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# Contact detection apparatus for vehicle


## Abstract

A contact detection apparatus includes a bumper beam, an absorber, a contact detection sensor, a tube holder, and a cover. The absorber is disposed in front of and adjacent to the bumper beam. The contact detection sensor includes a pressure tube and outputs a signal in accordance with a change in pressure of the pressure tube. The tube holder is a part of a front end of the absorber and has a groove holding the pressure tube therein. The cover is attached to a front end of the tube holder and includes a body covering a front face of the tube holder and a pressing member disposed in front of the pressure tube. An upper end of a rear face of the pressing member is disposed at a more backward position than a lower rear end of the pressing member.



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## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) The present application claims priority from Japanese Patent Application No. 2022-035477 filed on Mar. 8, 2022, the entire contents of which are hereby incorporated by reference.

BACKGROUND

(2) The disclosure relates to a contact detection apparatus for a vehicle.

(3) Some vehicles are provided with contact detection sensors. The contact detection sensor is provided on a rear side of a bumper cover of the vehicle. The contact detection sensor detects whether a contact object in contact with the vehicle is a human. For example, Japanese

Unexamined Patent Application Publication No. 2016-55711 discloses a structure to which a contact detection sensor for a vehicle is attached. The structure includes a shock absorbing member provided on a front side of a bumper beam. The shock absorbing member has, as a whole, a substantially U-shape that opens backward as seen in a vehicle width direction. The shock absorbing member has a groove on its front portion, and the groove holds a pressure tube therein. When the vehicle makes contact with a human, the pressure tube is compressed in a vertical direction, which causes a deformation of the shock absorbing member. This allows for detection of contact between the vehicle and the human. In contrast, when the vehicle makes contact with a contact object, such as a small animal, other than a human, the shock absorbing member deforms mainly at an upper portion and a lower portion, which suppresses a deformation of the pressure tube. This allows for detection of contact between the vehicle and the contact object other than a human.

SUMMARY

(4) An aspect of the disclosure provides a contact detection apparatus for a vehicle. The contact detection apparatus includes a bumper beam, an absorber, a contact detection sensor, a tube holder, and a cover. The bumper beam extends in a width direction of the vehicle. The absorber is disposed in front of and adjacent to the bumper beam and extends in the width direction of the vehicle. The contact detection sensor includes a pressure tube and is configured to output a signal in accordance with a change in pressure of the pressure tube. The pressure tube extends in the width direction of the vehicle and is held by the absorber. The tube holder is a part of a front end of the absorber and has a groove that opens in a frontward direction of the vehicle and holds the pressure tube therein. The cover is attached to a front end of the tube holder and includes a body and a pressing member. The body covers a front face of the tube holder. The pressing member extends from the body in a backward direction of the vehicle and is disposed in front of the pressure tube. The upper end of a rear face of the pressing member is disposed at a more backward position than a lower end of the rear face of the pressing member in the backward direction of the vehicle.

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## Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The accompanying drawings are included to provide a further understanding of the disclosure, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments and, together with the specification, serve to explain the principles of the disclosure.

(2) FIG. **1** is a schematic plan view of a contact detection apparatus according to one example embodiment of the disclosure.

(3) FIG. **2** is an enlarged left cross-sectional view of the contact detection apparatus illustrated in FIG. **1** taken along a line **2-2**.

(4) FIG. **3** is an enlarged cross-sectional view of a portion of an absorber including a tube holder illustrated in FIG. **2**.

(5) FIG. **4** is a cross-sectional diagram schematically illustrating an exemplary operation of the contact detection apparatus at the time of frontal contact between a vehicle and a human and corresponding to FIG. **3**.

(6) FIG. **5** is a cross-sectional diagram schematically illustrating an exemplary operation of the contact detection apparatus at the time of frontal contact between a vehicle and a contact object other than a human and corresponding to FIG. **3**.

DETAILED DESCRIPTION

(7) When a vehicle makes contact with a human facing in a frontward direction of the vehicle, a bumper cover of the vehicle comes into contact with rear surfaces of the feet of the human, causing the human to bend the feet at the knees. In this case, a contact load inputted from the human to the

vehicle is not enough large to appropriately compress a pressure tube in some cases. In such a case, a contact detection apparatus can fail to properly detect whether the contact object in contact with the vehicle is a human.

(8) It is desirable to provide a contact detection apparatus for a vehicle that makes it possible to properly determine whether a contact object in contact with the vehicle is a human.

(9) In the following, a contact detection apparatus **10** according to an example embodiment of the disclosure is described with reference to the accompanying drawings. In these drawings, arrows FR, UP, and LH indicate a frontward direction, an upward direction, and a leftward direction (one-side direction along a vehicle width direction) of a vehicle (e.g., automobile) V to which the contact detection apparatus **10** is applied, respectively. Hereinafter, explanations referring to directions are made on the basis of the upward, downward, frontward, backward, leftward, and rightward directions of the vehicle V unless otherwise noted. Note that the following description is directed to illustrative examples of the disclosure and not to be construed as limiting to the disclosure. Factors including, without limitation, numerical values, shapes, materials, components, positions of the components, and how the components are coupled to each other are illustrative only and not to be construed as limiting to the disclosure. Further, elements in the following example embodiments which are not recited in a most-generic independent claim of the disclosure are optional and may be provided on an as-needed basis. The drawings are schematic and are not intended to be drawn to scale. Throughout the present specification and the drawings, elements having substantially the same function and configuration are denoted with the same reference numerals to avoid any redundant description. In addition, elements that are not directly related to any embodiment of the disclosure are unillustrated in the drawings.

(10) As illustrated in FIGS. **1** and **2**, the contact detection apparatus **10** may be provided on a front end of the vehicle V and detect contact of the vehicle V with a contact object. The contact detection apparatus **10** includes a bumper beam **20** which is a structural member of the vehicle V, an absorber **30** provided in front of the bumper beam **20**, and a pressing cover **50** attached to the absorber **30**. The contact detection apparatus **10** further includes a contact detection sensor **40**. Described below are exemplary configurations of these components of the contact detection apparatus **10**

(11) [Bumper Beam **20**]

(12) The bumper beam **20** extends in the rightward-leftward direction or a vehicle width direction. The bumper beam **20** may have a substantially rectangular closed cross-sectional shape as seen in a longitudinal direction of the bumper beam **20**. The bumper beam **20** may include a front panel **22** which is a front end of the bumper beam **20** and a rear panel **24** which is a rear portion of the bumper beam **20**.

(13) The front panel **22** may be a metal plate member having a thickness in the frontward-backward direction and extending in the rightward-leftward direction. The front panel **22** may have a recess **22**A in a vertical middle portion of the front panel **22**. The recess **22**A may be recessed by one step in the backward direction. An upper portion of the front panel **22** above the recess **22**A may correspond to a upper flange **22**B, and a lower portion of the front panel **22** below the recess **22**A may correspond to a lower flange **22**C.

(14) Like the front panel **22**, the rear panel **24** may be a metal plate member extending in the rightward-leftward direction. The rear panel **24** may have a substantially hat-shape that opens in the frontward direction as seen in a longitudinal direction of the rear panel **24**. The rear panel **24** may have an upper end joined to the upper flange **22**B of the front panel **22**, and a lower end joined to the lower flange **22**C of the front panel **22**.

(15) Paired front side frames **60** that are structural members of the vehicle V may be provided behind the bumper beam **20**. The front side frame **60** may extend in the frontward-backward direction. Opposite ends of the bumper beam **20** in the vehicle width direction may be joined to respective front ends of the front side frames **60** with respective crash boxes **62** interposed therebetween.

(16) [Absorber **30**]
(17) The absorber **30** may include a resin foam material such as urethane foam. The absorber **30** may have a substantially elongated shape extending in the rightward-leftward direction or a longitudinal direction, and may be provided in front of and adjacent to the recess **22**A of the bumper beam **20**. The absorber **30** may have a substantially trapezoidal shape as seen in cross-sectional view in the longitudinal direction. For example, the absorber **30** may have a lower face inclining downward in the backward direction as seen in the rightward-leftward direction. The absorber **30** may have a rear face fixed to a front face of the recess **22**A of the bumper beam **20**. A bumper cover **64** may be provided in front of the absorber **30**. The bumper cover **64** may be a front end of the vehicle V and cover the absorber **30** from in front of the absorber **30**.
(18) As illustrated in FIG. **3**, a tube holder **32** is provided on a front end of the absorber **30**. The tube holder **32** holds the pressure tube **42** to be described later, and the pressing cover **50** is attached to the tube holder **32**. The tube holder **32** may overhang from an upper end of the absorber **30** in the frontward direction. A groove **34** that opens in the frontward direction may be provided at a vertical middle portion of the tube holder **32**. The groove **34** may extend over the entire length of the absorber **30**. The groove **34** may have a substantially inverted C-shape that opens in the frontward direction in left cross-sectional view. For example, the groove **34** may include a holding groove **34**A and an opening groove **34**B. The holding groove **34**A may be a rear portion of the groove **34** and hold the pressure tube **42** therein. The opening groove **34**B may be an opening of the groove **34**. The holding groove **34**A may have a substantially oval shape having a longitudinal length in the frontward-backward direction as seen in side cross-sectional view. The opening groove **34**B may extend in the frontward-backward direction to communicate with the holding groove **34**A. The holding groove **34**A may have a vertical dimension larger than the width dimension (vertical dimension) of the opening groove **34**B. The opening groove **34**B may extend from a vertical middle portion of the holding groove **34**A in the frontward direction. That is, the holding groove **34**A and the opening groove **34**B may be disposed at the same vertical position. Further, a pair of overhangs **34**C may be provided on respective rear ends of the opening groove **34**B. The overhangs **34**C may overhang inward from the inner periphery of the holding groove **34**A in the upward direction and the downward direction, respectively.
(19) [Contact Detection Sensor **401**]
(20) The contact detection sensor **40** includes the pressure tube **42** held by the absorber **30**, and a pressure sensor **44** that outputs a signal in accordance with a change in pressure of the pressure tube **42**. In a broad sense, the pressure sensor **44** may be regarded as a pressure detector.
(21) The pressure tube **42** may have an elongated shape having a longitudinal length in the rightward-leftward direction. The pressure tube **42** may be a hollow structure having a substantially annular cross-sectional shape. The pressure tube **42** is embedded in the holding groove **34**A of the groove **34** and held by the tube holder **32** of the absorber **30**. The pressure tube **42** may have a diameter lager than the width dimension of the opening groove **34**B.
(22) The pressure sensor **44** may be provided at each of opposite longitudinal ends of the pressure tube **42**, and may be fixed to the body of the vehicle V at a non-illustrated position. The pressure sensor **44** may be electrically coupled to an ECU **46**. In a broad sense, the ECU **46** may be regarded as a contact determination unit. When the pressure tube **42** deforms, the pressure sensor **44** may output a signal to the ECU **46** in accordance with a change in pressure inside the pressure tube **42**.
(23) On the basis of the signal outputted from the pressure sensor **44**, the ECU **46** may calculate the value of the change in pressure inside the pressure tube **42**, determine whether a value of the change in pressure is greater than a threshold, and determine whether a contact object in contact with the bumper cover **64** is a human or a contact object, such as a small animal, other than a human. For example, in a case where the value of the change in pressure inside the pressure tube **42** is greater than or equal to the threshold, the ECU **46** may determine that the contact object is a human, whereas in a case where the value of the change in pressure inside the pressure tube **42** is

less than the threshold, the ECU **46** may determine that the contact object is an object other than a human.

(24) [Pressing Cover **50**]

(25) The pressing cover **50** may include a resin material. The pressing cover **50** is attached to the tube holder **32** of the absorber **30**. The pressing cover **50** includes a cover body **52** and a pressing member **54**. In one embodiment, the pressing cover **50** may serve as a "cover". In one embodiment, the cover body **52** may serve as a "body" of the pressing cover **50**.

(26) The cover body **52** may have a substantially elongated plate shape extending in the rightward-leftward direction. The cover body **52** may have a substantially U-shape that opens in the backward direction in side cross-sectional view. For example, the cover body **52** may have a front wall **52**A having a thickness in the frontward-backward direction, an upper wall **52**B extending from an upper end of the front wall **52**A in the backward direction, and a lower wall **52**C extending from a lower end of the front wall **52**A in the backward direction. The cover body **52** may be attached to the tube holder **32** by fitting the cover body **52** into the tube holder **32** from the front such that the tube holder **32** is held between the upper wall **52**B and the lower wall **52**C that are disposed on the respective ends of the tube holder **32** in the upward-downward direction. In a state where the cover body **52** is attached to the tube holder **32**, the front wall **52**A may be disposed in front of and adjacent to the tube holder **32**.

(27) The pressing member **54** may have a substantially elongated rib shape having a thickness in the upward-downward direction and extending in the rightward-leftward direction. The pressing member **54** may extend from a vertical middle portion of the cover body **52** in the backward direction. The pressing member **54** may have a thickness dimension smaller than the width dimension (vertical dimension) of the opening groove **34**B of the absorber **30**, and the pressing member **54** may be received in the opening groove **34**B. That is, the pressing member **54** may be disposed in front of the pressure tube **42**. A rear end of the pressing member **54** may be disposed more frontward than a rear end of the opening groove **34**B so that the pressing member **54** is prevented from protruding more backward than the overhangs **34**C of the holding groove **34**A. In the example embodiment, the rear end of the pressing member **54** may be disposed at a slightly more frontward position than the rear end of the opening groove **34**B. The pressing member **54** may be disposed at a vertical middle portion of the opening groove **34**B, and a gap between the pressing member **54** and an upper side of the opening groove **34**B and a gap between the pressing member **54** and a lower side of the opening groove **34**B may be set to the same distance.

(28) A rear face of the pressing member **54** may serve as a pressing face **54**A. The pressing face **54**A may have a curved shape extending more backward at a more upper portion in side cross-sectional view. In more detail, the pressing face **54**A may be curved into a substantially arc shape defining a dent that faces obliquely downward in the backward direction in side cross-sectional view. Accordingly, an upper end **54**B of the pressing face **54**A is disposed at a more backward position than a lower end **54**C of the pressing face **54**A.

(29) [Workings and Effects]

(30) Now, workings and effects of the example embodiment of the disclosure are described together with exemplary operations of the contact detection apparatus **10** at the time of frontal contact between the vehicle V and a human and frontal contact between the vehicle V and a contact object other than a human.

(31) When the vehicle V makes frontal contact with a human, the bumper cover **64** may come into contact with the feet of the human, causing the human to fall onto the hood of the vehicle V. In this case, as illustrated in FIG. **4**, a contact load F**1** may be mainly applied obliquely downward in the backward direction to the bumper cover **64** and an upper portion of the pressing cover **50** attached to the front end (the tube holder **32**) of the absorber **30**. When the contact load F**1** is applied to the upper portion of the pressing cover **50**, the pressing cover **50** may be inclined obliquely downward in the backward direction and displaced in the backward direction. Thus, the pressing member **54**

of the pressing cover **50** may be inclined and displaced in the backward direction inside the opening groove **34**B of the absorber **30**. The upper end **54**B of the pressing face **54**A of the pressing member **54** may be thereby brought into contact with a front portion of the pressure tube **42** so that the pressing member **54** is pressed against the pressure tube **42**. When the pressing cover **50** is further displaced in the backward direction, substantially the entirety of the pressing face **54**A may be brought into contact with an outer surface of the pressure tube **42** so that the pressing face **54**A is pressed against the pressure tube **42**. The pressure tube **42** may be thereby compressed and deformed, resulting in a change in pressure inside the pressure tube **42**. The pressure sensor **44** may output a signal in accordance with the change in pressure inside the pressure tube **42** to the ECU **46**. On the basis of the signal, the ECU **46** may detect that the contact object is a human.

(32) In contrast, when the vehicle V makes frontal contact with a contact object, such as a small animal, other than a human, a lower portion of the bumper cover **64** may come into contact with the contact object. In this case, as illustrated in FIG. **5**, a contact load F**2** may be mainly applied obliquely upward in the backward direction to the bumper cover **64** and a lower portion of the pressing cover **50** attached to the front end (the tube holder **32**) of the absorber **30**. When the contact load F**2** is applied to the lower portion of the pressing cover **50**, the pressing cover **50** may be inclined obliquely downward in the frontward direction. Thus, the pressing member **54** of the pressing cover **50** may be inclined in the frontward direction inside the opening groove **34**B of the absorber **30**. That is, as seen from the left side, the pressing face **54**A may move in a counterclockwise direction, which moves the upper end **54**B away from the pressure tube **42** in the frontward direction and moves the lower end **54**C closer to the pressure tube **42** in the backward direction. In this example, the lower end **54**C of the pressing face **54**A of the pressing member **54** may be disposed at a more frontward position than the upper end **54**B of the pressing face **54**A of pressing member **54**. That is, the lower end **54**C of the pressing face **54**A may be disposed more distant from the pressure tube **42** in the frontward direction than the upper end **54**B is. This helps to prevent the pressing face **54**A from coming into contact with the pressure tube **42** even when the lower end **54**C is displaced closer to the pressure tube **42** in the backward direction. In other words, the pressing member **54** is prevented from easily pressing the pressure tube **42**. Accordingly, the change in pressure inside the pressure tube **42** may be small when the vehicle V makes contact with a contact object other than a human. On the basis of the small change in pressure inside the pressure tube **42**, the ECU **46** may detect that the contact object is an object, such as a small animal, other than a human.

(33) According to the contact detection apparatus **10** of the example embodiment described above, the pressure tube **42** is received in the groove **34** of the tube holder **32** which is a part of the front end of the absorber **30**, and the pressing cover **50** is attached to the front end of the tube holder **32**. The pressing member **54** of the pressing cover **50** is disposed inside the opening groove **34**B of the groove **34** and disposed in front of the pressure tube **42**. The upper end **54**B of the pressing face **54**A of the pressing member **54** is disposed more backward than the lower end **54**C of the pressing face **54**A. In other words, the lower end **54**C of the pressing face **54**A is disposed more distant from the pressure tube **42** in the frontward direction than the upper end **54**B is. Accordingly, as described above, when the vehicle V makes contact with a human, the upper end **54**B of the pressing face **54**A of the pressing cover **50** may be inclined in the backward direction and brought into contact with the pressure tube **42**. Thus, the pressing face **54**A may be appropriately pressed against the pressure tube **42**. In contrast, when the vehicle V makes contact with a contact object other than a human, the pressing face **54**A of the pressing cover **50** inclined in the frontward direction is prevented from easily coming into contact with the pressure tube **42**. As a result, the pressing face **54**A is prevented from easily pressing the pressure tube **42**. Accordingly, when the vehicle V makes contact with a human, the pressure tube **42** may be appropriately deformed, and the deformation of the pressure tube **42** may be large. In contrast, when the vehicle V makes contact with a contact object, such as a small animal, other than a human, the deformation of the pressure tube **42** may be

small. Thus, according to the contact detection apparatus **10** of the foregoing example embodiment, it is possible to properly detect whether the contact object in contact with the vehicle V is a human.
(34) Further, the pressing face **54**A of the pressing member **54** may be curved into an arc shape defining a dent that faces in the backward direction as seen in the vehicle width direction. For example, the pressing face **54**A may have an arc shape that opens obliquely downward in the backward direction as seen in the vehicle width direction. Such a pressing face **54**A may be pressed against the pressure tube **42** when the vehicle V makes contact with a human. Accordingly, it is possible to effectively compress the pressure tube **42** by the pressing face **54**A.
(35) The groove **34** may include the holding groove **34**A and the opening groove **34**B. The holding groove **34**A may receive the pressure tube **42** therein, and the opening groove **34**B may be the opening of the holding groove **34**A. The opening groove **34**B may have the overhangs **34**C at the rear ends. The overhangs **34**C may overhang inside the holding groove **34**A. Accordingly, the pressing face **54**A of the pressing member **54** may be disposed in front of and adjacent to the pressure tube **42** while the pressing member **54** is disposed inside the opening groove **34**B. Thus, when the vehicle V makes frontal contact with a human, the pressure tube **42** may be appropriately pressed by the upper end **54**B of the pressing face **54**A inclined in the backward direction. In contrast, when the vehicle V makes frontal contact with a contact object other than a human, the rear end of the upper face of the pressing cover **50** inclined in the frontward direction may be brought into contact with the overhang **34**C provided at the upper side of the opening groove **34**B. This helps to prevent the pressing member **54** from inclining in the frontward direction and prevents the lower end **54**C of the pressing face **54**A from easily displaced toward the pressure tube **42**. Accordingly, when the vehicle V makes contact with a contact object other than a human, it is possible to further prevent the pressing member **54** from easily pressing the pressure tube **42**.
(36) Although the pressing face **54**A of the pressing member **54** may be curved into an are shape as seen in the vehicle width direction in the foregoing example embodiment, the shape of the pressing face **54**A is not limited to this example. For example, although not illustrated, the pressing face **54**A may have steps such that the upper end **54**B of the pressing face **54**A is disposed more backward than the lower end **54**C of the pressing face **54**A. Alternatively, for example, the pressing face **54**A may be a straight inclined surface extending more backward at a more upper portion such that the upper end **54**B of the pressing face **54**A is disposed more backward than the lower end **54**C of the pressing face **54**A as seen in the vehicle width direction.
(37) In the foregoing example embodiment, the gap between the pressing member **54** and the upper side of the opening groove **34**B and the gap between the pressing member **54** and the lower side of the opening groove **34**B may be set to the same distance. However, the gap between the pressing member **54** and the lower side of the opening groove **34**B may be set to be greater than the gap between the pressing member **54** and the upper side of the opening groove **34**B by, for example, shifting the lower surface of the opening groove **34**B to a lower position than that in the foregoing example embodiment. In this case, when the vehicle V makes contact with a human, the pressing member **54** of the pressing cover **50** inclined in the backward direction is prevented from easily interfering with the lower surface of the opening groove **34**B. Accordingly, when the vehicle V makes contact with a human, it is possible to appropriately incline the pressing cover **50** in the backward direction so that the pressure tube **42** is compressed by the pressing member **54** of the pressing cover **50**.
(38) In the foregoing example embodiment, the opening groove **34**B may extend from the vertical middle portion of the holding groove **34**A in the frontward direction. That is, the holding groove **34**A and the opening groove **34**B may be disposed at the same vertical position. However, the vertical position of the opening groove **34**B with respect to the holding groove **34**A may be changed as desired. For example, the vertical position of the upper side of the opening groove **34**B may be shifted upward from the vertical middle portion of the holding groove **34**A. In this case, as the opening groove **34**B is shifted to a more upward position, the pressing member **54** of the

pressing cover **50** may be disposed more upward than in the foregoing example embodiment and disposed at a position in front of and obliquely above the pressure tube **42**. Accordingly, when the vehicle V makes contact with a human, it is possible to effectively press the pressure tube **42** by the pressing member **54** inclined in the backward direction.

(39) Note that the term “contact” used hereinabove may be used interchangeably with the term “collision”. Although some embodiments of the disclosure have been described in the foregoing by way of example with reference to the accompanying drawings, the disclosure is by no means limited to the embodiments described above. It should be appreciated that modifications and alterations may be made by persons skilled in the art without departing from the scope as defined by the appended claims. The disclosure is intended to include such modifications and alterations in so far as they fall within the scope of the appended claims or the equivalents thereof.

## Claims

1. A contact detection apparatus for a vehicle, the contact detection apparatus comprising: a bumper beam extending in a width direction of the vehicle; an absorber disposed in front of and adjacent to the bumper beam and extending in the width direction of the vehicle; a contact detection sensor including a pressure tube and configured to output a signal in accordance with a change in pressure of the pressure tube, the pressure tube extending in the width direction of the vehicle and being held by the absorber; a tube holder comprising a part of a front end of the absorber and having a groove that opens in a frontward direction of the vehicle and holds the pressure tube therein; and a cover attached to a front end of the tube holder and comprising a body and a pressing member, the body covering a front face of the tube holder, the pressing member extending from the body in a backward direction of the vehicle and being disposed in front of the pressure tube, wherein an upper end of a rear face of the pressing member is disposed at a more backward position than a lower end of the rear face of the pressing member in the backward direction of the vehicle.

2. The contact detection apparatus according to claim 1, wherein the rear face of the pressing member is curved into an arc shape defining a dent that faces in the backward direction of the vehicle as seen in the width direction of the vehicle.

3. The contact detection apparatus according to claim 1, wherein the groove comprises a holding groove receiving the pressure tube, and an opening groove comprising an opening of the groove and extending in the frontward direction and the backward direction of the vehicle as seen in the width direction of the vehicle, wherein the opening groove has an overhang at a rear end of the opening groove, the overhang overhanging inside the holding groove.

4. The contact detection apparatus according to claim 2, wherein the groove comprises a holding groove receiving the pressure tube, and an opening groove comprising an opening of the groove and extending in the frontward direction and the backward direction of the vehicle as seen in the width direction of the vehicle, wherein the opening groove has an overhang at a rear end of the opening groove, the overhang overhanging inside the holding groove.