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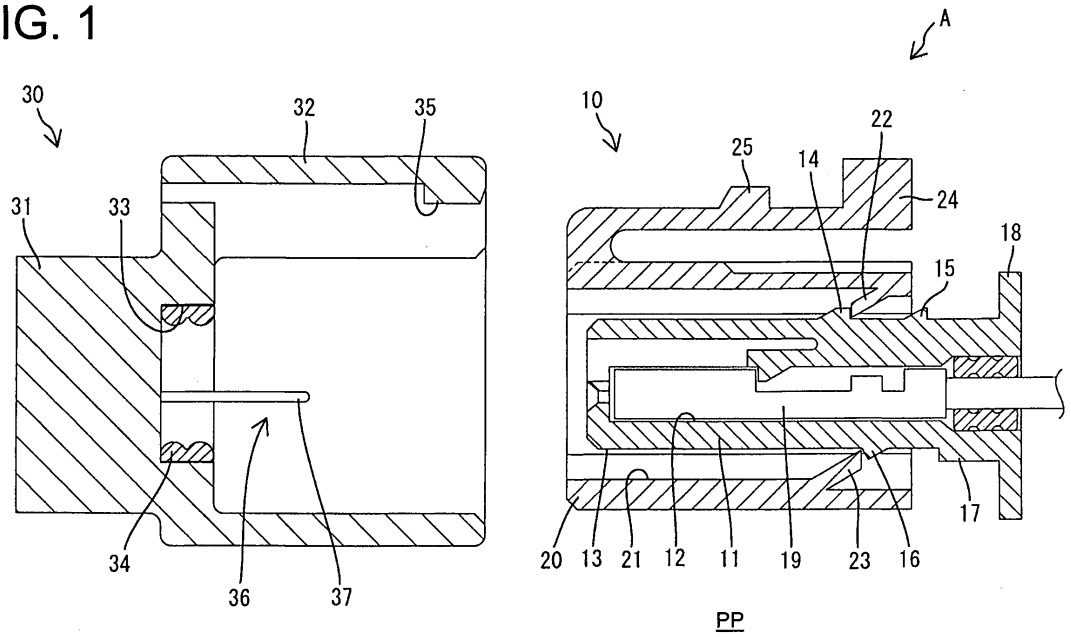
(54) Connector comprising a housing including an inner housing having a seal portion and assembling method therefor

(57) An object of the present invention is to protect a seal portion provided in a female housing.

A connector A includes a female housing 10 and a male housing 30. The female housing 10 has a seal surface 13 (female seal portion) on the outer periphery and includes an inner housing 11 for accommodating a female terminal fitting 19 and an outer housing 20 for holding the inner housing 11 movably back and forth between a protection position where the seal surface 13 is covered over and a protection releasing position where protection for the seal surface 13 is released. The male housing 30 includes a terminal holding portion 31 for holding a male terminal fitting 36, a receptacle 32 projecting from the terminal holding portion 31 and surrounding the outer housing 20 and a seal ring 34 (male seal portion) provided in the terminal holding portion 31 to be held in close contact with the seal surface 13.

FIG. 1



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Description

[0001] The present invention relates to a connector and assembling method Therefor.

[0002] In Japanese Unexamined Patent Publication No. 2001-283972 is disclosed a technology for sealing a clearance between connected parts of male and female housings by close contact of a seal surface formed on the outer periphery of a terminal accommodating portion of the female housing and a seal member provided on the inner periphery of a receptacle of the male housing by externally fitting the receptacle, in which a male terminal fitting is mounted, into the terminal accommodating portion accommodating a female terminal fitting. Further, in Japanese Unexamined Patent Publication No. 2009-272253 is disclosed a technology for sealing a clearance between connected parts of male and female housings by close contact of a seal member formed on the outer periphery of a terminal accommodating portion of the female housing and a seal surface formed on the inner periphery of a receptacle of the male housing by externally fitting the receptacle, in which a male terminal fitting is mounted, into the terminal accommodating portion accommodating a female terminal fitting.

[0003] In the above connectors, the female housing is formed with a tubular fitting portion surrounding the terminal accommodating portion to protect the seal surface on the outer periphery of the terminal accommodating portion and the seal member in a state where the two housings are not connected. A space between the inner periphery of this tubular fitting portion and the outer periphery of the terminal accommodating portion serves as a connection space into which the receptacle is inserted. Since this connection space is open toward the front side of the female housing, external matters may enter the connection space to damage the seal surface and the seal member.

[0004] The present invention was completed in view of the above situation and an object thereof is to protect a seal portion provided in a female housing.

[0005] This object is solved according to the invention by the features of the independent claims. Particular embodiments of the invention are subject of the dependent claims.

[0006] According to one aspect of the invention, there is provided a connector, comprising a housing and a mating housing connectable to each other;

the housing including: an inner housing including a seal portion and adapted to at least partly accommodate at least one terminal fitting, and an outer housing for holding the inner housing movably back and forth between a protection position where the seal portion is protected and a protection releasing position where protection for the seal portion is released; and

the mating housing including: a terminal holding portion for holding at least one mating terminal fitting, a receptacle projecting from the terminal holding portion and at least partly surrounding the outer housing, and a mating seal portion provided in or at the terminal holding portion and capable of being held in close contact with the seal portion.

[0007] In connecting the two housings, the seal portion comes into close contact with the mating seal portion if the inner housing is moved to the protection releasing position, whereby connected parts of the two housings are sealed.

[0008] According to a particular embodiment, the seal portion is provided on the outer periphery of the inner housing and/or at the protection position the seal portion is protected by being covered over by the outer housing.

[0009] In a state where the housing and the mating housing are not connected, the seal portion on the outer periphery of the inner housing at least partly is covered over by the outer housing and protected from the interference of an external matter if the inner housing is arranged at the protection position.

[0010] Further, since the receptacle of the mating housing is configured to at least partly surround the outer housing, it is not necessary to secure a connection space for the entrance of the receptacle in a clearance between the inner housing and the outer housing. Thus, the clearance between the outer periphery of the inner housing and the inner periphery of the outer housing can be narrowed, wherefore the female seal portion can be reliably protected from an external matter having entered the clearance between the inner housing and the outer housing.

[0011] According to a further particular embodiment, there is provided a connector, comprising a female housing and a male housing connectable to each other; the female housing including an inner housing including a female seal portion on the outer periphery and adapted to accommodate a female terminal fitting, and an outer housing for holding the inner housing movably back and forth between a protection position where the female seal portion is covered over and a protection releasing position where protection for the female seal portion is released; and the male housing including a terminal holding portion for holding a male terminal fitting, a receptacle projecting from the terminal holding portion and surrounding the outer housing, and a male seal portion provided in the terminal holding portion and capable of being held in close contact with the female seal portion.

[0012] In connecting the two housings, the female seal portion comes into close contact with the male seal portion if the inner housing is moved to the protection releasing position, whereby connected parts of the two housings are sealed.

[0013] In a state where the female housing and the male housing are not connected, the female seal portion on the outer periphery of the inner housing is covered over by the outer housing and protected from the interference of an external matter if the inner housing is arranged at the protection position. Further, since the receptacle of the male housing is configured to surround the outer housing, it is not necessary to secure a con-

nection space for the entrance of the receptacle in a clearance between the inner housing and the outer housing. Thus, the clearance between the outer periphery of the inner housing and the inner periphery of the outer housing can be narrowed, wherefore the female seal portion can be reliably protected from an external matter having entered the clearance between the inner housing and the outer housing.

[0014] Particularly, the seal portion (particularly the female seal portion) is a seal surface integrally or unitarily formed on the outer peripheral surface of the inner housing.

[0015] If the seal portion is a seal ring separate from the inner housing, the seal ring may come into contact with the inner periphery of the outer housing to be displaced when the inner housing is moved back and forth. However, since the seal portion is the seal surface integral or unitary to the inner housing in the above embodiment, there is no likelihood that the seal surface is displaced even if coming into contact with the inner periphery of the outer housing.

[0016] Further particularly, the housing and the mating housing include at least one pair of lock portions which interfere with each other while the two housings are being connected, thereby restricting a connecting operation of the two housings, at least one of which is resiliently deformed to release an interference state when a specified connecting force is applied to the two housings in the interference state and which are engaged with each other to inseparably lock the two housings when the two housings reach a properly connected state.

[0017] Further particularly, the inner housing includes an operating portion used to move the housing in a direction to connect the housing to the mating housing.

[0018] Further particularly, the inner housing and the outer housing include at least one pair of first locking portions which are engaged with each other to restrict a movement of the inner housing from the protection position to the protection releasing position and/or at least one pair of second locking portions which are engaged with each other with the inner housing located at the protection releasing position.

[0019] Further particularly, an engaged state of the pair of first locking portions is released when the operating portion is operated with a force smaller than a connecting force necessary to release the interference state of the pair of lock portions.

[0020] Further particularly, the pair of second locking portions are kept engaged even if the operating portion is operated with the same force as the connecting force necessary to release the interference state of the pair of lock portions.

[0021] Further particularly, the female housing and the male housing include a pair of lock portions which interfere with each other while the two housings are being connected, thereby restricting a connecting operation of the two housings, at least one of which is resiliently deformed to release an interference state when a predetermined connecting force is applied to the two housings in the interference state and which are engaged with each other to inseparably lock the two housings when the two housings reach a properly connected state; the inner housing includes an operating portion used to move the female housing in a direction to connect the female housing to the male housing; the inner housing and the outer housing include a pair of partial locking portions which are engaged with each other to restrict a movement of the inner housing from the protection position to the protection releasing position and a pair of full locking portions which are engaged with each other with the inner housing located at the protection releasing position; an engaged state of the pair of partial locking portions is released when the operating portion is operated with a force smaller than a connecting force necessary to release the interference state of the pair of lock portions; and the pair of full locking portions are kept engaged even if the operating portion is operated with the same force as the connecting force necessary to release the interference state of the pair of lock portions.

[0022] In connecting the two housings, the operating portion of the inner housing is operated in a connecting direction with the inner housing temporarily held at the protection position by the engagement of the pair of partial locking portions. The connecting operation of the two housings is restricted halfway by the interference of the pair of lock portions. If an operating force applied to the operating portion is increased in this interference state, the pair of partial locking portions are disengaged while the pair of lock portions are kept in the interference state. Thus, the inner housing is moved from the protection position to the protection releasing position. If the operating force applied to the operating portion is increased in this state, the interference state of the pair of lock portions is released. Therefore, at least one of the lock portions is resiliently deformed to release the interference state of the two lock portions and the connecting operation of the two housings is resumed. When reaching the properly connected state, the two housings are inseparably locked by the engagement of the pair of lock portions.

[0023] According to another aspect of the invention, there is provided a method of assembling a connector, comprising a housing and a mating housing connectable to each other, the method comprising the following steps: providing the housing including an inner housing including a seal portion; at least partly accommodating at least one terminal fitting in the inner housing; holding the inner housing in an outer housing of the housing movably back and forth between a protection position where the seal portion is protected and a protection releasing position where protection for the seal portion is released; providing the mating housing having a terminal holding portion for holding at least one mating terminal fitting; at least partly surrounding the outer housing by means of a receptacle projecting from the terminal holding portion; and providing a mating seal portion in or at the terminal hold-

ing portion and to be held in close contact with the seal portion.

[0024] According to a particular embodiment, the seal portion is provided on the outer periphery of the inner housing and/or at the protection position the seal portion is protected by being covered over by the outer housing.

[0025] Particularly, the seal portion is a seal surface integrally or unitarily formed on the outer peripheral surface of the inner housing.

[0026] Further particularly, the housing and the mating housing include at least one pair of lock portions which interfere with each other while the two housings are being connected, thereby restricting a connecting operation of the two housings, at least one of which is resiliently deformed to release an interference state when a specified connecting force is applied to the two housings in the interference state and which are engaged with each other to inseparably lock the two housings when the two housings reach a properly connected state.

[0027] Further particularly, the inner housing includes an operating portion used to move the housing in a direction to connect the housing to the mating housing.

[0028] Further particularly, the inner housing and the outer housing include at least one pair of first locking portions which are engaged with each other to restrict a movement of the inner housing from the protection position to the protection releasing position and/or at least one pair of second locking portions which are engaged with each other with the inner housing located at the protection releasing position.

[0029] Further particularly, an engaged state of the pair of first locking portions is released when the operating portion is operated with a force smaller than a connecting force necessary to release the interference state of the pair of lock portions, and/or wherein the pair of second locking portions are kept engaged even if the operating portion is operated with the same force as the connecting force necessary to release the interference state of the pair of lock portions.

[0030] According to the above, both an operation of moving the inner housing from the protection position to the protection releasing position and an operation of properly connecting the two housings can be performed by operating the operating portion once in a state where the two housings are not connected and the inner housing is at the protection position. Therefore, operability is better as compared with the case where two operations are independently performed.

[0031] These and other objects, features and advantages of the present invention will become more apparent upon reading of the following detailed description of preferred embodiments and accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

FIG. 1 is a section showing an unconnected state of a female housing and a male housing in a first embodiment,

FIG. 2 is a section showing a state while the two housings are being connected,

FIG. 3 is a section showing a state where the two housings are further connected,

FIG. 4 is a section showing a state where the two housings are properly connected,

FIG. 5 is a section showing an unconnected state of a female housing and a male housing in a second embodiment,

FIG. 6 is a section showing a state while the two housings are being connected,

FIG. 7 is a section showing a state where the two housings are further connected,

FIG. 8 is a section showing a state where the two housings are properly connected,

FIG. 9 is a section of a female housing of a third embodiment,

FIG. 10 is a section showing an unconnected state of the female housing and a male housing,

FIG. 11 is a section showing a state where the two housings are properly connected,

FIG. 12 is a section of a female housing of a fourth embodiment,

FIG. 13 is a section showing an unconnected state of the female housing and a male housing, and

FIG. 14 is a section showing a state where the two housings are properly connected.

<First Embodiment>

[0032] Hereinafter, a specific first embodiment of the present invention is described with reference to FIGS. 1 to 4. A connector A according to the first embodiment includes a female housing 10 and a male housing 30. Sides of the female and male housings 10, 30 to be connected are referred to as front or front side.

[0033] The female housing 10 is formed by assembling an inner housing 11 made e.g. of synthetic resin and an outer housing 20 likewise made e.g. of synthetic resin. At least one cavity 12 for at least partly accommodating a female terminal fitting 19 is formed in the inner housing 11. The inner housing 11 particularly substantially is block-shaped and a seal surface 13 (as a particular female seal portion) integral or unitary to the inner housing 11 is formed on the outer periphery of (particularly a front end part of) the inner housing 11. At least one first restricting projection 14 and at least one second restricting projection 15 located behind the first restricting projection 14 are formed on the upper surface (outer surface) of the inner housing 11. A (particularly substantially pointed or mountain-shaped) locking projection 16 (as a particular first or partial locking portion of an inner housing) and a locking step 17 (as a particular second or full locking portion of the inner housing) located behind the first or partial locking portion are formed on the lower surface (outer surface) of the inner housing 11. The rear end surface of the inner housing 11 serves as an operating portion 18.

[0034] The outer housing 20 particularly is substantially in the form of a (particularly substantially rectangular or polygonal) tube with open front and/or rear surfaces, and the inner space of the outer housing 20 serves an accommodation space 21 for at least partly accommodating the inner housing 11. At least one retaining piece 22 (which particularly substantially extends obliquely downward or inward toward the front particularly substantially in a cantilever manner and/or is resiliently deformable) is formed on the (e.g. upper) inner surface (particularly the ceiling surface) of the accommodation space 21. A resilient locking piece 23 (as a particular first or partial locking portion and/or second or full locking portion of an outer housing) which substantially extends obliquely upward or inward toward the back (particularly substantially in a cantilever manner) and/or is resiliently deformable is formed on the (e.g. lower) inner surface (particularly the bottom surface) of the accommodation space 21. At least one lock arm 24 (as a particular lock portion of the female housing) which substantially extends backward (particularly substantially in a cantilever manner) and/or is resiliently deformable in a vertical direction (direction crossing a connecting direction of the two housings 10, 30) is formed on the (e.g. upper) surface (outer surface) of the outer housing 20. At least one lock projection 25 is formed on the upper or outer surface of the lock arm 24.

[0035] The female housing 10 is to be assembled by at least partly inserting the inner housing 11 into the accommodation space 21, particularly substantially from behind the outer housing 20. In an unconnected state of the two housings 10, 30 (before the two housings 10, 30 are connected or a state where the two housings 10, 30 are separated), the inner housing 11 is arranged at a protection position PP shown in FIGS. 1 and 2 to protect the seal surface 13 of the inner housing 11. In a state where the inner housing 11 is at the protection position PP, an area of the inner housing 11 from the front end to a position slightly before the rear end is accommodated in the accommodation space 21 in forward and backward directions (directions parallel to connecting and separating directions of the two housings 10, 30). The seal surface 13 formed on the front end part of the inner housing 11 particularly is entirely covered over by the outer housing 20.

[0036] Further, the resilient locking piece 23 is engaged with the locking projection 16 from front, thereby stopping the inner housing 11 so as not to move any further forward relative to the outer housing 20, and/or the retaining piece 22 is engaged with the first restricting projection 14 from behind, thereby preventing the inner housing 11 from being separated (detached) backward. By these locking actions, the inner housing 11 is held or positioned at the protection position PP particularly with movements thereof in forward and backward directions relative to the outer housing 20 restricted.

[0037] When a pushing force is applied to the operating portion 18 in connecting direction or from behind in the state where the inner housing 11 is at the protection position PP, the locking projection 16 and the resilient locking piece 23 are disengaged and the resilient locking piece 23 is resiliently deformed to be separated from the locking projection 16. This allows the inner housing 11 to move forward relative to the outer housing 20. When the inner housing 11 reaches a protection releasing position PRP shown in FIGS. 3 and 4, the locking step 17 is engaged with the resilient locking piece 23 from behind, whereby the inner housing 11 is stopped so as not to move any further forward and the second restricting projection 15 is engaged with the retaining piece 22 from front. By these locking actions, the inner housing 11 particularly is held or positioned at the protection releasing position PRP with movements thereof in forward and backward directions relative to the outer housing 20 restricted.

[0038] When the inner housing 11 is moved to the protection releasing position PRP, the front end part of the inner housing 11, i.e. an area where the seal surface 13 is formed, projects forward from the accommodation space 21, i.e. from the front end surface of the outer housing 20. In a state where the inner housing 11 is at the protection releasing position PRP and the two housings 10, 30 are not connected, the seal surface 13 may be damaged or the like due to the interference of an external matter since being exposed on the outer surface of the female housing 10.

[0039] The male housing 30 is made e.g. of synthetic resin and an integral or unitary assembly of a (particularly substantially block-shaped) terminal holding portion 31 and a receptacle 32 in the form of a rectangular tube substantially extending forward (substantially same direction as a moving direction of the male housing 30 to be connected to the female housing 10) from the outer periphery of the terminal holding portion 31. At least one male terminal fitting 36 is to be held or positioned in the terminal holding portion 31 and a tab 37 of the corresponding male terminal fitting 36 at least partly projects from the front end surface of the terminal holding portion 31 (back end surface of the receptacle 32). The terminal holding portion 31 particularly is formed with at least one fitting recess 33 by recessing the front end surface thereof. At least one seal ring or member 34 (as a particular male seal portion) particularly substantially surrounding the tab 37 is to be mounted on or to (particularly the inner periphery of) the fitting recess 33. At least one receiving portion 35 (as a particular lock portion of the male housing) projecting downwardly (inwardly of the receptacle 32) is formed at or near a front end part of a (particularly upper) wall portion forming the receptacle 32.

[0040] Next, functions of this first embodiment are described. In connecting the two housings 10, 30, the female housing 10 is at least partly inserted into the receptacle 32 with the inner housing 11 held at the protection position PP. At this time, not only the inner housing 11, but also the outer housing 20 are accommodated into the receptacle 32. As the two housings 10, 30 are con-

nected particularly by pushing the operating portion 18 by one hand while holding the male housing 30 by the other hand, the lock projection 25 of the lock arm 24 and the receiving portion 35 come into contact with each other to reach an interference state IS as shown in FIG. 2 and a connecting operation of the two housings 10, 30 is restricted by the interference (engagement) of the lock projection 25 and the receiving portion 35. A connecting force (locking force) necessary to release this interference state of the lock projection 25 and the receiving portion 35 particularly is larger than a locking force between the resilient locking piece 23 and the locking projection 16.

[0041] When an operating force applied to the operating portion 18 is increased in this state, the resilient locking piece 23 is resiliently deformed to be separated from the locking projection 16 and the inner housing 11 held at the protection position PP moves forward to the protection releasing position PRP as shown in FIG. 3 and particularly is held or positioned at the protection releasing position PRP by the engagement of the resilient locking piece 23 and the locking step 17. Since the lock arm 24 is not resiliently deformed and the interference state IS of the lock projection 25 and the receiving portion 35 is maintained during this time, the connecting operation of the two housings 10, 30 does not proceed any further. Further, a locking force between the resilient locking piece 23 and the locking step 17 particularly is larger than the connecting force (locking force) necessary to release this interference state IS of the lock projection 25 and the receiving portion 35.

[0042] When the operating force applied to the operating portion 18 is increased after the inner housing 11 is moved to the protection releasing position PRP, the lock arm 24 is resiliently deformed and the lock projection 25 is separated from the receiving portion 35 with the resilient locking piece 23 and the locking step 17 kept engaged. This causes the connecting operation of the two housings 10, 30 to proceed and the two housings 10, 30 are properly connected as shown in FIG. 4. Then, the lock arm 24 is resiliently at least partly restored to engage the lock projection 25 and the receiving portion 35. By this locking action, the two housings 10, 30 are inseparably locked.

[0043] When the two housings 10, 30 are properly connected, the front end part of the inner housing 11 projecting forward from the outer housing 20 is inserted into the fitting recess 33 and the seal surface 13 is resiliently held in close contact with the inner peripheral surface of the seal ring or member 34. Since connected parts of the two housings 10, 30 are sealed in a fluid- or liquid-tight manner in this way, even if fluid or water enters a clearance between the two housings 10, 30 from the outside, any further fluid or water entrance is hindered by a close contact area between the seal ring or member 34 and the seal surface 13. Thus, connected parts of the female terminal fitting 19 and the male terminal fitting 36 are kept fluid- or watertight.

[0044] In separating the two housings 10, 30 in a state where the two housings 10, 30 are properly connected, the lock arm 24 is resiliently deformed in an unlocking direction to disengage the lock projection 25 and the receiving portion 35 and the two housings 10, 30 are pulled apart in that state. Further, the inner housing 11 held or positioned at the protection releasing position PRP is moved backward relative to the outer housing 20 and held or positioned at the protection position PP. It particularly does not matter which of an operation of moving the inner housing 11 to the protection position PP and an operation of separating the two housings 10, 30 by unlocking the lock arm 24 is performed first.

[0045] The female housing 10 forming the connector A of the first embodiment has the seal surface 13 on the outer periphery and includes the inner housing 11 for at least partly accommodating the female terminal fitting 19 and the outer housing 20 for holding the inner housing 11 movably back and forth between the protection position PP where the seal surface 13 is protected (e.g. at least partly is covered over) and the protection releasing position PRP where protection for the seal surface 13 is released. On the other hand, the male housing 30 includes the terminal holding portion 31 for holding the male terminal fitting(s) 36, the receptacle 32 projecting from the terminal holding portion 31 and at least partly surrounding the outer housing 20 and the seal ring or member 34 that is provided in the terminal holding portion 31 and can be held in close contact with the seal surface 13.

[0046] In the unconnected state of the female housing 10 and the male housing 30, the seal surface 13 on the outer periphery of the inner housing 11 is protected from the interference of an external matter (particularly since being covered over by the outer housing 20) if the inner housing 11 is arranged at the protection position PP. Further, since the receptacle 32 of the male housing 30 at least partly surrounds the outer housing 20, it is not necessary to secure a connection space for the entrance of the receptacle 32 in the clearance between the inner housing 11 and the outer housing 20. Thus, the clearance between the outer periphery of the inner housing 11 and the inner periphery of the outer housing 20 can be narrowed, wherefore the seal surface 13 can be reliably protected from an external matter having entered the clearance between the inner housing 11 and the outer housing 20.

[0047] Further, the female seal portion provided on the inner housing 11 is the seal surface 13 integrally or unitarily formed on the outer periphery of the inner housing 11. The technical meaning of this configuration is as follows. If the female seal portion is a seal ring separate from the inner housing, the seal ring may come into contact with the inner periphery of the outer housing 20 to be displaced when the inner housing is moved back and forth. However, since the female seal portion is the seal surface 13 integral or unitary to the inner housing 11 in this first embodiment, there is no likelihood that the seal surface 13 is displaced even if coming into contact with

the inner periphery of the outer housing 20.

[0048] Further, the female housing 10 and the male housing 30 are provided with at least one pair of lock portions (lock arm 24 and receiving portion 35) which interfere with each other while the two housings 10, 30 are being connected, restricting the connecting operation of the two housings 10, 30, at least one of which is resiliently deformed to release the interference state IS when a specified (predetermined or predeterminable) connecting force is applied to the two housings 10, 30 in this interference state IS, and which are engaged with each other and inseparably lock the two housings 10, 30 when the two housings 10, 30 reach a properly connected state. The inner housing 11 includes the operating portion 18 used to move the female housing 10 in the direction to connect the female housing 10 to the male housing 30.

[0049] Further, the inner housing 11 and the outer housing 20 particularly are provided with the resilient locking piece 23 and the locking projection 16 as a pair of first or partial locking portions which are engaged with each other particularly to restrict a movement of the inner housing 11 from the protection position PP to the protection releasing position PRP. Further, the inner housing 11 and the outer housing 20 are provided with the resilient locking piece(s) 23 and the locking step(s) 17 as at least one pair of second or full locking portions which are engaged with each other in a state where the inner housing 11 is moved forward to the protection releasing position PRP. The resilient locking piece 23 and the locking projection 16 are disengaged when the operating portion 18 is operated with a force smaller than the connecting force necessary to release the interference state IS of the lock arm 24 and the receiving portion 35. Further, the resilient locking piece 23 and the locking step 17 particularly are kept engaged even if the operating portion 18 is operated with the same force as the connecting force necessary to release the interference state IS of the lock arm 24 and the receiving portion 35.

[0050] According to this configuration, both an operation of moving the inner housing 11 from the protection position PP to the protection releasing position PRP and an operation of properly connecting the two housings 10, 30 particularly can be performed by operating the operating portion 18 once in a state where the two housings 10, 30 are not connected and the inner housing 11 is at the protection position. Therefore, operability is better as compared with the case where two operations are independently performed.

[0051] Accordingly, to protect a seal portion provided in a female housing, a connector A includes a female housing 10 and a male housing 30. The female housing 10 has a seal surface 13 (female seal portion) particularly on the outer periphery and includes an inner housing 11 for at least partly accommodating at least one female terminal fitting 19 and an outer housing 20 for holding the inner housing 11 movably back and forth between a protection position PP where the seal surface 13 is covered over and a protection releasing position PRP where protection for the seal surface 13 is released. The male housing 30 includes a terminal holding portion 31 for holding at least one male terminal fitting 36, a receptacle 32 projecting from the terminal holding portion 31 and at least partly surrounding the outer housing 20 and a seal ring or member 34 (male seal portion) provided in the terminal holding portion 31 to be held in close contact with the seal surface 13.

<Second Embodiment>

[0052] Hereinafter, a specific second embodiment of the present invention is described with reference to FIGS. 5 to 8. A connector B of this second embodiment differs from the first embodiment in a seal portion for sealing connected parts of a female housing 40 and a male housing 50. Since the other configuration is similar or substantially the same as in the first embodiment, the similar or same components are denoted by the same reference signs and structures, functions and effects thereof are not described.

[0053] A seal ring or member 26 (as a particular female seal portion) separate from an inner housing 11 is to be mounted on or to (particularly the outer periphery of a front end part of) the inner housing 11 with movements in forward and backward directions restricted. In a state where the inner housing 11 is at a protection position PP, the seal ring 26 mounted to or on (particularly the front end part of) the inner housing 11 is entirely accommodated in an accommodation space 21 and substantially covered over by an outer housing 20.

[0054] Further, in a state where the inner housing 11 is at a protection releasing position PRP, the front end part of the inner housing 11, i.e. an area where the seal ring 26 is formed is at least partly exposed forward from the accommodation space 21 and projects forward from the front end surface of the outer housing 20. Since being exposed on the outer surface of the female housing 40 in this state, the seal ring 26 may be damaged or the like due to the interference of an external matter. A terminal holding portion 31 of the male housing 50 is formed with at least one fitting recess 33 by recessing the front end surface thereof. The inner periphery of the fitting recess 33 serves as a seal surface 38 (as a particular male seal portion) integral or unitary to the male housing 50.

[0055] Next, functions of the second embodiment are described. In connecting the two housings 40, 50, the female housing 40 at least partly is inserted into the receptacle 32 with the inner housing 11 held at the protection position PP and the two housings 40, 50 are further connected by pushing the operating portion 18. Then, as shown in FIG. 6, a lock projection 25 of a lock arm 24 and a receiving portion 35 come into contact to reach an interference state IS, thereby restricting a connecting operation of the two housings 40, 50 by the interference (engagement) of the lock projection 25 and the receiving portion 35.

[0056] When an operating force applied to the operat-

ing portion 18 is increased in this state, a resilient locking piece 23 is resiliently deformed to be separated from a locking projection 16 and the inner housing 11 held at the protection position PP moves forward to a protection releasing position PRP as shown in FIG. 7 and is held at the protection releasing position PRP by the engagement of the resilient locking piece 23 and a locking step 17. Since the interference state IS of the lock projection 25 and the receiving portion 35 is kept during this time, the connecting operation of the two housings 40, 50 does not proceed.

[0057] When the operating force applied to the operating portion 18 is increased after the inner housing 11 is moved to the protection releasing position PRP, the lock arm 24 is resiliently deformed and the lock projection 25 is separated from the receiving portion 35 with the resilient locking piece 23 and the locking step 17 kept engaged. Thus, the connecting operation of the two housings 40, 50 proceeds. When the two housings 40, 50 are properly connected as shown in FIG. 8, the lock arm 24 is resiliently at least partly restored to engage the lock projection 25 and the receiving portion 35. By this locking action, the two housings 40, 50 are inseparably locked.

[0058] When the two housings 40, 50 are properly connected, the seal ring 26 on the front end part of the inner housing 11 substantially projecting forward from the outer housing 20 at least partly is inserted into the fitting recess 33 and resiliently held in close contact with the seal surface 38. In this way, connected parts of the two housings 40, 50 are sealed in a fluid- or liquid-tight manner.

<Third Embodiment>

[0059] Next, a specific third embodiment of the present invention is described with reference to FIGS. 9 to 11. A connector C of this third embodiment includes a female housing 60 and a male housing 80. Note that since functions and effects of this third embodiment are similar or substantially the same as in the first embodiment, they are not described.

[0060] The female housing 60 is formed by assembling an inner housing 61 made e.g. of synthetic resin and an outer housing 70 likewise made e.g. of synthetic resin. A cavity 62 for at least partly accommodating at least one female terminal fitting 68 is formed in the inner housing 61. The inner housing 61 particularly is substantially block-shaped and at least one seal surface 63 (as a particular female seal portion) integral or unitary to the inner housing 61 is formed on (particularly the outer periphery of a front end part of) the inner housing 61. At least one restricting projection 64 is formed on the upper surface (outer surface) of the inner housing 61. At least one (particularly substantially pointed or mountain-shaped) locking projection 65, at least one locking step 66 located behind the locking projection 65 and at least one retaining step 67 located before the locking projection 65 are formed on the lower surface (outer surface) of the inner housing 61.

[0061] The outer housing 70 particularly is substantially in the form of a (particularly substantially rectangular or polygonal) tube with open front and rear surfaces, and the inner space of the outer housing 70 serves an accommodation space 71 for at least partly accommodating the inner housing 61. A retaining piece 72 which substantially extends obliquely downward toward the front (particularly substantially in a cantilever manner) and/or is resiliently deformable is formed on the (e.g. upper) inner surface (ceiling surface) of the accommodation space 71. At least one resilient locking piece 73 which substantially extends obliquely inwardly or upward toward the back (particularly substantially in a cantilever manner) and is resiliently deformable is formed on the (e.g. lower) inner surface (bottom surface) of the accommodation space 71. At least one lock arm 74 which substantially extends backward in a cantilever manner and is resiliently deformable in a vertical direction (direction crossing a connecting direction of the two housings 60, 80) is formed on the e.g. upper surface (outer surface) of the outer housing 70. At least one lock projection 75 is formed on the upper or outer surface of the lock arm 74.

[0062] The female housing 60 is assembled by at least partly inserting the inner housing 61 into an accommodation section of the outer housing 70. In an unconnected state of the two housings 60, 80 (before the two housings 60, 80 are connected or a state where the two housings 60, 80 are separated), the inner housing 61 is arranged at a protection position PP shown in FIG. 9 to protect the seal surface 63 of the inner housing 61. In a state where the inner housing 61 is at the protection position PP, an area of the inner housing 61 from the front end to a position slightly before the rear end is accommodated in the accommodation space 71 in forward and backward directions (directions substantially parallel to connecting and separating directions of the two housings 60, 80). The seal surface 63 formed on the front end part of the inner housing 61 particularly is substantially entirely covered over by the outer housing 70.

[0063] Further, the resilient locking piece 73 particularly is engaged with the locking projection 65 from front, thereby stopping the inner housing 61 so as not to move any further forward relative to the outer housing 70, and/or the retaining step 67 particularly is engaged with a base end part (base part) of the resilient locking piece 73 from front, thereby preventing the inner housing 61 from being separated (detached) backward. By these locking actions, the inner housing 61 particularly is held or positioned at the protection position PP with movements thereof in forward and backward directions relative to the outer housing 70 restricted.

[0064] When a pushing force is applied to the inner housing 61 at the protection position from behind, the locking projection 65 and the resilient locking piece 73 are disengaged and the resilient locking piece 73 is resiliently deformed to be separated from the locking projection 65. This allows the inner housing 61 to move for-

ward relative to the outer housing 70. When the inner housing 61 reaches a protection releasing position PRP shown in FIG. 10, the locking step 66 is engaged with the resilient locking piece 73 from behind, whereby the inner housing 61 particularly is stopped so as not to move any further forward and the restricting projection 64 particularly is engaged with the retaining piece 72 from front. By these locking actions, the inner housing 61 particularly is held or positioned at the protection releasing position PRP with movements thereof in forward and backward directions relative to the outer housing 70 restricted.

[0065] When the inner housing 61 is moved to the protection releasing position PRP, the front end part of the inner housing 61, i.e. an area where the seal surface 63 is formed, is exposed forward from the accommodation space 71 and projects forward from the front end surface of the outer housing 70. Since being exposed on the outer surface of the female housing 60 in this state, the seal surface 63 may be damaged or the like due to the interference of an external matter.

[0066] The male housing 80 is made e.g. of synthetic resin and an integral or unitary assembly of a (particularly substantially block-shaped) terminal holding portion 81 and a receptacle 82 in the form of a (particularly substantially rectangular or polygonal) tube substantially extending forward (substantially same direction as a moving direction of the male housing 80 to be connected to the female housing 60) from the outer periphery of the terminal holding portion 81. At least one male terminal fitting 86 is held or at least partly accommodated) in the terminal holding portion 81 and a tab 87 of the corresponding male terminal fitting 86 at least partly projects from the front end surface of the terminal holding portion 81 (back end surface of the receptacle 82). The terminal holding portion 81 is formed with at least one fitting recess 83 by recessing the front end surface thereof. A seal ring or member 84 (as a particular male seal portion) particularly at least partly surrounding the tab 87 is mounted on the inner periphery of the fitting recess 83. A receiving portion 85 substantially projecting downwardly (inwardly of the receptacle 82) is formed at or on (particularly a front end part of an upper wall portion forming) the receptacle 82.

[0067] Next, functions of this third embodiment are described. In connecting the two housings 60, 80, the female housing 60 held or positioned at the protection position PP is moved to the protection releasing position PRP in advance. In that state, the female housing 60 at least partly is inserted into the receptacle 82. At this time, not only the inner housing 61, but also the outer housing 70 are at least partly accommodated into the receptacle 82. As the two housings 60, 80 are connected, the lock arm 74 is resiliently deformed by the interference of the lock projection 75 and the receiving portion 85. When the two housings 60, 80 reach a properly connected state, the lock arm 74 is resiliently at least partly restored to engage the lock projection 75 and the receiving portion 85. By this locking action, the two housings 60, 80 are inseparably locked.

[0068] When the two housings 60, 80 are properly connected, the front end part of the inner housing 61 projecting forward from the outer housing 70 at least partly is inserted into the fitting recess 83 and the seal surface 63 is resiliently held in close contact with the inner peripheral surface of the seal ring or member 84. Since connected parts of the two housings 60, 80 are sealed in a fluid- or liquid-tight manner in this way, even if fluid (e.g. water) enters a clearance between the two housings 60, 80 from the outside, any further fluid entrance (e.g. water entrance) is hindered by a close contact area between the seal ring or member 84 and the seal surface 63. Thus, connected parts of the female terminal fitting 68 and the male terminal fitting 86 are kept fluidtight (e.g. watertight).

[0069] In separating the two housings 60, 80 in a state where the two housings 60, 80 are properly connected, the lock arm 74 is resiliently deformed in an unlocking direction to disengage the lock projection 75 and the receiving portion 85 and the two housings 60, 80 are pulled apart in that state. Further, the inner housing 61 held at the protection releasing position PRP is moved backward relative to the outer housing 70 and held or positioned at the protection position PP. It does not matter which of an operation of moving the inner housing 61 to the protection position PP and an operation of separating the two housings 60, 80 by unlocking the lock arm 74 is performed first.

<Fourth Embodiment>

[0070] Hereinafter, a specific fourth embodiment of the present invention is described with reference to FIGS. 12 to 14. A connector D of this fourth embodiment differs from the third embodiment in a seal portion for sealing connected parts of a female housing 90 and a male housing 95. Since the other configuration is similar or substantially the same as in the third embodiment, the similar or same components are denoted by the same reference signs and structures, functions and effects thereof are not described.

[0071] A seal ring or member 69 (as a particular female seal portion) separate from an inner housing 61 is to be mounted on or to (particularly the outer periphery of or near a front end part of) the inner housing 61 with movements in forward and backward directions restricted. In a state where the inner housing 61 is at a protection position PP, the seal ring 69 mounted on the front end part of the inner housing 61 substantially is entirely accommodated in an accommodation space 71 and/or covered over by an outer housing 70.

[0072] Further, in a state where the inner housing 61 is at a protection releasing position PRP, the front end part of the inner housing 61, i.e. an area where the seal ring 69 is formed or provided, at least partly is exposed substantially forward from the accommodation space 71 and substantially projects forward from the front end surface of the outer housing 70. Since being exposed on the outer surface of the female housing 90 in this state,

the seal ring 69 may be damaged or the like due to the interference of an external matter.

[0073] A terminal holding portion 81 of the male housing 95 is formed with at least one fitting recess 83 by recessing the front end surface thereof. The inner periphery of the fitting recess 83 serves as a seal surface 88 (as a particular male seal portion) integral or unitary to the male housing 95.

[0074] Next, functions of this fourth embodiment are described. In connecting the two housings 90, 95, the inner housing 61 held at the protection position PP is moved forward or displaced to the protection releasing position PRP. In that state, the female housing 90 is inserted into a receptacle 82. At this time, not only the inner housing 61, but also the outer housing 70 at least partly are accommodated into the receptacle 82. While the two housings 90, 95 are being connected, the lock arm 74 is resiliently deformed by the interference of a lock projection 75 and a receiving portion 85.

[0075] When the two housings 90, 95 reach a properly connected state, the lock arm 74 is resiliently at least partly restored to engage the lock projection 75 and the receiving portion 85. By this locking action, the two housings 90, 95 are inseparably locked. When the two housings 90, 95 are properly connected, the seal ring 69 on the front end part of the inner housing 61 projecting forward from the outer housing 70 at least partly is inserted into the fitting recess 83 and the seal ring or member 69 is resiliently held in close contact with the seal surface 88. In this way, connected parts of the two housings 90, 95 are sealed in a fluid-tight (at least partly liquid-tight) manner.

<Other Embodiments>

[0076] The present invention is not limited to the above described and illustrated embodiments. For example, the following embodiments are also included in the technical scope of the present invention.

(1) Although the female seal portion is the seal surface integral or unitary to the inner housing and the male seal portion is the seal ring that is an independent component separate from the male housing in the above first and third embodiments, both the female seal portion and the male seal portion may be seal rings or members that are independent components.

(2) Although the male seal portion is the seal surface integral or unitary to the male housing and the female seal portion is the seal ring that is an independent component separate from the inner housing in the above second and fourth embodiments, both the female seal portion and the male seal portion may be seal rings that are independent components.

(3) Although the lock portion of the female housing is the resiliently deformable lock arm and that of the male housing is the receiving portion that is not resiliently deformed in the above first and second embodiments, the lock portion of the female housing may be a receiving portion that is not resiliently deformed and that of the male housing may be a resiliently deformable lock arm.

(4) Although only the lock portion of the female housing out of those of the female housing and the male housing is the resiliently deformable lock arm in the first and second embodiments, both the lock portion of the female housing and that of the male housing may be resiliently deformable lock arms.

(5) Although the seal portion has been exemplarily described as a seal ring in the above embodiments, it should be understood that any seal member such as a seal plate may be used according to the invention.

Reference Numerals

[0077]

A ... connector
10 ... female housing (housing)
11 ... inner housing
13 ... seal surface (seal portion or female seal portion)
16 ... locking projection (first/partial locking portion of inner housing)
17 ... locking step (second/full locking portion of inner housing)
18 ... operating portion
19 ... female terminal fitting (terminal fitting)
20 ... outer housing
23 ... resilient locking piece (first/partial locking portion, second/full locking portion of outer housing)
24 ... lock arm (lock portion of female housing)
30 ... male housing (mating housing)
31 ... terminal holding portion
32 ... receptacle
34 ... seal ring (mating/male seal portion)
35 ... receiving portion (lock portion of mating/male housing)
36 ... male terminal fitting (mating terminal fitting) B, C, D ... connector
26, 69 ... seal ring (seal portion or female seal portion)
38, 88 ... seal surface (mating/male seal portion)
40,60,90 ... female housing (housing)
50, 80, 95 ... male housing (mating housing)
61 ... inner housing
63 ... seal surface (seal portion or female seal portion)
68 ... female terminal fitting (terminal fitting)
70 ... outer housing
81 ... terminal holding portion
82 ... receptacle
84 ... seal ring (mating seal portion or male seal portion)

86 ... male terminal fitting (mating terminal fitting)

Claims

1. A connector (A; B; C; D), comprising:

   a housing (10; 40; 60; 90) and a mating housing (30; 50; 80; 95) connectable to each other;
   the housing (10; 40; 60; 90) including:

   • an inner housing (11; 61) including a seal portion (13; 63) and adapted to at least partly accommodate at least one terminal fitting (19; 68), and
   • an outer housing (20; 70) for holding the inner housing (11; 61) movably back and forth between a protection position (PP) where the seal portion (13; 63) is protected and a protection releasing position (PRP) where protection for the seal portion (13; 63) is released; and

   the mating housing (30; 50; 80; 95) including:

   • a terminal holding portion (31; 81) for holding at least one mating terminal fitting (36; 86),
   • a receptacle (32; 82) projecting from the terminal holding portion (31; 81) and at least partly surrounding the outer housing (20; 70), and
   • a mating seal portion (34; 38; 88; 84) provided in or at the terminal holding portion (31; 81) and capable of being held in close contact with the seal portion (13; 63).

2. A connector according to claim 1, wherein the seal portion (13; 63) is provided on the outer periphery of the inner housing (11; 61) and/or at the protection position (PP) the seal portion (13; 63) is protected by being covered over by the outer housing (20; 70).

3. A connector according to any one of the preceding claims, wherein the seal portion (13; 63) is a seal surface integrally or unitarily formed on the outer peripheral surface of the inner housing (11; 61).

4. A connector according to any one of the preceding claims, wherein the housing (10; 40; 60; 90) and the mating housing (30; 50; 80; 95) include at least one pair of lock portions (24, 35) which interfere with each other while the two housings are being connected, thereby restricting a connecting operation of the two housings, at least one of which is resiliently deformed to release an interference state (IS) when a specified connecting force is applied to the two housings in the interference state (IS) and which are engaged with each other to inseparably lock the two housings when the two housings reach a properly connected state.

5. A connector according to any one of the preceding claims, wherein the inner housing (11; 61) includes an operating portion (18) used to move the housing (10; 40; 60; 90) in a direction to connect the housing (10; 40; 60; 90) to the mating housing (30; 50; 80; 95).

6. A connector according to any one of the preceding claims, wherein the inner housing (11; 61) and the outer housing (20; 70) include at least one pair of first locking portions (16, 23) which are engaged with each other to restrict a movement of the inner housing (11; 61) from the protection position (PP) to the protection releasing position (PRP) and/or at least one pair of second locking portions (17, 23) which are engaged with each other with the inner housing (11; 61) located at the protection releasing position (PRP).

7. A connector according to claim 6, wherein an engaged state of the pair of first locking portions (16, 23) is released when the operating portion (18) is operated with a force smaller than a connecting force necessary to release the interference state (IS) of the pair of lock portions (24, 35).

8. A connector according to claim 6 or 7, wherein the pair of second locking portions (17, 23) are kept engaged even if the operating portion (28) is operated with the same force as the connecting force necessary to release the interference state (IS) of the pair of lock portions (24; 35).

9. A method of assembling a connector (A; B; C; D), comprising a housing (10; 40; 60; 90) and a mating housing (30; 50; 80; 95) connectable to each other, the method comprising the following steps:

   providing the housing (10; 40; 60; 90) including an inner housing (11; 61) including a seal portion (13; 63);
   at least partly accommodating at least one terminal fitting (19; 68 in the inner housing (11; 61);
   holding the inner housing (11; 61) in an outer housing (20; 70) of the housing (10; 40; 60; 90) movably back and forth between a protection position (PP) where the seal portion (13; 63) is protected and a protection releasing position (PRP) where protection for the seal portion (13; 63) is released;
   providing the mating housing (30; 50; 80; 95) having a terminal holding portion (31; 81) for holding at least one mating terminal fitting (36; 86);
   at least partly surrounding the outer housing (20;

70) by means of a receptacle (32; 82) projecting from the terminal holding portion (31; 81); and providing a mating seal portion (34; 38; 88; 84) in or at the terminal holding portion (31; 81) and to be held in close contact with the seal portion (13; 63).

10. An assembling method according to claim 9, wherein the seal portion (13; 63) is provided on the outer periphery of the inner housing (11:61) and/or at the protection position (PP) the seal portion (13; 63) is protected by being covered over by the outer housing (20; 70).

11. An assembling method according to claim 9 or 10, wherein the seal portion (13; 63) is a seal surface integrally or unitarily formed on the outer peripheral surface of the inner housing (11:61).

12. An assembling method according to any one of the preceding claims 9 to 11, wherein the housing (10; 40; 60; 90) and the mating housing (30; 50; 80; 95) include at least one pair of lock portions (24, 35) which interfere with each other while the two housings are being connected, thereby restricting a connecting operation of the two housings, at least one of which is resiliently deformed to release an interference state (IS) when a specified connecting force is applied to the two housings in the interference state (IS) and which are engaged with each other to inseparably lock the two housings when the two housings reach a properly connected state.

13. An assembling method according to any one of the preceding claims 9 to 12, wherein the inner housing (11; 61) includes an operating portion (18) used to move the housing (10; 40; 60; 90) in a direction to connect the housing (10; 40; 60; 90) to the mating housing (30; 50; 80; 95).

14. An assembling method according to any one of the preceding claims 9 to 13, wherein the inner housing (11; 61) and the outer housing (20; 70) include at least one pair of first locking portions (16, 23) which are engaged with each other to restrict a movement of the inner housing (11; 61) from the protection position (PP) to the protection releasing position (PRP) and/or at least one pair of second locking portions (17, 23) which are engaged with each other with the inner housing (11; 61) located at the protection releasing position (PRP).

15. An assembling method according to claim 14, wherein an engaged state of the pair of first locking portions (16, 23) is released when the operating portion (18) is operated with a force smaller than a connecting force necessary to release the interference state (IS) of the pair of lock portions (24, 35), and/or wherein the pair of second locking portions (17, 23) are kept engaged even if the operating portion (28) is operated with the same force as the connecting force necessary to release the interference state (IS) of the pair of lock portions (24; 35).

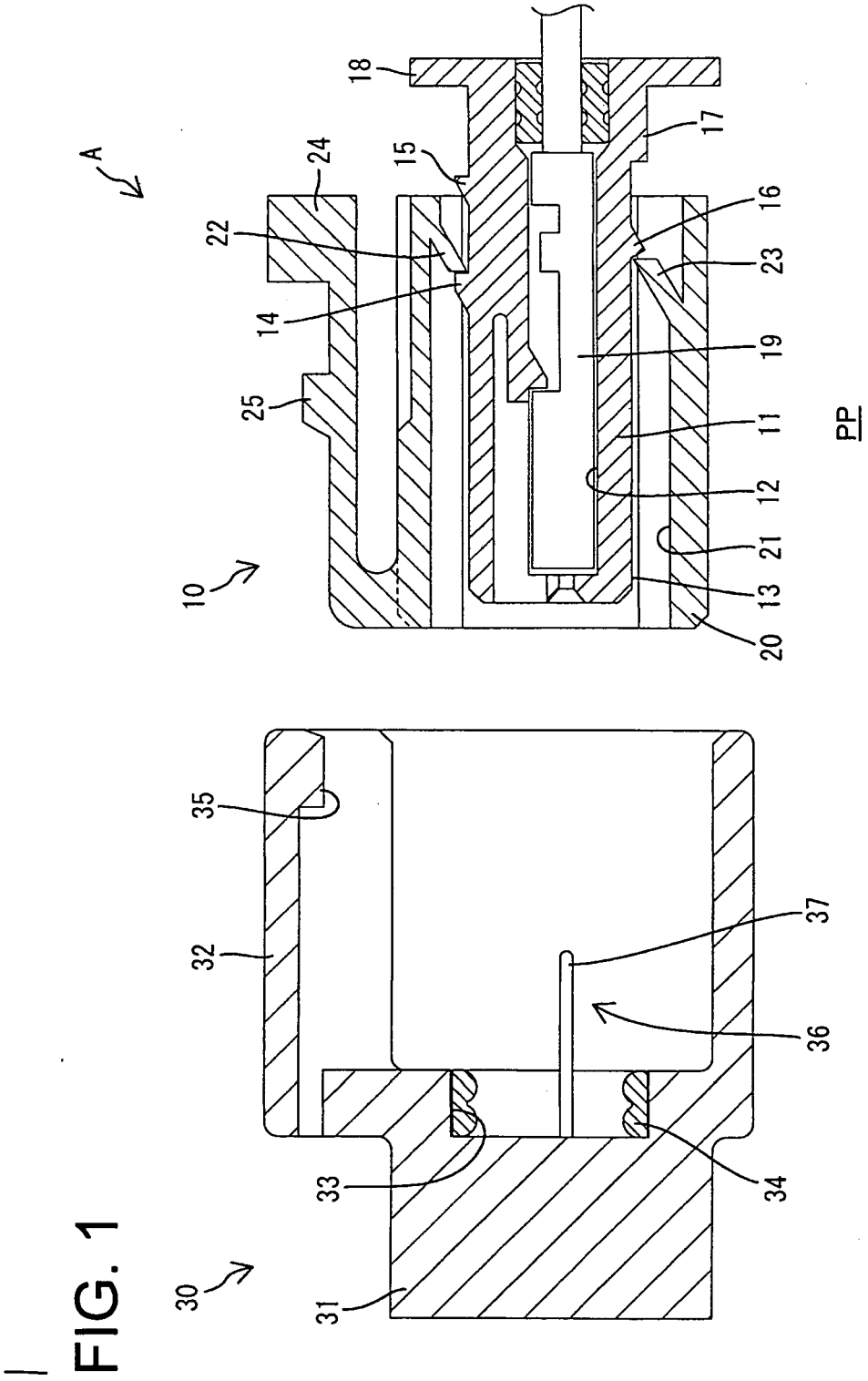
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FIG. 1

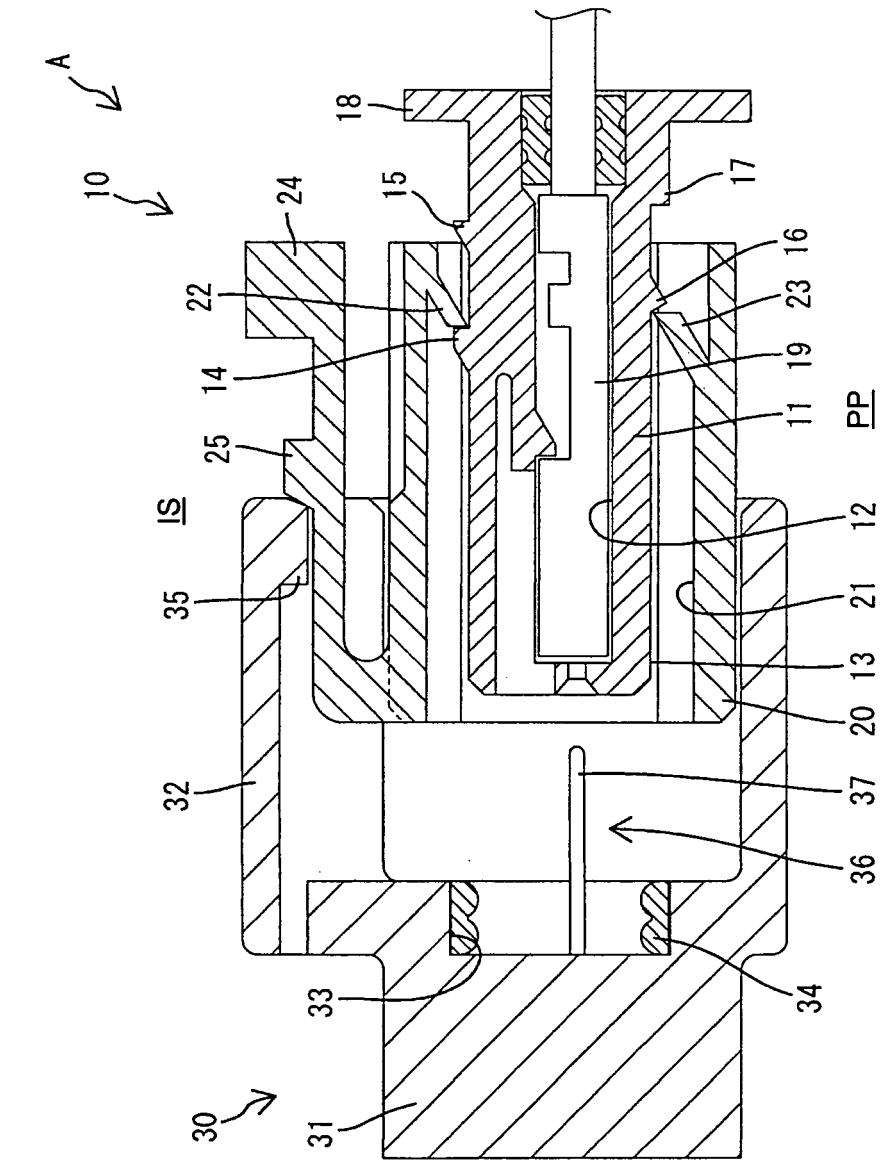
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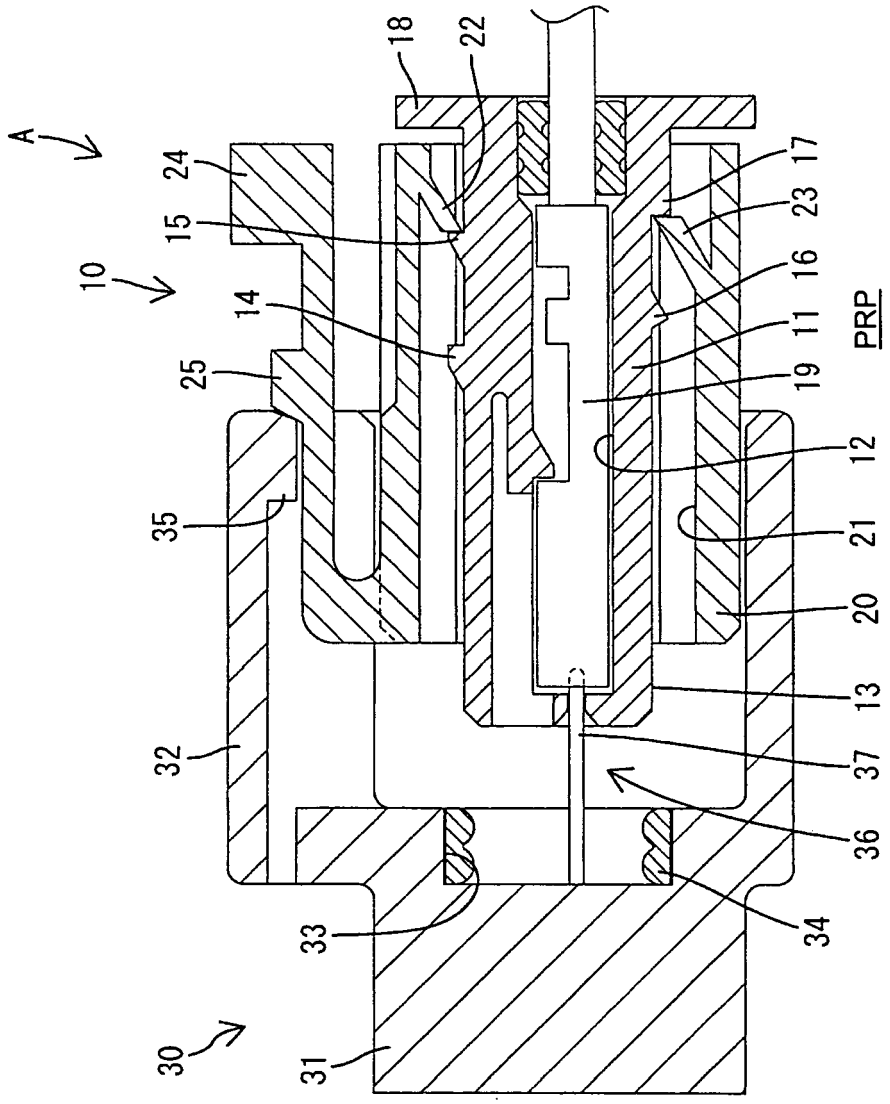
FIG. 2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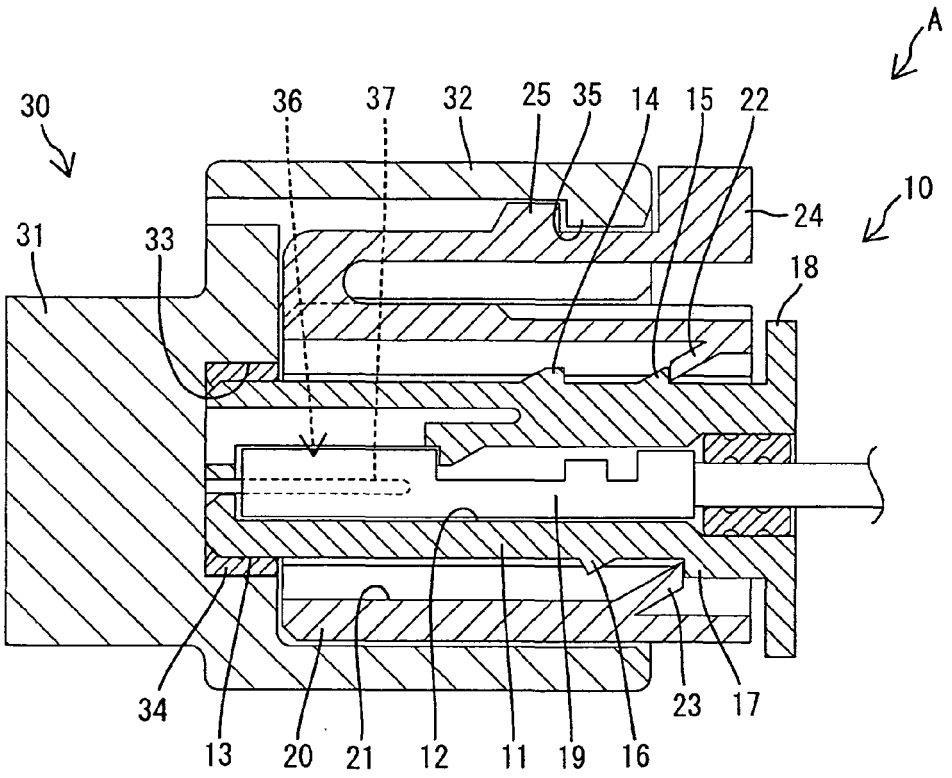
PRP

FIG. 3

FIG. 4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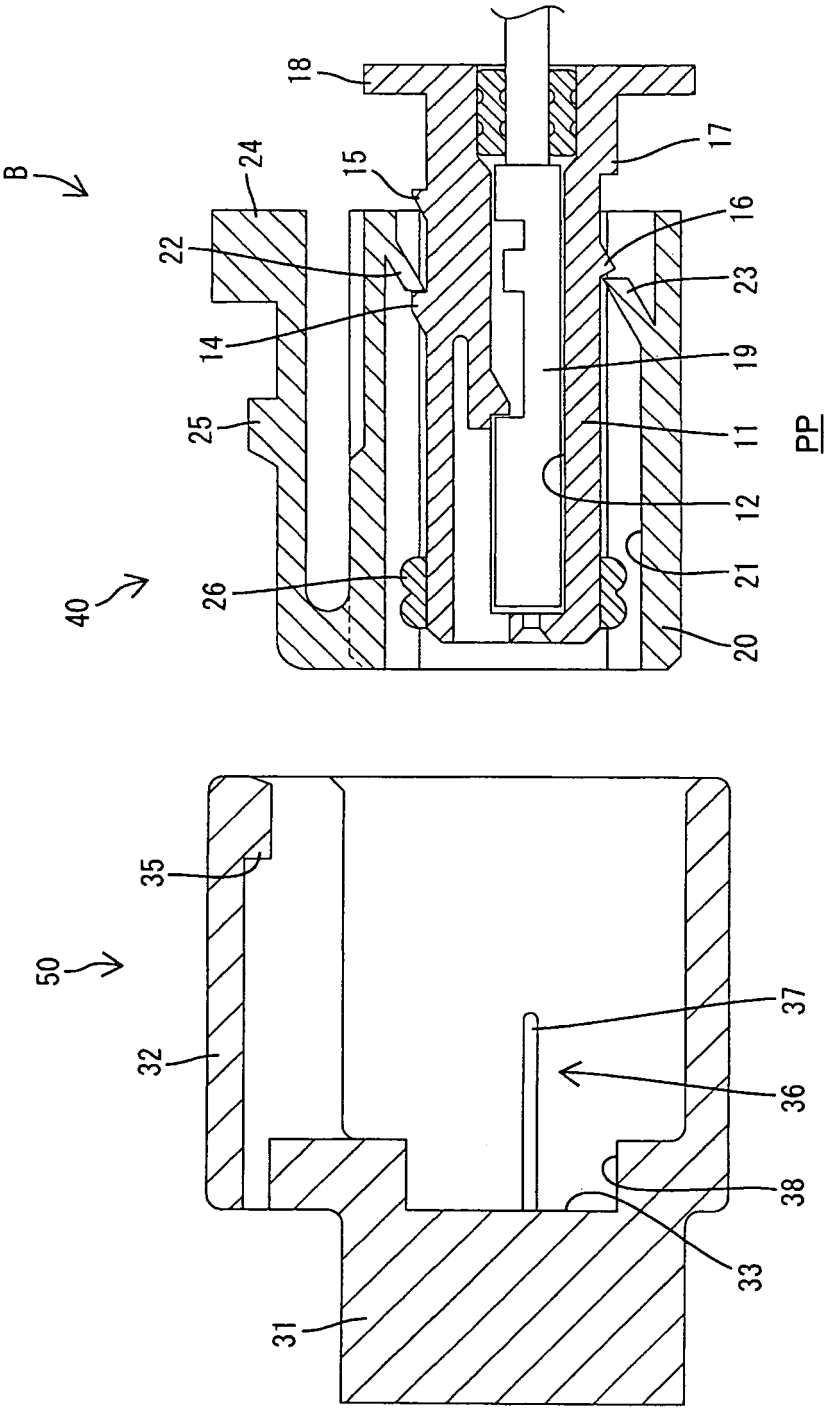
17
PRP

FIG. 5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PP
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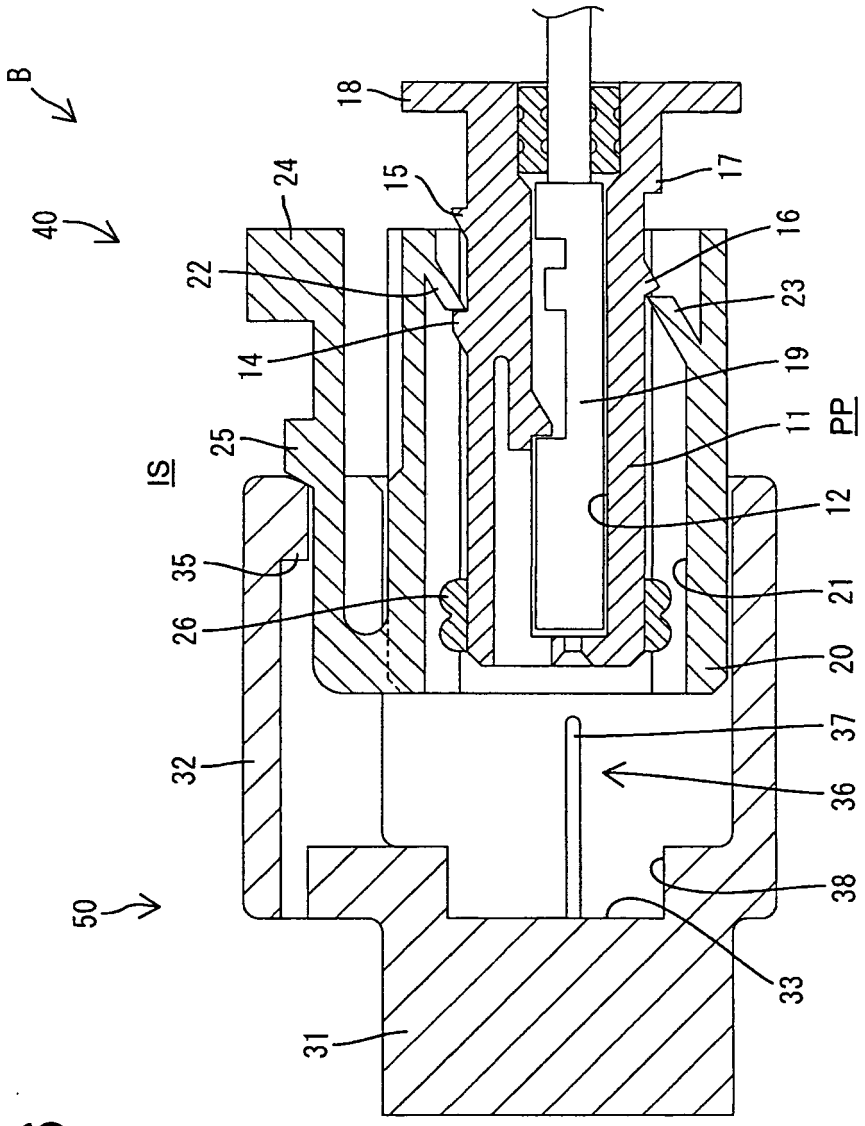
31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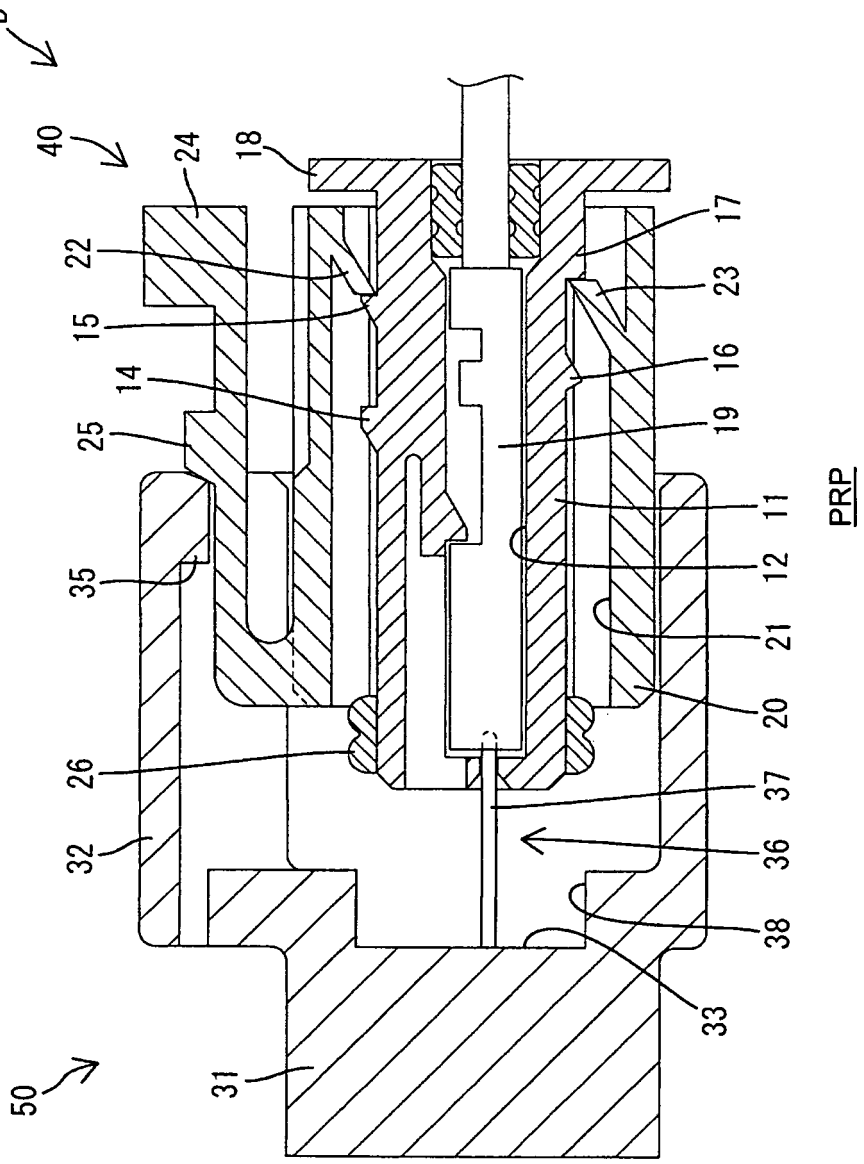
31

FIG. 6

FIG. 7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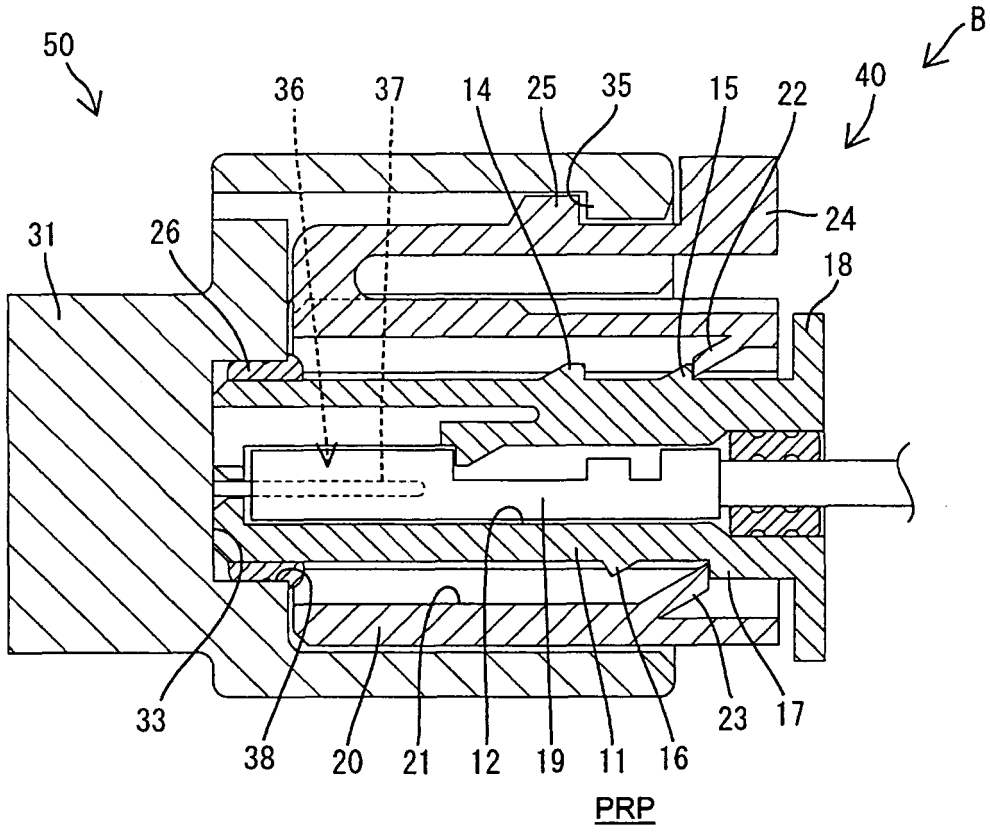
33
PRP

FIG. 8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B
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36
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14
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23
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PRP

FIG. 9

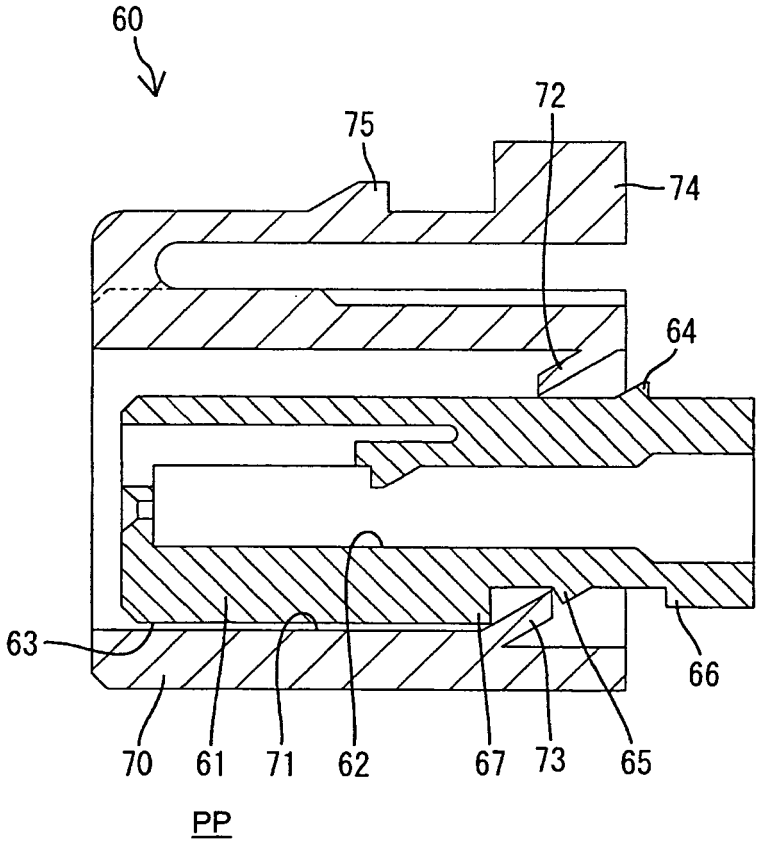
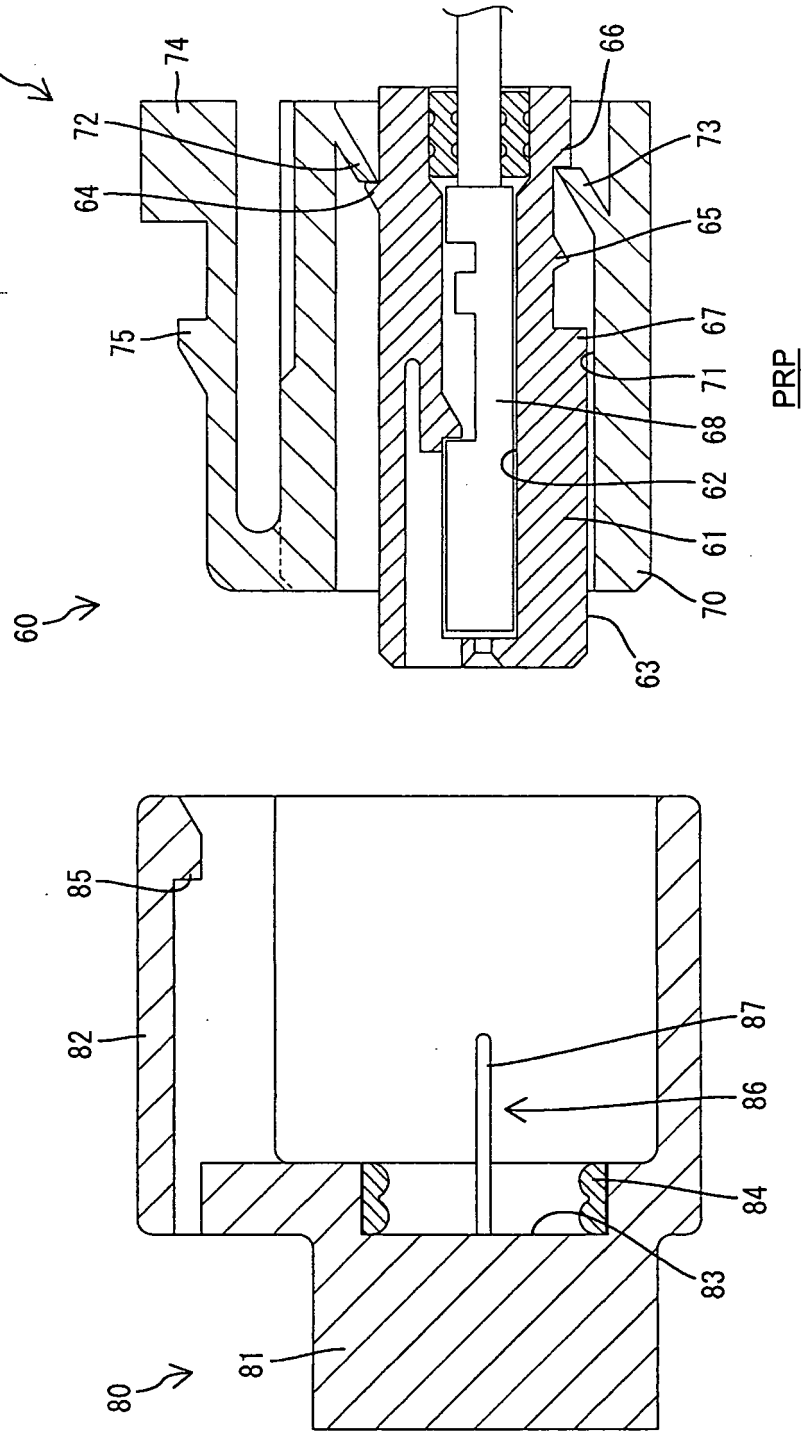


FIG. 10


C
74
72
64
66
73
65
67
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70
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PRP
75
60
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82
87
86
84
83
81
80

FIG. 11

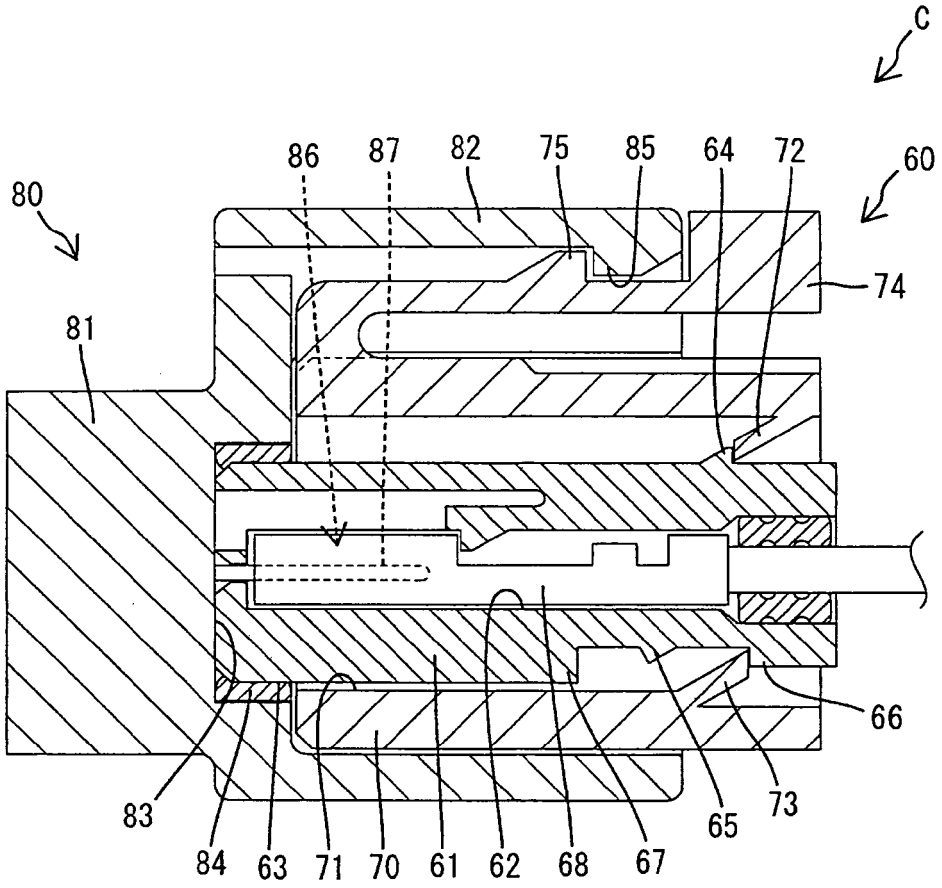


FIG. 12

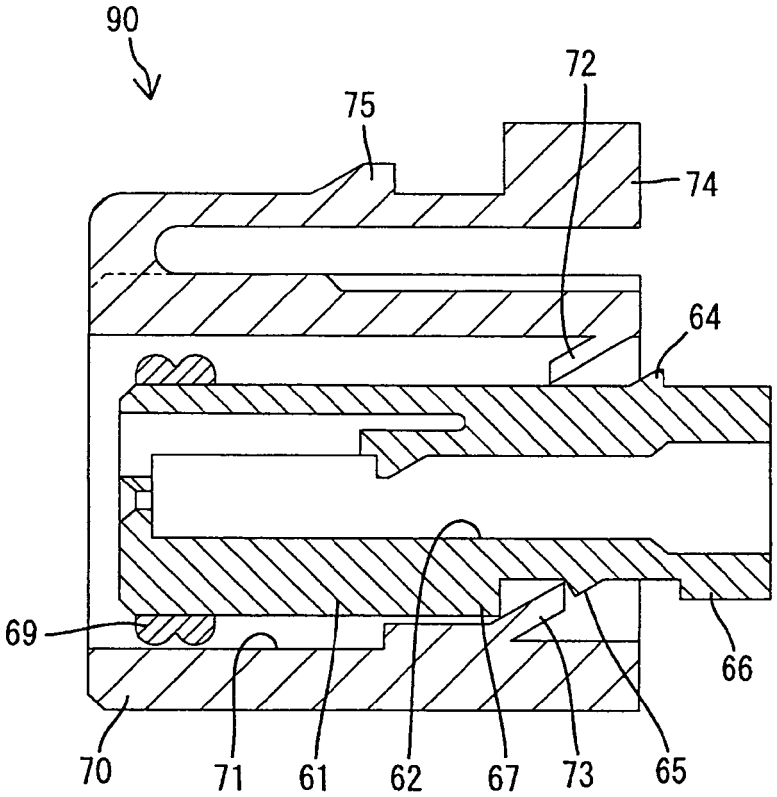
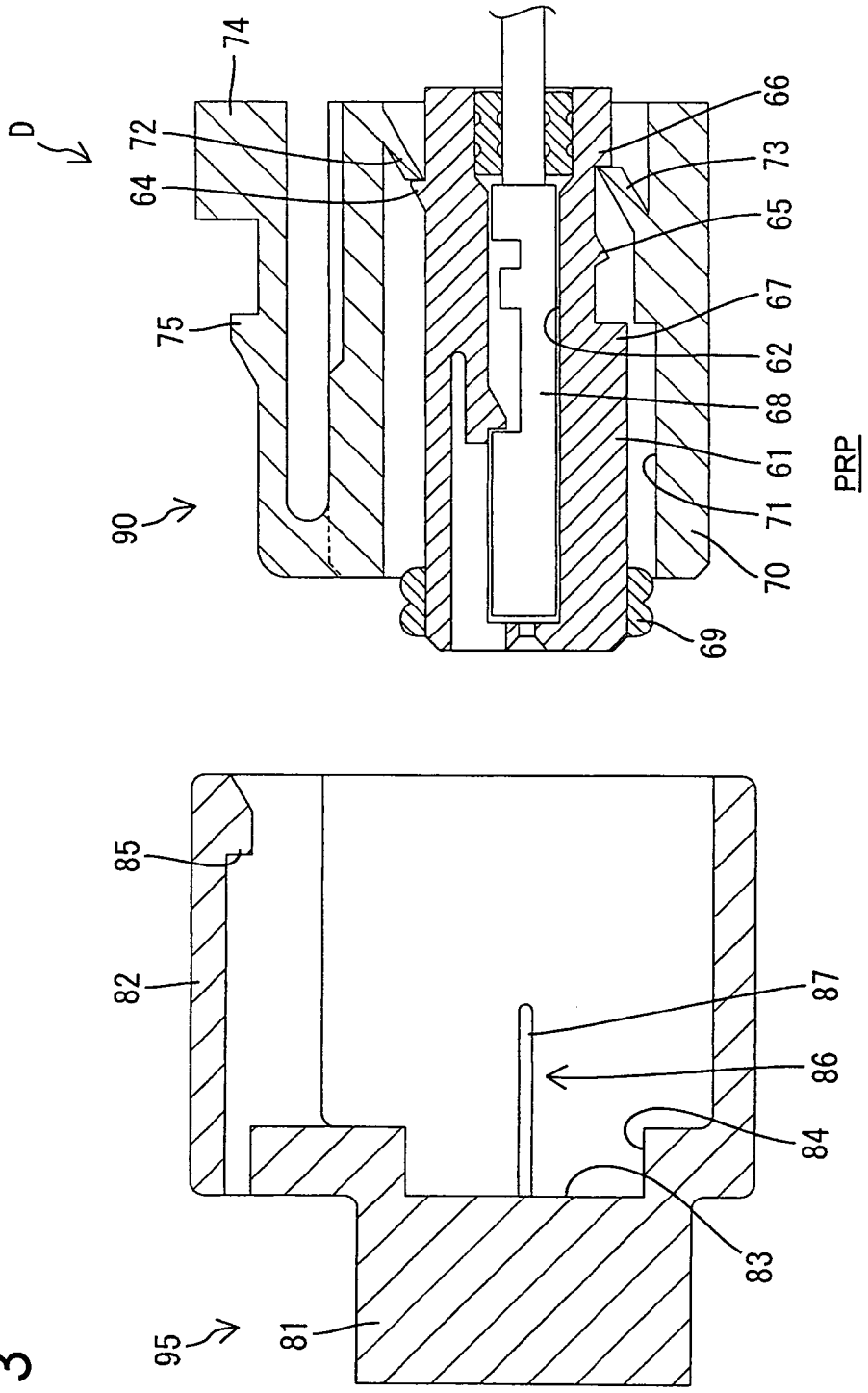


FIG. 13


D
74
72
64
75
90
66
73
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PRP
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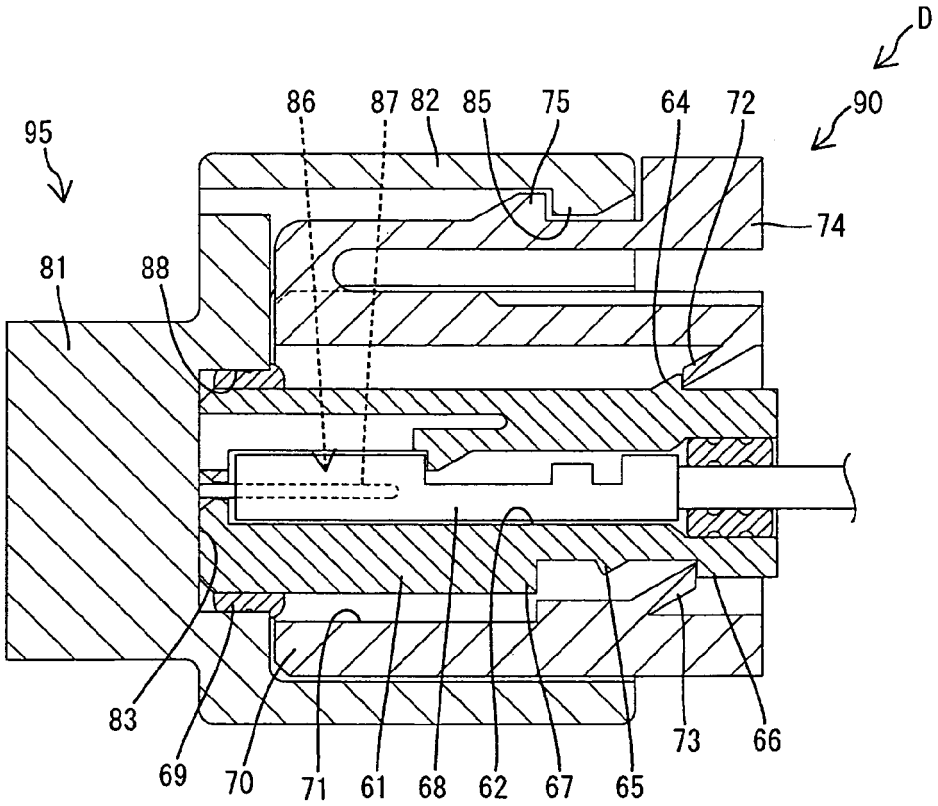
83
95
81

FIG. 14



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EUROPEAN SEARCH REPORT

Application Number
EP 12 00 5335

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2009 272253 A (SUMITOMO WIRING SYSTEMS) 19 November 2009 (2009-11-19) * figures 1-3,6,7 *	1-15	INV. H01R13/506 H01R13/52
A,D	JP 2001 283972 A (SUMITOMO WIRING SYSTEMS) 12 October 2001 (2001-10-12) * figures 1,3,4,5,6,7,9,10,11 *	1-15	
A	US 2005/048820 A1 (YAMASHITA KAZUNORI [JP]) 3 March 2005 (2005-03-03) * figures 4,5 *	1-15	
A	EP 0 691 711 A1 (GROTE & HARTMANN [DE]) 10 January 1996 (1996-01-10) * figures 3-4 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)
H01R

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Place of search	Date of completion of the search	Examiner
The Hague	8 January 2013	Esmiol, Marc-Olivier

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