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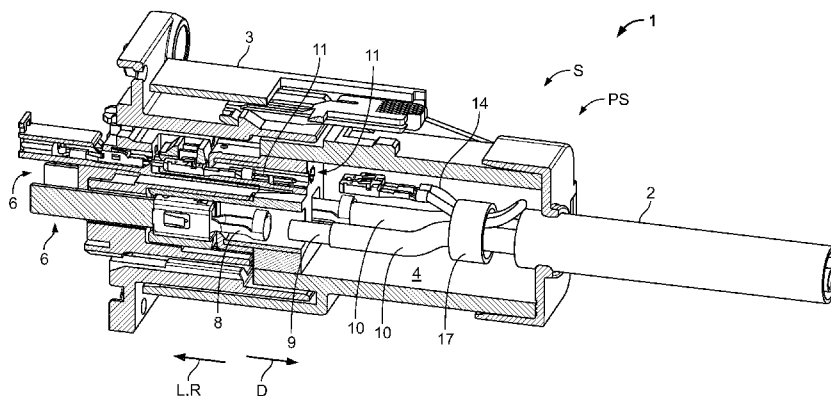


Fig. 2

(57) Abstract: The invention relates to a connector (1) for connection to a mating connector. In order to be able to detect a line (2) being pulled out of the connector (1), there is provision according to the invention for the connector (1) to have an indicator member (14) and a separation device (17), the separation device (17) being constructed so as to act mechanically on the indicator member (14) and so as to be able to be mechanically coupled to the line (2).

CONNECTOR WITH INDICATOR BODY AND SEPARATION DEVICE MOUNTABLE TO A CABLE

5 The invention relates to a connector having a connector housing in which an indicator member for error examination and at least one plug contact are arranged, the plug contact being constructed so as to be able to be assembled with a mating plug contact at the insertion side and so as to be able to be connected to a line at the connection side.

10 Connectors having indicator members are known. The indicator member of the known connectors is constructed to determine whether the connector is connected to a mating connector. To this end, for example, an electrical connection of the indicator member with plug contacts of the mating connector is queried. If the connector and mating connector are not assembled, the query of the indicator member may indicate an error state.

15 In particular, connectors of the type mentioned in the introduction are used for the transmission of the drive energy of electrically drivable vehicles. Connectors for such an application are generally suitable for conducting high electrical power levels, that is to say, high electrical currents and/or high electrical voltages. The plug contacts of such a connector are therefore generally constructed in such a manner that they can receive and
20 transmit the drive energy of a line or a mating plug contact. However, examination of the state of the connector may be desirable in many applications, for example, in data transmission, in safety-related applications and with connectors which are otherwise difficult to examine or reach.

25 With connectors, however, in addition to a disengaged plug type connection, there may be other error sources which cannot be queried or detected using the known indicator members.

30 An object of the invention is therefore to provide a connector by means of which error causes other than open plug type connections can be queried.

This object is achieved for the connector mentioned in the introduction by means of a separation device which is constructed so as to act mechanically on the indicator member and so as to be able to be mechanically coupled to the line.

In an assembled state of the connector, in which the line is connected to the plug contact at the connection side, the separation device may be mechanically coupled or secured to the line so that the separation device moves with the line. Consequently, a change of the connector into a malfunctioning state, in which the line has been at least partially pulled out of the connector housing, may influence the indicator member and be indicated thereby. In this malfunctioning state, the insertion state of the connector with a mating connector may be unimpeded. Known connectors cannot therefore indicate this malfunctioning state, but the connector according to the invention can.

The solution according to the invention may be further improved by means of different embodiments which are advantageous per se and which can be freely combined with each other. These embodiments and the advantages connected therewith are set out below, the structural measures and the effects thereof being described purely by way of example for a connector having only one indicator member and a separation device. Of course, the connector may have a plurality of indicator members and/or a plurality of separation devices.

In a first advantageous embodiment, the connector may have two indicator contacts which are arranged inside the connector housing. The indicator member and the indicator contacts may be adapted to each other in such a manner that the indicator contacts can be bridged by means of the indicator member. In particular, the indicator contacts, in an operating state of the connector in which it is connected to the line in a state ready to use, can be bridged by the indicator member.

The indicator contacts may be plug contacts which are received in the connector housing and which each have an insertion end which is orientated in an insertion direction for connection to a mating connector, and a contact end opposite the insertion end along the indicator contact for connection to the indicator member. If the plug ends of the indicator contacts are arranged in a connector face of the connector, and similarly to the plug contact can be connected to the mating connector, not only can it be determined with the connector according to the invention whether the line has been pulled out of the connector, but also whether the connector and the mating connector are assembled.

Alternatively, the indicator contacts may be arranged at ends of an indicator bridge which can be connected to the connector housing so as to be fixed in terms of movement. In this instance, the indicator member may have two connection lines. The indicator contacts do

not need to be able to be reached via the connector face in this embodiment, but may be accessible inside the connector. The connection lines may be bridged in the operating state by the indicator bridge and be released from the indicator bridge in the malfunctioning state. In order to determine the state of the connector, the connection lines extend, for example, with the line, to a control unit which can determine and output the state of the connector or initiate other steps.

In the operating state of the connector, in which the line is conductively connected to the plug contact of the connector at the connection side, the two indicator contacts can be bridged by means of the indicator member. In the malfunctioning state of the connector, in which the drive conductor, in comparison with the operating state, is at least partially pulled out of the connector housing, however, the two indicator contacts may be electrically separated from each other. In particular, it may be the case that the indicator member no longer bridges the indicator contacts in the malfunctioning state of the connector. The bridging state of the indicator contacts may be queried, for example at the insertion ends of the indicator contacts, and consequently the operating or malfunctioning state may be determined.

In the malfunctioning state, in comparison with the operating state, the line may be moved by a distance with respect to the connector housing so that the line is released from the plug contacts of the connector. This distance covered by the line relative to the connector housing may be considered to be a minimum distance which extends in a malfunctioning direction between an operating position of the line in the operating state and a malfunctioning position of the line in the malfunctioning state.

If a conductor end of the line is no longer connected to the plug contacts of the connector, short-circuits may occur inside the connector. Such short-circuits may impair the operation of a device which is connected to the connector. For example, an energy storage device of a vehicle may be short-circuited and become ignited. A risk of personal injury may further arise if the conductor end of the line is pulled out of the connector housing. The malfunctioning state may occur at the latest in this malfunctioning position in order to prevent personal injury, for example, owing to electrocution.

In order to mechanically couple the separation device to the line, the separation device may have a securing element which can be secured to the line. The separation device may thereby be coupled to the conductor so as to transmit movement or to the indicator

member so as to be fixed in terms of movement. A movement of the line can thus be transmitted to the separation device and by the separation device to the indicator member so that the change of the line is automatically transmitted to the indicator member and this is also changed from the operating state into the malfunctioning state.

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The line may, for example, be a cable which comprises at least one conductor and to the outer shape of which the securing element can be adapted. It is generally sufficient for the securing element for connection to the line to be curved in one direction, that is to say, to be shaped at least partially or completely in an annular manner or as a polygon. The securing element may also be constructed so as to be able to be readily positioned or fitted and, to this end, may be constructed so as to be open at one side, for example, in the form of a cramp.

10

In order to be able to readily secure the separation device to the line, the securing element may be constructed as a securing socket or sleeve which can be connected to the line in a positive-locking manner or in a non-positive-locking manner. For example, the securing socket or sleeve may be able to be secured to a cover of the line or to a conductor of the line. In order to connect the separation device to the line, it may be pressed or crimped, for example, onto the cover or the conductor. In particular the securing element may be constructed as a line end sleeve which can be pressed onto the line.

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Alternatively, the securing element may be constructed as a resilient ring which is resiliency expanded when the line, that is to say, the cover which is arranged around the conductor, or the conductor itself, extend together with the indicator member through the securing element. The resilient securing element may be produced, for example, from plastics material or rubber. In particular, the separation device may comprise the resilient ring. Such a resilient ring can be readily pulled onto the line and the indicator member, without tools being required, for example, for crimping.

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The indicator member may be constructed, for example, as a conductor loop whose ends conductively connect the indicator contacts to each other in the operating state. Alternatively, however, the indicator member may also have a conductive plastics material which bridges the indicator contacts in the operating state and which is produced, for example, with the connector housing by means of a multi-component injection-moulding method.

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So that the separation device can mechanically act on the indicator member, the separation device may alternatively have a lateral projection which, at least in the operating state of the conductor, overlaps with the indicator member in such a manner that the indicator member abuts the projection when changing from the operating state into the malfunctioning state. The indicator member may at least partially extend around the projection in the operating state. Owing to the lateral projection, the line may also be coupled to the indicator member so as to transmit movement by means of the separation device.

In order to prevent the indicator member from sliding off the lateral projection, the projection may have a retention recess which opens in the malfunctioning direction. The retention recess may be delimited transversely relative to the malfunctioning direction by the securing element and by a protrusion of the projection that extends in the malfunctioning direction. In order to save structural space inside the connector housing, the protrusion may form a free end of the projection.

In order to separate the indicator contacts when changing from the operating state into the malfunctioning state, however, the connection between the indicator contacts may be interrupted in another manner. For example, the indicator member may be interrupted generally in the operating state and mechanically in the malfunctioning state. To this end, the lateral projection may be formed, for example, with a cutting edge for separating the indicator member. In particular, the cutting edge may separate the indicator member when leaving the operating state or shortly thereafter. The cutting edge may be arranged so as to be directed away from the plug contact and face towards a loop end of the indicator member. Consequently, the cutting edge, in the malfunctioning direction orientated from the operating position to the malfunctioning position of the line, may be arranged at least partially upstream of the indicator member and in particular upstream of the loop end thereof. Alternatively, the indicator member may have a thin wire which bridges the indicator contacts and which, when changing into the malfunctioning state, tears off or snaps.

If the indicator member is coupled to the line so as to be able to transmit movement by means of the separation device, the indicator member may bridge the indicator contacts so as to be removable from them. To this end, the indicator member may be releasably assembled, for example, with the contact ends of the indicator contacts. If the indicator

member has to be separated in order to determine that the operating state has been left, it may be securely connected to the indicator contacts. For example, the indicator contacts may be plug type contacts which are formed at the ends of the indicator member and which are securely anchored in the connector housing.

The connector according to the invention has been described until now in an assembled state, a conductor being connected to plug contacts of the connector at the connection side in the operating state, the indicator member bridging the indicator contacts and the separation element being coupled to the conductor so as to mechanically act on the indicator member. However, the connector may also be present in a ready-to-assemble state, for example, as a construction kit, in which the conductor is not necessarily provided and at least the separation element and optionally also the indicator member may each be able to be operated separately from the connector housing. The construction kit may further contain a plurality of separation elements and/or indicator members, which can be adapted for various conductors and/or connectors.

The invention is explained below by way of example with reference to embodiments and the drawings. The various features of the embodiments may be combined independently of each other, as already set out in the individual advantageous embodiments.

In the drawings:

Figure 1 is a schematic sectioned view of a first embodiment of a connector according to the invention in an operating state;

Figure 2 is a schematic sectioned view of the connector according to the invention according to the embodiment of Figure 1 in a malfunctioning state;

Figure 3 is a schematic sectioned view of a second embodiment of the connector according to the invention in an operating state; and

Figure 4 is a schematic sectioned view of the connector according to the invention of the embodiment of Figure 3 in a malfunctioning state.

The Figures illustrate the connector according to the invention in an assembled state, a conductor being connected to plug contacts of the connector at the connection side in the operating state, the indicator member bridging the indicator contacts and the separation element being mechanically coupled to the conductor. However, the connector may also be present in a ready-to-assemble state, for example, as a construction kit, in which the conductor is not provided and at least the separation element and optionally also the

indicator member may each be able to be operated separately from the connector housing. The construction kit may further contain a plurality of separation elements and/or indicator members, which can be adapted for various conductors and/or connectors.

5 The structure and/or function of a connector according to the invention are first described with reference to the embodiment of Figure 1.

Figure 1 is a schematic, perspective sectioned view of the connector 1, the connector 1 being illustrated in the operating state B thereof in a plane which extends parallel with a longitudinal direction L of a line 2. In the operating state B, the line is arranged in an operating position PB in the connector 1.

10 The connector 1 may be constructed with a connector housing 3 which delimits a connection space 4 of the connector 1, for example, transversely relative to the longitudinal direction L. Furthermore, the connector 1 may be constructed with a connector face 5 which is directed in an insertion direction R for connection to a mating connector.

For connection to the mating connector, the connector 1 may comprise at least one and, particularly as shown in Figure 1, two plug contacts 6, whose connector ends 7 located in the insertion direction R are arranged in the connector face 5 and are constructed in particular for plug connection with plug contacts of the mating connector. The plug contacts 6 are, for example, constructed to transmit drive energy of an electrically drivable vehicle. In the operating state B, the conductor 2 is conductively connected to the plug contact 6, the conductor 2 being able to be retained in a non-releasable manner by means of the conductive connection in the illustrated operating position PB. A connection end 8 which is arranged along the plug contact 6 opposite the insertion end 7 may be constructed for conductive connection to the line 2. For example, a conductor end 9 of a conductor 10 of the line 2 may be connected to one of the connection ends 8 in a conductive manner, and in particular in an electrically conductive manner. To this end, the connection end 8 may be secured, for example, to the conductor end 9 and in particular be crimped, screwed, soldered or connected by other known means to the conductor end 9.

35 At least one indicator contact 11 for determining the operating state B or a malfunctioning state of the connector 1 may be provided in the connector housing 3. The indicator

contact 11 may be constructed so as to have an insertion end 12 which is orientated in the insertion direction R and which is arranged in the connector face 5 and which can be assembled, for example, with a mating indicator contact of a mating connector in order to query the state of the connector 1. A contact end 13 of the indicator contact 11 located
5 along the indicator contact 11 opposite the insertion end 12 may be accessible via the connection space 4. In the embodiment of Figure 1, the connector 1 comprises two indicator contacts 11, but only one of which is visible and the other is covered.

The connector 1 may further have an indicator member 14 which may be provided in the
10 connection space 4 in the operating state B shown. The indicator member 14 is preferably constructed with two bridging ends 15, of which one is conductively connected to one of the indicator contacts 11 at least in the operating state B. According to the embodiment of Figure 1, the bridging ends 15 may be releasably assembled with the indicator contacts 11 in the operating state B. To this end, the contact ends 13 of the indicator contact 11
15 may be formed, for example, as contact pins and the bridging ends 15 of the indicator member 14 may be constructed as contact sockets.

The indicator member 14 thus bridges the indicator contacts 11 or short-circuits them in the operating state B. Between the bridging ends 15, the indicator member 14 may have a
20 line portion 16 which conductively connects the bridging ends 15 to each other. For example, the line portion 16 may be constructed as a conductor loop.

The connector 1 may further have a separation device 17 which is constructed so as to be able to be mechanically coupled to the line 2 or to the conductor 10 thereof and so as to
25 mechanically act on the indicator member 14. According to the embodiment of Figure 1, the separation device 17 may have an annular securing element 18 which connects the line 2 or the conductor 10 thereof to the indicator member 14 so as to be fixed in terms of movement. The separation device 17 may even comprise the securing element 18 and, for example, may be a crimp ring, through which a portion of the line 2 and in particular
30 the conductor 10 and a portion of the indicator member 14 may extend. The movement-transmitting coupling of the line 2 to the indicator member 16 may thus be produced by means of crimping of the indicator member 14 with the line 2 by means of the separation device 17. Alternatively, the annular separation device 17 may, for example, have or even comprise a resilient ring which is produced, for example, from rubber or plastics material.
35 Such a separation device 17 may optionally be assembled without the use of a tool.

Figure 2 is a sectioned view of the connector 1 of the embodiment of Figure 1 in the plane of Figure 1 and in a malfunctioning state S, in which the conductor 2 in comparison with the operating state B of Figure 1 moves in a malfunctioning direction D relative to the insertion housing 3 and is at least partially pulled therefrom.

The malfunctioning direction D extends in the embodiment illustrated counter to the insertion direction R or the longitudinal direction L. The malfunctioning direction D may, however, also be orientated differently. For example, if the connector 1, in place of the straight configuration of the illustrated embodiment, is constructed in an angled manner, the malfunctioning direction D may have an angle with respect to the insertion direction R that is comparable with the angle of the connector 1.

In the malfunctioning state S, the connection between the indicator member 14 and the indicator contacts 11 may in particular be separated. Furthermore, the connection of the line 2 to the plug contacts 6 may also be interrupted by the movement of the conductor 2 relative to the connector housing 3. If the conductor end 9 in such a malfunctioning position PS of the line 2 is released or torn from the connection with the connection end 8, undesirable closing operations and, for example, a short-circuit with respect to other conductive components of the connector or an additional connector 10 of the line 2 may occur inside the connection space 4. Consequently, it may be desirable for the connection of the indicator member 14 with respect to the indicator contacts 11 to be released before the danger of an undesirable closure operation occurs.

The movement of the line 2 relative to the connector housing 3 in the malfunctioning direction D may be transmitted by the separation device 17 to the indicator member 14, at least when changing from the operating state B into the malfunctioning state S.

In order to reliably prevent the risk of injury or short-circuits with conductive elements outside the connection space 4, the indicator member 14 may be separated from the indicator contacts 11 and changed into the malfunctioning state S at the latest when the conductor ends 9 are pulled out of the connection space 4. A separation of the indicator member 14 from the indicator contacts 11 may be detected and a device which is connected to the connector 1 by means of the line 2 may be switched off. If the state of the connector 1 is queried by means of a mating connector which can be connected to the indicator contacts 11, an undesirable opening of a plug type connection of the connector and mating connector may also be detected.

Figure 3 shows a second embodiment of the connector 1 according to the invention in the operating state B. For elements which correspond in terms of function and/or structure to the elements of the embodiment of Figures 1 and 2, the same reference numerals are used. For the sake of brevity, only the differences with respect to the embodiment of Figures 1 and 2 are set out.

The embodiment of Figure 3 differs in particular owing to the configuration of the separation device 17. In this instance, the separation device 17 may also be by means of the securing element 18 which may be in the form of an annular line end sleeve and through which the conductor 10 can extend. The securing element 18 may be secured to a cover 19 of the line 2 and, for example, be pressed or compressed onto the line 2. The securing element 18 is, for example, a crimped sleeve.

The separation device 17 may be constructed with a lateral projection 20 which may extend transversely relative to a centre axis of the securing element 18 away from the outer side thereof. In the assembled state of the connector 1, the centre axis of the securing element 18 may extend parallel with the longitudinal direction L of the line 2.

The lateral projection 20 may in the assembled state or in the operating state B of the connector 1, be arranged downstream of a portion of the line portion 16 in the longitudinal direction L. If the line 20 is now moved in the malfunctioning direction D, that is to say, in this instance counter to the longitudinal direction L, from the operating position PB of the operating state B in the direction towards the malfunctioning state S, the lateral projection 20 may abut the line portion 16 of the indicator member 14 counter to the longitudinal direction L and consequently transmit the movement of the line 2 to the indicator member 14.

The lateral projection 20 may have a protrusion 21 which extends counter to the longitudinal direction L for positioning the line portion 16. Between the protrusion 21 and the securing element 18, there may be arranged a retention recess 22 which can receive a cross-section of the line portion 16. The retention recess 22 may open in the assembled state of the connector 1 counter to the longitudinal direction L and be delimited transversely relative to the longitudinal direction L by the protrusion 21 and the securing element 18. In the operating position PB thereof, the line portion 16 may be arranged at least partially transversely relative to the longitudinal direction L between the securing

element 18 and the protrusion 21 and the line portion 16 consequently cannot slide transversely relative to the longitudinal direction L off the lateral projection 20. The protrusion 21 may be arranged at a free end of the lateral projection 20.

5 In addition, the lateral projection 20 may be constructed with a cutting edge 23 which, when moving from the operating state B into the malfunctioning state S, separates the line portion 16. To this end, the cutting edge 23 may be orientated in particular counter to the longitudinal direction L.

10 The cutting edge 23 may extend between the protrusion 21 and the securing element 18 transversely to the longitudinal direction L and may be directed in the assembled state of the connector 1 counter to the longitudinal direction L. In particular, the cutting edge 23 may be directed towards the line portion 16.

15 In the operating position PB of the line 2, the line portion 16 may be spaced apart from the projection 20, and in particular from the cutting edge 23 thereof, in order to prevent undesirable damage to the indicator member 14, for example, abrasion brought about by vibrations.

20 Figure 4 illustrates the embodiment of Figure 3 in a malfunctioning state S.

In the malfunctioning state S, the conductor end 9 can be moved into the malfunctioning position PS and separated from the plug contact 6. Alternatively, the plug contact 6 may remain at least partially connected to the conductor end 9, both in the first embodiment
25 and in this embodiment, even if the line 2 is moved out of the operating position PB. In the embodiment of Figure 4, the line 2 is constructed with two conductors 10, the line end 9 of the conductor 10 at the front in the drawing being pulled out of the plug contact 6. The conductor end 9 of the rear conductor 10 in the drawings is still connected to the connection end 8 of the plug contact 6. However, the connection end 8 is torn from the
30 remaining plug contact 6. In Figure 4, the line 2 is moved so far away relative to the connector housing 3 that the conductor ends 9 and even the connection end 8 of the plug contact 6 which is still connected to the line 2 are completely pulled out of the connection space 4.

The separation device 17 is still secured to the line 2 in the illustrated embodiment. The cutting edge 23 has separated the line portion 16 of the indicator member 14 which is still connected to the indicator contacts 11.

Claims

1. Connector (1) having a connector housing (3), in which at least one indicator member (14) for error examination and one plug contact (6) are arranged, the plug contact (6) being constructed so as to be able to be assembled with a mating plug contact at the insertion side and so as to be able to be connected to a line (2) at the connection side, characterised by a separation device (17) which is constructed so as to act mechanically on the indicator member (14) and so as to be able to be mechanically coupled to the line (2).

2. Connector (1) according to claim 1, characterised by two indicator contacts (11) which are arranged inside the connector housing (3) and which can be bridged by means of the indicator member (14).

3. Connector (1) according to claim 2, characterised in that, in an operating state (B) of the connector (1), in which a line (2) is conductively connected to the plug contact (6) at the connection side, the two indicator contacts (11) are bridged by means of the indicator member (14) and, in a malfunctioning state (S) of the connector (1), in which the line (2), in comparison with the operating state (B), is at least partially pulled out of the connector housing (3), the two indicator contacts (11) are electrically separated from each other.

4. Connector (1) according to claim 3, characterised in that, in the malfunctioning state (S), in comparison with the operating state (B), the line (2) is moved by a predetermined minimum distance with respect to the connector housing (3).

5. Connector (1) according to any one of claims 1 to 4, characterised in that the separation device (17) has a securing element (18) which can be secured to the line (2).

6. Connector (1) according to claim 5, characterised in that the securing element (18) is at least partially annular.

7. Connector (1) according to claim 5 or 6, characterised in that the securing element (18) is constructed as a securing sleeve which can be connected to the line (2) in a positive-locking manner or in a non-positive-locking manner.

8. Connector (1) according to any one of claims 5 to 7, characterised in that the securing element (18) is constructed as a line end sleeve and can be pressed onto the line (2).

5 9. Connector (1) according to claim 5 or 6, characterised in that the securing element (18) is a resilient ring and is resiliency expanded when a line (2) and the indicator member (14) extend through the securing element (18).

10 10. Connector (1) according to any one of claims 1 to 9, characterised in that the indicator member (14) has a loop-like line portion (16) whose ends (15) conductively connect the indicator contacts (11) to each other in the operating state (B).

15 11. Connector (1) according to any one of claims 1 to 10, characterised in that the separation device (17) has a lateral projection (20) and the indicator member (14) at least partially extends around the projection (20) in the operating state (B).

12. Connector (1) according to claim 11, characterised in that the lateral projection (20) is constructed with a cutting edge (23) for separating the indicator member (14).

20 13. Connector (1) according to any one of claims 2 to 12, characterised in that the indicator contacts (11) are plug contacts which are received in the connector housing (3) and which each have an insertion end (12) which is directed in the insertion direction (R) for connection to a mating connector and a contact end (13) opposite the insertion end (12) along the indicator contacts (11) for connection to the indicator member (14).

25 14. Connector (1) according to any one of claims 2 to 12, characterised in that the indicator member (14) in the operating state (B) is removably or securely connected to the indicator contacts (11).

30 15. Connector (1) according to claim 3, characterised in that the indicator member (14) is mechanically interrupted in the malfunctioning state (S).

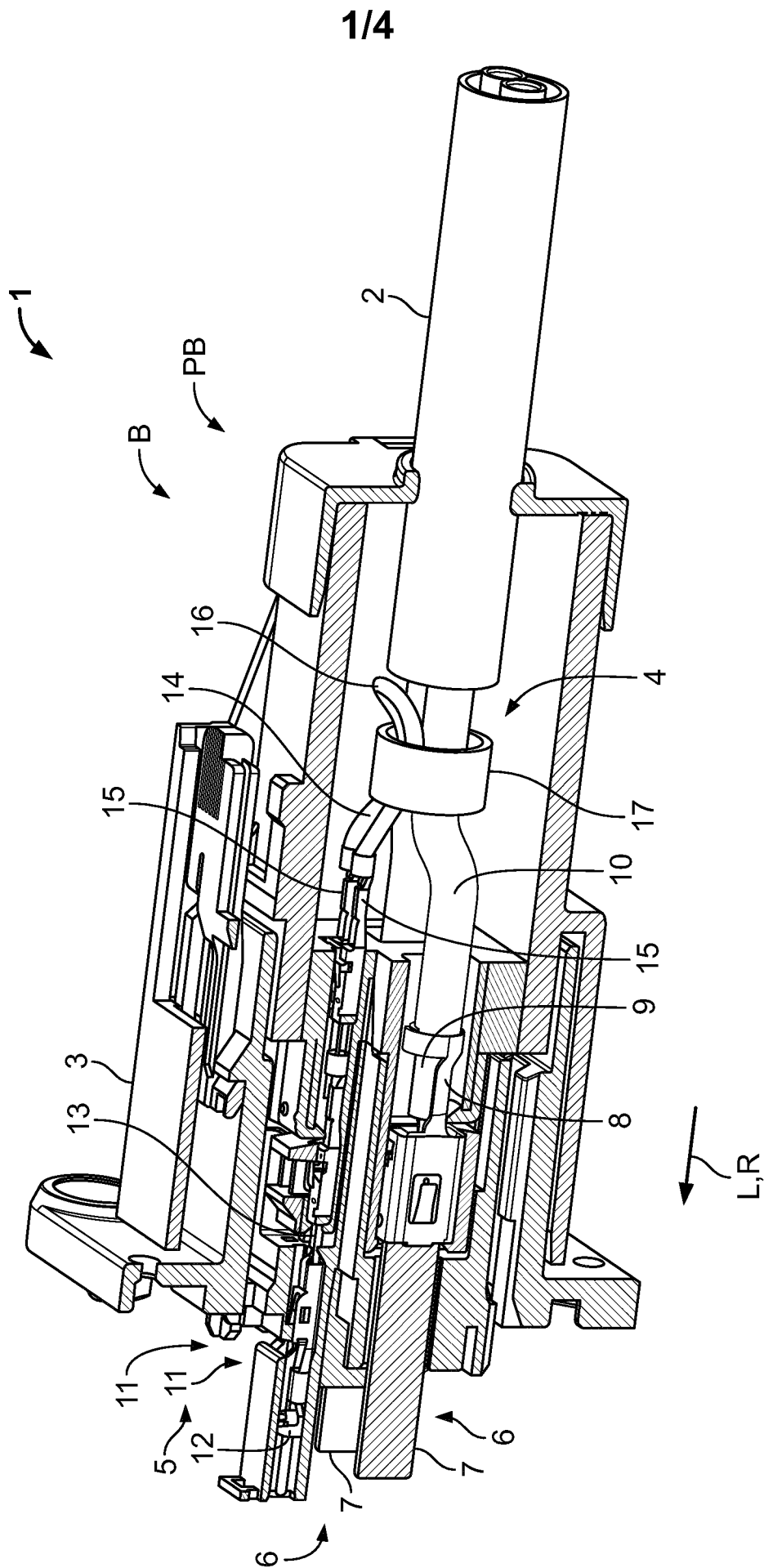


Fig. 1

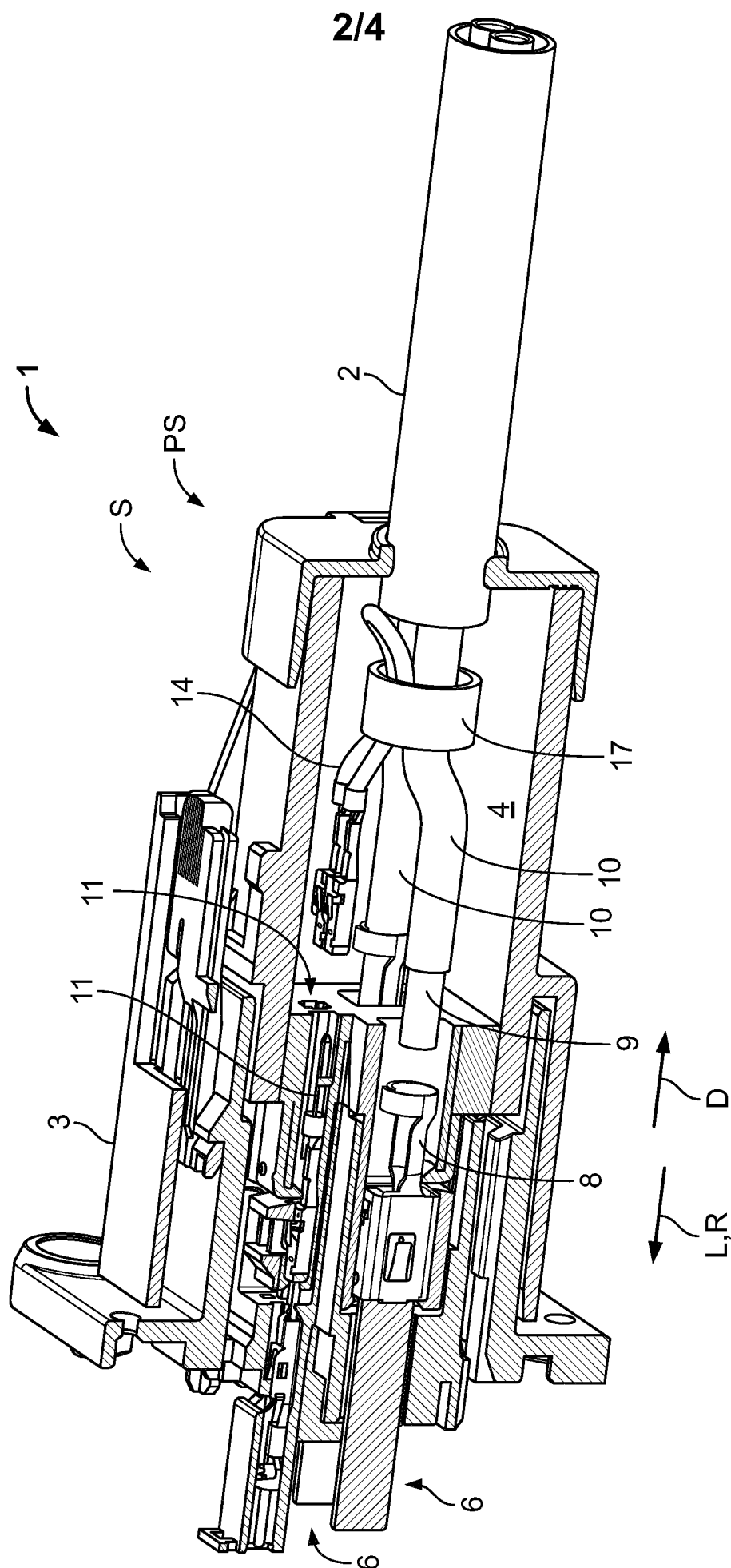


Fig. 2

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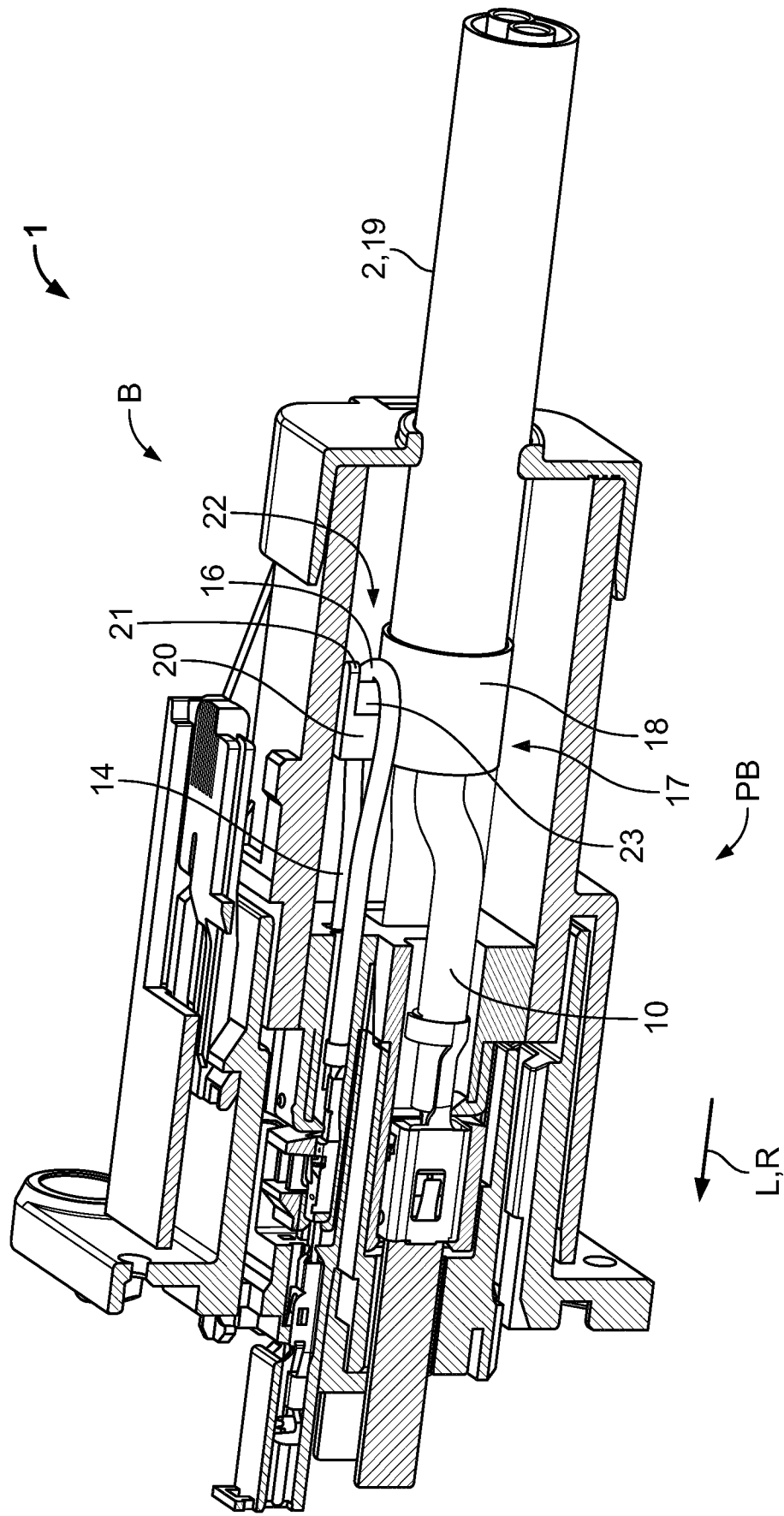


Fig. 3

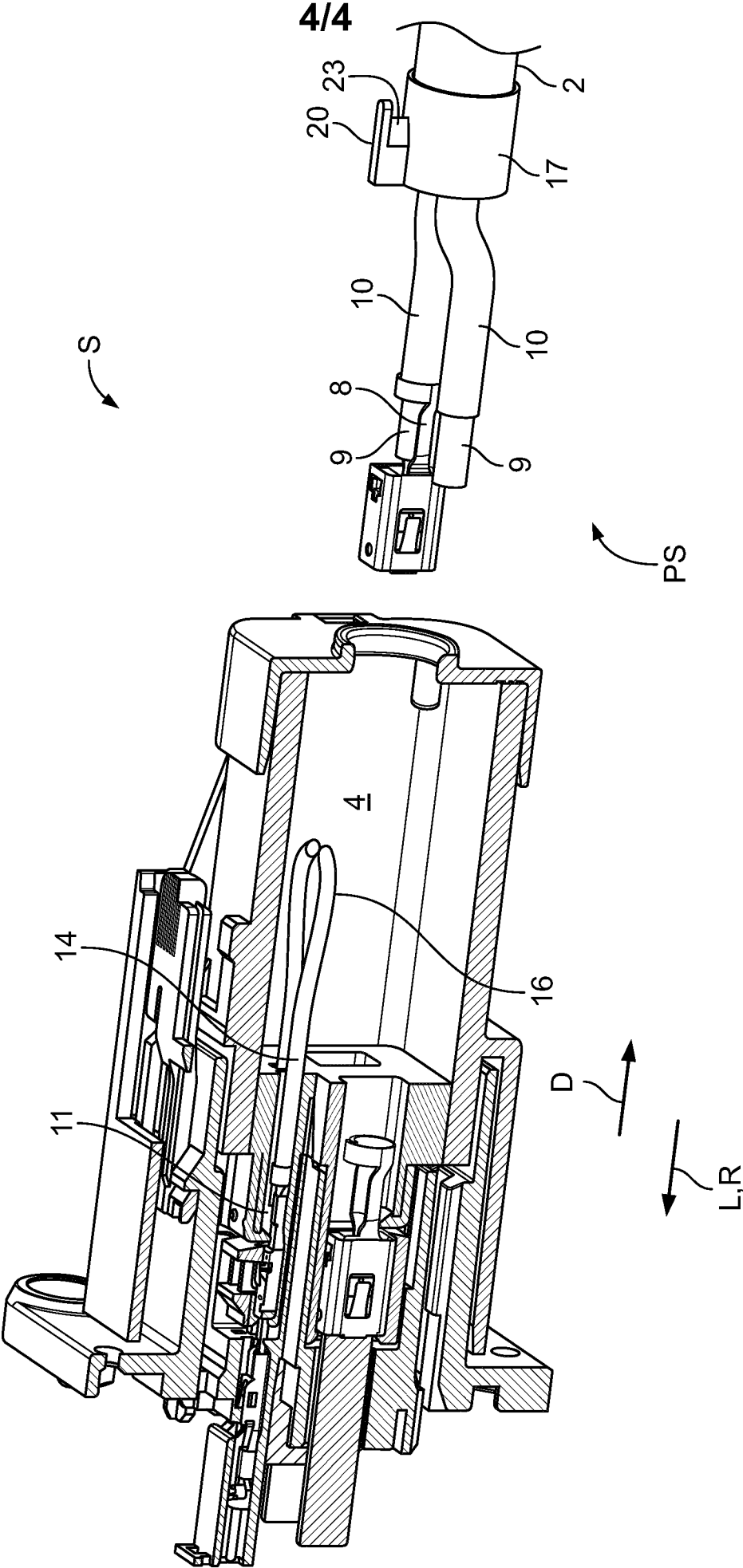


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/074521

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R13/703
ADD.

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	EP 0 708 500 A1 (CABLAGE CI E FRANCAISE [FR]) 24 April 1996 (1996-04-24) figures 1-3	1, 2, 5
A	wo 2010/143078 A2 (FRAMATOME CONNECTORS INT [FR]; ODORFER FRANK [DE]; REGNIER VINCENT [DE] 16 December 2010 (2010-12-16) figures 2A-2B	11, 12



Further documents are listed in the continuation of Box C.



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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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