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### Housing

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#### Abstract

A housing that is to be housed in a receptacle case and to which an electric wire is connected in an inside thereof includes a protrusion. The protrusion extends from a first surface of a side of the housing on which the electric wire is inserted into the inside in a first direction. A dimension from the first surface to a distal end of one side of the protrusion is larger than a diameter of the electric wire.

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#### Background/Summary

## CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of the filing date under 35 U.S.C. § 119(a)-(d) of Japanese Patent Application No. 2024-020127, filed on Feb. 14, 2024.

## FIELD OF THE INVENTION

[0002] The present invention relates to a housing and, more particularly, to a housing for an electrical connector.

## BACKGROUND OF THE INVENTION

[0003] Electrical connectors for motors may need to be low profile, depending on the application of where the motor is attached. Elements of small parts of low-profile electrical connectors tend to be thin, which creates a risk that the parts may be damaged when a large load is applied.

[0004] A housing is attached to a core wire which, after forming work, should be connected to a connector body without applying a large load to the small parts of the low-profile electrical connector. However, if the housing is forcibly attached to the connector body in a state where core wires are overlapping each other or in a state where the dimensions after the forming work of the core wire are not within the range of the dimensions allowed to house the housing in the connector body, the connector body or the housing may become defective. The forming work of the core wire and the work of attaching the housing to the connector body depend on an operator.

[0005] Japanese patent application No. JP2018-206501A discloses an electrical connector in which, by opening the upper part of the cable insertion port provided in the housing, work can be performed on the cable from the opened portion. However, JP2018-206501A does not disclose the forming work of core wires after connecting the cable to be inserted into the cable connector and the terminal to be housed in the cable connector.

## SUMMARY OF THE INVENTION

[0006] A housing that is to be housed in a receptacle case and to which an electric wire is connected in an inside thereof includes a protrusion. The protrusion extends from a first surface of a side of the housing on which the electric wire is inserted into the inside in a first direction. A dimension from the first surface to a distal end of one side of the protrusion is larger than a diameter of the electric wire.

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## Description

### BRIEF DESCRIPTION OF DRAWINGS

[0007] The invention will now be described by way of example with reference to the accompanying figures, of which:

[0008] FIG. 1 is an isometric view of a housing according to an exemplary embodiment;

[0009] FIG. 2 is a side view of the housing of FIG. 1;

[0010] FIG. 3 is a top view of the housing of FIG. 1;

[0011] FIG. 4 is an isometric view of a receptacle case according to an exemplary embodiment;

[0012] FIG. 5 is a cross sectional view after core wires are attached to the housing of FIG. 1;

[0013] FIG. 6 is a cross sectional view of the path of housing the housing of FIG. 1 in the receptacle case of FIG. 4;

[0014] FIG. 7 is a cross sectional view of housing the housing of FIG. 1 in the receptacle case of FIG. 4 further along the path; and

[0015] FIG. 8 is a cross sectional view of the housing of FIG. 1 housed in the receptacle case of FIG. 4.

### DETAILED DESCRIPTION

[0016] Referring to the accompanying drawings, a housing **10** according to an exemplary embodiment of the present invention and a receptacle case **100** in which the housing **10** is housed will be described below. For convenience of explanation, as shown in each drawing, the direction

in which the housing **10** and the receptacle case **100** are housed is a first direction Z, the upper side and the lower side in the first direction Z is (U) and (D) respectively, a second direction X is orthogonal to the first direction Z, and a third direction Y is orthogonal to the second direction X. The front and the rear in the second direction X is (F) and (B) respectively, and the right direction and left direction of the third direction Y is (R) and (L) respectively.

[0017] As shown in FIG. 5, a cable **30**, for example, is connected to the inside of the housing **10**. The cable **30** has a power core wire for supplying power to a servo motor, a brake core wire for operating a holding brake, an encoder core wire for detecting the position of the drive unit, and so on. The housing **10**, to which each of these core wires is connected, is mated with a terminal unit after the core wires are housed in the receptacle case **100** and is connected to a terminating end of the servo motor via the terminal unit.

[0018] [The cable **30**, as shown in FIGS. 5-8, is composed of ten core wires **31** as electric wires, an interposition that covers the surrounding of the ten core wires **31** and is composed of cotton yarn or the like, a braided shield that covers the interposition, and a sheath that covers the braided shield. The interposition, braided shield, and sheath are referred to as the protective layer. A portion of a core wire **31**, in which the coating with insulating material has been removed and the conductive element is exposed is referred to as a core wire body portion **32**, and the portion coated, is referred to as a core wire **31**.

[0019] As shown in FIGS. 5-8, the housing **10** comprises a terminal housing section **11**, in which a crimp terminal **20** as a terminal is to be housed, and a protrusion **12**, which serves as a criterion for determining whether the forming work of the core wire **31** has been performed as specified, are formed. As used throughout the specification, one intended meaning of “forming work” is as follows: the “forming work” is the bending of the core wire **31**, as shown in FIGS. 5-8, from a straight state. The housing **10** is formed as an integral piece by injection molding a resin material, which is an electrically insulating material.

[0020] The protrusion **12**, as shown in FIGS. 1-3 and 5-8, serves as a guide when the housing **10** is housed in the receptacle case **100**, as well as serving as a criterion to determine whether the forming work of the core wire **31** has been performed as specified. As shown in FIG. 3, the protrusion **12** is formed on the four corners of the housing **10**. The protrusion **12**, as shown in FIG. 2, extends from the first surface **13** of the housing **10** to the upper side U in the first direction Z when the direction in which the core wire **31** is attached to the crimp terminal **20** is the upper side U in the first direction Z.

[0021] As shown in FIGS. 1-3 and 5-8, the protrusion **12** has a guide **14** projecting outwardly from the first surface **13**. At the distal end portion of the guide **14** on the U (upper) side in the first direction Z, a chamfer **15**, as shown in FIGS. 1-3 and 6-7, is formed in the second direction X on the outer side of the housing **10**. As shown in FIGS. 1, and 3, an oblique surface **16** that is chamfered is formed on the four protrusions **12**. The guide **14** extends from the first surface **13** to the D (lower) side as the other side in the first direction Z.

[0022] As shown in FIGS. 2 and 5-8, the dimension L from the first surface **13** to the distal end **12A** of the protrusion **12** is larger than the diameter of any of the core wires **31** included in the cable **30**.

[0023] As shown in FIG. 1, mutual spacing between two protrusions **12** is one-half or more of the dimension in the third direction Y as the longitudinal direction of the first surface **13**. By making the mutual spacing between the two protrusions **12** one-half or more of the dimension of the first surface **13** in its longitudinal direction, it is easier to visually check whether the forming work of the core wire **31** is being carried out as specified. As shown in FIG. 1, in the present embodiment, the shape of the first surface **13** is rectangular, and since the dimension in the third direction Y is larger than the dimension in the second direction X, the third direction Y is the longitudinal direction of the first surface **13**. When the shape of the first surface **13**, when viewed in a plan view, is square, circular, or the like, that is, when the dimension in the second direction X and that in the

third direction Y are the same, the same dimension in the second direction X and the third direction Y is used as the dimension in the longitudinal direction.

[0024] As shown in FIGS. 5-8, the core wire body portion **32** of the core wire **31** of the cable **30** inserted into the receptacle case **100** is crimped to the crimp terminal **20**. A terminal unit, for housing a plurality of terminals, is mated from the lower side D of the housing **10**. The terminals housed in the terminal unit are made conductive with the crimp terminals **20**.

[0025] As shown in FIG. 4, a pair of cables **30** are connected to the receptacle case **100** from the rear B in the second direction X. The receptacle case **100** houses the housing **10** to which the core wires **31** are attached.

[0026] As shown in FIG. 2, the receptacle case **100** has a case body **110** to be housed along with the housing **10**, a clamp **120** for securing the cable **30** inserted into the case body **110**, and a packing. The case body **110**, as shown in FIGS. 5-8, is provided with a first opening **111** at the rear B in the second direction X and a second opening **112** at the lower side D in the first direction Z. The case body **110** is also provided with a housing section **113**. The housing section **113** houses the housing **10** after the core wire **31** is attached to the crimp terminal **20**, which is housed in the housing **10**, thereby completing the forming of the core wire **31**.

[0027] When the case body **110** is fixed to the cable **30**, the cable **30** is first inserted into the ring-shaped packing, and then the cable **30** is inserted into the case body **110**. The clamp **120** has a female thread, and the case body **110** has a male thread. In fastening the clamp **120** to the case body **110**, the ring-shaped packing is crushed by the case body **110** and the clamp **120**, causing the ring-shaped packing to be elastically deformed and to adhere closely to the cable **30**, thereby fixing the case body **110** and the cable **30**. The case body **110** and the clamp **120** are each formed as an integral piece by injection molding a resin material, which is an electrical insulating material.

[0028] The procedures for attaching the core wire **31** to the housing **10** and for forming the core wire **31** are now described in reference to FIG. 5. In FIGS. 5-8, the hatched indication for the cross section for the cable **30** is omitted.

[0029] As shown in FIG. 5, an operator inserts the cable **30** through the first opening **111** and the second opening **112**. The operator removes the protective layer at the distal end of the cable **30** protruding from the second opening **112** to expose the core wire **31**. The operator also removes the coating of the core wire **31** to expose the core wire body portion **32**. The operator then crimps the crimp terminal **20** to the core wire body portion **32**. The operator houses the crimp terminal **20** that is crimped to the core wire body portion **32** in the terminal housing section **11** of the housing **10**. In the present embodiment, ten crimp terminals **20** that are crimped to ten core wires **31** are each housed in the terminal housing section **11** of the housing **10**. At this time, the core wire **31** is attached in the direction in which the protrusion **12** of the housing **10** extends.

[0030] The direction of the core wire **31**, after it is attached to the housing **10**, is changed from a straight state. As shown in FIGS. 5-8, a bending section **33** is provided to bend the core wire **31**. When bending the core wire **31** from the straight state, the operator carries out the forming work so that a part of the core wire **31** does not exceed the distal end **12A** of the protrusion **12**.

[0031] Since the protrusion **12** is formed on the housing **10**, by visually checking whether a part of the core wire **31** after being formed by the operator exceeds the distal end **12A** of the protrusion **12**, it is easy to determine whether the forming work of the core wire **31** has been performed as specified. In addition, for example, by placing a flat plate against the distal end **12A** of the protrusion **12**, and checking whether the core wire **31** is in contact with the flat plate, it is easy to determine whether the core wire **31** after being formed is within the dimension L from the first surface **13** to the distal end **12A** in the first direction Z and whether the forming work of the core wire **31** has been performed as specified.

[0032] If the ten core wires **31** are each attached to the crimp terminal **20** through free paths, for example, it may be impossible to house the housing **10** in the receptacle case **100** due to the core wires **31** intersecting each other and overlapping in the first direction Z. Also, if, for example, the

radius of curvature of the bending section 33 of the core wire 31 is increased and the forming of the core wire 31 is performed so that it is far away from the first surface 13 of the housing 10 (as in this case and some other cases) will not be able to reach a predetermined position in the first direction Z of the receptacle case 100 and will be unable to be housed.

[0033] When connecting the core wires 31 drawn from the cable 30 to the housing 10, they can be arranged regularly so that they do not overlap each other in the first direction Z. Furthermore, the forming of the core wires 31 may be performed so that they pass close to the first surface 13 of the housing 10.

[0034] After the forming of the core wires 31 is completed, the housing 10 is housed in the housing section 113. As shown in FIGS. 6-7, the housing 10 is inserted into the housing section 113 while tilting the housing 10 toward the F (front) side in the second direction X. The cable 30 is then pulled from the first opening 111 side to house the housing 10 in the housing section 113. When housing the housing 10 in the housing section 113, the guide 14 of the protrusion 12 is to precede other elements of the housing 10. The chamfer 15 formed on the outside of the housing 10 in the second direction X of the guide 14 makes snagging on the entrance portion of the second opening 112 in the lower side D or on the protruding portion of the inner wall of the receptacle case 100 less likely to occur, thereby preventing the housing 10 from being forcibly inserted into the receptacle case 100. Accordingly, it is possible to prevent excessive load on the housing 10 and the receptacle case 100 from occurring.

[0035] As shown in FIG. 8, when the housing 10 is in a housing completion position of the housing section 113, the terminal unit is mated from the lower side D of the housing 10, and the terminal set and the receptacle case 100 are fixed by fasteners. In addition, the clamp 120 is fastened to the case body 110 to fix the cable 30 to the case body 110. The dimension L as the length of the protrusion 12 is set to a dimension where the distal end 12A of the protrusion 12 does not come into contact with a ceiling surface 115 of the receptacle case 100 opposite the first surface 13 when the housing 10 has reached the housing completion position of the housing section 113. That is, the dimension L as the length of the protrusion 12 is smaller than the dimension of the distance between the first surface 13 and the ceiling surface 115.

[0036] The housing 10, as described above, allows for easily determining, by visual inspection, whether the forming work of the core wire 31 has been performed as specified by visually checking whether a part of the core wire 31 after forming exceeds the distal end 12A of the protrusions 12. If, in a low-profile electrical connector, it is easy to determine whether the forming of the core wire is appropriate, the work of forming the core wire and the work of attaching a housing to the connector body will be less dependent on the operator. The housing 10 is also less likely to snag on elements of the receptacle case 100, as described above, thereby preventing the housing 10 from being forcibly inserted into the receptacle case 100. Accordingly, excessive load on the housing 10 and receptacle case 100 can be prevented.

[0037] Other than the above, in a range not deviating from the gist of the present invention, it is possible to select among the configurations given in the above embodiment or change to another configuration as appropriate.

## Claims

1. A housing that is to be housed in a receptacle case and to which an electric wire is connected in an inside thereof, comprising: a protrusion extending from a first surface of a side of the housing on which the electric wire is inserted into the inside in a first direction, a dimension from the first surface to a distal end of a side of the protrusion is larger than a diameter of the electric wire.
2. The housing of claim 1, wherein the protrusion is one of at least two protrusions formed on the housing, a mutual spacing between the at least two protrusions is greater than or equal to one-half of a dimension of the first surface in a longitudinal direction.

3. The housing of claim 2, wherein a protrusion is formed on each of four corners of the first surface.
  4. The housing of claim 3, wherein each protrusion has a guide outwardly projecting from the first surface.
  5. The housing of claim 4, wherein the guide extends along the protrusion in the first direction to a side of the protrusion opposite the first surface.
  6. The housing of claim 1, wherein a dimension from the first surface to a distal end of the protrusion is smaller than a dimension of a distance between the first surface and the receptacle case when the housing is housed in the receptacle case.
  7. A housing, comprising: a first surface; a protrusion extending from the first surface in a first direction; and an inside receiving an electric wire, a dimension from the first surface to a distal end of a side of the protrusion is larger than a diameter of the electric wire.
  8. The housing of claim 7, further comprising a terminal housing section extending through the first surface.
  9. The housing of claim 8, wherein a crimp terminal is housed in the terminal housing section.
  10. The housing of claim 8, wherein the housing has a plurality of terminal housing sections, each terminal housing section houses one crimp terminal.
  11. The housing of claim 7, wherein the protrusion has a guide, the guide has a chamfer formed thereon.
  12. The housing of claim 11, wherein the guide projects outwardly from the first surface.
  13. An electrical connector, comprising: a cable having an electric wire, the electric wire has an end; a housing having a first surface, a protrusion extending from the first surface in a first direction, and an inside receiving the end of the electric wire, a dimension from the first surface to a distal end of a side of the protrusion is larger than a diameter of the electric wire; and a receptacle case having a case body, the case body has a housing section that houses the housing.
  14. The electrical connector of claim 13, wherein the receptacle case has a clamp abutting the case body, the clamp fixes the cable to the case body.
  15. The electrical connector of claim 13, wherein the case body has a first opening and a second opening perpendicular to the first opening, the cable passes through the first opening.
  16. The electrical connector of claim 13, wherein the receptacle case has a ceiling surface, a distal end of the protrusion does not contact the ceiling surface when the housing is housed in the receptacle case.
  17. The electrical connector of claim 16, wherein a dimension of the protrusion is smaller than a distance between the first surface and the ceiling surface.
  18. The electrical connector of claim 13, wherein the housing has a terminal housing section extending through the first surface, a crimp terminal is housed in the terminal housing section.
  19. The electrical connector of claim 18, wherein the cable has a plurality of electric wires and the housing has a plurality of terminal housing sections, each terminal housing section houses one crimp terminal.
  20. The electrical connector of claim 19, wherein each electric wire is attached to one crimp terminal.
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