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(71) Applicant: **Sumitomo Wiring Systems, Ltd.**
Yokkaichi-shi, Mie 510-8503 (JP)

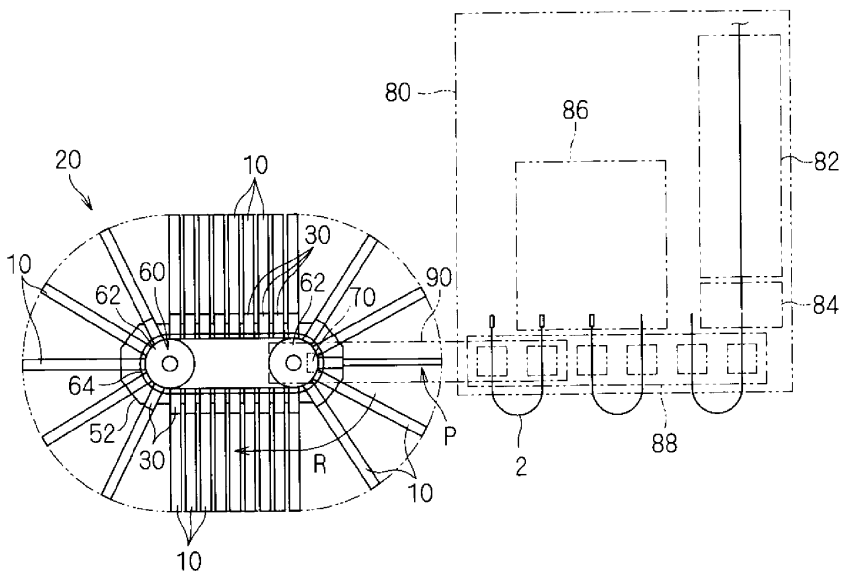
(72) Inventors:
- **GOTO Koichiro**
  Yokkaichi-shi
  Mie 510-8503 (JP)
- **SHIRAKAWA Junichi**
  Yokkaichi-shi
  Mie 510-8503 (JP)

(74) Representative: **Horn Kleimann Waitzhofer**
Ganghoferstrasse 29a
80339 München (DE)

(54) ELECTRICAL WIRE HOLDING BAR CONVEYING DEVICE

(57) An electric wire holding bar conveying apparatus is an apparatus for conveying a plurality of electric wire holding bars that can parallelly hold the ends of electric wires with a terminal. The apparatus includes: a plurality of bar supports whose position can be changed between the circulation position that supports the electric wire holding bars with the ends of the electric wires with a terminal facing vertically upward and the receiving position that supports the electric wire holding bars with the ends of the electric wires with a terminal being laid flat; a circulation drive mechanism that circulates the plurality of bar supports along a circulation path; and a position change mechanism that rotates the bar supports about the rotational axis of a rotational shaft in a section of the circulation path to change their position from the circulation position to the receiving position and from the receiving position to the circulation position.

Fig. 1



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Description

Technical Field

[0001] The present invention relates to a technology for manufacturing wire harnesses.

Background Art

[0002] Wire harnesses are manufactured, for example, through a cutting/crimping process, a temporary bundling process, and an assembly process. The cutting/crimping process is a process for cutting wires to the predetermined length and crimping terminals onto the ends of the wires to manufacture electric wires with a terminal(s). The temporary bundling process is a process for bundling the plurality of electric wires fitted with a terminal or inserting the terminals of a plurality of electric wires into connectors, etc., to manufacture temporary bundles. Also, the assembly process is a process for assembling a plurality of electric wires with a terminal and a plurality of temporary bundles into the predetermined routing geometries to manufacture the wire harness.

[0003] One apparatus used in such manufacturing processes of wire harnesses is the electric wire holding bar conveying apparatus disclosed in Patent Document 1. The electric wire holding bar conveying apparatus is the apparatus for circulating along a circulation path a plurality of electric wire holding bars that are capable of holding multiple types of electric wires with a terminal. In each electric wire holding bar, a plurality of electric wire holders capable of holding the ends of electric wires with a terminal are linearly arranged so as to parallelly hold the ends of the electric wires. As the plurality of electric wire holding bars are circulated, each time an electric wire holding bar is set at the receiving location, a mechanism for transferring electric wires with a terminal transfers different types of electric wires with a terminal onto the bar such that multiple types of electric wires with terminals are held by one electric wire holding bar.

[0004] Moreover, in the electric wire holding bar conveying apparatus disclosed in Patent Document 1, each electric wire holding bar is supported on the circulation path with the plurality of electric wire holders facing upwards. The mechanism for transferring electric wires with a terminal is configured to transfer wires with a terminal onto the electric wire holders from the above.

Citation List

Patent Documents

[0005] Patent Document 1: JP 2010-287369A

Summary of Invention

Technical Problem

[0006] In the electric wire holding bar conveying apparatus disclosed in Patent Document 1, the electric wire holding bars are circulated while being held in a position that allows the mechanism for transferring electric wires with a terminal to transfer electric wires with a terminal onto the bars (i.e., a position in which the electric wire holders face upwards). Therefore, the electric wires with a terminal are pinched by the electric wire holders and laid on the electric wire holding bars while protruding from one side of the electric wire holding bars and hanging down from the other side of the bars. Accordingly, to minimize tangling up of the electric wires with a terminal held on adjacent electric wire holding bars supported on the circulation path, the plurality of electric wire holding bars are conveyed while being spaced apart from one another at relatively large intervals. This arrangement, however, creates the problem of the apparatus occupying a large space.

[0007] Accordingly, the object of the present invention is to convey a plurality of wire holding bars in a maximally space-saving manner.

Solution to Problem

[0008] A first aspect is an electric wire holding bar conveying apparatus for conveying a plurality of electric wire holding bars on which a plurality of electric wire holders capable of holding ends of electric wires with a terminal are linearly arranged, the electric wire holding bars being capable of holding the ends of the electric wires in parallel, a terminal being crimped onto an end of the electric wires, the apparatus comprising: a plurality of bar supports capable of supporting the plurality of electric wire holding bars such that each electric wire holding bar extends outward with respect to a circulation path, the plurality of bar supports being capable of changing their position between a circulation position in which the electric wire holding bars are supported such that the ends of the electric wires with a terminal held by the electric wire holders face vertically upward and a receiving position in which the electric wire holding bars are supported such that the ends of the electric wires with a terminal held by the electric wire holders are laid flat; a circulation drive mechanism for circulating the plurality of bar supports along the circulation path; and a position change mechanism that rotates each bar support about a rotational axis in a section of the circulation path to change its position from the circulation position to the receiving position and from the receiving position to the circulation position.

[0009] A second aspect is an electric wire holding bar conveying apparatus according to the first aspect, wherein the position change mechanism transmits the force exerted by the circulation drive mechanism to move the

bar supports along the circulation path as rotational force about the rotational axes to change the position of the bar supports.

[0010] A third aspect is an electric wire holding bar conveying apparatus according to the first or second aspect, wherein each bar support includes a receiving position change transmission that projects to one side of the rotational axis of the bar support in a direction perpendicular to the circulation path and the rotational axis when the bar support is in the circulation position and a circulation position change transmission that projects to one side of the rotational axis of the bar support in a direction perpendicular to the circulation path and the rotational axis when the bar support is in the receiving position, and wherein the position change mechanism includes a receiving position change guide provided on a path of movement of the receiving position change transmission of the bar support in the circulation position and a circulation position change guide provided on a path of movement of the circulation position change transmission of the bar support in the receiving position.

[0011] A fourth aspect is an electric wire holding bar conveying apparatus according to any one of the first to third aspects, wherein the circulation path includes straight-line paths.

[0012] A fifth aspect is an electric wire holding bar conveying apparatus according to the fourth aspect, wherein the circulation path includes a pair of curved paths of a semicircular shape and a pair of straight-line paths that connects the pair of curved paths.

[0013] A sixth aspect is an electric wire holding bar conveying apparatus according to any one of the first to fifth aspects, wherein the position change mechanism successively changes the position of the plurality of bar supports from the circulation position to the receiving position and from the receiving position to the circulation position as the bar supports are moved by the circulation drive mechanism such that only one bar support is in the receiving position at any moment.

Advantageous Effects of Invention

[0014] According to the electric wire holding bar conveying apparatus of the first aspect, the position of a plurality of bar supports can be changed between the circulation position that supports the electric wire holding bars such that the ends of the electric wires with a terminal held by the electric wire holders face vertically upward and the receiving position that supports the electric wire holding bars such that the ends of the electric wires with a terminal held by the electric wire holders are laid flat. Each bar support is configured to be rotated about the rotational axis in a section of the circulation path by the position change mechanism to change its position from the circulation position to the receiving position and from the receiving position to the circulation position. Accordingly, tangling up of electric wires with a terminal held by adjacent electric wire holding bars can be minimized while interference between electric wires with a terminal and electric wire holding bars can be also minimized. This allows a plurality of electric wire holding bars to be arranged at smaller intervals on the circulation path, thus enabling conveyance of the plurality of electric wire holding bars in a maximally space-saving manner.

[0015] According to the electric wire holding bar conveying apparatus of the second aspect, as the position change mechanism is configured to transmit the force exerted by the circulation drive mechanism to move the bar support along the circulation path as rotational force around the rotational axis to change the position of the bar support, this provides the arrangement for changing the position of the bar support without providing a separate driving source.

[0016] According to the electric wire holding bar conveying apparatus of the third aspect, wherein each bar support includes a receiving position change transmission that projects to one side of the rotational axis of the bar support in a direction perpendicular to the circulation path and the rotational axis when the bar support is in the circulation position and a circulation position change transmission that projects to one side of the rotational axis of the bar support in a direction perpendicular to the circulation path and the rotational axis when the bar support is in the receiving position, and wherein the position change mechanism includes a receiving position change guide provided on the path of movement of the receiving position change transmission of each bar support when the bar support is in the circulation position and a circulation position change guide provided on the path of movement of the circulation position change transmission of each bar support when the bar support is in the receiving position. Accordingly, while being circulated by the circulation drive mechanism, the position of the bar support is changed from the circulation position to the receiving position by the receiving position change transmission coming into abutment with the receiving position change guide, and the position of the bar support is changed from the receiving position to the circulation position by the circulation position change transmission coming into abutment with the circulation position change guide. In this way, the position of the bar support can be changed with a simple structure.

[0017] According to the electric wire holding bar conveying apparatus of the fourth aspect, moreover, as the circulation path is configured as a path that includes straight-line paths, even in the straight-line paths where the intervals between adjacent electric wire holding bars are smaller than in the curved paths, tangling up, etc., of the electric wires with a terminal held by adjacent electric wire holding bars can be minimized, thus conveying a plurality of electric wire holding bars in a more space-saving manner.

[0018] According to the electric wire holding bar conveying apparatus of the fifth aspect, as the circulation path includes a pair of curved paths of a semicircular shape and a pair of straight-line paths that connects the

pair of curved paths, the plurality of electric wire holding bars can be conveyed in a still more space-saving manner.

[0019] According to the electric wire holding bar conveying apparatus of the sixth aspect, as the position change mechanism successively changes the position of the plurality of bar supports from the circulation position to the receiving position and from the receiving position to the circulation position as they are moved by the circulation drive mechanism such that only one bar support is in the receiving position at any moment, only the bar support placed in the location where electric wires with a terminal are transferred to the electric wire holding bars is set in the receiving position such that tangling up, etc., of electric wires with a terminal held by adjacent electric wire holding bars can be minimized more reliably.

Brief Description of Drawings

[0020]

Fig. 1 is a schematic plan view showing the relationship among a cutting/crimping apparatus, a transfer mechanism, and an electric wire holding bar conveying apparatus.
Fig. 2 is a front view of an electric wire holding bar.
Fig. 3 is a plane view of the electric wire holding bar.
Fig. 4 is a side view of the electric wire holding bar.
Fig. 5 is a partial side view of the electric wire holding bar conveying apparatus showing a bar support in the circulation position.
Fig. 6 is a view showing the bar support prior to moving to the receiving location.
Fig. 7 is a partial side view of the electric wire holding bar conveying apparatus showing the bar support in the receiving position.
Fig. 8 is a view showing the bar support moved to the receiving location.
Fig. 9 is a plan view showing the circulation chain and bar supports.
Fig. 10 is a view showing an electric wire holding bar held by a bar support.
Fig. 11 is a view showing the manner of conveyance in the liner paths.
Fig. 12 is a view showing how the condition of a position maintaining biasing member is determined by the position of the bar support.

Description of Embodiments

[0021] An embodiment of an electric wire holding bar conveying apparatus will be described hereinafter (see Fig. 1). The electric wire holding bar conveying apparatus 20 is an apparatus for conveying a plurality of electric wire holding bars 10 that hold a plurality of electric wires 2 with a terminal(s).

[0022] For convenience of description, the manufacturing process of wire harnesses is described first. Wire harnesses are manufactured through a cutting/crimping process, a temporary bundling process, and an assembly process. The cutting/crimping process is a process for manufacturing electric wires 2 with a terminal by cutting wires to the predetermined length, stripping the ends of the electric wires of the sheathing, and crimping terminals onto the exposed cores. This process can be performed by a cutting/crimping apparatus comprising a measuring mechanism, a cutting mechanism, and a terminal crimping mechanism. The temporary bundling process is a process for manufacturing bundles that are subunits for constituting parts of a wire harness. That is, a wire harness may be formed by combining a plurality of temporary bundles (as well as discrete electric wires 2 with a terminal). This process manufactures temporary bundles by inserting the terminals of the electric wire 2 with a terminal into connectors, bundling the electric wires, etc. In addition, intermediate processes are also performed on the electric wires as required. For example, such intermediate processes include crimping special terminals, such as terminals with rubber plugs, etc., removing the sheathing from intermediate sections of the electric wires, splicing, and twisting. The assembly process is a process for assembling temporary bundles and electric wires 2 with various terminals to routing geometries by bundling these bundles and electric wires to manufacture a completed wire harness. Wire harnesses thus manufactured are incorporated into vehicles and other electrical apparatuses after inspection and other processes.

[0023] In the manufacturing process of wire harnesses, the electric wire holding bar conveying apparatus 20 is used in the step of setting manufactured electric wires 2 with a terminal on the electric wire holding bars 10.

<Overview of Electric Wire Holding Bar Conveying Apparatus>

[0024] The electric wire holding bar conveying apparatus 20 includes a plurality of bar supports 30, a circulation drive mechanism 60, and a position change mechanism 70 (see Fig. 5). The electric wire holding bar conveying apparatus 20 is installed downstream of a cutting/crimping apparatus 80 that manufactures electric wires 2 with a terminal and is configured to convey each electric wire holding bar 10 to a point at which the bar 10 receives electric wires 2 with a terminal transferred from the cutting/crimping apparatus 80 by a transfer mechanism 90 (hereafter "receiving location P") (see Fig. 1).

[0025] Briefly, the electric wire holding bar conveying apparatus 20 causes the circulation drive mechanism 60 to circulate along a circulation path R a plurality of bar supports 30 that support the plurality of electric wire holding bars 10. Furthermore, the electric wire holding bar conveying apparatus 20 causes the position change mechanism 70 to place the bar supports 30 in a receiving position at receiving location P (or at a section of the circulation path that contains receiving position P) (see Fig. 8) and also place the bar supports 30 in a circulation

position elsewhere (see Figs. 6 and 11). In the circulation position, the electric wire holding bars 10 occupy less space than in the receiving position. In this way, the electric wire holding bar conveying apparatus 20 supports and conveys the electric wire holding bars 10 at narrower intervals therebetween, thus reducing the overall area occupied for the number of electric wire holding bars 10 conveyed.

<Electric Wire Holding Bars>

[0026] In each electric wire holding bar 10, a plurality of electric wire holders 12 capable of holding the ends of electric wires 2 with a terminal are linearly arranged and configured to parallelly hold the ends of the electric wires (see Figs. 2-4). In this embodiment, an end of an electric wire 2 with a terminal refers to an end portion of the electric wire where the core is covered with sheathing, which is the portion of the electric wire proximally adjacent to the terminal crimped onto the exposed core. More particularly, each electric wire holding bar 10 is formed in a generally elongated shape comprising a plurality of electric wire holders 12 and a main bar body 15.

[0027] The electric wire holders 12 are members for holding the ends of electric wires 2 with a terminal, each comprising a pair of elastic pinching pieces 13 and a pinching piece fixing portion 14.

[0028] The elastic pinching pieces 13 are formed by blanking and bending sheet metal material to have a flat proximal portion and a distal curvature. More particularly, the flat portion is formed in a plate shape and the curvature continues from the flat portion to form a gentle S-shaped curve.

[0029] Each pinching piece fixing portion 14 is a member made of synthetic resin in an overall shape of an approximate rectangular solid that supports a pair of elastic pinching pieces 13. The pinching piece fixing portion 14 is configured to support a pair of elastic pinching pieces 13 so that the tips of the elastic pinching pieces 13 are spaced apart from each other with their flat portions abutting on each other (back-to-back). More particularly, each pinching piece fixing portion 14 is provided with a recess that opens on one end face through which a pair of elastic pinching pieces 13 can be fitted in. Formed deep in the pinching piece fixing portion 14 are walls that pinch and support a pair of elastic pinching pieces 13 with their flat portions abutting on each other. Furthermore, the pinching piece fixing portion 14 supports the pair of fitted elastic pinching pieces 13 such that portions of the curvatures near their tips come close to each other to leave a gap smaller than the diameter of the electric wire with a terminal (including cases where they come into contact with each other).

[0030] Subsequently, by pushing an end of the electric wire 2 with a terminal between a pair of elastic pinching pieces 13, the end of the electric wire is held between the portions of the curvatures of the elastic pinching pieces 13close to each other and the opened end face of the pinching piece fixing portion 14.

[0031] Note that the electric wire holder 12 is one example and that other configurations may be employed. For example, a configuration may be employed in which the electric wire holders include a comb tooth-like member so that an end of an electric wire 2 with a terminal can be pushed in between, and hooked on, the teeth of the comb tooth-like member to support the electric wire.

[0032] The main bar body 15 has a main base body 16 and a pair of end members 18.

[0033] The main base body 16 is formed in a bar shape (a square rod in this case) and the aforementioned plurality of electric wire holders 12 are parallelly supported on one side surface of the bar that extends in the longitudinal direction. More specifically, the main base body 16 supports the aforementioned plurality of electric wire holders 12 in a manner that aligns the electric wire holders 12 in the direction in which each pair of elastic pinching pieces 13 oppose each other. For example, the plurality of electric wire holders 12 may advantageously be supported by fitting in the main base body 16 in a convexo-concave manner. Other arrangements may also be employed, such as one where individual electric wire holders 12 are secured to the main base body 16 with a screw, etc.

[0034] In addition, the main base body 16 has an engaging recess 17 that opens on one side surface thereof. The engaging recess 17 is a member for engaging the engaging protrusion 33 of the bar support 30, to be described below. The engaging recess 17 is formed in an approximate L-shape that extends from the bottom surface of the main base body 16 (the end opposite to that where the electric wire holders 12 are supported) toward the electric wire holders 12 and is bent from the top end toward one end the main base body 16. The engaging recess 17 is formed in a sufficient size to permit the aforementioned engaging protrusion 33 to be disposed and moved in the recess (see Fig. 10). That is, the engaging protrusion 33 is inserted into the engaging recess 17 at its open proximal portion and disposed in its bent top portion.

[0035] The pair of end members 18 is fixed to both longitudinal ends of the main base body 16 with screws, etc. to sandwich the plurality of electric wire holders 12 supported on the main base body 16 in the direction of their alignment in order to secure the holders against dislodgement. Moreover, the pair of end members 18 includes biasing recesses 19 that open at both longitudinal ends of the electric wire holding bar 10. The biasing recesses 19 are members in which the top ends of the anti-dislodgement biasing members 35, to be described below, of the bar support 30 are disposed. In this embodiment, the biasing recesses 19 are formed to have a cylindrical interior space that corresponds to the cylindrical top end shape of the anti-dislodgement biasing members 35 such that these top ends may be disposed in the biasing recesses.

<Cutting/crimping apparatus and Transfer Mechanism>

[0036] For convenience of description, the cutting/crimping apparatus 80 and the transfer mechanism 90 are briefly described.

[0037] The cutting/crimping apparatus 80 includes a measuring mechanism 82, a cutting mechanism 84, a terminal crimping mechanism 86, and a cutting/crimping transfer mechanism 88. The measuring mechanism 82 is responsible for measuring and feeding the predetermined length of the electric wire downstream at a time. The cutting mechanism 84 is provided downstream of the measuring mechanism 82 for cutting off each predetermined length of the electric wire fed by the measuring mechanism 82 and stripping the sheathing off the ends of the cut-off electric wire. Also, the terminal crimping mechanism 86 is provided downstream of the cutting mechanism 84 for crimping a terminal(s) onto the exposed core of each electric wire cut off at the cutting mechanism 84 and stripped of the sheathing. The cutting/crimping transfer mechanism 88 is responsible for gripping the electric wires cut off by the cutting mechanism 84 in the vicinity of both ends (adjacent to the portions stripped of the sheathing that correspond to the ends of the electric wires 2 with a terminal) and transferring them downstream. The cutting/crimping transfer mechanism 88 is configured to transfer the electric wires (the electric wires 2 with a terminal) to the delivery point for the transfer mechanism 90 located downstream of the terminal crimping mechanism 86.

[0038] Note that in the foregoing cutting/crimping apparatus 80, electric wires 2 with a terminal (prior to terminal crimping) are handled to maintain the wire ends approximately in parallel to the horizontal direction.

[0039] The transfer mechanism 90 includes a pairs of wire grippers 92 and a transfer drive unit 96 (see Fig. 7). The wire grippers 92 are configured to grip the ends of an electric wire 2 with a terminal. Note that also in the transfer mechanism 90, electric wires 2 with a terminal are handled to maintain the wire ends in approximately parallel to the horizontal direction. The transfer drive unit 96 is configured to transfer the pair of wire grippers 92 between the position where the wire grippers can grip the ends of the electric wire 2 with a terminal that has been moved to the downstream end of the cutting/crimping transfer mechanism 88 or the position where the electric wire 2 with a terminal is transferred to (gripped by) electric wire holders 12 on the electric wire holding bar 10 of the electric wire holding bar conveying apparatus 20 positioned at receiving location P, and the positions above these positions. Subsequently, the transfer drive unit 96 raises the pair of wire grippers 92 while the pair of wire grippers 92, which have been transferred to the cutting/crimping transfer mechanism 88 by the transfer drive unit 96, grips an end of the electric wire 2 with a terminal. In this state, the transfer drive unit 96 causes the pair of wire grippers 92 to transfer the ends of the electric wire 2 with a terminal to the position above the electric wire holders 12 of the electric wire holding bars 10 for supporting the ends of electric wires 2 with a terminal and to lower the wire ends. This causes the ends of the electric wire 2 with a terminal gripped by the pair of wire grippers 92 to be also gripped by the predetermined electric wire holders 12. Subsequently, the pair of wire grippers 92 release their grip on the electric wire 2 with a terminal and are transferred back to the cutting/crimping transfer mechanism 88 by the transfer drive unit 96.

<Electric Wire Holding Bar Conveying Apparatus>

[0040] As described above, the electric wire holding bar conveying apparatus 20 includes a plurality of bar supports 30 and a circulation drive mechanism 60 (see Fig. 5).

[0041] The bar supports 30 are members for supporting a plurality of electric wire holding bars 10 and capable of circulating along annular circulation path R (see Figs. 1 and 10). The circulation path R is a path that includes outwardly convex curved paths and straight-line paths and, in this embodiment, includes a pair of curved paths of a semicircular shape and a pair of straight-line paths that connects the pair of curved paths.

[0042] The circulation drive mechanism 60 is responsible for circulating the plurality of bar supports 30 along circulation path R (see Figs. 1 and 5). The circulation drive mechanism 60 includes a pair of gears 62, a circulation chain 64, and a drive unit 66.

[0043] The gears 62 are a pair of spur gears rotatable about parallel rotating axes and supported on the base rack 52 at spaced-apart positions in approximately the same plane. One of the pair of gears 62 is rotatably driven by the drive unit 66. The drive unit 66 may be a motor whose drive shaft is directly coupled to the rotational shaft of one of the gears 62. Alternatively, the drive unit 66 may be an arrangement that includes a transmission mechanism, such as transmission gears, and a motor, whereby the motor rotates one of the gears 62 via the transmission mechanism.

[0044] Moreover, the annular circulation chain 64 is fitted on the pair of gears 62. In other words, the circulation chain 64, fitted on the pair of gears 62, is run along circulation path R including a pair of semicircular paths along the pair of gears 62 and a pair of straight-line paths that connects the pair of semicircular paths. In this embodiment, circulation path R lies in a plane approximately parallel to a horizontal plane. The rotation of the drive unit 66 rotates the pair of gears 62 and circulates the circulation chain 64 along circulation path R. In this exemplary description, the circulation chain 64 is rotated clockwise as seen in a planar view.

[0045] However, the circulation drive mechanism 60 is not limited to the combination of a pair of gears 62 and the circulation chain 64. Rather, any arrangement, such as the combination of a pair of pulleys and a driving belt, will suffice as long as it can circulate the plurality of bar

supports 30 along circulation path R.

[0046] The foregoing plurality (e.g., fifty) of bar supports 30 are supported to the circulation chain 64 via the support bases 42. More particularly, the plurality of bar supports 30 are provided to support the plurality of electric wire holding bars 10 such that each holding bar 10 extends outward across circulation path R, and the plurality of bar supports 30 are parallelly arranged at approximately regular intervals along circulation path R.

[0047] In a brief overview, the bar supports 30 are supported by the support bases 42 in such a manner that the position of the bar supports 30 can be changed between the circulation position and the receiving position. As used herein, the circulation position refers to the position in which the electric wire holding bars 10 are supported so that the ends of the electric wires 2 with a terminal held by the electric wire holders 12 face vertically upward (see Figs. 5-6). Note that the position in which the ends of the electric wires 2 with a terminal face vertically upward refers to the position of the electric wire holding bars 10 and that this is not limited to cases where the ends of the electric wires 2 with a terminal are completely parallel to the vertical. In other words, when this position is assumed, the electric wire holders 12 of the electric wire bar supports 10 are oriented transversally. In this embodiment, it is assumed that, in the circulation position, the electric wire holding bars 10 support the electric wire holders 12 in such a way that causes the electric wire holders 12 to face downstream in circulation path R. Also, the receiving position refers to a position in which the electric wire holding bar 10 is supported so that the ends of the electric wires 2 with a terminal in the electric wire holders 12 lie flat and a position in which the wire ends are rotated 90 degrees from the circulation position about rotational axes radially traversing circulation path R (see Figs. 7-8). In other words, when the receiving position is assumed, the electric wire holders 12 of the electric wire holding bar 10 faces upward.

[0048] However, the circulation position and the receiving position of the bar supports 30 are not limited to those in which the direction of the height of the electric wire holding bars 10 is turned horizontal and vertical, respectively. Rather, these positions may also be inclined relative to the horizontal or vertical direction so as to avoid interference between the electric wires 2 with a terminal held on the electric wire holding bar 10 with those on the adjacent electric wire holding bar 10 or to receive the electric wires 2 with a terminal from the transfer mechanism 90.

[0049] Each bar support 30 includes a trough 32, a support end portion 34, a rotational shaft 36, a receiving position change transmission 38, and a circulation position change transmission 39 (see Figs. 6 and 10). The bar support 30 is an elongated member comprising the trough 32, the support end portion 34, and the rotational shaft 36 continuously formed from the distal to proximal ends.

[0050] The trough 32 is formed as an elongated trough in which the bottom portion of one longitudinal end of an electric wire holding bar 10 can be accommodated. More particularly, the gap between the opposing plates of the trough 32 is set to be the same as or greater (slightly greater in this embodiment) than the thickness dimension of the electric wire holding bar 10 (see Fig. 6). Moreover, the longitudinal dimension of the trough 32 is set to be smaller than that of the electric wire holding bar 10 and its depth dimension of the trough 32 is set to be smaller than the height dimension of the electric wire holding bar 10 (see Fig. 10). Furthermore, the opening of the trough 32 is formed to flare gradually and outwardly to its edges. This facilitates accommodation of the electric wire holding bar 10 in the trough 32. The trough 32 also includes an engaging protrusion 33 that can engage the aforementioned engaging recess 17 of the electric wire holding bar (see Figs. 4 and 10).

[0051] The support end portion 34 is a member for positioning the electric wire holding bar 10 by abutting against the end of the electric wire holding bar 10 accommodated in the trough 32. The support end portion 34 is formed in a rectangular solid to plug the proximal end of the trough 32. The support end portion 34 includes an anti-dislodgement biasing member 35 capable of biasing the electric wire holding bar 10 in the trough 32 towards the top end of the trough 32.

[0052] The anti-dislodgement biasing member 35 includes a base portion protruding from the end of the support end portion 34 located on the trough 32 and an advanceable/retractable portion advanceably and retractably protruding from the top end of the base portion (Fig. 10). The advanceable/retractable portion of the anti-dislodgement biasing member 35 is biased in the direction of advancement with respect to the base portion. In this embodiment, the anti-dislodgement biasing member 35 is formed as an approximate cylinder. For example, a plunger in which an advanceable/retractable portion is biased in the direction of advancement by a compression spring may be used as the anti-dislodgement bias member 35. Further, the anti-dislodgement biasing member 35 is formed in a shape that can enter the biasing recess 19 formed in either end member 18 of the electric wire holding bar 10.

[0053] When the electric wire holding bar 10 is accommodated in the trough 32, the anti-dislodgement biasing member 35 enters the biasing recess 19 of the electric wire holding bar 10, and the engaging protrusion 33 of the bar support 30 enters the engaging recess 17 of the electric wire holding bar 10. At the moment, as the advanceable/retractable portion of the anti-dislodgement biasing member 35 is pressed and retracted by the electric wire holding bar 10, the advanceable/retractable portion is applying pressing force to the electric wire holding bar 10 in the direction of advancement (toward the top end of the trough 32). Once the electric wire holding bar 10 is set on the bottom of the trough 32, the biasing force of the anti-dislodgement biasing member 35 moves the electric wire holding bar 10 towards the top end of the

trough 32 and the engaging protrusion 33 moves to the bent top end of the engaging recess 17, thus engaging the engaging recess 17. In this way, the electric wire holding bar 10 is supported by the bar support 30 while it is secured against dislodgement from the opening and the top end of the trough 32.

[0054] Each rotational shaft 36 is a member supported by the support base 42 in a manner that allows the rotational shaft to rotate about the axis of rotation (Fig. 5). More particularly, the rotational shaft 36 is formed in a cylindrical or columnar shape protruding from the proximal end of the support end portion 34 in the longitudinal direction of the bar support 30. Moreover, the rotational shaft 36 is supported by the support base 42 with its center axis extending radially across circulation path R. By virtue of the rotational shaft 36 being supported by the support base 42, the bar support 30 is rotationally provided around the center axis of the rotational shaft 36.

[0055] The support base 42 is a member secured to the circulation chain 64 to support the bar support 30 (see Fig. 9). For example, a chain with attachments may be advantageously used as the circulation chain 64 such that the support bases 42 are secured with screws, etc., to the brackets provided on the circulation chain. The support bases 42 are secured at approximately regular intervals to the circulation chain 64 in the direction of its extension.

[0056] Each support base 42 includes a support hole 43 that rotatably supports the rotational shaft 36 of the bar support 30 (Fig. 5). The support hole 43 is formed to allow the rotational shaft 36 to pass therethrough, more particularly, formed as a through-hole with approximately the same diameter as the outer diameter of the rotational shaft 36. Additionally, the rotational shaft 36 is rotatably supported while being secured against dislodgement from the support hole 43.

[0057] The support base 42 also includes a circulation traveler 46 that stabilizes the position of support of the bar support 30. The circulation traveler 46 includes traveling rollers 47 rotatable about axes extending radially across circulation path R. The traveling rollers 47 are provided in contact with flat surfaces of the base rack 52, on which the circulation drive mechanism 60 is supported, that extend along the plane in which circulation path R exists. In this embodiment, a pair of traveling rollers 47 is provided. More particularly, one of the traveling rollers 47 is provided in contact with a flat surface outside of and below the circulation chain 64, whereas the other traveling roller 47 is provided in contact with a flat surface inside of and above the circulation chain 64. When the bar support 30 is moved along circulation path R, the traveling rollers 47 are in contact with the flat surfaces of the base rack 52, thus limiting the tilt of the bar support 30 and maintaining the position of the bar support 30.

[0058] Note, however, that the inner traveling roller 47 may be omitted from the circulation traveler 46.

[0059] The bar support 30 supported by the support base 42 is controllably rotated to change between the circulation position and the receiving position. As such a rotation control mechanism, an arrangement may be employed that includes a protrusion provided on the outer periphery of the rotational shaft 36 and control pieces provided on the support base 42 along the circumferential direction of the rotational shaft 36. The control pieces locate the protrusion therebetween and abut against the protrusion when the bar support 30 is in the circulation position and the receiving position (not shown).

[0060] Additionally, the bar support 30 is supported by the support base 42 in a manner that maintains the bar support 30 in the circulation position or the receiving position. More particularly, the bar support 30 is coupled to the support base 42 via a position maintaining biasing member 48 (see Figs. 5 and 12). The position maintaining biasing member 48 is a tension spring (a coil spring in this embodiment). Provided on the proximal end of the rotational shaft 36 is a projection piece 37 jutting out in one direction from the periphery thereof. Provided at the top end of the projection piece 37 is a shaft protruding in parallel with the center axis of the rotational shaft 36 toward the interior of circulation path R. The support base 42 includes a protrusion that juts out toward the interior of circulation path R from a position opposite the aforementioned shaft across the center axis of the rotational shaft 36. Moreover, one end of the position maintaining biasing member 48 is secured to the shaft provided on the projection piece 37 while the other end is secured to the protrusion provided on the support base 42. The position maintaining biasing member 48 is maximally extended when the bar support 30 is in an intermediate position between the circulation position and the receiving position. The position maintaining biasing member 48 is contracted when the bar support 30 is in the circulation position and the receiving position. This means that once in the circulation position or the receiving position, the bar support 30 is maintained in that position unless circumferential force greater than the biasing force of the position maintaining biasing member 48 acts along the circumference of the rotational shaft 36.

[0061] The bar support 30 further includes a receiving position change transmission 38 and a circulation position change transmission 39 (see Figs. 6 and 8). The receiving position change transmission 38 and the circulation position change transmission 39 are acted upon by the position change mechanism 70 when the position of the bar support 30 is changed.

[0062] The receiving position change transmission 38 comes into abutment with a receiving position change guide 72, to be described below, of the position change mechanism 70 while the bar support 30 is moved along circulation path R. When in the circulation position, the receiving position change transmission 38 projects to one side of the rotational shaft 36 (upward in this embodiment) in a direction perpendicular to circulation path R and the rotational axis of the rotational shaft 36. More particularly, the receiving position change transmission 38 is provided on the top end of the projection piece 37.

In this embodiment, the receiving position change transmission 38 is formed in a shape of a roller rotatably mounted on the shaft on the projection piece 37. In other words, the receiving position change transmission 38 includes an outer peripheral surface that surrounds an axis parallel with the rotational shaft 36 and comes into abutment with the receiving position change guide 72.

[0063] The circulation position change transmission 39 comes into abutment with a circulation position change guide 76, to be described below, of the position change mechanism 70 while the bar support 30 is moved along circulation path R. When in the receiving position, the circulation position change transmission 39 protrudes to one side of the rotational shaft 36 (downward in this embodiment) in a direction perpendicular to circulation path R and the rotational axis of the rotational shaft 36. In this embodiment, the circulation position change transmission 39 is formed as a bar (a cylindrical rod in this case) protruding from the outer surface of the support end portion 34. In other words, the circulation position change transmission 39 is provided to project downward from the support end portion 34 when the bar support 30 is in the receiving position. More particularly, when the bar support 30 is in the receiving position, the circulation position change transmission 39 protrudes tiltedly in the upstream direction (slightly, in this embodiment) along circulation path R with respect to the direction connecting the bottom and the opening of the trough 32 of the bar support 30.

<Position Change Mechanism>

[0064] The position change mechanism 70 is responsible for changing the position of each bar support 30 between the circulation position and the receiving position by rotating the bar support 30 about the rotational axis of the rotational shaft 36 (see Figs. 5-8). More particularly, the position change mechanism 70 changes the position of the bar support 30 from the circulation position to the receiving position and from the receiving position to the circulation position in one section of circulation path R (in a curved path, in this embodiment). That section of circulation path R is a range that contains receiving location P. That is, receiving location P, at which electric wires 2 with a terminal are transferred onto the electric wire holding bars 10 by the transfer mechanism 90, is set in a section of a curved path of circulation path R, where electric wire holding bars 10 are spaced apart from adjacent bars at larger intervals than in the straight paths. The position change mechanism 70 changes the position of the bar supports 30 to the receiving position at least by receiving location P.

[0065] In this embodiment, the position change mechanism 70 is configured to successively change the position of the bar supports 30 from the circulation position to the receiving position, and then back to the circulation position from the receiving position such that among the plurality of the bar supports 30, the one at receiving position P alone is placed in the receiving position (see Fig. 1). In other words, the position change mechanism 70 changes the position of each bar support 30 from the circulation position to the receiving position as the bar support 30 moves to receiving location P from the immediately upstream position, and then back to the circulation position from the receiving position as the bar support 30 moves from receiving location P to the immediately downstream position.

[0066] The position change mechanism 70 is configured to transmit the force exerted by the circulation drive mechanism 60 to move the bar support 30 as rotational force about the rotational shaft 36 so as to change the position of the bar support 30. The position change mechanism 70 includes a receiving position change guide 72 and a circulation position change guide 76. The receiving position change guide 72 and the circulation position change guide 76 are provided to change the position of the bar support 30 by abutting against the receiving position change transmission 38 and the circulation position change transmission 39, respectively. The receiving position change guide 72 and the circulation position change guide 76 are supported directly or indirectly by the base rack 52.

[0067] The receiving position change guide 72 is provided on the path of movement of the receiving position change transmission 38 of the bar support 30 when the bar support is in the circulation position (above the path of movement of the rotational shaft 36 in this embodiment). Furthermore, the receiving position change guide 72 is disposed in a location where it does not interfere with the receiving position change transmission 38 of the bar support 30 when placed in the receiving position.

[0068] In this embodiment, the receiving position change guide 72 is disposed on the path of movement of the receiving position change transmission 38 of the bar support 30 in the circulation position and has an abutment face 73 that gradually inclines downward from upstream to downstream of circulation path R. It is preferable if the abutment face 73 is provided for rotating the bar support 30 at least until the position maintaining biasing member 48 biases the bar support 30 over to the receiving position. In other words, the abutment face 73 is formed in such a range (a vertical range) as to allow the abutment face 73 to remain in abutment with the receiving position change transmission 38 until the line connecting both ends of the position maintaining biasing member 48 crosses the center axis of the rotational shaft 36 to the receiving position side. Furthermore, the abutment face 73 is disposed in a position where the abutment face 73 abuts against the receiving position change transmission 38 of the bar support 30 in the circulation position while the bar support 30 is moved along circulation path R from the position immediately upstream of receiving location P to receiving location P. Moreover, the receiving position change guide 72 is configured to change the position of the bar support 30 to the receiving position by the time the bar support 30 reaches receiving

location P (including the very moment receiving location P is reached). In other words, the downstream end of the abutment face 73 is provided upstream of receiving location P.

[0069] While being circulated in the circulation position, the bar support 30 gradually assumes the receiving position as the outer peripheral surface of the receiving position change transmission 38 is brought into abutment against the abutment face 73 of the receiving position change guide 72 and moved (see Figs. 6 and 8). After the bar support 30 is placed in the receiving position, the receiving position change transmission 38 of the bar support 30 passes under the receiving position change guide 72 without interfering with the change guide 72.

[0070] The circulation position change guide 76 is provided on the path of movement of the circulation position change transmission 39 of the bar support 30 when the bar support is in the receiving position (below the path of movement of the rotational shaft 36 in this embodiment). Furthermore, the circulation position change guide 76 is disposed in a location where it does not interfere with the circulation position change transmission 39 of the bar support 30 when placed in the circulation position. In this embodiment, the circulation position change guide 76 is formed in a shape of a roller rotatably supported on a support piece erected on the base rack 52. More particularly, the circulation position change guide 76 is rotatably supported about an axis extending radially across circulation path R.

[0071] The circulation position change guide 76 is disposed in a position where the guide 76 abuts against the circulation position change transmission 39 of the bar support 30 in the receiving position while the bar support 30 is moved along circulation path R from receiving location P to the position immediately downstream of receiving location P. Moreover, in order to change the position of the bar support 30 to the circulation position by the time the bar support 30 reaches the position immediately downstream of receiving location P, the circulation position change guide 76 is provided upstream of the foregoing downstream position.

[0072] While being circulated in the receiving position, the bar support 30 gradually assumes the circulation position as the circulation position change transmission 39 is brought into abutment against the outer peripheral surface of the circulation position change guide 76 and moved (see Fig. 8). After the bar support 30 is placed in the circulation position, the circulation position change transmission 39 of the bar support 30 passes over the circulation position change guide 76 without interfering with the change guide 76.

<Operation of Electric Wire Holding Bar Conveying Apparatus>

[0073] The following describes the operation of the electric wire holding bar conveying apparatus 20.

[0074] It is assumed that initially, the plurality of bar supports 30 support an electric wire holding bar 10. In this state, the plurality of electric wire holding bars 10 are conveyed along circulation path R by the operation of the circulation drive mechanism 60.

[0075] If any of the electric wire holding bars 10 is set in place at receiving location P, the conveyance is suspended. The position of the bar support 30 is changed from the circulation position to the receiving position by the position change mechanism 70 while this electric wire holding bar 10 is moved to receiving location P from the position immediately upstream thereof.

[0076] In this state, an electric wire 2 with a terminal manufactured by the cutting/crimping apparatus 80 is transferred by the transfer mechanism 90 onto the electric wire holding bar 10 held by the bar support 30 now placed in the receiving position at receiving location P. Once the predetermined number and types of electric wires 2 with a terminal are transferred onto the electric wire holding bar 10, the circulation drive mechanism 60 is operated to convey the plurality of the electric wire holding bars 10 so as to set the immediately upstream bar support 30 (electric wire holding bar 10) at receiving location P. At this point, the position of the bar support 30 is changed from the receiving position to the circulation position, halfway through that conveyance from receiving location P to the position immediately downstream thereof.

[0077] Subsequently, electric wires 2 with a terminal are transferred to the electric wire holding bar 10 set at receiving location P in the same manner as described above.

[0078] The electric wires 2 with a terminal may be transferred to the electric wire holders 12 of the electric wire holding bar 10 all at once during a single stop of the holding bar at receiving position P or during each stop in multiple circulations of the holding bar. In the latter case, a different type of electric wire 2 with a terminal may be transferred each time the electric wire holding bar 10 stops at receiving location P.

[0079] Once the transfer of electric wires 2 with a terminal onto the electric wire holding bar 10 of each bar support 30 is completed, the electric wire holding bars 10 are removed from the bar supports 30. This provides electric wire holding bars 10 each carrying different types or the same type of electric wires 2 with a terminal. Alternatively, if different types of electric wires 2 with a terminal constituting a temporary bundle are held by each electric wire holding bar 10, a plurality of electric wire holding bars 10 holding a plurality of electric wires 2 with a terminal for a temporary bundle may be provided.

[0080] According to the electric wire holding bar conveying apparatus 20 thus constructed, the position of a plurality of bar supports 30 can be changed between the circulation position that supports the electric wire holding bars 10 such that the ends of the electric wires 2 with a terminal held by the electric wire holders 12 face vertically upward and the receiving position that supports the electric wire holding bars 10 such that the ends of the electric

wires 2 with a terminal are laid flat. Each bar support 30 is configured to be rotated about the rotational axis of the rotational shaft 36 in a section of circulation path R by the position change mechanism 70 to change its position from the circulation position to the receiving position and from the receiving position to the circulation position. Accordingly, tangling up of electric wires 2 with a terminal held by adjacent electric wire holding bars 10 can be minimized while interference between electric wires 2 with a terminal and electric wire holding bars 10 can be also minimized. This allows a plurality of electric wire holding bars 10 to be arranged at smaller intervals on circulation path R, thus enabling conveyance of the plurality of electric wire holding bars 10 in a maximally space-saving manner.

[0081] Additionally, as the position change mechanism 70 is configured to transmit the force exerted by the circulation drive mechanism 60 to move the bar support 30 along circulation path R as rotational force about the rotational axis of the rotational shaft 36 to change the position of the bar support 30, this realizes the arrangement for changing the position of the bar support 30 without providing a separate driving source.

[0082] Each bar support 30 includes a receiving position change transmission 38 that projects to one side of the rotational axis of the rotational shaft 36 in a direction perpendicular to circulation path R and the rotational axis when the bar support 30 is in the circulation position and a circulation position change transmission 39 that projects to one side of the rotational axis of the rotational shaft 36 in a direction perpendicular to circulation path R and the rotational axis when the transmission 39 is in the receiving position. The position change mechanism 70 includes a receiving position change guide 72 provided on the path of movement of the receiving position change transmission 38 of each bar support 30 when the bar support is in the circulation position and a circulation position change guide 76 provided on the path of movement of the circulation position change transmission 39 of each bar support 30 when the bar support is in the receiving position. Accordingly, while being circulated by the circulation drive mechanism 60, the position of the bar support 30 is changed from the circulation position to the receiving position by the receiving position change transmission 38 coming into abutment with the receiving position change guide 72, and the position of the bar support 30 is changed from the receiving position to the circulation position by the circulation position change transmission 39 coming into abutment with the circulation position change guide 76. In this way, the position of the bar support 30 can be changed with a simple structure.

[0083] Moreover, as circulation path R is configured as a path that includes straight-line paths, even in the straight-line paths where the intervals between adjacent electric wire holding bars 10 are smaller than in the curved paths, tangling up, etc., of the electric wires 2 with a terminal held by adjacent electric wire holding bars 10 can be minimized, thus conveying a plurality of electric wire holding bars 10 in a more space-saving manner. In other words, this can reduce the occupied area for the predetermined number of electric wire holding bars 10 to be conveyed.

[0084] Although the dimension of each electric wire holding bar 10 along circulation path R is smaller when the bar support 30 is in the receiving position than in the circulation position, the overall dimension of the electric wire holding bar 10 and electric wires 2 with a terminal held thereby is smaller when the bar support 30 is in the circulation position than in the receiving position.

[0085] Furthermore, as circulation path R includes a pair of curved paths of a semicircular shape and a pair of straight-line paths that connects the pair of curved paths, the plurality of electric wire holding bars 10 can be conveyed in a still more space-saving manner.

[0086] Moreover, since the position change mechanism 70 successively changes the position of the plurality of bar supports 30 from the circulation position to the receiving position and from the receiving position to the circulation position as they are moved by the circulation drive mechanism 60 such that only one bar support 30 is in the receiving position at any moment, only the bar support 30 placed in the location where electric wires 2 with a terminal are transferred to the electric wire holding bars 10 is set in the receiving position such that tangling up, etc., of electric wires 2 with a terminal held by adjacent electric wire holding bars 10 can be minimized more reliably.

[0087] An example in which circulation path R includes a pair of curved paths of a semicircular shape and a pair of straight-line paths that connects the pair of curved paths has been described so far. However, circulation path R may be any other type of circulation path. Although receiving location P is set in a section of a curved path in the described example, receiving location P may be set in a section of the straight-line paths.

[0088] Further, the position change mechanism 70 is not limited to the configuration for changing the position of only the bar support 30 moved to receiving location P to the receiving position. That is, the position change mechanism 70 may alternatively be configured to change the position of the bar supports 30 that has been moved into a section of circulation path R that contains receiving location P to the receiving position. It is preferred, however, that the electric wire holding bar 10 whose position is to be changed to the receiving position be in a curved path of circulation path R, where the gaps between electric wire holding bars 10 are greater than in the straight-line paths. More preferably, only the one bar support 30 moved to receiving location P is placed in the receiving position as this can more reliably limit tangling up of electric wires 2 with a terminal held in adjacent electric wire holding bars 10.

[0089] Further, the position change mechanism 70 is not limited to the foregoing configuration; rather, it will suffice as long as the mechanism 70 is capable of changing the position of the bar supports 30 between the cir-

culation position and the receiving position. For example, the position change mechanism may have a configuration in which a receiving position change guide and a circulation position change guide are disposed one of above and below the rotational axis of the rotational shaft 36. That is, each bar support may be provided with a receiving position change transmission that projects above the rotational shaft 36 when in the circulation position and a circulation position change transmission that projects above the rotational shaft 36 when in the receiving position, wherein these transmissions change from the circulation position to the receiving position and from the receiving position to the circulation position by coming into abutment against the receiving position change guide or the circulation position change guide provided above the rotational shaft 36. It is preferred that, of the transmissions provided on circulation path R, the one that is moved about the rotational axis of the rotational shaft 36 in the downstream direction in circulation path R by its position change guide be preferably formed in a shape that extends obliquely downstream and that the position change guide against which this transmission abuts be set at a relatively obtuse oblique angle.

[0090] Moreover, for example, the position change mechanism 70 may have the following configuration: that is, each bar support may be provided with a transmission that projects to one side of the rotational axis of the rotational shaft 36 in a direction perpendicular to circulation path R and the rotational axis when the bar support is in the circulation position. Additionally, the foregoing bar support may be coupled to the support base 42 with a biasing member that biases the bar support in the rotational direction to place the bar support in the circulation position. Furthermore, a position change guide may be provided on the path of movement of the transmission. The position change guide includes a position change surface that is provided on, and intersects, the path of movement of the transmission of the bar support in the circulation position and a regulating surface that is capable of abutting against the transmission of the bar support placed in the receiving position at the receiving location and provided in a plane along circulation path R. As the bar support is moved to the receiving location, the transmission abuts against the position change surface to change the position of the bar support and the transmission abuts against the regulation surface at the receiving location to prevent the bar support from changing its position to the circulation position. When the transmission is moved to a location where it is no longer in contact with the regulation surface, the position of the bar support is changed to the circulation position by the biasing force of the biasing member.

[0091] In addition, the position change mechanism may be configured to change the position of each bar support 30 moved to receiving location P by rotatably driving the bar support with a motor.

[0092] Having described the electric wire holding bar conveying apparatus 20 in detail, the foregoing description is illustrative in all aspects and the present invention is not limited thereto. It is understood that countless variants not illustrated herein are conceivable without deviating from the scope of the present invention.

Reference Signs List

[0093]

2	Electric wire with a terminal
10	Electric wire holding bar
12	Electric wire holder
20	Electric wire holding bar conveying apparatus
30	Bar support
38	Receiving position change transmission
39	Circulation position change transmission
60	Circulation drive mechanism
70	Position change mechanism
72	Receiving position change guide
76	Circulation position change guide
P	Receiving location
R	Circulation path

Claims

1. An electric wire holding bar conveying apparatus for conveying a plurality of electric wire holding bars on which a plurality of electric wire holders capable of holding ends of electric wires with a terminal are linearly arranged, the electric wire holding bars being capable of holding the ends of the electric wires in parallel, a terminal being crimped onto an end of the electric wires, the apparatus comprising:

   a plurality of bar supports capable of supporting the plurality of electric wire holding bars such that each electric wire holding bar extends outward with respect to a circulation path, the plurality of bar supports being capable of changing their position between a circulation position in which the electric wire holding bars are supported such that the ends of the electric wires with a terminal held by the electric wire holders face vertically upward and a receiving position in which the electric wire holding bars are supported such that the ends of the electric wires with a terminal held by the electric wire holders are laid flat;

   a circulation drive mechanism for circulating the plurality of bar supports along the circulation path; and

   a position change mechanism that rotates each bar support about a rotational axis in a section of the circulation path to change its position from the circulation position to the receiving position and from the receiving position to the circulation position.

2. An electric wire holding bar conveying apparatus according to claim 1,
wherein the position change mechanism transmits the force exerted by the circulation drive mechanism to move the bar supports along the circulation path as rotational force about the rotational axes to change the position of the bar supports.

3. An electric wire holding bar conveying apparatus according to claim 1 or 2,
wherein each bar support includes a receiving position change transmission that projects to one side of the rotational axis of the bar support in a direction perpendicular to the circulation path and the rotational axis when the bar support is in the circulation position, and a circulation position change transmission that projects to one side of the rotational axis of the bar support in a direction perpendicular to the circulation path and the rotational axis when the bar support is in the receiving position, and
wherein the position change mechanism includes a receiving position change guide provided on a path of movement of the receiving position change transmission of the bar support in the circulation position and a circulation position change guide provided on a path of movement of the circulation position change transmission of the bar support in the receiving position.

4. An electric wire holding bar conveying apparatus according to any one of claims 1-3,
wherein the circulation path includes straight-line paths.

5. An electric wire holding bar conveying apparatus according to claim 4,
wherein the circulation path includes a pair of curved paths of a semicircular shape and a pair of straight-line paths that connects the pair of curved paths.

6. An electric wire holding bar conveying apparatus according to any one of claims 1-5,
wherein the position change mechanism successively changes the position of the bar supports from the circulation position to the receiving position and from the receiving position to the circulation position as the plurality of bar supports are moved by the circulation drive mechanism such that only one bar support is in the receiving position at any moment.

Fig. 1

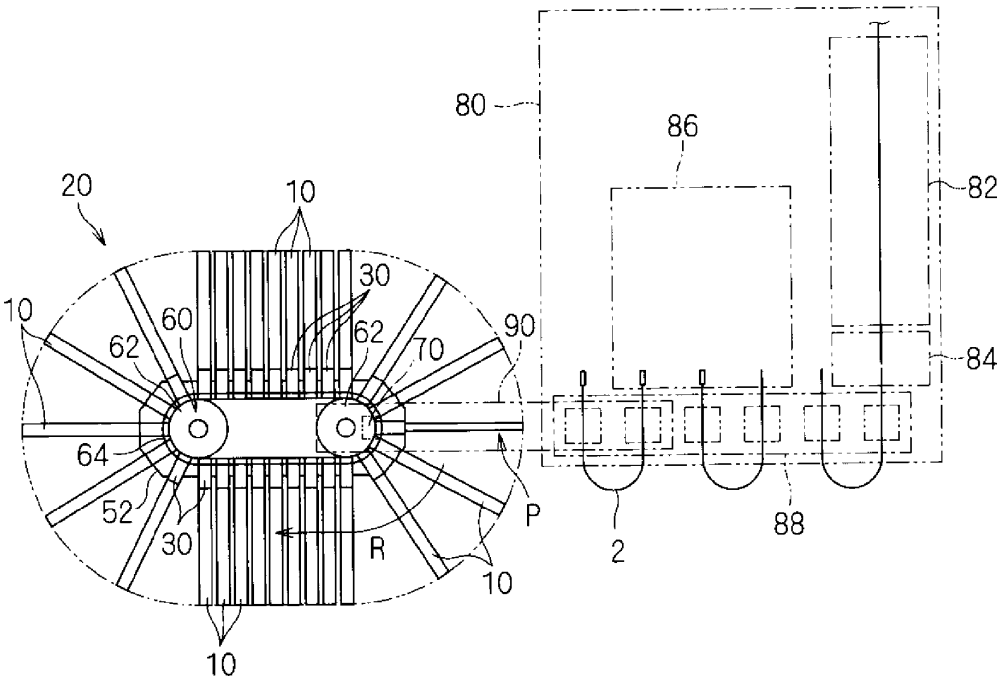

Fig. 2

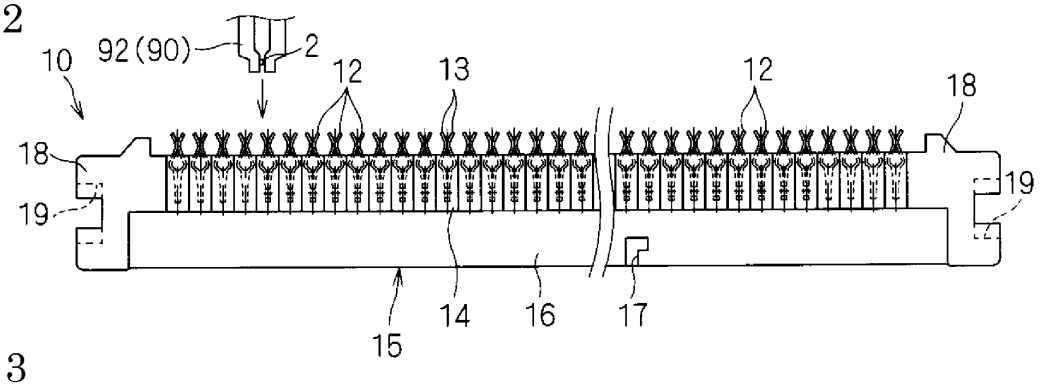

Fig. 3

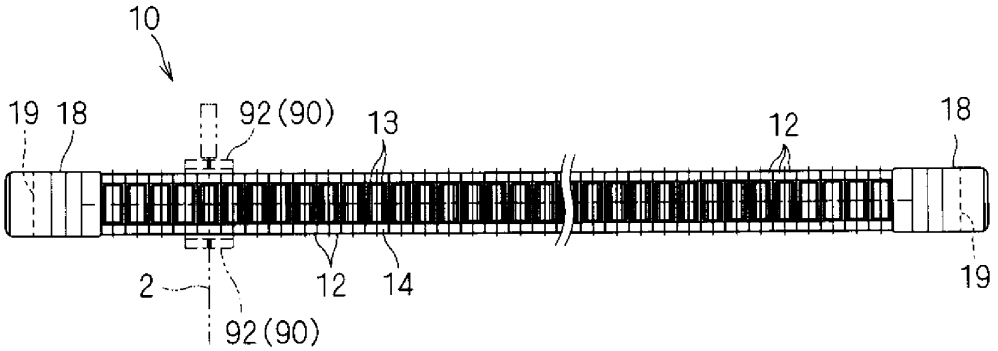

Fig. 4

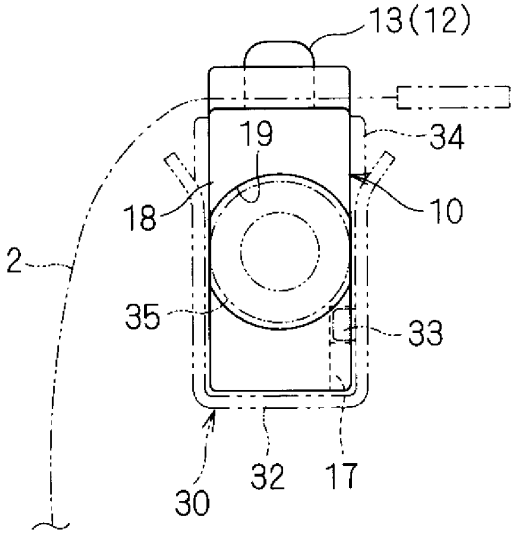
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Fig. 5

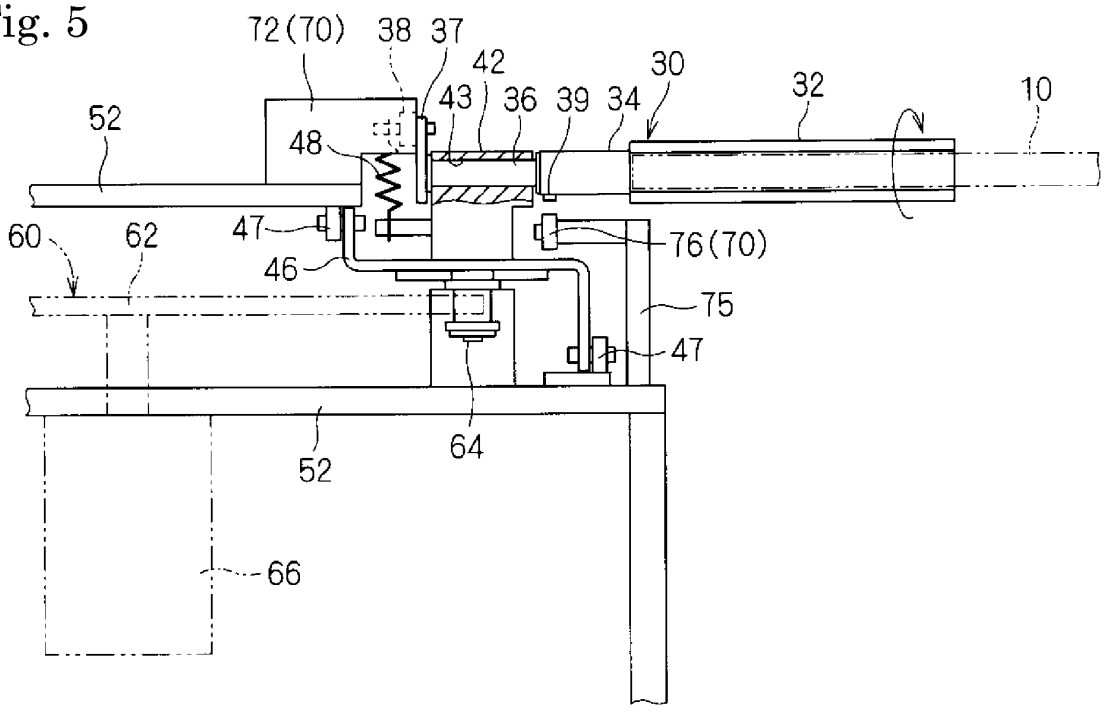
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Fig. 6

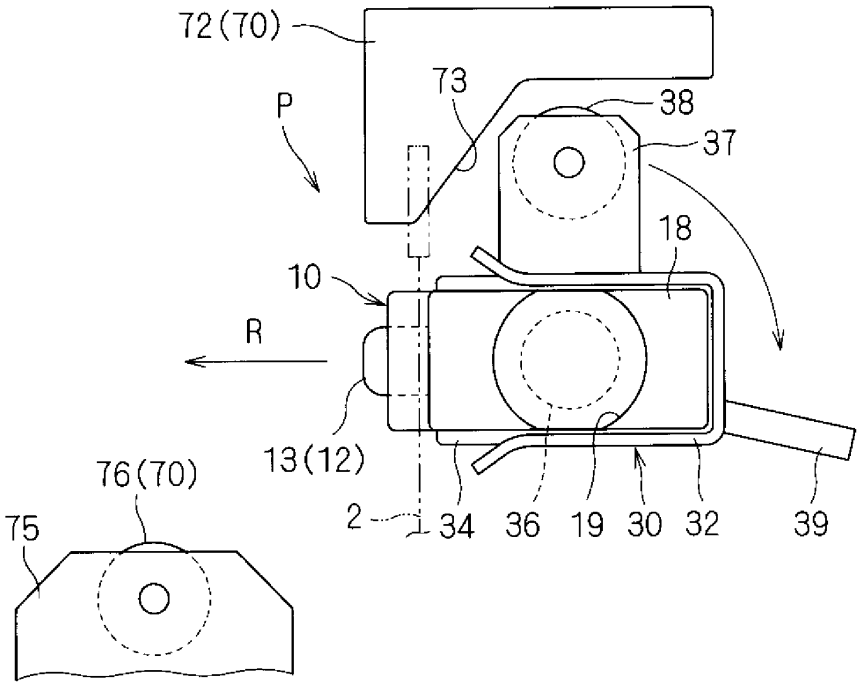
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Fig. 7

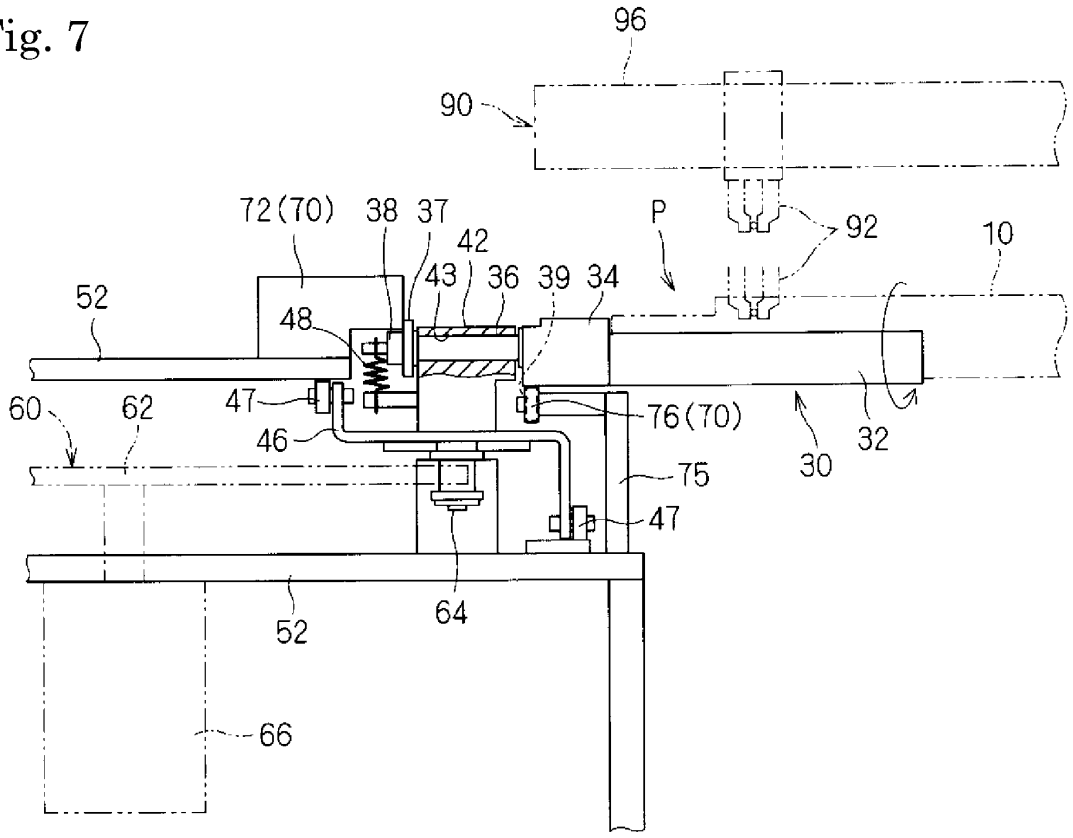
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Fig. 8

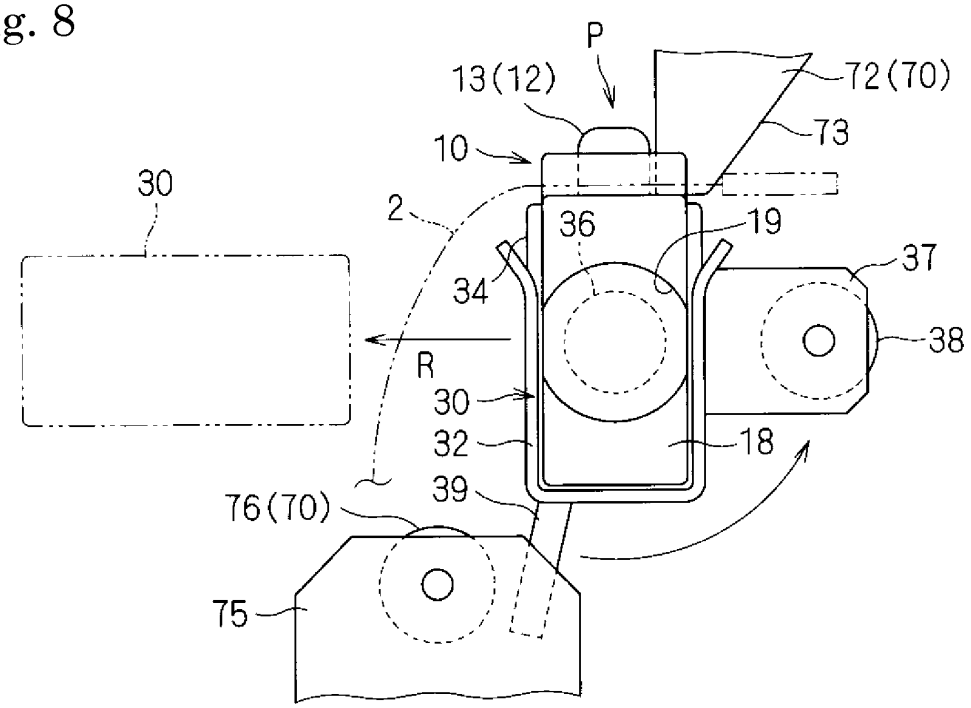
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Fig. 9

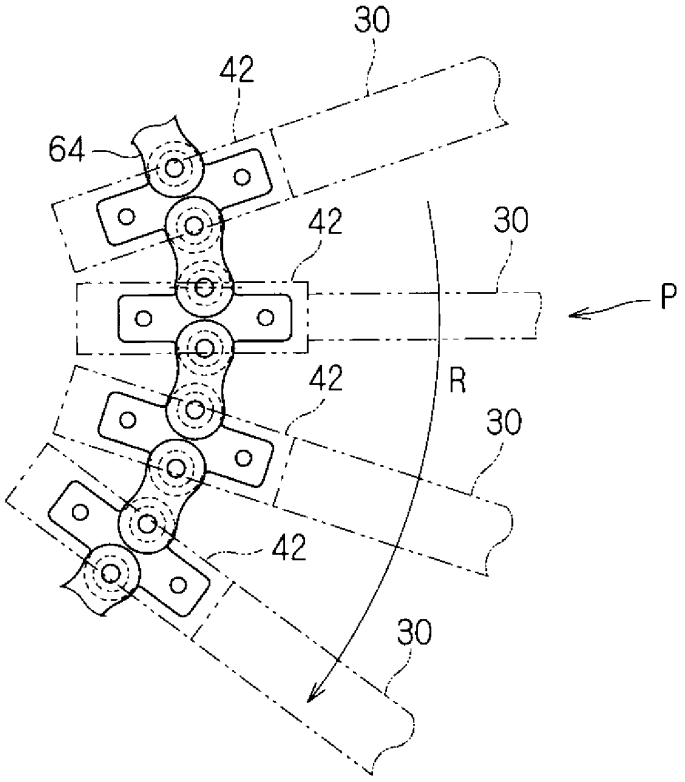
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Fig. 10

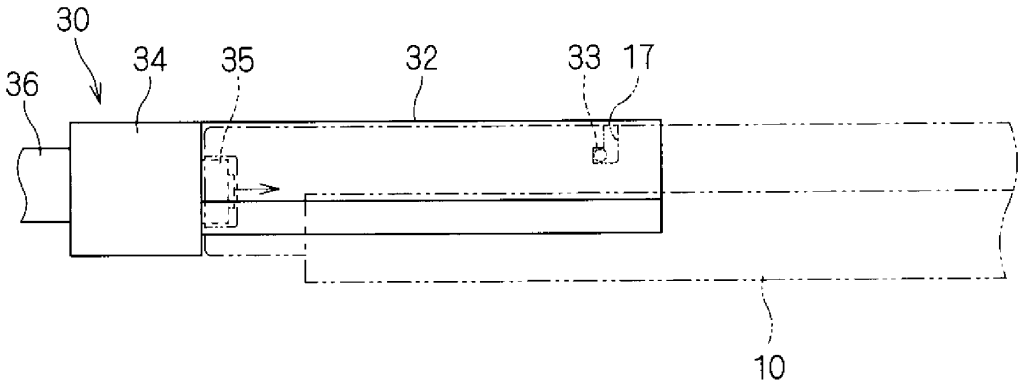


Fig. 11

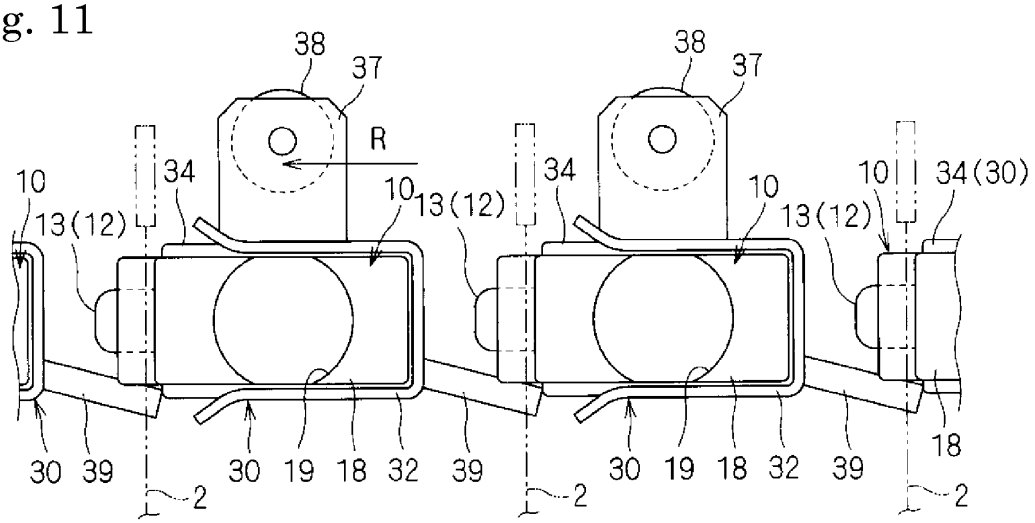
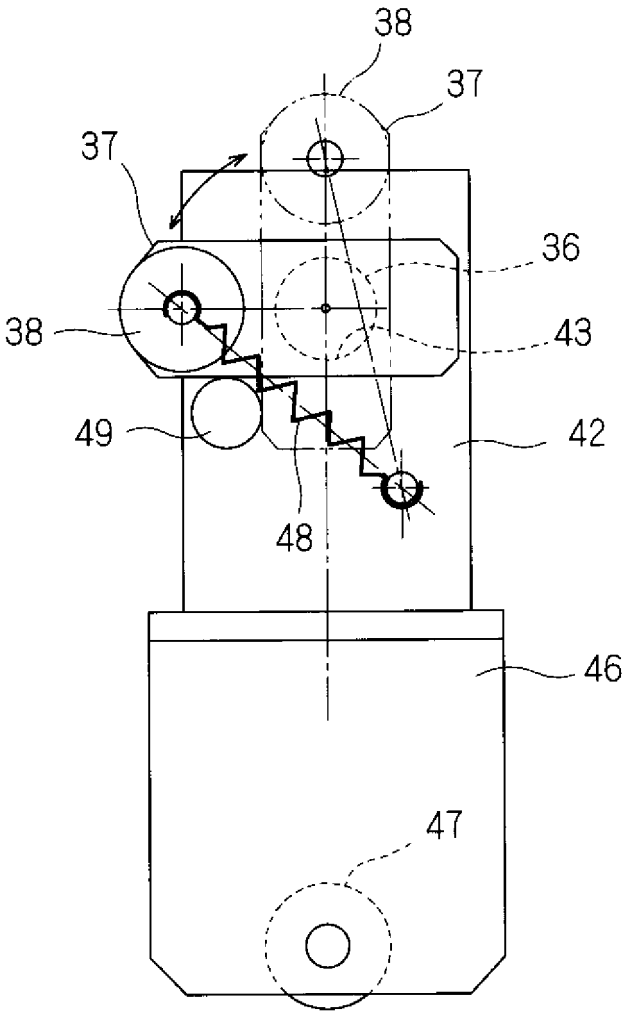


Fig. 12



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/069086

A. CLASSIFICATION OF SUBJECT MATTER
H01B13/012(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01B13/012, B65B27/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-287369 A (Sumitomo Wiring Systems, Ltd.), 24 December 2010 (24.12.2010), entire text & CN 101924314 A	1-6
A	JP 10-112229 A (Yazaki Corp.), 28 April 1998 (28.04.1998), entire text (Family: none)	1-6
A	JP 2001-332144 A (Sumitomo Wiring Systems, Ltd.), 30 November 2001 (30.11.2001), entire text (Family: none)	1-6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Patent documents cited in the description

- JP 2010287369 A **[0005]**