thereby affecting the consistency of electrical performance of the connector.

SUMMARY

[0008] An object of the present disclosure is to provide an angled RF coaxial connector that can overcome at least one of the drawbacks in the prior art.

[0009] According to a first aspect of the present disclosure, an angled RF coaxial connector with a two-piece type inner conductor comprises an outer body and an inner conductor disposed in the outer body. The inner conductor comprises a first inner conductor section and a second inner conductor section that are perpendicular to each other. The first inner conductor section is provided at one end thereof with a first weld segment welded to the second inner conductor section, and the second inner conductor section is provided at one end thereof with a second weld segment welded to the first inner conductor section. The first weld segment is cylindrical and includes a central recess and a closed outer peripheral wall portion surrounding the central recess.

[0010] The second weld segment may be cylindrical or frustoconical.

[0011] The central recess may be used to contain the molten solder during welding.

[0012] The solder may be a preformed solder sheet or ring, a solder paste, or a solder wire.

[0013] The height of the outer peripheral wall portion may be designed to be sufficient to prevent the molten solder from overflowing from the central recess.

[0014] The outer peripheral wall portion may be provided with an opening for allowing insertion of the second weld segment of the second inner conductor section.

[0015] The opening may be provided in a central region of the height of the outer peripheral wall portion.

[0016] The cross-sectional profile of the second weld segment may match the shape of the opening.

[0017] An end of the second weld segment may be provided with a vertically-through cutout.

[0018] An end of the second weld segment may be provided with two through cutouts perpendicular to each other.

[0019] An end of the second weld segment may be provided with a through cutout and a through hole perpendicular to each other.

[0020] The second weld segment may be provided with a recessed portion on the center of an end surface thereof and one or more through holes perpendicular to and across the recessed portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] These and other aspects of the present disclosure will be better understood after a reading of the followed detailed description together with the attached drawings wherein:

[0022] Figs.1a and 1b are a perspective view and a sectional view of the conventional angle connector;

[0023] Figs.2a and 2b are a perspective view and a sectional view of an angle connector according to an embodiment of the present disclosure;

[0024] Fig. 3 is a perspective view of a first inner conductor section according to an embodiment of the present disclosure;

[0025] Fig. 4 is a perspective view of a second inner conductor section according to an embodiment of the present disclosure;

[0026] Figs. 5-7 are perspective views of a second inner conductor sections according to alternative embodiments of the present disclosure.

DETAILED DESCRIPTION

[0027] The present disclosure will be described as follows with reference to the accompanying drawings, in which several embodiments of the present disclosure are shown. However, it is to be understood that the present disclosure may be embodied in many different forms and should not be limited to the embodiments that are described herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. It will also be appreciated that the embodiments disclosed herein can be combined in any way to provide many additional embodiments.

[0028] It should be understood that, in all the drawings, the same reference signs present the same elements. In the figures, the size of certain features may be modified for clarity.

[0029] It should be understood that the terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present disclosure. Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. Well-known functions or constructions may not be described in detail for brevity and/or clarity.

[0030] As used herein, the singular forms “a/an”, “said” and “the” are intended to

include the plural forms as well, unless the context clearly indicates otherwise. The terms “comprising”, “encompassing” and “containing” when used in this specification, specify the presence of stated features, but do not preclude the presence of one or more other features. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items. As used herein, phrases such as “between X and Y” and “between about X and Y” should be interpreted to include X and Y. As used herein, phrases such as “between about X and Y” mean “between about X and about Y”. As used herein, phrases such as “from about X to Y” mean “from about X to about Y.”

[0031] In the specification, when one element is referred to as being “on” another element, “attached to” another element, “connected” to another element, “coupled” to another element, or “in contact with” another element, the element may be directly located on another element, attached to another element, linked to another element, or in contact with another element, or there may be present with an intermediate element. By contrast, where one element is referred to as being “directly” on another element, “directly attached to” another element, “directly connected to” another element, “directly coupled” to another element, or “in direct contact with” another element, there will not be present with an intermediate element. In the specification, where one feature is arranged to be “adjacent” to another feature, it may mean that one feature has a portion that overlaps with an adjacent feature or a portion that is located above or below an adjacent feature.

[0032] Spatially relative terms, such as “above”, “below”, “left”, “right”, “front”, “back”, “high”, “low” and the like, may be used herein to describe one feature's relationship to another feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in

use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is inverted, features described as “under” or “beneath” other features would then be described as “over” the other features. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the descriptors of relative spatial relationships used herein shall be interpreted accordingly.

[0033] As shown in Figs. 2a and 2b, the angled RF coaxial connector 1 according to an embodiment of the present disclosure comprises an outer body 10 and an inner conductor 20 disposed in the outer body 10. The outer body 10 is made of a conductive metal material and is L-shaped, and includes a cylindrical first outer body section 11 and a second outer body section 12 that are perpendicular to each other. The first outer body section 11 and the second outer body section 12 may be integrally formed, or may be formed separately and fixed together by known connecting means, such as the mating threads shown herein.

[0034] The inner conductor 20 is made of a conductive metal material and is L-shaped. Correspondingly, the inner conductor 20 comprises a first inner conductor section 21 and a second inner conductor section 22 perpendicular to each other. The first inner conductor section 21 is disposed in the first outer body section 11, and the second inner conductor section 22 is disposed in the second outer body section 12. An opening 10a is provided on the first outer body section 11 and is located above the joint of the first inner conductor section 21 and the second inner conductor section 22. As shown in Fig. 2b, the opening 10a is closed by an end cap 10b. The first inner conductor section 21 and the second inner conductor section 22 can be welded together by passing a welding device through the opening 10a, as described in detail below. After the welding is completed, the opening 10a is closed by the end cap 10b.

[0035] A first dielectric spacer 31 is arranged in the first outer body section 11 and electrically isolates the first outer body section 11 from the first inner conductor section 21. A central hole 31a of the first dielectric spacer 31 mechanically supports the first inner conductor section 21 and aligns the central axes of the first inner conductor section 21 and the first outer body section 11. A second dielectric spacer 32 is arranged in the second outer body section 12 and electrically isolates the second outer body section 12 from the second inner conductor section 22. A central hole 32a of the second dielectric spacer 32 mechanically supports the second inner conductor section 22 and aligns the central axes of the second inner conductor section 22 and the second outer body section 12.

[0036] As shown in Fig. 3, the first inner conductor section 21 is elongated and cylindrical, and one end of the first inner conductor section 21 is configured to be electrically connected to an inner conductor of a mating coaxial connector, while the other end thereof is provided with a first weld segment 211 welded to the second inner conductor section 22. The first weld segment 211 is cylindrical, and includes a central recess 212 and a closed outer peripheral wall portion 213 surrounding the central recess 212. The central recess 212 is used to contain the molten solder (e.g., a preformed solder sheet or ring, a solder paste, a solder wire, etc.) during welding, and the height of the outer peripheral wall portion 213 is designed to be sufficient to prevent the molten solder from overflowing from the central recess 212. The outer peripheral wall portion 213 is provided with an opening 214 for allowing the second inner conductor section 22 to be inserted for welding. In one embodiment, the opening 214 is provided in a central region of the height of the outer peripheral wall portion 213.

[0037] As shown in Fig. 4, the second inner conductor section 22 is elongated and

cylindrical, and one end of the second inner conductor section 22 is configured to be electrically connected to an inner conductor of a coaxial cable, while the other end thereof is provided with a second weld segment 221 welded to the first inner conductor section 21. The second weld segment 221 may be in the shape of a chamfered cylinder or a truncated cone. The cross-sectional profile of the second weld segment 221 matches the shape of the opening 214 so that an operator can insert the second weld segment 221 into the recess 212 through the opening 214 and close the opening 214.

[0038] As shown in Fig. 4, an end of the second weld segment 221 is provided with a vertically-through cutout 222 so as to facilitate the solder to enter the bottom space of the central recess 212 from above through the cutout 222 and facilitate the gas and the solder slag in the bottom space to be discharged from the central recess 212 during welding, thereby ensuring 360-degree reliable welding and that the welding spot structure can be easily controlled. In another embodiment, as shown in Fig. 5, the end of the second weld segment 221 may be provided with two through cutouts 222' perpendicular to each other, so that there is no need to adjust the axial direction of the cutouts when the second weld segment 221 is inserted into the central recess 212. In another embodiment, as shown in Fig. 6, the end of the second weld segment 221 may be provided with a through cutout 222'' and a through hole 223'' perpendicular to each other. In another embodiment, as shown in Fig. 7, it is also possible to provide a recess 222''' on the center of the end surface of the second weld segment 221 and one or more through holes 223''' perpendicular to and across the recess 222'''. The steps of assembling the angled RF coaxial connector 1 will be described below. First, the first inner conductor section 21 and the second inner conductor section 22 are inserted into the central hole 31a of the first dielectric layer 31 and the central hole 32a of the second

dielectric layer 32, respectively. Then, the first dielectric layer 31 together with the first inner conductor section 21 is inserted into the first outer body section 11, and the second dielectric layer 32 together with the second inner conductor section 22 is inserted into the second outer body section 12. The operator observes the weld segment 211 of the first inner conductor section 21 and the weld segment 221 of the second inner conductor section 22 through the opening 10a of the first outer body section 11. The end of the second weld segment 221 is inserted into the central recess 212 through the opening 214 of the first weld segment 211, and the direction of the cutout 222 of the second weld segment 221 is adjusted so that a longitudinal axis of the cutout 222 is parallel to a central axis of the first weld segment 211. Subsequently, the molten solder is loaded into the central recess 212 by a welding device (such as a resistance or an automatic induction welding device) until the solder fills up the central recess 212. After the solder is cooled, the first inner conductor section 21 will be firmly fixed to the second inner conductor section 22.

[0039] Although exemplary embodiments of this disclosure have been described, those skilled in the art should appreciate that many variations and modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this disclosure. Accordingly, all such variations and modifications are intended to be included within the scope of this disclosure as defined in the claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.

CLAIMS

1. An angled RF coaxial connector with a two-piece type inner conductor, comprising:

an outer body;

an inner conductor disposed in the outer body, the inner conductor comprising a first inner conductor section and a second inner conductor section that are perpendicular to each other, the first inner conductor section being provided at one end thereof with a first weld segment welded to the second inner conductor section, and the second inner conductor section being provided at one end thereof with a second weld segment welded to the first inner conductor section,

wherein the first weld segment is cylindrical and includes a central recess and a closed outer peripheral wall portion surrounding the central recess.
2. The angled RF coaxial connector according to claim 1, wherein the second weld segment is cylindrical or frustoconical.
3. The angled RF coaxial connector according to claim 1, wherein the central recess is configured to receive the molten solder during welding.
4. The angled RF coaxial connector according to claim 3, wherein the solder is a preformed solder sheet or ring, a solder paste, or a solder wire.
5. The angled RF coaxial connector according to claim 1, wherein the height of the outer peripheral wall portion is configured to be sufficient to prevent the molten solder from overflowing from the central recess.
6. The angled RF coaxial connector according to any one of claims 1 to 5, wherein

the outer peripheral wall portion is provided with an opening for allowing insertion of the second weld segment of the second inner conductor section.

7. The angled RF coaxial connector according to claim 6, wherein the opening is provided in a central region of the height of the outer peripheral wall portion.

8. The angled RF coaxial connector according to claim 6, wherein the cross-sectional profile of the second weld segment matches the shape of the opening.

9. The angled RF coaxial connector according to any one of claims 1 to 5, wherein an end of the second weld segment is provided with a through cutout.

10. The angled RF coaxial connector according to any one of claims 1 to 5, wherein an end of the second weld segment is provided with two through cutouts perpendicular to each other.

11. The angled RF coaxial connector according to any one of claims 1 to 5, wherein an end of the second weld segment is provided with a through cutout and a through hole perpendicular to each other.

12. The angled RF coaxial connector according to any one of claims 1 to 5, wherein the second weld segment is provided with a recessed portion on the center of an end surface thereof and one or more through holes perpendicular to and across the recessed portion.

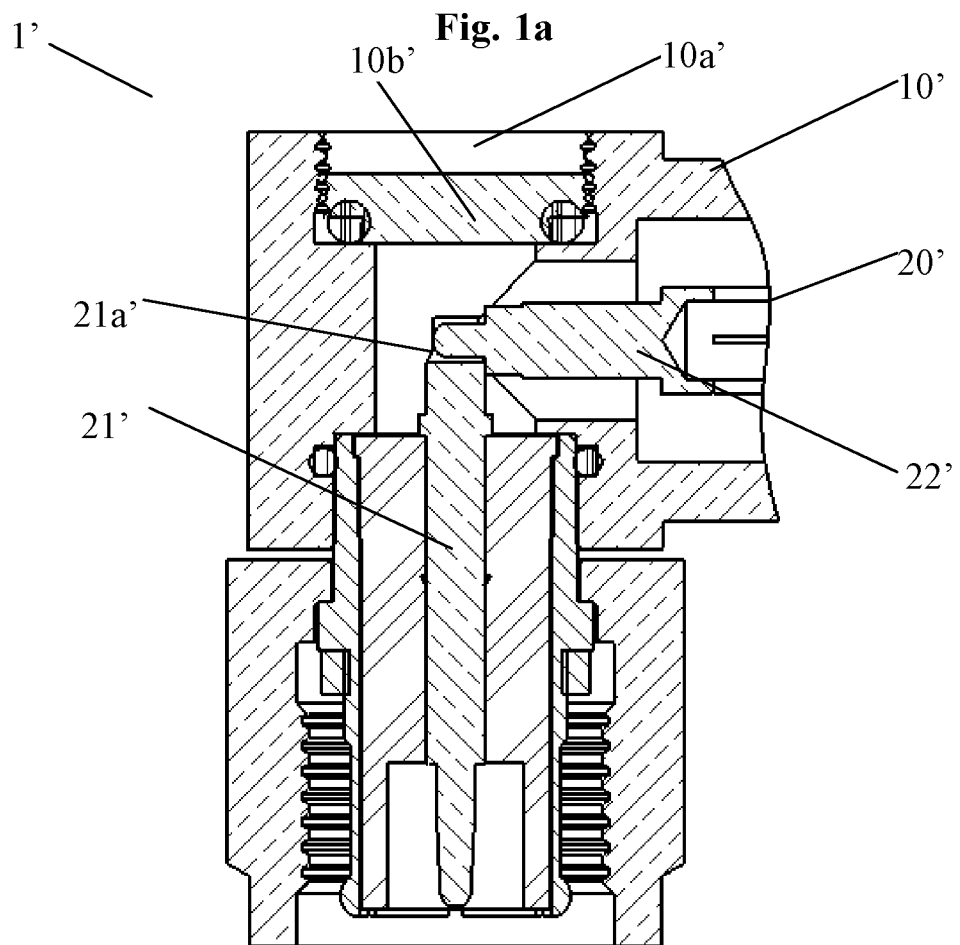
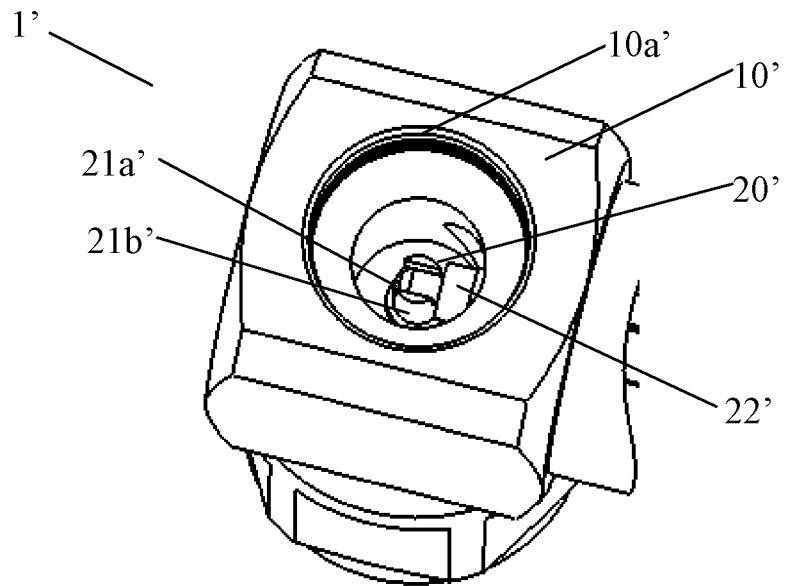


Fig. 1b

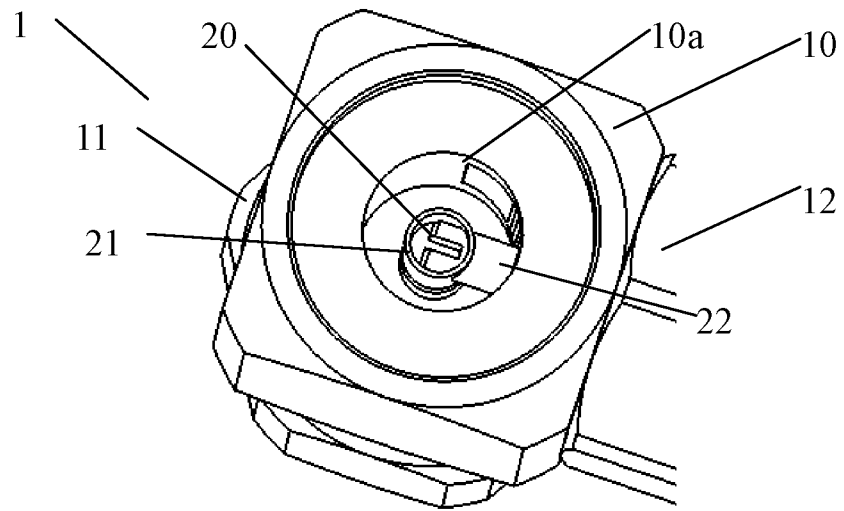


Fig. 2a

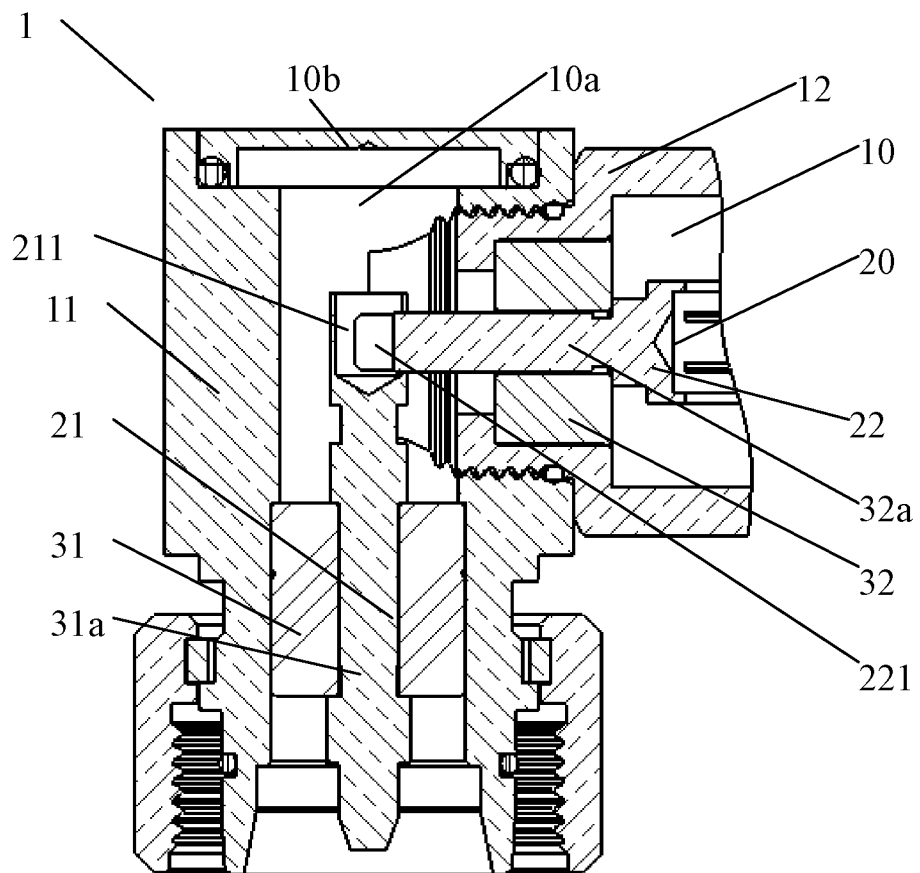


Fig. 2b

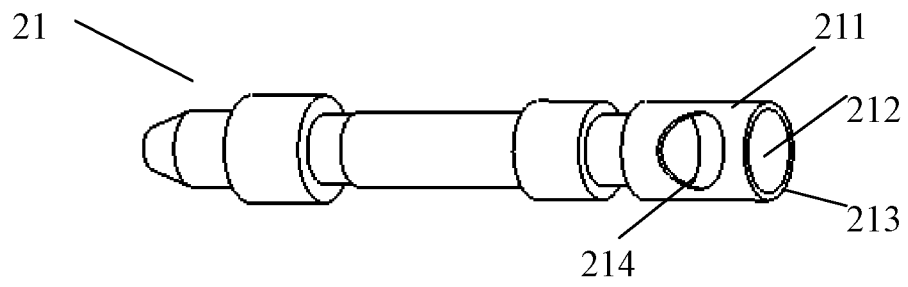


Fig. 3

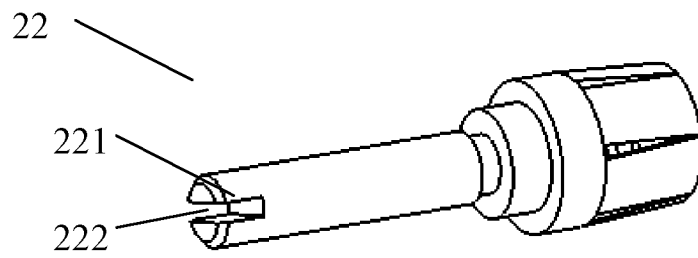


Fig. 4

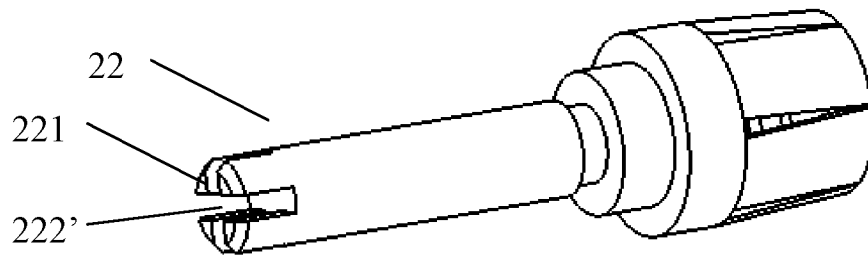


Fig. 5

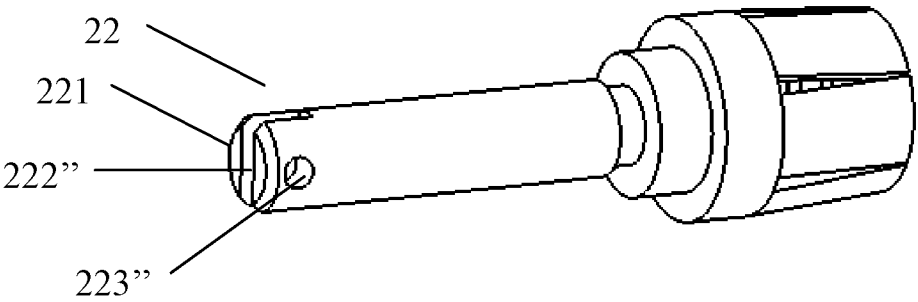


Fig. 6

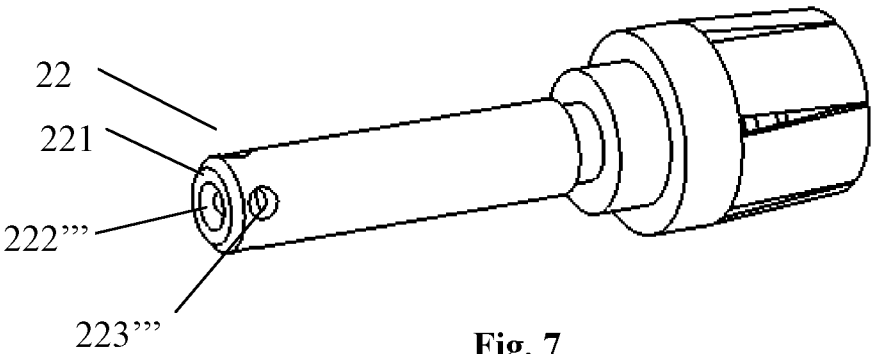


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/017411**A. CLASSIFICATION OF SUBJECT MATTER****H01R 9/05(2006.01)i, H01R 24/38(2011.01)i, H01R 103/00(2006.01)n**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01R 9/05; H01R 13/627; H01R 24/54; H01R 24/38; H01R 103/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: coaxial, perpendicular, weld, recess, opening

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004-0137790 A1 (JOON LEE et al.) 15 July 2004 See paragraphs [0011]-[0021], claims 1-3 and figures 1-4.	1-12
A	US 2015-0280374 A1 (MEGAPHASE, LLC) 01 October 2015 See paragraphs [0027]-[0032], claim 11 and figures 1-4.	1-12
A	US 2007-0004277 A1 (EBBE K. PETERSEN et al.) 04 January 2007 See paragraphs [0016]-[0024] and figures 1-3.	1-12
A	US 6361348 B1 (JOHN WESLEY HALL et al.) 26 March 2002 See column 3, line 60 - column 5, line 34 and figures 2-7.	1-12
A	US 6287144 B1 (JEAN-MARC BAFFERT) 11 September 2001 See claims 1-5 and figures 1-6.	1-12



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search

30 May 2019 (30.05.2019)

Date of mailing of the international search report

30 May 2019 (30.05.2019)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

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Authorized officer

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Telephone No. +82-42-481-8405



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2019/017411

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