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## Magnet fixing implement


### Abstract

A magnet fixing implement for fixing a magnet for rotation angle detection, attached to a rotation center portion of an indicator needle of an analog meter, includes a main body, a magnet holder provided on an upper surface of the main body, and configured to hold the magnet at a rotation center of the indicator needle, a slit formed in the main body in a flat shape perpendicular to the rotation center, and configured to accommodate the rotation center portion of the indicator needle, a rotation shaft holder provided below the slit of the main body, and configured to hold a rotation shaft of the indicator needle, and an indicator needle restricting portion protruding toward an outer side from an outer peripheral edge of the main body, and configured to restrict a rotation of the indicator needle with respect to the main body.



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| **Inventors:** | **Koike; Tatsuo (Tokyo, JP)** |
| **Applicant:** | **c/o ALPS ALPINE CO., LTD.** (Tokyo, JP) |
| **Family ID:** | **1000008767191** |
| **Assignee:** | **ALPS ALPINE CO., LTD. (Tokyo, JP)** |
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*Primary Examiner:* Deherrera; Kristina M

*Assistant Examiner:* Courson; Tania

*Attorney, Agent or Firm:* IPUSA, PLLC

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## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation application of International Application No. PCT/JP2021/013542 filed on Mar. 30, 2021 and designated the U.S., which is based upon and claims priority to Japanese Patent Application No. 2020-066968, filed on Apr. 2, 2020, and Japanese Patent Application No. 2020-102578, filed on Jun. 12, 2020, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

(1) The present disclosure relates to magnet fixing implements.

2. Description of the Related Art

(2) Japanese Registered Utility Model No. 3161399 (hereinafter referred to as "Patent Document 1") proposes a magnet fixing implement, attached to a rotation center portion of an indicator needle of a pressure gauge, and configured to hold a magnet for detecting a rotation angle of the indicator needle.

(3) However, because the magnet fixing implement proposed in Patent Document 1 has a cover located above the magnet, it is difficult to reduce a thickness of the magnet fixing implement, and it is not possible to install the magnet fixing implement when a gap between the indicator needle and a transparent plate of the pressure gauge is narrow. Moreover, the magnet fixing implement proposed in Patent Document 1 cannot be installed for general purpose use with respect to indicator needles having various sizes, because the dimensions of each part need to be adapted to the indicator needle having a particular size.

(4) In addition, because the technique proposed in Patent Document 1 requires the provision of a replacement transparent plate having the same external shape as the transparent plate of the pressure gauge, additional costs, such as the cost of components, the cost of molds, or the like, become additionally required for this provision of the replacement transparent plate. Moreover, because the technique proposed in Patent Document 1 requires the provision of the replacement transparent plate according to an outer diameter of a meter, it is not possible to easily adapt to a plurality of kinds of meters having different outer diameters. Further, a conventional method determines a center position of an analog meter, and attaches a magnetic sensor to the center position, but there is a problem in that this method is troublesome to perform.

SUMMARY OF THE INVENTION

(5) According to one aspect of the present disclosure, a magnet fixing implement for fixing a magnet for rotation angle detection, attached to a rotation center portion of an indicator needle of an analog meter, includes a main body; a magnet holder provided on an upper surface of the main body, and configured to hold the magnet at a rotation center of the indicator needle; a slit formed in the main body in a flat shape perpendicular to the rotation center, and configured to accommodate the rotation center portion of the indicator needle; a rotation shaft holder provided below the slit of the main body, and configured to hold a rotation shaft of the indicator needle; and an indicator needle restricting portion protruding toward an outer side from an outer peripheral edge of the main body, and configured to restrict a rotation of the indicator needle with respect to the main body.

(6) According to another aspect of the present disclosure, a positioning device for positioning a sensor unit with respect to a center of a front surface of a generally circular and transparent cover member covering a display surface of an analog meter, includes a pair of clamping members provided to oppose each other in a first direction, and configured to clamp an outer peripheral surface of an outer frame of the cover member; a rack extending in the first direction, and configured to link the pair of clamping members so that a separation distance of the pair of clamping members is adjustable; a center block positioned on a back surface side of the cover

member at an intermediate position of the pair of clamping members, regardless of the separation distance of the pair of clamping members; and a positioning member positioned on the front surface side at the intermediate position of the pair of clamping members, regardless of the separation distance of the pair of clamping members, and configured to position the sensor unit with respect to the center of the front surface of the cover member.
(7) Other objects and further features of the present invention will be apparent from the following detailed description when read in conjunction with the accompanying drawings.

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## Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a perspective view of an external appearance of a magnet fixing implement according to a first embodiment;
(2) FIG. **2** is a plan view of the magnet fixing implement according to the first embodiment;
(3) FIG. **3** is a side view of the magnet fixing implement according to the first embodiment;
(4) FIG. **4** is a front view of the magnet fixing implement according to the first embodiment;
(5) FIG. **5** is a bottom view of the magnet fixing implement according to the first embodiment;
(6) FIG. **6** is a perspective cross sectional view illustrating a cross section of the magnet fixing implement according to the first embodiment along a section line A-A;
(7) FIG. **7** is a disassembled perspective view of a structure according to the first embodiment;
(8) FIG. **8** is a diagram for explaining a method of attaching the magnet fixing implement according to the first embodiment;
(9) FIG. **9** is a diagram for explaining the method of attaching the magnet fixing implement according to the first embodiment;
(10) FIG. **10** is a diagram for explaining a method of attaching a magnet according to the first embodiment;
(11) FIG. **11** is a diagram for explaining the method of attaching the magnet according to the first embodiment;
(12) FIG. **12** is a cross sectional view of the structure illustrated in FIG. **11** along a line A-A;
(13) FIG. **13** is a diagram for explaining an operation of fitting a long needle of an indicator needle with respect to the magnet fixing implement according to the first embodiment;
(14) FIG. **14** is a diagram for explaining the operation of fitting the long needle of the indicator needle with respect to the magnet fixing implement according to the first embodiment;
(15) FIG. **15** is a diagram illustrating an example of a configuration of a rotation angle detection system according to the first embodiment;
(16) FIG. **16** is a perspective view of an external appearance of the positioning device according to a second embodiment viewed from above;
(17) FIG. **17** is a perspective view of the external appearance of the positioning device according to the second embodiment viewed from below;
(18) FIG. **18** is a plan view illustrating an example of an installation of a sensor unit to an analog meter according to the second embodiment;
(19) FIG. **19** is a side view illustrating the example of the installation of the sensor unit to the analog meter according to the second embodiment; and
(20) FIG. **20** is a diagram illustrating an extension example of the positioning device according to the second embodiment.
DESCRIPTION OF THE PREFERRED EMBODIMENTS
First Embodiment
(21) Hereinafter, a first embodiment will be described with reference to the drawings.
Configuration of Magnet Fixing Implement **100**

(22) FIG. **1** is a perspective view of an external appearance of a magnet fixing implement **100** according to a first embodiment. FIG. **2** is a plan view of the magnet fixing implement **100** according to the first embodiment. FIG. **3** is a side view of the magnet fixing implement **100** according to the first embodiment. FIG. **4** is a front view of the magnet fixing implement **100** according to the first embodiment. FIG. **5** is a bottom view of the magnet fixing implement **100** according to the first embodiment. FIG. **6** is a perspective cross sectional view illustrating a cross section of the magnet fixing implement **100** according to the first embodiment along a section line A-A (refer to FIG. **3**).
(23) The magnet fixing implement **100** illustrated in FIG. **1** through FIG. **6** is a member having a relatively thin and generally disk-shaped main body **100**A. In order to fix a disk-shaped magnet **20** for detecting a rotation angle (refer to FIG. **7** through FIG. **9**), with respect to a rotation center portion **30**A (a portion where a rotation shaft **32** is provided) of an indicator needle **30** (refer to FIG. **7** through FIG. **9**) of an analog meter, the magnet fixing implement **100** is attached to the rotation center portion **30**A of the indicator needle **30**. The magnet fixing implement **100** is formed by an injection molding of an elastic resin material, such as a polypropylene (PP) resin or the like, for example. In the following description, for the sake of convenience, a direction along a rotation center AX**2** of the rotation shaft **32** is regarded as an up-down direction or a Z-axis direction, a length direction of a long needle portion **36** of the indicator needle **30** is regarded as a front-rear direction or an X-axis direction, and a width direction of the long needle portion **36** of the indicator needle **30** is regarded as a left-right direction or a Y-axis direction.
(24) As illustrated in FIG. **1** through FIG. **6**, the main body **100**A of the magnet fixing implement **100** is formed with a slit **102** having a constant height range and parallel with respect to an XY-plane, at a center portion along the up-down direction (the Z-axis direction). The slit **102** is a portion that accommodates a portion of the indicator needle **30** centered about the rotation center AX**2**. The slit **102** has an opening **102**A at an end on a positive side of the Y-axis. Hence, it is possible to slide and insert the rotation center portion **30**A of the indicator needle **30** into the slit **102** from the opening **102**A. A top surface **102**B and a bottom surface **102**C of the opening **102**A have a tapered shape, and are sloped so that the height range of the opening **102**A gradually increases toward an outer side (positive side of the Y-axis). Accordingly, the rotation center portion **30**A of the indicator needle **30** can easily be inserted into the slit **102** from the opening **102**A. The slit **102** is formed in the main body **100**A of the magnet fixing implement **100**, and an upper wall portion **110** forms an upper side (positive side of the Z-axis) of the slit **102**, while a lower wall portion **120** forms a lower side (negative side of the Z-axis) of the slit **102**. Each of the upper wall portion **110** and the lower wall portion **120** is parallel with respect to the XY-plane and has a thin plate shape.
(25) In the upper wall portion **110**, a cutout upper slide groove **111** extending in the left-right direction (Y-axis direction) is formed with a constant width in the front-rear direction (X-axis direction) from an end on the left side (positive side of the Y-axis) toward a center AX**1**, at a center portion along the front-rear direction (X-axis direction). The upper slide groove **111** is formed so that a cylindrical portion **34** (refer to FIG. **7** and FIG. **8**), projecting upward at the rotation center portion **30**A of the indicator needle **30**, does not interfere with the upper wall portion **110** when sliding the indicator needle **30** into the slit **102**. For this reason, the width of the upper slide groove **111** in the front-rear direction (X-axis direction) is larger than a diameter of the cylindrical portion **34**.
(26) In addition, an annular magnet holder **112** having a constant height is formed on an upper surface of the upper wall portion **110**. The magnet holder **112** is a portion for holding the disk-shaped magnet **20** on an inner side thereof. The height of the magnet holder **112** from the upper surface of the upper wall portion **110** is approximately the same size as a thickness of the magnet **20**, and an inner diameter of the magnet holder **112** is approximately the same size as an outer diameter of the magnet **20**. Thus, the magnet holder **112** has a minimum required size, and

contributes to size reduction of the main body **100**A. An inner peripheral edge **112**A (that is, an upper opening) at an upper end of the magnet holder **112** has an inner diameter slightly smaller than a maximum outer diameter of the magnet **20**. For this reason, the magnet **20** can be pushed into the magnet holder **112** from above, to fit the magnet **20** in the magnet holder **112** while pressing and spreading the inner peripheral edge **112**A. Further, the magnet holder **112** can hold the magnet **20**, so that the inner peripheral edge **112**A prevents the magnet **20** from easily falling off.
(27) In the lower wall portion **120**, a cutout guide **121** extending in the left-right direction (Y-axis direction) is formed from an end on the left side (positive side of the Y-axis) toward the center AX**1**, at the center portion along the front-rear direction (X-axis direction). The guide **121** is formed to prevent the rotation shaft **32** (refer to FIG. **7**) of the indicator needle **30** from interfering with the lower wall portion **120** and to guide the rotation shaft **32** to the rotation shaft holder **122**, when sliding the indicator needle **30** into the slit **102**. For this reason, a width of the guide **121** in the front-rear direction (X-axis direction) is larger than a diameter of the rotation shaft **32** excluding the rotation shaft holder **122** and a rotation shaft restricting portion **124**.
(28) The rotation shaft holder **122** for holding the rotation shaft **32** that is disposed to project downward at the rotation center portion **30**A of the indicator needle **30**, is formed at the center AX**1** of the guide **121**. The rotation shaft holder **122** has a circular shape in a plan view viewed from above. The inner diameter of the rotation shaft holder **122** is smaller than the diameter of the rotation shaft **32**.
(29) The rotation shaft restricting portion **124** for restricting the rotation shaft **32** from falling off the rotation shaft holder **122**, is formed at an entrance of the rotation shaft holder **122** of the guide **121**. A width of the rotation shaft restricting portion **124** is smaller than the diameter of the rotation shaft **32**, and is also smaller than the diameter of the rotation shaft holder **122**.
(30) In this case, the guide **121** is a space sandwiched between a first elastic beam **123**A provided on the front side (positive side of the X-axis) of the guide **121**, and a second elastic beam **123**B provided on the rear side (negative side of the X-axis) of the guide **121**. That is, a wall surface on the front side (positive side of the X-axis) of the guide **121** is formed on the first elastic beam **123**A, and a wall surface on the rear side (negative side of the X-axis) of the guide **121** is formed on the second elastic beam **123**B.
(31) The first elastic beam **123**A and the second elastic beam **123**B are elastically deformable in the front-rear direction (X-axis direction), and both ends thereof in the left-right direction (Y-axis direction) are supported by the lower wall portion **120**.
(32) Accordingly, when the rotation shaft **32** is caused to slide inside the guide **121** toward the rotation shaft holder **122**, the magnet fixing implement **100** according to the first embodiment can fit the rotation shaft **32** into the rotation shaft holder **122** while pressing and spreading the rotation shaft restricting portion **124** by the rotation shaft **32**.
(33) In this state, the magnet fixing implement **100** according to the first embodiment can press and spread the rotation shaft holder **122** by the rotation shaft **32**, and adjust the size according to the diameter of the rotation shaft **32**. Hence, the magnet fixing implement **100** according to the first embodiment can positively hold the rotation shaft **32** by the rotation shaft holder **122**, without generating play between the rotation shaft holder **122** and the rotation shaft **32**.
(34) In addition, the rotation shaft holder **122** can hold the rotation shaft **32** in correspondence with various diameters of the rotation shaft **32**, because the diameter thereof about the center AX**1** is variable due to the elastic deformation of the first elastic beam **123**A and the second elastic beam **123**B.
(35) Further, the magnet fixing implement **100** according to the first embodiment can prevent the rotation shaft **32** held by the rotation shaft holder **122** from easily falling out from the rotation shaft holder **122**, by the rotation shaft restricting portion **124** provided at the entrance of the rotation shaft holder **122**.
(36) Both the center of the rotation shaft holder **122** and the center of the magnet holder **112**

coincide with the center AX**1** of the magnet fixing implement **100**. Moreover, the center of the rotation shaft holder **122** coincides with a rotation center AX**2** of the rotation shaft **32**, regardless of the diameter of the rotation shaft **32**. For this reason, the magnet fixing implement **100** according to the first embodiment can align the rotation center AX**2** of the rotation shaft **32** to coincide with the center AX**1** of the magnet fixing implement **100**, that is, the center of the magnet **20**, regardless of the diameter of the rotation shaft **32**. Accordingly, the magnet fixing implement **100** according to the first embodiment can reduce axial runout of the magnet **20** caused by the rotation of the rotation shaft **32**.

(37) In addition, the magnet fixing implement **100** protrudes to the outer side (X-axis direction) from the outer peripheral edge of the main body **100**A (upper wall portion **110**), and is provided with an indicator needle restricting portion **130** that restricts the rotation of the indicator needle **30** with respect to the main body **100**A (upper wall portion **110**).

(38) More particularly, the indicator needle restricting portion **130** includes a protrusion **131** protruding frontward (positive direction of the X-axis) that is a longitudinal direction of the long needle portion **36** of the indicator needle **30**, from the outer peripheral edge of the front side (positive side of the X-axis) of the upper wall portion **110**, and a tongue **132** extending rightward (negative direction of the Y-axis) that is a width direction of the long needle portion **36** of the indicator needle **30**, from an upper surface of the protrusion **131**. The tongue **132** is elastically deformable in a direction (Z-axis direction) parallel to the rotation center AX**2**, and can press down on the long needle portion **36** of the indicator needle **30** disposed below the tongue **132** from above the long needle portion **36**.

(39) In addition, the tongue **132** is provided with an inclination from the protrusion **131**, so that a gap **130**A between the tongue **132** and the protrusion **131** gradually widens toward a downward direction (negative direction of the Z-axis). Thus, the indicator needle restricting portion **130** can hold both ends in the width direction of the long needle portion **36** of the indicator needle **30** disposed in the gap **130**A, by a first contact surface **131**A of the protrusion exposed at the gap **130**A, and a second contact surface **132**A of the tongue **132** exposed at the gap **130**A.

Configuration of Structure **10**

(40) FIG. **7** is a disassembled perspective view of a structure **10** according to the first embodiment. As illustrated in FIG. **7**, the structure **10** according to the first embodiment includes the magnet fixing implement **100**, the magnet **20**, and the indicator needle **30**. The magnet fixing implement **100** is attached to the indicator needle **30**, by inserting the indicator needle **30** into the slit **102** so that the center AX**1** of the magnet fixing implement **100** coincides with the rotation center AX**2** of the rotation shaft **32** of the indicator needle **30**.

(41) The magnet **20** is attached to the magnet holder **112** of the magnet fixing implement **100**, in order to detect the rotation angle of the indicator needle **30**. By attaching the magnet **20** to the magnet holder **112**, a center **20**A of the magnet **20** coincides with the center AX**1** of the magnet fixing implement **100**. The magnet **20** has a thin disk shape. In the plan view, the magnet **20** is magnetized to the N pole and the S pole on respective sides of a boundary line **20**B passing through the center **20**A of the magnet **20**.

Method of Assembling Structure **10**

(42) Next, a method of assembling the structure **10** according to the first embodiment will be described, with reference to FIG. **8** through FIG. **12**. FIG. **8** and FIG. **9** are diagrams for explaining a method of attaching the magnet fixing implement **100** according to the first embodiment. FIG. **10** and FIG. **11** are diagrams for explaining a method of attaching the magnet **20** according to the first embodiment. FIG. **12** is a cross sectional view of the structure **10** illustrated in FIG. **11** along a line A-A.

(43) First, as illustrated in FIG. **8**, the rotation center portion **30**A of the indicator needle **30** is inserted into the slit **102** from the opening **102**A formed on the magnet fixing implement **100** on the positive side of the Y-axis, and caused to slide inside the slit **102** in the negative direction of the Y-

axis. In this state, the rotation shaft **32** of the indicator needle **30** is caused to slide in the negative direction of the Y-axis inside the guide **121** between the first elastic beam **123**A and the second elastic beam **123**B. Moreover, in this case, the cylindrical portion **34** of the indicator needle **30** is caused to slide in the negative direction of the Y-axis inside the upper slide groove **111** formed in the upper wall portion **110**.

(44) Further, when the rotation shaft **32** of the indicator needle **30** abuts the rotation shaft restricting portion **124** having a width narrower than the rotation shaft **32** inside the guide **121**, the rotation center portion **30**A of the indicator needle **30** is pressed further in the negative direction of the Y-axis. Hence, the rotation shaft **32** of the indicator needle **30** can be fitted into the rotation shaft holder **122** while pressing and spreading the rotation shaft restricting portion **124** by the rotation shaft **32** of the indicator needle **30**.

(45) As a result, as illustrated in FIG. **9**, the magnet fixing implement **100** is attached to the indicator needle **30** so that the center AX**1** of the magnet fixing implement **100** coincides with the rotation center AX**2** of the rotation shaft **32** of the indicator needle **30**.

(46) In addition, by performing the operation of fitting the rotation shaft **32** into the rotation shaft holder **122**, it is possible to simultaneously perform an operation of fitting the indicator needle **30** that will be described later. Hence, as illustrated in FIG. **9**, the long needle portion **36** of the indicator needle **30** is fitted into the gap **130**A of the indicator needle restricting portion **130** projecting frontward (positive direction of the X-axis) from the main body **100**A of the magnet fixing implement **100**. As a result, the rotation of the indicator needle **30** with respect to the main body **100**A of the magnet fixing implement **100** is restricted.

(47) Moreover, as illustrated in FIG. **10** and FIG. **11**, the magnet **20** for rotation angle detection is fitted into the magnet holder **112** of the magnet fixing implement **100**. Thus, as illustrated in FIG. **11**, in the magnet fixing implement **100**, the magnet **20** is attached to the magnet holder **112**, so that the center AX**1** of the magnet fixing implement **100**, the rotation center AX**2** of the rotation shaft **32** of the indicator needle **30**, and the center of the magnet **20** for rotation angle detection coincide with one another.

(48) Although the magnet **20** for rotation angle detection is fitted into the magnet holder **112** of the magnet fixing implement **100** after the operation of fitting the rotation shaft **32** of the indicator needle **30** into the rotation shaft holder **122** in the example described above, an operation sequence may fit the magnet **20** for rotation angle detection into the magnet holder **112** of the magnet fixing implement **100** before the operation of fitting the rotation shaft **32** of the indicator needle **30** into the rotation shaft holder **122**.

(49) As illustrated in FIG. **12**, the height of the magnet holder **112** is approximately the same size as the thickness of the magnet **20**, and the inner diameter of the magnet holder **112** is approximately the same size as the outer diameter of the magnet **20**. Hence, the magnet holder **112** has the minimum required size, and contributes to size reduction of the main body **100**A.

(50) Further, as illustrated in FIG. **12**, the inner peripheral edge **112**A (that is, the upper opening) at the upper end of the magnet holder **112** has the inner diameter slightly smaller than the maximum outer diameter of the magnet **20**. For this reason, the magnet **20** can be pushed into the magnet holder **112** from above, to fit the magnet **20** in the magnet holder **112** while pressing and spreading the inner peripheral edge **112**A. In addition, the magnet holder **112** can hold the magnet **20**, so that the inner peripheral edge **112**A prevents the magnet **20** from easily falling off. More particularly, because the inner peripheral edge **112**A is shaped to hold a curved rim of an outer periphery of the magnet **20**, the magnet holder **112** does not require a cover for covering the magnet **20**, and thus, the height of the magnet holder **112** is the same as the thickness of the magnet **20**. Accordingly, both the thickness and the size of the magnet fixing implement **100** according to the first embodiment can be made small. For example, in the present embodiment, the thickness of the magnet **20** is 1 mm, and the diameter of the magnet **20** is 20 mm. On the other hand, the thickness of the magnet fixing implement **100** is approximately 3 mm, and the length of one side of the

magnet fixing implement **100** is approximately 23 mm.

(51) Various magnets **20** having different diameters and thicknesses can be attached to the magnet fixing implement **100** according to the first embodiment, by varying the shape of the magnet holder **112**.

Operation of Fitting Long Needle Portion **36** of Indicator Needle **30**

(52) FIG. **13** and FIG. **14** are diagrams for explaining an operation of fitting the long needle portion **36** of the indicator needle **30** with respect to the magnet fixing implement **100** according to the first embodiment.

(53) As illustrated in FIG. **13**, when an operation is performed to slide the rotation center portion **30**A of the indicator needle **30** inside the slit **102** in the negative direction of the Y-axis, and fit the rotation shaft **32** of the indicator needle **30** into the rotation shaft holder **122**, the long needle portion **36** of the indicator needle **30** abuts an inclined bottom surface **131**B of the protrusion **131** of the indicator needle restricting portion **130** provided to protrude frontward (positive direction of the X-axis) from the main body **100**A of the magnet fixing implement **100**.

(54) In this state, when the rotation center portion **30**A of the indicator needle **30** is caused to further slide inside the slit **102** in the negative direction of the Y-axis, the long needle portion **36** of the indicator needle **30** moves in the negative direction of the Y-axis while being elastically deformed along the bottom surface **131**B.

(55) Then, when the long needle portion **36** of the indicator needle **30** rides over the bottom surface **131**B, the long needle portion **36** of the indicator needle **30** pushes the tongue **132** of the indicator needle restricting portion **130** upward, and becomes disposed in the gap **130**A between the tongue **132** and the protrusion **131**, as illustrated in FIG. **14**.

(56) Accordingly, as illustrated in FIG. **14**, both ends in the width direction (Y-axis direction) of the long needle portion **36** of the indicator needle **30** are held by the first contact surface **131**A of the protrusion **131** exposed at the gap **130**A, and the second contact surface **132**A of the tongue **132** exposed at the gap **130**A.

(57) Because the width and height position of the gap **130**A are variable due to the elastic deformation of the tongue **132**, the indicator needle restricting portion **130** can hold both ends in the width direction of the long needle portion **36** in correspondence with the various widths and thicknesses of the long needle portion **36**.

Example of Configuration of Rotation Angle Detection System **200**

(58) FIG. **15** is a diagram illustrating an example of a configuration of a rotation angle detection system **200** according to the first embodiment. As illustrated in FIG. **15**, the rotation angle detection system **200** includes an analog meter **210**, a rotation angle detection device **220**, and a rotation angle transmitter **230**.

(59) The analog meter **210** includes the indicator needle **30**, and a glass lid **211**. The magnet fixing implement **100** described in the embodiment is attached to the indicator needle **30** of the analog meter **210**. The analog meter **210** is a water meter, a power meter, a gas meter, or the like, for example.

(60) The rotation angle detection device **220** is attached to a center (that is, the rotation center AX**2** of the indicator needle **30**) of a surface of the glass lid **211**. The rotation angle detection device **220** magnetically detects a rotation angle of the indicator needle **30**, using a rotation angle detecting sensor (not illustrated) disposed at a position opposing the magnet **20** attached to the magnet fixing implement **100**. In addition, the rotation angle detection device **220** transmits a rotation angle detection signal indicating the detected rotation angle to the rotation angle transmitter **230**, via a cable or wireless communication (for example, BLUETOOTH™ wireless communication). For example, the rotation angle detection device **220** successively detects the rotation angle of the indicator needle **30** at predetermined time intervals (for example, n second intervals), and successively transmits the rotation angle detection signal to the rotation angle transmitter **230** at predetermined time intervals (for example, n second intervals).

(61) The rotation angle transmitter **230** receives the rotation angle detection signal transmitted from the rotation angle detection device **220**, and performs a predetermined process (for example, monitoring display, abnormal detection, recording, data transmission to other devices, or the like), using the rotation angle of the indicator needle **30** indicated by the rotation angle detection signal. For example, the rotation angle transmitter **230** transmits the rotation angle detection signal indicating the detected rotation angle to a gateway or cloud, via wireless communication (for example, BLUETOOTH™ wireless communication, SIGFOX™ wireless communication).
(62) In addition, the rotation angle detection device **220** may be supplied with power from a battery of the rotation angle transmitter **230** via a cable, for example. In this case, a configuration associated with the rotation angle detecting sensor of the rotation angle detection device **220** can be minimized, and the rotation angle detection device **220** can be configured to have a small size.
(63) As described above, the magnet fixing implement **100** according to the first embodiment, that is, the magnet fixing implement **100** for fixing the disk-shaped magnet **20** for detecting the rotation angle, attached to the rotation center portion **30**A of the indicator needle **30** of the analog meter, includes the main body **100**A, the magnet holder **112** provided on the upper surface of the main body **100**A and configured to hold the magnet **20** on the rotation center AX**2** of the indicator needle **30** in a state perpendicular to the rotation center AX**2**, the slit **102** formed in the main body **100**A in a flat shape perpendicular to the rotation center AX**2** and configured to accommodate the rotation center portion **30**A of the indicator needle **30**, the rotation shaft holder **122** provided below the slit **102** of the main body **100**A and configured to hold the rotation shaft **32** of the indicator needle **30**, and the indicator needle restricting portion **130** protruding toward the outer side from the outer peripheral edge of the main body **100**A and configured to restrict the rotation of the indicator needle **30** with respect to the main body **100**A.
(64) Thus, the magnet fixing implement **100** according to the first embodiment can fix the magnet **20** to the rotation center portion **30**A of the indicator needle **30**, in a state where the center of the magnet **20** coincides with the rotation center AX**2** of the indicator needle **30**, by simply attaching the magnet **20** to the rotation center portion **30**A of the indicator needle **30**, with respect to the various indicator needles **30** having the rotation shafts **32** with different diameters or the like. Further, because the magnet **20** is held on the upper surface of the main body **100**A, the magnet fixing implement **100** according to the first embodiment does not require a cover for covering the upper surface of the magnet **20**, and the main body **100**A can be made thin. Hence, the magnet fixing implement **100** according to the first embodiment can provide the thin magnet fixing implement **100** for general purpose use, capable of easily and positively fix the magnet **20** to the rotation center portion **30**A of the indicator needle **30** in a state where the center of the magnet **20** coincides with the rotation center AX**2** of the indicator needle **30**.
(65) In addition, in the magnet fixing implement **100** according to the first embodiment, the main body **100**A includes the first elastic beam **123**A and the second elastic beam **123**B disposed below the slit **102** and opposing each other, the rotation shaft holder **122** is provided between the first elastic beam **123**A and the second elastic beam **123**B, and the rotation shaft **32** is held by sandwiching the rotation shaft **32** between the first elastic beam **123**A and the second elastic beam **123**B.
(66) Hence, the magnet fixing implement **100** according to the first embodiment can align the center of the magnet **20** to coincide with the rotation center AX**2** of the indicator needle **30**, by simply holding the rotation shaft **32** by the rotation shaft holder **122**, regardless of the diameter of the rotation shaft **32**.
(67) Moreover, in the magnet fixing implement **100** according to the first embodiment, the main body **100**A includes the guide **121** extending between the first elastic beam **123**A and the second elastic beam **123**B so that the width thereof gradually decreases from the outer peripheral edge of the main body **100**A toward the rotation shaft holder **122**, and configured to guide the rotation shaft **32** to the rotation shaft holder **122**.

(68) Accordingly, the magnet fixing implement **100** according to the first embodiment can easily and positively attach the rotation shaft **32** with respect to the rotation shaft holder **122**.
(69) Further, in the magnet fixing implement **100** according to the first embodiment, the indicator needle restricting portion **130** includes the protrusion **131** protruding from the outer peripheral edge of the main body **100**A in the longitudinal direction of the indicator needle **30**, and the tongue **132** extending from the protrusion **131** in the width direction of the indicator needle **30**, elastically deformable in the direction parallel to the rotation center AX**2**, and configured to press down on the indicator needle **30**.
(70) Thus, because the tongue **132** is elastically deformable, the magnet fixing implement **100** according to the first embodiment can adjust the height position of the tongue **132** that presses down on the indicator needle **30**, according to the various thicknesses of the indicator needle **30**.
(71) In addition, in the magnet fixing implement **100** according to the first embodiment, the tongue **132** is provided with the inclination from the protrusion **131**, so that the gap **130**A between the tongue **132** and the protrusion **131** gradually widens in the direction parallel to the rotation center AX**2**, and the indicator needle restricting portion **130** holds both ends in the width direction of the indicator needle **30** disposed in the gap **130**A, by the first contact surface **131**A of the protrusion **131** exposed at the gap **130**A and the second contact surface **132**A of the tongue **132** exposed at the gap **130**A.
(72) Accordingly, by the elastic deformation of the tongue **132**, the magnet fixing implement **100** according to the first embodiment can hold both ends of the indicator needle **30**, by adjusting the width of the gap **130**A according to the various widths of the indicator needle **30**.
(73) Further, in the magnet fixing implement **100** according to the first embodiment, the slit **102** includes the opening **102**A at the outer peripheral edge of the main body **100**A, and the rotation center portion **30**A of the indicator needle **30** can be accommodated inside the slit **102**, by sliding the rotation center portion **30**A of the indicator needle **30** into the slit **102** from the opening **102**A in the direction perpendicular to the rotation center AX**2**.
(74) As a result, the magnet fixing implement **100** according to the first embodiment can easily and positively accommodate the rotation center portion **30**A of the indicator needle **30** inside the slit **102**.
(75) Moreover, the magnet fixing implement **100** according to the first embodiment is integrally famed, using an elastic resin material.
(76) Thus, the magnet fixing implement **100** according to the first embodiment can easily and positively integrally form the portion to be elastically deformed.
(77) The magnet fixing implement **100** according to the first embodiment is formed by the injection molding of the resin material.
(78) Accordingly, the magnet fixing implement **100** according to the first embodiment can be famed with an even higher accuracy.

## Second Embodiment

(79) Hereinafter, a second embodiment will be described, with reference to the drawings.

### Configuration of Positioning Device **100**

(80) FIG. **16** is a perspective view of an external appearance of a positioning device **100** according to the second embodiment viewed from above. FIG. **17** is a perspective view of the positioning device **100** according to the second embodiment viewed from below. In the following description, for the sake of convenience, a direction perpendicular to a front surface **210**A of a cover glass **210** of an analog meter **200** is regarded as the up-down direction (Z-axis direction). In addition, the side of the front surface **210**A of the cover glass **210** is regarded as the upper side (positive side of the Z-axis), and a back surface side of the cover glass **210** is regarded as the lower side (negative side of the Z-axis).
(81) The positioning device **100** illustrated in FIG. **16** is a device for positioning a sensor unit **300** with respect to a center of the front surface **210**A of the generally circular and transparent cover

glass **210** (an example of a “cover member”) covering a display surface of the analog meter **200**.
(82) As illustrated in FIG. **16**, positioning device **100** includes a pair of clamping members **111** and **112**, two racks **121** and **122**, a pinion gear **123**, a center block **130**, a positioning plate **140**, and two pins **151** and **152**. All of the components forming the positioning device **100** are formed of a relatively hard material (for example, a resin material, a metal material).
(83) The pair of clamping members **111** and **112** is provided to oppose each other in the X-axis direction (one example of a “first direction”). The pair of clamping members **111** and **112** clamps an outer peripheral surface **212**A of an outer frame **212** of the cover glass **210** provided in the analog meter **200**. The pair of clamping members **111** and **112** is a so-called V-shaped block having support surfaces **111**A and **112**A forming a V-shape in the plan view viewed from above. The support surfaces **111**A and **112**A oppose each other. As illustrated in FIG. **16** and FIG. **17**, the pair of clamping members **111** and **112** clamps the outer peripheral surface **212**A by pressing against the outer peripheral surface **212**A of the outer frame **212** by each of the support surfaces **111**A and **112**A.
(84) In addition, the clamping member **111** includes a first through hole **111**B and a second through hole **111**C that are parallel to each other and penetrate the clamping member **111** in the X-axis direction. The first through hole **111**B is provided on the clamping member **111** on the positive side of the Y-axis, and an end of the rack **121** on the positive side of the X-axis is inserted into the first through hole **111**B. In the clamping member **111**, an inner diameter of the first through hole **111**B is reduced by tightening two screws **113** provided near the first through hole **111**B, thereby fixing the end of the rack **121** on the positive side of the X-axis. The second through hole **111**C is provided on the clamping member **111** on the negative side of the Y-axis, and an end of the rack **122** on the positive side of the X-axis is slidably inserted into the second through hole **111**C.
(85) Moreover, the clamping member **112** includes a first through hole **112**B and a second through hole **112**C that are parallel to each other and penetrate the clamping member **112** in the X-axis direction. The first through hole **112**B is provided on the clamping member **112** on the negative side of the Y-axis, and an end of the rack **122** on the negative side of the X-axis is inserted into the first through hole **112**B.
(86) In the clamping member **112**, an inner diameter of the first through hole **112**B is reduced by tightening two screws **113** provided near the first through hole **112**B, thereby fixing the end of the rack **122** on the negative side of the X-axis. The second through hole **112**C is provided on the clamping member **112** on the positive side of the Y-axis, and an end of the rack **121** on the negative side of the X-axis is slidably inserted into the second through hole **112**C.
(87) The two racks **121** and **122** are parallel to each other, and are provided to extend in the X-axis direction. The two racks **121** and **122** link the pair of clamping members **111** and **112**, so that a separation distance of the pair of clamping members **111** and **112** is adjustable. The racks **121** and **122** are both a rod-shaped member extending linearly in the X-axis direction. The two racks **121** and **122** include a plurality of rack teeth **121**A and **122**A formed continuously in the X-axis direction on inner portions of the two racks **121** and **122**, respectively.
(88) The rack **121** is provided on the positive side of the Y-axis. The end of the rack **121** on the positive side of the X-axis is fixed to the clamping member **111**, in a state where this end of the rack **121** is inserted through the first through hole **111**B of the clamping member **111**. The end of the rack **121** on the negative side of the X-axis is slidably inserted through the second through hole **112**C of the clamping member **112**.
(89) The rack **122** is provided on the negative side of the Y-axis. The end of the rack **122** on the negative side of the X-axis is fixed to the clamping member **112**, in a state where this end of the rack **122** is inserted through the first through hole **112**B of the clamping member **112**. The end of the rack **122** on the positive side of the X-axis is slidably inserted through the second through hole **111**C of the clamping member **111**.
(90) The pinion gear **123** is provided in a circular accommodating space **131** famed on the back

side of the center block **130**, between the two racks **121** and **122**. The pinion gear **123** is rotatable inside the accommodating space **131** of the center block **130**. The pinion gear **123** engages each of the rack teeth **121**A of the rack **121** and the rack teeth **122**A of the rack **122**. Hence, as the pinion gear **123** rotates, the pinion gear **123** can move the two racks **121** and **122** by the same amount in mutually different directions along the X-axis direction.

(91) More particularly, in a case where the pinion gear **123** rotates clockwise (arrow D**1**) when viewed from the bottom side as illustrated in FIG. **17**, the rack **121** is moved in the negative direction of the X-axis, and the rack **122** is moved in the positive direction of the X-axis by the same amount as the rack **121**. In this case, the clamping member **111** fixed to the rack **121**, and the clamping member **112** fixed to the rack **122**, move by the same amount in directions so as to approach each other. Thus, the center block **130** maintains a state located at an intermediate position between the pair of clamping members **111** and **112**.

(92) In contrast, in a case where the pinion gear **123** rotates counterclockwise (arrow D**2**) when viewed from the bottom side as illustrated in FIG. **17**, the rack **121** is moved in the positive direction of the X-axis, and the rack **122** is moved in the negative direction of the X-axis by the same amount as the rack **121**. In this case, the clamping member **111** fixed to the rack **121**, and the clamping member **112** fixed to the rack **122**, move by the same amount in directions so as to separate from each other. Thus, the center block **130** maintains a state located at the intermediate position between the pair of clamping members **111** and **112**.

(93) The center block **130** is a block-shaped member extending in the Y-axis direction. The center block **130** extends perpendicularly to each of the two racks **121** and **122**, and extends to outer sides of the two racks **121** and **122**, respectively. A center of the center block **130** overlaps a center of the positioning device **100**. The center of the center block **130** is always in a state overlapping the center of the positioning device **100**, regardless of variations in the separation distance of the pair of clamping members **111** and **112**. The "center of the positioning device **100**" is the intermediate position between the pair of clamping members **111** and **112** in the X-axis direction, and is the intermediate position between the two racks **121** and **122** in the Y-axis direction.

(94) As illustrated in FIG. **17**, the center block **130** includes the circular housing space **131** at the center on the back side thereof. The housing space **131** accommodates the pinion gear **123** in a state rotatable around the center of the positioning device **100**, as a rotation center thereof.

(95) In addition, the center block **130** includes a first through hole **132**A and a second through hole **132**B that are parallel to each other and penetrate the center block **130** in the X-axis direction. The first through hole **132**A is provided in the center block **130** on the positive side of the Y-axis, and the rack **121** is slidably inserted through the first through hole **132**A. The first through hole **132**A has an opening on the side of the accommodating space **131**. Hence, the rack teeth **121**A of the portion of the rack **121** inserted through the first through hole **132**A can engage the pinion gear **123**. The second through hole **132**B is provided in the center block **130** on the negative side of the Y-axis, and the rack **122** is slidably inserted through the second through hole **132**B. The second through hole **132**B has an opening on the side of the accommodating space **131**. Thus, the rack teeth **122**A of the portion of the rack **122** inserted through the second through hole **132**B can engage the pinion gear **123**.

(96) The positioning plate **140** is an example of a "positioning member". The positioning plate **140** is a flat member disposed to oppose an upper surface of the center block **130**, and extends in the Y-axis direction. The positioning plate **140** extends perpendicularly to each of the two racks **121** and **122**, and extends to the outer sides of the two racks **121** and **122**, respectively. A center of the positioning plate **140** overlaps the center of the positioning device **100**. The center of the positioning plate **140** always overlaps the center of the positioning device **100**, regardless of the variations in the separation distance of the pair of clamping members **111** and **112**.

(97) A retaining hole **141** is formed at the center of the positioning plate **140**. The retaining hole **141** has the same shape as an external shape of a protrusion **301**A of a sensor case **301** provided in

the sensor unit **300**. By fitting the protrusion **301**A of the sensor case **301** into the retaining hole **141**, the positioning plate **140** can retain the sensor unit **300** so that the center of the positioning plate **140** coincides with the center of the sensor case **301**. That is, by retaining the sensor unit **300**, the positioning plate **140** can position the magnetic sensor **302** provided at the center of the sensor unit **300**, with respect to the center of the front surface **210**A of the cover glass **210**.
(98) Moreover, the positioning plate **140** includes a groove **143** cutout from an outer peripheral edge of positioning plate **140** and reaching retaining hole **141**. The groove **143** is provided to pull a cable **303** of the sensor unit **300** from the retaining hole **141** toward the outer side of the positioning plate **140**, when removing the positioning plate **140** from the sensor unit **300** after attaching the sensor unit **300** to the front surface **210**A of the cover glass **210**.
(99) The two pins **151** and **152** engage both the center block **130** and the positioning plate **140**, to position the positioning plate **140** at the intermediate position between the pair of clamping members **111** and **112**. As described above, the center of the center block **130** is always in a state overlapping the center of the positioning device **100** (that is, the center of the front surface **210**A of the cover glass **210**), and does not depend on the variations in the separation distance of the pair of clamping members **111** and **112**. The positioning device **100** according to the present embodiment positions the positioning plate **140** with respect to center block **130**, by the two pins **151** and **152**. Hence, similar to the center block **130**, the positioning device **100** according to the present embodiment can position the center of the positioning plate **140** in the state overlapping the center of the positioning device **100** (that is, the center of the front surface **210**A of the cover glass **210**).
(100) In the present embodiment, the two pins **151** and **152** having a round rod shape are used, for example. The pin **151** is provided on the positive side of the Y-axis. A lower end of the pin **151** is fixed in a state inserted through a support hole **133**A formed in the center block **130** on the positive side of the Y-axis. An upper end of the pin **151** is inserted through a support hole **142**A formed in the positioning plate **140** on the positive side of the Y-axis. Thus, the pin **151** positions the positioning plate **140** on the positive side of the Y-axis.
(101) The pin **152** is provided on the negative side of the Y-axis. A lower end of the pin **152** is fixed in a state inserted through a support hole **133**B formed in the center block **130** on the negative side of the Y-axis. An upper end of the pin **152** is inserted through a support hole **142**B formed in the positioning plate **140** on the negative side of the Y-axis. Hence, the pin **152** positions the positioning plate **140** on the negative side of the Y-axis.
Method of Attaching Sensor Unit **300**
(102) Next, a method of attaching the sensor unit **300** using the positioning device **100** will be described.
(103) (1) First, an operator pulls the pair of clamping members **111** and **112** in directions to separate from each other, to widen the separation of the pair of clamping members **111** and **112**, and form a space for placing the cover glass **210** and the outer frame **212** on the upper surface of the center block **130**. In this case, the center of the center block **130** maintains the state coinciding with the center of the positioning device **100**.
(104) (2) Next, the operator places the cover glass **210** and the outer frame **212** on the upper surface of the center block **130**. Because the positioning device **100** according to the second embodiment can place the cover glass **210** and the outer frame **212** on the center block **130**, it is relatively easy to perform the subsequent clamping by the pair of clamping members **111** and **112**.
(105) (3) Next, the operator pushes the pair of clamping members **111** and **112** in directions to close upon each other, to narrow the separation of the pair of clamping members **111** and **112**, and cause the support surfaces **111**A and **112**A to make contact with the outer peripheral surface of the outer frame **212**. Thus, the outer frame **212** is clamped by the pair of clamping members **111** and **112** according to the outer diameter of the outer frame **212**, to align the center of the positioning device **100** to coincide with the center of the front surface **210**A of the cover glass **210**.
(106) (4) Next, the operator fits the support holes **142**A and **142**B of the positioning plate **140** over

the upper ends of the pins **151** and **152**, respectively. As a result, the center of positioning device **100**, the center of the front surface **210**A of the cover glass **210**, and the center of the positioning plate **140** coincide with one another.
(107) (5) Next, the operator peels off the releasing paper of a double-sided tape adhered to a bottom surface of the sensor case **301**, and fits the protrusion **301**A of the sensor case **301** into the retaining hole **141** of the positioning plate **140**. Thus, the center of the sensor case **301** coincides with the center of the front surface **210**A of the cover glass **210**.
(108) (6) Next, the operator presses the sensor case **301** against the front surface **210**A of the cover glass **210**. Accordingly, the sensor case **301** is fixed to the front surface **210**A of the cover glass **210**, in a state where the center of the sensor case **301** coincides with the center of the front surface **210**A of the cover glass **210**.
(109) (7) Next, the operator pulls the positioning plate **140** upward, and pulls the cable **303** from the retaining hole **141** of the positioning plate **140** through the groove **143** to the outer side of the positioning plate **140**.
(110) (8) Next, the operator removes the cover glass **210** and the outer frame **212** from the positioning device **100**, and attaches the cover glass **210** and the outer frame **212** to a case **201** of the analog meter **200**.
(111) (9) Next, the operator fixes the cover glass **210** and the outer frame **212** to each other by a fixing means, such as a transparent tape or the like, so that the cover glass **210** does not rotate.
(112) By the procedure described above, the operator can attach the sensor unit **300** to the front surface **210**A of the cover glass **210**, in the state where the center of the front surface **210**A of the cover glass **210** of the analog meter **200** coincides with the center of the sensor case **301**. Hence, the positioning device **100** according to the second embodiment can easily position the magnetic sensor **302** to the center of the analog meter **200**, with respect to a plurality of kinds of analog meters **200** having different outer diameters.
Example of Installation of Sensor Unit **300**
(113) FIG. **18** is a plan view illustrating an example of an installation of the sensor unit **300** to the analog meter **200** according to the second embodiment. FIG. **19** is a side view illustrating the example of the installation of the sensor unit **300** to the analog meter **200** according to the second embodiment. In FIG. **19**, a cross section is illustrated for the sensor unit **300**.
(114) The analog meter **200** illustrated in FIG. **18** is a water meter, a power meter, a gas meter, or the like, for example. As illustrated in FIG. **18**, the analog meter **200** includes the case **201**, a display surface **202**, an indicator needle **203**, a magnet **204**, a cover glass **210**, and the outer frame **212**. The case **201** is a cylindrical member forming the external shape of the analog meter **200**, and having a closed bottom surface. The display surface **202** is a horizontal surface facing the space above the analog meter **200**, and provided inside the case **201**. The display surface **202** has a circular shape in the plan view. A scale for representing various measured values in a stepwise manner is successively printed on the display surface **202** along a circumferential direction. The indicator needle **203** has the rotation shaft **203**A, and rotates around the rotation shaft **203**A as the rotation center thereof, to point and indicate a value of the scale printed on the display surface **202** according to various measured values. The magnet **204** has a disk shape, and is attached to the rotation center of the indicator needle **203**. In the plan view, the magnet **204** is magnetized to the N pole and the S pole on respective sides of a boundary line passing through a center of the magnet **204**. The cover glass **210** is an example of a “generally circular and transparent cover member”, and is a transparent and disk-shaped glass member covering the display surface **202**. The “generally circular and transparent cover member” is not limited to glass, and may be made of a resin. The outer frame **212** is a circular picture-frame-shaped member fitted into and attached to an edge of an opening in an upper side (positive side of the Z-axis) of the case **201**. The outer frame **212** holds an outer peripheral edge of the cover glass **210** disposed on the inner side thereof.
(115) As illustrated in FIG. **18** and FIG. **19**, the sensor unit **300** is attached to the center of the front

surface **210**A of the cover glass **210** (that is, the rotation center of the indicator needle **203**) provided in the analog meter **200**, using the positioning device **100**. The magnet **204** is provided at the center inside the sensor case **301** of the sensor unit **300**, facing the analog meter **200** (negative side of the Z-axis). The magnetic sensor **302** opposes the magnet **204** attached to the rotation center of the indicator needle **203** of the analog meter **200**, by attaching the sensor unit **300** to the center of the front surface **210**A of the cover glass **210**. Hence, the magnetic sensor **302** can magnetically detect the rotation angle of the indicator needle **203**. Further, the sensor unit **300** transmits the rotation angle detection signal indicating the rotation angle detected by the magnetic sensor **302** to the rotation angle transmitter **230**, via the cable **303** and a wireless communication device **220**. For example, the sensor unit **300** successively detects the rotation angle of the indicator needle **203** at predetermined time intervals (for example, n second intervals), and successively transmits the rotation angle detection signal to the rotation angle transmitter **230** at predetermined time intervals (for example, n second intervals).

(116) The rotation angle transmitter **230** receives the rotation angle detection signal transmitted from the sensor unit **300**, and performs a predetermined process (for example, monitoring display, abnormal detection, recording, data transmission to other devices, or the like), using the rotation angle of the indicator needle **203** indicated by the rotation angle detection signal. For example, the rotation angle transmitter **230** transmits the rotation angle detection signal indicating the detected rotation angle to a gateway or cloud, via wireless communication (for example, BLUETOOTH™ wireless communication, SIGFOX™ wireless communication).

Extension Example of Positioning Device **100**

(117) FIG. **20** is a diagram illustrating an extension example of the positioning device **100** according to the second embodiment. In the extension example illustrated in FIG. **20**, the positioning device **100** further includes a pair of V-shaped adapters **161** and **162**. The pair of V-shaped adapters **161** and **162** is attached to the support surfaces **111**A and **112**A of the pair of clamping members **111** and **112**, so that each of the V-shaped support surfaces **161**A and **162**A can reduce a minimum diameter of the outer frame clampable by the pair of clamping members **111** and **112**.

(118) According to the present disclosure, it is possible to provide a magnet fixing implement for general purpose use, that can easily and positively fix a magnet to a rotation center portion of an indicator needle, in a state where a center of the magnet coincides with a rotation center of the indicator needle.

(119) In addition, according to the present disclosure, a positioning device can easily position a magnetic sensor at a center of a meter, with respect to a plurality of kinds of meters having different outer diameters.

(120) In the present specification, “generally circular” of “generally circular and transparent cover member” is not limited to a perfect circular shape, and may include cases where a protrusion, an irregularity, a cutout, or the like is provided in a portion of the circular shape. In other words, the “cover member” may have any shape that enables the “sensor unit” to be positioned at the center by the “positioning device”.

(121) Although the embodiments are numbered with, for example, “first,” or “second,” the ordinal numbers do not imply priorities of the embodiments. Many other variations and modifications will be apparent to those skilled in the art.

(122) While embodiments of the present invention are described in detail above, the present invention is not limited to these embodiments, and various variations and modifications may be made within the scope of the present invention as recited in the claims.

## Claims

1. A magnet fixing implement for fixing a magnet for rotation angle detection, attached to a rotation center portion of an indicator needle of an analog meter, comprising: a main body; a magnet holder provided on an upper surface of the main body, and configured to hold the magnet above the indicator needle; a slit formed in the main body in a flat shape perpendicular to a rotation center of the indicator needle, and configured to accommodate the rotation center portion of the indicator needle; a rotation shaft holder provided below the slit of the main body, and configured to hold a rotation shaft of the indicator needle; and an indicator needle restricting portion protruding toward an outer side from an outer peripheral edge of the main body, and configured to restrict a rotation of the indicator needle with respect to the main body.
2. The magnet fixing implement as claimed in claim 1, wherein the slit includes an opening at the outer peripheral edge of the main body, and the rotation center portion of the indicator needle is accommodatable inside the slit, by sliding the rotation center portion of the indicator needle into the slit from the opening in the direction perpendicular to the rotation center.
3. The magnet fixing implement as claimed in claim 1, which is made of an elastic resin material.
4. The magnet fixing implement as claimed in claim 1, wherein the main body includes a first elastic beam and a second elastic beam disposed below the slit and to oppose each other, and the rotation shaft holder is provided between the first elastic beam and the second elastic beam, and holds the rotation shaft by sandwiching the rotation shaft between the first elastic beam and the second elastic beam.
5. The magnet fixing implement as claimed in claim 4, wherein the main body includes a guide extending between the first elastic beam and the second elastic beam so that a width thereof gradually decreases from the outer peripheral edge of the main body toward the rotation shaft holder, and configured to guide the rotation shaft to the rotation shaft holder.
6. The magnet fixing implement as claimed in claim 1, wherein the indicator needle restricting portion includes a protrusion protruding from the outer peripheral edge of the main body in a longitudinal direction of the indicator needle, and a tongue extending from the protrusion in a width direction of the indicator needle, elastically deformable in a direction parallel to the rotation center, and configured to press down on the indicator needle.
7. The magnet fixing implement as claimed in claim 6, wherein the tongue is provided with an inclination from the protrusion, so that a gap between the tongue and the protrusion gradually widens in the direction parallel to the rotation center, and the indicator needle restricting portion holds both ends in the width direction of the indicator needle disposed in the gap, by a first contact surface of the protrusion exposed at the gap and a second contact surface of the tongue exposed at the gap.
8. The magnet fixing implement as claimed in claim 1, which is integrally formed, using an elastic resin material.
9. The magnet fixing implement as claimed in claim 8, which is formed by an injection molding of the resin material.