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(54) **OPTICAL CONNECTOR, CONNECTOR ADAPTER, OPTICAL FIBER LINE, AND OPTICAL COMMUNICATION SYSTEM**

(75) Inventor: **Seiji KATOH**, Sakura-shi (JP)

(73) Assignee: **FUJIKURA LTD.**, TOKYO (JP)

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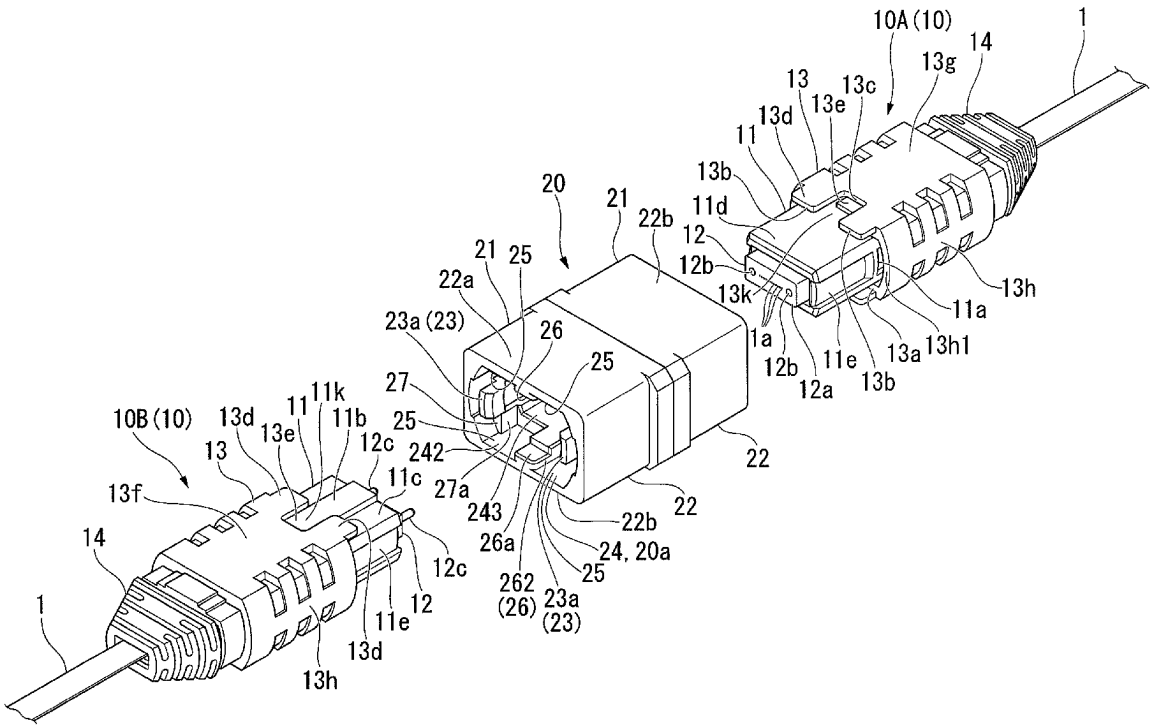
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G02B 6/36 (2006.01)

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(57) **ABSTRACT**

There are provided an optical connector having one or more protruding portions protruding and one or more recessed portions depressed relative to a reference plane corresponding to a reference face of a coupling of a standard optical connector in a connecting end face of a coupling into which a housing receiving a ferrule is inserted, a connector adapter to which the optical connector can be inserted and coupled, an optical fiber line using the optical connector and the connector adapter to connect optical fibers, and an optical communication system.



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IPR2024-00118
U.S. Patent No. 11,340,413

FIG. 1A

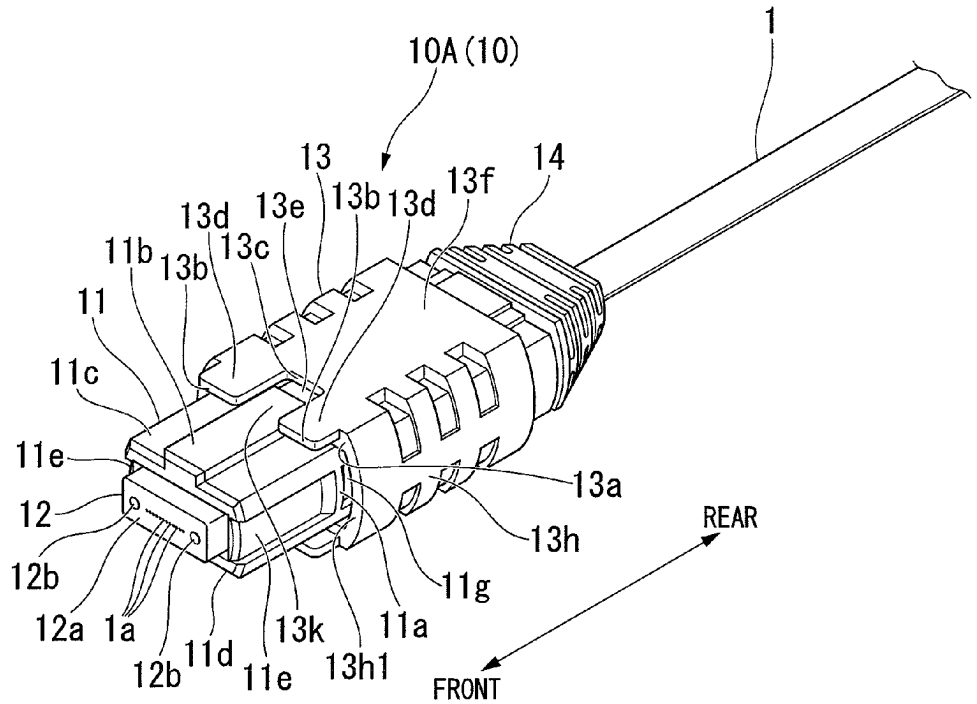

1
10A (10)
13
14
13f
13b
13d
13e
13d
13c
11b
13b
11
11c
11e
12
12b
12a
1a
12b
11d
11e
13k
13h1
11a
11g
13h
13a
REAR
FRONT

FIG. 1B

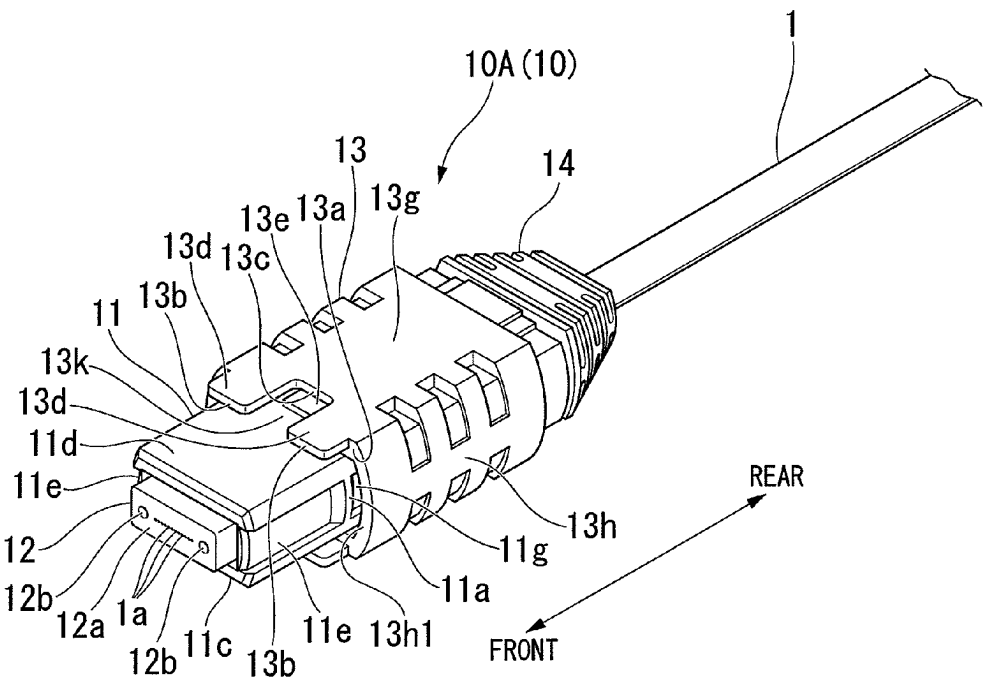

1
10A (10)
13
14
13g
13a
13e
13d
13c
13b
11
13k
13d
11d
11e
12
12b
12a
1a
12b
11c
13b
11e
13h1
11a
11g
13h
REAR
FRONT

FIG. 2

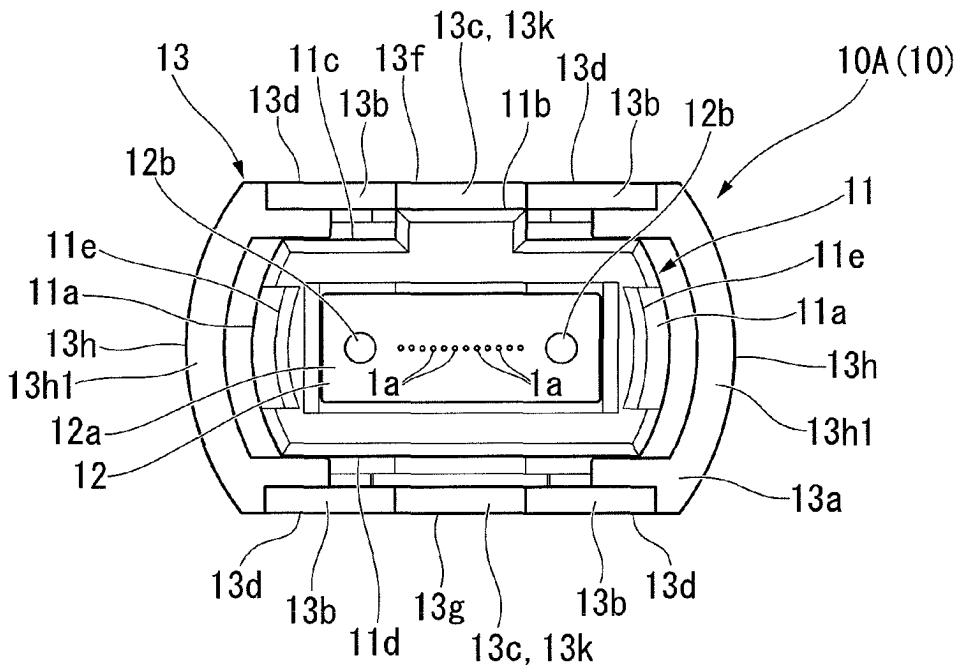

13
11c
13f
13c, 13k
13d
10A (10)
13d
13b
11b
13b
12b
12b
11
11e
11e
11a
11a
13h
13h
13h1
13h1
1a
1a
12a
12
13a
13d
13b
11d
13g
13c, 13k
13b
13d

FIG. 3

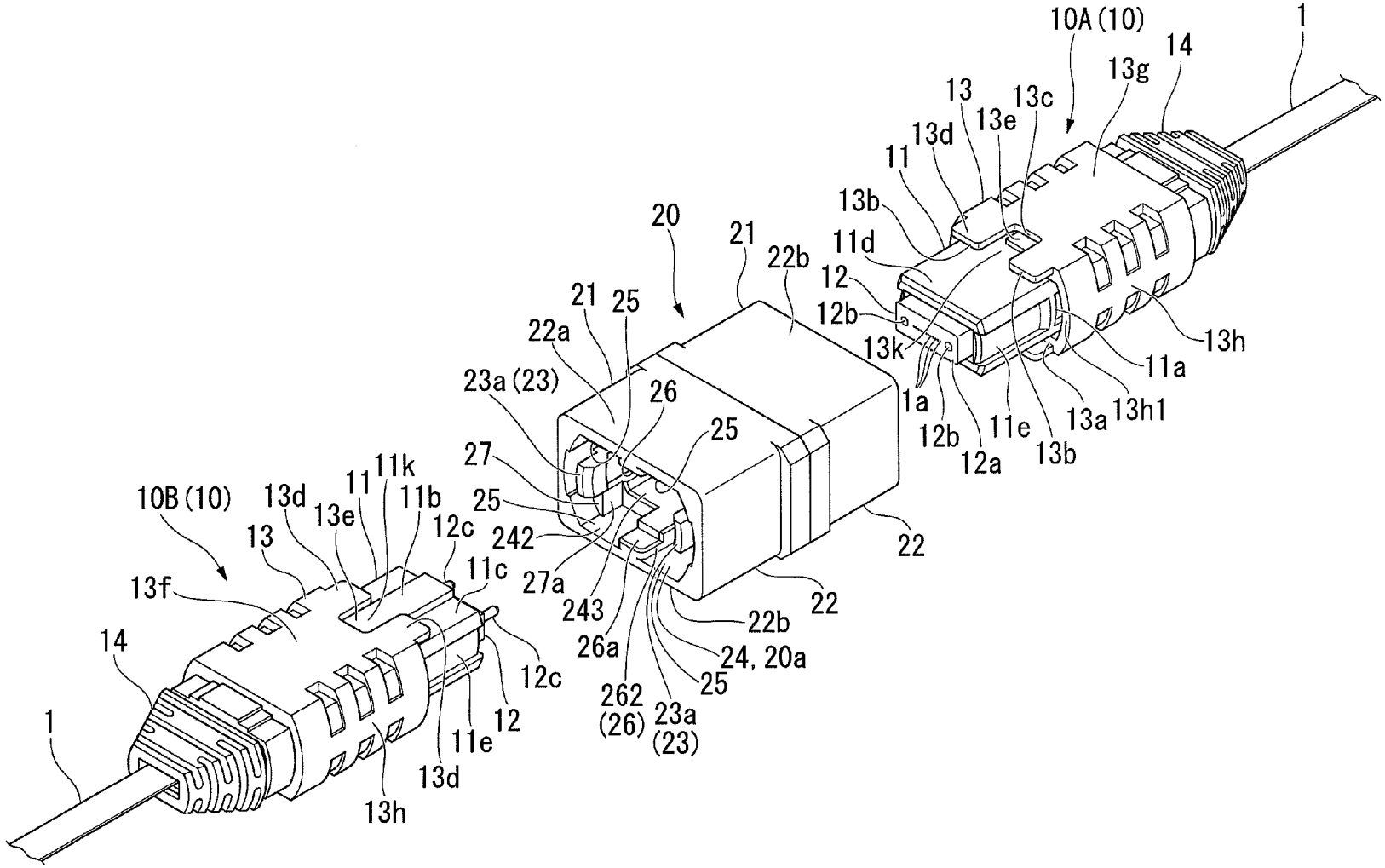
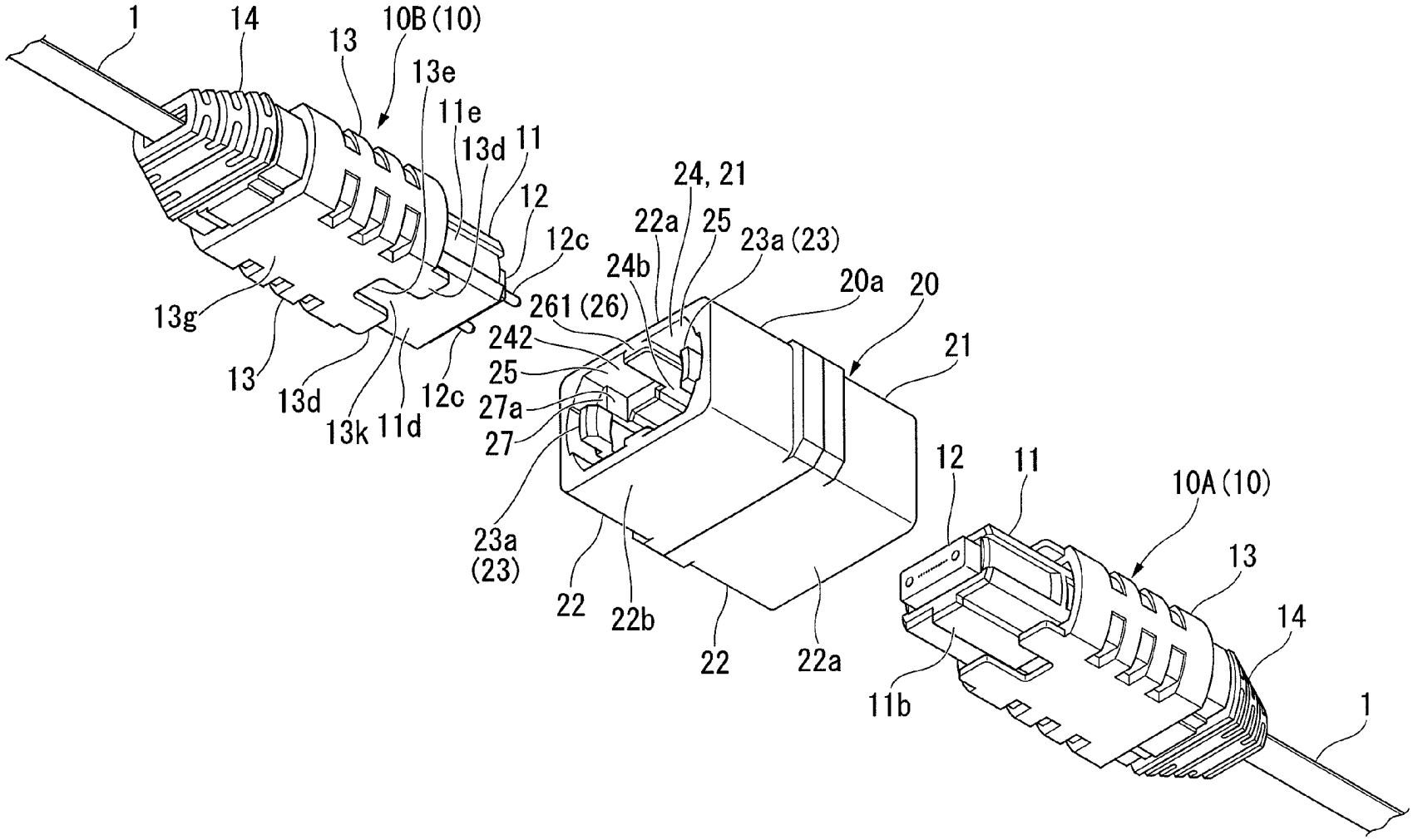

10A (10)
1
14
13g
13
13c
13e
13d
11
13b
11d
12
12b
13k
1a
12b
12a
11e
13b
13a
13h1
11a
13h
20
21
22b
21
25
22a
23a (23)
26
25
27
25
242
27a
243
26a
262
(26)
23a
(23)
25
24, 20a
22b
22
22
10B (10)
13d
13e
11
11k
11b
13
12c
13f
11c
14
1
12c
12
11e
13d
13h

FIG. 4


1
14
13
10B (10)
13e
11e
13d
11
12
12c
24, 21
22a
25
23a (23)
24b
20a
20
261 (26)
242
25
27a
27
21
13g
13
13d
13k
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12c
23a
(23)
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22b
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22a
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11
10A (10)
13
14
11b
1

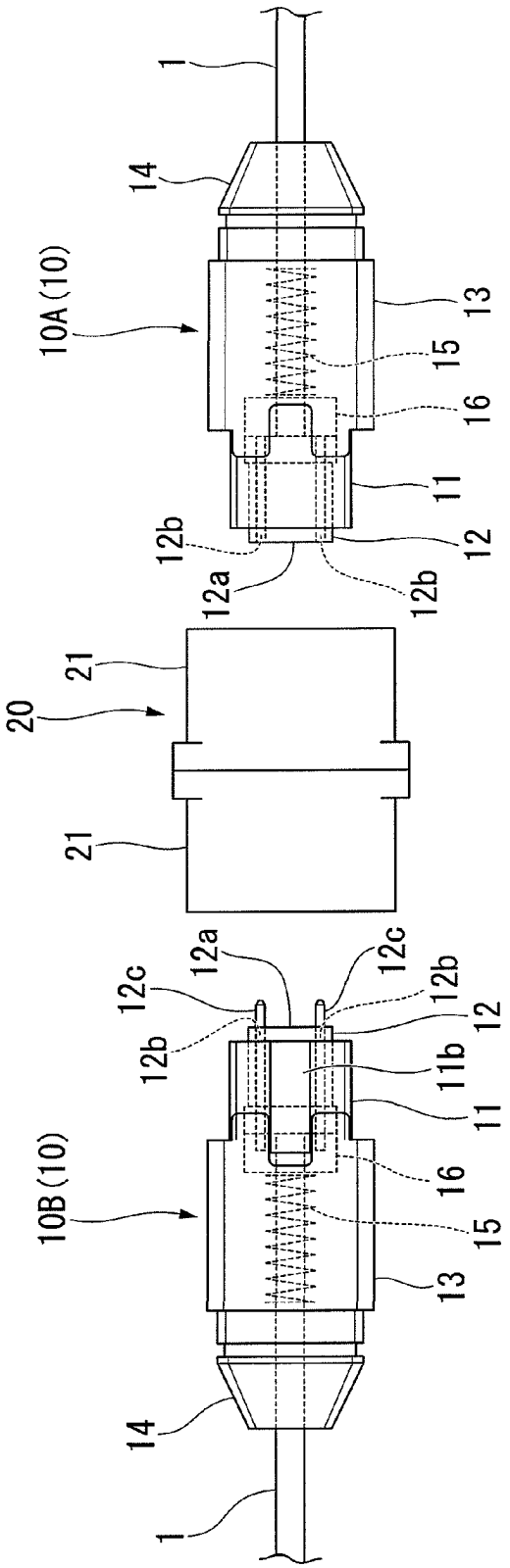

1
14
10A(10)
13
15
16
11
12b
12
12a
12b
21
20
21
12a
12c
12c
12b
12b
12
11b
11
16
15
10B(10)
13
14
1

FIG. 5

FIG. 6

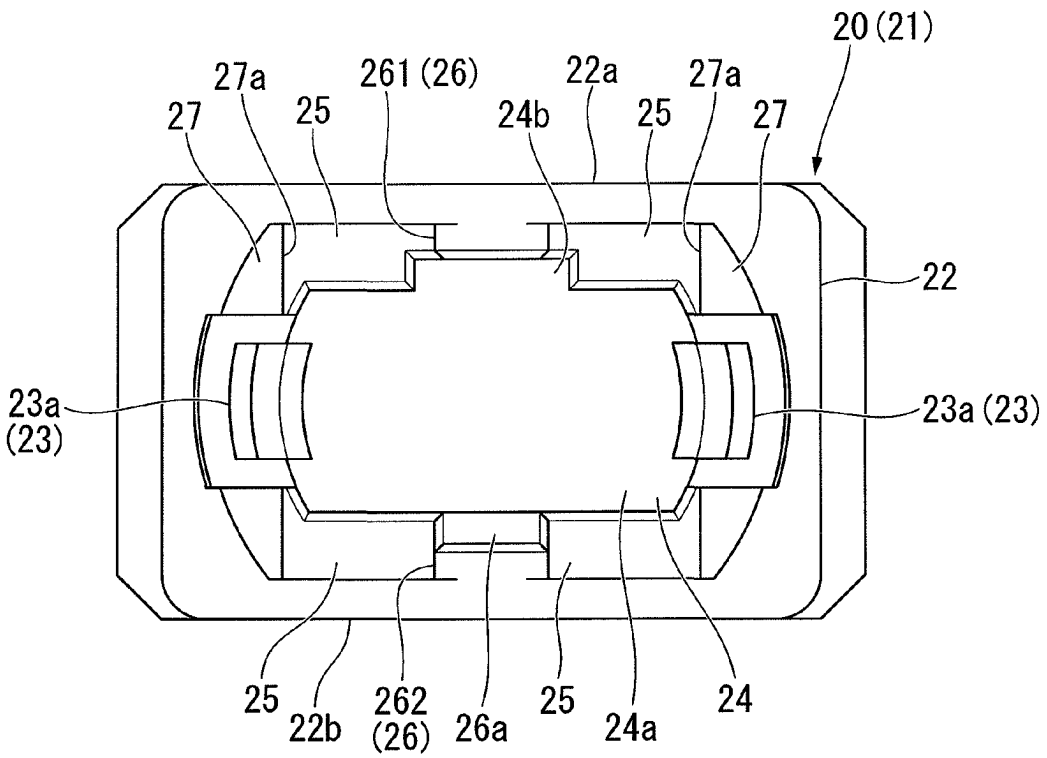

20 (21)
27a
261 (26)
22a
27a
27
25
24b
25
27
22
23a
(23)
23a (23)
25
22b
262
(26)
26a
25
24a
24

FIG. 7

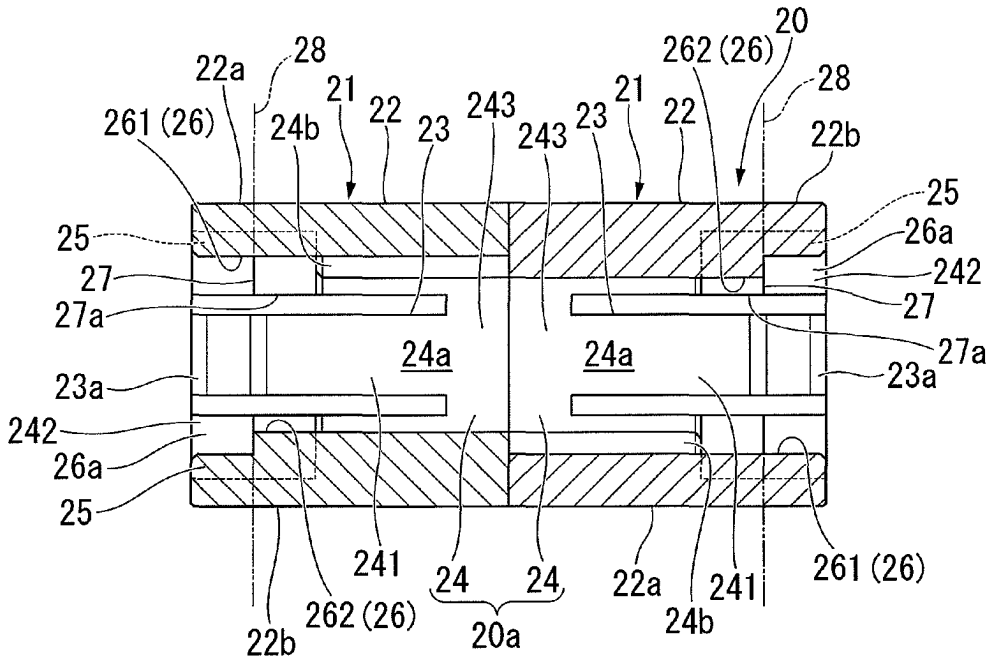

20
28
22a
21
22
23
243
243
23
21
22
28
262 (26)
261 (26)
24b
22b
25
26a
242
27
27a
24a
24a
23a
241
24
24
22a
241
261 (26)
22b
262 (26)
20a
24b

FIG. 8

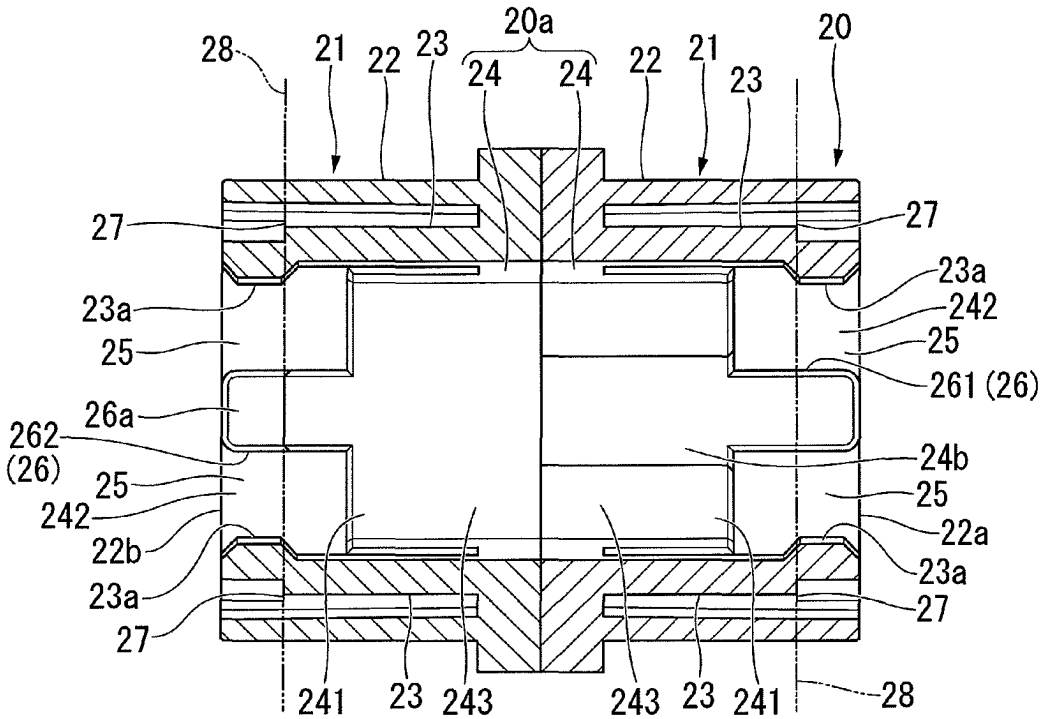

20a
28
21
22
23
24
24
22
21
23
20
27
23a
242
25
261 (26)
26a
262
(26)
24b
25
22a
23a
27
241
23
243
243
23
241
28

FIG. 9

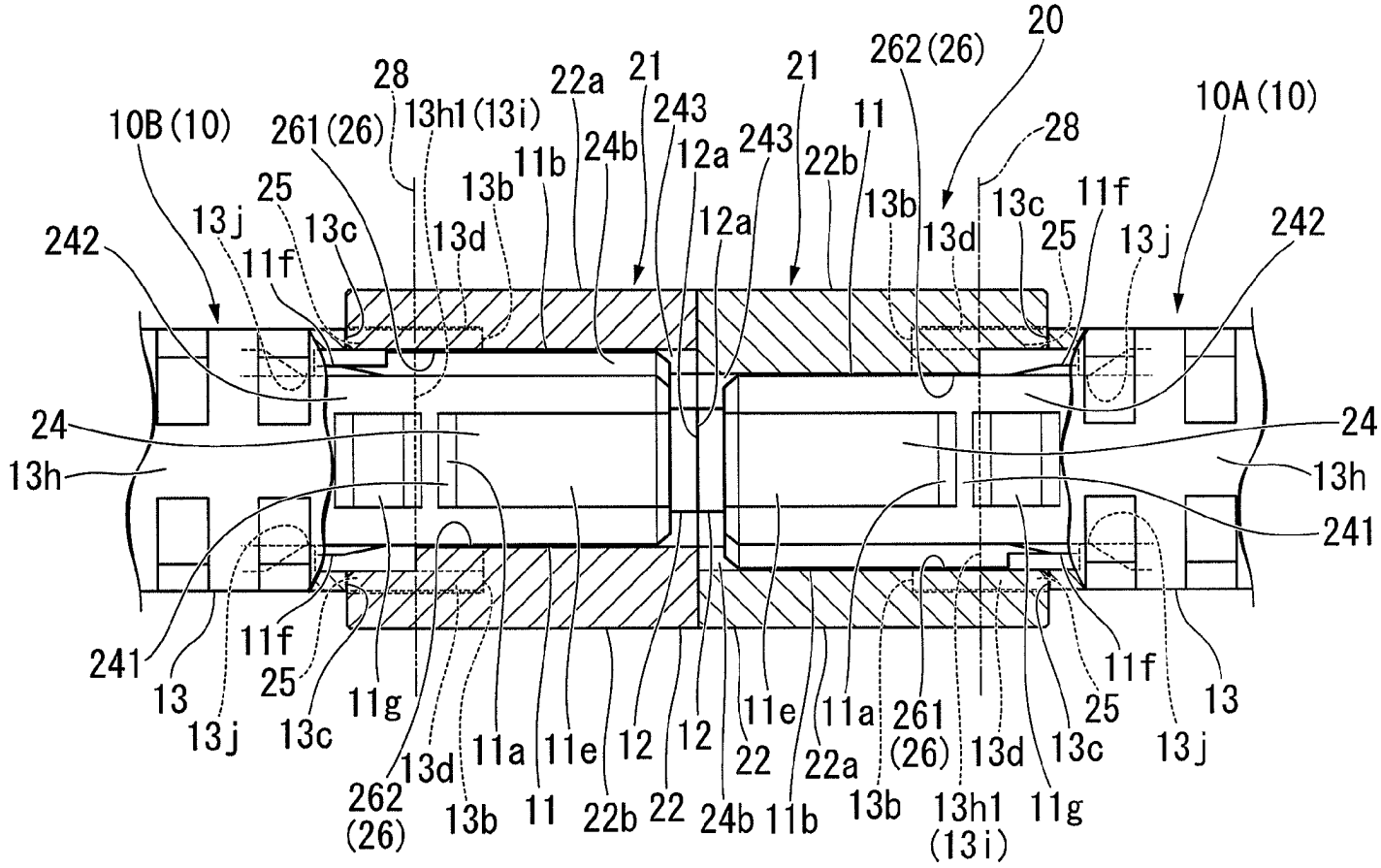

10B (10)
261 (26)
28
13h1 (13i)
22a
21
243
21
262 (26)
20
10A (10)
11
28
242
13j
25
13c
11f
13d
13b
11b
24b
12a
243
22b
13b
13c
11f
25
13j
242
24
24
13h
13h
241
241
11f
25
13
13j
13c
11g
262 (26)
13d
13b
11a
11
11e
22b
12
22
12
24b
22
11e
11b
11a
22a
13b
261 (26)
13h1 (13i)
13d
11g
13c
25
11f
13
13j

FIG. 10

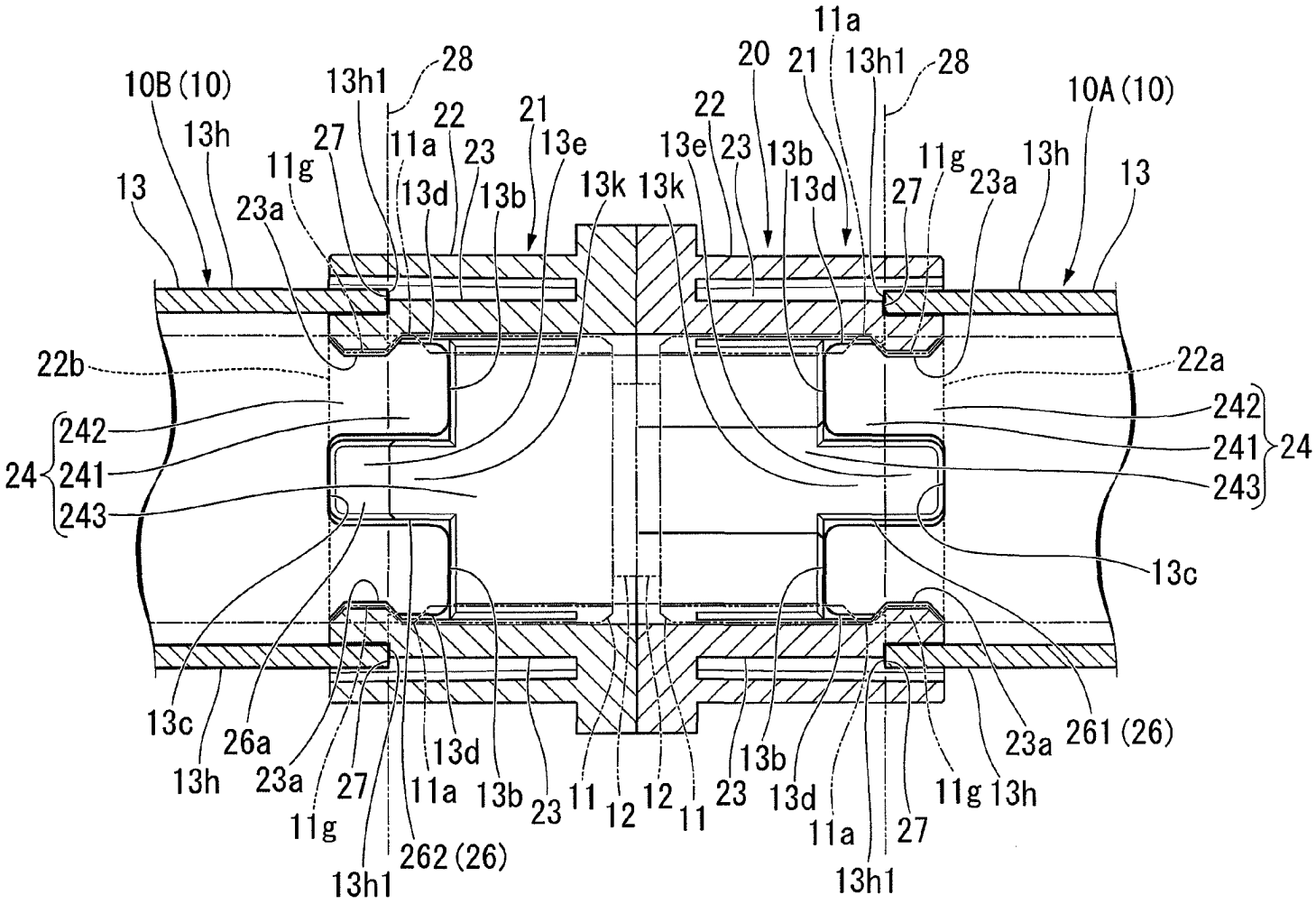
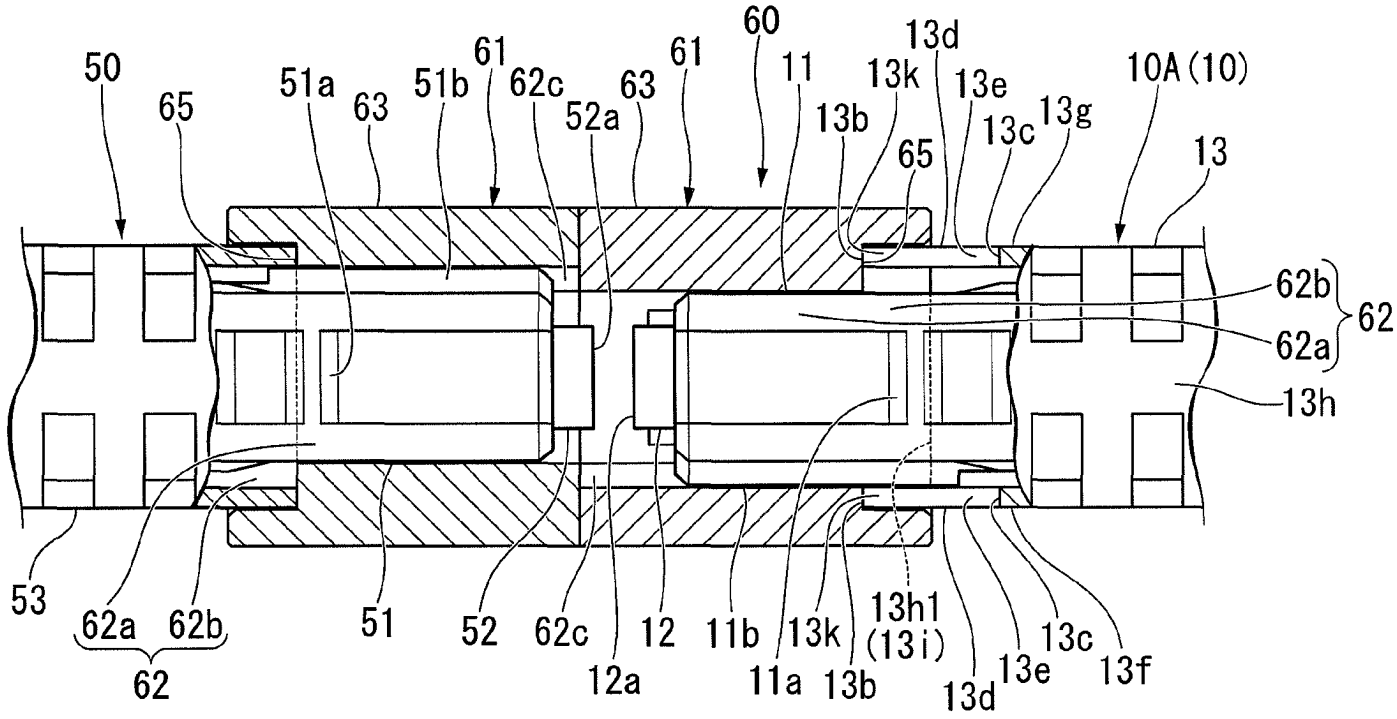

10B (10)
13h
13
13h1
28
27
11g
23a
11a
22
13d
23
13b
21
13e
13k
20
10A (10)
22b
22a
242
241
243
24
13c
26a
11
12
262 (26)
261 (26)

FIG. 11


50
65
51a
63
51b
61
62c
52a
63
61
60
11
13d
13k
13e
13b
65
13c
13g
10A (10)
13
62b
62a
62
13h
53
62a
62b
62
51
52
62c
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12
11b
11a
13k
13b
13h1
(13i)
13d
13e
13c
13f

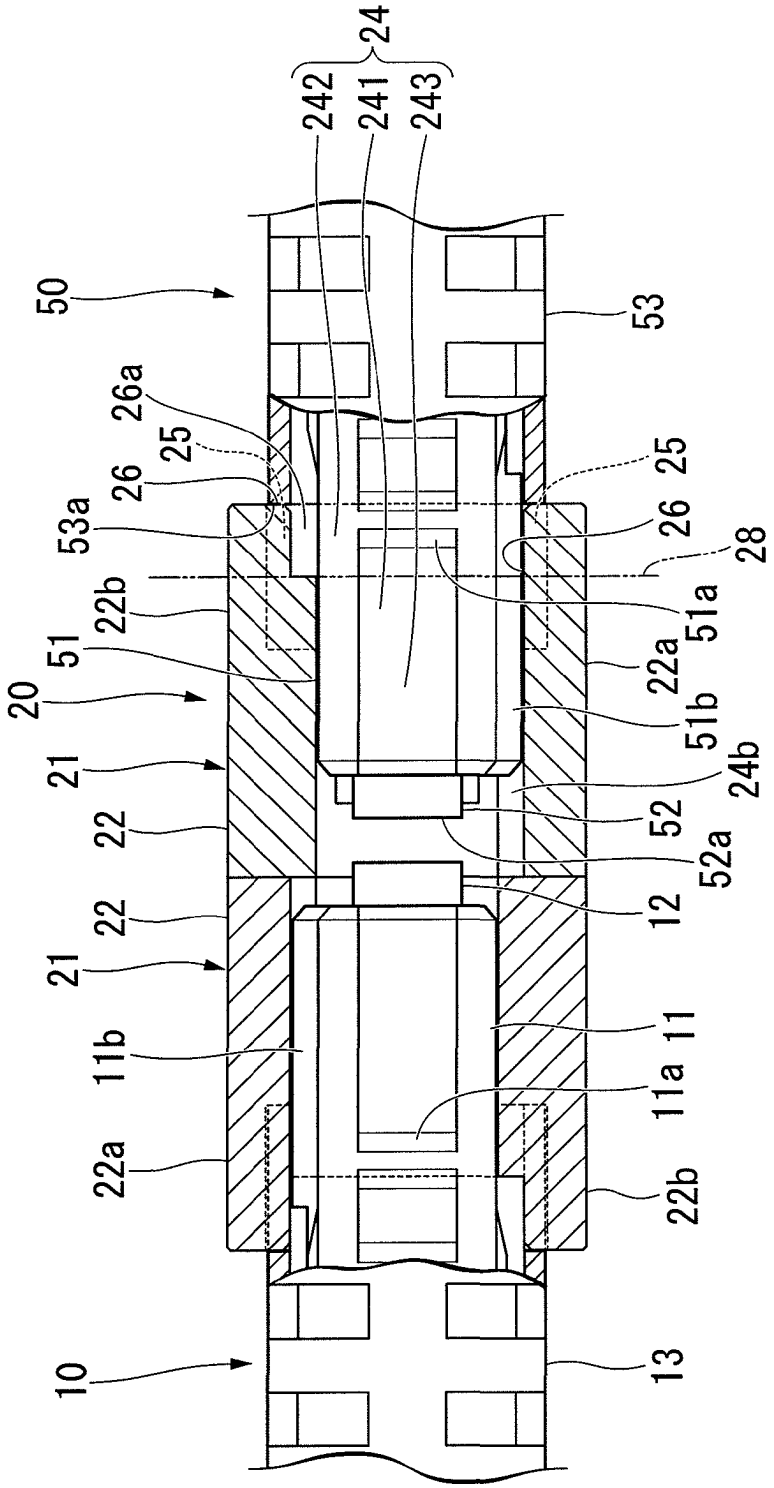

24
242
241
243
50
53
26a
25
26
53a
25
26
28
22b
51a
51
22a
20
51b
21
24b
22
52
52a
22
12
21
11b
11
11a
22a
22b
10
13

FIG. 12

FIG. 13

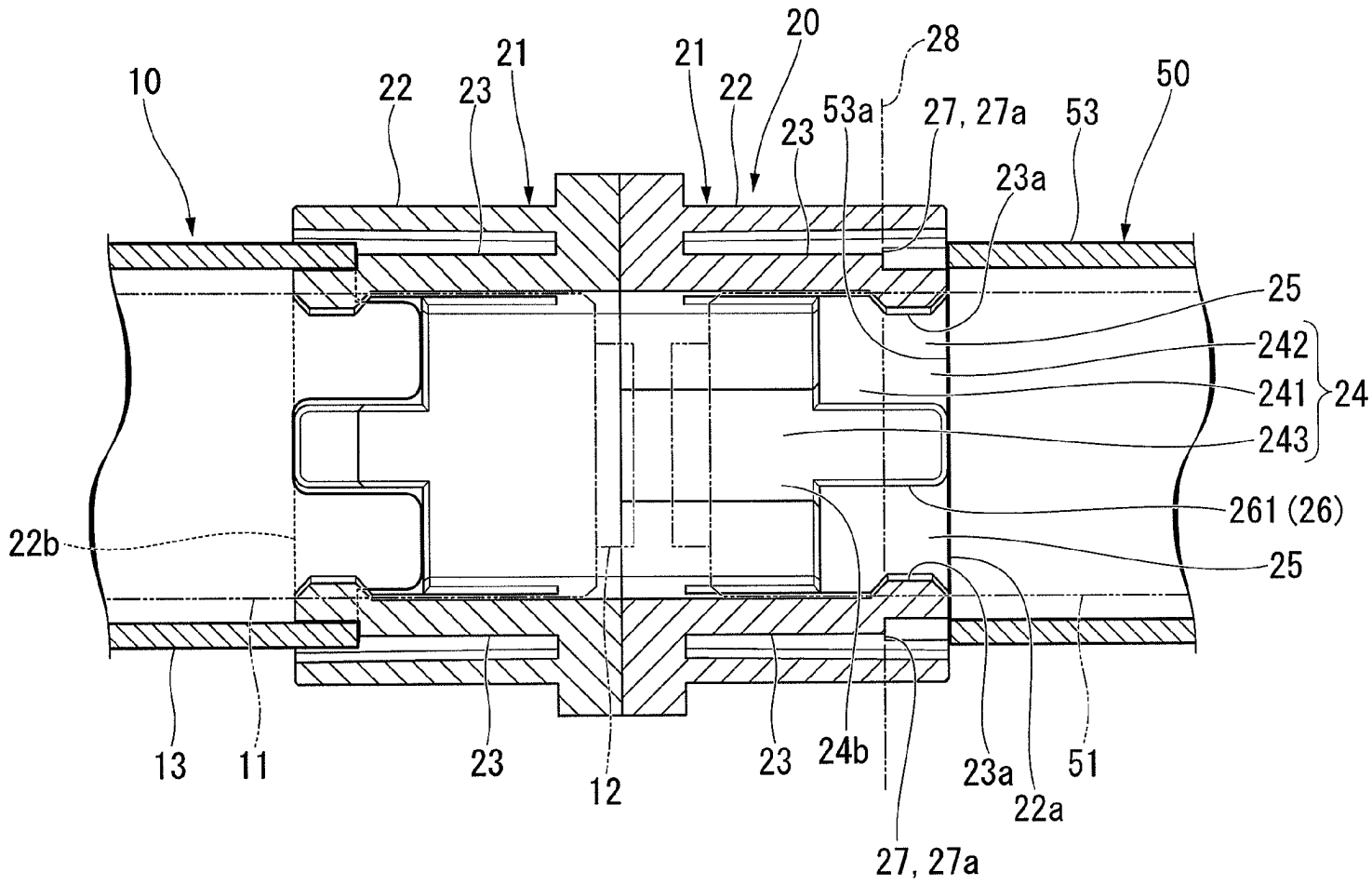

10
22
23
21
21
22
20
23
53a
28
27, 27a
53
50
23a
25
242
241
24
243
261 (26)
25
22b
13
11
23
12
23
24b
23a
22a
51
27, 27a

FIG. 14A

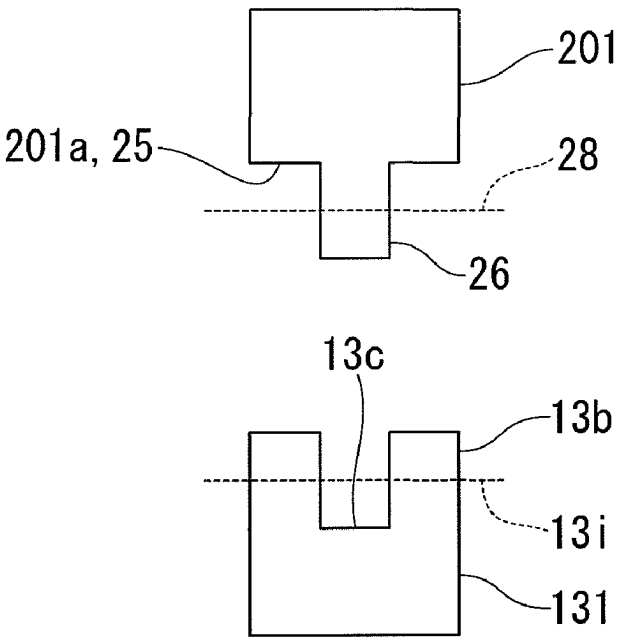


FIG. 14B

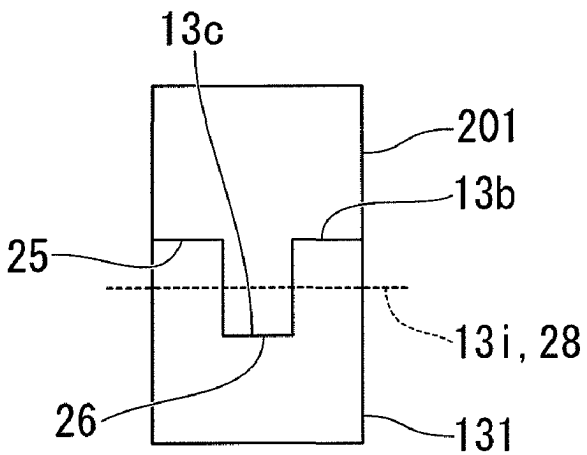


FIG. 15A

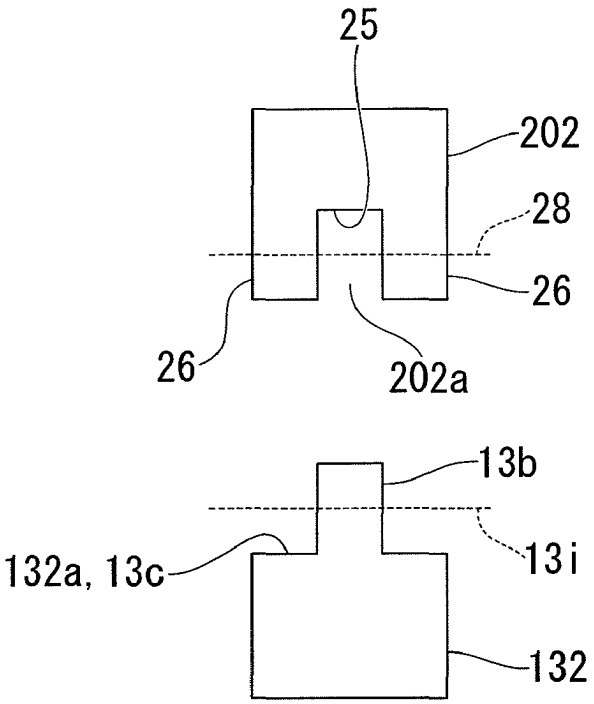


FIG. 15B

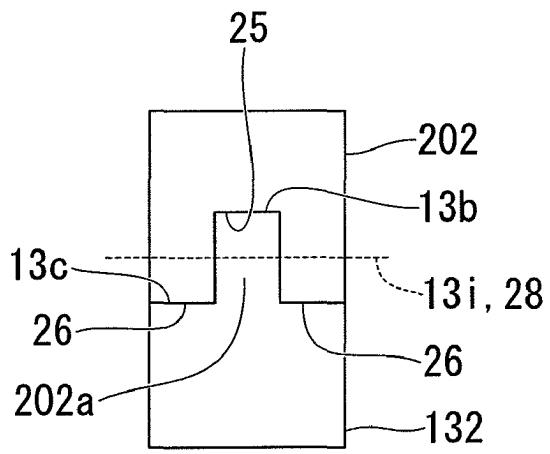


FIG. 16

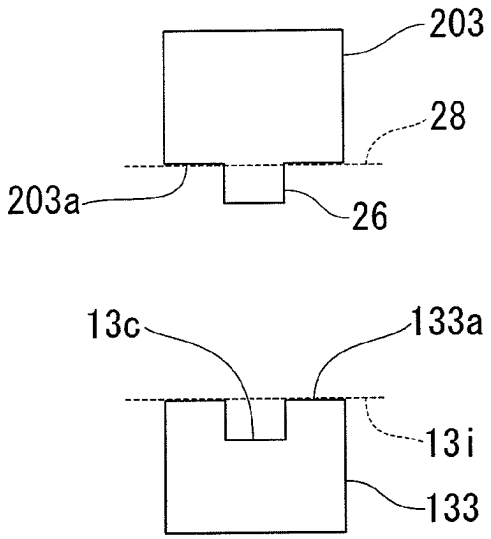


FIG. 17

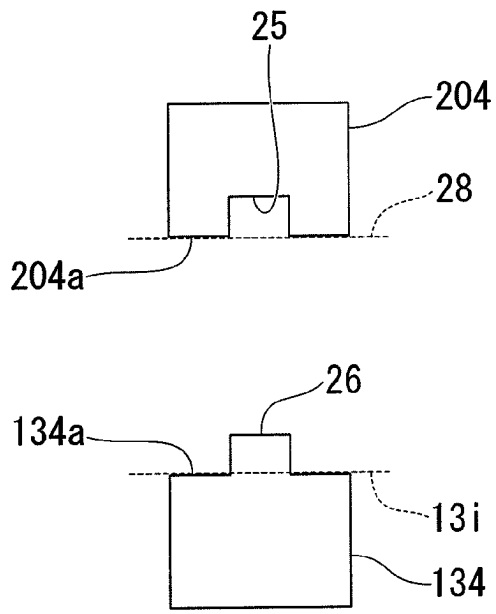


FIG. 18A

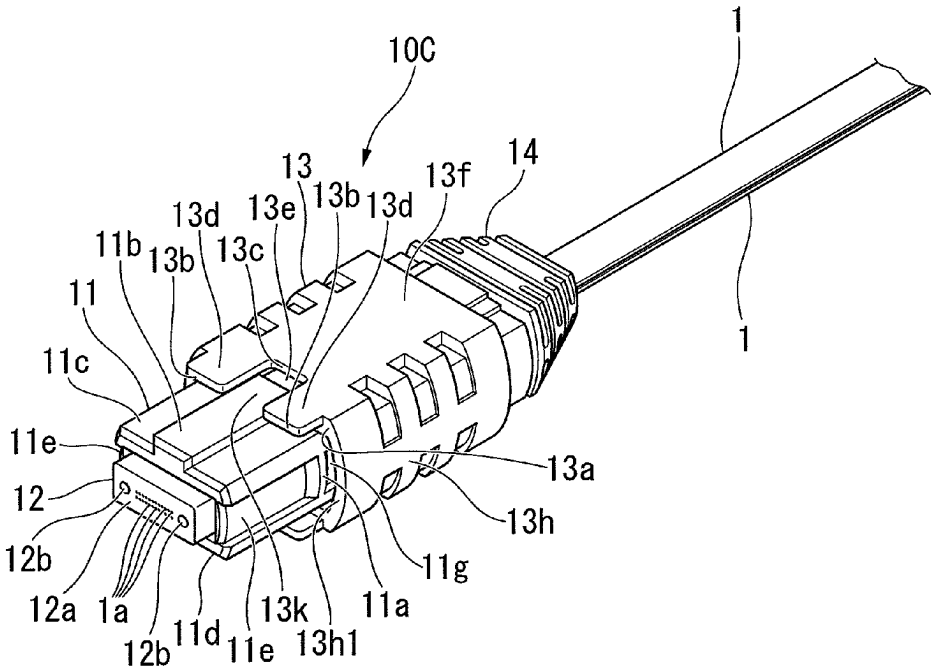


FIG. 18B

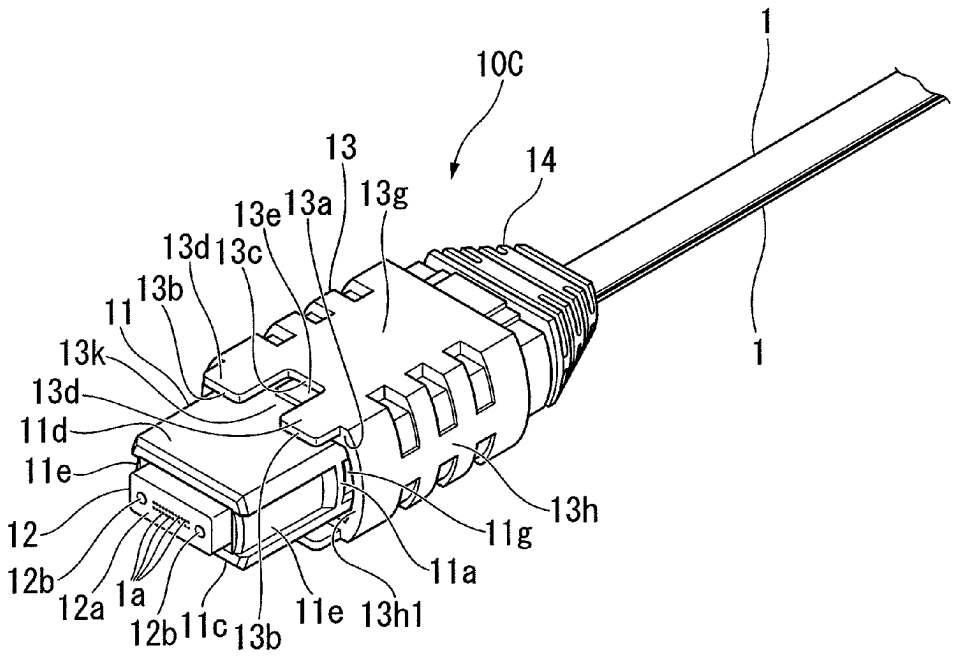
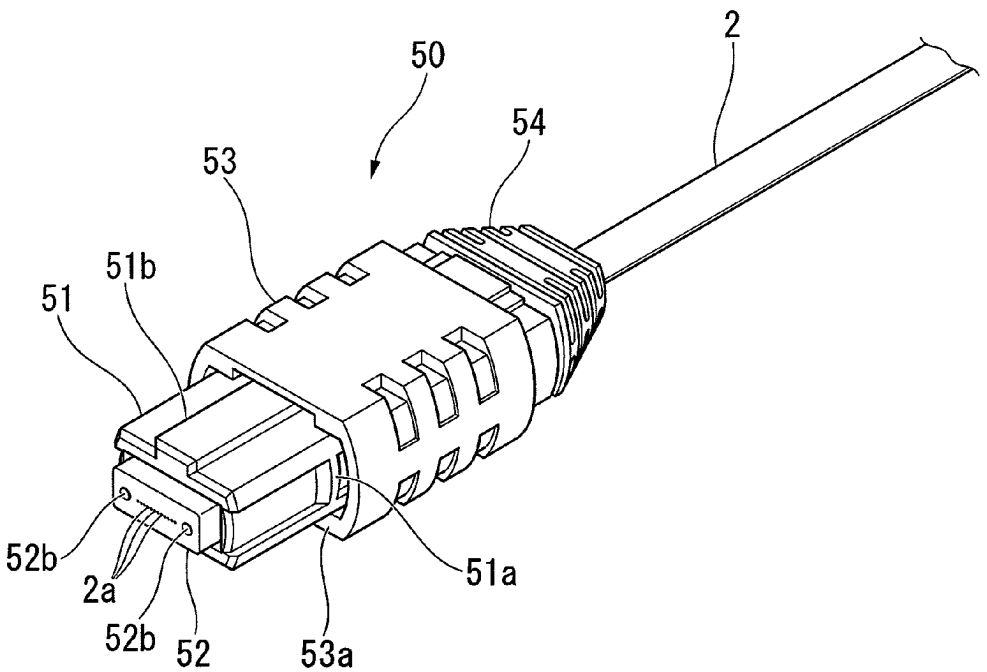


FIG. 19



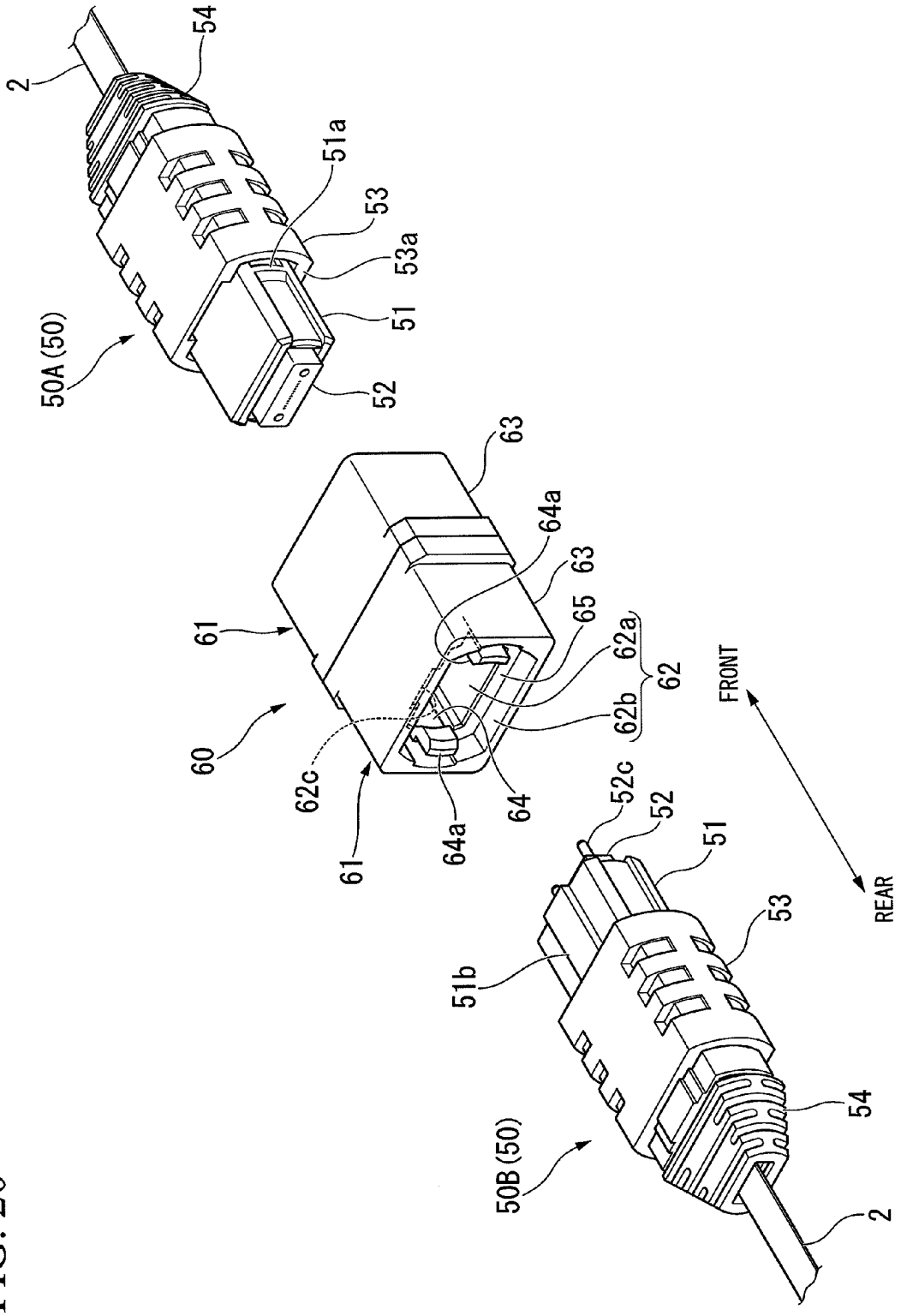
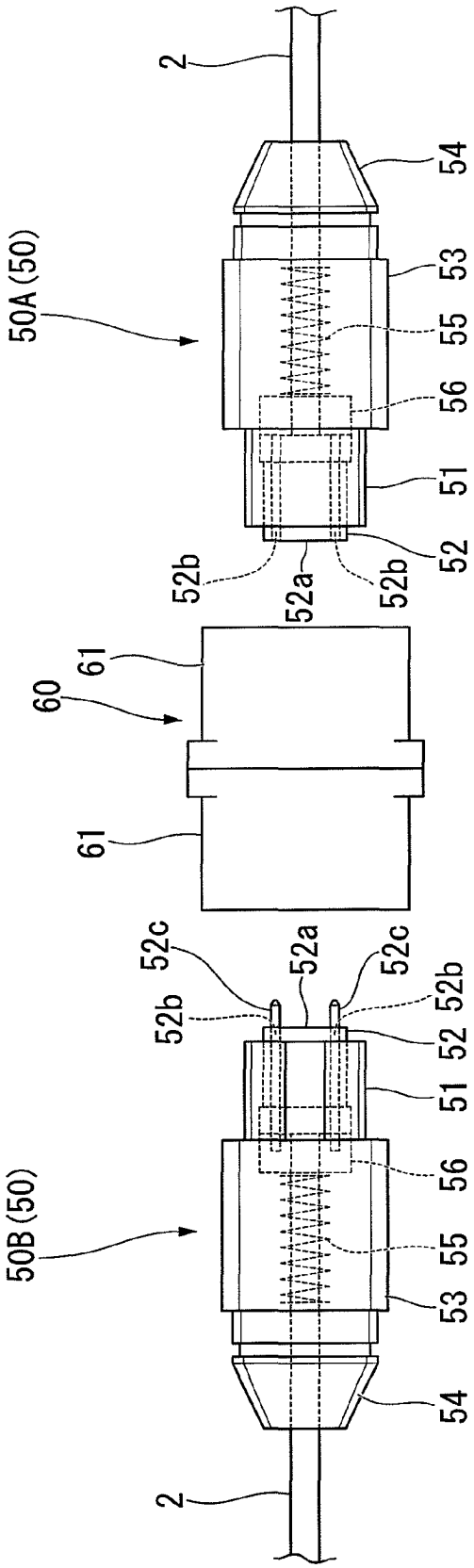

2
54
51a
53
53a
51
52
50A (50)
63
64a
63
65
62a
62
62b
61
60
62c
64
64a
61
52c
52
51
53
51b
54
50B (50)
2
FRONT
REAR

FIG. 20

FIG. 21


2
54
50A (50)
53
55
56
51
52
52b
52a
52b
61
60
61
52c
52a
52c
52b
52b
52
51
56
50B (50)
55
53
54
2

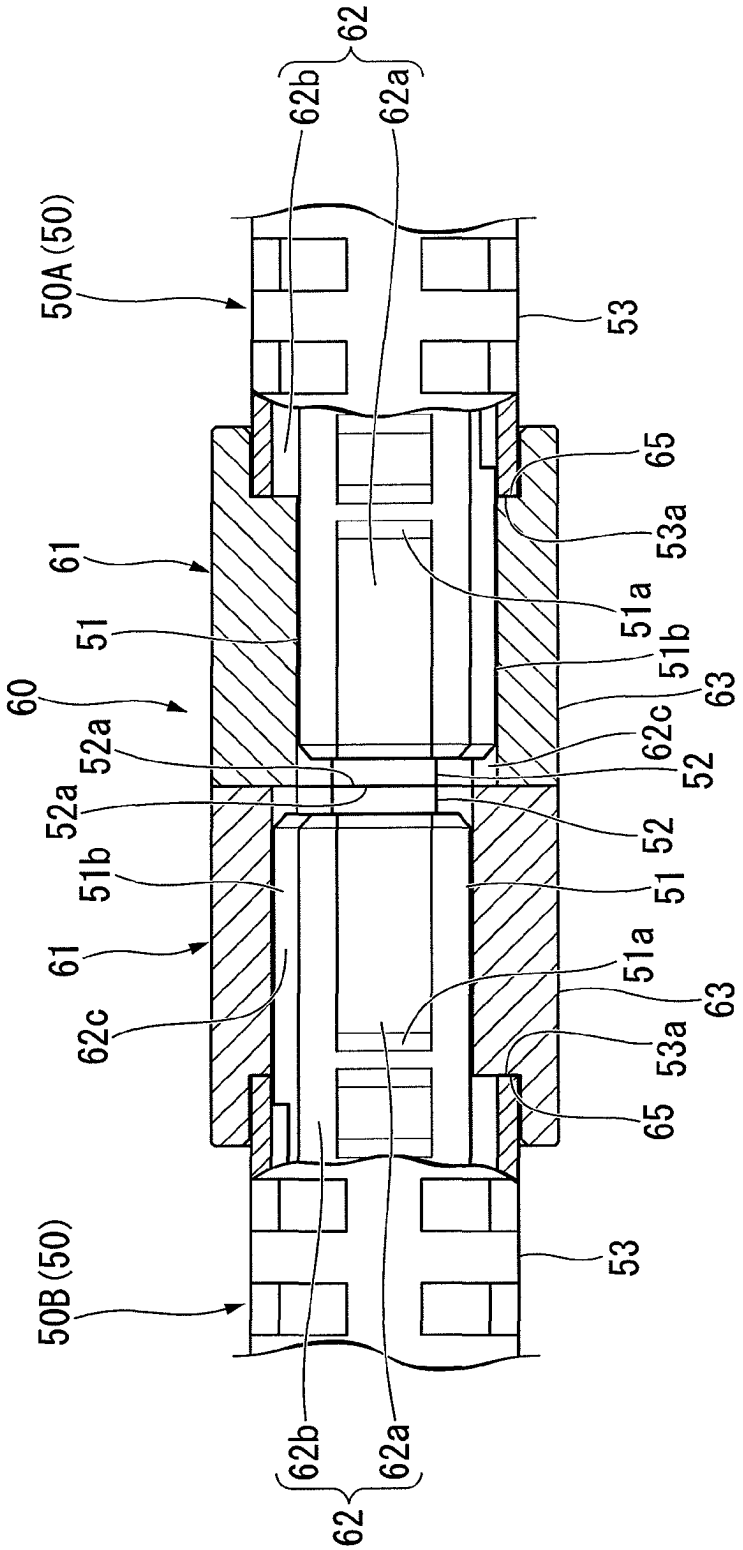

62
62b
62a
50A (50)
53
65
53a
61
51a
51
51b
60
63
52a
62c
52
52a
52
51b
51
61
51a
63
62c
53a
65
50B (50)
53
62b
62a
62

FIG. 22

FIG. 23

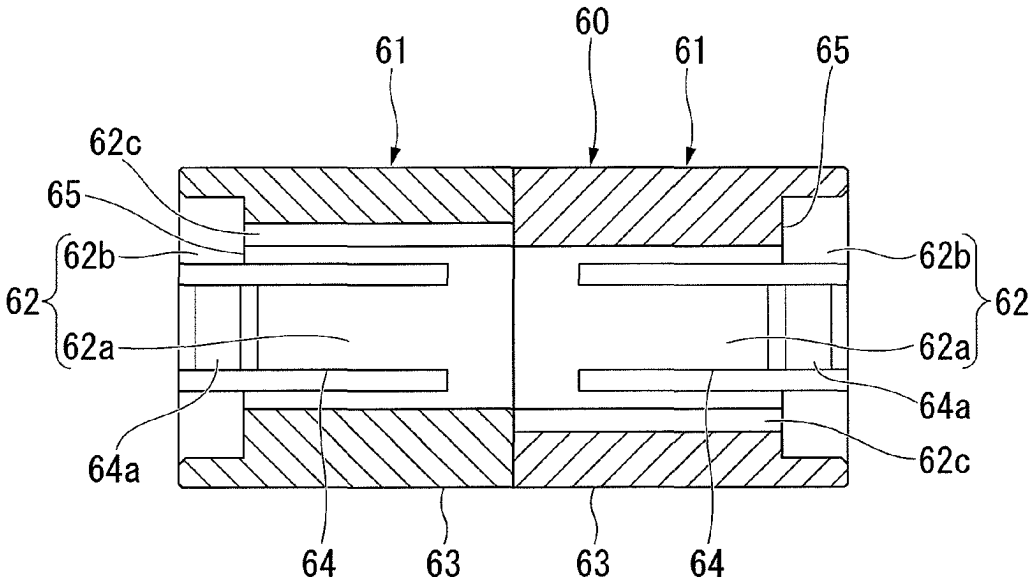
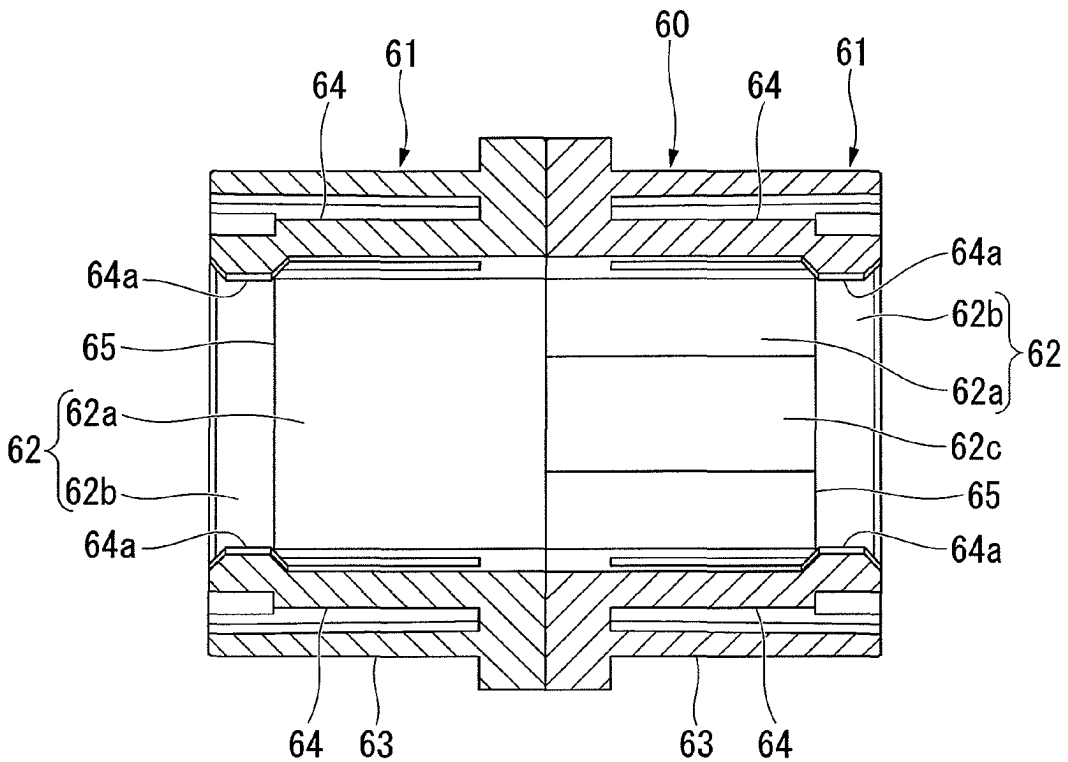

61
60
61
65
62c
65
62b
62
62a
62b
62
62a
64a
64a
62c
64
63
63
64

FIG. 24


60
61
64
64
61
64a
64a
62b
62
65
62a
62
62a
62c
62b
65
64a
64a
64
63
63
64

OPTICAL CONNECTOR, CONNECTOR ADAPTER, OPTICAL FIBER LINE, AND OPTICAL COMMUNICATION SYSTEM

[0001] Priority is claimed on Japanese Patent Application No. 2010-222800, filed Sep. 30, 2010, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to an optical connector, an optical fiber line, and an optical communication system, and more particularly, to an optical connector that is inserted into an opening of a connector adapter and that is connected to another optical connector inserted into the other opening, a connector adapter to which the optical connector can be inserted and coupled, an optical fiber line that optically connects optical fibers using the optical connector and the connector adapter, and an optical communication system.

[0004] 2. Description of the Related Art

[0005] An optical connector having a slide lock structure and being coupled to a connector adapter or the like in a push-on manner has been widely diffused.

[0006] An example of such a type of optical connector is an MPO type optical connector (an F13 type optical connector defined in the JIS C5982 or an optical connector defined in the IEC 61754-7; MPO: Multi-fiber Push On) (for example, see Japanese Unexamined Patent Application Publication No. H10-206689, "F13 TYPE MULTI-CORE OPTICAL FIBER CONNECTOR C5982: 1997, JIS Handbook Electronic Test Method/Optoelectronics Part, published by Japanese Standards Association, Apr. 24, 1998", and "IEC 61754-7 Fiber Optic Connector Interface Part 7: Type MPO Connector Family").

SUMMARY OF THE INVENTION

[0007] Optical connectors having a variety of configurations have been developed.

[0008] There exists an optical connector (hereinafter, also referred to as "nonstandard optical connector") of which the external structure and the coupling structure to a connector adapter are the same as an optical connector (hereinafter, also referred to as "standard optical connector") having the standard structure defined for example in the JIS or the IEC standard, but of which the internal structure, the mechanical characteristics, and the like are different from the standard ones.

[0009] The nonstandard optical connector has the same external structure as the standard optical connector and thus they cannot be visually distinguished from each other.

[0010] Since the nonstandard optical connector can be inserted into and coupled to the same connector adapter as the standard optical connector, the nonstandard optical connector can be inserted into a connector adapter, thereby causing erroneous connection to the standard optical connector.

[0011] Accordingly, it is difficult to use the nonstandard optical connector as distinct from the standard optical connector.

[0012] An MPO type optical connector will be described below as an example.

[0013] Regarding the MPO type optical connector, the number of cores defined in the JIS is 12 cores, but 24-core and 48-core MPO type optical connectors (hereinafter, referred to as "24 MPO and 43 MPO") in which optical fibers are two-dimensionally arranged have been developed.

[0014] The basic structure other than a ferrule of the 24 MPO and 48 MPO (hereinafter, also abbreviated as 24 and 48 MPOs) is based on the JIS or the IEC standard.

[0015] The 24 and 48 MPOs can be connected using a standard connector adapter defined in the standard.

[0016] However, in the 24 and 48 MPOs, the spring pressure defined in the IEC standard is not sufficient as a spring pressure of a built-in spring pressing the ferrule to realize stable physical contact (PC) coupling of end faces of the optical fibers exposed from the end face of the ferrule.

[0017] Accordingly, in order to realize the stable PC coupling, it is necessary to raise the spring pressure of the 24 and 48 MPOs.

[0018] However, when the 24 and 48 MPOs (nonstandard optical connectors) having the raised spring pressure are assembled using the same components (components other than a spring) as the 24 and 48 MPOs (standard optical connectors) of which the spring pressure is defined in the IEC standard, the nonstandard optical connectors are not visually distinguishable from the standard 24 and 48 MPOs.

[0019] In this case, when it is intended to connect the 24 and 48 MPOs having a spring pressure sufficient to realize the PC coupling, the 24 and 48 MPOs having a spring pressure defined in the IEC may be connected to the 24 and 48 MPOs having an enhanced spring pressure.

[0020] The invention is made in consideration of the above-mentioned circumstances

[0021] A goal of the invention is to provide an optical connector that can realize its use as distinct from a standardized optical connector at a low cost, a connector adapter to which the optical connector can be inserted and coupled, an optical fiber line in which optical fibers are coupled using the optical connector and the connector adapter, and an optical communication system.

[0022] To achieve the above-mentioned goal, the invention provides the following configurations.

[0023] A first invention provides an optical connector including a housing that receives a ferrule and a coupling into which the housing is inserted.

[0024] Additionally, a connecting end face includes one or more protruding portions protruding and one or more recessed portions depressed relative to a reference plane corresponding to a reference face of a coupling of a standardized optical connector.

[0025] A second invention provides the optical connector according to the first invention, further including a key protruding from a side surface of the housing and extending in a connector length direction.

[0026] Additionally, the coupling includes one or more the protruding portions or the recessed portions on the side of the key.

[0027] A third invention provides the optical connector according to the second invention.

[0028] Additionally, the connecting end face of the coupling includes the recessed portions just above the key and the protruding portions on at least one side in the width direction of the recessed portions.

[0029] A fourth invention provides the optical connector according to the second or third invention.

[0030] Additionally, the connecting end face of the coupling includes one or more the protruding portions or the recessed portions on the opposite side of the key.

[0031] A fifth invention provides a connector adapter to which the optical connector is to be inserted and coupled, the connector adapter according to any one of the first to fourth inventions can be inserted and coupled.

[0032] In addition, the connector adapter includes an opening end portion into which the optical connector is inserted, the opening end portion including one or more adapter protrusions protruding and one or more adapter recesses depressed relative to an adapter reference plane, an adapter reference plane corresponding to an adapter reference face coming in contact with the reference face of the coupling of the standardized optical connector in a connector adapter to which the standardized optical connector is inserted and coupled

[0033] Additionally, the optical connector is to be coupled to the connector adapter by inserting the protruding portions of the connecting end face of the coupling into the adapter recesses and by receiving the adapter protrusions in the recessed portions of the connecting end face.

[0034] A sixth invention provides an optical fiber line and a connector coupling section in which optical fibers are coupled to each other using the optical connector according to any one of the first to fourth inventions and the connector adapter according to the fifth invention.

[0035] A seventh invention provides an optical communication system including optical fibers coupled to each other using the optical connector according to any one of the first to fourth inventions attached to an end of the optical fibers and using the connector adapter according to the fifth invention.

[0036] An eighth invention provides the optical communication system according to the seventh invention.

[0037] Additionally, the optical connectors to be identified differ from each other in the number of at least one of the protruding portions and recessed portions of the coupling.

[0038] A ninth invention provides the optical communication system according to the seventh or eighth invention.

[0039] Additionally, the optical connectors to be identified differ from each other in the number of at least one of the protruding portions and recessed portions of the coupling.

[0040] A tenth invention provides the optical communication system according to any one of the seventh to ninth inventions.

[0041] Additionally, the optical connectors to be identified differ from each other in the color of at least a part of the optical connectors.

[0042] An eleventh invention provides the optical communication system according to the tenth invention.

[0043] Additionally, the optical connectors to be identified differ from each other in the color of the coupling.

[0044] Since the optical connector according to the invention employs the coupling having the connecting end face in which the protruding portions and the recessed portions are formed relative to the reference plane corresponding to a reference face of a coupling of a standardized optical connector (hereinafter, also referred to as a standard optical connector), it is possible to restrict the fitting (coupling) to a connector adapter (standard connector adapter) for the standard optical connector.

[0045] That is, since the optical connector can restrict the fitting (coupling) to a standard connector adapter with a simple configuration at a low cost, it is possible to realize its use as distinct from a standard optical connector at a low cost.

[0046] The connector adapter according to the invention can be used in connection between the optical connectors and can restrict the fitting (coupling) of the standard optical connector.

[0047] Accordingly, when the connector adapter is configured so that it can be used in connection between the optical connectors according to the invention which are inserted and coupled from both ends of the connector adapter, it is possible to effectively contribute to prevention of erroneous connection between the optical connector according to the invention and a standard optical connector.

[0048] As a result, in the optical fiber line and the optical communication system in which optical fibers are connected to each other using the optical connector and the connector adapter according to the invention, it is possible to realize use of the optical connector according to the invention as distinct from a standard optical connector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] FIGS. **1**A and **1**B are diagrams illustrating an external structure of an optical connector (MPO type optical connector) according to a first embodiment of the invention, where FIG. **1**A is a perspective view as seen from a side (top side) of a housing having a key and FIG. **1**B is a perspective view as seen from a bottom side opposite to the top side of the housing having a key.

[0050] FIG. **2** is a diagram illustrating a structure of the optical connector as seen from the front side thereof.

[0051] FIG. **3** is a diagram illustrating a connector adapter according to the first embodiment of the invention (a connector adapter according to the invention) to which the optical connector shown in FIGS. **1**A and **1**B can be inserted and coupled, where an adapter protrusion and an adapter recess corresponding to a protruding portion and a recessed portion on the bottom surface of the optical connector.

[0052] FIG. **4** is a perspective view illustrating an adapter protrusion and an adapter recess, corresponding to a recessed portion and a protruding portion on the top surface of the optical connector, of the connector adapter shown in FIG. **3**.

[0053] FIG. **5** is a plan view (a model diagram) illustrating the optical connector (an F type optical connector) shown in FIG. **1** and an optical connector (an M type optical connector) having a configuration in which guide pins are disposed in the optical connector.

[0054] FIG. **6** is a diagram illustrating the structure of the connector adapter shown in FIG. **3** as seen from the opening side of a connector insertion hole.

[0055] FIG. **7** is a front sectional view illustrating the internal structure of the connector adapter shown in FIG. **3**.

[0056] FIG. **8** is a horizontal sectional view illustrating the internal structure of the connector adapter shown in FIG. **3**.

[0057] FIG. **9** is a front sectional view illustrating a state in which the optical connectors shown in FIG. **1** are connected (coupled) to each other using the connector adapter shown in FIG. **3**.

[0058] FIG. **10** is a horizontal sectional view illustrating a state in which the optical connectors shown in FIG. **1** are connected (coupled) to each other using the connector adapter shown in FIG. **3**.

[0059] FIG. **11** is a front sectional view illustrating prevention of erroneous coupling of the optical connector shown in FIGS. **1**A and **1**B to a standardized connector adapter (standard connector adapter).

[0060] FIG. **12** is a front sectional view illustrating prevention of erroneous coupling of a standardized optical connector (MPO type optical connector, standard optical connector) to the connector adapter shown in FIG. **3**.

[0061] FIG. **13** is a horizontal sectional view illustrating prevention of erroneous coupling of a standardized optical connector (MPO type optical connector, standard optical connector) to the connector adapter shown in FIG. **3**.

[0062] FIGS. **14**A and **14**B are model diagrams illustrating an example of the relation between the protruding portion and the recessed portion of a coupling of the optical connector and the adapter recess and the adapter protrusion of the connector adapter, where FIG. **14**A shows a state before coupling (fitting) the optical connector to the connector adapter and FIG. **14**B shows a state at the time of coupling (fitting).

[0063] FIGS. **15**A and **15**B are model diagrams illustrating another example of the relation between the protruding portion and the recessed portion of a coupling of the optical connector and the adapter recess and the adapter protrusion of the connector adapter, where FIG. **15**A shows a state before coupling (fitting) the optical connector to the connector adapter and FIG. **15**B shows a state at the time of coupling (fitting).

[0064] FIG. **16** is a model diagram illustrating a front end structure (a recessed-protruding shape of a connecting end face) of a coupling of an optical connector according to Comparative Example 1 and a protruded-recessed structure of an opening end portion of a connector adapter according to Comparative Example 1.

[0065] FIG. **17** is a model diagram illustrating a front end structure (a protruded-recessed shape of a connecting end face) of a coupling of an optical connector according to Comparative Example 2 and a protruded-recessed structure of an opening end portion of a connector adapter according to Comparative Example 2.

[0066] FIGS. **18**A and **18**B are perspective views illustrating optical connectors according to other embodiments of the invention.

[0067] FIG. **19** is a perspective view illustrating a standard optical connector shown in FIGS. **12** and **13**.

[0068] FIG. **20** is a perspective view illustrating the standard optical connector shown in FIGS. **12** and **13** and a standardized connector adapter (standard connector adapter) to which the standard optical connector can be inserted and coupled (fitted).

[0069] FIG. **21** is a plan view illustrating the standard optical connector and the standard connector adapter shown in FIG. **20**.

[0070] FIG. **22** is a front sectional view illustrating a state in which the standard optical connectors shown in FIG. **20** are connected to each other using a standard connector adapter.

[0071] FIG. **23** is a front sectional view illustrating the internal structure of the standard connector adapter shown in FIGS. **11** and **20**.

[0072] FIG. **24** is a horizontal sectional view illustrating the internal structure of the standard connector adapter shown in FIGS. **11** and **20**.

DETAILED DESCRIPTION OF THE INVENTION

[0073] Hereinafter, a first embodiment of the invention will be described with reference to the accompanying drawings.

[0074] As shown in FIGS. **1**A and **1**B, an optical connector **10** according to this embodiment has the same configuration as an optical connector **50** (see FIGS. **19** and **20**) to be described later which is a standardized MPO type optical connector based on the JIS C5982 or the IEC 61754-7, except for a coupling.

[0075] The constituent elements other than the coupling **13** of the optical connector **10** are the same as the optical connector **50**.

[0076] In this specification, the optical connector **10** is treated as an MPO type optical connector.

[0077] Here, the optical connector **50** which is a standardized MPO type optical connector based on the JIS C5982 or the IEC 61754-7 is an example of a standardized optical connector.

[0078] In this embodiment, the side of the optical connector **10** in which a ferrule **12** at an end (front end) of a sleeve-like housing **11** is disposed is defined as a front side and the opposite side thereof is defined as a rear side as indicated by arrows in FIGS. **1**A and **1**B.

[0079] In the optical connector **10**, the ferrule **12** attached to an end of an optical fiber **1** is received in an end (front end) of the sleeve-like housing **11**.

[0080] In the optical connector **10**, a spring **15** (see FIG. **5**) elastically impelling the ferrule **12** to the front side of the connector is disposed in the housing **11**.

[0081] The optical connector **10** further includes a tubular coupling **13** into which the housing **11** is inserted and which is disposed to be slidable within a movable range guaranteed in an axis line direction relative to the housing **11** and a boot **14** that is attached to a rear end portion opposite to the front end portion of the housing **11** in which the ferrule **12** is disposed.

[0082] The optical connector **10** shown in the drawing is attached to an end of the optical fiber **1**.

[0083] The optical fiber **1** is inserted into the tubular boot **14** and is guided into the housing **11** of the optical connector **10**.

[0084] The optical fiber **1** extends from the rear end of the boot **14**.

[0085] The optical connector **10** is a plastic connector assembled using the housing **11**, the ferrule **12**, the coupling **13**, and the boot **14**, which are plastic-molded products.

[0086] The housing **11** has a structure based on the JIS C5982 or the IEC 61754-7.

[0087] In the ferrule **12**, the end portion in which a butt-joint end face **12***a* (contact end face) is formed protrudes from the front end of the housing **11**.

[0088] However, the ferrule **12** can be pushed into the rear side of the housing **11** against the elastic impelling force of the spring in the housing **11**.

[0089] The ferrule **12** employs an MT type optical connector (an F12 type optical connector defined in the JIS c 5981, MT: Mechanically Transferable).

[0090] The MT type optical connector may be based on the IEC 61754-5.

[0091] In this embodiment, a 12-core optical fiber tape is employed as the optical fiber **1**.

[0092] Herein, the ferrule **12** is a 12-core MT type optical connector attached to an end of the 12-core optical fiber tape (optical fiber **1**).

[0093] As shown in FIGS. **1**A and **1**B, the ferrule **12** of the optical connector **10** has a plate-like shape having a rectangular end face **12***a*.

[0094] As shown in FIG. **5**, a pair of guide pin holes **12***b* passing through the ferrule **12** from front to rear is formed at both end portions in the width direction parallel to the length direction of the end face **12***a* of the ferrule **12**.

[0095] In the end face **12***a* of the ferrule **12**, ends of 12 bare optical fibers **1***a* interfering with the end of the optical fiber **1** (optical fiber tape) and being fixed to the ferrule **12** are exposed between the pair of guide pin holes **12***b*.

[0096] The ends of the bare optical fibers **1***a* exposed from the end face **12***a* of the ferrule **12** are arranged in a line in the spacing direction of the pair of guide pin holes **12***b*.

[0097] The number of cores of the optical fiber tape used as the optical fiber **1** is not limited to 12, and may be, for example, 2, 4, or 8.

[0098] The number of cores of the ferrule **12** (MT type optical connector) corresponds to the number of cores of the optical fiber tape.

[0099] As shown in FIG. **5**, the optical connectors **10** are classified into two types of an F type optical connector **10**A having a configuration in which the front ends of the pair of guide pin holes **12***b* are opened in the end face **12***a* of the ferrule **12** and an M type optical connector **10**B in which guide pins **12***c* to be inserted and fitted into the pair of guide pin holes **12***b* of the ferrule **12** of the F type optical connector **10**A protrude from the end face of the ferrule **12**.

[0100] FIGS. **1**A and **1**B show the F type optical connector **10**A.

[0101] The M type optical connector **10**B is the same as the F type optical connector **10**A, except that it includes a pair of guide pins **12***c*.

[0102] As shown in FIG. **5**, the optical connectors **10** are inserted into the connector adapter **20** (hereinafter, also simply referred to as "adapter") from both ends thereof, respectively, and the end faces **12***a* of the ferrules **12** are butt jointed to each other, whereby the connection coupling between the optical fibers **1** can be realized.

[0103] Here, one of the pair of optical connectors **10** inserted into the adapter **20** and connected to each other is an F type optical connector **10**A and the other thereof is an M type optical connector **10**B.

[0104] The optical connectors **10**A and **10**B inserted into the adapter **20** from both ends thereof are connected to each other by inserting and fitting portions, which protrude from the end face of the ferrule **12**, of the pair of guide pins **12***c* of the M type optical connector **10**B into the empty guide pin holes **12***b*, which are opened from the end face **12***a* of the ferrule **12**, of the front end of the F type optical connector **10**A and butt jointing the ferrules **12**.

[0105] At this time, a pair of guide pins **12***c* performs a function of positioning the ferrules **12** of the optical connectors **10**A and **10**B with high accuracy.

[0106] As a result, the optical connectors **10**A and **10**B are butt jointed to each other in a state where the bare optical fibers **1***a* exposed from the end face **12***a* of the ferrules **12** are positioned with high accuracy, thereby connector-coupling (optically connecting) the optical fibers **1**.

[0107] The guide pins **12***c* of the M type optical connector **10**B are fixed and locked to a pink lamp **16** disposed between the ferrule **12** and the spring **15** disposed in the back thereof.

[0108] In the F type optical connector **10**A, a pink lamp **16** is disposed between the ferrule **12** and the spring **15** so as to set the spring pressure of the spring **15** to be equal to that of the M type optical connector **10**B.

[0109] Here, in the F type optical connector **10**A, a spacer that can maintain the distance between the ferrule **12** and the spring **15** so as to be equal to that in the case where the pink lamp **16** is disposed therebetween may be used instead of the pink lamp **16**.

[0110] In the F type optical connector **10**A, the spring **15** may come in direct contact with the rear end of the ferrule **12** so as to elastically impel the ferrule **12** to the connector front side.

[0111] Specifically, the spring **15** is a coil spring.

[0112] In the optical connector **10** shown in FIG. **5**, the optical fiber **1** is inserted into the spring **15** and the spring is interposed between a spring bearing not shown and disposed in the housing **11** and the pink lamp **16** in the front thereof.

[0113] A fiber insertion portion that is a groove or a through-hole passing the optical fiber **1** is formed in the pink lamp **16**.

[0114] The pink lamp **16** is interposed between the ferrule **12** and the spring **15** in the state where the optical fiber **1** is received in the fiber insertion portion.

[0115] As shown in FIGS. **1**A, **1**B and **2**, in the housing **11** of the optical connector **10**, a section (hereinafter, also referred to as a cross-section) perpendicular to the axis line direction thereof has a long and thin (flat) sleeve shape.

[0116] The housing **11** has a configuration in which both main wall portions **11***c* and **11***d* (an upper wall portion **11***c* and a lower wall portion **11***d*) having a long plate shape and being parallel to each other are bridged to each other by side wall portions **11***e* on both ends in the length direction of the cross-section.

[0117] The distance between the pair of side wall portions **11***e* is greater than the distance between the pair of main wall portions **11***c* and **11***d*.

[0118] As shown in FIGS. **1**A, **1**B, and **2**, a section (hereinafter, also referred to as a cross-section) perpendicular to the axis line direction of the coupling **13** has a long and thin (flat) tubular shape.

[0119] The housing **11** is inserted into the coupling in a state where the length direction of the cross-section is set to be parallel to the length direction of the cross-section of the housing **11**.

[0120] The coupling **13** has a configuration in which two face plate portions **13***f* and **13***g* (an upper plate portion **13***f* and a lower plate portion **13***g*) parallel to each other are bridged to each other by side plate portions **13***h* at both ends of the length direction of the cross-section thereof.

[0121] In this description, the upside of the optical connector **10** is defined as the top and the downside is defined as the bottom in FIGS. **1**A and **2**.

[0122] In this description, the length direction of the cross-section of the housing **11** and the coupling **13** in the optical connector **10** is defined as a "width direction" and the short side direction perpendicular to the length direction of the cross-section is defined as a "thickness direction".

[0123] As shown in FIGS. **1**A, **1**B and **2**, the front end faces of a pair of side plate portions **13***h* are perpendicular to the center axis direction of the coupling **13**.

[0124] The front end face (the connecting end face) of the coupling **13** includes a reference end face **13***a* that is formed perpendicular to the center axis direction of the coupling **13** and that includes the front end faces **13***h***1** of the pair of side plate portions **13***h*, protruding portions **13***b* protruding to the

connector front side from the referenced end face **13***a*, and recessed portions **13***c* depressed to the connector rear side from the reference end face **13***a*.

[0125] The protrusions **13***d* forming the protruding portions **13***b* of the front end face and cutouts **13***e* forming the recessed portions **13***c* of the front end face are formed at the front end of the coupling **13**.

[0126] The protrusions **13***d* and the cutouts **13***e* are all formed in the face plate portions **13***f* and **13***g* of the coupling **13**.

[0127] The protrusions **13***d* protrude to the connector front side from a coupling reference plane **13***i* which is a virtual plane (see FIG. **5**) overlapping with the reference end face **13***a* perpendicular to the center axis line of the coupling **13**.

[0128] The cutouts **13***e* are recessed places depressed to the connector rear side from the coupling reference plane **13***i*.

[0129] The protruding portions **13***b* in the front end face of the coupling **13** indicate protrusion shaped portions formed by the outer end faces of the protrusions **13***d* among the front end face of the coupling **13**.

[0130] The recessed portions **13***c* indicate recess shaped portions formed by the inner circumferential surfaces of the cutouts **13***e* in the front end face of the coupling **13**.

[0131] As shown in FIGS. **19** and **22**, the coupling **53** of the standardized optical connector **50** (hereinafter, also referred to as the standard optical connector) based on the JIS standard (JIS C5982) or the IEC standard (IEC 61754-7) has a front end face **53***a* (reference face) perpendicular to the center axis direction of the coupling **53**.

[0132] On the contrary, the optical connector **10** is different from the standardized optical connector **50**, in that the coupling **13** has the configuration in which the protruding portions **13***b* protruding to the connector front side and the recessed portions **13***c* depressed to the connector rear side relative to the coupling reference plane **13***i*.

[0133] The position (the position relative to the housing **11**) of the reference end face **13***a* of the coupling **13** in the optical connector is the same as the position (the position of the standard optical connector **50** relative to the housing **51**) of the front end face **53***a* of the coupling **53** in the standard optical connector **50**.

[0134] The front end face of the coupling **13** of the optical connector **10** includes the protruding portions **13***b* protruding to the connector front side from the coupling reference plane **13***i* corresponding to the front end face **53***a* (the reference face) of the coupling **53** of the standard optical connector **50** and the recessed portions **13***c* depressed to the connector rear side from the coupling reference plane **13***i*.

[0135] The coupling **13** is elastically impelled to the connector front side relative to the housing **11** by a coupling spring not shown but disposed inside the coupling.

[0136] Stopper contact protrusions **13***j* (see FIG. **9**) coming in contact with front stopper protrusions **11***f* (see FIG. **9**) protruding from the outer circumferential surface of the housing **11** from the front side protrudes inside the coupling **13**.

[0137] Specifically, the stopper contact protrusions **13***j* of the coupling **13** protrude from the face plate portions **13***f* and **13***g* of the coupling **13**.

[0138] Specifically, the front stopper protrusions **11***f* of the housing **11** protrude from the main wall portions **11***c* and **11***d* of the housing **11**.

[0139] The coupling **13** is located at a front movement limit position at which the stopper contact protrusions **13***j* come in contact with the front stopper protrusions **11***f* of the housing **11** by means of the elastic impelling force of the coupling spring.

[0140] In FIGS. **1**A and **1**B, the coupling **13** is located at the front movement limit position.

[0141] The coupling **13** is maintained in the state where it is stopped at the front movement limit position by means of the elastic impelling force of the coupling spring, when a displacing force from the front movement limit position to the rear side is not given to the housing **11**.

[0142] As shown in FIGS. **1**A and **1**B, the coupling **13** is located at a position moving to the connector rear side from the front end of the housing **11** when it is located at the front movement limit position.

[0143] The coupling **13** can be manually moved to slide against the elastic impelling force of the coupling spring from the front movement limit position to the connector rear side relative to the housing **11**.

[0144] The coupling **13** having moved from the front movement limit position to the connector rear side is restored to the front movement limit position by means of the elastic impelling force of the coupling spring, when the displacing force to the connector rear side relative to the housing **11** is removed (unloaded).

[0145] FIGS. **7** and **8** illustrate an adapter **20** used to connect the optical connectors **10** (the F type optical connector **10**A and the M type optical connector **10**B).

[0146] As shown in FIGS. **3** and **4**, the optical connector **10** can be inserted into the connector insertion hole **20***a* formed to pass through the adapter **20** from the front end, whereby the optical connector can be coupled (fitted) to the adapter **20** in a push-on manner.

[0147] As shown in FIGS. **7** and **8**, the adapter **20** includes a pair of adapter half bodies **21** having the same configuration and being assembled into a body.

[0148] Each adapter half body **21** has a schematic structure in which a pair of elastic engagement pieces **23** locking the optical connector **10** inserted into the connector fitting hole **24** to the adapter half body **21** protrudes inside a tubular connector receiving housing **22** through which the connector fitting hole **24** is formed.

[0149] The elastic engagement piece **23** is formed of a thin and long piece extending from one end in the axis line direction of the connector receiving housing **22** to the other end.

[0150] Two elastic engagement pieces **23** are separated from each other inside the connector fitting hole **24** and extend along the inner surface of the connector fitting hole **24**.

[0151] Two adapter half bodies **21** are formed in a body by bringing the end portions (end portions in the axis line direction, hereinafter, also referred to as base end portions) on the side in which the elastic engagement pieces **23** of the connector receiving housings **22** protrude into contact with each other and cause the connector fitting holes **24** inside the connector receiving housing **22** to communicate with each other.

[0152] The adapter **20** includes a tubular adapter housing in which the connector receiving housings **22** of two adapter half bodies **21** are formed in a body.

[0153] The connector receiving housing **22** of the adapter half body **21** is also referred to as a half-body housing.

[0154] The connector insertion hole **20***a* of the adapter **20** is formed by causing the connector fitting holes **24** of the adapter half bodies **21** to communicate with each other.

[0155] In the adapter **20**, the front end portions opposite to the base end portions of the half-body housings **22** of two adapter half bodies **21** are formed of openings at both ends in the axis line direction of the connector insertion hole **20***a*.

[0156] The optical connectors **10** can be inserted into the connector insertion hole **20***a* from the openings.

[0157] In this description, the openings are treated as openings used to insert the optical connectors into the connector fitting holes **24** in the adapter half bodies **21** of the adapter **20**.

[0158] In this description, the openings are also referred to as fitting-hole openings and the end portion opposite to the base end portion of the half-body housing **22** in each adapter half body **21** is also referred to as an opening end portion (or half-body opening end portion).

[0159] Since both end portions in the axis line direction of the adapter **20** are the opening end portions of the adapter half bodies, both end portions in the axis line direction of the adapter **20** may be referred to as the opening end portions.

[0160] As shown in FIGS. **3** and **4**, the optical connector **10** can be coupled to the adapter half body **21** by pushing the optical connector into the connector fitting hole **24** from the opening end portion of the adapter half body **21**.

[0161] As shown in FIGS. **4** and **9**, the optical connector **10** is inserted into the adapter half body **21** by inserting a reverse-insertion preventing key **11***b* protruding from the outer circumferential surface of the housing **11** into a key groove **24***b* formed in the inner surface of the half-body housing **22** of the adapter half body **21**.

[0162] The insertion of the optical connector **10** into the adapter half body **21** is carried out by allowing an operator to press a portion of the optical connector **10**, which is located in the back of the coupling **13**, for example, the boot **14**, to touch the adapter half body **21** with his or her finger.

[0163] The key **11***b* of the housing **11** of the optical connector **10** is a ridged portion formed on the upper wall portion **11***c* of the housing **11** so as to extend along the axis line direction of the housing **11** from the front end of the housing **11**.

[0164] The key **11***b* protrudes from the upper wall portion **11***c* at the center in the width direction of the housing **11**.

[0165] In this description, the side on which the key **11***b* is disposed in the optical connector **10** is defined as the upside (the top side) and the opposite side is defined as the downside (the bottom side).

[0166] As shown in FIGS. **3** and **4** and FIGS. **6** to **8**, the connector fitting hole **24** of each adapter half body **21** positions the optical connector **10** inserted into the connector fitting hole **24** from the opening so that it can butt joint the optical connector inserted into the adapter **20** from the opposite side (the ferrules butt each other).

[0167] In the inner surface of the half-body housing **22** of the adapter half body **21** shown in the drawings, grooved adapter recesses **25** into which the protrusions **23***d* at the front end of the coupling **13** of the optical connector **10** are inserted and are formed to extend from the fitting hole opening to the half-body base end portion (on which the base end portion of the half-body housing **22** is disposed).

[0168] Adapter protrusions **26** that are received in the cutouts **13***e* of the coupling **13** of the optical connector **10** are formed on the inner surface of the half-body housing **22**.

[0169] As shown in FIGS. **3**, **4**, and **6**, protruding wall portions **27***a* forming coupling contact faces **27**, with which the front end faces **13***h***1** of the side plate portions **13***h* on both ends in the width direction of the coupling **13** of the optical connector **10** inserted into the connector fitting hole **24** come in contact, protrude from the inner surface of the half-body housing **22**.

[0170] The section of the connector fitting hole **24** has a thin and long shape of which the length direction is parallel to the spacing direction between a pair of elastic engagement pieces **23**.

[0171] The protruding wall portions **27***a* protrude from the inner surface of the half-body housing **22** at both ends in the length direction of the section of the connector fitting hole **24** toward both ends in the short side direction of the section (the up and down direction in FIG. **6**) of the connector fitting hole **24** with the elastic engagement pieces **23** interposed therebetween.

[0172] The protruding wall portions **27***a* protrude from four positions of the inner surface of the half-body housing **22**.

[0173] The protruding wall portions **27***a* extend from the positions slightly departing from the fitting-hole opening to the half-body base end portion in the vicinity of the half-body opening end toward the half-body base end portion.

[0174] The coupling contact face **27** is formed by the end faces of the protruding wall portions **27***a* facing the fitting-hole opening.

[0175] The connector fitting hole **24** of the adapter half body **21** in the drawings includes a housing receiving hole **241** extending from the coupling contact face **27** to the half-body base end portion and an entrance hole portion **242** extending from the coupling contact face **27** to the fitting-hole opening.

[0176] The adapter recesses **25** formed in the inner surface of the half-body housing **22** extend from the entrance hole portion **242** to the housing receiving hole **241**.

[0177] Here, the inner surface of the housing receiving hole **241** includes a positioning hole portion **243**, which is a region in which the adapter recesses **25** are not formed, on the side separated to the half-body base end portion from the region in which the adapter recesses **25** are formed.

[0178] The positioning hole portion **243** includes neither the adapter recesses **25** nor the adapter protrusions **26**.

[0179] As shown in FIGS. **6**, **7**, and **8**, the key groove **24***b* of the adapter half body **21** is formed in the inner surface of the half-body housing **22** so as to extend in the axis line direction of the half-body housing **22**.

[0180] The key groove **24***b* is a part of the positioning hole portion **243**.

[0181] As shown in FIGS. **7** and **8**, the housing receiving hole **241** constitutes the entire part, which is deep from the entrance hole portion **242**, of the connector fitting hole **24** and the end portion close to the half-body base end portion (close to the base end portion of the half-body housing **22**) thereof is the end portion of the connector fitting hole **24** close to the half-body base end portion.

[0182] The positioning hole portion **243** of the housing receiving hole **241** includes the key groove **24***b* and a fitting-hole main hole portion **24***a* that has a long and thin sectional shape (which is a section perpendicular to the axis line direction) and into which the part of the housing **11** of the optical connector **10** other than the key **11***b* is inserted.

[0183] The key groove **24***b* is formed by elongating the central portion in the length direction of the section of the fitting-hole main hole portion **24***a* toward an end in the short side direction (the up and down direction in FIGS. **6** and **7**) of the section perpendicular to the length direction of the section of the fitting-hole main hole portion **24***a*.

[0184] Two elastic engagement pieces **23** of the adapter half body **21** are disposed at both ends in the length direction of the section of the connector fitting hole **24**.

[0185] The ends of two elastic engagement pieces **23** are located in the entrance hole portion **242** of the connector fitting hole **24**.

[0186] When the optical connector **10** is inserted into and coupled to the adapter half body **21**, the key **11***b* of the housing **11** is inserted into the key groove **24***b* of the adapter half body **21** and the part of the housing **11** other than the key **11***b* is inserted between the pair of elastic engagement pieces **23** in the connector fitting hole **24**.

[0187] As shown in FIGS. **9** and **10**, the optical connector **10** is inserted into the connector fitting hole **24** of the adapter half body **21** from the front end thereof.

[0188] When the optical connector **10** is inserted into the connector fitting hole **24** of the adapter half body **21**, the protruding claws **23***a* of the pair of elastic engagement pieces **23** in the adapter half body **21** are placed on engagement protrusions **11***a* protruding from the front ends of the both side wall portions **11***e* in the front end portion of the housing **11**.

[0189] The protruding claws **23***a* are formed at the ends of the elastic engagement pieces **23** in a shape protruding toward the opposite elastic engagement pieces **23** facing each other.

[0190] The elastic engagement pieces **23** are elastically deformed when the protruding claws **23***a* are placed on the engagement protrusions **11***a* of the housing **11**.

[0191] When the optical connector **10** is further inserted into the adapter half body **21** (when the housing **11** is further inserted into the connector fitting hole **24**), the front ends (the reference end face **13***a*) of the side plate portions **13***h* of the coupling **13** butt the protruding claws **23***a* at the ends of the elastic engagement pieces **23** placed on the engagement protrusions **11***a*.

[0192] With the further insertion of the optical connector **10** into the adapter half body **21**, the coupling **13** slides back to the connector rear side relative to the housing **11**.

[0193] With the further insertion of the optical connector **10** into the adapter half body **21**, the end portions (the protruding claws **23***a*) of the elastic engagement pieces **23** go over the engagement protrusions **11***a* and go into the connector rear side (an engaging recessed portion **11***g*) of the engagement protrusions **11***a*, whereby the butting state with the front ends (the reference end face **13***a*) of the side plate portions **13***h* of the coupling **13** is released.

[0194] In the optical connector **10**, when the butting of the end portions (the protruding claws **23***a*) of the elastic engagement pieces **23** with the front end (the reference end face **13***a*) of the side plate portions **13***h* of the coupling **13** is released, the coupling **13** moves to the front movement limit position by means of the elastic impelling force of the coupling spring.

[0195] In the optical connector **10**, the end portions of the pair of elastic engagement pieces **23** of the adapter half body **21** are received inside the coupling **13** (specifically in the inner surface of the side plate portions **13***h*) (the state shown in FIG. **10**).

[0196] In this way, the optical connector **10** is completely coupled to the adapter half body **21** and the adapter **20**.

[0197] At this time, the front ends (the reference end face **13***a*) of the side plate portions **13***h* of the coupling of the optical connector **10** come in contact with the coupling **13** contact face **27** of the adapter half body **21**.

[0198] The coupling **13** receiving the end portions of the elastic engagement pieces **23** of the adapter half body **21** regulating the rising-up of the end portions of the elastic engagement pieces **23** from the outer circumferential surface of the housing **11** and holds the engagement of the elastic engagement pieces **23** with the engagement protrusions **11***a*.

[0199] As shown in FIGS. **3**, **4**, and **10**, the coupling **13** of the optical connector **10** is inserted into the connector fitting hole **24** from the entrance hole portion **242** opened in the opening end portion of the adapter half body **21**.

[0200] When the optical connector **10** is inserted into and coupled to the adapter half body **21**, the coupling **13** is inserted into the connector fitting hole **24** until the front ends of the side plate portions **13***h* at both ends in the width direction thereof come in contact with the coupling contact face **27** of the adapter half body **21**.

[0201] Among the part of the coupling **13** inserted into the connector fitting hole **24**, the part in the back of the coupling reference plane **13***i* (see FIG. **5**) is received in the entrance hole portion **242**.

[0202] As shown in FIGS. **6** to **10**, the optical connector **10** is coupled to the adapter half body **21** by inserting the housing **11** into the connector fitting hole **24** of the adapter half body **21**, inserting the protrusions **13***d* of the coupling **13** into the adapter recesses **25** of the adapter half body **21**, and receiving the adapter protrusions **26** of the adapter half body **21** in the cutouts **13***e* of the coupling **13**.

[0203] Since the protruding claws **23***a* of the pair of elastic engagement pieces **23** are located in the entrance hole portion **242**, the protruding claws **23***a* at the ends of the elastic engagement pieces **23** engage with both engagement protrusions **11***a* of the housing **11** of the optical connector **10** in the entrance hole portion **242**.

[0204] By inserting the coupling **13** of the optical connector **10** into the connector fitting hole **24** until the front ends of the side plate portions **13***h* come in contact with the coupling contact face **27** of the adapter half body **21**, the coupling receives the end portions of the elastic engagement pieces **23** engaging with both engagement protrusions **11***a* of the housing **11**.

[0205] As shown in FIGS. **1**A, **1**B and **2** to **4**, the front ends of a pair of face plate portions **13***f* and **13***g* (the upper plate portion **13***f* and the lower plate portion **13***g*) of the coupling **13** of the optical connector **10** have the configuration in which the cutout **13***e* is formed between two protrusions **13***d*.

[0206] Two protrusions **13***d* of the upper plate portion **13***f* are disposed on both sides of the key **11***b* of the housing **11**.

[0207] The entire part including the cutout **13***e* between the pair of protrusions **13***d* constitutes an adapter-protrusion receiving recessed portion **13***k* receiving the adapter protrusion **26** of the adapter half body **21**.

[0208] The adapter-protrusion receiving recessed portion **13***k* is formed just above the key **11***b* of the housing **11** of the optical connector **10**.

[0209] The two protrusions **13***d* and the cutout **13***e* of the lower plate portion **13***g* are formed at positions corresponding to the two protrusions **13***d* and the cutout **13***e* of the upper plate portion **13***f* in the thickness direction (the up and down direction) of the optical connector **10**.

[0210] The shapes and sizes of the front end faces of the upper plate portion **13***f* and the lower plate portion **13***g* of the coupling **13** of the optical connector **10** shown in the drawings can be set to be the same.

[0211] As shown in FIGS. **6** to **10**, four adapter recesses **25** in total are formed in the half-body housing **22** of the adapter half body **21** so as to receive four protrusions **13***d* in total protruding two by two from the front ends of the pair of face plate portions **13***f* and **13***g* of the coupling **13** of the optical connector **10**.

[0212] The adapter recesses **25** are formed two by two in a wall portion **22***a* (hereinafter, also referred to as a key-groove side wall portion) on the side in which the key groove **24***b* is formed and a wall portion **22***b* opposite thereto (hereinafter, also referred to as a bottom side wall portion), with the fitting-hole main hole portion **24***a* having a flat section of the connector fitting hole **25** interposed therebetween, in the half-body housing **22**.

[0213] The half-body housing **22** of the adapter half body **21** shown in the drawings has a rectangular tubular shape of which the length direction of the section is parallel to the length direction of the section of the fitting-hole main hole portion **24***a*.

[0214] Among a pair of wall portions extending in the length direction of the section of the half-body housing **22**, the wall portion having the key groove **24***b* formed therein is the key-groove side wall portion **22***a* and the other wall portion is the bottom side wall portion **22***b*.

[0215] As shown in FIGS. **6** to **10**, the adapter protrusions **26** of the half-body housing **22** are defined between a pair of adapter recesses **25** of the key-groove side wall portion **22***a* and between a pair of adapter recesses **25** of the bottom side wall portion **22***b* in the half-body housing **22**.

[0216] The adapter protrusion **26** (referenced by reference numeral **261** in the drawing) of the key-groove side wall portion **22***a* and the adapter protrusion **26** (referenced by reference numeral **262** in the drawing) of the bottom side wall portion **22***b* have a protruding claw shape extending in the axis line direction of the connector fitting hole **24**.

[0217] The adapter protrusion **261** of the key-groove side wall portion **22***a* corresponds to the key groove **24***b* in the position in the length direction of the section (the spacing direction between both wall portions **22***a* and **22***b* with the connector fitting hole **24** interposed therebetween) of the connector fitting hole **24** having a flat section.

[0218] The adapter protrusion **261** extends in the axis line direction of the connector fitting hole **24** from the key groove **24***b* to the half-body opening end portion.

[0219] The face (the protruding end face) of the adapter protrusion **261** facing the bottom side wall portion **22***b* is formed to be flush with the groove bottom of the key groove **24***b*.

[0220] As shown in FIGS. **7** and **8**, in the adapter half body **21**, a virtual plane of which the position in the axis line direction of the connector fitting hole **24** corresponds to the coupling contact face **27** and which is perpendicular to the center axis line of the connector fitting hole **24** is hereinafter referred to as an adapter reference plane.

[0221] The adapter reference plane is referenced by reference numeral **28**.

[0222] The adapter recess **25** of the adapter half body **21** shown in the drawing is formed in a groove shape extending (being depressed) from the opening of the connector fitting hole **24** over the adapter reference plane **28** to the half-body base end portion (the base end portion of the half-body housing **22**).

[0223] The adapter protrusion **26** is a protrusion extending (protruding) from the adapter reference plane **28** to the half-body opening end portion (the fitting-hole opening end portion).

[0224] As shown in FIGS. **9** and **10**, the optical connector **10** is inserted and coupled to the adapter half body **21** by receiving the adapter protrusions **26** of the adapter half body **21** in the adapter-protrusion receiving recessed portions **13***k* on the top side (the upper plate portion **13***f*) and the bottom side (the lower plate portion **13***g*) of the coupling **13** and inserting the protrusions **13***f* into the adapter recesses **25** of the half-body housing **22**.

[0225] The optical connector **10** having been completely inserted into and coupled to the adapter half body **21** can be detached from the adapter half body **21** by putting the coupling **13** to the connector rear side.

[0226] The elastic engagement pieces **23** of the adapter half body **21** engaging with the engagement protrusions **11***a* of the housing **11** of the optical connector **10** is forcibly disengaged from the engagement protrusions **11***a* by means of the detaching force for moving the coupling **13** to the connector rear side, by moving the coupling **13** to the connector rear side to detach the elastic engagement pieces from the coupling **13**.

[0227] The optical connector **10** can be attached to and detached from the adapter half body **21** in a push-pull manner.

[0228] As shown in FIGS. **3** and **4**, the optical connector **10** can be inserted into and coupled to the connector fitting hole **24** only in the direction in which the key **11***b* of the housing **11** can be inserted into the key groove **24***b* of the connector fitting hole **24** of the adapter half body **21**.

[0229] Here, as shown in FIGS. **7** to **9**, a pair of adapter half bodies **21** constituting the adapter **20** are formed in a body in the direction in which the key grooves **24***b* of the connector fitting holes **24** are located on the opposite sides with the center axis line of the connector insertion hole **21***a* interposed therebetween.

[0230] Accordingly, as shown in FIGS. **5** and **9**, the insertion directions of a pair of optical connectors **10**, which is inserted into the adapter **20** from both sides and connected to each other, into the adapter **20** are reversed.

[0231] As shown in FIGS. **3** and **4**, an end cutout **26***a* used to distinguish the key-groove side wall portion **22***a* from the adapter protrusion **26** is formed at an end of the adapter protrusion **26** of the bottom side wall portion **22***b* in the extending direction to the opening end portion of the connector fitting hole **24** among two adapter protrusions **26** of the adapter half body **21**.

[0232] The end cutout **26***a* is not formed in the adapter protrusion **26** of the key-groove side wall portion **22***a* but is formed only in the adapter protrusion **26** of the bottom side wall portion **22***b*.

[0233] Accordingly, the optical connector **10** can be coupled to the adapter half body **21** by inserting the optical connector into the connector fitting hole **24** from the opening end portion of the half-body housing **22** in the direction in which the lower wall portion **11***d* of the housing **11** butts the bottom side wall portion **22***b* of the half-body housing **22**.

[0234] The end cutout **26***a* serves as direction distinguishing means that can allow the visual distinction between the side having the key groove **24***b* and the side not having the key groove **24***b* in the short side direction of the section of the connector fitting hole **24** having a flat section inside the adapter half body **21**, from the outside of the adapter half body **21**.

[0235] The direction distinguishing means is not limited to the formation of the end cutout **26***a*, but the coloring of the adapter protrusion or the like may be employed.

[0236] The direction distinguishing means is not limited to the configuration in which it is provided to the adapter protrusion, but may be provided to a position other than the adapter protrusion of the opening end portion of the adapter half body **21**.

[0237] The end cutout **26***a* may be formed only in the adapter protrusion **26** of the key-groove side wall portion **22***a*.

[0238] As shown in FIG. **11**, when the optical connector **10** is inserted into a connector adapter **60** used to connect the standard optical connectors **50**, it cannot be coupled to the connector adapter **60**.

[0239] Here, the standard optical connector **50** and the connector adapter **60** for connection thereof will be described below.

[0240] The connector adapter **60** is a standardized connector adapter based on the JIS standard (JIS C5982) or the IEC standard (IEC 61754-7).

[0241] Hereinafter, this connector adapter is also referred to as a standard adapter.

[0242] The standard optical connector **50** shown in FIG. **20** is an MPO type optical connector having a configuration based on the JIS C5982 or the IEC 61754-7.

[0243] The optical connector **50** is assembled to an end of an optical fiber **2** which is an optical fiber tape.

[0244] The optical connector **50** includes a ferrule **52** attached to the end of the optical fiber **2**, a sleeve-like housing **51** that receives the ferrule **52** in the end (the front end) thereof, and a spring **55** (see FIG. **21**) that elastically impels the ferrule **52** received in the housing **51** to the connector front side.

[0245] The optical connector **50** further includes a tubular coupling **53** into which the housing **51** is inserted and which disposed to be slidable within a movable range guaranteed in the axis line direction of the housing **51** and a boot **54** attached to the rear end of the housing **51** opposite to the front end at which the ferrule **52** is disposed.

[0246] The standard optical connector **50** shown in the drawing is different from the optical connector **10**, only in the coupling **53**.

[0247] The configuration of the standard optical connector **50** other than the coupling **53** is the same as the optical connector **10**.

[0248] The elements of the standard optical connector **50** other than the coupling **53** are those as the optical connector **10**.

[0249] As described above, the front end face **53***a* (the reference face) of the coupling **53** is a flat surface perpendicular to the center axis line of the coupling **53**.

[0250] As shown in FIG. **21**, an F type standard optical connector **50**A in which a pair of guide pin holes **52***b* are formed in the end face **52***a* of the ferrule **52** and an M type optical connector **50**B in which guide pins **52***c* to be inserted and fitted into the pair of guide pin holes **52***b* protrude from the end of the ferrule **52** are used for the connection between the standard optical connectors **50** using the standard adapter **60**.

[0251] In the connection between the standard optical connectors **50**, the F type standard optical connector **50**A is inserted into and coupled to a tubular standard adapter **60** from one end in the axis line direction thereof, the M type standard optical connector **50**A is inserted into and coupled to the standard adapter **60** from the other end in the axis line direction, and the ferrules **52** at the ends of the standard optical connectors **50** are butt-jointed.

[0252] As shown in FIGS. **20**, **23**, and **24**, the standard adapter **60** has a configuration in which a pair of standard adapter half bodies **61** having the same configuration is formed in a body.

[0253] Each standard adapter half body **61** has a configuration in which a pair of elstic engagement claws **64** detachably engaging with both engagement protrusions **51***a* of the housing **51** of the standard optical connector **50** protrudes in a tubular body **63** having a connector hole **62** formed therethrough, into which the standard optical connector **50** is inserted.

[0254] The elastic engagement claw **64** is an elastic piece extending in the connector hole **62** from one end in the axis line direction of the tubular body **63** to the other end in the axis line direction of the tubular body **63**.

[0255] The elastic engagement claw **64** detachably engages with the housing **51** by causing protrusions **64***a* protruding from the ends thereof to engage with both engagement protrusions **51***a* of the housing **51** of the standard optical connector **50**.

[0256] The connector hole **62** of the standard adapter half body **61** has a configuration in which an enlarged opening portion **62***b* obtained by enlarging the housing receiving hole **62***a* is formed at one end in the axis line direction of the housing receiving hole **62***a* receiving and positioning the housing **51** of the standard optical connector **50**.

[0257] The housing receiving hole **62***a* includes a key groove **62***c* into which a key **51***b* protruding from the housing **51** of the standard optical connector **50** is inserted.

[0258] The enlarged opening portion **62***b* is formed in a size (sectional size) sufficient to receive the coupling **53** of the standard optical connector **50**.

[0259] The insertion and coupling of the standard optical connector **50** to the standard adapter half body **61** can be achieved by thrusting the standard optical connector **50** into the connector hole **62** from the enlarged opening portion **62***b* at one end in the axis line direction of the connector hole **62**.

[0260] The thrust of the standard optical connector **50** into the connector hole **62** is performed by causing an operator to press a part of the optical connector **50** located in the back of the coupling **53**, for example, the boot **54** with his or her finger toward the adapter half body **61**.

[0261] As shown in FIG. **22**, the standard optical connector **50** is coupled (fitted) to the standard adapter half body **61** by inserting the housing **51** into the housing receiving hole **62***a* of the connector hole **62** and receiving the end portion of the elastic engagement claws **64** engaging with the housing **51** from both sides in the front end portion of the coupling **53** inserted into the enlarged opening portion **62***b* of the connector hole **62**.

[0262] By receiving the end portions of the elastic engagement claws **64** engaging with both engagement protrusions **51***a* of the housing **51**, the coupling **53** restricts the disengagement due to the rising-up of the ends of the elastic engagement claws **64** from the housing **51** and maintains the engaged state of the elastic engagement claws **64** with the housing **51**.

[0263] The coupling **53** of the standard optical connector **50** is inserted into the enlarged opening portion **62***b* of the connector hole **62** and the front end face **53***a* thereof comes in contact with a coupling contact face **65** (an adapter reference face) which is a stepped face located in the boundary between

the enlarged opening portion **62***b* of the connector hole **62** and the housing receiving hole **62***a* on the deeper side.

[0264] In the connector hole **62**, the coupling contact face **65** is formed along the outer circumference of the deep end of the enlarged opening portion **62***b*.

[0265] The protrusions **64***a* at the ends of the pair of elastic engagement claws **64** of the standard adapter half body **61** are positioned in the enlarged opening portion **62***b*.

[0266] Accordingly, the protrusions **64***a* at the ends of the elastic engagement claws **64** engage with both engagement protrusions **51***a* of the housing **51** of the standard optical connector **50** in the enlarged opening portion **62***b*.

[0267] The coupling **53** of the standard optical connector **50** is inserted into the enlarged opening portion **62***b* until the front end face **53***a* thereof comes in contact with the coupling contact face **65** of the standard adapter half body **61**, whereby the ends of the elastic engagement claws **64** engaging with both engagement protrusions **51***a* of the housing **51** is received in the coupling.

[0268] As shown in FIG. **11**, when the optical connector **10** is inserted into the connector hole **62** of the standard adapter half body **61** of the standard adapter **60**, the ends of the protrusions **13***d* at the front end of the coupling **13** comes in contact with the coupling contact face **65** at the deep end of the enlarged opening portion **62***b* of the standard adapter half body **61**.

[0269] Accordingly, the front end faces **13***h***1** of the side plate portions **13***h* of the coupling **13** of the optical connector **10** do not come in contact with the coupling contact face **65**.

[0270] As shown in FIG. **11**, since the ends of the protrusions **13***d* of the coupling **13** of the optical connector **10** come in contact with the coupling contact face **65** of the standard adapter half body **61**, the side plate portions **13***h* of the coupling **13** are located at the positions not coming in contact with the pair of elastic engagement claws **64** of the standard adapter half body **61**.

[0271] In the optical connector **10** shown in the drawing, since the ends of the protrusions **13***d* come in contact with the coupling contact face **65**, the side plate portions **13***h* of the coupling **13** are not inserted into the enlarged opening portion **62***b* of the standard adapter half body **61** and is located at the positions separated outward from the tubular body **63** of the standard adapter half body **61**.

[0272] Accordingly, since the ends of the protrusions **13***d* in the optical connector **10** come in contact with the coupling contact face **65**, the end portions of the pair of elastic engagement claws **64** of the standard adapter half body **61** are not received inside the coupling **13** (in the inner surfaces of the side plate portions **13***h*).

[0273] Accordingly, the optical connector **10** is not coupled to the standard adapter half body **61**.

[0274] The optical connector **10** can satisfactorily prevent from being erroneously coupled to the standard adapter half body **61** of the standard adapter **60**.

[0275] As shown in FIG. **11**, since the ends of the protrusions **13***d* in the optical connector **10** come in contact with the coupling contact face **65**, the ferrule **12** at the front end thereof can be located at a position separated from the ferrule **52** of the standard optical connector **50** inserted into and coupled to the standard adapter **60** from the side opposite to the optical connector **10**.

[0276] As shown in FIGS. **1**A, **1**B, and **10**, and the like, Each engagement protrusion **11***a* of the housing **11** of the optical connector **10** has a mountain shape in which slopes formed on both sides of an apex portion, which extends in the thickness direction of the housing **11**, in the connector inserting direction come closer to the apex portion.

[0277] On the other hand, as shown in FIG. **24** and the like, the protrusion **64***a* at the end of each elastic engagement claw **64** of the standard adapter **61** has a mountain shape in which slopes formed on both sides of an apex portion (apex face) thereof in the length direction of the elastic engagement claws **64** come closer to the apex portion.

[0278] When the standard optical connector **50** is inserted into the connector hole **62** of the standard adapter half body **61**, the protrusions **64***a* at the ends of the elastic engagement claws **64** are smoothly engaged with and disengaged from the engagement protrusions **51***a* of the housing **51** by means of the displacement of the housing **51** of the standard optical connector **50** in the axis line direction of the connector hole **62**.

[0279] The force necessary for disengaging the protrusions **64***a* at the ends of the elastic engagement claws **64**, which engage with the engagement protrusions **51***a* of the housing **51** on the rear side, from the engagement protrusions **51***a*, is small.

[0280] The protrusions **23***a* at the ends of the elastic engagement pieces **23** of the adapter **20** has the same shape as the protrusions **64***a* at the ends of the elastic engagement claws **64** of the standard adapter **60**.

[0281] As described above, regarding the coupling **13** of the optical connector **10**, the movable range in which the coupling can move in the axis line direction relative to the housing **11**, in other words, the range in which the coupling can slide back from the front movement limit position, is guaranteed.

[0282] Accordingly, even in the state (FIG. **11**) where the ends of the protrusions **13***d* of the coupling **13** of the optical connector **10** come in contact with the coupling contact face **65**, the housing **11** can be thrust into the connector hole **62** of the standard adapter half body **61** against the elastic impelling force of the coupling spring.

[0283] In the optical connector **10**, by thrusting the housing **11***a* into the connector hole **62** of the standard adapter half body **61**, the protrusions **64***a* at the ends of the elastic engagement claws **64** can engage with the engagement protrusions **11***a* of the housing **11**.

[0284] This engagement can be caused when the protruding height of the protrusions **13***d* of the coupling **13** from the coupling reference plane to the connector front side is smaller than the movable range of the coupling **13** in the axis line direction relative to the housing **11**.

[0285] However, the force necessary for disengaging the protrusions **64***a* at the ends of the elastic engagement claws **64** having engaged with the engagement protrusions **11***a* of the housing **11** is small.

[0286] The engagement between the engagement protrusions **11***a* of the housing **11** and the protrusions **64***a* at the ends of the elastic engagement claws **64** in the state where the ends of the protrusions **13***d* of the coupling **13** come in contact with the coupling contact face **65** is smoothly released by means of the elastic impelling force of the coupling spring.

[0287] In the optical connector **10** shown in the drawing, in the state where the ends of the protrusions **13***d* of the coupling **13** come in contact with the coupling contact face **65** (FIG. **11**) and the coupling **13** is located at the front movement limit

position relative to the housing **11**, the ferrule **12** is located at a position separated from the ferrule **52** of the standard optical connector **50**.

[0288] Accordingly, the optical connector **10** can satisfactorily prevent the erroneous connection to the standard optical connector **50** in the standard adapter **60**.

[0289] When an operator inserts the optical connector **10** into the standard adapter half body **61** with his or her finger, the part of the coupling **13** in the back of the coupling reference plane cannot be inserted into the connector hole **62** (specifically, the enlarged opening portion **62***b*), whereby the operator can simply recognize the erroneous insertion.

[0290] Since the protruding portions **13***b* and the recessed portions **13***c* are formed in the coupling **13**, the optical connector **10** can be simply visually distinguished from the standard optical connector **50**.

[0291] The optical connector **10** can employ standardized elements based on the standard as constituent elements, except for the coupling **13**.

[0292] The optical connector **10** can be simply assembled by only using the coupling **13** having the protruding portions **13***b* and the recessed portions **13***c* instead of the coupling of the standardized optical connector **50**.

[0293] Since the plastic coupling **13** having the protruding portions **13***b* and the recessed portions **13***c* has a simple structure and can be easily molded with resin, it is possible to manufacture the plastic coupling **13** at a low cost.

[0294] The erroneous connection between the optical connector **10** and the standard optical connector **50** can be simply prevented at a low cost, by only using the coupling **13** having the protruding portions **13***b* and the recessed portions **13***c*.

[0295] As shown in FIGS. **12** and **13**, the standard optical connector **50** cannot be coupled to the adapter half body **21**, even when it is inserted into the connector fitting hole **24** of the adapter half body **21** of the adapter **20** for connecting the optical connectors **10**.

[0296] When the standard optical connector **50** is inserted into the connector fitting hole **24** of the adapter half body **21** from the front end thereof, the front end face **53***a* of the coupling **53** comes in contact with the adapter protrusions **26** inside the opening end portion of the half-body housing **22** of the adapter half body **21**.

[0297] Accordingly, the coupling **53** of the standard optical connector **50** cannot be inserted into the entrance hole portion **242** inside the opening end portion of the half-body housing **22** and the end portions of the elastic engagement pieces **23** of the adapter half body **21** cannot be received in the coupling **53**.

[0298] Accordingly, the adapter **20** can satisfactorily prevent the erroneous coupling to the standard optical connector **50**.

[0299] When the force for the thrust into the adapter **20** is not given to the housing **51** of the standard optical connector **50** inserted into the adapter half body **21**, the adapter **20** shown in the drawing can locate the ferrule **52** of the standard optical connector **50** at the position separated from the ferrule **12** of the optical connector **10** inserted and fitted (coupled) to the adapter **20** from the side opposite to the standard optical connector **50**.

[0300] As a result, the adapter **20** can prevent the erroneous connection between the optical connector **10** and the standard optical connector **50** in the adapter **20**.

[0301] As described above, the optical connector **10** can satisfactorily prevent the erroneous coupling to the connector adapter (the standard adapter **60**) for the standard optical connector **50** and the adapter **20** can satisfactorily prevent the erroneous coupling to the standard optical connector **50**.

[0302] Accordingly, even when the optical connector **10** and the adapter **20** are used to connector-connect the optical fibers in a spot where an optical fiber in which the standard optical connector **50** is assembled to the end thereof and the standard adapter **60** exist, it is possible to easily use the optical connector **10** and the standard optical connector **50** as distinct from each other.

[0303] The number of protruding portions and the number of recessed portions disposed in the coupling of the optical connector are not limited to the number of protruding portions **13***b* and the number of recessed portions **13***c* in the coupling **13** of the optical connector **10** shown in FIGS. **1**A and **1**B.

[0304] The coupling of the optical connector may have one or more protruding portions protruding and one or more recessed portions depressed relative to the coupling reference plane.

[0305] The connector adapter to which an optical connector including a coupling having the protruding portions and the recessed portions formed therein can be inserted and coupled needs to have one or plural (one or more) adapter recesses formed to receive all the protruding portions of the coupling and one or more adapter protrusions formed to be able to be received in the recessed portions of the coupling.

[0306] Here, the adapter recess is a recessed portion depressed toward the deep side of the adapter relative to the adapter reference plane which is superimposed on the coupling reference plane of the optical connector coupled (fitted) to the adapter, and the adapter protrusion is a protruding portion protruding in the opposite side of the deep side of the adapter from the adapter reference plane.

[0307] FIGS. **14**A, **14**B, **15**A and **15**B show examples of a combination of the protruding portions and the recessed portions formed in the coupling of the optical connector and the adapter recesses and the adapter protrusions formed in the adapter to which the optical connector can be inserted and coupled.

[0308] The elements common to FIGS. **14**A, **14**B, **15**A and **15**B are referenced by common reference numerals.

[0309] A coupling **131** shown in FIGS. **14**A and **14**B include a recessed portion **13***c* depressed from the coupling reference plane **13***i* and protruding portions **13***b* formed on both sides of the recessed portion **13***c*.

[0310] The protruding portions **13***b* protrude from the coupling reference plane **13***i*.

[0311] An adapter **201** has an adapter protrusion **26** formed therein.

[0312] An end face **201***a* of the adapter **201** is located in the back of the adapter reference plane **28** (on the opposite side of the end of the adapter protrusion **26** about the adapter reference plane **28**.

[0313] In the adapter **201**, the entire region located in the back of the adapter reference plane **28** serves as the adapter recess **25**.

[0314] In the example shown in FIGS. **14**A and **14**B, the coupling **131** can receive the adapter protrusion **26** of the adapter **201** between the protruding portions **13***b* on the both sides of the recessed portion **13***c*.

[0315] By causing the coupling **131** to receive the adapter recess **26** between the protruding portions **13***b* on both sides

of the recessed portion **13***c*, the coupling reference plane **13***i* can be flush with the adapter reference plane **28**.

[0316] When the coupling **131** receives the adapter protrusion **26** between the protruding portions **13***b* on both sides of the recessed portion **13***c* so that the coupling reference plane **13***i* is flush with the adapter reference plane **28**, the protruding portions **13***b* are inserted into the end face **201***a* of the adapter **201** from the adapter reference plane **28**.

[0317] The coupling **131** shown in FIGS. **14**A and **14**B include the protruding portions **13***b*

[0318] Accordingly, even when the optical connector including the coupling **131** is inserted into the standard adapter **60**, it cannot be coupled to the standard adapter **60**, thereby preventing the erroneous connection to the standard optical connector **50** in the standard adapter **60**.

[0319] The adapter **201** shown in FIGS. **14**A and **14**B include the adapter protrusion **26**.

[0320] Accordingly, when the standard optical connector **50** is inserted into the adapter, the adapter cannot be coupled to the standard optical connector **50**, thereby preventing the erroneous connection between the optical connector including the coupling **131** and the standard optical connector **50**.

[0321] As shown in FIGS. **15**A and **15**B, a coupling **132** includes a protruding portion **13***b*.

[0322] An end face **132***a* of the coupling **132** other than the protruding portion **13***b* is located in the back of the coupling reference plane **13***i* (on the opposite side of the end of the protruding portion **13***b* about the coupling reference plane **13***i*).

[0323] In the front end face (connecting end face) of the coupling **132**, the entire part located in the back of the coupling reference plane **13***i* serves as the recessed portion **13***c*.

[0324] An adapter **202** includes an adapter recess **25** depressed from the adapter reference plane **28** and adapter protrusions **26** formed on both sides of the adapter recess **25**.

[0325] The adapter protrusions **26** protrude from the adapter reference plane **28**.

[0326] The space between the adapter protrusions **26** on both sides of the adapter recess **25** of the adapter **202** is formed by a protruding-portion receiving cutout **202***a* (including the adapter recess **25**) receiving the protruding portion **13***b* of the coupling **132**.

[0327] The adapter protrusions **26** may be received in the recessed portions **13***c* of the coupling **132** at the time of inserting and coupling the optical connector including the coupling **132** shown in FIGS. **15**A and **15**B to the adapter **202**.

[0328] The adapter protrusions **26** may be formed in a tubular shape including protrusions protruding from both sides of the protruding portion receiving cutout **202***a* and the protruding portion receiving cutout **202***a* along the opening end portion of the adapter **202**.

[0329] In the example shown in FIGS. **15**A and **15**B, the protruding portion **13***d* of the coupling **132** can be inserted into the protruding portion receiving cutout **202***a* of the adapter **202**, so that the coupling reference plane **13***i* is flush with the adapter reference plane **28**.

[0330] The coupling **132** can receive the adapter protrusions **26** of the adapter **202** between the protruding portions **13***c* on both sides of the recessed portion **13***b*.

[0331] The coupling **132** can allow the coupling reference plane **13***i* to be flush with the adapter reference plane **28** by receiving the adapter protrusions **26** between the protruding portions **13***c* on both sides of the recessed portion **13***b*.

[0332] When the adapter protrusions **26** are received between the protruding portions **13***c* on both sides of the recessed portion **13***b* of the coupling **131** and the coupling reference plane **13***i* is thus flush with the adapter reference plane **28**, the protruding portion **13***b* is inserted into the end face **201***a* of the adapter **201** from the adapter reference plane **28**.

[0333] The coupling **132** shown in FIGS. **15**A and **15**B include the protruding portion **13***b*

[0334] Accordingly, even when the optical connector including the coupling **132** is inserted into the standard adapter **60**, it cannot be coupled to the standard adapter **60**, thereby preventing the erroneous connection to the standard optical connector **50** in the standard adapter **60**.

[0335] The adapter **202** shown in FIGS. **15**A and **15**B include the adapter protrusions **26**

[0336] Accordingly, even when the standard optical connector **50** is inserted thereto, it cannot be coupled to the standard optical connector **50**, thereby preventing the erroneous connection between the optical connector including the coupling **132** and the standard optical connector **50**.

Comparative Examples

[0337] FIGS. **16** and **17** show comparative examples.

[0338] First, the comparative example (Comparative Example 1) shown in FIG. **16** will be described.

[0339] The front end face of the coupling **133** of the optical connector according to Comparative Example 1 includes a flat portion **133***a* being flush with the coupling reference plane **13***i* and a recessed portion **13***c*.

[0340] The coupling **133** does not include any protruding portion **13***b*.

[0341] On the other hand, the adapter **203** shown in FIG. **16** includes a coupling receiving face including a flat portion **203***a* being flush with the adapter reference plane **28** and an adapter protrusion **26**.

[0342] By receiving the adapter protrusion **26** of the adapter **203** in the recessed portion **13***c* of the coupling **133**, the coupling reference plane **28** can be made to be flush with the adapter reference plane **13***i*.

[0343] When a standard optical connector is inserted into and coupled to the adapter **203** according to Comparative Example 1, the front end face of the coupling of the standard optical connector comes in contact with the adapter protrusion **26**, thereby preventing the coupling to the standard optical connector.

[0344] However, the optical connector including the coupling **133** can be inserted into the standard adapter up to the same position as the standard optical connector and can be coupled to the standard adapter similarly to the standard optical connector, thereby not preventing an erroneous coupling.

[0345] The front end face of a coupling **134** of an optical connector according to the comparative example (Comparative Example 2) shown in FIG. **17** includes a flat portion **133***a* being flush with the coupling reference plane **13***i* and a protruding portion **13***b*.

[0346] The recessed portion **13***c* is not formed in the front end face of the coupling **134**.

[0347] On the other hand, an adapter **204** shown in FIG. **17** includes a coupling receiving face having a flat portion **204***a* being flush with the adapter reference plane **28** and an adapter recess **25**.

[0348] By inserting the protruding portion **13***b* of the coupling **134** into the adapter recess **25** of the adapter **204**, the coupling reference plane **28** can be made to be flush with the adapter reference plane **13***i*.

[0349] When the optical connector including the coupling **134** according to Comparative Example 2 is inserted into the standard adapter, the protruding portion **13***b* comes in contact with the coupling contact face **65** of the standard adapter **60**, thereby preventing the coupling to the standard adapter.

[0350] On the other hand, since the adapter **204** does not include the adapter protrusion **26**, the standard optical connector can be inserted and coupled thereto, thereby not preventing the coupling to the standard optical connector.

[0351] The optical connector including the coupling **134** shown in FIGS. **14**A, **14**B, **15**A, **15**B and **17** can be satisfactorily prevented from being erroneously connected to a standard optical connector in a standard adapter.

[0352] However, when the optical connector including the coupling **134** shown in FIG. **17** is used to connector-connect optical fibers along with the adapter **204** in a place (spot) where optical fibers with a standard optical connector attached to the ends thereof and the standard adapter, it is not possible to prevent the erroneous connection to the standard optical connector in the adapter **204**.

[0353] The optical connector including the coupling **133** shown in FIG. **16** cannot prevent the erroneous connection to a standard optical connector in a standard adapter.

[0354] On the contrary, the optical connectors including the couplings **131** and **132** shown in FIGS. **14**A, **14**B, **15**A and **15**B can satisfactorily prevent the erroneous connection to a standard optical connector in a standard adapter and can satisfactorily prevent the erroneous connection to a standard optical connector in the adapters **201** and **202** used for the connection.

[0355] The optical connectors including the couplings **131** and **132** shown in FIGS. **14**A, **14**B, **15**A and **15**B and the adapters **201** and **202** used for the connection thereof effectively contribute to the prevention of the erroneous connection to a standard optical connector.

[0356] The optical connector and the adapter according to the invention can be employed by an optical communication system such as a connecting place or a branching place of optical fibers constituting optical fiber lines and a LAN.

[0357] In the optical communication system, for example, plural types of optical fibers different in the number of cores of optical fiber tapes, the types of the optical fibers, and the like may be used.

[0358] In this case, to distinguish the different optical fibers, the optical connectors according to the different embodiments may be applied to optical connectors to be identified.

[0359] For example, when the optical connectors to be identified differ from each other in the number of at least one of the protruding portions and the recessed portions of the couplings, it is possible to effectively contribute to the distinction of the optical connectors.

[0360] Also, when the optical connectors to be identified differ from each other in the arrangement of at least one of the protruding portions and/or the recessed portions of the couplings, it is possible to effectively contribute to the distinction of the optical connectors.

[0361] By using the adapters of which the number or arrangement of the adapter protrusions and the adapter recesses is set to allow the insertion and coupling of the optical connectors thereto depending on the number and/or the arrangement of the protruding portions and/or the recessed portions of the coupling for each optical connector, it is possible to prevent the erroneous connection between optical connectors.

[0362] For example, in the optical communication system such as a connecting place or a branching place of optical fibers and a LAN, plural connector coupling sections in which optical fibers are connector-connected to each other using a connector adapter so as to connect a plurality of lines are often provided.

[0363] In these places, the optical connector and the adapter according to the invention can be effectively utilized to realize the connector connection between optical fibers as distinct from a standard optical connector.

[0364] In addition, the optical connectors and the connector adapters may be distinguished from each other by changing the colors of a part (for example, the housing) of the optical connectors and the corresponding connector adapters.

[0365] For example, by changing the color of a housing depending on a spring pressure of an optical connector, it is possible to prevent the erroneous connection.

[0366] In terms of easy identification, it is preferable that the place of the optical connector of which the color should be changed is a coupling thereof.

[0367] The number of cores corresponding to the optical connector according to the invention can be properly set.

[0368] An example thereof is shown in FIGS. **18**A and **18**B.

[0369] An optical connector **10**C shown in FIGS. **18**A and **18**B is a 24-core optical connector (MPO type optical connector) attached to an end of two 12-core optical fiber tapes.

[0370] The optical connector **10**C shown in the drawing is assembled using the same components as the optical connector **10** shown in FIGS. **1**A and **1**B, except that a 24-core ferrule is employed as the ferrule **12**.

[0371] In the 24-cores optical connector **10**C, the spring pressure of the spring **15** elastically impelling the ferrule is set to be larger than the spring pressure defined in the IEC standard so as to guarantee a butting force suitable for realizing the PC connection at the time of butt jointing the ferrules.

[0372] Hereinafter, the optical connector **10**C is also referred to as an optical connector with a changed spring pressure.

[0373] The optical connector **10**C includes a coupling **13** having protruding portions **13***b* and recessed portions **13***c* formed therein.

[0374] Accordingly, the optical connector **10**C can prevent the erroneous connection to an optical connector (standard-coupling optical connector) including the same housing and coupling (hereinafter, also referred to as a standard coupling) as the standard optical connector **50**, thereby using the optical connector in satisfactory distinction from the standard-coupling optical connector.

[0375] For example, since a 24-core optical connector (hereinafter, referred to as a standard-coupling 24 MPO) (of the spring pressure is defined in the IEC standard), which is assembled using the same components as the standard optical connector **50** except that the 24-core ferrule is employed, is different from the optical connector **10**C shown in FIGS. **18**A and **18**B in the appearance of the coupling, they can be easily visually distinguished from each other.

[0376] The connection between the standard coupling optical connectors can be performed using the standard adapter **60**, but the optical connector **10**C is not coupled to the stan-

dard adapter **60** and thus does not cause the erroneous connection to the standard-coupling 24 MPO in the standard adapter **60**.

[0377] The standard-coupling connector is not coupled to the adapter **20** used for the connection between the optical connector **10**C and thus the optical connector **10**C does not cause the erroneous connection to the standard-coupling 24 MPO in the adapter **20**.

[0378] As a result, it is possible to satisfactorily used the optical connector **10**C as distinct from a standard-coupling 24 MPO.

[0379] While preferred embodiments of the invention have been described and illustrated above, it should be understood that these are exemplary of the invention and are not to be considered as limiting

[0380] Additions, omissions, substitutions, and other modifications can be made without departing from the scope of the present invention

[0381] Accordingly, the invention is not to be considered as being limited by the foregoing description, and is only limited by the scope of the appended claims.

1. An optical connector comprising:
a housing that receives a ferrule; and
a coupling into which the housing is inserted, wherein
the connecting end face includes one or more protruding portions protruding and one or more recessed portions depressed relative to a reference plane corresponding to a reference face of a coupling of a standardized optical connector.

2. The optical connector according to claim **1**, further comprising a key protruding from a side surface of the housing and extending in a connector length direction,
wherein the coupling includes one or more the protruding portions or the recessed portions on the side of the key.

3. The optical connector according to claim **2**, wherein the connecting end face of the coupling includes the recessed portions just above the key and the protruding portions on at least one side in the width direction of the recessed portions.

4. The optical connector according to claim **2**, wherein the connecting end face of the coupling includes one or more the protruding portions or the recessed portions on the opposite side of the key.

5. The optical connector according to claim **3**, wherein the connecting end face of the coupling includes one or more the protruding portions or the recessed portions on the opposite side of the key.

6. A connector adapter to which the optical connector according to claim **1** is to be inserted and coupled, the connector adapter comprising:
an opening end portion into which the optical connector is inserted, the opening end portion including one or more adapter protrusions protruding and one or more adapter recesses depressed relative to an adapter reference plane, the adapter reference plane corresponding to an adapter reference face coming in contact with the reference face of the coupling of the standardized optical connector in a connector adapter to which the standardized optical connector is inserted and coupled, wherein
the optical connector is to be coupled to the connector adapter by inserting the protruding portions of the connecting end face of the coupling into the adapter recesses and by receiving the adapter protrusions in the recessed portions of the connecting end face.

7. An optical fiber line comprising:
a connector coupling section in which optical fibers are coupled to each other using the optical connector according to claim **1** and
a connector adapter to which the optical connector is to be inserted and coupled, the connector adapter comprising:
an opening end portion into which the optical connector is inserted, the opening end portion including one or more adapter protrusions protruding and one or more adapter recesses depressed relative to an adapter reference plane, the adapter reference plane corresponding to an adapter reference face coming in contact with the reference face of the coupling of the standardized optical connector in a connector adapter to which the standardized optical connector is inserted and coupled, wherein
the optical connector is to be coupled to the connector adapter by inserting the protruding portions of the connecting end face of the coupling into the adapter recesses and by receiving the adapter protrusions in the recessed portions of the connecting end face.

8. An optical communication system comprising:
optical fibers coupled to each other using the optical connector according to claim **1** attached to an end of the optical fibers and
a connector adapter to which the optical connector is to be inserted and coupled, the connector adapter comprising:
an opening end portion into which the optical connector is inserted, the opening end portion including one or more adapter protrusions protruding and one or more adapter recesses depressed relative to an adapter reference plane, the adapter reference plane corresponding to an adapter reference face coming in contact with the reference face of the coupling of the standardized optical connector in a connector adapter to which the standardized optical connector is inserted and coupled, wherein
the optical connector is to be coupled to the connector adapter by inserting the protruding portions of the connecting end face of the coupling into the adapter recesses and by receiving the adapter protrusions in the recessed portions of the connecting end face.

9. The optical communication system according to claim **8**, wherein
the optical connectors to be identified differ from each other in the number of at least one of the protruding portions and recessed portions of the coupling.

10. The optical communication system according to claim **8**, wherein
the optical connectors to be identified differ from each other in the arrangement of at least one of the protruding portions and recessed portions of the coupling.

11. The optical communication system according to claim **9**, wherein
the optical connectors to be identified differ from each other in the arrangement of at least one of the protruding portions and recessed portions of the coupling.

12. The optical communication system according to claim **8**, wherein
the optical connectors to be identified differ from each other in the color of at least a part of the optical connectors.

13. The optical communication system according to claim **9**, wherein

the optical connectors to be identified differ from each other in the color of at least a part of the optical connectors.

14. The optical communication system according to claim **10**, wherein

the optical connectors to be identified differ from each other in the color of at least a part of the optical connectors.

15. The optical communication system according to claim **11**, wherein

the optical connectors to be identified differ from each other in the color of at least a part of the optical connectors.

16. The optical communication system according to claim **12**, wherein

the optical connectors to be identified differ from each other in the color of the coupling.

17. The optical communication system according to claim **13**, wherein

the optical connectors to be identified differ from each other in the color of the coupling.

18. The optical communication system according to claim **14**, wherein

the optical connectors to be identified differ from each other in the color of the coupling.

19. The optical communication system according to claim **15**, wherein

the optical connectors to be identified differ from each other in the color of the coupling.

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