

ELECTRIC CONNECTOR

BACKGROUND

1. Technical Field

[0001]

The present invention relates to an electric connector. More particularly, the present invention relates to an electric connector whose coupling with a counterpart connector is facilitated via manipulation of a manipulation lever.

2. Related Art

[0002]

Large numbers of patents present electric connectors that are so contrived that a manipulation lever is fitted to the housing of either one of a pair of first and second connectors that couple together, and by engaging this manipulation lever with the housing of the other connector and turning it, coupling of the first and second connectors can be effected smoothly. A representative example is set forth in JP-A-2005-123102 issued in Japan.

[0003]

Fig. 18 is an exploded perspective view of a related art electric connector, and Fig. 19 is a sectional view of the electric connector of Fig. 18 in the assembled state. As Fig. 18 shows, the electric connector 50 set forth in JP-A-2005-123102 includes: a plurality of pins 51; a connector housing 52 in which the pins 51 are housed; a rear holder 55 that is installed to the rear portion of the connector housing 52 and has a plurality of through-holes through which the pins 51 are inserted; a sealing member 54 that is interposed between the connector housing 52 and the rear holder 55; and a manipulation lever 53 and rear cover 56 that are fitted to the rear portion of the connector housing 52.

[0004]

Among these component parts, the connector housing 52 is provided with a rail 52_A that extends in the horizontal direction, and the rear cover 56 is provided with a guide slot 56_A into which the rail 52_A is inserted. A guide slot 56_A is also

provided in the bottom wall of the rear cover 56 in Fig. 18. Further, these guide slots 56_A, 56_A are each provided with a rear holder pressing portion 56_B, 56_B, these rear holder pressing portions 56_B, 56_B being composed of a level portion 57 that contacts against the rear surface of the rear holder 55, and an inclined portion 58 that slides over the edge of the rear face of the rear holder 55.

[0005]

The rear cover 56 is mounted to the connector housing 52 by being slid horizontally onto the rear portion of the connector housing 52. More precisely, the guide slots 56_A, 56_A of the rear cover 56 are mounted onto the upper and lower rails 52_A, 52_A of the connector housing 52, then the rear cover 56 is fitted by being slid onto the rear portion of the connector housing 52. By means of such sliding motion, the rear holder pressing portions 56_B, 56_B of the rear cover 56 contact with and are pressed against the rear portion of the rear holder 55. As a result, the rear holder 55 is moved toward the fixed position on the connector housing 52, while clamping the seal member 54 between itself and the rear portion of the connector housing 52. In tandem with the sliding motion of the rear cover 56, the inclined portions 58 contact against the rear surface edges of the rear holder 55, so that the rear holder 55 slides along the sloping surfaces of the inclined portions 58 and is moved toward the rear portion of the connector housing 52. Then the inclined portions 58 move beyond the rear surface edges, and the level portions 57 contact with the rear surfaces of the rear holder 55. Thereby, the pressed state is maintained, and watertightness is preserved between the outer surfaces of the electric wire portions of the wired pins 51 that were installed earlier and the sealing member (see Fig. 19).

[0006]

According to this electric connector 50, the sliding of the rear cover 56 results in the rear holder 55 being fixed to the connector housing 52, and simultaneously in the sealing member 54 being clamped, so that watertightness is preserved between the outer surfaces of the electric wire portions of the wired pins 51 and the sealing member 54. More precisely, guide slots 56_A and rear holder

pressing portions 56_B are provided in the rear cover 56, and horizontally-extending rails 52_A are provided on the connector housing 52; by mounting the guide slots 56_A in the rear cover 56 onto the rails 52_A on the connector housing 52, and sliding the rear cover 56 onto to the rear portion of the connector housing 52, the rear holder 55 is fixed to the connector housing 52, and at the same time the sealing member 54 is clamped, so that watertightness exists between the outer surfaces of the wired pins 51 and the sealing member. With this structure however, the rails 52_A that are provided on the connector housing 52 are formed as strip protrusions that project from the outer walls of the connector housing 52, because of which, limits are placed on the mechanical strength. In particular, a large load is imposed on the rails 52_A when the rear cover 56 is mounted, and when such load acts on the rails there will be danger of breakage or similar. Further, fabrication of the rear cover 56 is troublesome because the rear cover 56 must be provided with rear holder pressing portions 56_B that have a complex shape made up of a level portion 57 that contacts with the rear surface of the rear holder 55 and an inclined portion 58 that slides over the rear surface edges of the rear holder 55. Moreover, assembling these items is also troublesome.

SUMMARY

[0007]

An advantage of some aspects of the invention is to provide an electric connector that can proactively detect misassembly of the connector components when the rear cover is fitted.

[0008]

Another advantage of the present invention is to provide an electric connector that can determine the mounting status of the sealing member, and the joining status of the connector housing and rear holder, when the rear cover is fitted.

[0009]

According to an aspect of the invention, an electric connector includes: a

connector housing inside which pins are housed, and which has at the front an insertion portion into which a counterpart connector is inserted, and at the rear a holder mounting portion; a sealing member that is mounted onto the outer periphery of the holder mounting portion; a rear holder the front end portion of which is a contacting surface for contacting with the sealing member; which has at the front a mating cavity that is fixed onto the holder mounting portion, and at the rear a cover installation portion; and which is fixed to the connector housing with the sealing member interposed; and a rear cover which is mounted to the cover installation portion via sliding motion. The electric connector incorporates the features that a latching portion is provided in location adjacent to the cover installation portion at the rear of the rear holder, an engaging portion into which the latching portion engages are provided in the holder mounting portion of the connector housing, and if the latching portion is in a state of non-engagement with the engaging portion when the rear holder is mounted to the connector housing, the sliding motion of the rear cover is blocked.

[0010]

The latching portions and engaging portions may preferably be provided in locations on the rear holder and the holder mounting portion, respectively, that are opposite each other.

[0011]

The latching portions may preferably be constituted of a latching member possessing resilience and formed on part of the outer wall of the rear holder, the latching member may preferably have a latching bar and projecting block, and the engaging portion may preferably have a latching slot that is formed in the wall of the connector housing, so that if the connector housing and rear holder are not completely fixed together and the latching portion do not engage onto the engaging portion, then, just before latching into the latching slot, the latching bar will run up the connector housing's wall, with the result that the latching member will be pushed upward, and consequently the projecting block will block the rear cover from being mounted via sliding motion onto the cover installation portion.

[0012]

Also, part of the outer wall of the rear holder may preferably be formed as a double wall constituted of an inner plate and an outer plate with a gap therebetween, and the latching portion may preferably be provided on the inner plate.

[0013]

Also, a manipulation lever one portion of which latches into the counterpart connector to effect coupling of the two connectors may preferably be mounted to the wall of the rear holder.

[0014]

Thanks to the foregoing structure, the present invention yields the superior advantages that will now be described. Namely, according to an aspect of the invention, a latching portion and an engaging portion are provided at the rear of the rear holder and in the holder mounting portion, respectively, and if the latching portion fails to engage with the engaging portion when the rear holder is fitted into the connector housing, so that a non-engaged state results, then sliding motion of the rear cover at the cover installation portion will be blocked by the latching portion. Thus, should mounting of the sealing member and joining of the connector housing and rear holder be incomplete, it will not be possible to mount the rear cover. Consequently, during mounting of the rear cover it is possible to sense whether the sealing member, and the connector housing and rear holder, have been fully mounted, and hence to proactively detect incomplete assembly of the connector.

[0015]

According to another preferable aspect, providing the latching portion and the engaging portion in locations on the rear holder and the connector housing, respectively, that are opposite each other, will enable the rear holder to be fixed to the connector housing by means of the latching portion and engaging portion, which will be opposite each other, so that engagement of the rear holder to the connector housing will be stable and firm.

[0016]

According to another preferable aspect, the latching portion and engaging portion can be formed in a simple manner by machining the outer wall of the rear holder and the wall surface of the connector housing.

[0017]

According to another preferable aspect, by making a part of the outer wall of the rear holder to be a double wall constituted of an inner plate and an outer plate, the rear cover can be fitted by being slid into the gap between the inner wall plate and outer wall plate, and therefore can be fitted stably without being exposed to the exterior. Further, the manipulation lever for effecting coupling of the two connectors can also be fitted in the gap between the double walls.

[0018]

According to another preferable aspect, the fact that the manipulation lever is fitted to the rear holder facilitates coupling with the counterpart connector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

Illustrating an electric connector of an embodiment of the invention, Fig. 1A is a perspective view of the whole connector and Fig. 1B is an exploded version of the perspective view of Fig. 1A.

Illustrating the electric connector of Fig. 1 turned through 180 degrees, Fig. 2A is a perspective view of the whole connector and Fig. 2B is an exploded version of the perspective view of Fig. 2A.

Illustrating the connector housing of Figs. 1 and 2, Fig. 3A is an enlarged perspective view of the connector housing in Fig. 1B, and Fig. 3B is an enlarged perspective view of the connector housing in Fig. 2B.

Illustrating the rear holder of Figs. 1 and 2, Fig. 4A is an enlarged perspective view of the rear holder in Fig. 1B, and Fig. 4B is an enlarged

perspective view of the rear holder in Fig. 2B.

Illustrating the rear cover of Figs. 1 and 2, Fig. 5A is an enlarged perspective view of the rear cover in Fig. 1B, and Fig. 5B is an enlarged perspective view of the rear cover in Fig. 2B.

Illustrating the manipulation lever of Figs. 1 and 2, Fig. 6A is an enlarged perspective view of the manipulation lever in Fig. 1B, and Fig. 6B is an enlarged perspective view of the manipulation lever in Fig. 2B.

Illustrating the manipulation lever in the process of being mounted to the rear holder, Fig. 7A is a perspective view with a cut made through the relevant parts, and Fig. 7B is a side view of Fig. 7A.

Illustrating the manipulation lever after mounting to the rear holder, Fig. 8A is a perspective view with a cut made through the relevant parts, and Fig. 8B is a side view of Fig. 8A.

Illustrating the process of joining the connector housing and the rear holder, Fig. 9A is a perspective view of the items prior to being joined, Fig. 9B is a perspective view of the items after being joined, and Fig. 9C is an enlarged sectional view of portion IXC in Fig. 9B.

Illustrating the process of mounting the rear cover to the connector housing plus rear holder assembly shown in Fig. 9, Fig. 10A is a perspective view of the items prior to such mounting, Fig. 10B is a perspective view of the items after such mounting, and Fig. 10C is an enlarged sectional view of portion XC in Fig. 10B.

Illustrating the process of joining the connector housing and the rear holder, Fig. 11A is a perspective view of the items prior to being joined, Fig. 11B is a perspective view of the items after being joined, and Fig. 11C is an enlarged sectional view of portion XIC in Fig. 11B.

Illustrating the process of mounting the rear cover to the connector housing plus rear holder assembly shown in Fig. 11, Fig. 12A is a perspective view of the items prior to being joined, Fig. 12B is a perspective view of the items in the process of being joined, and Fig. 12C is an enlarged view of portion XIIC in Fig. 12B.

Illustrating mounting of the rear cover to the rear holder, Fig. 13A is a plan view, and Figs. 13B to 13D show stepwise the states in the mounting of the rear cover, being sectional views along line XIIIIB – XIIIIB in Fig. 13A.

Illustrating mounting of the rear cover to the rear holder, Fig. 14A is a plan view, and Figs. 14B and 14C show stepwise the states in the mounting of the rear cover, being sectional views along line XIVB – XIVB in Fig. 14A.

Illustrating the male connector, Fig. 15A is a perspective view of the whole connector, and Fig. 15B is an exploded version of the perspective view of Fig. 15A.

Illustrating the two connectors in the state prior to coupling, Fig. 16A is a perspective view of the whole, Fig. 16B is a rear view seen in direction X in Fig. 16A, Fig. 16C is a sectional view of the housing side of a line cut along XVIC – XVIC in Fig. 16B, and Fig. 16D is a sectional view of the manipulation lever side of a line cut along XVIC – XVIC in Fig. 16B.

Illustrating the two connectors in the state after coupling, Fig. 17A is a perspective view of the whole, Fig. 17B is a rear view seen in direction X in Fig. 17A, Fig. 17C is a sectional view of the housing side of a line cut along XVIIC – XVIIC in Fig. 17B, and Fig. 17D is a sectional view of the manipulation lever side of a line cut along XVIIC – XVIIC in Fig. 17B.

Fig. 18 is an exploded perspective view of a related art electric connector.

Fig. 19 is a sectional view of the electric connector of Fig. 18 in the assembled state.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0020]

Exemplary embodiments of the present invention will now be described with reference to the accompanying drawings. First will be described, with reference to Figs. 1 to 6, the whole of an electric connector according to a first embodiment, and the individual parts composing such connector. Figs. 1 and 2 show the whole connector and its individual parts, while Figs. 3 to 6 show the individual parts. The arrows between the parts in Figs. 1B and 2B indicate the

direction of assembly.

[0021]

As shown in Figs. 1 and 2, this electric connector (“connector” below) 1 consists of a female connector, and has a plurality of female pins 2, a female connector housing 3 in which the pins 2 are housed (“connector housing” below), a rear holder 6 that is mounted to the rear of the connector housing 3, a manipulation lever 30 that is mounted to the outer wall of the rear holder 6 and facilitates coupling with the counterpart connector, and a rear cover 20 that is mounted to the rear portion of the rear holder 6 and covers the rear end portions of the pins 2. The structure is such that a ring-like sealing member 35 is mounted to the outer periphery wall of the connector housing 3, and a terminal position assurance (“TPA” below) 38 that senses the fitting condition of the pins is mounted to a sidewall of the connector housing 3. The individual parts composing the connector will now be described in detail.

[0022]

As shown in Figs. 1 and 2, the female pins 2 are made up of two types of female pin of differing sizes; more precisely, relatively large-sized female pins (“large pins” below) 2_A, and female pins of a smaller size (“small pins” below) 2_B. The female pins of each type have a contacting portion at the forward end and a lead wire fixing portion at the rear end, the lead wires being connected to the fixing portions. Ring-shaped sealing members 2_C are fitted around the outer peripheries of the lead wires of the large pins 2_A. The small pins 2_B are gathered into a cluster of, for example, 20 pins, and a ring-like sealing member 2_D is fitted around the periphery of such pin cluster.

[0023]

As shown in Fig. 3, the connector housing 3 is enclosed by roughly rectangular front and rear walls 3₁, 3₂ at the front and rear and by a pair of opposed top and bottom walls 3₃, 3₃ and left and right sidewalls 3₄, 3₄, around its periphery, and has a front portion constituted of an insertion portion 3_A for insertion of the counterpart connector, and a rear portion constituted of a roughly oblong member

having a coupling portion 3_B that is fitted into the rear holder 6. Such member is formed as a molding of insulating synthetic resin.

[0024]

In the interior of this connector housing 3 there are formed, from the rear wall 3₂ towards the front wall 3₁, through-holes 4_A, 4_B through which the two types of female pins 2_A, 2_B are inserted (see Fig. 3B). The large pins 2_A are inserted into the through-holes 4_A, and the cluster of small pins 2_B is inserted into the through-hole 4_B. In the front wall 3₁ there are formed insertion holes for insertion of the male pins of the counterpart connector 40 (see Fig. 15) that connect with the pins 2_A, 2_B inserted through the insertion holes 4_A, 4_B in the rear wall 3₂. Further, the front wall 3₁ of the connector housing 3 is divided up by a narrow slot. Division of the front wall 3₁ by such slot means that coupling with the counterpart connector will be smooth, since during insertion into such connector the slot's width will contract.

[0025]

In one of the sidewalls 3₄ of the insertion portion 3_A there is formed a mounting hole 5_B into which the TPA 38 is mounted. Also, in the top and bottom walls 3₃, 3₃ at the rear end of the coupling portion 3_B there is formed a flat-bottomed latching groove 5_A into which a latching bar 11_B of the rear holder 6 to be described later (see Fig. 9) latches. Between this flat-bottomed latching groove 5_A and the rear wall 3₂ is located a sidewall portion 5_{A'} that constitutes the sidewall of the flat-bottomed latching groove 5_A. This sidewall portion 5_{A'} is formed as a part of the top wall 3₃. A similar latching groove 5_A and sidewall portion 5_{A'} are also formed in the bottom wall 3₃. Further, a rib 3₀ that restricts the motion of the sealing member 35 is formed on the outer periphery of the connector housing 3 at the boundary between the insertion portion 3_A and the holder coupling portion 3_B.

[0026]

As shown in Fig. 4, the rear holder 6 has roughly rectangular front and rear walls 6₁, 6₂ at the front and rear, and an outer periphery constituted of a member

that is enclosed by pairs of opposed outer walls, namely top and bottom walls 6_3 , 6_3 and left and right sidewalls 6_4 , 6_4 . Such member is formed as a molding of insulating synthetic resin. In the front wall 6_1 at the front of the rear holder 6 there is formed a mating cavity 6_C for insertion of the coupling portion 3_B of the connector housing 3. The interior of this mating cavity 6_C is partitioned by a partitioning wall 6_D , and in the partitioning wall 6_D there are formed through-holes through which the two types of pin 2_A , 2_B are inserted.

[0027]

The top and bottom walls 6_3 , 6_3 are each provided with a cover mounting portion RC and a lever mounting portion LC, to which are mounted a rear cover 20 and a manipulation lever 30 respectively, and with a housing latching portion LA that engages with the connector housing 3. The top and the bottom cover mounting portions RC, lever mounting portions LC and housing latching portions LA are each formed with the same structure, and all are formed by molding of the top and bottom walls 6_3 , 6_3 into a particular structure. Likewise the bottom wall 6_3 and the top wall 6_3 both have the same structure. To avoid duplication in the description therefore, the top wall 6_3 only is described below.

[0028]

As shown in Fig. 4, the top wall 6_3 has a particular thickness and a certain gap 6_G formed between the inner and outer surfaces, being a double wall, or more precisely being composed of an outer plate 6_A and an inner plate 6_B with the gap 6_G interposed. This gap 6_G is of a dimension such that the flange 33_B of the manipulation lever 30 to be described later can be inserted therein and turned. The outer plate 6_A is foreshortened in the front-rear direction, that is, extends from the front wall 6_1 to a point short of the rear wall 6_2 . In other words, the width of the outer plate 6_A stops short compared to that of the left and right sidewalls 6_4 , 6_4 . As a result of such foreshortening of the outer plate 6_A , the rear wall 6_2 is also foreshortened compared to the front wall. It is in between the foreshortened outer plate 6_A and rear wall 6_2 that the cover and lever mounting portions RC, LB and the housing latching portion LA are formed.

[0029]

The outer plate 6_A is partitioned by plural slits 8₀, 8₀, which extend from the rear edge to shortly before the front wall 6₁, into three areas, namely into first to third areas 6_{A1} to 6_{A3}, being in this manner partially divided up. The first and third areas 6_{A1} and 6_{A3} are formed to the same size, while the second area 6_{A2} is formed larger than the first and third areas 6_{A1} and 6_{A3}. Roughly in the center of this large second area 6_{A2} there is provided a rectangular recess 9 having a particular width and depth and extending from the rear wall 6₂ toward the front wall 6₁. The second area 6_{A2} is further divided into subareas 6_{A21}, 6_{A21} at the two ends of the recess 9. The bottom 9_A of the recess 9 is formed to be flat. Thanks to the recess bottom 9_A being made flat, the cut portion 33_B of the flange 33_B of the pivot projection 33 to be described later can be aligned with such flat surface, and hence it will be a simple matter to remove the pivot projection 33 from the gap 6_G.

[0030]

The rear portions of the first and third areas 6_{A1} and 6_{A3} are extended past a step difference 6₀ toward the rear wall 6₂. Such extensions constitute support projections 7_A, 7_A of a particular thickness and width. The thickness of these support projections 7_A, 7_A is such as to enable insertion into the flat-bottomed slots 22₀ of the rear cover 20.

[0031]

The inner plate 6_B is partitioned into five areas, namely into first to fifth areas 6_{B1} to 6_{B5}, being in this manner partially divided up. The first and fifth areas 6_{B1} and 6_{B5} – the side areas – are the same size. Likewise the second and fourth areas 6_{B2} and 6_{B4} are the same size. The first and fifth areas 6_{B1} and 6_{B5} form support projections 7_A, 7_A. The third area 6_{B3} has a larger surface area than the other areas, and an edge that is extended to the rear. In the third area 6_{B3} there is formed a receiving hole 10_A into which the pivot projection 33 of the manipulation lever 30 fits. The receiving hole 10_A is formed almost exactly beneath the recess 9 in the outer plate 6_A. Also, the receiving hole 10_A communicates with the gap 6₀. At the extended edge portion of the third area 6_{B3} there is formed a guide surface

10_B which consists of an inclined plane. Further, the bottom of the third area 6_{B3} forms a surface of the inner wall 6_B, surrounding the mating cavity 6_C, the thickness thereof being such as to enable insertion into the flat-bottomed slots 22₀ of the rear cover 20.

[0032]

Thus, the support projections 7_A, 7_A and the inner plate 6_B are formed to the same thickness, and are inserted into the flat-bottomed slots 22₀ of the rear cover 20 to be described later. At the left and right sidewalls 6₄, 6₄ surfaces of the rear wall 6₂ there are formed mounting portions 12_A, 12_A into which the rear cover 20 will be inserted.

[0033]

Also, on the rear wall 6₂, between the two mounting portions 12_A, 12_A, there is formed a rail projection 6_{2A} with top and bottom edges projecting outward at particular heights. Such a rail projection 6_{2A} is also formed at the bottom of the rear wall 6₂. Thanks to the provision of these rail projections 6_{2A}, the rear cover 20 will, for example, when inserted into one of the fitting portions 12_A, be guided by the rail projections 6_{2A} and as a result will be held to the rear holder 6, and will not separate from the rear holder 6. The rail projections 6_{2A} are separation prevention projections since they prevent separation of the rear cover 20.

[0034]

Latching portions 11, 11 that engage with the connector housing 3 are formed in the second and fourth areas 6_{B2}, 6_{B4}. These latching portions 11, 11 are formed almost exactly beneath the subareas 6_{A21}, 6_{A21} of the outer plate 6_A, and have each the same structure.

[0035]

As shown in Fig. 9C, these latching portions 11 have: a base portion 11₀ that is joined to the inner plate 6_B; a latching arm 11_A that extends from the base portion and has a particular length; and, located at the end of the latching arm 11_A, an upper projection that projects upward from the end portion, that is, a projecting block 11_C, and a lower projection that projects downward, that is, a latching bar

11_B. Partially separated from the inner plate 6_B by a long incision, the latching arm 11_A is an elastic arm piece possessing resilience. The latching bar 11_B engages into the flat-bottomed latching groove 5_A in the connector housing 3. The projecting block 11_C performs the role of inhibiting mounting of the rear cover 20 to the rear holder 6 if engagement of the latching bar 11_B with the latching groove 5_A is incomplete. Further, when engagement of the latching bar 11_B with the latching groove 5_A is completely effected, the top of the projecting block 11_C will contact against the sidewall 22_A of the rear cover 20, so that motion of the latching arm 11_A will be restricted, rendering firm the engagement of the latching bar 11_B with the latching groove 5_A. As a result, the connector housing 3 and rear holder 6 will be soundly joined.

[0036]

The cover and lever mounting portions RC, LB and the housing latching portion LA are formed between the outer and inner plates 6_A and 6_B and the rear wall 6₂, as shown in Fig. 4. The cover mounting portion RC is composed principally of the support projections 7_A, 7_A, the inner plate 6_B of the second area 6_{B2} between the support projections 7_A, 7_A, and the rail projection 6_{2A}. The lever mounting portion LB is composed principally of the gap 6_G between the inner and outer plates 6_A, 6_B, and the receiving hole 10_A provided in the inner plate 6_B. Further, the housing latching portion LA is made up of the latching portions 11, 11 provided in the second and fourth areas 6_{B2}, 6_{B4} of the inner plate 6_B, and the latching portions 11 are composed of a base portion 11₀ that is joined to the inner plate 6_B, a latching arm 11_A that extends from the base portion and has a particular length, and, located at the end of the latching arm 11_A, a projecting block 11_C that projects upward from the end portion and a latching bar 11_B that projects downward (see Fig. 9C). Thus, according to such structure the housing latching portion LA, cover mounting portion RC and lever mounting portion LB are gathered in the rear holder 6; consequently it is a simple matter to form these, and moreover it is possible to link the cover mounting portion RC and lever mounting portion LB with the housing latching portion LA. More precisely, the connector

housing 3 usually houses the pins and their accessories, etc., and therefore has a complex structure, so that providing the above-mentioned latching portion, etc., on the connector housing 3 would render the structure thereof even more complex, whereas it is a simple matter to form the housing latching portion LA, etc., on the rear holder 6 since few other parts are mounted thereon. Also, gathering together the housing latching portion LA, cover mounting portion RC and lever mounting portion LB in the rear holder facilitates linking of these items, so that it is possible, for example, to first link the rear holder 6 to the connector housing 3 via the housing latching portion LA, then mount the manipulation lever 30 via the lever mounting portion LB, and then install the rear cover 20 via the cover mounting portion RC, thus effecting assembly of the connector in a successive and simple manner.

[0037]

As shown in Fig. 5, the rear cover 20 is a member for leading out in a particular direction the multiple lead wires that are drawn out from the rear wall 6₂ of the rear holder 6, and has a pair of opposed sidewalls 21, 21 with a space 25 of a particular size therebetween, and a top wall 24 connected to the sidewalls 21, 21, being formed as a molding of insulating synthetic resin. The top wall 24 is formed as a curved surface, being joined to the sidewalls 21, 21 at its side and top edges, and having one edge formed as an opening 26. The inner interior of this opening 26, that is, at the end portions of the sidewalls 21, 21, is approximately enclosed by an enclosing wall 24_A. In the top wall 24 there is provided a projection 24_B onto which the latching portion 32_A of the manipulation lever 30 latches. The opening 26 serves as a lead-out hole that leads the lead wires out to the exterior.

[0038]

The gap 25 between the pair of sidewalls 21, 21 serves as an insertion opening for insertion of the rear wall 6₂ of the rear holder 6. Since both sidewalls 21, 21 have the same structure, the description below will deal with one sidewall only.

[0039]

The sidewall 21 is formed with a thick edge, and in this thick edge there is formed a flat-bottomed slot 22₀ enclosed by opposed first and second sidewall portions 22_A, 22_B. More precisely, the flat-bottomed slot 22₀ has opposed first and second sidewall portions 22_A, 22_B of which one, the first sidewall portion 22_A, constitutes part of the sidewall 21, and the other, the second sidewall portion 22_B, constitutes part of the inner wall. Roughly at the longitudinal center of the outer face of the first sidewall portion 22_A there is formed a latching projection 22_C that projects upward. This latching projection 22_C is formed as a roughly square-shaped low-profile projection. The latching projection 22_C performs a misinsertion prevention role, preventing the rear cover 20 from being mounted in the wrong direction because of the manipulation lever 30 after the manipulation lever 30 has been mounted to the rear holder 6. In addition, when fitted into the latching groove 36_B in the manipulation lever 30, the latching projection 22_C also performs the role of fixing the manipulation lever 30 in the required position. The space between the first and second sidewall portions 22_A, 22_B, or in other words the gap that is the flat-bottomed slot 22₀, is formed to have a width that is almost the same as or slightly larger than the thickness of the support projections 7_A, 7_A of the rear holder 6. The flat-bottomed slot 22₀ serves as a guide slot for when the rear cover 20 is mounted to the rear holder 6, and as an installation slot for the rear cover 20. Also, the second sidewall portion 22_B is provided with a guide rail 23.

[0040]

As shown in Fig. 6, the manipulation lever 30 has a pair of opposed lever arms 31, 31, and a connecting piece 32 that connects the lever arms 31, 31, the whole being formed as a molding of insulating synthetic resin. Each of the lever arms 31, 31 is constituted of a flat plate body and both have the same structure. More precisely, each lever arm 31 has an outer wall 31_A and an inner wall 31_B, and in each inner wall 31_B there are formed a pivot projection 33 that supports the lever, a cam hole 34, and a pair of first and second cam slots 36, 37. The pivot

projection 33 is formed to have an axle 33_A whose base rises from the inner wall 31_B of the lever arm 31, and a flange 33_B integrated with the top of the axle 33_A. The cam hole 34 runs through both the inner and the outer walls 31_A, 31_B. The connecting piece 32 is provided with a latching portion 32_A. During coupling with the counterpart connector 40, this latching portion 32_A is latched onto the projection 29_B of the rear cover 20, thereby fixing the manipulation lever 30 in the required position.

[0041]

The manipulation lever 30 is mounted to the rear holder 6 so as to turn freely, but the axle 33_A is provided with a turn restricting portion 33_{A'} that restricts such turning. As Fig. 6C shows, this turn restricting portion 33_{A'} is of a teardrop shape, such that its cross-section, supposing the axle 33_A to be cut through in a plane orthogonal to the direction in which the axle 33_A rises up from the lever arm 31, has flat edges 33_{A1} and a circular edge 33_{A2}.

[0042]

The flange 33_B is in the shape of a disc with a cut-off portion 33_{B'} at the edge, and is of a size that enables insertion into the receiving hole 10_A. The provision of the cut-off portion 33_{B'} facilitates installation to the receiving hole 10_A.

[0043]

The pair of first and second cam slots 36, 37 are formed on the side that faces in the opposite direction to the pivot projection 33's direction of insertion. These cam slots 36, 37 are formed by further reducing the thickness of the lever arm 31 past the step difference portion 31_C. More precisely, the first cam slot 36 has: a guide face 36_A over which the latching projection 22_C of the rear cover 20 slides; a first stopper 36₁ against which the latching projection 22_C contacts; and a latching slot 36_B into which the latching projection 22_C latches, the first stopper 36₁ and latching slot 36_B being formed as a part of the step difference portion 31_C. The guide face 36_A is formed to extend from the connecting piece 32 toward the edge of the lever arm 31, with a particular width and length. Also, the pivot

projection 33 is formed in a location near to the first stopper 36₁.

[0044]

The second cam slot 37 is provided on the opposite edge to that where the connecting piece 32 of the lever arm 31 is provided. The second cam slot 37 is formed as a reduced-thickness portion with a guide surface 37_A in the inner wall 31_B past the step difference 31_C. This guide surface 37_A of the second cam slot 37 formed past the step difference 31_C is also a surface over which the latching projection 22_C slides, but is formed to have a size that is smaller than the guide surface 36_A of the first cam slot 36. In addition, the step difference 31_C serves as a second stopper.

[0045]

The cam hole 34 runs through both the inner and the outer walls 31_A, 31_B of the lever arm 31. The cam hole 34 has a guide hole 34_A that guides the engaging projection 42 (see Fig. 15) of the counterpart connector 40 to be described later. A step difference portion 34_B is formed around the guide hole 34_A. The flange 42_B of the engaging projection 42 of the counterpart connector 40 latches onto this step difference portion 34_B.

[0046]

As shown in Figs. 1 and 2, the sealing member 35 is constituted of a ring-like member with a hollow interior, and is formed from rubber material possessing resilience. The outer peripheral surface of this ring-like member will preferably be given an indented-and-protruding form. Rendering the outer peripheral surface indented-and-protruding will make for good watertightness with the counterpart connector 40.

[0047]

The process of assembling the connector 1 will now be described with reference to Figs. 1 to 14. Figs. 7 and 8 are explanatory views illustrating the mounting of the manipulation lever to the rear holder. In Figs. 7 and 8, parts of the rear holder and manipulation lever are excised to facilitate understanding of the internal structure. Figs. 8 to 12 are explanatory views illustrating joining of

the rear holder to the connector housing, while Figs. 13 and 14 are explanatory views illustrating installation of the rear cover to the rear holder.

[0048]

This connector 1 is assembled via the following processes: (I) sealing member mounting process, (II) holder joining process, (III) pin mounting process, (IV) TPA mounting process, (V) lever mounting process, and (VI) rear cover mounting process.

[0049]

In the (I) sealing member mounting process, the sealing member 35 is mounted over the outer surface of the coupling portion 3_B of the connector housing 3 until contact is made with the rib 3_o, these items being among the connector components shown in, for example, Figs. 1 and 2. When the sealing member 35 is mounted as far as the position where it contacts the rib 3_o, the inner periphery of the sealing member 35 fits tightly against the outer periphery of the connector housing 3, enabling mounting of the rear holder 6. Mounting of the sealing member 35 effects a watertight sealing between the housing connector 3 and rear holder 6 to be described later. In the (II) holder joining process, succeeding the sealing member 35 the coupling portion 3_B of the connector housing 3 is inserted into the rear holder 6. Via such insertion, the latching bar 11_B of the latching portion 11 is sunk into the latching groove 5_A and engages into the mating cavity 6C. The rear holder 6 is thereby latched and fixed to the connector housing 3. In the (III) pin mounting process, the large pins 2_A and the cluster of small pins 2_B are inserted from the rear of the rear holder 6 through the through-holes 4_A and 4_B, respectively, in the connector housing 3, and thereby both sets of pins are housed and fixed inside the connector housing 3 with the rear holder 6 mounted thereto. In the (IV) TPA mounting process, the TPA 38 is inserted into the mounting hole 5_B in the connector housing 3, fixing the female pins 2 inside the connector housing 3.

[0050]

Subsequently in the (V) lever mounting process, the work of installing the

manipulation lever 30 to the assembly assembled in processes (I) to (IV) is carried out. In this installation work, first of all the manipulation lever 30 is positioned at the rear of the rear holder 6 as shown in Fig. 7A and pushed in with the pivot projections 33, 33 provided on the lever arms 31, 31 oriented toward the receiving holes 10_A, 10_A. Via such pushing-in, the flanges 33_B, 33_B of each pivot projection 33, 33 are slid over the guide surfaces 10_B, 10_B, and simultaneously the lever arms 31, 31 are pushed outwards, that is, in the upward and downward directions indicated by the arrows Y₁, Y₁ in Fig. 7B, so that gaps G₀, G₀ are formed between the inner walls 31_B, 31_B of the lever arms 31, 31 and the respective outer walls 6_A, 6_A of the rear holder. When the lever arms 31, 31 are pushed in further, the flanges 33_B, 33_B are inserted through the respective receiving holes 10_B, 10_B into the gaps 6_G, 6_G, as shown in Fig. 8. Simultaneously with such insertion, the lever arms 31, 31 are returned by their elastic resilience to their original positions, so that the aforementioned gaps G₀, G₀ are eliminated and the lever arms' inner walls 31_B, 31_B contact against the outer plates 6_A, 6_A. When the manipulation lever 30 is turned in this state, the edges of the flanges 33_B, 33_B enter into the gaps 6_G, 6_G between the inner and outer plates 6_A, 6_B, becoming undislodgeable therefrom, and the manipulation lever 30 is installed in a freely turnable state relative to the rear holder 6. Thus, the flanges 33_B, 33_B will not be dislodged even if subjected to an external force opposite to that exerted when the manipulation lever 30 was pushed in. This means that after being mounted to the rear holder 6, the manipulation lever 30 will not become detached therefrom even if an impact or other strong external force should act on the manipulation lever 30.

[0051]

When the manipulation lever 30 is mounted to the rear holder 6, a gap G (see Fig. 13B) into which the first sidewall portion of the rear cover 20 will be pushed is formed between the lever arms 31, 31 of the manipulation lever 30 and the inner plates 6_B, 6_B of the rear holder 6. This gap G is composed of a first gap G₁ that is opposite the guide surface 36_A of the manipulation lever 30, and a second gap G₂ that is opposite the inner wall 31_B, the first gap G₁ being wider than the

second gap G_2 .

[0052]

Finally, the rear cover 20 is installed to the rear holder 6. In the (VI) rear cover mounting process, firstly the rear cover 20 is positioned at the part of the connector housing 3 indicated by arrow A_1 in Fig. 13A, that is, on the side where the manipulation lever 30's connecting piece 32 is located, and the rear cover 20 is inserted in the direction of the first gap G_1 between the rear holder and the manipulation lever 30. Such insertion is effected along the direction of one of the mounting portions 12_A , so that one of the support projections 7_A will be inserted into the flat-bottomed slots 22_0 , 22_0 of the rear cover 20. The rear cover 20's guide rails 23, 23 will be inserted along the rail projections 6_{2A} , 6_{2A} . In this way the rear cover 20, being inserted through one of the mounting portions 12_A , will be supported by the support projections 7_A , 7_A , the inner plate 6_B of the third area 6_{B3} , and the rail projections 6_{2A} , and therefore will not become detached from the rear holder 6.

[0053]

The foregoing processes (I) to (VI) complete the assembly of the connector 1. However, there will be cases where the rear holder 6 is not joined completely to the connector housing 3 in the (II) holder joining process. When such a case occurs, not only will the rear holder 6 and connector housing 3 not be completely joined, but also the sealing member 35 will not be fully mounted and the desired waterproofing effects will not be obtained. Such a state will constitute misassembly of the connector 1. Accordingly, this connector 1 is rendered able to sense such misassembly by utilizing the latching portions 11, 11 of the rear holder 6.

[0054]

This misassembly sensing will now be described with reference to Figs. 11 and 12. Figs. 11 and 12 are explanatory views illustrating the misassembly, and correspond to Figs. 9 and 10 respectively.

[0055]

First of all, the sealing member 35 is mounted to the coupling portion 3_B at the rear of the connector housing 3, the mating cavity 6_C at the front of the rear holder 6 is mated onto the coupling portion 3_B, and the rear holder 6 is pushed onto the coupling portion 3_B. Such pushing-on of the rear holder 6 brings the front wall 6₁ surface of the rear holder 6 into contact with an edge face of the sealing member 35. If the rear holder 6 is incompletely pushed in at this point, then due to the resilience of the latching arm 11_A, the latching bar 11_B of the latching portion 11 will climb on top of the sidewall portion 5_A of the latching groove 5_A, and the projecting block 11_C will be lifted upward (see Fig. 11C). If it is attempted to mount the rear cover 20 to the rear holder 6 in such a state, then as shown in Fig. 12C, such attempt to slide the rear cover 20 onto the rear holder 6 will fail because the first sidewall portion 22_A of the rear cover 20 will collide with the projecting block 11_C. It will thus be possible to sense, from the fact that the rear cover 20 cannot be mounted, that the sealing member 35 has not been properly pressed against the connector housing 3, and that the connector housing 3 and rear holder 6 are in a non-joined state.

[0056]

If on the other hand, as shown in Figs. 9 and 10, the rear holder 6 is fully pushed in, so that the latching bar 11_B of the latching portion 11 sinks into and engages with the flat-bottomed latching groove 5_A, then since the projecting block 11_C will already have retracted downward, the sliding motion of the rear cover 20 will not be inhibited. When the rear cover 20 is mounted onto the rear holder 6, the sealing member 35 will be mounted in the regular position, so that watertightness between the connector housing 3 and rear holder 6 is reliably effected, and at the same time, complete joining of the connector housing 3 and rear holder 6 will be assured. In such state, the top of the projecting block 11_C will contact with the rear cover 20's first sidewall portion 22_A, restricting the mobility thereof, so that the engagement of the connector housing 3 and rear holder 6 will be firm.

[0057]

Also, as Fig. 5 shows, the pair of opposed sidewalls 21, 21 have identical structure, which might pose a risk of the rear cover 20 being mounted in the direction of arrow A_2 in Fig. 14A. If the rear cover 20 were mounted in that direction, the manipulation lever 30 could not be manipulated. Accordingly this connector 1 is so contrived that it is not possible to mount the rear cover 20 in the direction of arrow A_2 . More precisely, if the rear cover 20 is mounted to the rear holder 6 in the direction of arrow A_2 in Fig. 14, the first sidewall portion 22_A of the rear cover 20 will enter inside the second gap G_2 , and although the entrance of the second gap G_2 is rendered large by the presence of the manipulation lever 30's second cam slot 37 at such opening, the second cam slot 37's length is less than the width of the first cam slot 36, so that when the rear cover 20 is pushed in further, the latching projection 22_C on the sidewall 22_A surface will collide with the step difference portion 31_C that serves as second stopper, and any further pushing-in of the rear cover 20 will be blocked. In this way, mounting of the rear cover 20 in the direction of arrow A_2 is rendered impossible.

[0058]

The connector 1 thus assembled is coupled with a counterpart connector 40. The male connector that is such counterpart connector will now be described. Fig. 15 illustrates the male connector, Fig. 15A being a perspective view of the whole male connector, and Fig. 15B being an exploded version of the perspective view in Fig. 15A.

[0059]

The counterpart connector 40 consists of a male connector, being composed, as Fig. 15 shows, of a plurality of male pins 43 and a male connector housing 41 in which such pins are housed.

[0060]

The male pins 43 are composed of relatively large-sized male pins 43_A and smaller-sized male pins 43_B that are connected to the female large pins 2_A and small pins 2_B, respectively, of the connector 1. The male connector housing 42 has roughly rectangular front and rear walls 41₁, 41₂ at the front and rear, and an outer

periphery that is enclosed by pairs of opposed outer walls, specifically by upper and lower walls 41₃, 41₃ and left and right sidewalls 41₄, 41₄. In the front wall 41₁ there is formed a hollow cavity having an insertion opening into which the connector 1 is inserted, and the inner wall of this hollow cavity stands close to the rear wall 41₂, the whole being formed as a molding of insulating synthetic resin.

[0061]

In the rear wall 41₂ of the male connector housing 41 there are formed fitting holes 41_A, 41_B into which the male pins 42 fit. On the top and bottom walls 41₃, 41₃ of the connector housing there are formed engaging projections 42, 42 that project outwards from locations close to the insertion opening. These engaging projections 42, 42 are composed of a pivot 42_A that rises from the wall surface, and a flange 42_B that is provided on top of the pivot 42_A; these are formed to be integrated with the male connector housing 41. The flange 42_B is roughly a disc in shape. The engaging projections 42 are of a size to engage with the cam holes 34 of the manipulation lever 30 of the connector 1. To assemble this counterpart connector 40, the large pins 43_A and small pins 43_B are inserted into the fitting holes 41_A and 41_B respectively of the male connector housing 41 and fixed therein.

[0062]

Coupling of the connector 1 and the counterpart connector 40 will now be described. Figs. 16 and 17 are explanatory views illustrating coupling of the two connectors, Fig. 16 illustrating the uncoupled and Fig. 17 the coupled state. In Figs. 16B, 16C, 17B and 17C, the counterpart connector 40 is omitted.

[0063]

To couple the connector 1 and the counterpart connector 40, the connector 1 is brought near to the counterpart connector 40, and the insertion portion 3_A of the connector housing 3 located at the front of the connector 1 is inserted into the fitting hole 41_A in the front face of the connector housing 41 of the counterpart connector 40 (see Fig. 16A). Before the two connectors 1, 40 are coupled, the cam holes 34, 34 of the manipulation lever 30 are, as shown in Figs. 16A to 16C, held in positions parallel to the rear holder 6 without being engaged onto the

engaging projections 42, 42 of the counterpart connector 40. These positions are held via contacting of the outer surfaces of the latching projection 22_C of the rear cover 20 with the first stopper 36₁ inside the first cam slot 36 and the circular edge 33_{A2} of the turn restricting portion 33_{A'}, as shown in Fig. 16D. Thanks to such holding, the manipulation lever 30 will not rock in the arrow B directions (see Figs. 16A and 16C).

[0064]

Next, the counterpart connector 40's latching projections 42, 42 are inserted into the open portions of the manipulation lever 30's cam holes 34, 34 as shown in Fig. 17, after which the manipulation lever 30 is rotated to the rear of the rear cover 20, by grasping the manipulation lever 30's connecting piece 32 between finger and thumb. As a result of such rotation of the manipulation lever 30, the counterpart connector 40's latching projections 42, 42 are guided into the guide portions of the cam holes 34, 34 and the two connectors 1, 40 are drawn in directions such that they approach each other. When the manipulation lever 30 is rotated further, the connecting piece 32 moves to the rear of the rear cover 20, whereupon coupling of the two connectors 1, 40 is complete and electric contact is effected between the pins 2, 43 of the two connectors 1, 40. Upon such completion of the coupling of the two connectors 1, 40, the manipulation lever 30 is fixed in the position at the rear of the rear cover 20 to which the connecting piece 32 thereof moved. The fixing of the manipulation lever 30 in this position is effected as follows. The latching projection 22_C of the rear cover 20 enters inside the latching groove 36_B, and a flat edge 33_{A1} of the turn restricting portion 33_{A'} contacts against an outer face of the latching projection 22_C in such entered state, so that turning of the pivot projection 33 – that is, turning of the manipulation lever 30 – is restricted, as shown in Fig. 17D. As a result of such holding and fixing, the manipulation lever 30 will not rock in the arrow C directions. Also, latching of the manipulation lever 30 is rendered even more reliable by the fact that the latching portion 32_A provided on the connecting piece 32 latches onto the projection 24_B on the top wall 24 of the rear cover 20.

[0065]

In addition, when the two connectors 1, 40 are coupled, the outer periphery surface of the sealing member 35 contacts liquid-tightly against the inner wall of the fitting hole 41_A in the counterpart connector, thereby rendering sound the watertightness between the two connectors 1, 40.

What is claimed is:

1. An electric connector comprising:

a connector housing inside which pins are housed, and which has at the front an insertion portion into which a counterpart connector is inserted, and at the rear a holder mounting portion;

a sealing member that is mounted onto the outer periphery of the holder mounting portion;

a rear holder the front end portion of which serves as a contacting surface for contacting with the sealing member; which has at the front a mating cavity that is fixed onto the holder mounting portion, and at the rear a cover installation portion; and which is fixed to the connector housing with the sealing member interposed; and

a rear cover which is mounted to the cover installation portion via sliding motion;

a latching portion being provided in location adjacent to the cover installation portion at the rear of the rear holder, an engaging portion into which the latching portion engage being provided in the holder mounting portion of the connector housing, and the sliding motion of the rear cover being blocked if the latching portion is in a state of non-engagement with the engaging portion when the rear holder is mounted to the connector housing.

2. The electric connector according to claim 1, wherein the latching portion and engaging portion are provided in locations on the rear holder and the holder mounting portion, respectively, that are opposite each other.

3. The electric connector according to claim 1, wherein the latching portion is constituted of a latching member possessing resilience and formed on part of the outer wall of the rear holder, the latching member has a latching bar and projecting block, and the engaging portion has a latching slot that is formed in the wall of the connector housing, so that if the connector housing and rear holder are not completely fixed together and the latching portion do not engage onto the engaging

portion, then, just before latching into the latching slot, the latching bar will run up the connector housing's wall, with the result that the latching member will be pushed upward, and consequently the projecting block will block the rear cover from being mounted via sliding motion onto the cover installation portion.

4. The electric connector according to claim 3, wherein part of the outer wall of the rear holder is formed as a double wall constituted of an inner plate and an outer plate with a gap therebetween, and the latching portion is provided on the inner plate.

5. The electric connector according to claim 1, wherein a manipulation lever one portion of which latches into the counterpart connector to effect coupling of the two connectors is mounted to the wall of the rear holder.