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(54) **SENSOR UNIT, APPARATUS WITH SENSOR UNIT AND ASSEMBLING METHOD OF SENSOR UNIT**

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(57) **ABSTRACT**

A sensor unit includes a sensor, a coupler, and a body. The coupler is connected to the sensor. The sensor is to be connected to an outside of the sensor unit via the coupler. The body supports the sensor and the coupler. The body is to be attached to an equipment from an outside of the equipment which includes an object to be detected by the sensor. The body includes an external appearance to distinguish the sensor unit from an another sensor unit which has an another sensor different from the sensor.

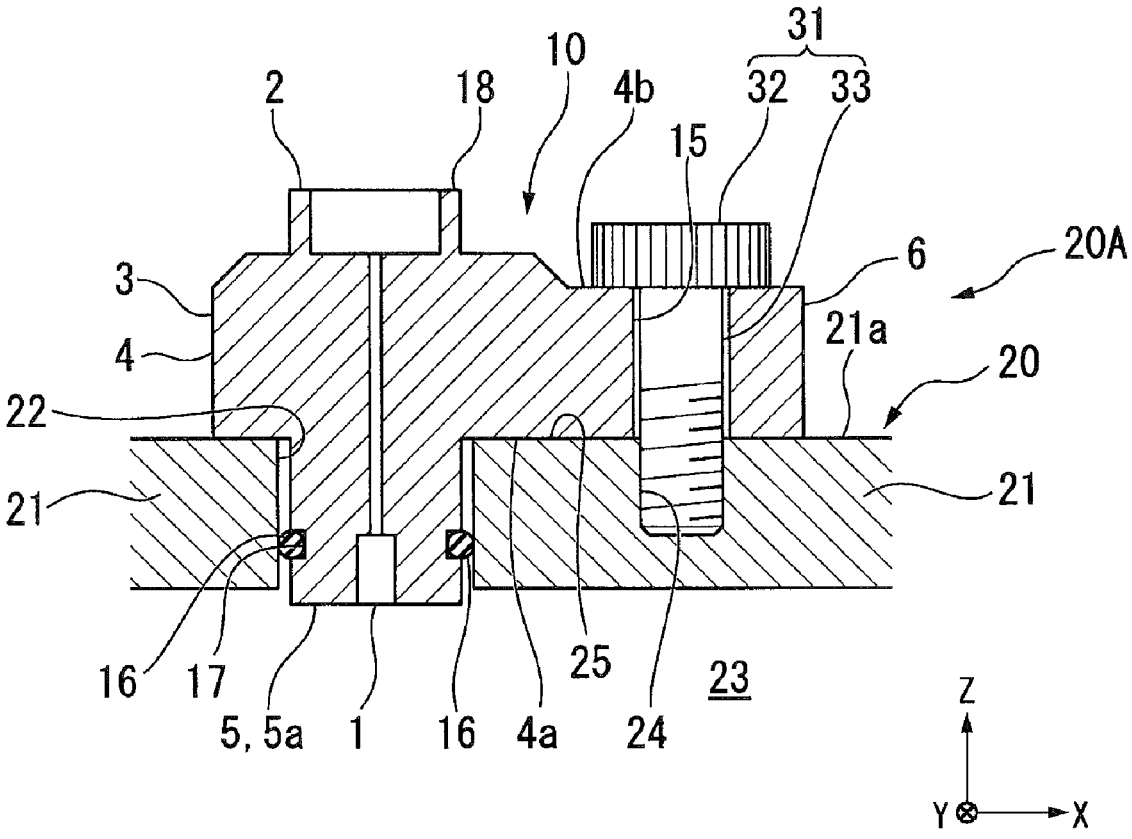


Fig.1

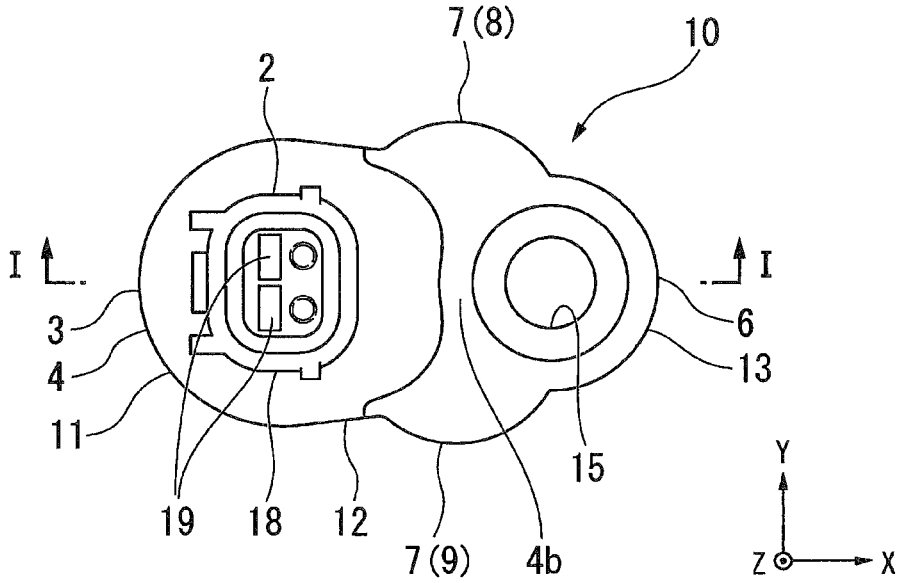

7(8)
10
2
I
I
3
4
11
6
13
15
19
18
12
7(9)
4b
Y
Z
X

Fig.2

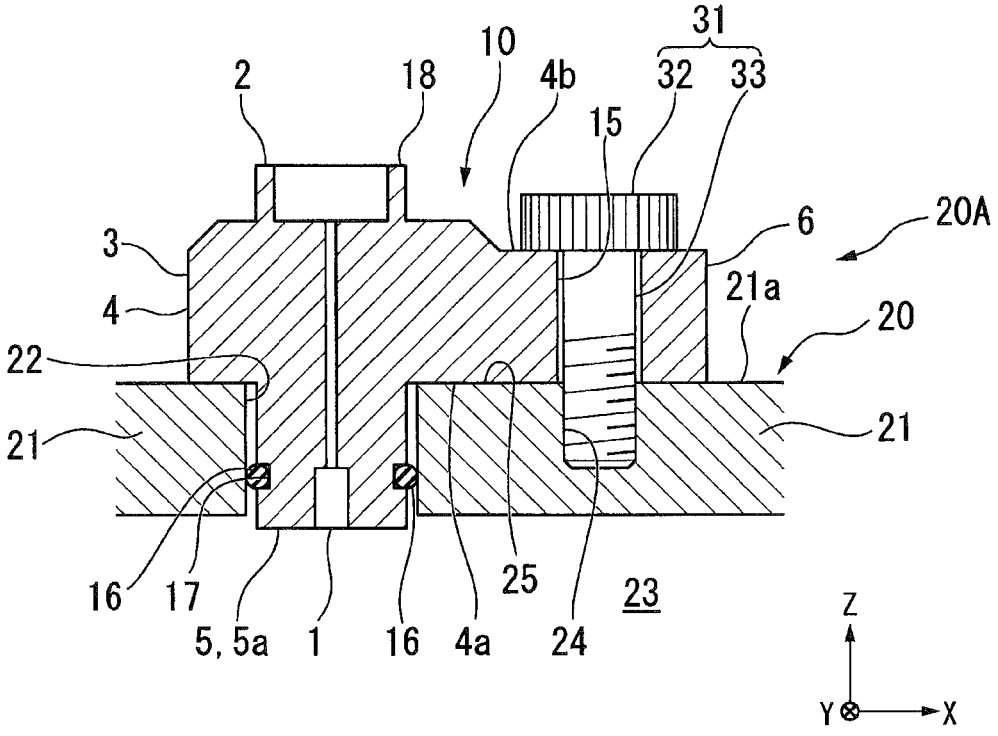

31
10
2
18
4b
32
33
15
3
6
20A
4
21a
20
22
21
21
16
17
5, 5a
1
16
4a
25
24
23
Z
Y
X

Fig.3

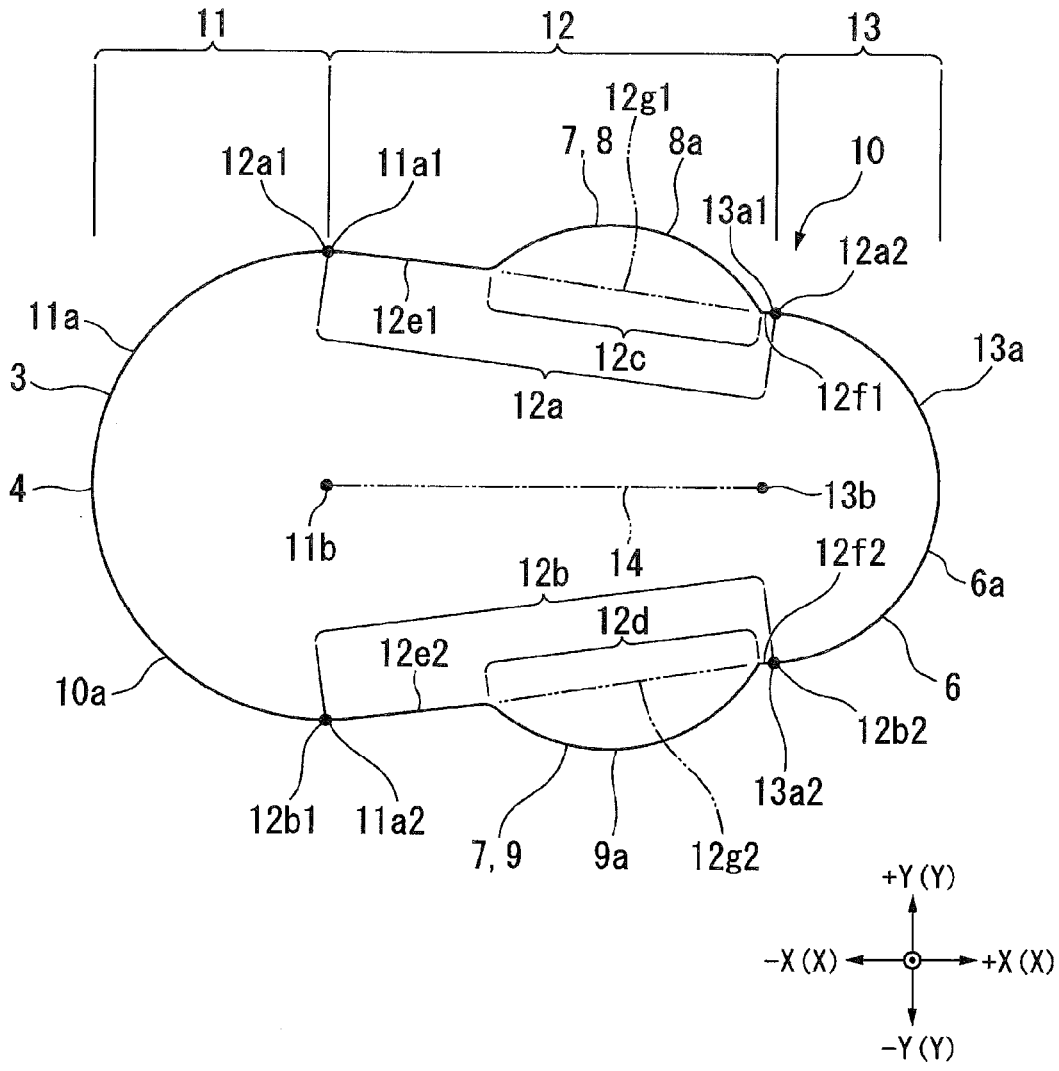

11
12
13
12g1
7, 8
8a
10
12a1
11a1
13a1
12a2
11a
12e1
12c
13a
3
12a
12f1
4
13b
11b
14
12f2
6a
12b
12d
12e2
6
10a
12b2
13a2
12b1
11a2
7, 9
9a
12g2
+Y (Y)
−X (X)
+X (X)
−Y (Y)

Fig.4

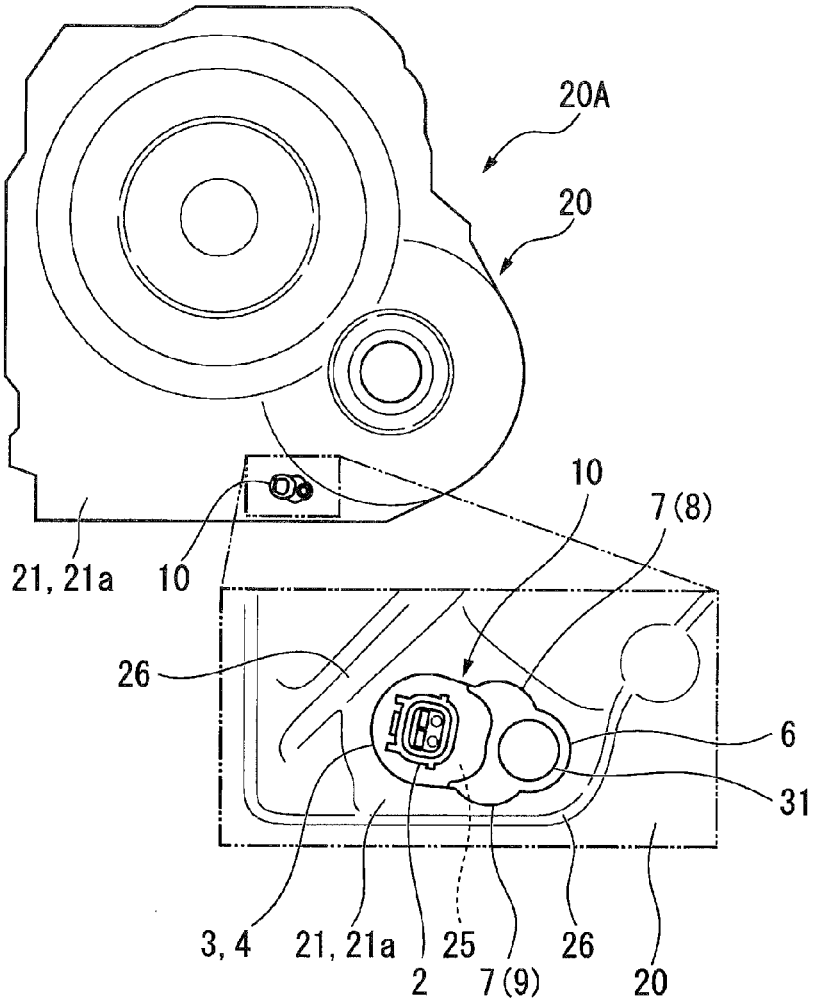

20A
20
10
7(8)
21, 21a
10
26
6
31
3, 4
21, 21a
2
25
7(9)
26
20

Fig.5

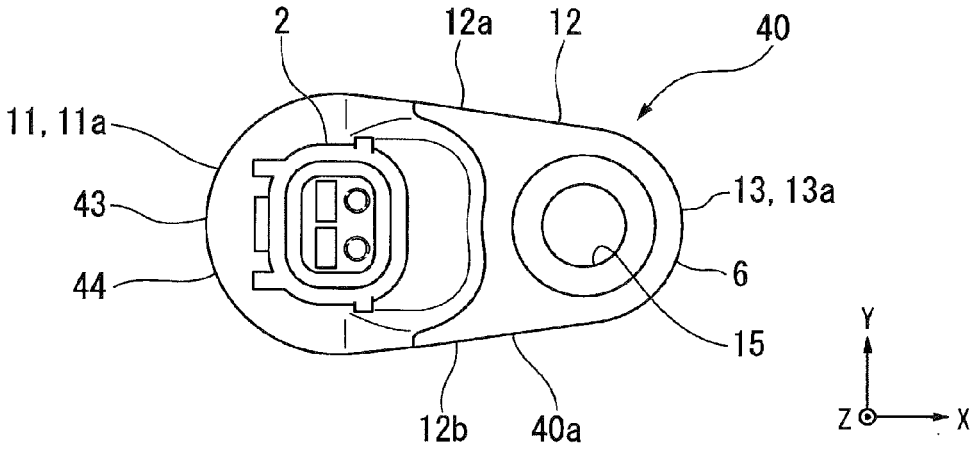

2
12a
12
40
11, 11a
43
44
13, 13a
6
15
12b
40a
Y
Z
X

Fig.6

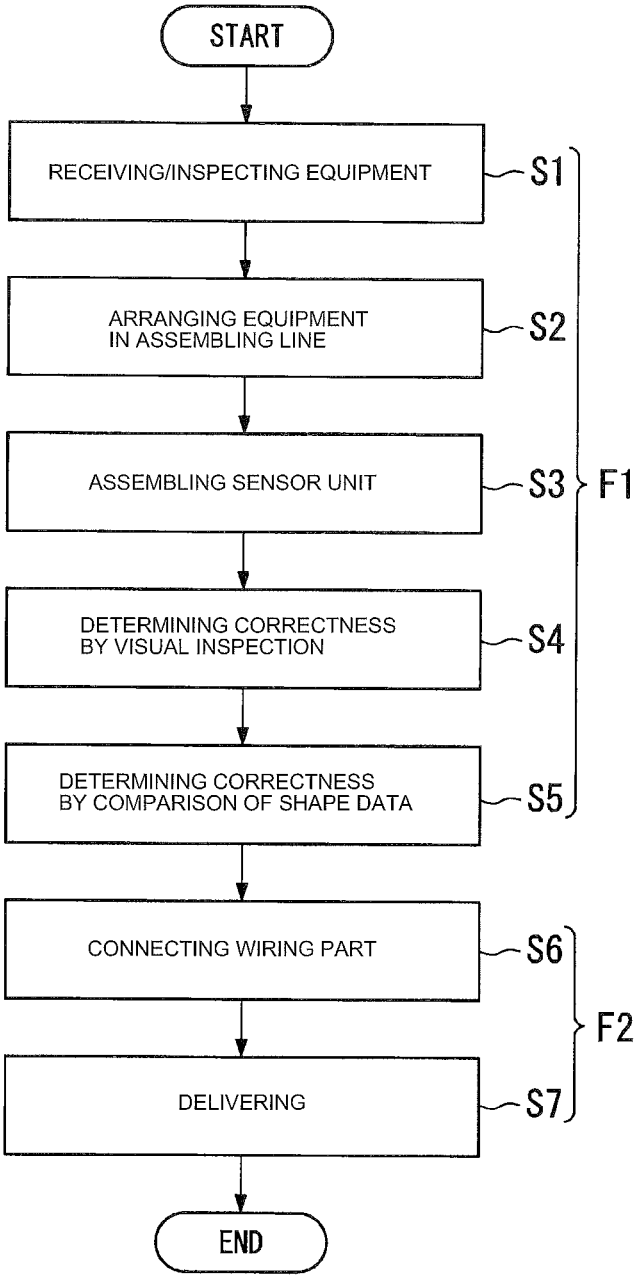
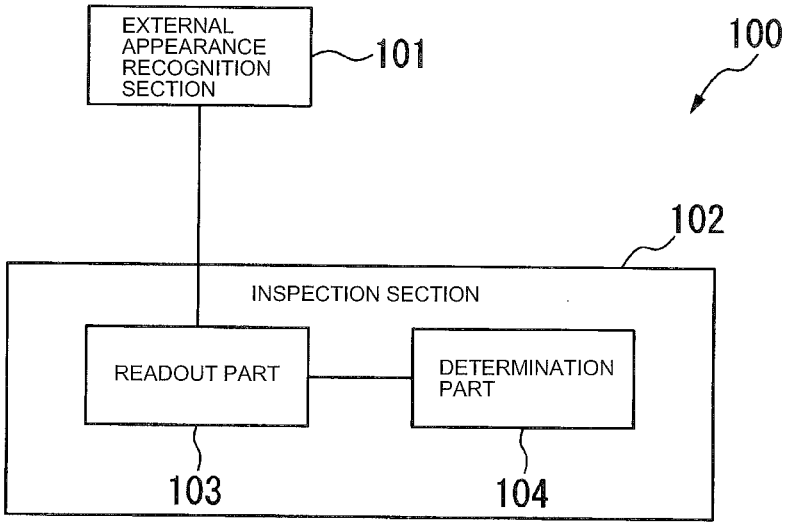

START
RECEIVING/INSPECTING EQUIPMENT
S1
ARRANGING EQUIPMENT IN ASSEMBLING LINE
S2
ASSEMBLING SENSOR UNIT
S3
F1
DETERMINING CORRECTNESS BY VISUAL INSPECTION
S4
DETERMINING CORRECTNESS BY COMPARISON OF SHAPE DATA
S5
CONNECTING WIRING PART
S6
F2
DELIVERING
S7
END

Fig.7


EXTERNAL APPEARANCE RECOGNITION SECTION
101
100
102
INSPECTION SECTION
READOUT PART
DETERMINATION PART
103
104

SENSOR UNIT, APPARATUS WITH SENSOR UNIT AND ASSEMBLING METHOD OF SENSOR UNIT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. §119 to Japanese Patent Application No. 2016-108557, filed May 31, 2016. The contents of this application are incorporated herein by reference in their entirety.

BACKGROUND

1. Field

[0002] The present invention relates to a sensor unit, an apparatus with the sensor unit and an assembling method of the sensor unit.

2. Description of the Related Art

[0003] Various sensors are used for a vehicle such as a motorcar and the like. For example, for a transmission of the motorcar there is used a sensor such as ATF, etc. for detecting an oil temperature. The sensor is a sensor unit which is provided with a sensor element and a coupler to which the wiring is connected, for example. In the sensor unit, there may be cases where a characteristic of the sensor element is changed by a technical improvement and the like. When the characteristic of the sensor is changed, the necessity for changing a content of control may be caused in response to the change of a medium value, a threshold, etc. for example. Since the content of the control and the characteristic of the sensor element are required to be matched, the sensor unit which has a specific sensor element in response to the control content is selected from a plurality of sensor units and assembled into the target equipment.

[0004] Since it is necessary to select the specific sensor unit from the plurality of sensor units which can be assembled into the equipment, the technique capable of preventing an incorrect sensor unit from being assembled is proposed (see Japanese Patent Application Laid-Open Publication No. 2009-154739 and Japanese Patent Application Laid-Open Publication No. H06-147754).

[0005] For example, in order to prevent the incorrect sensor unit from being assembled, it is effective that a coupler of the sensor unit to be used is formed in a different shape from a coupler of another sensor unit. When this configuration is employed, in the case where another sensor unit is assembled into the equipment by error, the wiring is not connected to that sensor unit, so that the equipment inviting the erroneous assembly of the sensor unit may be removed.

SUMMARY

[0006] According to a first aspect of the present invention, a sensor unit includes a sensor element, a coupler, and a body. The coupler is connected to the sensor element . The body is configured to support the sensor element and the coupler and to be assembled from an outside into equipment which has a part to be detected. The body has an external appearance identification part capable of distinguishing the sensor unit from other sensor unit which has other sensor element different from the sensor element.

[0007] According to a second aspect of the present invention, a sensor unit includes a sensor, a coupler, and a body. The coupler is connected to the sensor. The sensor is to be connected to an outside of the sensor unit via the coupler. The body supports the sensor and the coupler. The body is to be attached to an equipment from an outside of the equipment which includes an object to be detected by the sensor. The body includes an external appearance to distinguish the sensor unit from an another sensor unit which has an another sensor different from the sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

[0009] FIG. **1** is a plan view of a sensor unit in accordance with an embodiment of the present invention;

[0010] FIG. **2** is a cross sectional view taken along line I-I of the sensor unit as shown in FIG. **1**;

[0011] FIG. **3** is a plan view of an external shape of the sensor unit as shown in FIG. **1**;

[0012] FIG. **4** is a plan view of equipment with the sensor unit in which the sensor unit as shown in FIG. **1** is assembled into the equipment;

[0013] FIG. **5** is a plan view of an example of the sensor unit which has another sensor element;

[0014] FIG. **6** is a flow chart of a sensor unit assembling method in accordance with the embodiment of the present invention; and

[0015] FIG. **7** is a block diagram showing an example of a correctness determination device to be usable in the sensor unit assembling method in accordance with the embodiment of the present invention.

DESCRIPTION OF THE EMBODIMENTS

[0016] The embodiments will now be described with reference to the accompanying drawings, wherein like reference numerals designate corresponding or identical elements throughout the various drawings. Hereunder, an embodiment of the present invention will be explained with reference to accompanying drawings.

[Sensor Unit]

[0017] FIG. **1** is a plan view of a sensor unit **10** in accordance with an embodiment of the present invention. FIG. **2** is a cross sectional view of the sensor unit **10** taken along line I-I of FIG. **1**. FIG. **3** is a plan view of an external shape of the sensor unit **10**. FIG. **4** is a plan view of equipment **20**A with the sensor unit in which the sensor unit **10** is assembled into the equipment **20**.

[0018] In the following description, an XYZ rectangular coordinate system may be employed. The X direction is a longitudinal direction of a main body section **4** of a body **3** of the sensor unit **10**. The Y direction is the direction orthogonal to the X direction in a plane along a mounting surface **4***a* of the main body section **4** and corresponds to the width direction of the main body section **4**. The Z direction is the direction orthogonal to the X direction and the Y direction and corresponds to the thickness direction of the

main body section **4**. The plan view is a view as seen from the thickness direction (Z direction) of the main body section **4**.

[0019] In FIG. **3**, one direction (right direction) of the X direction is referred to as +X direction, and the opposite direction thereto is referred to as −X direction. One direction (upward direction) of the Y direction is referred to as +Y direction, and the opposite direction thereto is referred to as −Y direction.

[0020] As shown in FIGS. **1** and **2**, the sensor unit **10** has a sensor element **1**, a coupler **2** and the body **3**. As shown in FIG. **2**, the body **3** has the main body section **4** formed substantially in the shape of a plate, and an insertion section **5** provided on one surface **4***a* (mounting surface **4***a*) of the main body section **4**. As shown in FIG. **1**, the main body section **4** has a main part **6** and an external appearance identification part **7** which projects from the main part **6** in a plan view. As shown in FIG. **2**, the mounting surface **4***a* is a surface which faces an external surface **21***a* of a casing **21** of the equipment **20**. The mounting surface **4***a* of the main body section **4** abuts on the external surface **21***a* of the casing **21**.

[0021] As shown in FIG. **3**, the main part **6**, in a plan view, has a first end portion **11** of a curved convex shape, an extension portion **12** which extends in the longitudinal direction (the X direction) from the first end portion **11**, and a second end portion **13** of a curved convex shape formed in a tip of the extension portion **12**.

[0022] The first end portion **11** is formed in the shape of a curved convex projecting in the direction (the −X direction) away from the extension portion **12** and has an outer edge **11***a* in the shape of a circular arc, for example. The extension portion **12** has a pair of lateral edges **12***a*, **12***b* of a straight line shape and becomes gradually narrower in width in the extending direction (the +X direction). The lateral edges **12***a*, **12***b* approach each other from one ends **12***a***1**, **12***b***1** to the other ends **12***a***2**, **12***b***2**. Each of the lateral edges **12***a*, **12***b* extends in the tangential direction of the outer edge **11***a* of a circular arc shape from one end **11***a***1** and the other end **11***a* **2** of the outer edge **11***a*.

[0023] The second end portion **13** is formed in a curved convex shape projecting in the direction (the +X direction) away from the extension portion **12** and has an outer edge **13***a* of a circular arc shape connecting the other ends **12***a***2**, **12***b***2** of the lateral edges **12***a*, **12***b* of the extension portion **12**, for example. The tangential directions extending from one end **13***a***1** and the other end **13***a***2** of the outer edge **13***a* correspond to the directions of the lateral edges **12***a*, **12***b*. A contour line **6***a* of the main part **6** is configured by the outer edge **11***a* of the first end portion **11**, the lateral edges **12***a*, **12***b* of the extension portion **12** and the outer edge **13***a* of the second end portion **13**. The shapes of the outer edges **11***a*, **13***a* of the first end portion **11** and the second end portion **13** are not limited to the circular arc shape but may be an elliptic shape, a parabolic shape and the like.

[0024] Letting a center line **14** be a line connecting a center **11***b* of the circular arc-shaped outer edge **11***a* of the first end portion **11** and a center **13***b* of the circular arc-shaped outer edge **13***a* of the second end portion **13**, the lateral edges **12***a*, **12***b* are located in line-symmetric positions with respect to the center line **14**.

[0025] The external appearance identification part **7** has a first projecting portion **8** and a second projecting portion **9**. The projecting portions **8**, **9** each are configured to project from the lateral edges **12***a*, **12***b* of the main part **6** in a plan view (namely, when viewed from the direction perpendicular to the mounting surface **4***a*). The first projecting portion **8** is configured to project from the lateral edge **12***a* of the main part **6** in the direction perpendicular to the lateral edge **12***a* and away from the main part **6**. The projecting direction of the first projecting portion **8** contains components in the +Y direction and the +X direction. The first projecting portion **8** has an outer edge **8***a* of a circular arc shape, for example. The second projecting portion **9** is configured to project from the lateral edge **12***b* of the main part **6** in the direction perpendicular to the lateral edge **12***b* and away from the main part **6**. The projecting direction of the second projecting portion **9** contains components in the −Y direction and the +X direction. The second projecting portion **9** has an outer edge **9***a* of a circular arc shape, for example.

[0026] The projecting portions **8**, **9** are formed in the shape of a plate along the mounting surface **4***a* (namely, along an XY plane). The projecting portions **8**, **9** make it possible to distinguish the sensor unit **10** from another sensor unit based on the shape, in the determination of correctness of the sensor unit by the visual inspection and the comparison of shape data to be referred to later.

[0027] The first projecting portion **8** is formed in a middle portion **12***c* between the one end **12***a***1** and the other end **12***a***2** without being formed over the whole length of the lateral edge **12***a*. One end side portion **12***e***1** and the other end side portion **12***f***1** other than the middle portion **12***c* of the lateral edge **12***a* each are formed in a straight line shape and located on these respective extension lines. The lateral edge **12***a* has a straight line shape composed of the one end side portion **12***e***1**, the other end side portion **12***f***1** and an extension line **12***g***1** between the one end side portion and the other end side portion.

[0028] The second projecting portion **9** is formed in a middle portion **12***d* between the one end **12***b***1** and the other end **12***b***2** without being formed over the whole length of the lateral edge **12***b*. One end side portion **12***e***2** and the other end side portion **12***f***2** other than the middle portion **12***d* of the lateral edge **12***b* each are formed in a straight line shape and located on these respective extension lines. The lateral edge **12***b* has a straight line shape composed of the one end side portion **12***e***2**, the other end side portion **12***f***2** and an extension line **12***g***2** between the one end side portion and the other end side portion. Herein, the shapes of the outer edges **8***a*, **9***a* of the projecting portions **8**, **9** are not limited in particular but may be a curved convex shape such as a circular arc shape, an elliptic shape, a parabolic shape or the like, a polygonal shape such as a rectangular shape, an inverted V-shape or the like, an indeterminate shape, etc.

[0029] The sensor unit **10** has a contour line **10***a*, in a plan view. The contour line **10***a* is composed of the outer edge **11***a* (circular arc shape) of the first end portion **11** of the main part **6**, the one end side portion **12***e***1** (straight line shape) of the lateral edge **12***a*, the outer edge **8***a* (circular arc shape) of the first projecting portion **8**, the other end side portion **12***f***1** (straight line shape) of the lateral edge **12***a*, the outer edge **13***a* (circular arc shape) of the second end portion **13**, the other end side portion **12***f***2** (straight line shape) of the lateral edge **12***b*, the outer edge **9***a* (circular arc shape) of the second projecting portion **9** and the one end side portion **12***e***2** (straight line shape) of the lateral edge **12***b*.

[0030] As shown in FIGS. **1** and **2**, in the main body section **4** there is formed a through hole **15** through which

a fixture **31** is inserted. The through hole **15** is configured to pass through the main body section **4** in the thickness direction from the mounting surface **4***a* of the main body section **4** to an outer surface **4***b* (an opposite surface from the mounting surface **4***a*). A shape of the through hole **15** in a plan view is a circular shape, for example. The through hole **15** may be formed in an area including the second end portion **13** of the main body part **6** in a plan view.

[0031] The fixture **31** has a head portion **32** and a screw shaft portion **33** extending from the head portion **32**. The screw shaft portion **33** of the fixture **31** is inserted into the through hole **15** and screwed into a fixing hole **24** formed in the casing **21** of the equipment **20**. An outer diameter of the head portion **32** is larger than an inner diameter of the through hole **15**. The main body section **4** is fixedly secured to the casing **21** by the fixture **31**.

[0032] As shown in FIG. **2**, the insertion section **5** is formed in the mounting surface **4***a* of the main body section **4**. The insertion section **5** is configured to project in the direction (the downward direction of FIG. **2**) perpendicular to the mounting surface **4***a* and away from the main body section **4**. The insertion section **5** can be inserted into a mounting hole **22** which is formed in the casing **21** of the equipment **20**. A shape in a plan view of the insertion section **5** is not limited in particular but maybe a circular shape, a rectangular shape and the like, for example.

[0033] On an outer peripheral surface of the insertion section **5** there is formed an annular recess **17** along the circumferential direction of the insertion section **5** in order for fitting an O-ring **16** thereto. The O-ring **16** fitted to the annular recess **17** contacts an inner surface of the mounting hole **22** and an outer surface (a surface within the annular recess **17** in detail) of the insertion section over the whole circumference whereby to be able to seal fluid-tightly a clearance between the inner surface of the mounting hole **22** and the outer surface of the insertion section **5**.

[0034] The sensor element **1** is an element for detecting a temperature of oil (apart to be detected) such as an ATF, etc. and is a thermistor formed of a temperature sensitive resistor element, for example. The thermistor changes an electric resistor in response to the change of an oil temperature. The sensor element **1** is provided in an area including a tip surface **5***a* of the insertion section **5** and faces into an internal space **23** of the casing **21**. Therefore, the sensor element **1** can detect the oil temperature of the internal space **23**.

[0035] The coupler **2** is provided on the outer surface **4***b* of the main body section **4**. The coupler **2** has an annular wall portion **18** and a plurality of terminals **19**. The annular wall portion **18** is configured to project in the direction (the upward direction of FIG. **2**) perpendicular to the outer surface **4***b* and away from the main body section **4**. The plurality of terminals **19** are provided on the outer surface **4***b* on the inside of the annular wall portion **18**. The coupler **2** is formed in an area including the first end portion **11**, in a plan view. At least one of the plurality of terminals **19** is electrically connected to the sensor element **1** so as to be able to output a signal obtained from the sensor element **1**. The body **3** and the annular wall portion **18** of the coupler **2** can be formed integrally by resin molding.

[Equipment with Sensor Unit]

[0036] As shown in FIG. **4**, the equipment **20** into which the sensor unit **10** is assembled is a transmission to be used for the vehicle such as a motorcar and the like, for example. The internal space **23** of the casing **21** of the equipment **20** is sealingly filled with oil (fluid) such as an ATF (Automatic Transmission Fluid) and the like for smoothening speed change operation, etc.

[0037] The equipment **20** has an assembling part **25** formed of a part of the outer surface **21***a* of the casing **21**. The sensor unit **10** is assembled in the assembling part **25**. In the vicinity of the assembling part **25** there may be provided a protrusion **26** which projects in the height direction (the Z direction) with respect to the assembling part **25**.

[0038] A sensor unit (for example, a sensor unit **40** as shown in FIG. **5**) provided with another sensor element which is different from the sensor element **1** may be assembled in the assembling part **25**, instead of the sensor unit **10**. The equipment **20** into which the sensor unit **10** is assembled is referred to as equipment **20**A with a sensor unit. Herein, the equipment into which the sensor unit is assembled is not limited to the transmission but may be an engine, an electric motor and the like to be used for the motorcar, etc.

[Assembling Method of Sensor Unit]

[0039] Hereinafter, an assembling method of the sensor unit (a manufacturing method of the equipment with the sensor unit) according to the embodiment of the present invention will be described. FIG. **5** is a plan view of a sensor unit **40** as an example of another sensor unit. Herein, in the following description, the configuration corresponding to the sensor unit **10** is given like reference characters, and the description may be omitted. The sensor unit **40** has a similar configuration to the sensor unit **10** of FIG. **1**, except that another sensor element is provided instead of the sensor element **1** and the external appearance identification part **7** is not provided.

[0040] The sensor unit **40** is provided with another sensor element (not shown), a coupler **2**, and a body **43**. Another sensor element is different in characteristics from the sensor unit **10** of FIG. **1**. The body **43** has a main body section **44** formed substantially in a plate shape and the insertion section **5** (see FIG. **2**) provided on one surface (mounting surface) of the main body section **44**. The main body section **44** has a main part **6**. The main body section **44** has a similar configuration to the main body section **4** of the sensor unit **10** of FIG. **1**, except that the external appearance identification part **7** is not provided. The sensor unit **40**, in a plan view, has a contour line **40***a* composed of an outer edge **11***a* (circular arc shape) of a first end portion **11** of the main part **6**, a lateral edge **12***a* (straight line shape), an outer edge **13***a* (circular arc shape) of a second end portion **13** and a lateral edge **12***b* (straight line shape).

[0041] The sensor unit **40**, as with the sensor unit **10**, can be assembled into the assembling part **25** of the casing **21** in a posture in which a mounting surface of the main body section **44** faces the outer surface **21***a* of the casing **21** (see FIG. **2**). The insertion section **5** of the sensor unit **40** is inserted into the mounting hole **22**. Another sensor element is provided in an area including the tip surface **5***a* of the insertion section **5** thereby to face into the internal space **23** of the casing **21**.

[0042] FIG. **6** is a flow chart of an assembling method of the sensor unit in accordance with this embodiment. As shown in FIG. **6**, steps **1** to **5** are performed in a first plant F**1** (first production facilities), for example. Steps **6** and **7** are

performed in a second plant F2 (second production facilities) which is different from the first plant F1, for example. The first plant F1 and the second plant F2 may be located in different regions from each other.

(Step 1: Arrangement of Equipment in an Assembling Line)

[0043] In the first plant F1, after receiving and inspecting the equipment **20** (Step S1), the equipment **20** is arranged in a predetermined assembling line (Step S2).

(Step 2: Assembling of the Sensor Unit)

[0044] Next, as shown in FIGS. **2** and **4**, the sensor unit **10** is assembled into the assembling part **25** of the casing **21** (Step S3 of FIG. **6**). At that time, the sensor unit **10** is in the posture in which the mounting surface **4***a* of the main body section **4** faces the outer surface **21***a* of the casing **21**. Thus, the equipment **20**A with the sensor unit is obtained.

[0045] The insertion section **5** is inserted into the mounting hole **22**. The O-ring **16** provided on the outer surface of the insertion section **5** seals fluid-tightly the clearance between the inner surface of the mounting hole **22** and the outer surface of the insertion section **5**. The sensor element **1** is arranged in the area including the tip surface **5***a* of the insertion section **5** thereby to face into the internal space **23** of the casing **21**.

(Step 3: Correctness Determination by Visual Inspection)

[0046] The operator recognizes the external appearance of the sensor unit assembled into the equipment **20** by the visual inspection, and determines whether or not the sensor unit is the correct sensor unit to be assembled into the equipment **20**, by visual inspection (Step S4 of FIG. **6**). In this embodiment, the correct sensor unit is the sensor unit **10** of FIG. **1**.

[0047] For example, when it is recognized by the visual inspection that the sensor unit assembled into the equipment **20** has the external appearance identification part **7** (the projecting portions **8**, **9**) (see FIG. **1**), it can be determined that the assembled sensor unit is not the sensor unit **40** (see FIG. **5**) but the sensor unit **10** (see FIG. **1**).

[0048] When it is recognized by the visual inspection that the sensor unit assembled into the equipment **20** has no external appearance identification part **7** (projecting portions **8**, **9**), it can be determined that the assembled sensor unit is not the sensor unit **10** (see FIG. **1**). Like this, the determination of the correctness of the sensor unit can be performed based on the existence or nonexistence of the external appearance identification part **7** by visually inspecting the sensor unit.

[0049] In the case where it has been determined that the sensor unit assembled into the equipment **20** is the sensor unit **10**, the operator judges it to be "normal". In the case where it has been determined that the sensor unit assembled into the equipment **20** is not the sensor unit **10**, the operator judges it to be "error".

(Step 4: Correctness Determination by Comparison of Shape Data)

[0050] As shown in FIG. **6**, in this step, the shape data of the sensor unit assembled into the equipment **20** is obtained, and the correctness determination of the sensor unit is performed by comparing the shape data with the reference shape data (Step S5). Hereunder, this step will be described in detail.

[0051] FIG. **7** is a block diagram showing an example of a correctness determination device to be usable in the present step. The correctness determination device **100** has an external appearance recognition section **101** and an inspection section **102**. As the external appearance recognition section **101**, a shape inspection device provided with a light emitting element (a laser light source and the like) and a light receiving element may be employed, for example.

[0052] Light from the light receiving element is irradiated to the sensor unit assembled into the equipment **20**, and reflected light thereof is received by the light receiving element. Based on a light receiving position on the light receiving element, distance information to an object (the sensor unit) to be detected is obtained for each area of the detected object by a triangulation method, for example. The information (hereinafter, referred to as shape data) as to the shape (for example, the shape in a plan view, the shape in cross section or the like) of the detected object (the sensor unit) is extracted from this distance information. Thus, the shape data of the sensor unit assembled into the equipment **20** is provided.

[0053] The detection section **102** has a readout part **103** and a determination part **104**. In the readout part **103** there is obtained a data designating a specification of the sensor unit **10**. The data designating the specification is provided by QR codes (registered trademark), etc. in the specifications (not shown), etc., for example. In this embodiment, the data designating the specification is a data (referred to as a reference shape data) in relation to the external appearance of the sensor unit **10**. The reference shape data includes the information as to the shape (for example, the shape in a plan view, the shape in cross section and the like) of the sensor unit **10**.

[0054] In the determination part **104**, the shape data of the sensor unit obtained in the external appearance recognition section **101** is compared with the reference shape data of the sensor unit **10**. The determination part **104** determines the correctness of the sensor unit based on the existence or nonexistence of the external appearance identification part **7**.

[0055] In other words, in the case where the external appearance identification part **7** is included in the shape data of the sensor unit obtained in the external appearance recognition section **101**, the determination part **104** judges it to be "normal" and outputs a determination signal. To have obtained the determination of "normal" may be displayed on a display part (not shown). In the case where the external appearance identification part **7** is not included in the shape data of the sensor unit obtained in the external appearance recognition section **101**, the determination part **104** judges it to be "error" and outputs a determination signal. To have obtained the determination of "error" may be displayed on a display part (not shown).

(Step 5: Removal of Equipment from Assembling Line)

[0056] In the case where the sensor unit of the equipment with the sensor unit is judged to be normal in each of the step **3** and the step **4**, the equipment with the sensor unit is considered as a normal product and removed from the assembling line. In the case where the sensor unit of the equipment with the sensor unit is judged to be error in either

the step **3** or the step **4**, the equipment with the sensor unit is considered as an error product and removed from the assembling line.

(Step **6**: Connection of Wiring Part to Sensor Unit)

[0057] The equipment **20**A with sensor unit judged normal is transferred to the second plant F**2**. In the second plant F**2**, the wiring part (not shown) is connected to the coupler **2** of the sensor unit **10** of the equipment **20**A with sensor (Step S**6** of FIG. **6**).

(Step **7**: Delivery)

[0058] The equipment **20**A with the sensor unit, in which the wiring part is connected to the coupler **2** is delivered to a post step (Step S**7**).

[0059] The sensor unit **10** is provided with the external appearance identification part **7** capable of distinguishing the sensor unit from another sensor unit (for example, the sensor unit **40** of FIG. **5**), so that the determination of correctness (Steps **3**, **4**) can be performed by the visual inspection and the comparison of the shape data with respect to the sensor unit before the process (Step **6**) of connecting the wiring part to the sensor unit. Therefore, the incorrect assembling can be detected early and accurately by the two steps determination.

[0060] The external appearance identification part **7** makes it possible to distinguish the sensor unit **10** from another sensor unit on the basis of the shape, so that the accuracy of the determination of correctness can be heightened, and the cost required for the determination can be reduced.

[0061] In comparison with the above, in the case of distinguishing between the correct sensor unit and another sensor unit on the basis of the color of the sensor unit, the distinguishing of the color may become difficult due to an environment to perform the determination, a capacity of the operator and the like thereby to decrease the accuracy of the determination of the correctness. In addition, the cost of a coloring agent may increase depending on an adopted color.

[0062] Since the external appearance identification part **7** has the projecting portions **8**, **9** which project from the main body section **4** in a plan view, the projecting portions **8**, **9** can be easily recognized when the operator inspects the body **3** and assembles the body **3** into the equipment from the direction perpendicular to the mounting surface **4***a*. Therefore, it is possible to improve the accuracy in determination of the correctness of the sensor unit (Steps **3**, **4**).

[0063] Since the projecting portions **8**, **9** project in different directions from each other, so that, even if the operator inspects the sensor unit **10** from the position in which the first projecting portion **8** is hard to be inspected, the second projecting portion **9** is easy to be recognized. Therefore, it is possible to improve the accuracy in determination of the correctness of the sensor unit (Steps **3**, **4**).

[0064] Since the plurality of sensor units **10**, **40** may be assembled into the equipment **20**, there are advantages that common usage can be realized, and the like.

[0065] The equipment **20**A with sensor unit has the sensor unit **10**, so that, even if it is possible to assemble another sensor unit **40** into the equipment **20**, the determination of correctness (Steps **3**, **4**) can be performed by the visual inspection and the comparison of the shape data with respect to the sensor unit before the process (Step **6**) of connecting the wiring part to the sensor unit. Therefore, the incorrect assembling can be detected early and accurately.

[0066] According to the sensor unit assembling method of the embodiment, since the determination of correctness (Steps **3**, **4**) is performed by the visual inspection and the comparison of the shape data, the incorrect assembling can be detected early and accurately.

[0067] In the case where the step **6** of connecting the wiring part is performed in the second plant F**2** which is different from the first plant F**1** in which the step **2** is performed, when the incorrect assembling of the sensor unit is recognized at the time of connecting the wiring part in the second plant F**2**, the equipment **20** has to be returned from the second plant F**2** to the first plant F**1** whereby the production efficiency is deteriorated. Particularly, when the first plant F**1** and the second plant F**2** are located in the different areas, it takes a lot of time to return the equipment **20** whereby the deterioration of the production efficiency increases.

[0068] In comparison with this, according to the sensor unit assembling method of the embodiment, since the incorrect assembling can be inspected in the first plant F**1**, the equipment **20** is not required to be returned, so that the deterioration of the production efficiency can be avoided.

[0069] It is to be understood that the technical scope of the present invention is not limited to the above described embodiments but may include various changes and modifications of each of the above described embodiments without departing from the spirit and scope of the invention. In other words, the configuration and the like as described in the above embodiments are only an example, and various changes and modifications may be made properly.

[0070] For example, although the external appearance identification part **7** of the sensor unit **10** as shown in FIG. **1** has two projecting portions **8**, **9**, the number of the projecting portions may be one and an arbitrary number of more than three. Although the two projecting portions **8**, **9** of the sensor unit **10** as shown in FIG. **1** project in the different directions from each other, the projecting directions of the plural projecting portions may be the same direction.

[0071] The external appearance identification part **7** of the sensor unit **10** as shown in FIG. **1** has projecting portions **8**, **9**. However, it is sufficient that the external appearance identification part is configured so as to distinguish the sensor unit from another sensor unit. Therefore, it is not limited to the projecting portion (projection) but may be such a configuration that the distinguishing from another sensor unit is performed by a difference in shape (for example, difference in shape in a plan view), such as a recess, an opening and the like formed in the body, for example.

[0072] The external appearance recognition section **101** of the correctness determination device **100** used in the step **4** (correctness determination by comparison of the shape data) may be an imaging device such as a CCD and the like. In the case of using the imaging device, the shape data of the sensor unit is obtained based on an image (for example, an image in a plan view) of the sensor unit. In the determination part **104**, the shape data is compared with the reference shape data of the sensor unit **10**. The determination part **104** can determine the existence or nonexistence of the external appearance identification part **7** by pattern matching and the like.

[0073] In the case where the external appearance identification part **7** is included in the shape data of the sensor unit obtained in the external appearance recognition section **101**, the sensor unit is judged "normal". In the case where the external appearance identification part **7** is not included in the shape data of the sensor unit obtained in the external appearance recognition section **101**, the sensor unit is judged "error".

[0074] In the above described embodiment, the sensor unit having a sensor element which detects the temperature of the oil such as an ATF and the like is illustrated as the sensor unit **10**. However, the sensor unit is not limited to the temperature sensor, and it may be the sensor unit, etc. having the sensor element which detects a rotation rate of a turning part (a part to be detected), and the like, for example. In addition, without departing from the spirit of the present invention, it is possible to replace the component elements in the above described embodiment with the known component parts.

DESCRIPTION OF REFERENCE CHARACTERS

[0075] **1**: Sensor element, **2**: Coupler, **3**: Body, **4**: Main body section, **4***a*: Mounting surface, **7**: External appearance identification part, **8**: First projecting portion, **9**: Second projecting portion, **10**: Sensor unit, **20**: Equipment, **20**A: Equipment with sensor unit, **25**: Assembling part, **40**: Sensor unit (Another sensor unit)

[0076] A sensor unit (for example, a sensor unit **10** in an embodiment) according to a first embodiment includes a sensor element (for example, a sensor element **1** in the embodiment) , a coupler (for example, a coupler **2** in the embodiment) being connected to the sensor element, and a body (for example, a body **3** in the embodiment) configured to support the sensor element and the coupler and to be assembled from an outside into equipment which has a part to be detected, wherein the body has an external appearance identification part (for example, an external appearance identification part **7** in the embodiment) capable of distinguishing the sensor unit from other sensor unit which has other sensor element different from the sensor element.

[0077] According to a second embodiment, the body is provided with a main body section (for example a main body section **4** in the embodiment) which has a mounting surface (for example, a mounting surface **4***a* in the embodiment) facing the equipment, and the external appearance identification part has a projecting part (for example, projecting portions **8**, **9**) which projects from the main body section when viewed from the direction perpendicular to the mounting surface.

[0078] According to a third embodiment, the projecting part includes a first projecting portion (for example, a first projecting portion **8** in the embodiment) and a second projecting portion (for example, a second projecting portion **9** in the embodiment), the first projecting portion and the second projecting portion project in the different directions from each other with respect to the main body section.

[0079] According to a fourth embodiment, equipment with a sensor unit (for example, equipment **20**A with a sensor in the embodiment) includes a sensor unit as defined in any one of embodiments 1 to 3, and equipment into which the sensor unit is assembled, wherein the equipment has an assembling part (for example, an assembling part **25** in the embodiment) into which the sensor unit is able to be assembled, the assembling part is configured such that other sensor unit instead of the sensor unit is able to be assembled into the assembling part.

[0080] According to a fifth embodiment, a sensor unit assembling method includes the steps in the sequence of installing equipment which has a part to be detected, in a predetermined assembling line, assembling the sensor unit as defined in any one of embodiments 1 to 3 into the equipment, determining the correctness of the sensor unit on the basis of existence or nonexistence of the external appearance identification part by visually inspecting the sensor unit, determining the correctness of the sensor unit on the basis of the existence or nonexistence of the external appearance identification part by obtaining shape data of the sensor unit which is assembled into the equipment and comparing this shape data with reference shape data, and removing the equipment from the assembling line.

[0081] According to a sixth embodiment the method further includes, connecting wiring to a coupler of the sensor unit which is assembled into the equipment, wherein the step of connecting the wiring is performed in a second plant (for example, a second plant F**2** in the embodiment) which is different form a first plant (for example, a first plant F**1** in the embodiment) in which the step of assembling the sensor unit into the equipment is performed.

[0082] According to the first embodiment, since the external appearance identification part capable of distinguishing the sensor unit from other sensor unit is provided, the determination of correctness can be performed by the visual inspection and the comparison of shape data with respect to the sensor unit before the process of connecting the wiring to the sensor unit. Therefore, the incorrect assembling can be detected early and accurately by two step determination.

[0083] According to the second embodiment, since the external appearance identification part has the projecting part which projects from the main body section when viewed from the direction perpendicular to the mounting surface of the body, the projecting part can be easily recognized when an operator inspects the body and assembles the body into the equipment from the direction perpendicular to the mounting surface, for example. Therefore, it is possible to improve the accuracy in determination of the correctness of the sensor unit.

[0084] According to the third embodiment, the first projecting portion and the second projecting portion project in the different directions from each other. Therefore, even if the operator inspects the sensor unit from a position in which the first projecting portion is hard to be inspected, the second projecting portion is easy to be recognized. Thus, it is possible to improve the accuracy in determination of the correctness of the sensor unit.

[0085] According to the fourth embodiment, since a plurality of sensor units can be assembled into the equipment, there are advantages that common usage, etc. can be realized, and the like. In the fourth embodiment, there is provided the sensor unit as defined in any one of the first to third features. Therefore, even if it is possible to assemble the other sensor unit into the equipment, the determination of correctness can be performed by the visual inspection and the comparison of shape data with respect to the sensor unit before the process of connecting the wiring to the sensor unit, so that the incorrect assembling can be detected early and accurately.

[0086] According to the fifth embodiment, since the determination of correctness is performed by the visual inspection and the comparison of the shape data, the incorrect assembling can be detected early and accurately.

[0087] In the case where the process of connecting the wiring is performed in the second plant which is different from the first plant in which the process of assembling the sensor unit into the equipment is performed, when the incorrect assembling of the sensor unit is recognized at the time of connecting the wiring in the second plant, the equipment has to be returned from the second plant to the first plant whereby the production efficiency is deteriorated. Particularly, when the first plant and the second plant are located in different areas, it takes a lot of time to return the equipment whereby the production efficiency is deteriorated large. In comparison with this, according to the sixth embodiment, since the incorrect assembling can be inspected in the first plant, the equipment is not required to be returned, so that the deterioration of the production efficiency can be avoided.

[0088] Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. A sensor unit comprising:

a sensor element;

a coupler being connected to the sensor element; and

a body being configured to support the sensor element and the coupler and to be assembled from an outside into equipment which has a part to be detected;

wherein the body has an external appearance identification part capable of distinguishing the sensor unit from other sensor unit which has other sensor element different from the sensor element.

2. The sensor unit according to claim **1**, wherein the body is provided with a main body section which has a mounting surface facing the equipment, and the external appearance identification part has a projecting part which projects from the main body section when viewed from the direction perpendicular to the mounting surface.

3. The sensor unit according to claim **2**, wherein the projecting part includes a first projecting portion and a second projecting portion, the first projecting portion and the second projecting portion project indifferent directions from each other with respect to the main body section.

4. Equipment with a sensor unit comprising:

a sensor unit according to claim **1**; and

equipment into which the sensor unit is assembled;

wherein the equipment has an assembling part into which the sensor unit is able to be assembled, and the assembling part is configured such that other sensor unit instead of the sensor unit is able to be assembled into the assembling part.

5. A sensor unit assembling method comprising the steps in the sequence of:

installing equipment which has a part to be detected, in a predetermined assembling line;

assembling the sensor unit according to claim **1** into the equipment;

determining the correctness of the sensor unit on the basis of existence or nonexistence of the external appearance identification part by visually inspecting the sensor unit;

determining the correctness of the sensor unit on the basis of the existence or nonexistence of the external appearance identification part by obtaining shape data of the sensor unit which is assembled into the equipment and comparing this shape data with reference shape data; and

removing the equipment from the assembling line.

6. The sensor unit assembling method according to claim **5**, further comprising, connecting wiring to a coupler of the sensor unit which is assembled into the equipment, wherein the step of connecting the wiring is performed in a second plant which is different form a first plant in which the step of assembling the sensor unit into the equipment is performed.

7. A sensor unit comprising:

a sensor;

a coupler connected to the sensor, the sensor being to be connected to an outside of the sensor unit via the coupler; and

a body supporting the sensor and the coupler, the body being to be attached to an equipment from an outside of the equipment which includes an object to be detected by the sensor, the body comprising:

an external appearance to distinguish the sensor unit from an another sensor unit which has an another sensor different from the sensor.

8. The sensor unit according to claim **7**, wherein the body is provided with a main body section which has a mounting surface facing the equipment, and the external appearance has a projecting part which projects from the main body section when viewed from a direction perpendicular to the mounting surface.

9. The sensor unit according to claim **8**, wherein the projecting part includes a first projecting portion and a second projecting portion, the first projecting portion and the second projecting portion project indifferent directions from each other with respect to the main body section.

10. An apparatus comprising:

the sensor unit according to claim **7**; and

an equipment to which the sensor unit is attached;

wherein the equipment has an assembling part into which the sensor unit is assembled, and the assembling part is configured such that an another sensor unit instead of the sensor unit is able to be assembled into the assembling part.

11. A sensor unit assembling method comprising:

assembling the sensor unit according to claim **7** into an equipment;

installing the equipment in a predetermined assembling line;

determining the correctness of the sensor unit based on existence or nonexistence of the external appearance by visually inspecting the sensor unit;

determining the correctness of the sensor unit based on the existence or nonexistence of the external appearance by obtaining shape data of the sensor unit which is assembled into the equipment and comparing the shape data with reference shape data; and

removing the equipment from the assembling line.

12. The sensor unit assembling method according to claim **11**, further comprising, connecting wiring to a coupler of the sensor unit which is assembled into the equipment, wherein the step of connecting the wiring is performed in a second plant which is different form a first plant in which the step of assembling the sensor unit into the equipment is performed.

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