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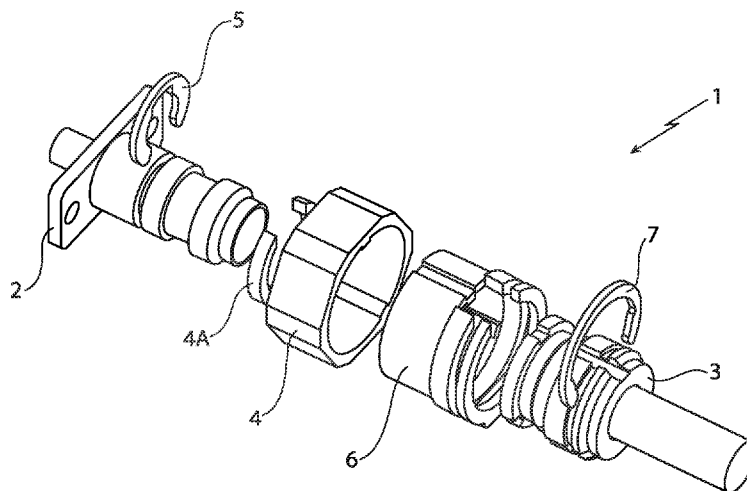


FIG. 2

(57) Abstract: The present invention concerns a connection group (1) including a first connector (2) and a second connector (3) designed to be coupled with each other. The connection group (1) includes also a first bushing (4) rotatably mounted on the first connector (2) by means of a first retaining ring (5), whereby the first bushing (4) is rotatable around a longitudinal axis of the first connector (2). Said first bushing (4) comprises internal teeth mutually arranged according to a given angular configuration. The second connector (3) is equipped with a second bushing (6) that is fixedly mounted on said second connector (3) by means of a second retaining ring (7) and through an internal groove profile, whereby the second connector (3) and the second bushing (6) are fixed to each other; said second bushing (6) having external slots arranged according to the given angular configuration, whereby said external slots of the second bushing (6) correspond to the internal teeth of the first bushing (4). The first connector (2) and the second bushing (6) are designed to

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be inserted, respectively, in the second connector (3) and the first bushing (4). The first bushing (4) is designed to be rotated around the longitudinal axis, thereby rotating also the second bushing (6) and the second connector (3) that is screwed around the first connector (2), whereby complete connection/coupling of the first and second connectors (2, 3) is achieved. The first and the second bushings are marked with one and the same graphical symbol and/or one and the same respective color.

INNOVATIVE CONNECTION MEANS FOR RF CONNECTORS, IN
PARTICULAR TNC CONNECTORS

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This Patent Application claims priority from Italian Patent Application No. 102023000011964 filed on June 12, 2023, the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD OF THE INVENTION

10 The present invention relates, in general, to radiofrequency (RF) connectors and, in particular, to TNC connectors.

STATE OF THE ART

15 Nowadays, radiofrequency (RF) connection through TNC (i.e., "Threaded Neill-Concelman") connectors is consolidated and used in every system that requires a connection to a transceiver.

20 However, with reference to the TNC connectors, it is worth noting that any coaxial cable fitted with a TNC connector can be coupled with any mating connector, even a wrong one. Thence, whenever the number of cables becomes high, the probability of cable mismating increases.

25 In this connection, US 4 111 514 A, which relates to a polarizing keying device for electrical connectors, discloses a device for discretely keying first and second matable connectors to prevent unintended mismating where a plurality of such connectors are located in the same
30 vicinity, said first matable connector including a first body shell with first external surface engagement means and said second matable connector including a rotatable captive second body shell extending axially over said first body shell during mating of said connectors, said second body
35 shell including second engagement means on the inside surface thereof for securing said first and second connectors in the

mated position, comprising: first means comprising a plurality of axial grooves within the external surface of said second body shell, said grooves having a discrete predetermined circumferential spacing; an annular channel within the external surface of said second body shell behind said grooves; second means comprising a key member surrounding and rotatable relative to said first body shell, said key member having an inside diameter greater than the outside diameter of said second body shell and a plurality of radially inwardly directed keys at the front of said key member spaced to correspond to said axial grooves in said second body shell and to engage said grooves when said connectors are mated and to prevent axial mating of said connectors if said grooves and keys do not correspond for at least one rotational relationship between said second body shell and said key member; means for restricting rotation of said key member relative to said first body shell; and said keys being positioned in said channel during mating of said first and second connectors to allow rotation of said second body shell relative to said first body shell.

Moreover, WO 2012/027381 A1 discloses a polarized shell for preventing coaxial connector mis-mating and US 4 229 064 A discloses polarizing adapter sleeves for electrical connectors.

OBJECT AND SUMMARY OF THE INVENTION

The Applicant has felt the need to solve the problem of potential mismating of cables equipped with TNC connectors, thereby achieving the present invention.

Therefore, an object of the present invention is that of providing a solution to the problem of potential mismating of cables equipped with TNC connectors.

This and other objects are achieved by the present invention in that it relates to a connection group, as defined in the appended claims.

In particular, the connection group according to the

present invention includes a first connector and a second connector designed to be coupled with each other. The connection group includes also a first bushing rotatably mounted on the first connector by means of a first retaining ring, whereby the first bushing is rotatable around a longitudinal axis of the first connector. Said first bushing comprises internal teeth mutually arranged according to a given angular configuration. The second connector is equipped with a second bushing that is fixedly mounted on said second connector by means of a second retaining ring and through an internal groove profile, whereby the second connector and the second bushing are fixed to each other; said second bushing having external slots arranged according to the given angular configuration, whereby said external slots of the second bushing correspond to the internal teeth of the first bushing. The first connector and the second bushing are designed to be inserted, respectively, in the second connector and the first bushing. The first bushing is designed to be rotated around the longitudinal axis, thereby rotating also the second bushing and the second connector that is screwed around the first connector, whereby complete connection/coupling of the first and second connectors is achieved. The first and the second bushings are marked with one and the same graphical symbol (e.g., colored graphical symbol) and/or one and the same color.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, preferred embodiments, which are intended purely by way of non-limiting, non-binding examples, will now be described with reference to the attached drawings (all not to scale), wherein:

- Figures 1-6 illustrate a connection group including a TNC connector and a mating connector designed to be coupled with each other by means of univocal coupling means according to an embodiment of the present invention;

- Figure 7 shows a predefined table of colors and/or graphic symbols;

- Figures 8 and 9 illustrate, respectively, a standard TNC connector mounted on an equipment and a TNC connector customized according to an embodiment of the present invention and mounted on an equipment;

- Figure 10 shows one possible set of couplings according to an aspect of the present invention.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The following description is presented to enable a person skilled in the art to comprehend, make and use the invention. Various modifications to the embodiments will be readily apparent to those skilled in the art, without departing from the scope of the present invention as claimed. Thence, the present invention is not intended to be limited to the embodiments shown and described, but is to be accorded the widest scope of protection consistent with the features defined in the appended claims.

Figures 1-6 illustrate a connection group 1 including a TNC connector 2 and a mating connector 3 designed to be coupled with each other by means of univocal coupling means according to an embodiment of the present invention.

In particular, Figures 1, 2 and 3 are, respectively, a first perspective view, an exploded view and a second perspective view of the connection group 1, Figure 4 shows a longitudinal section of the connection group 1, Figure 5 is a perspective view of a first mechanical bushing 4 belonging to the univocal coupling means, and Figure 6 shows a cross-section of the connection group 1.

The TNC connector 2 is equipped with the first bushing 4 longitudinally fixed to, and rotatably mounted on, said TNC connector 2 by means of a first retaining ring (or seeger) 5. Therefore, the first bushing 4 is free to rotate around a longitudinal axis of the TNC connector 2 (instead, longitudinal movements of the first bushing 4 are prevented).

The first bushing 4 has an internal teeth profile preferably including two or three teeth mutually arranged according to a given angular configuration. Moreover, the first bushing 4 includes a round slot 4A to accommodate the first retaining ring 5.

The mating connector 3 is equipped with a second mechanical bushing 6 that is rigidly mounted on the mating connector 3 through a standard internal groove profile and a second retaining ring (or seeger) 7. Thence, the mating connector 3 and the second bushing 6 are fixed to each other. Externally, the second bushing 6 has several slots, preferably two or three slots, arranged according to the given angular configuration, whereby said external slots of the second bushing 6 correspond to the internal teeth of the first bushing 4.

In order to couple the TNC connector 2 with the mating connector 3, the second bushing 6 is inserted in the first bushing 4 while the TNC connector 2 is inserted in the mating connector 3. Then, the first bushing 4 is rotated around the longitudinal axis (namely, it is screwed on the second bushing 6), thereby rotating also the second bushing 6 and the mating connector 3 that is screwed around the TNC connector 2, whereby complete connection/coupling is achieved.

It is worth noting that, for a generic TNC connector fitted with a TNC bushing, only the mating connector fitted with a corresponding bushing can be correctly coupled with said TNC connector.

In particular, with reference to Figure 3, in order to facilitate an operator who has to couple TNC connectors with corresponding mating connectors, each pair of corresponding bushings is marked by the same respective color and/or graphic symbol (or colored graphic symbol) according to a predefined table of colors and/or graphic symbols like the one shown in Figure 7, wherein each graphic symbol is made up of at least one line and, in some cases, also one or more

dots properly colored. Thence, in order to recognize a correct bushing pair, an operator recognizes firstly the same color, then the same graphic symbol(s); so, he/she can easily connect/couple two corresponding bushings.

5 The present invention solves the problem of mismating in RF connections, in particular when the number of TNC connectors becomes large. It is worth noting that, in the foregoing, the present invention has been described by making explicit reference to TNC connections, it being understood
10 that what the present invention teaches can be advantageously exploited, mutatis mutandis, with other types of connections.

The solution according to the present invention does not require any modifications to standard connectors.

15 The first and second retaining rings 5, 7 guarantee the correct mounting of the two bushings 4, 6. The first bushing 4 is able only to rotate about the TNC connector's axis, through a specific slot 4A provided on the first bushing (in this connection reference can be made to Figures 5 and 6).
20 Preferably, the internal diameter of the first bushing 4 is increased to allow the rotation of said first bushing 4 without any interferences.

The solution according to the present invention is safe because every component of the connection group 1 is mounted
25 so as not to be lost for vibrations, because each retaining ring 5, 7 is designed to maintain its contact with the shaft where it is mounted on, even during vibrations.

The connectors according to the present invention can be advantageously exploited on any existing equipment because
30 they have identical electrical and mechanical (mounting holes/screws, etc.) interfaces.

In this respect, Figure 8 shows a standard TNC connector mounted on an equipment, while Figure 9 shows a TNC connector customized according to the present invention and mounted on
35 an equipment. The customized TNC connector does not have electrical or mechanical impacts on internal connection to

PCB ("Printed Circuit Board") or other interfaces, while externally it has a minimal increase in length and a standard slot for the retaining seeger.

By varying number and angular configuration of the teeth of the first bushing 4, the number of possible couplings dramatically increases. Figure 10 shows one possible set of couplings, with three teeth and various angles combinations. The set of couplings can be modified also increasing the numbers of the combinations.

The TNC connector is customized in its dimensions, while maintaining its standard TNC interface; moreover, the mating connector is customized without modification on its electro-mechanical interface. Since the bushings are externally mounted, they do not modify the standard mechanical interface connection between TNC connector and its mating. So, without bushings, the connection can be carried out normally, with the standard TNC-mating.

New projects require a higher number of RF connections and incorrect mating connections are more frequent. The custom TNC connectors according to the present invention can be implemented on new products with a minimal impact on the development route. At the same time, they can easily substitute the present connectors currently mounted on existing equipment, being the internal side of the TNC connectors unmodified, and the customization only external.

The invention can be used on every equipment that require an RF connection and it can substitute the already existing components without any impacts.

As for the prior art solutions, it is worth noting that that one according to US 4 111 514 A, once a cable is assembled, does not allow the keys to be changed unless the entire cable is replaced.

The solution according to WO 2012/027381 A1 requires N connectors and N cables for each polarization key, which fact is expressly avoided by the present invention.

Also with the solution according to US 4 229 064 A, once

a cable is assembled, it is not possible to modify it.

In summary, the present invention is based on flexibility; in fact, differently from prior art solutions, the present invention allows to modify the key, both on the
5 cable and on the device connector, without their complete replacement and therefore with zero impact on the systems that use them.

In conclusion, it is clear that numerous modifications and variants can be made to the present invention, all
10 falling within the scope of the invention, as defined in the appended claims.

In this connection, it is worth noting that, although the present invention has been described with explicit reference to TNC connections, it can be advantageously
15 exploited for any connection of the RF type or the like.

CLAIMS

1. Connection group (1) including a first connector (2) and a second connector (3) designed to be coupled with each other;

5 wherein the connection group (1) includes also a first bushing (4) rotatably mounted on the first connector (2) by means of a first retaining ring (5), whereby the first bushing (4) is rotatable around a longitudinal axis of the first connector (2);

10 wherein said first bushing (4) comprises internal teeth mutually arranged according to a given angular configuration;

wherein the second connector (3) is equipped with a second bushing (6) that is fixedly mounted on said second connector (3) by means of a second retaining ring (7) and through an internal groove profile, whereby the second connector (3) and the second bushing (6) are fixed to each other; said second bushing (6) having external slots arranged according to the given angular configuration, whereby said external slots of the second bushing (6) correspond to the internal teeth of the first bushing (4);

wherein the first connector (2) and the second bushing (6) are designed to be inserted, respectively, in the second connector (3) and the first bushing (4);

25 wherein the first bushing (4) is designed to be rotated around the longitudinal axis, thereby rotating also the second bushing (6) and the second connector (3) that is screwed around the first connector (2), whereby complete connection/coupling of the first and second connectors (2, 3) is achieved;

wherein the first and the second bushings are marked with on and the same graphical symbol and/or one and the same respective color.

2. The connection group (1) of claim 1, wherein the first (4) and the second bushings (6) are designed so as to be coupled with different types of TNC or radiofrequency

connectors without requiring any modification to said first (4) and said second bushings (6), nor to said TNC/radiofrequency connectors.

3. Connection system comprising a plurality of
5 connection groups (1) as claimed in claim 1 or 2, wherein each connection group (1) includes a first bushing (4) and a second bushing (6) that are associated with one and the same graphical symbol and/or one and the same color that is/are different from the respective graphical symbols
10 and/or the respective colors associated with first and second bushing (4, 6) of the other connection groups, whereby connector mismatching is avoided thanks to the different graphical symbols/colors associated with the first and second bushings (4, 6) belonging to different connection
15 groups.

4. Method for connecting a couple of connectors, including:

- a) providing a first connector (2) and a second connector (3) designed to be coupled with each other;
- 20 b) providing a first bushing (4), a second bushing (6), a first retaining ring (5) and a second retaining ring (7), wherein said first bushing (4) comprises internal teeth mutually arranged according to a given angular configuration; wherein the second bushing (6) has external
25 slots arranged according to said given angular configuration, whereby said external slots of the second bushing (6) correspond to the internal teeth of the first bushing (4); wherein said second bushing (6) has an internal groove profile designed so as to fix the second bushing (6)
30 around the second connector (3);
- c) coupling the first bushing (4) with the first connector (2) by rotatably mounting the first bushing (4) on the first connector (2) by means of the first retaining ring (5), so that the first bushing (4) is rotatable around a
35 longitudinal axis of the first connector (2);
- d) coupling the second bushing (6) with the second

connector (3) by fixedly mounting the second bushing (6) on the second connector (3) by means of the second retaining ring (7) and the internal groove profile;

5 e) inserting the first connector (2) in the second connector (3) while inserting the second bushing (6) in the first bushing (4);

10 f) rotating the first bushing (4) around the longitudinal axis, thereby rotating also the second bushing (6) and the second connector (3) that is screwed around the first connector (2), whereby complete connection/coupling of the first and second connectors (2,3) is achieved.

5. Method for connecting several couples of connectors, including:

15 • providing a plurality of bushings identified, each, by respective graphical symbol and/or color and having the same features as the first and second bushings (4, 6) defined in the step b) of the method as claimed in claim 4;

• selecting a couple of bushings with the same graphical symbol and/or color; and,

20 • for each couple of connectors to be connected, carrying out the steps c)-f) of the method as claimed in claim 4.

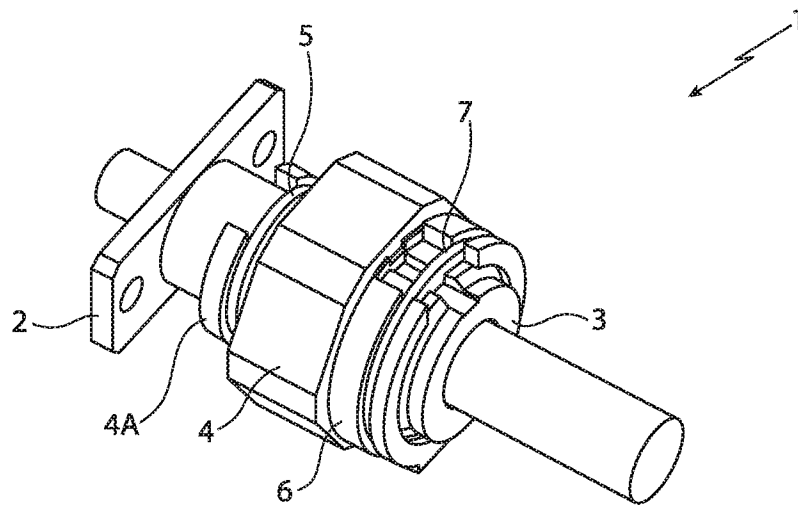


FIG. 1

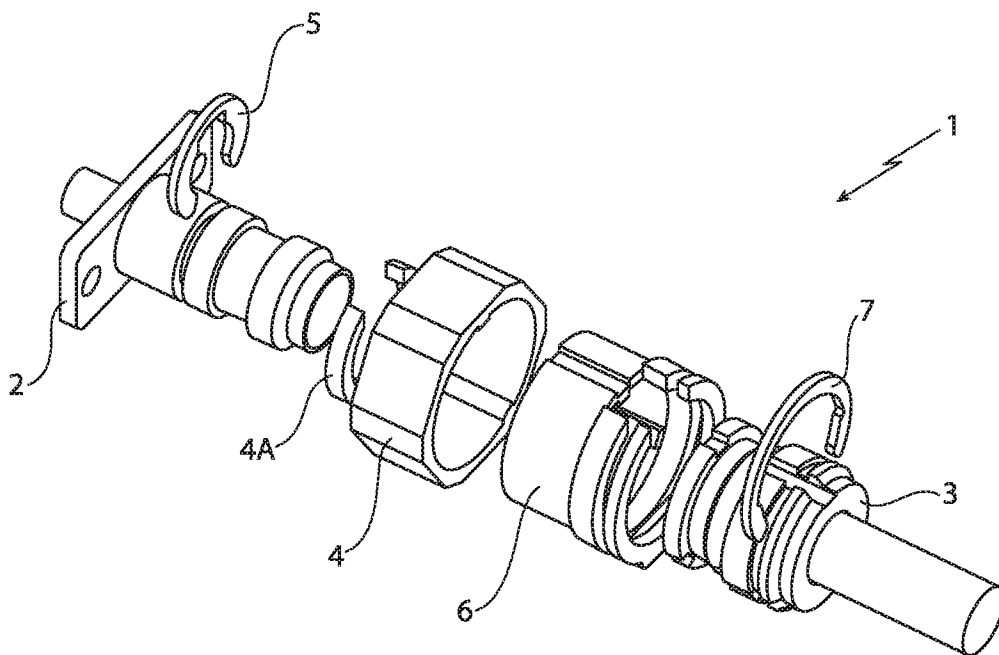


FIG. 2

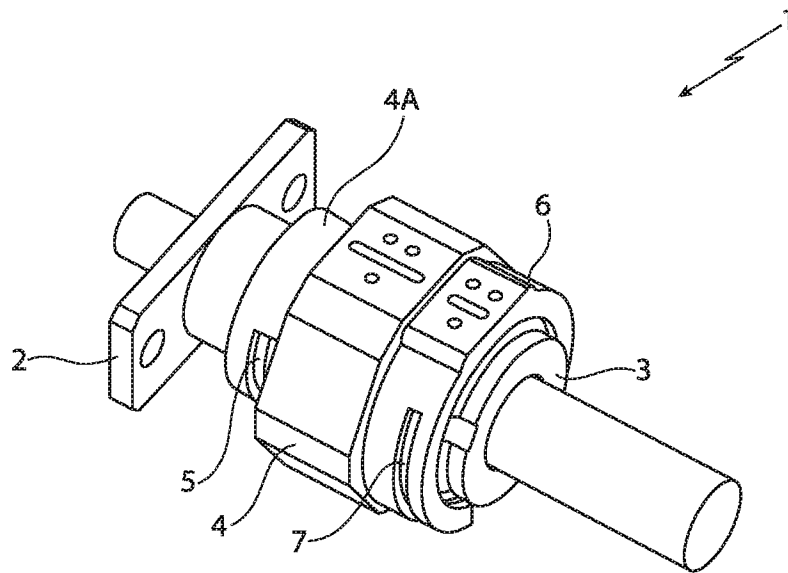


FIG. 3

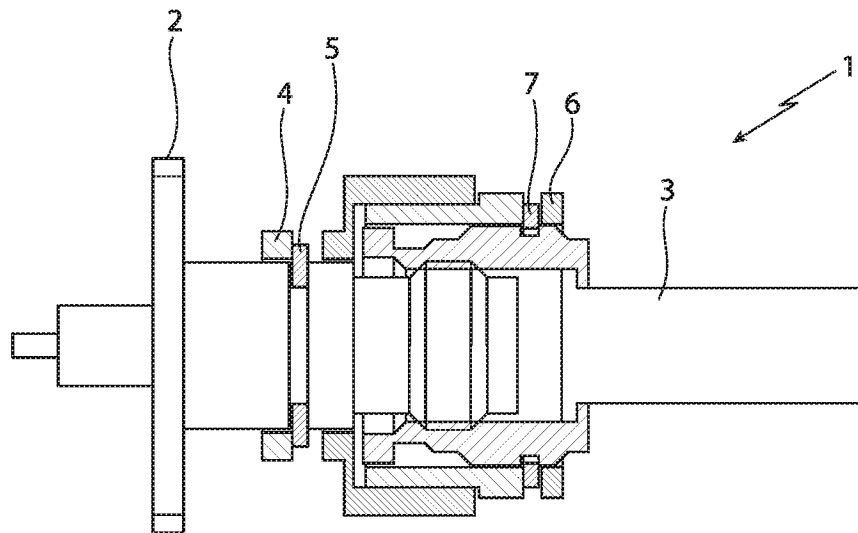


FIG. 4

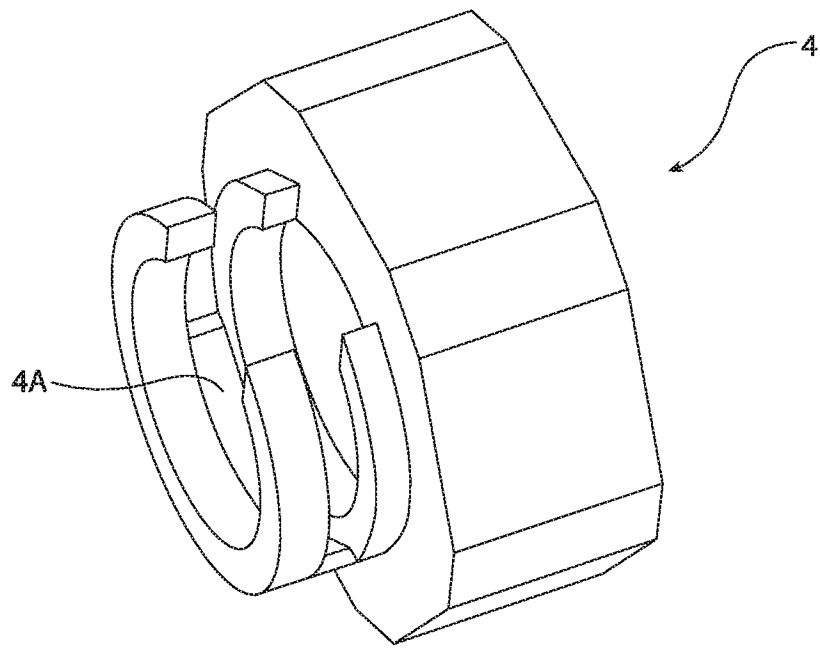


FIG. 5

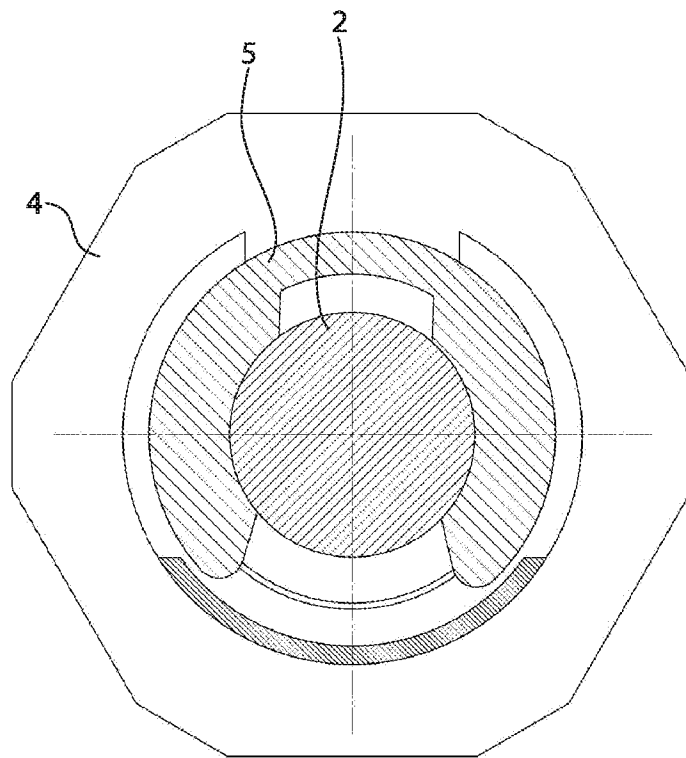


FIG. 6

		LINE	DOT – LINE	LINE – DOT	DOT – LINE – DOT	DOT – LINE – DOUBLE DOT	DOUBLE DOT – LINE – DOT	DOUBLE DOT – LINE – DOUBLE DOT
RED		—	·—	—·	·—·	—·:	·:·	·:·:
WHITE			·	·	· ·	·:	·:	·: :
BLACK			·	·	· ·	·:	·:	·: :
YELLOW								
GREEN			·	·	· ·	·:	·:	·: :
BLUE			·	·	· ·	·:	·:	·: :

FIG. 7

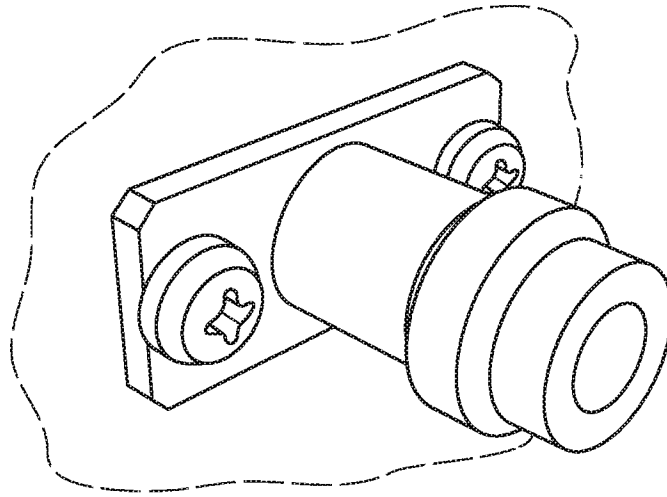


FIG. 8

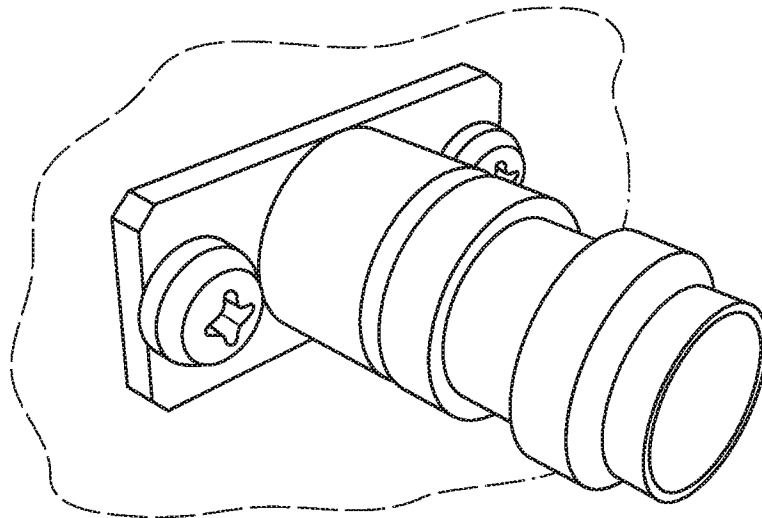


FIG. 9

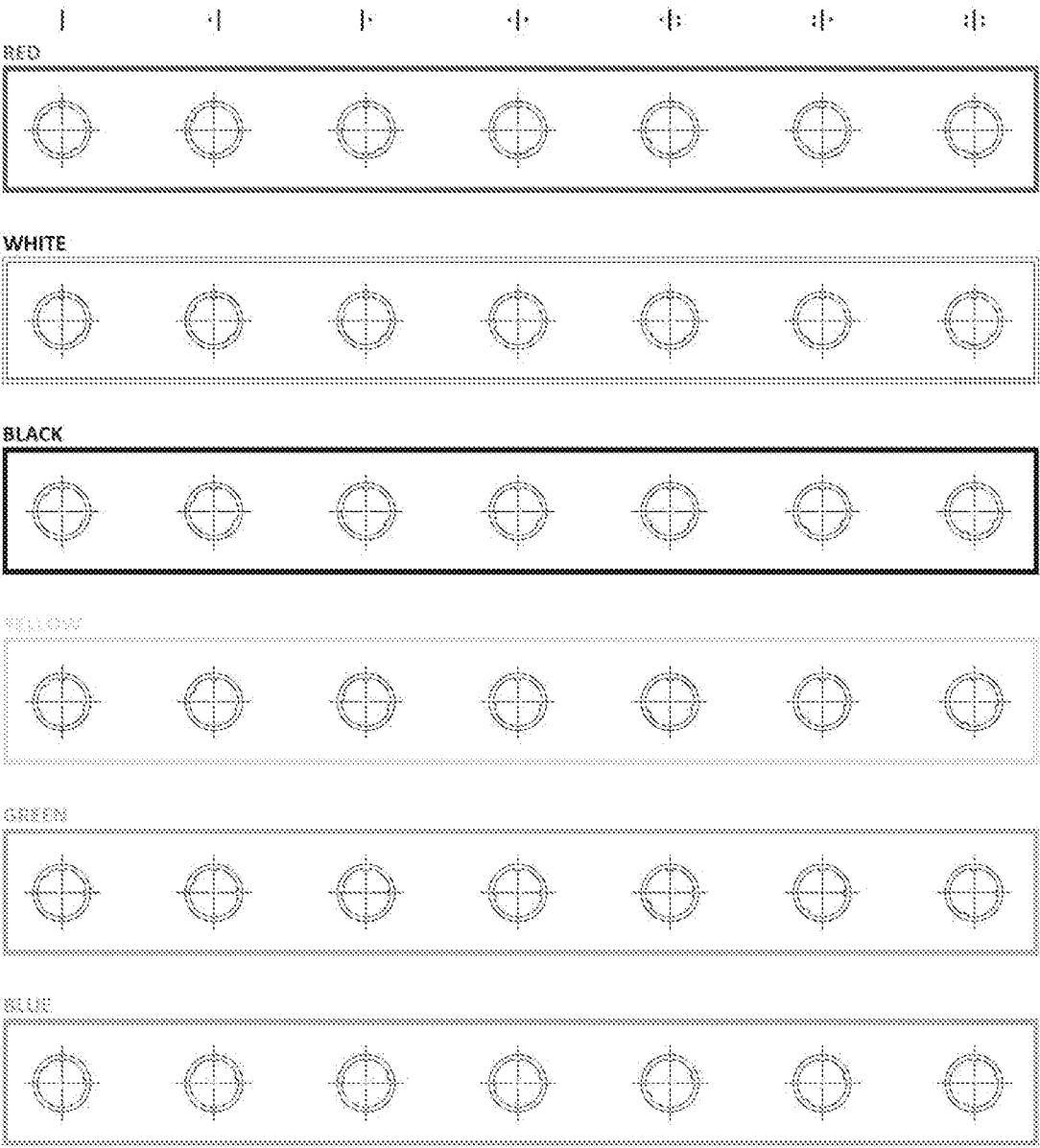


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/055745

A. CLASSIFICATION OF SUBJECT MATTER INV. H01R13/622 H01R13/645 H01R24/40 ADD. H01R13/46 H01R103/00		
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 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 111 514 A (BRISHKA ALEXANDER R ET AL) 5 September 1978 (1978-09-05)	4
Y	column 3, line 29 - column 4, line 27; figures 1,2,3,4,5 -----	1-3,5
Y	WO 2012/027381 A1 (DISTINCT INTUITIVE DESIGNS LLC [US]; KELLY MARK [US]) 1 March 2012 (2012-03-01) paragraph [0042] - paragraph [0053]; figure 8 -----	1-3,5
X	US 4 229 064 A (VETTER OTTOMAR H ET AL) 21 October 1980 (1980-10-21) column 4, line 49 - column 8, line 37; figures 1,2,4,5 -----	1,3,5
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 5 September 2024		Date of mailing of the international search report 18/09/2024
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Mateo Segura, C

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2024/055745

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4111514	A	05-09-1978	NONE	

WO 2012027381	A1	01-03-2012	US 8025536 B1	27-09-2011
			WO 2012027381 A1	01-03-2012

US 4229064	A	21-10-1980	NONE	
