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(54) **YARN BREAKAGE SENSOR FOR CREEL DEVICE**

(57) To suppress adherence of dust to a light emitting surface of a light emitter (35a) and a light receiving surface of a light receiver (35b) of a yarn breakage sensor (30, 30') for a creel device (10) and prevent erroneous detection of yarn breakage, the yarn breakage sensor (30, 30') being provided for each yarn supply package (P) so that a yarn (T) that is pulled out from the yarn supply package (P) moves through a yarn movement path that is defined by a pair of facing surfaces (33a) that face each other in an up-down direction, and the yarn breakage sensor (30, 30') including the light emitter (35a) disposed in such a way that a light emission surface thereof is exposed at one of the pair of facing surfaces (33a) and the light receiver (35b) disposed in such a way that a light receiving surface thereof is exposed at the other of the pair of facing surfaces (33a) and that faces the light emitter (35a).

The yarn breakage sensor (30, 30') includes a yarn guide (37, 38, 39) that is disposed at least on an upstream side, which is one of the upstream side and a downstream side, of the yarn movement path with respect to a path of the yarn (T) in which the yarn supply package (P) is on a most upstream side, the yarn guide (37, 38, 39) having a pair of restraining surfaces that face each other in the up-down direction. The distance (d) between the pair of restraining surfaces is smaller than or equal to 1/2 of the distance (D) between the pair of facing surfaces (33a).

FIG. 2A

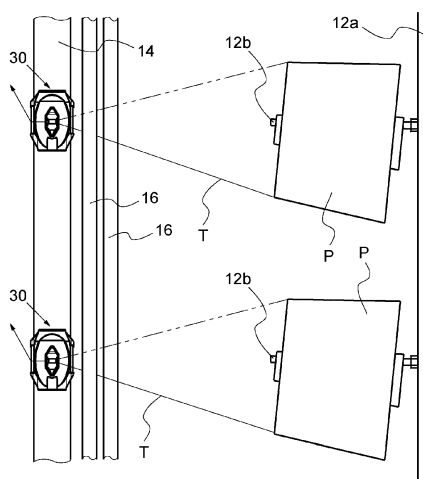
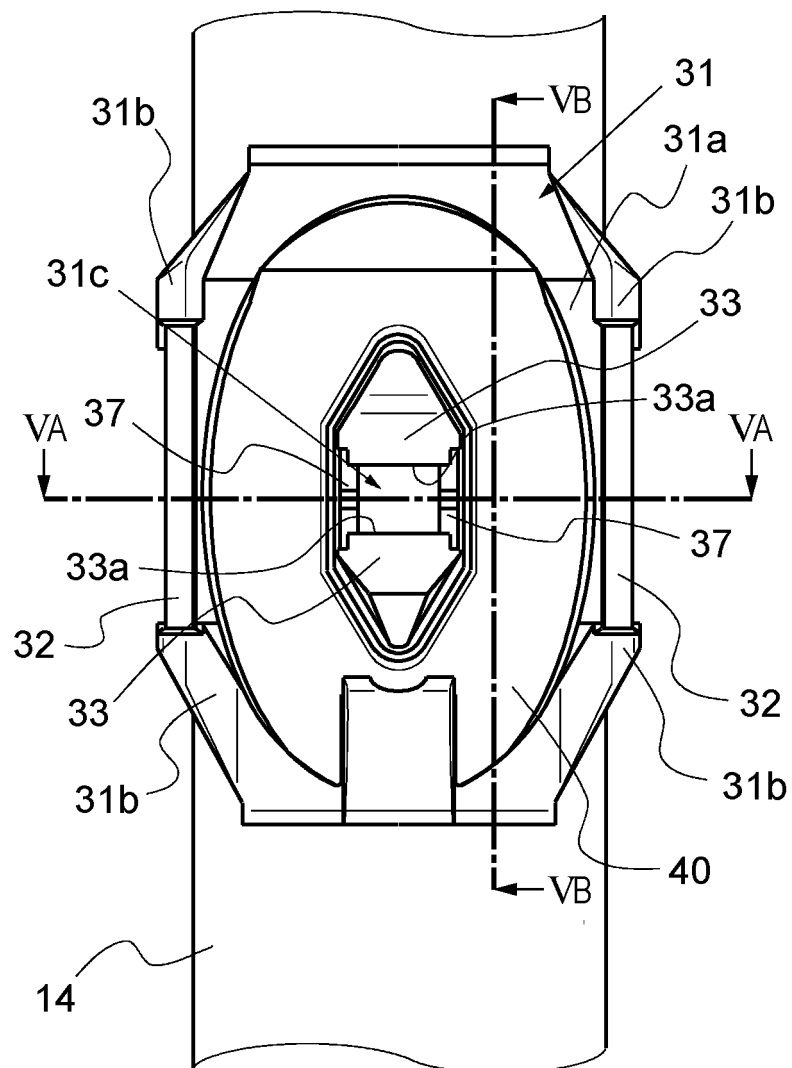


FIG. 4A



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn breakage sensor for a creel device. In particular, the present invention relates to a yarn breakage sensor that has a pair of facing surfaces that face each other in an up-down direction, that is provided in the creel device for each yarn supply package so that a yarn that is pulled out from the yarn supply package moves through a yarn movement path that is defined by the pair of facing surfaces, and that includes a light emitter that is exposed at one of the pair of facing surfaces and a light receiver that is exposed at the other of the pair of facing surfaces and that faces the light emitter.

2. Description of the Related Art

[0002] Creel devices are used to supply a large number of yarns to textile machinery, such as warper or a loom. A creel device can hold a large number (for example, several hundreds) of yarn supply packages and includes yarn breakage sensors that are disposed so as to correspond to the positions of the yarn supply packages (each of which are provided for a corresponding one of the yarn supply packages) so that the creel device can detect breakage of a yarn that is pulled out from each of the yarn supply packages (hereinafter, simply referred to as a "yarn"). That is, a creel device includes as many yarn breakage sensors as the yarn supply packages that the creel device can hold.

[0003] An example of such a yarn breakage sensor is disclosed in Japanese Unexamined Patent Application Publication No. 2006-298522. Japanese Unexamined Patent Application Publication No. 2006-298522, which is an application relating to a brake device for adjusting the tension of a yarn in a creel device, discloses that the brake device includes a yarn breakage sensor, although detailed description is not given.

[0004] To be specific, the brake device described in Japanese Unexamined Patent Application Publication No. 2006-298522 includes a plate-shaped brake body, as a main component, and a yarn breakage sensor that is integrally formed with the brake body so as to protrude from a front surface (a surface opposite to an attachment surface (back surface)) of the brake body. The yarn breakage sensor includes a pair of protrusions that are disposed at a substantially central part of the brake body. The pair of protrusions are located on both sides of the center of the brake body in the up-down direction and protrude from the brake body. The pair of protrusions have planar surfaces (facing surfaces) that face each other. The facing surfaces of the protrusions are parallel to each other and parallel to a width direction of the brake body. The brake device described in Japanese Unexam-

ined Patent Application Publication No. 2006-298522 is disposed on the creel device so that a yarn moves through a yarn movement path that is defined by the pair of facing surfaces of the protrusions.

[0005] It is described in Japanese Unexamined Patent Application Publication No. 2006-298522 that the yarn breakage sensor is a light transmissive sensor that detects the state of a yarn, which is passing through the brake device, as a waveform. Accordingly, it can be understood from this description that the yarn breakage sensor includes a light emitter and a light receiver (light emitter/receiver) and that the light emitter is disposed in one of the pair of protrusions and the light receiver is disposed in the other of the pair of protrusions. The light emitter/receiver is disposed so that a light emitting surface and a light receiving surface (light emitting/receiving surfaces) thereof are exposed at the facing surfaces of the protrusions, in which the light emitter/receiver is disposed, and so that the optical axis thereof crosses the yarn movement path. The yarn breakage sensor outputs a received-light waveform in accordance with the amount of received light.

[0006] Although not disclosed in Japanese Unexamined Patent Application Publication No. 2006-298522, the received-light waveform, which is output from the yarn breakage sensor, represents a change (in waveform) in accordance with movement of a yarn or the like when the yarn is moving (without suffering from yarn breakage). In other words, if yarn breakage occurs and movement of the yarn stops, the change in received-light waveform becomes smaller (negligibly small). Therefore, in the creel device, a yarn breakage detector, which is disposed on the creel device, determines whether or not yarn breakage has occurred by comparing the received-light waveform, which is output from the yarn breakage sensor, with, for example, a threshold (or a reference waveform).

[0007] In the creel device, as a yarn is being pulled out from a yarn supply package, the yarn repeats displacement so as to vibrate in the up-down direction, because the unwinding point of the yarn on the yarn supply package rotates along the peripheral surface of the yarn supply package. Accordingly, also in the yarn breakage sensor, the yarn vibrates in the up-down direction in the yarn movement path. As a result, in the yarn breakage sensor, the yarn may contact upper and lower facing surfaces, which define the yarn movement path, and, accordingly, dust may periodically adhere to the light emitting/receiving surfaces of the light emitter/receiver. Moreover, when the yarn contacts the facing surfaces, lint may become separated from the yarn and drop onto the light receiving surface (or the light emission surface), which is exposed at the lower facing surface, and thereby the light receiving surface (or the light emission surface) may become dusty.

[0008] If the light emitting/receiving surface of the light emitter/receiver becomes dusty, the light receiver cannot obtain a sufficient amount of received light and a change

in the received-light waveform in accordance with movement of the yarn cannot be detected even when the yarn is moving. As a result, erroneous detection of yarn breakage may occur.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to provide a yarn breakage sensor for a creel device that can reduce vibration (displacement) of a yarn in the up-down direction in the yarn movement path, suppress adherence of dust to a light emission surface of a light emitter and a light receiving surface of a light receiver due to the vibration of the yarn, and prevent erroneous detection of yarn breakage.

[0010] To achieve the object, according to the present invention, the yarn breakage sensor for a creel device includes a yarn guide that is disposed at least on an upstream side, which is one of the upstream side and a downstream side, of the yarn movement path with respect to a path of the yarn in which the yarn supply package is on a most upstream side, the yarn guide having a pair of restraining surfaces that face each other in the up-down direction; and a distance between the pair of restraining surfaces of the yarn guide in the up-down direction is smaller than or equal to $1/2$ of a distance between the pair of facing surfaces.

[0011] The term "path of the yarn" refers to, regarding each yarn breakage sensor disposed on the creel device, a path (movement path) along which the yarn moves in a state in which the yarn, which is pulled out from a yarn supply package corresponding to the yarn breakage sensor, is set so that the yarn passes (moves) through the yarn movement path of the yarn breakage sensor as described above. The terms "upstream side" and "downstream side" respectively refer to positions with respect to the path (movement path) of the yarn relative to the yarn movement path when the position of the yarn supply package is defined as the most upstream side. Accordingly, with respect to the yarn movement path, the upstream side is a side on which the yarn supply package is located and the downstream side is a side on which a textile machine to which the yarn is supplied is located.

[0012] In the yarn breakage sensor according to the present invention, the yarn breakage sensor may include a pair of protrusions that are disposed so as to protrude from a base plate so that the pair of facing surfaces are formed, and the yarn guide may be disposed on the base plate so as to be attached to the pair of the protrusions.

[0013] With the yarn breakage sensor according to the present invention, which includes the yarn guide on the upstream side of the yarn movement path, even if a yarn repeats displacement so as to vibrate in the up-down direction on the yarn supply package side of the yarn breakage sensor (yarn movement path) as the yarn is pulled out from the yarn supply package, the vibration is suppressed by the upper and lower restraining surfaces of the yarn guide. Therefore, the vibration of the yarn is

suppressed in the yarn movement path between the light emitter and the light receiver of the yarn breakage sensor. Thus, the probability of the yarn, which is moving through the yarn movement path, contacting the pair of facing surfaces that define the yarn movement path is reduced. As a result, adherence of dust to the light emitting/receiving surface is suppressed, and erroneous detection of the aforementioned yarn breakage can be suppressed.

[0014] In such a yarn breakage sensor, by disposing the yarn guide on the base plate so as to be attached to the protrusions of the yarn breakage sensor, it is possible to provide the yarn breakage sensor with such a yarn guide without adding a new component (excluding the yarn guide) to the yarn breakage sensor. Thus, the yarn breakage sensor has advantages in manufacturing (such as ease of manufacturing and reduction of manufacturing cost). That is, with this structure, the protrusions are inherent components of the yarn breakage sensor. Therefore, it is not necessary to additionally provide a dedicated component in order to fix the yarn guide to the base plate of the yarn breakage sensor so as to be positioned as described above. Thus, the yarn breakage sensor has the advantages in manufacturing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a partial schematic side view illustrating a creel device on which the present invention is based; Fig. 2A is a front view and Fig. 2B is a side view illustrating yarn breakage sensors disposed on the creel device;

Fig. 3 is a partially sectional view illustrating a yarn breakage sensor disposed on the creel device;

Fig. 4A is a front view and Fig. 4B is a side view illustrating a yarn breakage sensor according to an embodiment of the present invention;

Fig. 5A is a sectional view taken along line VA-VA in Fig. 4A, and Fig. 5B is a sectional view taken along line VB-VB in Fig. 4A.

Fig. 6A is a partially sectional side view and Fig. 6B is a front view illustrating the yarn breakage sensor according to the embodiment of the present invention;

Fig. 7A is a front view and Fig. 7B is a side view illustrating a yarn breakage sensor according to another embodiment of the present invention;

Fig. 8 is a partial side view illustrating the embodiment shown in Figs. 7A and 7B; and

Fig. 9 is side view illustrating a yarn guide of a yarn breakage sensor according to another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Hereinafter, a yarn breakage sensor for a creel device according to an embodiment of the present inven-

tion will be described with reference to Figs. 1 to 6B.

[0017] Fig. 1 is a partial schematic view illustrating a creel device 10 to which the present invention is applied. Fig. 1 illustrates an example in which the creel device 10 supplies yarns T to a take-up device 20, such as a warper. A large number of yarns T are pulled out from the creel device 10, arranged in the width direction of the take-up device 20 (the axial direction of a winding shaft 22) when viewed in the up-down direction, fed into the take-up device 20, and wound by the winding shaft 22, which is rotated by a driving device (not shown). Therefore, with respect to a horizontal direction, the creel device 10 is disposed at a position that is separated from the take-up device 20 in a direction (hereinafter, referred to as a "front-back direction") that is perpendicular to a direction (hereinafter, referred to as a "width direction") parallel to the width direction of the take-up device 20.

[0018] In the example shown in Fig. 1, the creel device 10 includes a plurality of yarn supply frames 12, which are supported by a machine frame (not shown). Each of the yarn supply frames 12 includes a plurality of support rods 12a, which extend in the up-down direction in the creel device 10. In the yarn supply frame 12, a plurality of pegs 12b, for hanging yarn supply packages P, are attached to each of the support rods 12a at predetermined distances in the longitudinal direction of the support rod 12a (Figs. 2A and 2B). With this structure, the creel device 10 can hold a large number of yarn supply packages P. In the creel device 10, each peg 12b is attached to the support rod 12a in such a way that, with respect to a horizontal direction, the peg 12b extends in a direction that is parallel to the width direction and that is inclined slightly upward. Accordingly, the creel device 10 has a structure in which a large number of pegs 12b are arranged in a matrix pattern as seen in the width direction. In the creel device 10, the yarn supply packages P are hung on the pegs 12b, and a large number of yarns T are pulled out from the yarn supply packages P and supplied to the take-up device 20.

[0019] As illustrated in Figs. 2A and 2B, the creel device 10 includes a plurality of sensor rods 14, which are disposed so as to correspond to the support rods 12a. Each of the sensor rods 14 is disposed so as to be separated from a corresponding one of the support rods 12a in the width direction and so as to extend in the up-down direction in the creel device 10. The sensor rod 14 has a rectangular cross section in a direction perpendicular to the longitudinal direction. The sensor rod 14 is disposed as follows: a side surface thereof having a smaller width (small-width side surface) faces a corresponding one of the support rods 12a; and, with respect to the front-back direction, one of side surfaces thereof having a larger width (large-width side surfaces) is located near a position on the support rod 12a to which the peg 12b is attached, and the other large-width side surface is located closer than the position to the take-up device 20.

[0020] The creel device 10 further includes a large number of yarn breakage sensors 30, which are disposed

so as to correspond to the pegs 12b. To be specific, in the creel device 10, each of the plurality of yarn breakage sensors 30 are disposed so as to correspond to one of the plurality of pegs 12b of each support rod 12a; and the plurality of yarn breakage sensors 30 are attached to the sensor rod 14 so as to be arranged in the up-down direction. That is, to each sensor rod 14, the same number of yarn breakage sensors 30 as the pegs 12b that are attached to a corresponding one of the support rods 12a are attached so as to be arranged in the longitudinal direction of the sensor rod 14. On each sensor rod 14, each of the plurality of yarn breakage sensors 30 is located at substantially the same height (in the up-down direction) as a corresponding one of the pegs 12b (to be specific, a corresponding one of the pegs 12b that are attached to one of the support rods 12a corresponding to the sensor rod 14 to which the yarn breakage sensor 30 is attached).

[0021] On each sensor rod 14, the yarn breakage sensors 30 are attached to the one of the large-width side surfaces of the sensor rod 14. Accordingly, as illustrated in Figs. 2A to 3, in the creel device 10, each yarn breakage sensor 30 is disposed in front of the yarn supply package P that is hung on a corresponding one of the pegs 12b so that a side portion thereof faces the yarn supply package P. A yarn T is pulled out from each yarn supply package P, passes through a corresponding one of the yarn breakage sensors 30, is deflected in the yarn breakage sensor 30, and is guided toward the take-up device 20.

[0022] Although the details are omitted, in the example shown in the figures, the creel device 10 includes two tension rods 16 that extend in the up-down direction so as to be located between each yarn supply package P and a corresponding one of the yarn breakage sensors 30. The yarn T pulled out from each yarn supply package P is looped over the two tension rods 16, and thereby the yarn T is slightly deflected forward (toward the take-up device 20) with respect to the front-back direction and then is guided from a position in front of the yarn breakage sensor 30 toward the yarn breakage sensor 30 (Fig. 3).

[0023] Figs. 4A to 5B illustrate an example of the yarn breakage sensor 30 in detail. The yarn breakage sensor shown in Figs. 4A to 5B basically has the same structure as the brake device described in Japanese Unexamined Patent Application Publication No. 2006-298522 and also functions as a brake device. All of the large number of yarn breakage sensors 30 of the creel device 10 have the same structure and are attached to the sensor rods 14 in the same manner. Therefore, one of the yarn breakage sensors 30 will be described below.

[0024] The yarn breakage sensor 30 includes a base plate 31 as a main component and is attached to the sensor rod 14 via the base plate 31. The base plate 31 includes a base portion 31a and substantially trapezoidal portions (trapezoidal portions). The base portion 31a has a substantially rectangular shape in a front view seen in the thickness direction of the base plate 31. The trapezoidal portions are integrally formed with the base por-

tion 31 a on both sides in the vertical direction, which is the transversal direction of the substantially rectangular base portion 31 a. The entirety of the base plate 31 has a substantially octagonal shape. The yarn breakage sensor 30 is attached to the sensor rod 14 in a direction such that the lateral direction, which is the longitudinal direction of the base portion 31 a of the base plate 31, coincides with the width direction, that is, in a direction such that the trapezoidal portions are respectively located above and below the base portion 31 a. The base portion 31 a of the base plate 31 has a dimension in the lateral direction (the width direction) that is the same as the dimension of the large-width side surface of the sensor rod 14, to which the yarn breakage sensor 30 is attached, in the width direction.

[0025] The yarn breakage sensor 30 includes a pair of guide bars 32 disposed on both sides of the base portion 31a in the width direction. The guide bars 32 are round bars extending parallel to the vertical direction (up-down direction) of the base portion 31a. Each guide bar 32 is attached to the base plate 31 via a pair of support portions 31 b, which are integrated with the base portion 31a and the trapezoidal portions of the base plate 31. That is, the base plate 31 includes the pair of support portions 31 b, which are disposed on each side of the base portion 31 a with respect to the width direction and which are formed so as to be separated from each other in the up-down direction. Each guide bar 32 is attached to the base plate 31 in such a way that both end portions thereof are supported by the pair of support portions 31 b.

[0026] Each support portion 31 b is formed in the base plate 31 so that, with respect to the thickness direction, a part of the support portion 31 b protrudes further than the front surface of the base portion 31 a (a surface opposite to a surface (back surface) that faces the sensor rod 14 when attached to the sensor rod 14) in a direction away from the back surface, that is, backward in the front-back direction (hereinafter, simply referred to as "backward") in a state in which the yarn breakage sensor 30 is attached to the sensor rod 14. Accordingly, each guide bar 32, which is supported by the support portions 31 b, is disposed so that, with respect to the thickness direction, a part thereof protrudes slightly further backward than the front surface of the base portion 31 a.

[0027] The base plate 31 includes a pair of protrusions 33 in which a light emitter and a light receiver (described below) are disposed. The pair of protrusions 33 are disposed at a substantially central part of the base plate 31 in the width direction so as to be separated from each other in the up-down direction with the substantially central part of the base plate 31 therebetween in the up-down direction. Each protrusion 33 is formed by, for example, press-forming the base portion 31 a, which has a plate-like shape, so that a part of the base portion 31 a is deformed (protrudes) in the thickness direction. Accordingly, the inside of each protrusion 33 is hollow.

[0028] Each protrusion 33 has, for example, a shape shown in the figures. A peripheral surface 33a of the pro-

trusion 33 close to the center of the base plate 31 (one of peripheral surfaces of the protrusion 33 that is not parallel to the front surface of the base portion 31 a) is a flat surface that is perpendicular to the front surface of the base portion 31 a and that extends parallel to the width direction. Accordingly, the peripheral surfaces 33a of the pair of protrusions 33, which are near the center of the base plate 31, face each other. Thus, the base plate 31 has the pair of facing surfaces, which are the peripheral surfaces 33a of the pair of protrusions 33 near the center of the base plate 31, which are separated from each other in the up-down direction and face each other, and which extend parallel to the width direction. The base plate 31 has a space 31 c (yarn movement path described below) between the pair of facing surfaces 33a.

[0029] Two peripheral surfaces of each protrusion 33 that are continuous with the facing surface 33a on both sides in the width direction are substantially perpendicular to the facing surfaces 33a. That is, each protrusion 33 is formed so that the two peripheral surfaces (both side-peripheral surfaces), which are peripheral surfaces that are continuous with the facing surface 33a on both sides of the facing surface 33a in the width direction, extend parallel to the vertical direction (up-down direction) of the base portion 31a. In the yarn breakage sensor 30 according to the present embodiment, the both side-peripheral surfaces of the each protrusion 33 are attachment surfaces to which a yarn guide (described below) is to be attached.

[0030] The yarn breakage sensor 30, including the base plate 31 having such a structure and the pair of guide bars 32, is attached to the sensor rod 14 with the aforementioned disposition in a state in which the back surface of the base plate 31 faces the sensor rod 14. When the yarn T is pulled out from the yarn supply package P, which is hung on the peg 12b corresponding to the yarn breakage sensor 30, the yarn T is guided by the tension rods 16 as described above from a position in front of the yarn breakage sensor 30 toward the yarn breakage sensor 30 and is looped over each of the pair of guide bars 32 of the yarn breakage sensor 30. Thus, the yarn T is guided along the base portion 31 a in the width direction on the base plate 31 of the yarn breakage sensor 30 (Fig. 5A).

[0031] The position of the yarn T, which is guided so as to cross the yarn breakage sensor 30 as described above, in the up-down direction is set so that the yarn T passes through the space 31 c, which is formed by the pair of facing surfaces 33a of the pair of protrusions 33. Accordingly, when the yarn T is supplied to the take-up device 20, the yarn T passes (moves) through the space 31 c in the yarn breakage sensor 30, and the space 31c serves as a yarn movement path through which the yarn T, pulled out from the yarn supply package P, moves.

[0032] Moreover, as described above, each of the pair of guide bars 32 is disposed in the yarn breakage sensor 30 so that, with respect to the front-back direction, a part thereof protrudes slightly further backward than the front

surface of the base portion 31 a. Accordingly, the yarn T, which is looped over the pair of guide bars 32 and guided as described above, moves through the yarn movement path 31 c at a position at which the yarn T is separated from the front surface of the base portion 31 a backward with respect to the front-back direction.

[0033] To detect the state of movement of the yarn T, which is moving through the yarn movement path 31 c, the yarn breakage sensor 30 includes a light emitter 35a and a light receiver 35b, which constitute an optical sensor (Figs. 5A and 5B). The light emitter 35a and the light receiver 35b are disposed in the pair of protrusions 33 of the base plate 31. To be specific, the light emitter 35a is disposed in one of the pair of protrusions 33 of the base plate 31 (in the example shown in the figures, the protrusion 33 on the upper side) and the light receiver 35b is disposed on the other one of the pair of protrusions 33. Moreover, holes 33b are formed in the facing surfaces 33a of the pair of protrusions 33. The holes 33b are holes for exposing the light emission surface of the light emitter 35a or the light receiving surface of the light receiver 35b to the yarn movement path 31 c. The holes 33b have shapes corresponding to the light emission surface and the light receiving surface (rectangular shapes in the example shown in the figures). Thus, the light emitter 35a and the light receiver 35b are disposed in the protrusions 33 as described above in such a way that the light emission surface and the light receiving surface thereof are exposed to the yarn movement path 31 c through the holes 33b in the facing surfaces 33a.

[0034] With the structure of the optical sensor, light (visible light, laser light, or the like) emitted by the light emitter 35a is received by the light receiver 35b, and the optical axis of the optical sensor crosses the yarn movement path 31 c in the up-down direction. Therefore, when the yarn T is moving through the yarn movement path 31 c in the width direction, the state of movement of the yarn T is detected by detecting the amount of light received by the light receiver 35b. To be specific, when the yarn T, which has multiple pieces of fluff on the surface thereof, is moving, the fluff moves and accordingly the amount of light received changes. Moreover, because the yarn T moves through the yarn movement path 31c while vibrating (being displaced) in the up-down direction as described above, the amount of light received changes also due to the vibration of the yarn T. Accordingly, when the yarn T is moving normally, the amount of light received represents a composite of the two changes. In other words, if yarn breakage occurs and movement of the yarn T stops, the amount of received light only negligibly changes, because the movement of fluff and the vibration of the yarn T described above do not occur. The yarn breakage sensor 30 includes a circuit board (not shown) for detecting the amount of light received, and the circuit board generates a signal that represents the change in the amount of light received as a waveform.

[0035] The signal, which is generated by the yarn breakage sensor 30 (the circuit board), is output to a yarn

breakage detector (not shown) disposed on the creel device. The yarn breakage detector determines whether or not yarn breakage has occurred by comparing a waveform representing the change in the amount of light received (received-light waveform), which is represented by the signal, with, for example, a reference threshold (or a reference waveform).

[0036] As described above, the yarn breakage sensor 30 according to the present embodiment also functions as the brake device described in Japanese Unexamined Patent Application Publication No. 2006-298522. Therefore, the yarn breakage sensor 30 includes a brake plate 40, which does not contribute to detection of yarn breakage. Descriptions of the structure and operation as the brake device will be omitted here, because they are the same as those described in Japanese Unexamined Patent Application Publication No. 2006-298522.

[0037] According to the present invention, the yarn breakage sensor 30, which is structured as described above, includes a yarn guide for suppressing the vibration of the yarn T in the yarn movement path 31 c when the yarn T is moving. Hereinafter, the structure and the like of the yarn guide of the yarn breakage sensor 30 according to the present embodiment will be described.

[0038] First, the yarn breakage sensor 30 according to the present embodiment includes a pair of yarn guides on both sides of the yarn movement path 31 c in the width direction. That is, the yarn guides are disposed on both of the upstream side (closer to the yarn supply package P) and the downstream side (closer to the take-up device 20) of the yarn movement path 31 c with respect to a path (movement path) of the yarn T, which extends from the yarn supply package P to the take-up device 20 through the yarn movement path 31c of the yarn breakage sensor 30. The pair of yarn guides are constituted by a pair of guide members 37. In other words, the yarn breakage sensor 30 according to the present embodiment includes the pair of guide members 37, and each of the guide members 37 corresponds to a yarn guide according to the present invention.

[0039] Each guide member 37 is a plate-shaped member that is made of a material (such as ceramics) that is considered to be appropriate for guiding the yarn T. As illustrated in Fig. 6A, each guide member 37 is formed so as to have a substantially angular U-shape as seen in the thickness direction by cutting out a part of a substantially rectangular member. That is, each guide member 37 has a substantially rectangular shape having a rectangular cutout 37a for allowing the yarn T to pass through the guide member 37. When seen in the thickness direction, the cutout 37a is located at a central part of the guide member 37 and is cut so as to be open in one of two end surfaces (perpendicular to the thickness direction) and one of peripheral surfaces (parallel to the thickness direction).

[0040] The dimension of each guide member 37 in the longitudinal direction (longitudinal dimension) is greater than the distance between the pair of facing surfaces 33a

of the base plate 31 in the up-down direction. The dimension of each guide member 37 in the transversal direction (transversal dimension) is greater than the dimension of the protrusion 33 in a protruding direction in which the protrusion 33 protrudes from the base portion 31 a of the base plate 31. The dimension of the cutout 37a, which is formed as described above, in the longitudinal direction, that is, the distance between upper and lower inner side surfaces 37a1, which are two of inner side surfaces that face each other in the longitudinal direction, is smaller than the distance between the pair of facing surfaces 33a of the base plate 31.

[0041] The pair of guide members 37 are disposed on the base plate 31 so as to be attached to the protrusions 33 at positions such that the yarn movement path 31 c in the base plate 31 is located between the pair of guide members 37 with respect to the width direction.

[0042] To be specific, each guide member 37 is disposed in such a direction that a peripheral surface thereof (hereinafter, referred to as a "back side surface") in which the cutout 37a is open is parallel to the up-down direction (the vertical direction of the base portion 31 a) so that the cutout 37a is located at a substantially central part of the yarn movement path 31 c in the base plate 31 with respect to the up-down direction. With respect to the front-back direction, each guide member 37 is disposed in such a direction that the cutout 37a extends parallel to the front-back direction so that the position of the back side surface coincides with the positions of end surfaces (parallel to the front surface of the base portion 31 a) of the protrusions 33 of the base plate 31.

[0043] One of the pair of guide members 37 is attached to the pair of protrusions 33 in a state in which the guide members 37 are in contact with an upstream one of the two attachment surfaces of each protrusion 33. Likewise, the other guide member 37 is attached to the pair of protrusions 33 in a state in which the guide members 37 are in contact with a downstream one of the two attachment surfaces of each protrusion 33. Accordingly, the pair of guide members 37 are disposed on the base plate 31 at positions that are adjacent to both ends of the yarn movement path 31 c in the base plate 31 with respect to the width direction in such a way that the guide members 37 are present in an area that covers the yarn movement path 31 c in the base plate 31 with respect to the up-down direction and the guide members 37 straddle the pair of protrusions 33. When each guide member 37 is attached to the base plate 31 (the pair of protrusions 33), the cutout 37a of each guide member 37 is located at a substantially central part of the yarn movement path 31 c with respect to the up-down direction, that is, at equal distance from the facing surfaces 33a.

[0044] The dimension of the cutout 37a of each guide member 37 in the transversal direction is substantially the same as the dimension of the protrusion 33 in the protruding direction (the front-back direction). Accordingly, when each guide member 37 is attached to the base plate 31 (the pair of protrusions 33) as described above,

a bottom surface 37a2 (one of inner side surfaces that is parallel to the longitudinal direction of the guide member 37) of the cutout 37a is located at substantially the same position as the front surface of the base portion 31 a in the front-back direction.

[0045] As described above, the dimension of each guide member 37 in the transversal direction of is greater than the dimension of the protrusion 33 in the protruding direction. Therefore, a peripheral surface of the guide member 37 (hereinafter, referred to as "front side surface") that is parallel to the back side surface is located farther than the base portion 31 a from the protrusions 33 (closer to the sensor rod 14 or forward) in the front-back direction. That is, a part of each guide member 37 that is closer than the cutout 37a to the front side surface in the transversal direction is located (disposed) closer than the front surface of the base portion 31 a to the sensor rod 14.

[0046] Therefore, the base portion 31 a has a hole that allows each guide member 37 to be disposed in such a way and that extends through the base portion 31 a in the thickness direction in accordance with the position of each guide member 37. The base plate 31 has a shape such that, when the yarn breakage sensor 30 is attached to the sensor rod 14, the back surface of the base portion 31 a is separated from the one of the large-width side surfaces of the sensor rod 14 in the front-back direction as illustrated in Fig. 5B. Accordingly, when the yarn breakage sensor 30 is attached to the sensor rod 14, a gap is formed between the back surface of the base portion 31 a and the one of the large-width side surfaces of the sensor rod 14, and a part of the guide member 37 that is closer than the cutout 37a to the front side surface is located in the gap.

[0047] When the yarn T moves through the yarn movement path 31 c in the yarn breakage sensor 30, which includes the pair of guide members 37 disposed as described above, the yarn T passes through the cutout 37a of each guide member 37 at a position of each guide member 37 in the width direction. Thus, the aforementioned vibration of the yarn T in the up-down direction, which occurs as the yarn T is pulled out from the yarn supply package P, is restrained by the upper and lower inner side surfaces 37a1, which face each other in the longitudinal direction (up-down direction), of the cutout 37a of at least the upstream one of the guide members 37. Accordingly, the upper and lower inner side surfaces 37a1 of the guide member 37 serve as restraining surfaces that restrain the vibration of the yarn T. That is, each guide member 37 has the pair of restraining surfaces 37a1 that restrain the vibration of the yarn T.

[0048] In the yarn breakage sensor 30 according to the present invention, the distance d between the pair of restraining surfaces 37a1 of each guide member 37 (in the up-down direction) is smaller than or equal to 1/2 of the distance D between the pair of facing surfaces 33a (of the base plate 31) of the yarn breakage sensor 30 (Fig. 6A).

[0049] If a yarn contacts each facing surface, dust adheres to the light emitting/receiving surfaces of the light emitter/receiver of the yarn breakage sensor. Such contact occurs because of the aforementioned vibration of the yarn. Therefore, in order to suppress adherence of dust, it is necessary to suppress vibration of the yarn in the yarn movement path of the yarn breakage sensor. The inventors of the present invention carried out in-depth research by examining the structure of general creel devices, the types of yarn supply packages held in the creel devices, and the like. As a result, the inventors found that it is possible to reduce the vibration of the yarn T in the yarn movement path to a level at which adherence of dust due to the vibration and occurrence of a trouble caused by the dust can be suppressed by using the following structure: providing the yarn breakage sensor with a yarn guide (guide member) having a pair of restraining surfaces for suppressing the vibration of the yarn, the pair of restraining surfaces facing each other with a distance, which is smaller than the distance between the pair of facing surfaces, therebetween; and making the distance between the pair of restraining surfaces of the yarn guide be smaller than or equal to $1/2$ of the distance between the pair of facing surfaces. Thus, in the yarn breakage sensor according to the present invention, the distance between the pair of facing surfaces of the yarn guide is set smaller than or equal to $1/2$ of the distance between the pair of facing surfaces that define the yarn movement path.

[0050] To be specific, in the present embodiment, the distance d between the pair of restraining surfaces 37a1 of each guide member 37, which corresponds to the yarn guide, is 1.5 mm, and the distance D between the pair of facing surfaces 33a is about 6 mm. Thus, in the yarn breakage sensor 30 according to the present embodiment, the distance d between the pair of restraining surfaces 37a1 is smaller than $1/3$ of the distance D between the pair of facing surfaces 33a. By making the distance between the pair of restraining surfaces 37a1 smaller, the vibration of the yarn T can be more effectively suppressed, and adherence of dust to the light emitting/receiving surfaces can be further reduced.

[0051] The present invention is not limited to the embodiment (exemplarily embodiment) described above and may be embodied in the following embodiments (modifications).

(1) In the embodiment described above, the yarn breakage sensor 30 includes the guide members 37, each of which corresponds to a yarn guide, which have the same structure, and which are disposed on both of the upstream side and the downstream side of the yarn movement path 31c. However, the structure of a yarn breakage sensor according the present invention is not limited to such a structure in which the yarn guides are disposed on both sides of the yarn movement path 31 c. The yarn guide may be disposed only on the upstream side of the yarn move-

ment path.

[0052] To be specific, the vibration of the yarn, which causes adherence of dust to the light emitting/receiving surfaces as described above, occurs due to rotation of the unwinding point of the yarn along the peripheral surface of the yarn supply package as the yarn is pulled out from the yarn supply package. Therefore, the vibration occurs at a position on the upstream side of the yarn movement path. Therefore, even with a structure in which the yarn guide is disposed only on the upstream side of the yarn movement path, it is possible to suppress the vibration of the yarn in the yarn movement path. Accordingly, the yarn breakage sensor according to the present invention may have a structure in which the yarn guide is disposed only on the upstream side of the yarn movement path. In this case, in the structure of the embodiment described above, the guide member 37 is disposed only on the upstream side of the yarn movement path 31 c.

[0053] However, with the structure in which the yarn guides are disposed on both sides of the yarn movement path as in the embodiment described above, it is possible to suppress the vibration of the yarn in the yarn movement path more effectively than with the structure in which the yarn guide is disposed only on the upstream side of the yarn movement path.

[0054] In the structure in which the yarn breakage sensor includes the guide members on both sides of the yarn movement path as in the embodiment described above, that is, the yarn breakage sensor includes a pair of guide members, it is not necessary that the pair of yarn guides be structurally the same as each other as in the embodiment, and the yarn guides may be structurally different from each other. For example, the guide members may be formed so that the distance between a pair of restraining surfaces of one of the guide members on the upstream side is smaller than the distance between a pair of restraining surfaces of the other guide member on the downstream side. In this case, the distance between the pair of restraining surfaces of the guide member on the downstream side may be smaller than or equal to $1/2$ or may be greater than $1/2$ of the distance between the pair of facing surfaces that define the yarn movement path. In the former case, the guide member corresponds to a yarn guide according to the present invention. In the latter case, the guide member does not correspond to a yarn guide according to the present invention. That is, in the latter case, the yarn breakage sensor has a structure in which a yarn guide according to the present invention is disposed only on the upstream side of the yarn movement path.

[0055] In the case where a yarn breakage sensor includes guide members on both sides of the yarn movement path, it is preferable that the structures of the guide members, including the distance between the pair of restraining surfaces, be the same. That is, the number of yarn breakage sensors in one creel device, which is the same as the number of yarn supply packages that can

be hung on the creel device, is several hundreds (or several thousands or more). Accordingly, it is necessary to prepare a considerably large number of yarn guides. In this case, it is advantageous, in the manufacturing cost and the like, to use yarn guides all of which have the same structure. Thus, in the case where a yarn breakage sensor includes a pair of yarn guides, preferably, the pair of yarn guides have the same structure.

[0056] In the embodiment described above, regarding the structure of the yarn guide, the yarn breakage sensor includes guide members each of which is a single member having a cutout that is formed so as to have a pair of restraining surfaces and which corresponds to a yarn guide according to the present invention. However, in a yarn breakage sensor according to the present invention, it is sufficient that a yarn guide have a pair of restraining surfaces, and it is not necessary that the yarn guide is a single member as in the embodiment described above. For example, two members having surfaces that serve as restraining surfaces may be disposed so that the restraining surfaces face each other in the up-down direction, and the two members may constitute a yarn guide.

[0057] In the embodiment described above, a yarn breakage sensor includes a pair of yarn guides disposed on both sides of the yarn movement path. In this case, however, it is not necessary that the pair of yarn guides of the yarn breakage sensor be constituted by the pair of guide members as in the embodiment. The pair of yarn guides may be included in a single member. For example, a single member including portions (guide portions), which are formed in the same way as the guide members according to the embodiment described above, at two positions that are separated from each other in the width direction may be attached to the base plate of the yarn breakage sensor, and the guide portions of this member may serve as a pair of yarn guides.

[0058] In the yarn guide according to the present invention, it is sufficient that the distance between the pair of restraining surfaces be smaller than or equal to $1/2$ of the distance between the pair of facing surfaces of the yarn breakage sensor (base plate). However, it is preferable that the distance be smaller and further preferable that the distance be smaller than $1/3$ of the distance between the facing surfaces as in the embodiment described above. Needless to say, it is necessary that the distance between the pair of restraining surfaces be greater than the thickness (diameter) of the yarn in the yarn supply package that is disposed in the creel device.

(2) Regarding the yarn guide, the pair of restraining surfaces of the yarn guide are located above or below the path of a yarn in the yarn movement path in the yarn breakage sensor so as to surround the path in the front-back direction. In other words, in the front-back direction, the restraining surfaces may be present only in a region (necessary region) including the path of the yarn. In the embodiment described above, the restraining surfaces of the yarn guide

(guide member 37) have transversal dimensions such that the back side surface extends from substantially the same position, in the front-back direction, on the front surface of the base plate. That is, the yarn guide according to the embodiment is present with respect to the front-back direction over a region extending from a position that is closer than the front surface of the base plate 31 to the sensor rod 14 to the end surface of the protrusion 33. However, it is not necessary that a yarn guide according to the present invention be present over such a region. A yarn guide according to the present invention may be formed so that the pair of restraining surfaces is present in the necessary region including the path of the yarn T with respect to the front-back direction. Accordingly, a member that serves as the yarn guide may be present at least in the necessary region in the front-back direction.

[0059] In the embodiment described above, the guide member 37, which serves as a yarn guide, has the cutout 37a that has an opening in the back side surface for inserting the yarn T between the pair of restraining surfaces. All of the inner side surfaces 37a1 the cutout 37a, which face each other in the up-down direction, serve as restraining surfaces. However, as described above, it is sufficient that the restraining surfaces be present at least in the necessary region in the front-back direction. Therefore, as in a guide member 39 illustrated in Fig. 9, parts of upper and lower inner side surfaces of the cutout of the yarn guide near the back side surface (near the opening) need not function as restraining surfaces.

[0060] To be specific, as with the guide member 37 according to the embodiment described above, the guide member 39 illustrated in Fig. 9 is a plate-shaped member in which a cutout 39a is formed. In the cutout 39a, the distance between the upper and lower side surfaces is the largest at the back side surface. As seen in the thickness direction, in a region (denoted by R1 in Fig. 9) from the back side surface to a boundary position (denoted by S in Fig. 9) near the middle in the transversal direction, the distance between the upper and lower side surfaces gradually decreases toward the boundary position S and becomes the smallest at the boundary position S. In a region (denoted by R2 in Fig. 9) closer than the boundary position S to the front side surface, the distance between the upper and lower side surfaces is uniform.

[0061] In the guide member 39, which has the cutout 39a formed as described above, the region R2 is the necessary region, and upper and lower inner side surfaces 39a1 in the region R2 of the cutout 39a correspond to a pair of restraining surfaces in the present invention. In the guide member 39, the distance between upper and lower inner side surfaces 39a3 in the region R1 of the cutout 39a is greater than the distance between the pair of restraining surfaces 39a1 in the region R2 with respect to the up-down direction. This structure is advantageous in guiding a yarn into the yarn movement path in the yarn

breakage sensor when, for example, setting a yarn supply package in the creel device.

[0062] Regarding the necessary region described above, the light emitter/receiver of the yarn breakage sensor is disposed at a position such that the optical axis thereof includes the path of the yarn with respect to the front-back direction. In other words, the path of the yarn necessarily passes through the optical axis of the light emitter/receiver with respect to the front-back direction. Accordingly, the necessary region (including the path of the yarn) can be defined, in relation to the device structure, as a region that is included in a region in which the light emitter/receiver is present in the front-back direction. Each restraining surface of the yarn guide extends over a region including the necessary region with respect to the front-back direction.

(3) In the embodiment described above, the guide member 37, which serves as a yarn guide, is disposed on the base plate 31 at a position that is adjacent to the protrusions 33 of the base plate 31 (the yarn movement path 31 c) in the aforementioned direction. However, in a yarn breakage sensor according to the present invention, the position of the yarn guide is not limited to the position that is adjacent to the yarn movement path in the width direction even if the yarn guide is attached to the base plate as in the embodiment. The position of the yarn guide may be separated from the yarn movement path in the width direction. Even if the yarn guide is disposed at a position that is separated from the yarn movement path in the width direction, the pair of restraining surfaces of the yarn guide are disposed so as to face each other in the up-down direction with a substantially central part of the yarn movement path therebetween as seen in the width direction.

[0063] In the yarn breakage sensor according to the present invention, the yarn guide need not be attached to the base plate and disposed on the base plate. The yarn guide may be disposed outside a region in which the base plate is present with respect to the width direction. To be specific, Figs. 7A to 8 illustrate an example of such a yarn guide. In the example illustrated in Figs. 7A to 8, as with the embodiment described above, yarn guides are disposed on both sides of the yarn movement path in the width direction.

[0064] In this example, a yarn breakage sensor 30' includes a bracket 34 for supporting guide members 38, which serve as a yarn guide. The bracket 34 includes a pair of thin-plate-shaped side walls 34a and a pair of thin-plate-shaped connection portions 34b. The side walls 34a are located so as to be separated from each other and face each other in a state in which the thickness directions thereof coincide. The connection portions 34b are integrally formed with the side walls 34a and connect the side walls 34a to each other. The bracket 34 is structured so that each connection portion 34b is continuous

with one of peripheral surfaces (parallel to the thickness direction) of each side wall 34a (connect the pair of side walls 34a at the peripheral surfaces). As seen in the thickness direction of the side walls 34a, the bracket 34 has a shape such that the dimension thereof in an extension direction in which the peripheral surface of the side wall 34a that is continuous with the connection portion 34b extends is sufficiently greater than the dimension thereof in a direction perpendicular to the extension direction. The bracket 34 has a structure in which, with respect to the longitudinal direction of the bracket 34, one of the pair of connection portions 34b is located near one end of each of the side walls 34a and the other of the pair of connection portions 34b is located near the other end of each of the side walls 34a.

[0065] The distance between the pair of side walls 34a of the bracket 34 is slightly greater than the dimension of the base plate 31 in the width direction. The distance between the pair of connection portions 34b in the longitudinal direction of the bracket 34 is slightly greater than the dimension of the base plate 31 in the up-down direction. That is, in the bracket 34, a space defined by the pair of side walls 34a and the pair of connection portions 34b as seen in the thickness direction of the connection portions 34b has a size in which the base plate 31 can be accommodated.

[0066] The bracket 34 is attached to the sensor rod 14 in such a way that the pair of side walls 34a face the two small-width side surfaces of the sensor rod 14 and the connection portions 34b face the one of the large-width side surfaces of the sensor rod 14. With respect to the up-down direction, the position of the bracket 34 is set so that the base plate 31, which is attached to the sensor rod 14, is located between the pair of connection portions 34b. Accordingly, when the bracket 34 is attached to the sensor rod 14 in this way, the thickness direction of the side walls 34a coincides with the width direction, and the thickness direction of the connection portions 34b coincides with the front-back direction.

[0067] Each side wall 34a of the bracket 34 includes a guide support portion 34c, which is formed on one of the peripheral surfaces near the connection portions 34b so as to protrude further backward than the connection portions 34b with respect to the front-back direction. In the example shown in the figures, the guide support portion 34c has a shape shown in the figures (details are omitted) and has a groove in which a corresponding one of the guide members 38, as a yarn guide, is disposed. The guide member 38 is attached to the guide support portion 34c so as to be accommodated in the groove.

[0068] The guide member 38, which is a yarn guide in this example, includes a U-shaped main portion and a hook-shaped portion formed in the main portion. Accordingly, the guide member 38 has a guide hole (eyelet) and a yarn can be inserted into the eyelet through a space between the U-shaped portion and the hook-shaped portion (Fig. 8). Such a yarn guide member of this type is commercially marketed as a component for textile ma-

chinery or the like. Thus, a yarn guide of a yarn breakage sensor according to the present invention is not limited to the yarn guide in the embodiment described above, and may have any appropriate structure that can restrain displacement of a yarn in the up-down direction.

[0069] In this example, a part of the inner peripheral surface of the eyelet of the yarn guide above the center of the eyelet serves as an upper restraining surface, a part of the inner peripheral surface of the eyelet below the center of the eyelet serves as a lower restraining surface, and the upper and lower restraining surfaces constitute a pair of restraining surfaces. In this example, when the guide member 38 is supported by the bracket 34 as described above, with respect to the up-down direction, the guide member 38 is disposed so that the center of the eyelet is located at a substantially central part of the yarn movement path as seen in the width direction; and, in the front-back direction, the guide member 38 is disposed so that the eyelet is located in the necessary region (in which the light emitter/receiver is present) as seen in the width direction.

[0070] In this example, the pair of restraining surfaces do not extend parallel to each other in the front-back direction. In this case, the distance between a pair of restraining surfaces in the present invention is the largest distance (denoted by "d" in Fig. 8) between the restraining surfaces with respect to the up-down direction in the necessary region in the front-back direction. In this example, the distance d is about 1.7 mm, the distance D between the pair of facing surfaces is about 6 mm, and d is smaller than or equal to 1/2 (smaller than 1/3) of D.

[0071] In the embodiment described above, the yarn guide has a structure in which the pair of restraining surfaces completely face each other in the up-down direction, in other words, the pair of restraining surfaces are present in the same region in the width direction as seen in the front-back direction (in a front view of the base plate). However, in a yarn breakage sensor according to the present invention, a pair of restraining surfaces of the yarn guide need not be present in the same region in the width direction. The restraining surfaces may be present in different regions (having different dimensions in the width direction and/or located at different positions in the width direction). Accordingly, for example, the pair of restraining surfaces may be located in the yarn guide at different positions that overlap in the width direction, or further alternatively, the pair of restraining surfaces may be located so as not to overlap with respect to the width direction. Thus, in a yarn breakage sensor according to the present invention, a pair of restraining surfaces of the yarn guide, which "face each other" in the up-down direction, only need to face each other as seen in the width direction. Therefore, the restraining surfaces need not face each other in such a way that the positions thereof in the width direction coincide with each other.

(4) In the embodiment described above, the yarn breakage sensor 30 also functions as a brake device

for adjusting the tension of a yarn. However, a yarn breakage sensor according to the present invention need not function as a brake device. Accordingly, the yarn breakage sensor need not include the brake plate, which is included in the embodiment.

[0072] In the embodiment described above, the yarn breakage sensor 30 includes the pair of guide bars 32 disposed on both sides of the base plate 31 in the width direction, and the guide bars 32 guide the yarn T and define the path of the yarn T in the front-back direction. However, a yarn breakage sensor need not include the guide bars. That is, a yarn breakage sensor according to the present invention need not include the pair of guide bars, which are included in the embodiment. In this case, for example, the creel device may include a pair of guide bars that are provided for each yarn breakage sensor and that are supported by the sensor rod or the like. Alternatively, for example, the creel device may include a pair of guide bars for each sensor rod, and the pair of guide bars may be used for a plurality of yarn breakage sensors attached to the sensor rod.

[0073] In the embodiment described above, the pair of facing surfaces of the base plate of the yarn guide are planar surfaces that extend parallel to each other and parallel to the width direction and the front-back direction. However, in the yarn breakage sensor according to the present invention, each of the pair of facing surfaces is not limited to such a planar surface. For example, each of the facing surfaces may be curved as seen in the front-back direction (in a front view of the base plate). In the case where each of the pair of facing surface is not planar as described above, the distance between the pair of facing surfaces of the yarn breakage sensor is not substantially uniform in the yarn movement path in the width direction. In this case, the distance between a pair of facing surfaces in the present invention is the distance between parts of the facing surfaces that are closest to each other in the up-down direction as seen in the front-back direction.

[0074] In a yarn breakage sensor according to the present invention, the shape the base plate, which is the main portion of the yarn breakage sensor, is not limited the shape shown in the embodiment described above and may be any appropriate shape that can be used in a creel device to which the present invention is applied. A yarn breakage sensor according to the present invention is not limited to any of the embodiments or modifications described above, which may be modified in various ways within the spirit and scope of the present invention.

[0075] A creel device to which a yarn breakage sensor according to the present invention is applied may be used for (supplying a yarn to) not only a take-up device, such as a warper in the embodiment described above, but for a loom for weaving a fabric or another textile machine that uses a large number of yarns.

Claims

1. A yarn breakage sensor (30, 30') for a creel device (10), the yarn breakage sensor (30, 30') having a pair of facing surfaces (33a) that face each other in an up-down direction, the yarn breakage sensor (30, 30') being provided in the creel device (10) for each yarn supply package (P) so that a yarn (T) that is pulled out from the yarn supply package (P) moves through a yarn movement path that is defined by the pair of facing surfaces (33a), and the yarn breakage sensor (30, 30') including a light emitter (35a) that is disposed in such a way that a light emission surface thereof is exposed at one of the pair of facing surfaces (33a) and a light receiver (35b) that is disposed in such a way that a light receiving surface thereof is exposed at the other of the pair of facing surfaces (33a) and the light receiver (35b) faces the light emitter (35a),
 wherein the yarn breakage sensor (30, 30') comprises a yarn guide (37, 38, 39) that is disposed at least on an upstream side, which is one of the upstream side and a downstream side, of the yarn movement path with respect to a path of the yarn (T) in which the yarn supply package (P) is on a most upstream side, the yarn guide (37, 38, 39) having a pair of restraining surfaces that face each other in the up-down direction, and
 wherein a distance (d) between the pair of restraining surfaces of the yarn guide (37, 38, 39) in the up-down direction is smaller than or equal to 1/2 of a distance (D) between the pair of facing surfaces (33a).
2. The yarn breakage sensor (30, 30') for a creel device (10) according to Claim 1,
 wherein the yarn breakage sensor (30, 30') includes a pair of protrusions (33) that are disposed so as to protrude from a base plate (31) so that the pair of facing surfaces (33a) are formed, and
 wherein the yarn guide (37, 38, 39) is disposed on the base plate (31) so as to be attached to the pair of the protrusions (33).

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FIG. 1

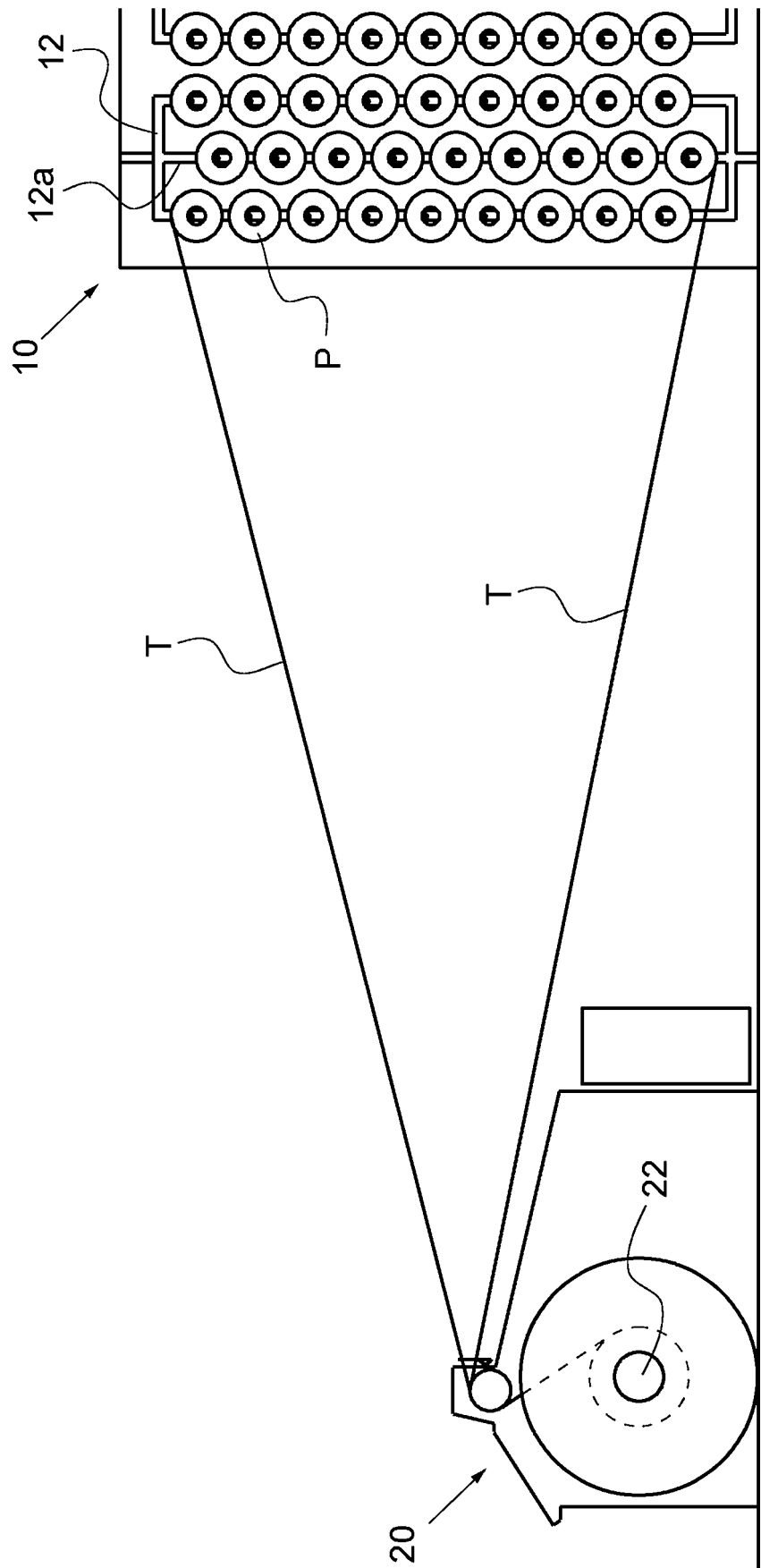


FIG. 2B

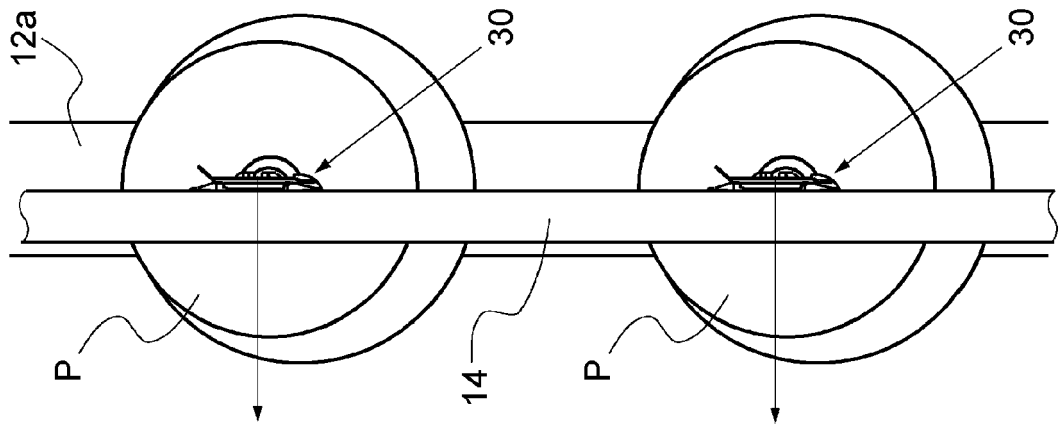


FIG. 2A

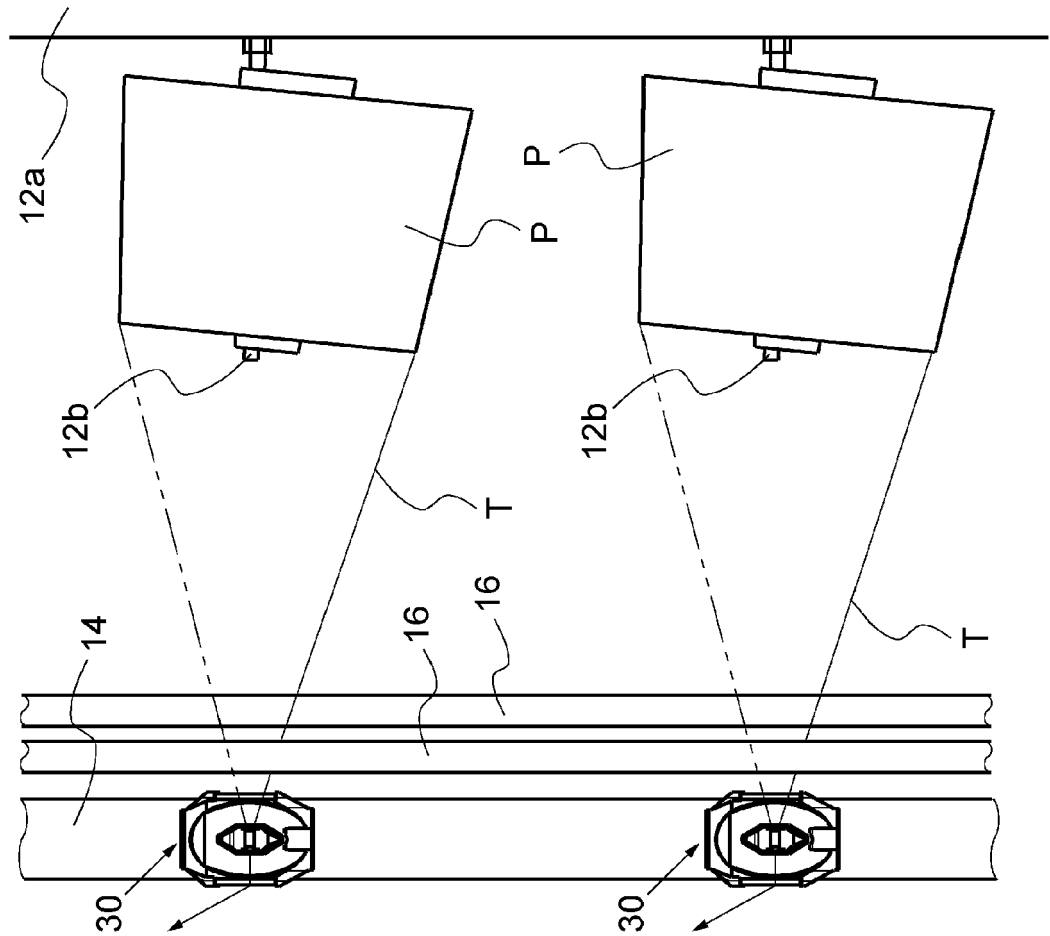


FIG. 3

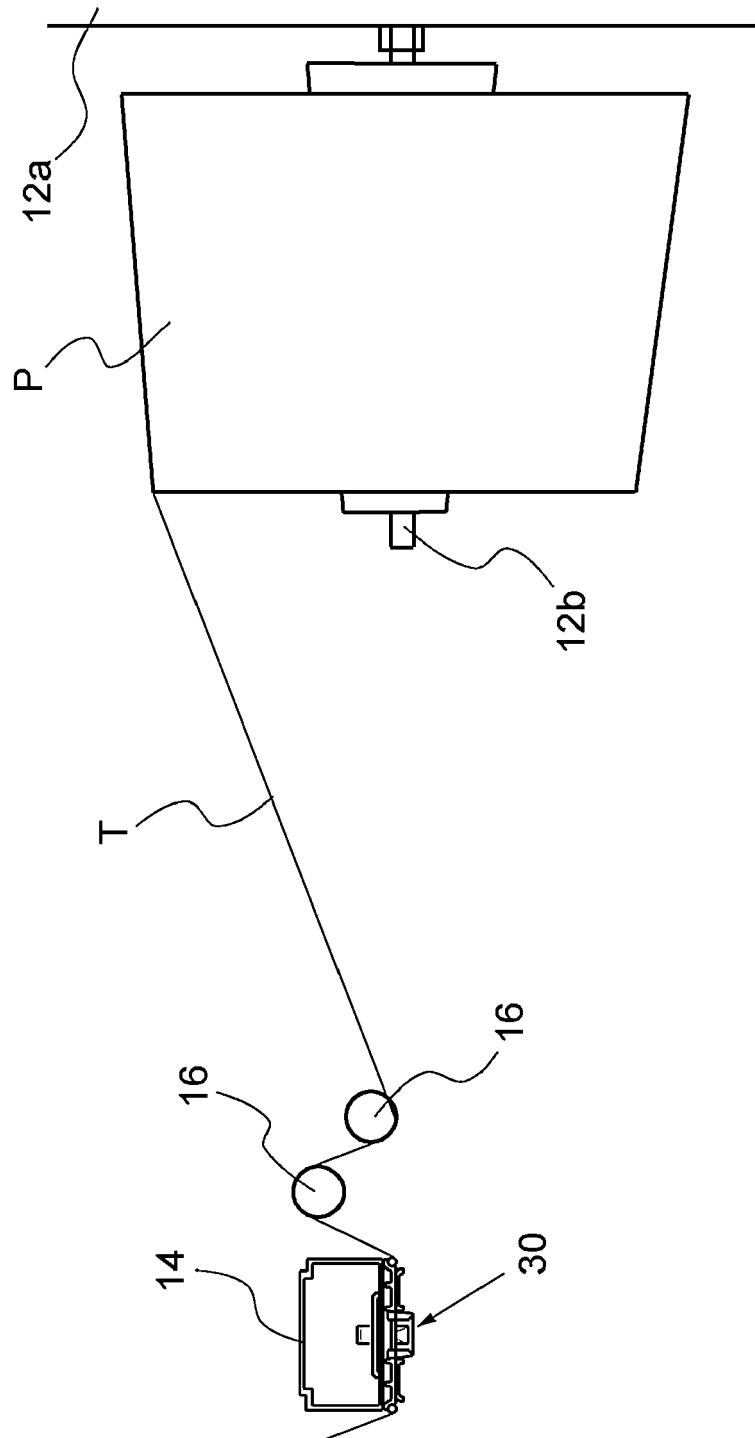


FIG. 4B

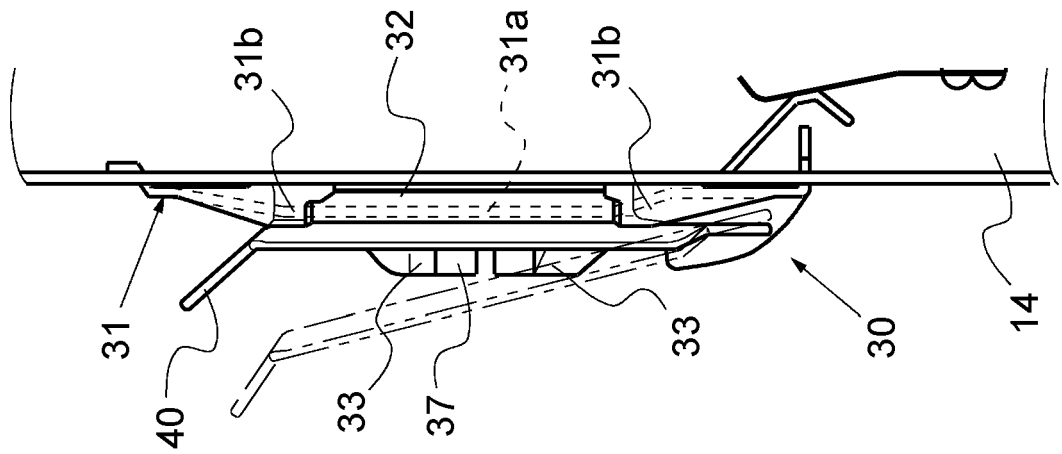


FIG. 4A

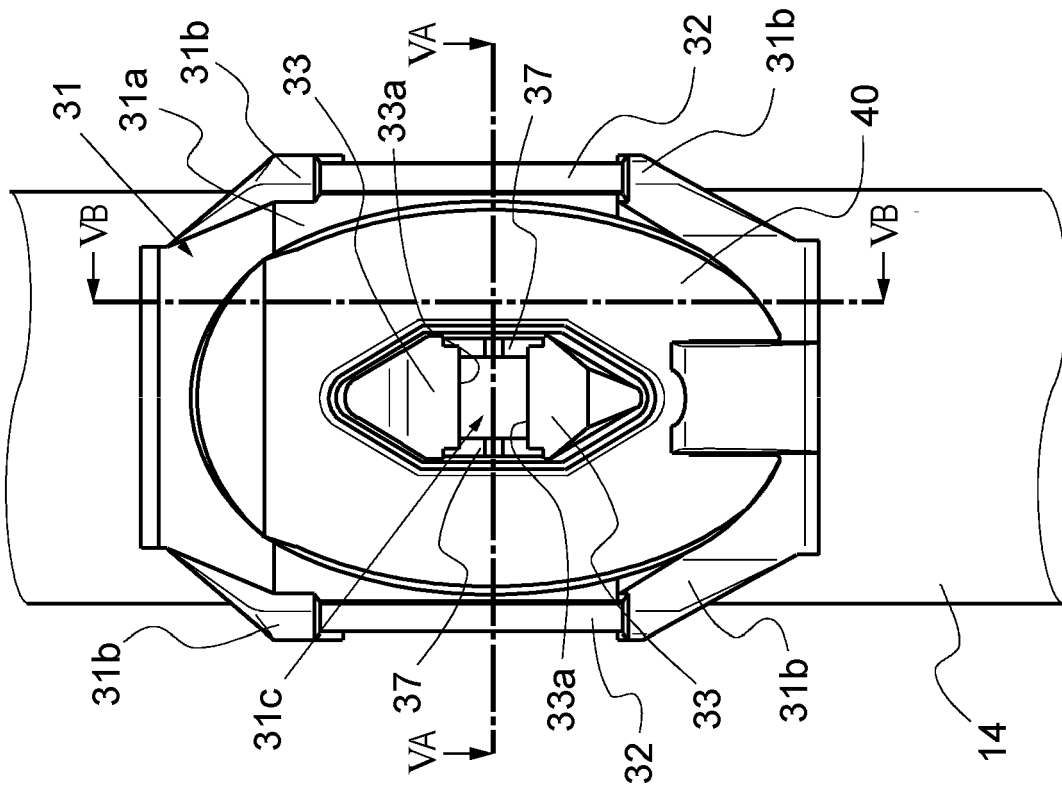


FIG. 5B

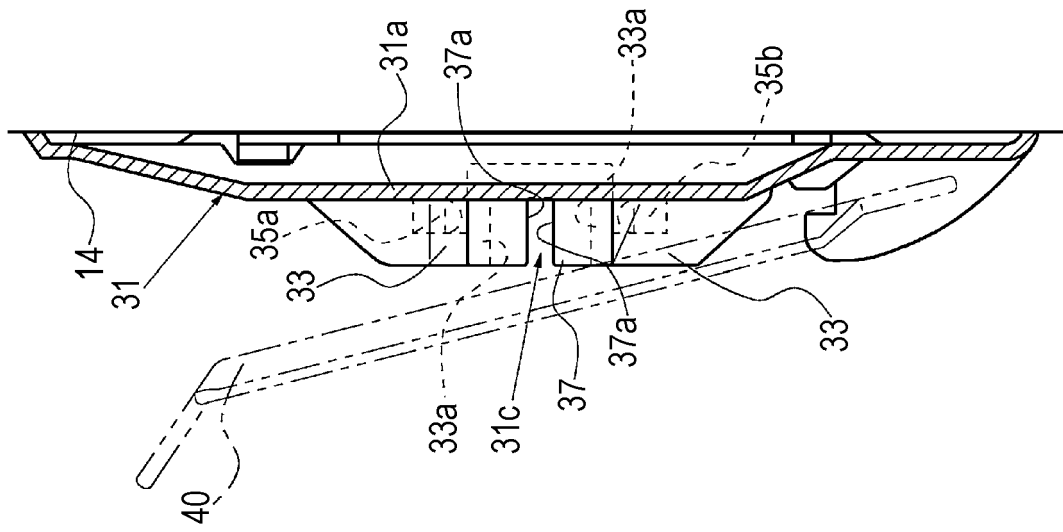


FIG. 5A

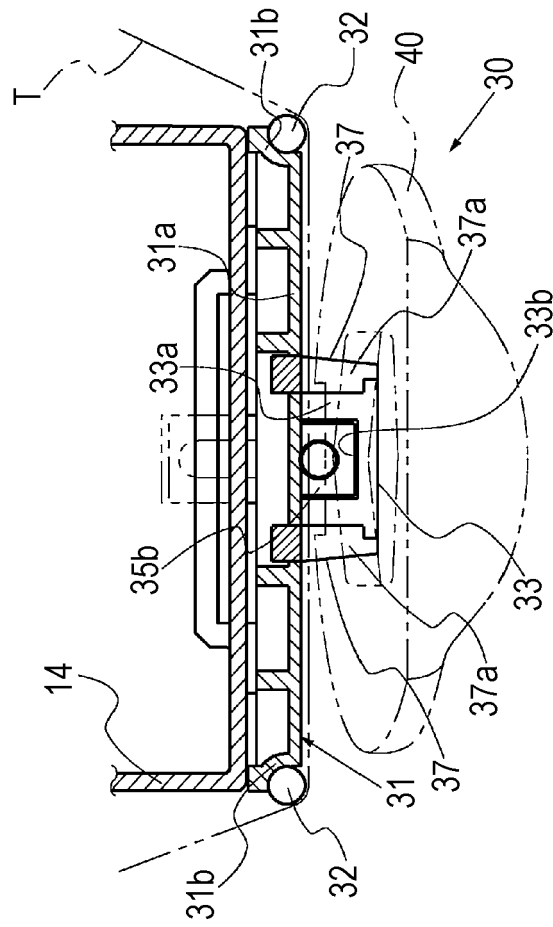


FIG. 6B

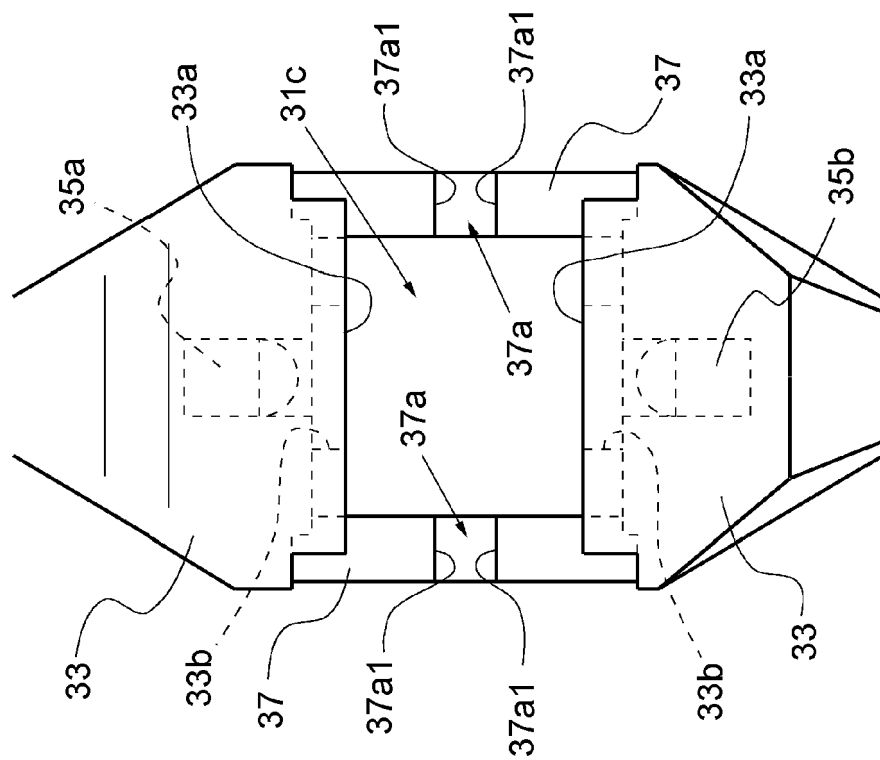


FIG. 6A

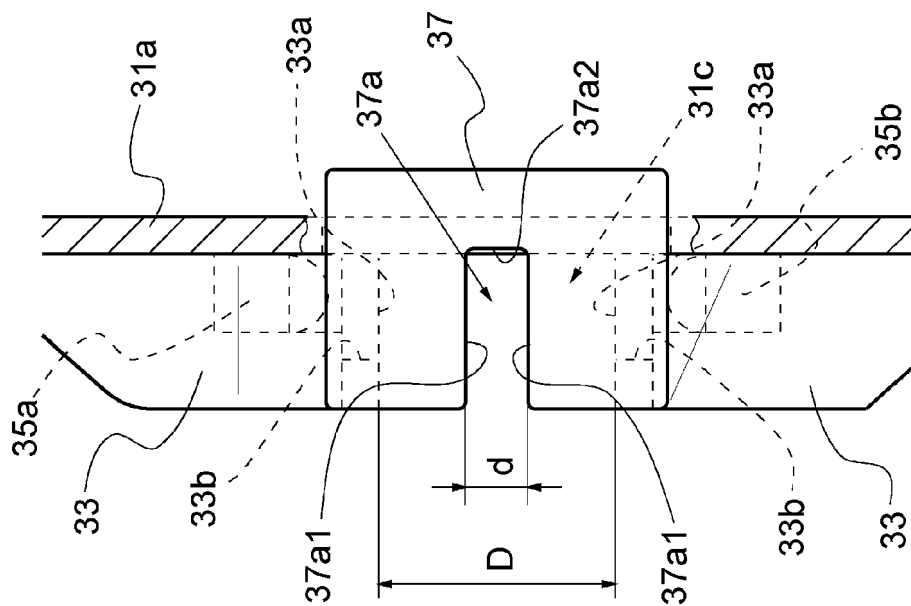


FIG. 7A

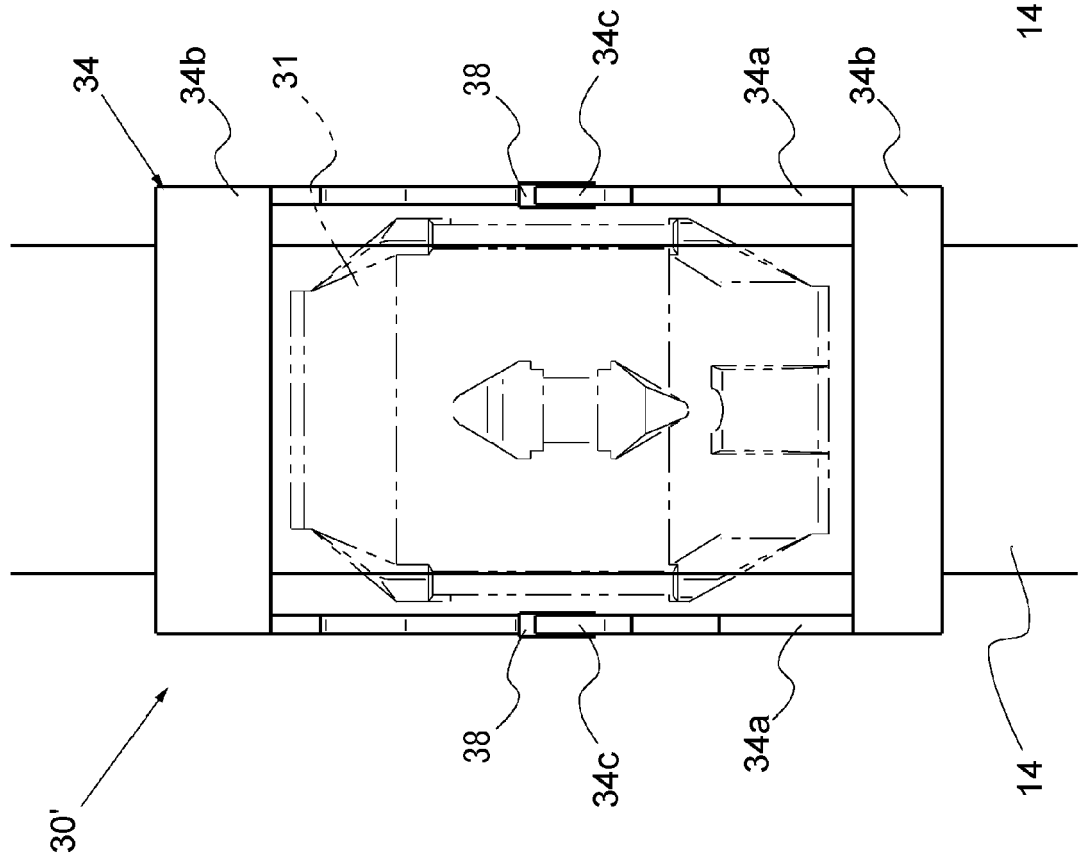


FIG. 7B

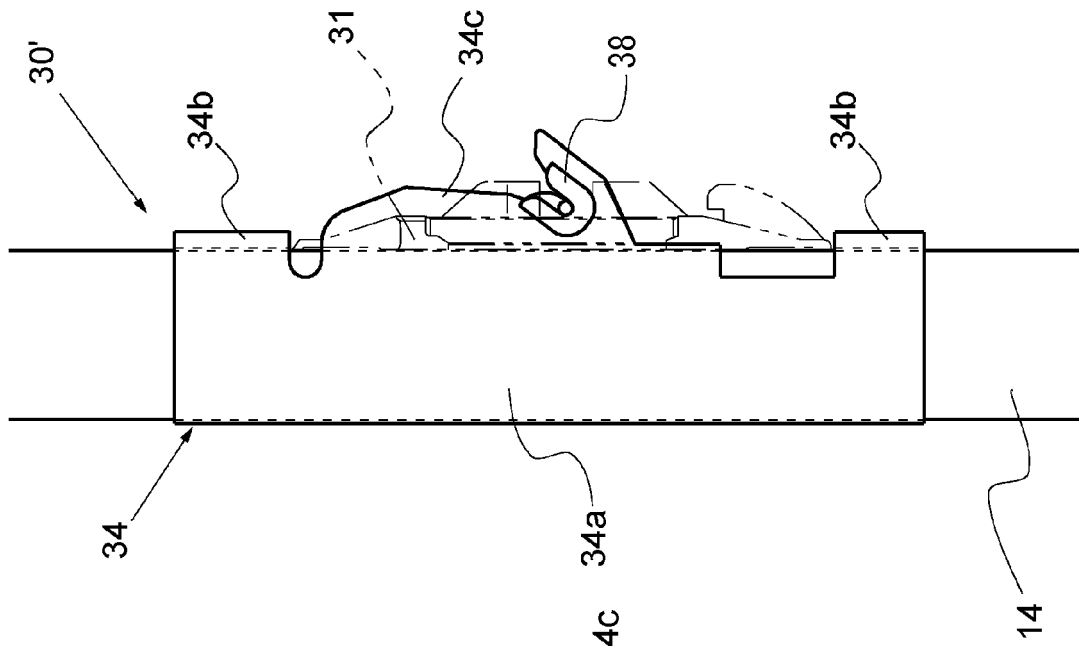


FIG. 8

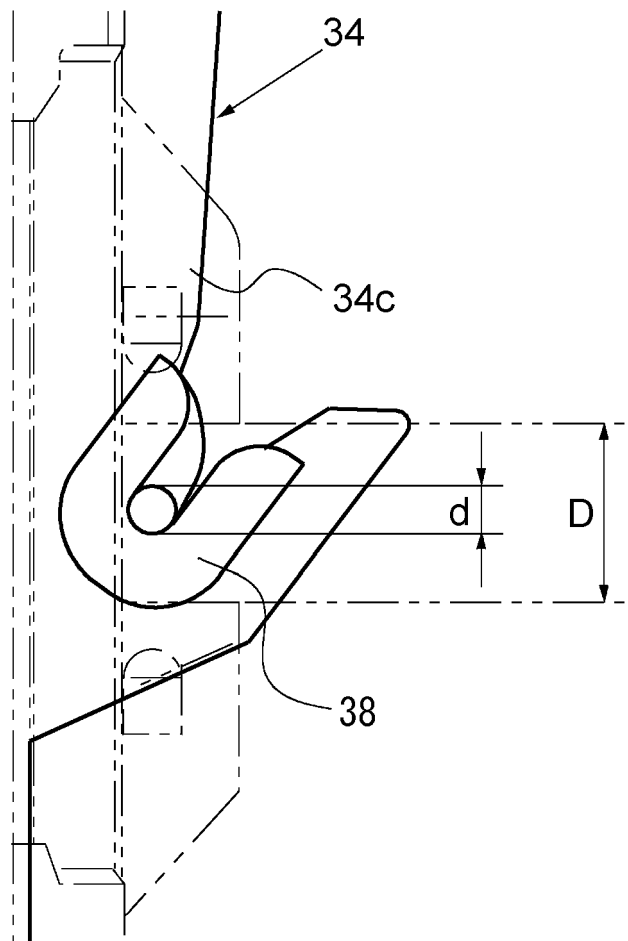
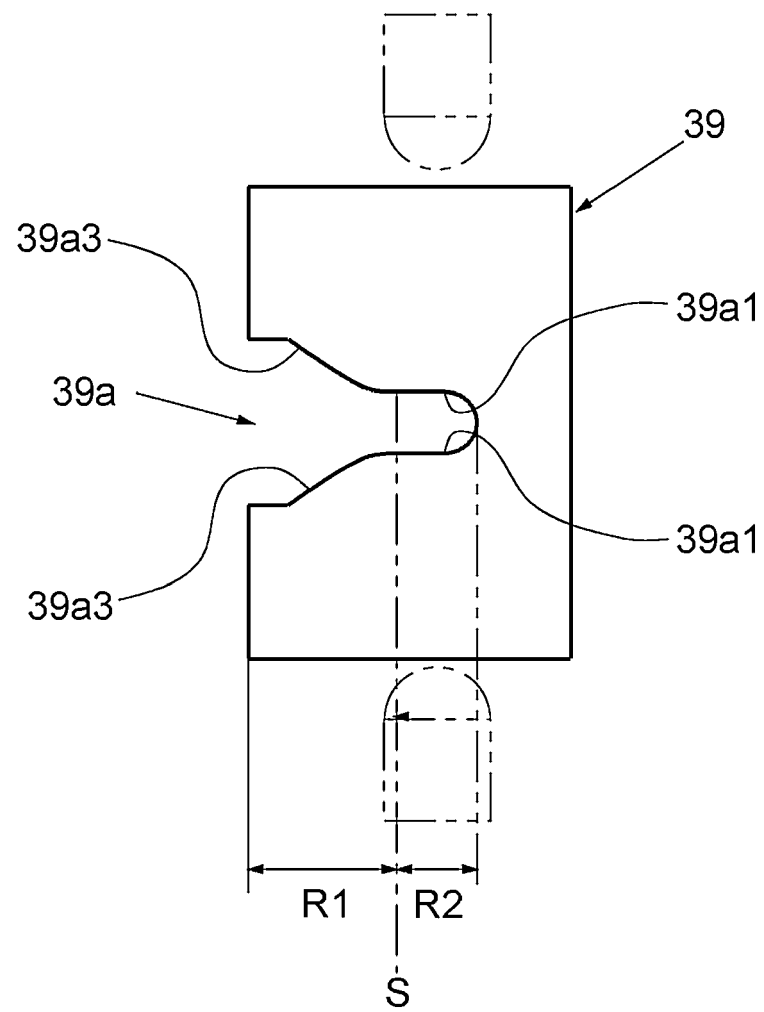


FIG. 9





EUROPEAN SEARCH REPORT

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