

# WIRE ROPE FLAW DETECTION APPARATUS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

[0001]

The present invention relates to a wire rope flaw detection apparatus suitable for detecting a flaw of a wire rope which is formed out of a plurality of twisted steel wires and which is used for suspending an elevator cage, a balance weight, etc.

### 2. Description of the Background Art

[0002]

In a machine using a wire rope, a structure is generally coupled to an end portion of the wire rope. For example, in an elevator, an elevator cage or a balance weight is coupled to an end portion of the wire rope. Alternatively, a socket for fixing an end portion of the wire rope and a building to each other is attached.

[0003]

In this manner, wire ropes for use in various machines including elevators have a structure in which strands constituted by steel wires are twisted. When such a wire rope is used for a long period of time, strands suffer a load repeatedly due to bending and tension in a portion where the strands are wrapped around a sheave or a pulley. For this reason, the strands may be worn out and broken. A standard for wire rope replacement

has been therefore set in JIS based on the number of broken strands. As a method for inspecting the condition of a flaw in the strands, there is a magnetic flux leakage testing method. The magnetic flux leakage testing method is a method in which a wire rope is magnetized in its longitudinal direction and magnetic flux leaking from a broken strand portion, that is, a flaw portion is detected by a magnetic sensor so as to examine the existence of breaking. Accordingly, any wire rope flaw detection apparatus to which the magnetic flux leakage testing method is applied has a magnetization unit for magnetizing a wire rope in its longitudinal direction and a magnetic sensor for detecting magnetic flux leakage.

[0004]

In the background art, such a wire rope flaw detection apparatus has been disclosed in JP-A-2008-292213. According to the background-art technique, a plurality of magnetic sensors are disposed circumferentially around a wire rope so that a flaw portion in a deep portion of the wire rope can be detected accurately by use of outputs from the plurality of magnetic sensors.

[0005]

In addition, in any wire rope flaw detection apparatus using the magnetic flux leakage testing method, each magnetic sensor must be disposed near the surface of a wire rope in order to detect magnetic flux leaking from a flaw portion. Therefore,

when the aforementioned wire rope flaw detection apparatus disclosed in JP-A-2008-292213 is used in a condition that a wire rope is coupled to a structure, the magnetic sensors must be disposed near the surface of the wire rope in such a manner that each magnetic sensor is split into sensor portions and the wire rope is held among the split sensor portions.

[0006]

A background-art technique of a structure in which a magnetic sensor is split in such a manner has been disclosed in JP-A-2010-210272. According to the background-art technique disclosed in JP-A-2010-210272, a magnetization unit, a magnetic sensor, a first sensor base and a second sensor base are provided. The magnetization unit magnetizes a wire rope in its longitudinal direction. The magnetic sensor includes a first sensor portion and a second sensor portion which are disposed separately to circumferentially cover a magnetized portion of the wire rope magnetized by the magnetization unit. The first sensor portion is provided in the first sensor base. The second sensor portion is provided in the second sensor base. The first sensor base and the second sensor base are disposed to be opposed to each other with the wire rope held therebetween. The first sensor base is attached to a jig placed in a predetermined position through a fixation rod or the like. In addition, according to this background-art technique, a connection unit is provided for connecting the first sensor

base and the second sensor base with each other. The connection unit is constituted by a plurality of connectors (i.e. a pair of hooks) which are provided on the first sensor base side and disposed to be opposed to each other with the wire rope held therebetween, and a plurality of engagement portions (i.e. a pair of through holes) which are provided in a mounting base attached to the second sensor base so that the aforementioned hooks can engage with the through holes respectively. The background-art technique disclosed in JP-A-2010-210272 can be applied even to the case in which a plurality of wire ropes are adjacent to each other as in the aforementioned elevator.

#### SUMMARY OF THE INVENTION

[0008]

However, the background-art technique disclosed in JP-A-2008-292213 gives no suggestion to a specific configuration for defining relative positions of the magnetic sensors to a wire rope in order to accurately detect a flaw portion in a deep portion of the wire rope. The flaw portion cannot be measured accurately unless the relative positions of the magnetic sensors to the wire rope are kept in predetermined relations.

[0009]

On the other hand, according to the background-art technique disclosed in JP-A-2010-210272, the connection unit constituted by the pair of hooks and the pair of through holes

is provided. The pair of hooks are provided on the side of the first sensor base having the first sensor portion as a split part of the magnetic sensor. The pair of through holes are provided on the side of the second sensor base having the second sensor portion as a split part of the magnetic sensor. The first sensor base is placed in a predetermined position through a fixation rod, a jig, etc. Thus, the relative position between the magnetic sensor and the wire rope can be kept in a predetermined relation. However, according to the background-art technique disclosed in JP-A-2010-210272, there is a fear that the first sensor base and the second sensor base may be connected not in a proper connection form but in a wrong form (for example, one of the first and second sensor bases may be disposed in a reverse direction) when the skill level of an operator is low. In such a case, the magnetic sensor including the first sensor portion provided in the first sensor base and the second sensor portion provided in the second sensor base may not be formed in a proper form. Even in such a case, however, measurement can be carried out. Accordingly, the operator may be not aware of the fact that the magnetic sensor is not formed in a proper form. As a result, inadequate measurement may be carried out.

[0010]

The present invention is accomplished under the aforementioned circumstances in the background art. An object

of the invention is to provide a wire rope flaw detection apparatus in which a first sensor portion provided in a first sensor base and forming one of split parts of a magnetic sensor and a second sensor portion provided in a second sensor base and forming the other split part of the magnetic sensor can be always disposed in a correct positional relation for forming a proper magnetic sensor regardless of the skill level of an operator.

[0011]

In order to attain the foregoing object, a wire rope flaw detection apparatus according to the invention includes: a magnetization unit which magnetizes a wire rope in a longitudinal direction thereof; a magnetic sensor which is disposed to circumferentially cover a magnetized portion of the wire rope magnetized by the magnetization unit, and which detects magnetic flux appearing in the magnetized portion of the wire rope and leaking from a flaw portion; a sensor base in which the magnetic sensor is provided, and which includes a first sensor base and a second sensor base opposed to each other with the wire rope held therebetween, the magnetic sensor being formed to be split into a first sensor portion provided in the first sensor base and a second sensor portion provided in the second sensor base, the first sensor portion and the second sensor portion being disposed to be opposed to each other with the wire rope held therebetween; and a connection unit which connects the first

sensor base and the second sensor base with each other, and which includes a plurality of connectors and a plurality of engagement portions, the connectors being opposed to each other with the wire rope held therebetween, the connectors engaging with the engagement portions respectively; wherein: the connectors are set so that one of the connectors has a different layout from the other connector; the engagement portions are set so that one of the engagement portions with which the one connector engages has a layout corresponding to the layout of the one connector, and the other of the engagement portions with which the other connector engages has a layout corresponding to the layout of the other connector; and each of the layouts includes at least one of a shape and a mounting position.

[0012]

According to the invention configured thus, when the first sensor base and the second sensor base are connected with each other, one connector of the connectors included in the connection unit is engaged with one engagement portion corresponding to the one connector, of the engagement portions included in the connection unit, while the other connector having a different layout from that of the one connector, of the connectors included in the connection unit is engaged with the other engagement portion corresponding to the other connector, of the engagement portions included in the connection unit. Only in this manner, connection between the first sensor base and the second sensor

base can be made. That is, there is only one connection form in which connection between the first sensor base and the second sensor base can be made. In the condition that the first sensor base and the second sensor base are connected with each other through the connectors and the engagement portions respectively, the first sensor portion provided in the first sensor base and the second sensor portion provided in the second sensor base are kept in a correct positional relation. Accordingly, in the invention, the first sensor portion provided in the first sensor base and forming one of the split parts of the magnetic sensor and the second sensor portion provided in the second sensor base and forming the other split part of the magnetic sensor can be always disposed in a correct positional relation for forming a proper magnetic sensor regardless of the skill level of an operator.

[0013]

In addition, according to the invention, in the aforementioned configuration, the connection unit includes a first connection unit and a second connection unit; the connectors included in the first connection unit are set so that one of the connectors has a different layout from the other connector, and the connectors included in the second connection unit are set so that one of the connectors has a different layout from the other connector; the engagement portions included in the first connection unit are set so that, of the engagement

portions included in the first connection unit, one engagement portion with which the one connector included in the first connection unit engages has a layout corresponding to the layout of the one connector included in the first connection unit and, of the engagement portions included in the first connection unit, the other engagement portion with which the other connector included in the first connection unit engages, has a layout corresponding to the layout of the other connector included in the first connection unit; and the engagement portions included in the second connection unit are set so that, of the engagement portions included in the second connection unit, one engagement portion with which the one connector included in the second connection unit engages has a layout corresponding to the layout of the one connector included in the second connection unit and, of the engagement portions included in the second connection unit, the other engagement portion with which the other connector included in the second connection unit engages has a layout corresponding to the layout of the other connector included in the second connection unit.

[0014]

According to the invention configured thus, the connection unit includes the first connection unit and the second connection unit. Accordingly, the first sensor base and the second sensor base can be connected more surely in a correct connection form through both the first connection unit and the

second connection unit.

[0015]

In addition, according to the invention, in the aforementioned configuration, the one connector included in the first connection unit includes a first protrusion which is provided on the first sensor base side, and the other connector included in the first connection unit includes a second protrusion which is provided on the first sensor base side and which has a different layout from the first protrusion; the one engagement portion included in the first connection unit includes a first insertion hole which is provided on the second sensor base side and with which the first protrusion engages, and the other engagement portion included in the first connection unit includes a second insertion hole which is provided on the second sensor base side and with which the second protrusion engages; the one connector included in the second connection unit includes a first extension portion which is provided on the second sensor base side and which extends in a direction perpendicular to an extending direction of the wire rope, and the other connector included in the second connection unit includes a second extension portion which is provided on the second sensor base side, which extends in a direction perpendicular to the extending direction of the wire rope, and which has a different layout from the first extension portion; and the one engagement portion included in the second connection

unit includes a first engagement groove which is provided on the first sensor base side and with which the first extension portion engages, and the other engagement portion included in the second connection unit includes a second engagement groove which is provided on the first sensor base side and with which the second extension portion engages.

[0016]

In addition, according to the invention, in the aforementioned configuration, a rod which is provided erectly on an upper surface of the first sensor base, and a block which is movably attached to the rod are provided; wherein: the first protrusion is provided on one side surface of the block and the second protrusion is provided on an opposite side surface of the block to the one side surface; the first extension portion and the second extension portion are provided on an upper end portion of the second sensor base; the first engagement groove with which the first extension portion engages is provided in one side surface of the first sensor base and the second engagement groove with which the second extension portion engages is provided in an opposite side surface of the first sensor base to the one side surface; and the first insertion hole with which the first protrusion engages is provided in the first extension portion and the second insertion hole with which the second protrusion engages is provided in the second extension portion.

[0017]

According to the invention, configuration is made in such a manner that a connection unit for connecting a first sensor base and a second sensor base with each other includes a plurality of connectors opposed to each other with a wire rope held therebetween, a first sensor portion as one of split parts of a magnetic sensor is provided in the first sensor base, a second sensor portion as the other split part of the magnetic sensor is provided in the second sensor base, and the connectors are set so that one of the connectors has a different layout from the other connector. In addition, according to the invention, configuration is made in such a manner that the connection unit has one engagement portion which is set to have a layout corresponding to the layout of the one connector so that the one connector can engage with the one engagement portion and the other engagement portion which is set to have a layout corresponding to the layout of the other connector so that the other connector can engage with the other engagement portion. With the configuration, according to the invention, there is only one connection form in which connection between the first sensor base and the second sensor base can be made. Thus, according to the invention, the first sensor portion provided in the first sensor base and forming one split part of the magnetic sensor and the second sensor portion provided in the second sensor base and forming the other split part of the magnetic

sensor can be always disposed in a correct positional relation for forming a proper magnetic sensor regardless of the skill level of an operator. Thus, there is no fear that inadequate measurement may be made as in the background art, so that it is possible to obtain a wire rope flaw detection apparatus with high reliability and excellent practicability, by which correct measurement can be always made.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Fig. 1 is a perspective view showing an embodiment of a wire rope flaw detection apparatus according to the invention;

Fig. 2 is an exploded perspective view of Fig. 1;

Figs. 3A and 3B are a plan view and a front view showing the positions where a first protrusion and a second protrusion provided in the embodiment are disposed; and

Figs. 4A and 4B are a plan view and a front view showing the shapes with which the first protrusion and the second protrusion applicable to the embodiment are disposed.

#### DETAILED DESCRIPTION OF THE INVENTION

[0019]

An embodiment of a wire rope flaw detection apparatus according to the invention will be described below with reference to the drawings.

[0020]

Fig. 1 is a perspective view showing an embodiment of

a wire rope flaw detection apparatus according to the invention. Fig. 2 is an exploded perspective view of Fig. 1. Figs. 3A and 3B are a plan view and a front view showing the positions where a first protrusion and a second protrusion provided in the embodiment are disposed.

[0021]

As shown in Fig. 1, the wire rope flaw detection apparatus according to the embodiment has a not-shown magnetization unit, a magnetic sensor and a sensor base. The magnetization unit magnetizes a wire rope 1 in its longitudinal direction. For example, the wire rope 1 suspends an elevator cage and a balance weight. The magnetic sensor is disposed to circumferentially cover a magnetized portion of the wire rope 1 magnetized by the magnetization unit. The magnetic sensor detects magnetic flux appearing in the magnetized portion of the wire rope 1 and leaking from a flaw portion. The magnetic sensor is provided in the sensor base.

[0022]

The aforementioned sensor base includes a first sensor base 5 and a second sensor base 6 which are opposed to each other with the wire rope 1 held therebetween. The aforementioned magnetic sensor is formed to be split into a first sensor portion 12a provided in the first sensor base 5 and a second sensor portion 12b provided in the second sensor base 6. The first sensor portion 12a and the second sensor

portion 12b are disposed to be opposed to each other with the wire rope 1 held therebetween.

[0023]

A guide surface 5a for guiding the wire rope 1 is formed in a lower end portion of the first sensor base 5. The guide surface 5a has a semicircular sectional shape corresponding to an upper half of the wire rope 1. In the same manner, a guide surface 6a for guiding the wire rope 1 is formed in an upper end portion of the second sensor base 6. The guide surface 6a has a semicircular sectional shape corresponding to a lower half of the wire rope 1. A lower end of the first sensor portion 12a is formed into a semicircular shape corresponding to the upper half of the wire rope 1, and an upper end of the second sensor portion 12b is formed into a semicircular shape corresponding to the lower half of the wire rope 1.

[0024]

A notch member 10a whose lower end has a semicircular shape corresponding to the guide surface 5a of the first sensor base 5 is provided in a side end portion of the first sensor base 5 from which the wire rope 1 enters the first sensor base 5. In the same manner, a notch member 10b whose upper end has a semicircular shape corresponding to the guide surface 6a of the second sensor base 6 is provided in a side end portion of the second sensor base 6 from which the wire rope 1 enters the second sensor base 6. Preferably, the notch members 10a and

10b are lower in strength than one strand as a constituent part of the wire rope 1 in order to prevent damage of the wire rope 1 to be measured. For example, the notch members 10a and 10b are made of resin.

[0025]

In addition, according to the embodiment, a connection unit is provided for connecting the first sensor base 5 and the second sensor base 6 with each other. The connection unit has a plurality of connectors which are opposed to each other with the wire rope 1 held therebetween, and a plurality of engagement portions with which the connectors engage respectively. In the embodiment, one of the connectors is set to have a different layout from that of the other connector. In addition, in the embodiment, one of the engagement portions with which the one connector engages is set to have a layout corresponding to the layout of the one connector, and the other of the engagement portions with which the other connector engages is set to have a layout corresponding to the layout of the other connector. Each of the layouts includes at least one of a shape and a mounting position.

[0026]

The connection unit includes, for example, a first connection unit and a second connection unit. Of connectors included in the first connection unit, one connector is set to have a different layout from that of the other connector,

and, of connectors included in the second connection unit, one connector is set to have a different layout from that of the other connector.

[0027]

In addition, of engagement portions included in the first connection unit, one engagement portion with which the one connector included in the first connection unit engages is set to have a layout corresponding to the layout of the one connector included in the first connection unit, and, of the engagement portions included in the first connection unit, the other engagement portion with which the other connector included in the first connection unit engages is set to have a layout corresponding to the layout of the other connector included in the first connection unit.

[0028]

Further, of engagement portions included in the second connection unit, one engagement portion with which the one connector included in the second connection unit engages is set to have a layout corresponding to the layout of the one connector included in the second connection unit, and, of the engagement portions included in the second connection unit, the other engagement portion with which the other connector included in the second connection unit engages is set to have a layout corresponding to the layout of the other connector included in the second connection unit.

[0029]

For example, one connector included in the first connection unit is constituted by a first protrusion 3a provided on the first sensor base 5 side, and the other connector included in the first connection unit is constituted by a second protrusion 3b provided on the first sensor base 5 side and having a different layout from the first protrusion 3a, that is, disposed asymmetrically to the first protrusion 3a.

[0030]

One engagement portion included in the first connection unit is constituted by a first insertion hole 7a which is provided on the second sensor base 6 side and with which the first protrusion 3a engages, and the other engagement portion included in the first connection unit is constituted by a second insertion hole 8a which is provided on the second sensor base 6 side and with which the second protrusion 3b engages.

[0031]

One connector included in the second connection unit is constituted by a first extension portion 7 which is provided on the second sensor base 6 side and which extends in a direction perpendicular to the extending direction of the wire rope 1, and the other connector included in the second connection unit is constituted by a second extension portion 8 which is provided on the second sensor base 6 side, which extends in a direction perpendicular to the extending direction of the wire rope 1,

and which has a different layout from that of the first extension portion 7.

[0032]

One engagement portion included in the second connection unit is constituted by a first engagement groove 5b which is provided on the first sensor base 5 side and with which the first extension portion 7 engages, and the other engagement portion included in the second connection unit is constituted by a second engagement groove 5c which is provided on the first sensor base 5 side and with which the second extension portion 8 engages.

[0033]

In addition, according to the embodiment, a rod 11 and a block 3 are provided. The rod 11 stands erectly on an upper surface of the first sensor base 5. The block 3 is movably attached to the rod 11. A spring 4 for urging the first sensor base 5 and the second sensor base 6 toward the wire rope 1 is provided in the portion of the rod 11 located between the block 3 and the upper surface of the first sensor base 5. In addition, a stopper 2 for preventing the block 3 from dropping out from the rod 11 is provided in an upper end of the rod 11.

[0034]

As also shown in Figs. 3A and 3B, the first protrusion 3a constituting one of the connectors of the first connection unit is provided on one side surface of the block 3, and the

second protrusion 3b constituting the other connector of the first connection unit is provided on the opposite side surface of the block 3. For example, the first protrusion 3a and the second protrusion 3b are set to have the same diameter. As shown in Fig. 3A, the first protrusion 3a is disposed on one side at a distance L3 from a plan-view center line, and the second protrusion 3b is disposed on the opposite side at a distance L4 from the same center line. In addition, as shown in Fig. 3B, the first protrusion 3a is disposed at a distance L5 below a side-view center line, and the second protrusion 3b is disposed at a distance L6 above the same center line. That is, in the embodiment, the first protrusion 3a and the second protrusion 3b are disposed asymmetrically with respect to the center position of the block 3.

[0035]

The first extension portion 7 constituting one of the connectors of the second connection unit and the second extension portion 8 constituting the other connector of the second connection unit are provided on the upper end portion of the second sensor base 6. For example, the first extension portion 7 is set to have a rectangular shape with a width L1, and the second extension portion 8 is set to have a rectangular shape with a smaller width L2 than the width L1 of the first extension portion 7.

[0036]

The first engagement groove 5b with which the first extension portion 7 engages and which constitutes one of the engagement portions of the second connection unit is provided in one side surface of the first sensor base 5, and the second engagement groove 5c with which the second extension portion 8 engages and which constitutes the other engagement portion of the second connection unit is provided in the opposite side surface of the first sensor base 5 to the aforementioned one side surface. The first engagement groove 5b is set to have a comparatively large width corresponding to the width L1 of the first extension portion 7, and the second engagement groove 5c is set to have a comparatively small width corresponding to the width L2 of the second extension portion 8.

[0037]

In addition, the first insertion hole 7a with which the first protrusion 3a engages and which constitutes one of the engagement portions of the first connection unit is provided near an upper end of the first extension portion 7, and the second insertion hole 8a with which the second protrusion 3b engages and which constitutes the other engagement portion of the first connection unit is provided near an upper end of the second extension portion 8.

[0038]

Further, in the embodiment, a bracket 9 having a U-shape in plan view is provided. The bracket 9 is fixed in a

predetermined position. An insertion hole 9a into which the first protrusion 3a protruding from the first insertion hole 7a provided in the first extension portion 7 is inserted is formed in one of a pair of opposite side plates of the bracket 9, and an insertion hole 9b into which the second protrusion 3b protruding from the second insertion hole 8a provided in the second extension portion 8 is inserted is formed in the other side plate of the bracket 9. The distance between the side plates of the bracket 9 is set to be substantially equal to the total sum of the thickness  $t_1$  of the first extension portion 7, the thickness  $t_1$  of the second extension portion 8 and the length  $t_2$  of the block 3. Due to the bracket 9, stable connection strength can be secured in both the first connection unit constituted by the first protrusion 3a with the first insertion hole 7a and the second protrusion 3b with the second insertion hole 7b, and the second connection unit constituted by the first extension portion 7 with the first engagement groove 5b and the second extension portion 8 with the second engagement groove 5c.

[0039]

The wire rope flaw detection apparatus configured thus according to the embodiment can detect the position of a flaw portion in the wire rope 1, that is, a broken place of strands forming the wire rope 1, based on magnetic flux leakage detected by the first sensor portion 12a and the second sensor portion

12b constituting the magnetic sensor when the wire rope 1 is magnetized in its longitudinal direction by the not-shown magnetization unit.

[0040]

In addition, according to the embodiment, to connect the first sensor base 5 and the second sensor base 6 with each other, the first protrusion 3a as a constituent part of the first connection unit is engaged with the first insertion hole 7a of the first extension portion 7 and the second protrusion 3b as a constituent part of the first connection unit is engaged with the second insertion hole 8a of the second extension portion 8, while the first extension portion 7 as a constituent part of the second connection unit is engaged with the first engagement groove 5b of the first sensor base 5 and the second extension portion 8 as a constituent part of the second connection unit is engaged with the second engagement groove 5c of the first sensor base 5. Only in this manner, the first sensor base 5 and the second sensor base 6 can be connected with each other. That is, there is only one connection form in which the first sensor base 5 and the second sensor base 6 can be connected with each other. In the condition that the first sensor base 5 and the second sensor base 6 are connected with each other through the first protrusion 3a with the first insertion hole 7a, the second protrusion 3b with the second insertion hole 8a, the first extension portion 7 with the first

engagement groove 5b, and the second extension portion 8 with the second engagement groove 5c, the first sensor portion 12a provided in the first sensor base 5 and the second sensor portion 12b provided in the second sensor base 6 are kept in a correct positional relation. Accordingly, in the embodiment, the first sensor portion 12a provided in the first sensor base 5 and forming one of the split parts of the magnetic sensor and the second sensor portion 12b provided in the second sensor base 6 and forming the other split part of the magnetic sensor can be always disposed in a correct positional relation for forming a proper magnetic sensor regardless of the skill level of an operator. In this manner, there is no fear that inadequate measurement may be made so that it is possible to obtain a highly-reliable wire rope flaw detection apparatus by which correct measurement can be always made.

[0041]

In addition, the first sensor base 5 and the second sensor base 6 can be connected with each other more surely in a correct connection form through both the first connection unit constituted by the first protrusion 3a with the first insertion hole 7a and the second protrusion 3b with the second insertion hole 8a, and the second connection unit constituted by the first extension portion 7 with the first engagement groove 5b and the second extension portion 8 with the second engagement groove 5c.

[0042]

In the aforementioned embodiment, configuration is made in such a manner that the first protrusion 3a and the second protrusion 3b as constituent parts of the first connection unit are set asymmetrically with respect to the center of the block 3. However, the invention is not limited to such a configuration. For example, as shown in Figs. 4A and 4B, the first protrusion 3a and the second protrusion 3b may be disposed to be aligned with the plan-view and side-view center lines of the block 3 respectively. In addition, the first protrusion 3a is set to have a shape with a diameter R1, and the second protrusion 3b is set to have a shape with a larger diameter R2 than the diameter R1 of the first protrusion 3a. Further, the first insertion hole 7a is set to have a comparatively small diameter corresponding to the diameter R1, and the second insertion hole 8a is set to have a comparatively large diameter corresponding to the diameter R2. Alternatively, the sizes of the diameters may be replaced with each other. Furthermore, the form may include both the sizes of the diameters and the asymmetry, that is, both the shapes and the mounting positions. Even when the first connection unit is configured thus, operation and effect equivalent to those of the first embodiment can be obtained.

[0043]

In the aforementioned embodiment, configuration is made in such a manner that the first connection unit constituted

by the first protrusion 3a with the first insertion hole 7a and the second protrusion 3b with the second insertion hole 8a, and the second connection unit constituted by the first extension portion 7 with the first engagement groove 5b and the second extension portion 8 with the second engagement groove 5c are provided. Alternatively, configuration may be made in such a manner that only the first connection unit or only the second connection unit is provided.

What is claimed is:

1. A wire rope flaw detection apparatus comprising:
  - a magnetization unit which magnetizes a wire rope in a longitudinal direction thereof;
  - a magnetic sensor which is disposed to circumferentially cover a magnetized portion of the wire rope magnetized by the magnetization unit, and which detects magnetic flux appearing in the magnetized portion of the wire rope and leaking from a flaw portion;
  - a sensor base in which the magnetic sensor is provided and which includes a first sensor base and a second sensor base opposed to each other with the wire rope held therebetween, the magnetic sensor being formed to be split into a first sensor portion provided in the first sensor base and a second sensor portion provided in the second sensor base, the first sensor portion and the second sensor portion being disposed to be opposed to each other with the wire rope held therebetween;
  - and
  - a connection unit which connects the first sensor base and the second sensor base with each other, and which includes a plurality of connectors and a plurality of engagement portions, the connectors being opposed to each other with the wire rope held therebetween, the connectors engaging with the engagement portions respectively; wherein:
    - the connectors are set so that one of the connectors has

a different layout from the other connector;

the engagement portions are set so that one of the engagement portions with which the one connector engages has a layout corresponding to the layout of the one connector, and the other of the engagement portions with which the other connector engages has a layout corresponding to the layout of the other connector; and

each of the layouts includes at least one of a shape and a mounting position.

2. A wire rope flaw detection apparatus according to Claim 1, wherein:

the connection unit includes a first connection unit and a second connection unit;

the connectors included in the first connection unit are set so that one of the connectors has a different layout from the other connector, and the connectors included in the second connection unit are set so that one of the connectors has a different layout from the other connector;

the engagement portions included in the first connection unit are set so that, of the engagement portions included in the first connection unit, one engagement portion with which the one connector included in the first connection unit engages has a layout corresponding to the layout of the one connector included in the first connection unit, and, of the engagement portions included in the first connection unit, the other

engagement portion with which the other connector included in the first connection unit engages has a layout corresponding to the layout of the other connector included in the first connection unit; and

the engagement portions included in the second connection unit are set so that, of the engagement portions included in the second connection unit, one engagement portion with which the one connector included in the second connection unit engages has a layout corresponding to the layout of the one connector included in the second connection unit and, of the engagement portions included in the second connection unit, the other engagement portion with which the other connector included in the second connection unit engages has a layout corresponding to the layout of the other connector included in the second connection unit.

3. A wire rope flaw detection apparatus according to Claim 2, wherein:

the one connector included in the first connection unit includes a first protrusion provided on the first sensor base side, and the other connector included in the first connection unit includes a second protrusion provided on the first sensor base side and having a different layout from the first protrusion;

the one engagement portion included in the first connection unit includes a first insertion hole which is provided

on the second sensor base side and with which the first protrusion engages, and the other engagement portion included in the first connection unit includes a second insertion hole which is provided on the second sensor base side and with which the second protrusion engages;

the one connector included in the second connection unit includes a first extension portion which is provided on the second sensor base side and which extends in a direction perpendicular to an extending direction of the wire rope, and the other connector included in the second connection unit includes a second extension portion which is provided on the second sensor base side, which extends in a direction perpendicular to the extending direction of the wire rope, and which has a different layout from the first extension portion; and

the one engagement portion included in the second connection unit includes a first engagement groove which is provided on the first sensor base side and with which the first extension portion engages, and the other engagement portion included in the second connection unit includes a second engagement groove which is provided on the first sensor base side and with which the second extension portion engages.

4. A wire rope flaw detection apparatus according to Claim 3, further comprising:

a rod which is provided erectly on an upper surface of

the first sensor base; and

a block which is movably attached to the rod; wherein:

the first protrusion is provided on one side surface of the block and the second protrusion is provided on an opposite side surface of the block to the one side surface;

the first extension portion and the second extension portion are provided on an upper end portion of the second sensor base;

the first engagement groove with which the first extension portion engages is provided in one side surface of the first sensor base and the second engagement groove with which the second extension portion engages is provided in an opposite side surface of the first sensor base to the one side surface; and

the first insertion hole with which the first protrusion engages is provided in the first extension portion and the second insertion hole with which the second protrusion engages is provided in the second extension portion.