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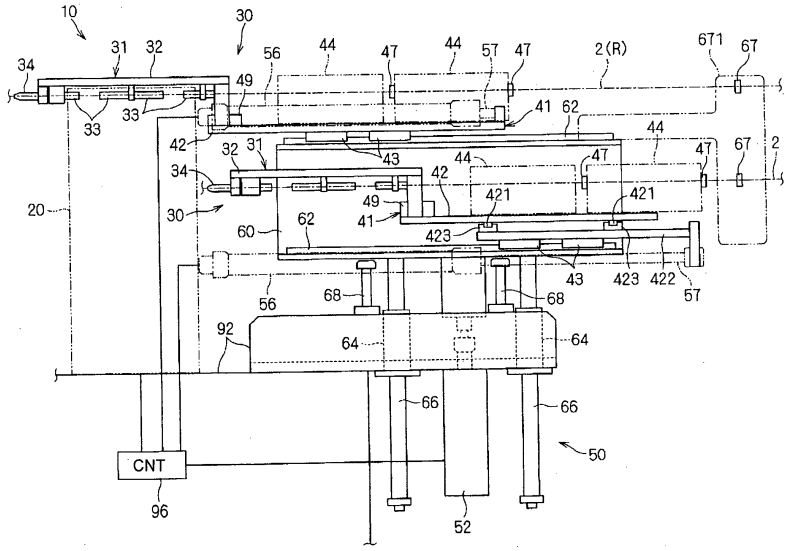
(54) WIRE-LENGTH-ADJUSTING DEVICE PROVIDED WITH WIRE REPLACEMENT MECHANISM

(57) A wire measuring apparatus with a wire replacement function is so configured that a wire to be measured is replaceable, and makes the replacement of the wire to be measured simpler. This apparatus includes a measuring mechanism unit capable of measuring a wire to a designed length on a feed path and feeding the wire, a plurality of wire support members each including a downstream guiding portion for supporting one end part of the wire in such a manner that the wire extends along the feed path and guiding the wire fed by the measuring mechanism unit to a wire path on a downstream side, and a moving mechanism unit capable of moving the plurality of wire support members between a set position where the supported wire is arranged on the feed path and a standby position different from the set position. The downstream guiding portion is arranged at a position downstream of the measuring mechanism unit in a state where the wire support member is arranged at the set position.

FIG. 1



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Description

Technical Field

[0001] This invention relates to a technique for measuring a wire in a process for manufacturing a terminal-provided wire.

Background Art

[0002] A terminal-provided wire to be assembled into a wiring harness or the like is manufactured by crimping a terminal to an end portion of a wire cut after being measured to a designed cutting length. A wire measuring apparatus used in a wire measuring process feeds a continuous wire while successively measuring the wire to the designed cutting length. In changing a lot or the like, the type of the wire may be changed depending on the product number of terminal-provided wires. The wire is replaced also when the wire in a wire supply source is not sufficient for the next lot.

[0003] Patent literature 1 discloses a wire measuring apparatus provided with a wire replacement function capable of replacing a wire to be supplied. This wire measuring apparatus provided with the wire replacement function includes a measuring mechanism unit for measuring a wire, a wire support member for supporting one end part of the wire, a support member arranging unit for supporting the wire support member at a position different from a wire feed path, and a moving mechanism unit for moving the wire support member between a set position for measuring the wire and a standby position different from the set position. The measuring mechanism unit includes a feeding unit for feeding the wire supported by the wire support member and having one end part thereof arranged on the wire feed path, a straightening unit for straightening the wire and a feed guiding unit provided on a downstream end part for guiding the wire onto a predetermined path on a downstream side. The feed guiding unit is configured to include a hole portion allowing the passage of the wire therethrough.

[0004] At the time of replacing the wire, the wire support member supported at the set position is moved to the standby position in a direction perpendicular to the wire feed path and a wire support member supported at another standby position is moved to the set position.

Citation List

Patent Literature

[0005] Patent literature 1: Japanese Unexamined Patent Publication No. 2011-54391

Summary of the Invention

Technical Problem

[0006] In the wire measuring apparatus provided with the wire replacement function of the above patent literature 1, the wire supported by the wire support member arranged at the set position is in a state where a downstream end portion thereof is inserted in the feed guiding unit. In moving the wire support portion from the set position to the standby position, the wire supported by the wire support member is desirably pulled out from the feed guiding unit if the wire support member is moved in the direction perpendicular to the wire feed path by the moving mechanism unit.

[0007] However, to satisfy the above request in the wire measuring apparatus with the wire replacement function of the patent literature 1, an operation step of pulling out the wire from the insertion guiding unit is additionally necessary and a configuration for pulling out the wire is also necessary at the time of replacing the wire.

[0008] Accordingly, the present invention aims to make the replacement of a wire to be measured simpler.

Solution to Problem

[0009] A first aspect is directed to a wire measuring apparatus with a wire replacement function capable of replacing a wire to be measured, including a measuring mechanism unit capable of measuring the wire to a designed length on a feed path and feeding the wire; a plurality of wire support members each including a downstream guiding portion for supporting one end part of the wire in such a manner that the wire extends along the feed path and guiding the wire fed by the measuring mechanism unit to a wire path on a downstream side; and a moving mechanism unit capable of moving the plurality of wire support members between a set position where the supported wire is arranged on the feed path and a standby position different from the set position; wherein the downstream guiding portion is arranged at a position downstream of the measuring mechanism unit in a state where the wire support member is arranged at the set position.

[0010] According to a second aspect, in the wire measuring apparatus with the wire replacement function according to the first aspect, each wire support member includes a straightening portion capable of straightening the wire by coming into contact with the outer periphery of the supported wire.

[0011] According to a third aspect, in the wire measuring apparatus with the wire replacement function according to the first aspect, the moving mechanism unit includes a movable support body for supporting the plurality of wire support members in parallel; an exchange driving unit for supporting the movable support body movably in a direction intersecting with the feed path and exchanging the plurality of wire support members be-

tween the standby position and an intermediate position upstream of the set position; and a forward/backward driving unit capable of moving the wire support member in a direction along the feed path between the set position and the intermediate position.

[0012] According to a fourth aspect, in the wire measuring apparatus with the wire replacement function according to the first aspect, each wire support member includes a main unit and an exchangeable unit having the downstream guiding portion exchangeably held on the main unit.

Effects of the Invention

[0013] According to the wire measuring apparatus with the wire replacement function according to the first aspect, the wire support member made movable between the set position and the standby position by the moving mechanism unit includes the downstream guiding portion for guiding the wire fed by the measuring mechanism unit to the wire path on the downstream side. Since this downstream guiding portion is arranged downstream of the measuring mechanism unit in the state where the wire support member is arranged at the set position, an operation and a configuration for pulling out the wire from the downstream guiding portion can be omitted and the wire to be measured can be more easily replaced in moving the wire support member from the set position to the standby position as compared with the case where the downstream guiding portion for guiding the wire to the downstream side is provided in the measuring mechanism unit.

[0014] According to the wire measuring apparatus with the wire replacement function according to the second aspect, since the wire support member includes the straightening portion capable of straightening the wire by coming into contact with the outer periphery of the supported wire, an operation step of setting the wire in the straightening portion at the time of replacing the wire can be omitted and the replacement of the wire can be efficiently performed.

[0015] According to the wire measuring apparatus with the wire replacement function according to the third aspect, the moving mechanism unit includes the exchange driving unit for supporting the movable support body, which supports the plurality of wire support members in parallel, movably in the direction intersecting with the feed path and exchanging the plurality of the wire support members between the standby position and the intermediate position and the forward/backward driving unit capable of moving the wire support member in the direction along the feed path between the set position and the intermediate position. Thus, the wire support member can be more easily moved by the moving mechanism unit.

[0016] According to the wire measuring apparatus with the wire replacement function according to the fourth aspect, since the wire support portion includes the main unit and the exchangeable unit having the downstream guiding portion exchangeably held on the main unit, the downstream guiding portion corresponding to the diameter of the wire can be used and the wire can be fed toward the downstream side with the flapping thereof more reliably suppressed also when the wire to be measured is replaced by a wire of a different type.

Brief Description of the Drawings

[0017]

FIG. 1 is a schematic overall view of a wire measuring apparatus with a wire replacement function,
FIG. 2 is a plan view of a measuring mechanism unit,
FIG. 3 is a schematic view showing a driving mechanism of the measuring mechanism unit,
FIG. 4 is a view showing an exchangeable unit of a wire support member,
FIG. 5 is a side view of a straightening portion,
FIG. 6 is a plan view of the straightening portion,
FIG. 7 is a front view of a moving mechanism unit,
FIG. 8 is a plan view showing a relationship between an upper wire support member and the moving mechanism unit,
FIG. 9 is a plan view showing a relationship between a lower wire support member and the moving mechanism unit,
FIG. 10 is a view showing the operation of the wire measuring apparatus provided with the wire replacement function, and
FIG. 11 is a view showing the operation of the wire measuring apparatus provided with the wire replacement function.

Embodiment of the Invention

[0018] Hereinafter, a wire measuring apparatus 10 provided with a wire replacement function according to an embodiment is described (see FIG. 1).

[0019] The wire measuring apparatus 10 with the wire replacement function is an apparatus for measuring a wire 2 to a set length and feeding it in a process for manufacturing a terminal-provided wire. Here, the set length is a length of the wire 2 used for the terminal-provided wire and set in correspondence with a routing path for each type of the terminal-provided wire. This wire measuring apparatus 10 with the wire replacement function is incorporated into a pressure cutting machine in some cases and arranged upstream of a cutting apparatus. Specifically, in the pressure cutting machine, the wire 2 measured to the set length and fed by the wire measuring apparatus 10 with the wire replacement function is cut by the cutting apparatus, an insulation coating of an end portion is removed by a coating removal apparatus and a terminal is crimped to a core exposed portion by a terminal crimping apparatus, thereby manufacturing a terminal-provided wire.

[0020] In the process for manufacturing terminal-provided wires, terminal-provided wires are generally manufactured lot by lot and the wire 2 may be replaced in switching a lot. Note that the replacement of the wire 2 may be a replacement by a different type of the wire 2 or a replacement by the same type of the wire 2. This wire measuring apparatus 10 with the wire replacement function is so configured that the wire 2 to be measured is replaceable.

[0021] The wire measuring apparatus 10 with the wire replacement function includes a measuring mechanism unit 20, a plurality of wire support members 30 and a moving mechanism unit 50. Roughly, the wire measuring apparatus 10 with the wire replacement function measures the wire 2 supported by the wire support member 30 to the set length and feeds the wire 2 along a feed path R. When the wire 2 is replaced, the wire support member 30 supporting the wire 2, which has been a target of measurement thus far, is exchanged by another wire support member 30 by the moving mechanism unit 50, thereby replacing the wire 2 to be measured.

[0022] Out of the wire measuring apparatus 10 with the wire replacement function, the measuring mechanism unit 20 and the moving mechanism unit 50 are fixed to a base unit 92 stalled on a floor or the like.

[0023] The measuring mechanism unit 20 is a part configured such that the wire 2 can be measured to the set length on the feed path R and fed to a downstream side (see FIGS. 2 and 3). Here, the measuring mechanism unit 20 is a feeding mechanism unit and includes pairs of feed rollers 22, a pair of roller support portions 24, a motor 26 and a transmission unit 27. Note that the feed path R is a path along which the wire 2 passes when being measured and fed in the wire measuring apparatus 10 with the wire replacement function. Here, the feed path R is set to be straight.

[0024] More specifically, the pairs of feed rollers 22 are rotatably supported on the pair of roller support portions 24 on opposite sides of the feed path R with rotary shafts thereof set in parallel (here, along a vertical direction). Here, two feed rollers 22 are supported on one roller support portion 24, i.e. two pairs of feed rollers 22 are supported. There may be provided only one, three or more pairs of feed rollers 22.

[0025] Further, the feed rollers 22 are indirectly driven and rotated by the motor 26 via the transmission unit 27. As shown in FIG. 3, the transmission unit 27 includes a drive gear 271 which is provided coaxially with the motor 26 and directly driven and rotated, a transmission gear 272 which is engaged with the drive gear 271, and coaxial gears 273 which are provided coaxially with the feed rollers 22 and engaged with either one of the drive gear 271 and the transmission gear 272. By this transmission unit 27, the feed rollers 22 are symmetrically driven and rotated at the opposite sides of the feed path R to feed the wire 2 toward the downstream side.

[0026] The pair of roller support portions 24 are provided movably toward and away from each other at the opposite sides of the feed path R. More specifically, the pair of roller support portions 24 are respectively supported by a cylinder 242. Although the cylinder 242 is an air cylinder, it goes without saying that the cylinder 242 may be a hydraulic cylinder. Further, instead of the cylinder 242, a combination of a pressing mechanism using a coil spring and a linear driving mechanism using a cylinder or a motor may be adopted. In a state where the pair of roller support portions 24 are moved to proximate positions, the feed rollers 22 sandwich the wire 2 passing on the feed path R. Specifically, by the rotation of the pairs of feed rollers 22, the wire 2 sandwiched therebetween is fed. Further, in a state where the pair of roller support portions 24 are moved to distant positions, the respective pairs of feed rollers 22 are spaced apart by a distance longer than the diameter of the wire 22, thereby releasing a state sandwiching the wire 2. Specifically, the wire 2 can be taken in and out from between the pairs of feed rollers 22.

[0027] The wire support member 30 is a member configured such that one end part of the wire 2 can be supported in a manner extending along the feed path R, i.e. substantially straight from an upstream side toward the downstream side. Here, two wire support members 30 are provided and alternately moved between a set position where the supported wire 2 is located on the feed path R and a standby position different from the set position by the moving mechanism unit 50. This wire support member 30 includes a measurement guiding portion 32, a downstream guiding portion 34, a support portion 42, straightening portions 44 and path guiding portions 47. It is assumed that the wire support member 30 is arranged at the set position in the following description on the wire support member 30.

[0028] The measurement guiding portion 32 is a part for guiding the wire 2 passing through the measuring mechanism unit 20 (see FIGS. 2 and 4). This measurement guiding portion 32 includes tubular wire insertion portions 33 through which the wire 2 is inserted to be guided. More specifically, the wire insertion portions 33 are cylindrical parts intermittently provided along a straight line and set to have an inner diameter larger than the outer diameter of the wire 2. As shown in FIG. 2, the wire insertion portions 33 are so intermittently formed (here, three wire insertion portions) in a direction along the feed path R as be located on opposite sides of facing parts of the two pairs of feed rollers 22. Specifically, the wire insertion portions 33 are formed not to interfere with the pairs of feed rollers 22 facing across the feed path R. End parts of the wire insertion portions 33 proximate to the facing parts of the respective pairs of feed rollers 22 are so formed that a length is gradually reduced in a facing direction of the feed rollers 22 across the feed path R as the end parts approach the facing parts. Specifically, the wire insertion portions 33 are formed to be able to guide the wire 2 over a wide range of the measuring mechanism unit 20 in the direction along the feed path R. This makes the wire 2 less exposed and suppresses

the stick-out of the wire 2 in the measuring mechanism unit 20.

[0029] The downstream guiding portion 34 is a part which is provided on a downstream end part of the wire support member 30 and guides the wire 2 fed by the measuring mechanism unit 20 to a wire path downstream of the measuring mechanism unit 20 (see FIG. 4). More specifically, the downstream guiding portion 34 is provided downstream of the wire insertion portions 33, i.e. arranged at a position downstream of the measuring mechanism unit 20 in a state where the wire support member 30 is arranged at the set position (see FIG. 1).

[0030] This downstream guiding portion 34 allows the passage of the wire 2 therethrough and includes restricting portions facing at least in one direction while being spaced apart by a distance shorter than the inner diameter of the wire insertion portions 33. Specifically, the downstream guiding portion 34 is formed to guide the wire 2 to the downstream side while suppressing the flapping of the wire 2 by more strictly positioning the wire 2 at least in one direction than the wire insertion portions 33 supporting the wire 2 on the feed path R. Further, the downstream guiding portion 34 is configured to provide a degree of freedom for the downstream wire path while restricting the wire 2 being fed to that wire path. Specifically, the wire 2 fed through the downstream guiding portion 34 may be treated on wire paths downstream of the downstream guiding portion 34 and having a certain degree of freedom. Thus, the downstream guiding portion 34 is preferably capable of guiding and restricting the wire 2 to each wire path within the range of the degree of freedom.

[0031] Accordingly, the downstream guiding portion 34 is formed to include a coil spring at a tip side here. This downstream guiding portion 34 is in the form of a nozzle as a whole and the coil spring (here, tight coil spring) extends from a tip part of a through hole formed in a base end side to the tip side. Specifically, the downstream guiding portion 34 is so formed that a tip part is resiliently deformable in a direction perpendicular to the feed path R for the wire 2 with a base end part of the coil spring as a supporting point. Further, the downstream guiding portion 34 is gradually narrowed toward the tip part (downstream end part). The tip part of the downstream guiding portion 34 has a substantially circular opening extending along the outer peripheral surface of the wire 2 and the diameter of the opening is set to be slightly larger than the outer diameter of the wire 2, and smaller than the inner diameter of the wire insertion portions 33 here. Preferably, the opening diameter of the tip part of the downstream guiding portion 34 is set at such a diameter that the wire 2 being fed can be smoothly fed to the downstream side with the flapping thereof suppressed. Note that this downstream guiding portion 34 may be in the form of a coil spring as a whole.

[0032] The downstream guiding portion 34 guides the wire 2 to the wire path downstream of the measuring mechanism unit 20 by coming into contact (it is not necessary to be constantly held in contact) with the outer periphery of the wire 2 passing inside in directions perpendicular to the feed path R (here, in all directions). Further, the tip part of the downstream guiding portion 34 is curved, whereby the downstream guiding portion 34 can guide and restrict the wire 2 to each downstream wire path within the range of that curvature deformation with the flapping suppressed.

[0033] Besides, a configuration for correction from upper and lower sides may be adopted as such a downstream guiding portion. A downstream guiding portion having the configuration for correction from upper and lower sides is formed by replacing the coil spring part of the configuration including the coil spring on the tip side by a part including a pair of wall portions facing each other. More specifically, the pair of wall portions are provided to face each other while being spaced apart by a distance slightly longer than the outer diameter of the wire 2 in a vertical direction. This enables this downstream guiding portion to guide the wire 2 to each wire path with a degree of freedom substantially in a horizontal direction while strictly positioning the wire 2 in the vertical direction in which the wire 2 is easily affected by gravity.

[0034] Further, a short downstream guiding portion may be adopted. The short downstream guiding portion is formed by omitting the coil spring part from the configuration including the coil spring on the tip side and includes a through hole allowing the passage of the wire 2 therethrough and having a smaller diameter than the wire insertion portions 33. Specifically, the short downstream guiding portion is configured to be able to move the wire 2 to each wire path while providing a degree of freedom by guiding the wire 2 to a fixed position as a base point of each downstream wire path.

[0035] Further, the downstream guiding portion only has to be able to guide the wire 2 to the wire path downstream of the measuring mechanism unit 20 while suppressing the flapping and may be a tapered tubular nozzle formed by die molding using a metal material or a resin material.

[0036] Further, the wire support member 30 is so configured as a whole that an exchangeable unit 31 is exchangeably held on a main unit 41. More specifically, the wire support member 30 is configured by holding the exchangeable unit 31 on a downstream side of the main unit 41. Here, the main unit 41 is a part configured by supporting the straightening portions 44 and the path guiding portions 47 on the support portion 42. Further, the exchangeable unit 31 is a part including the measurement guiding portion 32, the downstream guiding portion 34 and a held portion 39.

[0037] The support portion 42 is a plate-like member. This support portion 42 has the straightening portions 44 and the path guiding portions 47 directly or indirectly supported thereon and includes a holding portion 49 for supporting the exchangeable unit 31.

[0038] More specifically, the holding portion 49 is supported on one principle surface on a downstream end

part of the support portion 42. This holding portion 49 is formed to be able to hold the held portion 39 provided on an upstream end part of the exchangeable unit 31 (measurement guiding portion 32) in a certain posture. Here, an example of a combination of the held portion 39 and the holding portion 49 is described. The held portion 39 includes a part in the form of a rectangular plate laterally projecting from an upstream end part of the measurement guiding portion 32 and a turning portion provided on the upper surface of this part and having a surface capable of laterally applying a tensile force. Further, the holding portion 49 includes a recess into which a projecting part of the held portion 39 is fittable, a catching portion capable of catching the turning portion and a pulling lever capable of pulling the catching portion toward a lateral side of the measurement guiding portion 32. The exchangeable unit 31 is held on the main unit 41 by catching the turning portion by the catching portion and operating the pulling lever in a state where the projecting part of the held portion 39 is fitted in the recess of the holding portion 49. Note that, besides the above, the combination of the held portion 39 and the holding portion 49 can be a configuration for convexo-concave engagement of a holding portion with a held portion or a configuration for gripping a held portion by a holding portion.

[0039] The straightening portions 44 are parts for straightening the wire 2 supported by the wire support member 30 (see FIGS. 5 and 6). These straightening portions 44 are configured to be able to straighten the wire 2 by coming into contact with the outer periphery of the wire 2 being fed. Here, two straightening portions 44 are supported side by side on the support portion 42 in the direction along the feed path R. Alternatively, one, three or more straightening portions 44 may be provided.

[0040] More specifically, the straightening portion 44 includes a pair of roller support portions 45 and a plurality of straightening rollers 46. The plurality of straightening rollers 46 are respectively rotatably supported on the pair of roller support portions 45 on the opposite sides of the feed path R in such postures that rotary shafts thereof are parallel. More specifically, the plurality of straightening rollers 46 are supported on the respective roller support portions 45 in an offset manner in the direction along the feed path R. Here, three straightening rollers 46 are supported on each roller support portion 45. The number of the straightening rollers 46 supported on each roller support portion 45 is not limited to three. It is sufficient to support at least one or more straightening rollers 46 on each roller support portion 45 in an offset manner. Two, four or more straightening rollers 46 may be supported on each roller support portion 45. Further, different numbers of straightening rollers 46 may be supported on the roller support portions 45 such as three on one roller support portion 45 and four on the other.

[0041] A groove having a substantially V-shaped cross-section perpendicular to a circumferential direction is formed on the outer periphery of each straightening roller 46. Here, the bottom of the groove on the outer periphery of the straightening roller 46 is formed in a center in a direction of the rotary shaft. The wire 2 passing through between the plurality of straightening rollers 46 is fed through the vicinities of the bottoms of the grooves. The shape of the straightening rollers 46 is not limited to the above shape and grooves having a substantially U-shaped cross-section perpendicular to the circumferential direction may be formed.

[0042] The pair of roller support portions 45 are provided movably toward and away from each other on the opposite sides of the feed path R. More specifically, one roller support portion 45 is supported movably toward and away from the other roller support portion 45 by a cylinder 452. Although the cylinder 452 is an air cylinder here, it goes without saying that the cylinder 452 may be a hydraulic cylinder. Further, instead of the cylinder 242, a combination of a pressing mechanism using a coil spring and a linear driving mechanism using a cylinder or a motor may be adopted.

[0043] In a state where the pair of roller support portions 45 are proximate to each other, the respective straightening rollers 46 located on the opposite sides of the feed path R are in contact with the outer periphery of the wire 2 passing on the feed path R. Here, the respective straightening rollers 46 rotate according to the movement of the wire 2 due to the contact with the wire 2 passing along the feed path R. Further, the wire 2 passing between the respective straightening rollers 46 is fed in a meandering manner (here, in a slightly meandering manner) while receiving pressing forces from the straightening rollers 46 in directions across the feed path R. Note that the pressing forces of the plurality of straightening rollers 46 to the wire 2 by the cylinder 452 can be arbitrarily adjusted by a pressure regulating valve provided in the cylinder 452 and set at an appropriate value corresponding to each of various types of the wire 2. Further, in a state where the pair of roller support portions 45 are distant from each other, the respective straightening rollers 46 supported on the one roller support portion 45 are not in contact with the outer periphery of the wire 2. Preferably, the straightening rollers 46 supported on the respective roller support portions 45 may be arranged at positions spaced apart by a distance longer than the outer diameter of the wire 2 in the direction across the feed path R. Specifically, at these positions, the wire 2 is easily arranged on the feed path R between the respective straightening rollers 46.

[0044] Here, the two straightening portions 44 are arranged on the support portion 42 in such postures that the rotary shafts of the respective straightening rollers 46 are perpendicular. Specifically, the wire 2 receives pressing forces acting in perpendicular directions from the straightening rollers 46 in each straightening portion 44.

[0045] The path guiding portion 47 is a part for guiding the wire 2 onto the feed path R at a side upstream of the measurement guiding portion 32. This path guiding portion 47 includes a through hole allowing the passage of

the wire 2 therethrough and restricts the path for the wire 2 by the inner periphery of the through hole coming into contact with the outer periphery of the wire 2. The inner diameter of the through hole of the path guiding portion 47 is set to be larger than the outer diameter of the wire 2 and the inner periphery of the through hole is provided at a position surrounding the feed path R. Further, the path guiding portion 47 is provided at a distance from the upstream end part of the wire insertion portions 33 of the measurement guiding portion 32 in the direction along the feed path R. Preferably, a plurality of path guiding portions 47 may be provided while being spaced apart in the direction along the feed path R.

[0046] Here, the path guiding portion 47 is provided on each of opposite end parts (opposite end parts in the direction along the feed path R) of the upstream one of the two straightening portions 44. Specifically, the path guiding portions 47 are indirectly supported on the support portion 42 via the straightening portion 44. The path guiding portions 47 may directly stand on the support portion 42 or one, three or more path guiding portions may be provided at positions different from the above positions.

[0047] For the sake of description, the path along which the wire 2 supported by the wire support member 30 passes may be called a support path below when being described without being directly related to the measuring mechanism unit 20 (including the description of the wire support member 30 at the standby position).

[0048] The moving mechanism unit 50 is a part for moving a plurality of (here, two) wire support members 30 between the set position and the standby position. This moving mechanism unit 50 is configured to be able to move the two wire support members 30 in a direction intersecting with the feed path R (here, vertical direction perpendicular to the feed path R) and the direction along the feed path R. This moving mechanism unit 50 includes an exchange driving unit 52 and a forward/backward driving unit 56. Roughly, the moving mechanism unit 50 vertically moves the two wire support members 30 between an intermediate position retracted toward the upstream side from the set position and two standby positions (upper standby position and lower standby position) by the exchange driving unit 52 and moves the wire support member 30 between the set position and the intermediate position by the forward/backward driving unit 56.

[0049] As shown in FIGS. 1 and 7, the two wire support members 30 are supported on a movable support body 60. The movable support body 60 is formed to have a U shape (rectangular shape with one entire open side) when viewed in the direction along the feed path R, and the wire support members 30 are supported on respective facing pieces movably in the direction along the feed path R. Here, the movable support body 60 is provided in such a posture as to be open laterally, one wire support member 30 (hereinafter, upper wire support member 30) is supported on the upper facing piece and the other wire support member 30 (hereinafter, lower wire support member 30) is supported on the lower facing piece (between the facing pieces).

[0050] More specifically, a guide rail 62 shaped to extend in the direction along the feed path R extends on each facing piece of the movable support body 60. This guide rail 62 is, for example, a long member having a substantially rectangular cross-section, and a groove extending in a longitudinal direction is formed on each of opposite side surfaces extending in the longitudinal direction. The guide rail 62 may be fixed to each facing piece of the movable support body 60 by screws or the like.

[0051] Traveling portions 43 are fitted on the guide rail 62 movably in the longitudinal direction. For example, each traveling portion 43 may include a recess fittable to the guide rail 62 and projections to be fitted into the grooves of the guide rail 62 may be formed on parts of facing wall portions of the recess. The traveling portion 43 moves along the feed path R by sliding along the guide rail 62 in a state supporting the support portion 42.

[0052] Here, in the upper wire support member 30, the traveling portions 43 are provided on a bottom part of the support portion 42 (see FIGS. 7 and 8). The upper wire support member 30 is moved along the feed path R by the support portion 42 being moved along the guide rail 62. Note that a tip part of a forward/backward moving portion 57 of the forward/backward driving unit 56 to be described later is fixed to the support portion 42.

[0053] Further, the lower wire support member 30 is supported on the one facing piece between the pair of facing pieces of the movable support body 60 and can exit from the inner side between the pair of facing pieces to improve operability in setting the wire 2. More specifically, the support portion 42 of the lower wire support member 30 is supported on an intermediate support portion 422, which is supported on the movable support body 60 movably in the direction along the feed path R, movably in a direction perpendicular to the feed path R (here, direction connecting the opening side and the bottom side of the movable support body, i.e. lateral direction of FIG. 7) (see FIGS. 7 and 9).

[0054] The intermediate support portion 422 is a plate-like member. The traveling portions 43 are provided on a bottom part of the intermediate support portion 422. Note that the tip part of the forward/backward moving portion 57 of the forward/backward driving unit 56 to be described later is fixed to the intermediate support portion 422. Further, travel rails 421 extending along the direction perpendicular to the feed path R extend on the bottom surface of the support portion 42. These travel rails 421 can have the same shape as the above guide rails 62. On the other hand, slidable support portions 423 slidably supporting the travel rail 421 are provided on the upper surface of the intermediate support portion 422. These slidable support portions 423 are shaped to be relatively slidably fittable to the travel rails 421, i.e. can have the same shape as the above traveling portions 43.

[0055] The lower wire support member 30 is moved in

the direction along the feed path R by the intermediate support portion 422 being moved along the guide rail 62. Further, the lower wire support member 30 is moved into and out of the movable support body 60 by the support portion 42 being slid relative to the slidable support portions 423. Note that, as shown in FIGS. 7, 9, a pulling grip 48 may be provided on a side part of the support portion 42 to move the support portion 42 relative to the intermediate support portion 422.

[0056] Further, the movable support body 60 is supported on the base unit 92 movably in the direction (here, vertical direction) perpendicular to the feed path R (see FIG. 1). More specifically, the movable support body 60 is supported on slide shafts 66 supported on bearings 64 fixed to the base unit 92. Note that a downward movement of the movable support body 60 may be restricted at a position where the upper wire support member 30 is arranged at the intermediate position or the set position (position where the measurement guiding portion 32 does not interfere with the measuring mechanism unit 20 in the vertical direction). For example, as shown in FIG. 1, bolts 68 screwed into the base unit 92 can be used as stoppers.

[0057] The exchange driving unit 52 is configured to be able to move the movable support body 60 movably supported as described above between a position where the two wire support members 30 are located at the intermediate position and a position where the two wire support members 30 are located at the respective standby positions. An air cylinder, a hydraulic cylinder, a linear driving mechanism using a motor or the like (here, air cylinder) can be used as the exchange driving unit 52. The exchange driving unit 52 is arranged between the base unit 92 and the movable support body 60. The exchange driving unit 52 is configured to be able to push up the movable support body 60 by the amount of movement of the upper wire support member 30 from the intermediate position to the upper standby position, i.e. the amount of movement of the lower wire support member 30 from the lower standby position to the intermediate position.

[0058] The forward/backward driving unit 56 is configured to be able to move the wire support member 30 movably supported on the movable support body 60 in the direction along the feed path R between the intermediate position and the set position (see FIGS. 8 and 9). An air cylinder, a hydraulic cylinder, a linear driving mechanism using a motor or the like (here, air cylinder) can be used as the forward/backward driving unit 56. The forward/backward driving unit 56 is supported on the movable support body 60 and the tip part of the forward/backward moving portion 57 is directly or indirectly fixed to the support portion 42 or the intermediate support portion 422. Here, the wire support member 30 is arranged at the intermediate position in a state where the forward/backward moving portion 57 of the forward/backward driving unit 56 is advanced, and arranged at the set position in a state where the forward/backward moving portion 57 is retracted.

[0059] Further, a guide support piece 671 for supporting upstream guiding portions 67 at a side upstream of the wire support member 30 is attached to the movable support body 60 (see FIG. 1). Two upstream guiding portions 67 are supported on the guide support piece 671 in correspondence with the two wire support members 30. More specifically, each upstream guiding portion 67 includes a through hole allowing the passage of the wire 2 therethrough and the inner periphery of the through hole is provided at a position surrounding the feed path R. This upstream guiding portion 67 is a part which is maintained at a fixed position on the movable support body 60 in the direction along the feed path R and first guides the wire 2 supplied from the supply source to the feed path R.

[0060] Further, the wire measuring apparatus 10 with the wire replacement function includes a control unit 96 capable of controlling the measuring mechanism unit 20, the wire support members 30 and the moving mechanism 50 (see FIG. 1). The control unit 96 is configured by a general microcomputer including unillustrated CPU, ROM, RAM and the like. This control unit 96 is connected to the cylinder 242 and the motor 26 of the measuring mechanism unit 20, the cylinders 452 in the straightening portions 44 of the wire support members 30 and the exchange driving unit 52 and the forward/backward driving unit 56 of the moving mechanism 50 to be able to give various operation commands thereto. The control unit 96 controls the above respective components in a comprehensive manner in accordance with a software program stored in advance and various instructions entered through an input unit for operator operation. A configuration including switches for various operations can be adopted as the input unit.

[0061] When the wire 2 is measured, the control unit 96 gives a signal for driving and rotating the motor 26 to the measuring mechanism unit 20 based on information such as feeding speed and a feeding time stored in the ROM.

[0062] When the wire 2 is replaced, the control unit 96 first gives a signal for operating the cylinder 242 to move the roller support portions 24 away from each other to the measuring mechanism unit 20. Further, the control unit 96 gives a signal for operating the forward/backward driving unit 56 and the exchange driving unit 52 to move the wire support member 30 at the set position to the intermediate position and move this wire support member 30 to the one standby position (move the other wire support member 30 from the other standby position to the intermediate position) to the moving mechanism 50. Further, the control unit 96 gives a signal for operating the forward/backward driving unit 56 to move the wire support member 30 moved to the intermediate position to the set position to the moving mechanism 50.

[0063] When the wire 2 is set in the wire support member 30, the control unit 96 gives signals for operating the respective cylinders 452 to move the roller support por-

tions 45 away from each other to the respective straightening portions 44. When the wire 2 is set on the support path, the control unit 96 gives a signal for operating the respective cylinders 452 to move the roller support portions 45 toward each other to the respective straightening portions 44.

[0064] Next, the operation of the wire measuring apparatus 10 of the wire replacement function is described.

[0065] First, an operation of measuring the wire 2 in a state where one wire support member 30 is arranged at the set position is described. Note that an initial state is a state where the upper wire support member 30 is arranged at the set position (see

[0066] FIG. 1). At this time, the measuring mechanism unit 20 is maintained at the position, where the roller support portions 24 are proximate to each other, by the cylinder 242 and the pairs of feed rollers 22 are in a state sandwiching the wire 2 on the feed path R. Further, the respective straightening portions 44 are maintained at the positions, where the pair of roller support portions 45 are proximate to each other, by the respective cylinders 452 and the plurality of straightening rollers 46 are in contact with the outer periphery of the wire 2 on the feed path R from the opposite sides of the feed path R.

[0067] When the motor 26 is driven and rotated, the feed rollers 22 are rotated in directions to feed the wire 2 to the downstream side via the transmission unit 27. In this way, the wire 2 is measured to the set length and fed to the downstream side. More specifically, the wire 2 is fed to the downstream side while passing through the upstream guiding portion 67, the respective path guiding portions 47 and the respective straightening portions 44 and further through the wire insertion portions 32 and the downstream guiding portion 34. Specifically, the wire 2 is guided onto the feed path R by passing through the upstream guiding portion 67 and the respective path guiding portions 47. Further, the wire 2 receives pressing forces in the respective directions by the plurality of straightening rollers 46 of the respective straightening portions 44 to be straightened by passing through between the plurality of straightening rollers 46. Furthermore, the wire 2 is precisely guided onto the feed path R between the pairs of feed rollers 22 by passing through the wire insertion portions 33 and fed to the downstream side with the flapping suppressed by passing through the downstream guiding portion 34.

[0068] When the feed of the wire 2 for one lot is finished, the measuring mechanism unit 20 is stopped.

[0069] Next, an operation of exchanging the wire support member 30 at the set position and replacing the wire 2 is described.

[0070] First, in the measuring mechanism unit 20, the roller support portions 24 are moved away from each other by the cylinder 242 and the pairs of feed rollers 22 release the wire 2 (see chain double-dashed line of FIG. 2). In this state, the upper wire support member 30 at the set position is moved to the standby position (see FIG. 10). This operation is performed by the forward/backward driving unit 56. More specifically, the forward/backward driving unit 56 operates so that the forward/backward moving portion 57 moves forward, whereby the support portion 42 fixed to the tip part of the forward/backward moving portion 57 is moved to the upstream side along the guide rail 62 of the movable support body 60 (in the direction along the feed path R).

[0071] Then, the upper wire support member 30 moved to the intermediate position is moved to the upper standby position (see FIG. 11). In other words, the lower wire support member 30 arranged at the low standby position is moved to the intermediate position. This operation is performed by the exchange driving unit 52. More specifically, the exchange driving unit 52 operates so that a forward/backward moving portion moves forward, whereby the movable support body 60 is pushed upwardly. Further, the lower wire support member 30 moved to the intermediate position is moved to the set position (see FIG. 11). This operation is performed by the forward/backward driving unit 56. More specifically, the forward/backward driving unit 56 operates so that the forward/backward moving portion 57 retracts, whereby the intermediate support portion 422 fixed to the tip part of the forward/backward moving portion 57 is moved to the downstream side along the guide rail 62 of the movable support body 60.

[0072] When the lower wire support member 30 is moved to the set position, the roller support portions 24 are moved toward each other by the cylinder 242 and the pairs of feed rollers 22 sandwich the wire 2 (see solid line of FIG. 2).

[0073] Next, an operation of setting the wire 2 in the wire support member 30 at the standby position is described.

[0074] First, the pair of roller support portions 45 in each straightening portion 44 of the upper wire support member 30 moved to the standby position are driven away from each other by each cylinder 452 (see chain double-dashed line of FIGS. 5 and 6). In this way, the wire 2 on the support path is released from the state pressed by the straightening rollers 46.

[0075] In this state, an operator pulls the wire 2 to the upstream side from the support path and passes the wire 2 supported on another supply source onto the support path and sets it in the upper wire support member 30. More specifically, the operator passes the wire 2 through the upstream guiding portion 67 and the upstream path guiding portion 47, between the plurality of straightening rollers 46 of the upstream straightening portion 44, through the downstream path guiding portion 47 and between the plurality of straightening rollers 46 of the downstream straightening portion 44. Furthermore, the operator passes the wire 2 through the wire insertion portions 33 and the downstream guiding portion 34.

[0076] After the wire 2 is set in the wire support member 30, a switch for operating the cylinders 452 (switch of the input unit connected to the control unit 96 or the like) is pressed to drive the roller support portions 45 of each

straightening portion 44 toward each other (see solid line of FIGS. 5 and 6). In this way, the plurality of straightening rollers 46 of each straightening portion 44 are held in contact with the outer periphery of the wire 2 on the feed path R.

[0077] Note that the wire 2 is set in the lower wire support member 30 after the lower wire support member 30 is pulled out from the position inside the movable support body 60 by pulling the pulling grip 48 provided on the support portion 42 (see chain double-dashed line of FIG. 7).

[0078] According to the wire measuring apparatus 10 with the wire replacement function configured as described above, the wire support member 30 made movable between the set position and the standby position by the moving mechanism unit 50 includes the downstream guiding portion 34 for guiding the wire 2 fed by the measuring mechanism unit 20 to the fixed position on the downstream side. Since this downstream guiding portion 34 is arranged downstream of the measuring mechanism unit 20 in the state where the wire support member 30 is arranged at the set position, the operation and configuration for pulling out the wire 2 from the downstream guiding portion 34 can be omitted and the wire 2 to be measured can be more easily replaced in moving the wire support member 30 from the set position to the standby position as compared with the case where the downstream guiding portion 34 for guiding the wire 2 to the downstream side is provided in the measuring mechanism unit 20.

[0079] Further, according to the wire support member 30 configured to include the straightening portions 44 capable of straightening the wire 2 by coming into contact with the outer periphery of the supported wire 2, an operation step of setting the wire 2 in the straightening portions 44 at the time of replacing the wire 2 can be omitted and the replacement of the wire 2 can be efficiently performed.

[0080] Further, according to the moving mechanism unit 50 configured to include the exchange driving unit 52 for supporting the movable support body 60, which supports the plurality of wire support members 30 in parallel, movably in the direction intersecting with the feed path R and exchanging the plurality of the wire support members 30 between the standby position and the intermediate position and the forward/backward driving unit 56 capable of moving the wire support member 30 in the direction along the feed path R between the set position and the intermediate position, the wire support members 30 can be more easily moved by the moving mechanism unit 50.

[0081] Further, according to the wire support member configured to include the main unit 41 and the exchangeable unit 31 having the downstream guiding portion 34 exchangeably held on the main unit 41, the downstream guiding portion 34 corresponding to the diameter of the wire 2 can be used and the wire 2 can be fed toward the downstream side with the flapping thereof more reliably suppressed also when the wire 2 to be measured is replaced by a wire 2 of a different type.

[0082] Although the moving mechanism unit 50 has been described with respect to the example in which the movable support body 60 supports the two wire support member 30 in parallel one above the other and is vertically moved by the exchange driving unit 52, there is no limitation to this. For example, the moving mechanism unit 50 may be configured such that a movable support body supports two wire support members 30 side by side in a lateral direction (horizontal direction) and is laterally moved by an exchange driving unit. Further, the exchange driving unit may move the movable support body 60 along an oblique direction to the vertical and lateral directions.

[0083] Further, although the moving mechanism unit 50 has been described with respect to the example in which the movable support body 60 supports the plurality of wire support members 30 and is moved, the configuration of the moving mechanism unit 50 is not limited to this. For example, support tables capable of supporting the plurality of wire support members 30 at the set position and the standby position are respectively provided and the moving mechanism unit may selectively hold one of the plurality of wire support members 30 and move the target wire support member between the set position and the standby position.

[0084] Further, although the example in which the two wire support members 30 are provided has been described, three or more wire support members 30 may be provided. At the time of replacing the wire 2, the wire support member 30 supporting the wire 2 to be measured next out of the plurality of wire support members 30 may be successively moved to the intermediate position and the set position.

[0085] The measuring mechanism unit may be configured to include a straightening portion in addition to the feeding mechanism unit. Specifically, the straightening portion is arranged at a position where straightening rollers are constantly arranged at the opposite sides of the feed path R and the straightening portions 44 of the wire support members 30 are omitted. Note that the path guiding portions 47 may stand on the support portion 42 in the case of omitting the straightening portions 44 in the wire support members 30.

[0086] Further, although the configuration in which the measuring mechanism unit 20 as the feeding mechanism unit measures and feeds the wire 2 has been described, the measuring mechanism unit may be configured to include mechanisms for separately performing a measuring operation and a feeding operation.

[0087] Although the wire support member 30 has been so configured that the exchangeable unit 31 is exchangeably attached to the main unit 41, only the downstream guiding portion 34 may have an exchangeable configuration.

[0088] Although this wire measuring apparatus 10 with the wire replacement function has been described in de-

tail above, the above description is illustrative in all aspects and this invention is not limited thereto. It is understood that numerous modifications, which are not illustrated, can be envisaged without departing from the scope of this invention.

List of Reference Signs

[0089]

2 wire
10 wire measuring apparatus with wire replacement function
20 measuring mechanism unit
30 wire support member
31 exchangeable unit
32 measurement guiding portion
34 downstream guiding portion
41 main unit
44 straightening portion
50 moving mechanism unit
52 exchange driving unit
56 forward/backward driving unit
60 movable support body

Claims

1. A wire measuring apparatus with a wire replacement function capable of replacing a wire to be measured, comprising:

a measuring mechanism unit capable of measuring the wire to a designed length on a feed path and feeding the wire;
a plurality of wire support members each including a downstream guiding portion for supporting one end part of the wire in such a manner that the wire extends along the feed path and guiding the wire fed by the measuring mechanism unit to a wire path on a downstream side; and
a moving mechanism unit capable of moving the plurality of wire support members between a set position where the supported wire is arranged on the feed path and a standby position different from the set position;
wherein the downstream guiding portion is arranged at a position downstream of the measuring mechanism unit in a state where the wire support member is arranged at the set position.

2. A wire measuring apparatus with a wire replacement function according to claim 1, wherein:

each wire support member includes a straightening portion capable of straightening the wire by coming into contact with the outer periphery of the supported wire.

3. A wire measuring apparatus with a wire replacement function according to claim 1, wherein the moving mechanism unit includes:

a movable support body for supporting the plurality of wire support members in parallel;
an exchange driving unit for supporting the movable support body movably in a direction intersecting with the feed path and exchanging the plurality of wire support members between the standby position and an intermediate position upstream of the set position; and
a forward/backward driving unit capable of moving the wire support member in a direction along the feed path between the set position and the intermediate position.

4. A wire measuring apparatus according to claim 1, wherein:

each wire support member includes a main unit and an exchangeable unit having the downstream guiding portion exchangeably held on the main unit.

FIG. 1

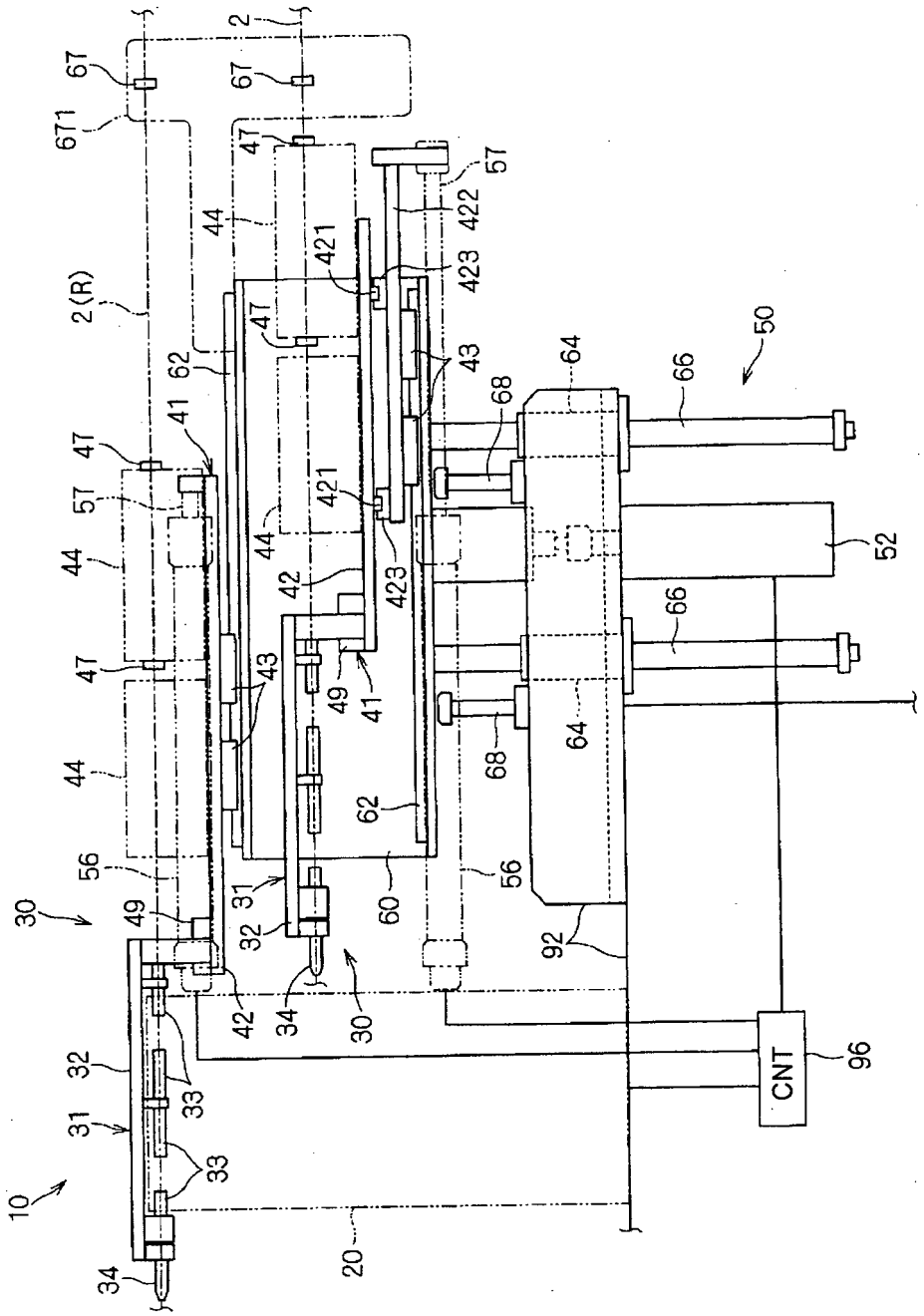
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FIG. 2

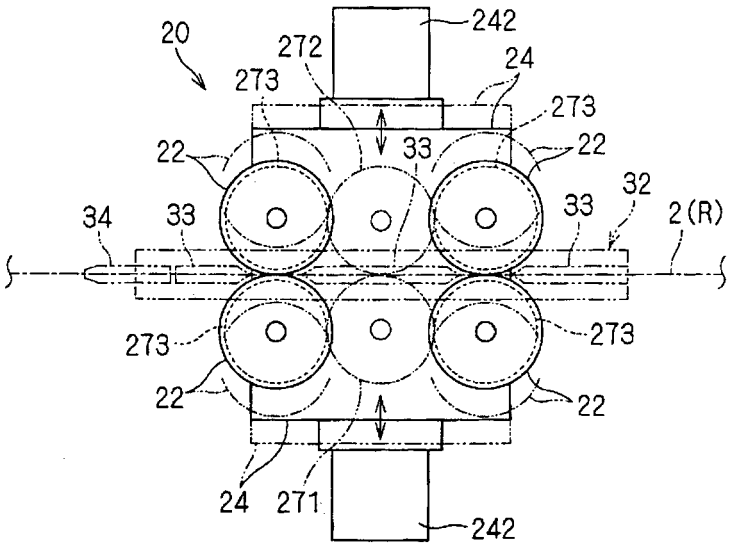
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FIG. 3

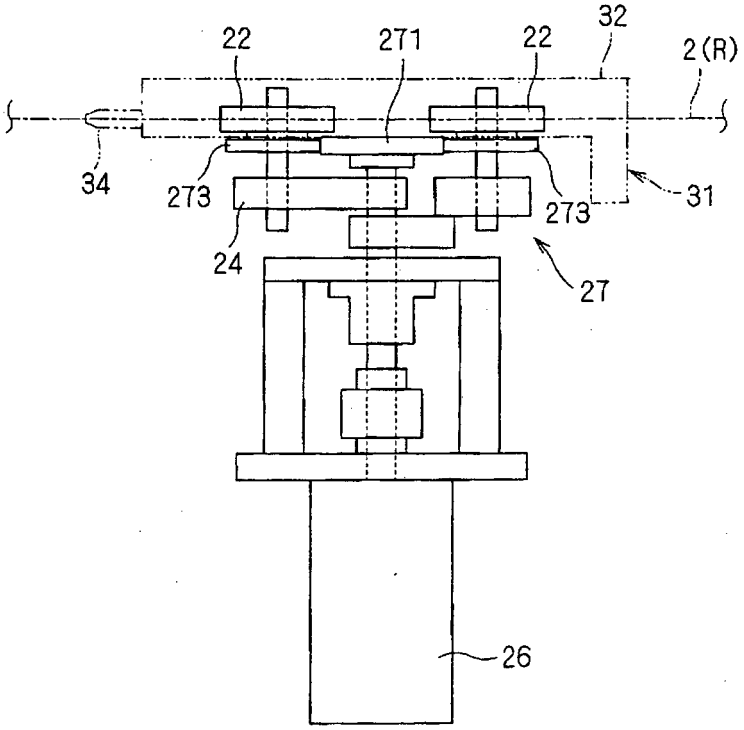
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FIG. 4

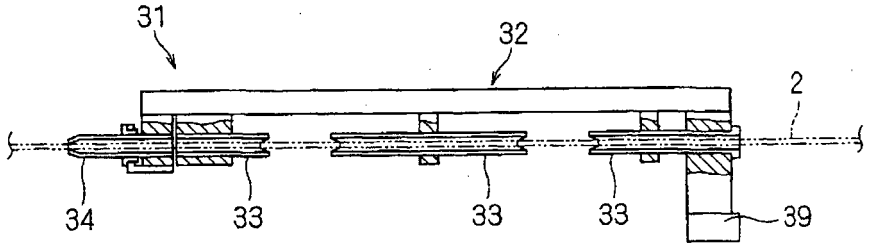

FIG. 5

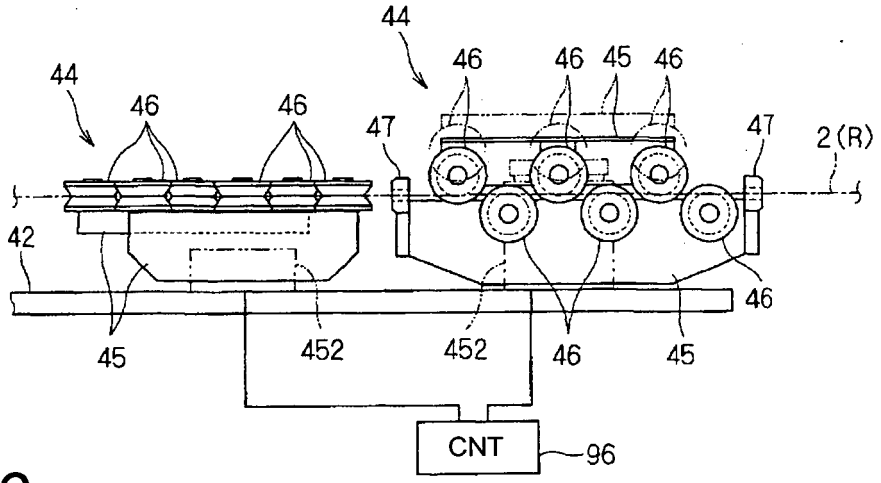

FIG. 6

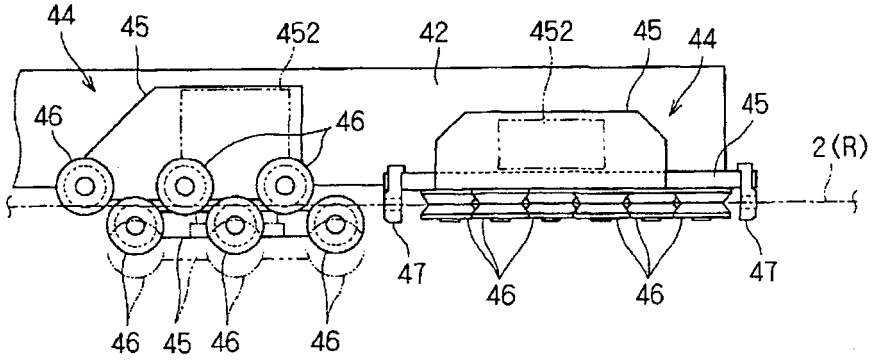

FIG. 7

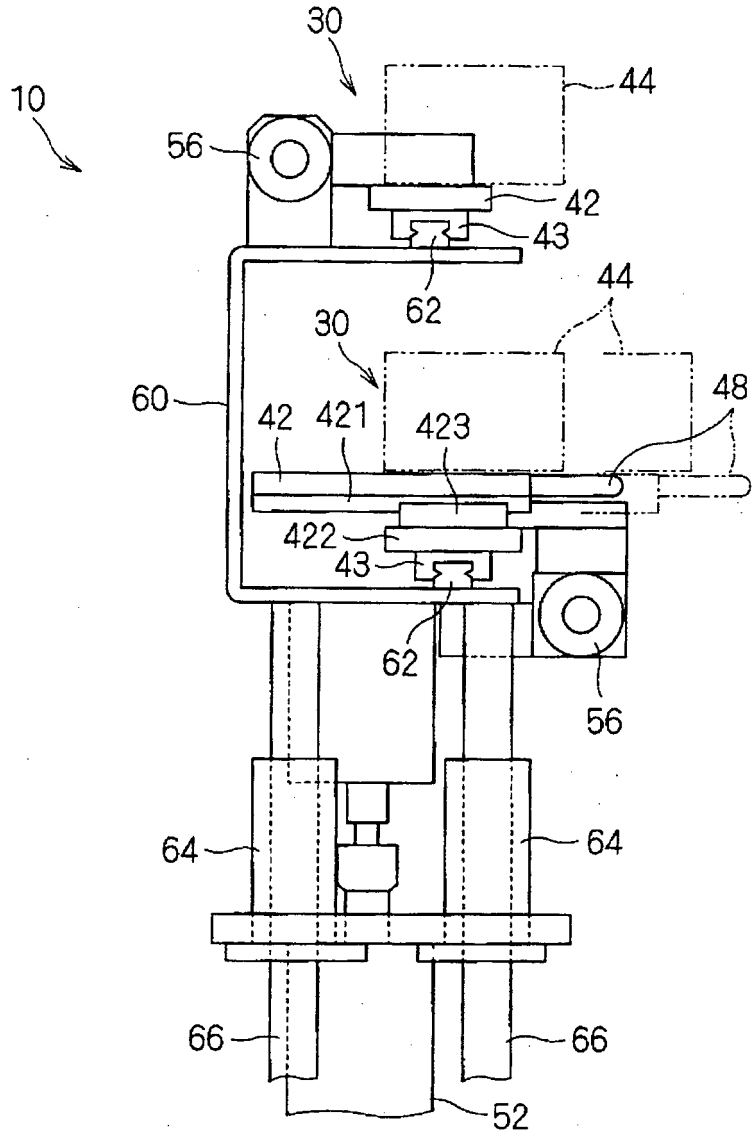

FIG. 8

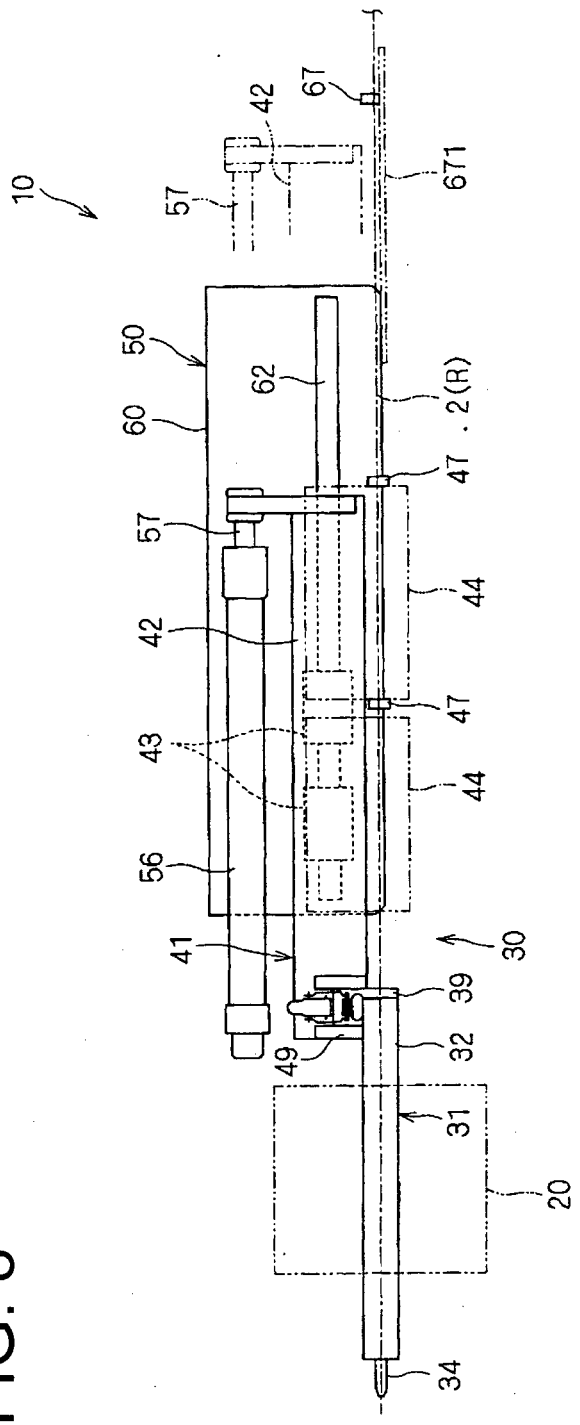
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FIG. 9

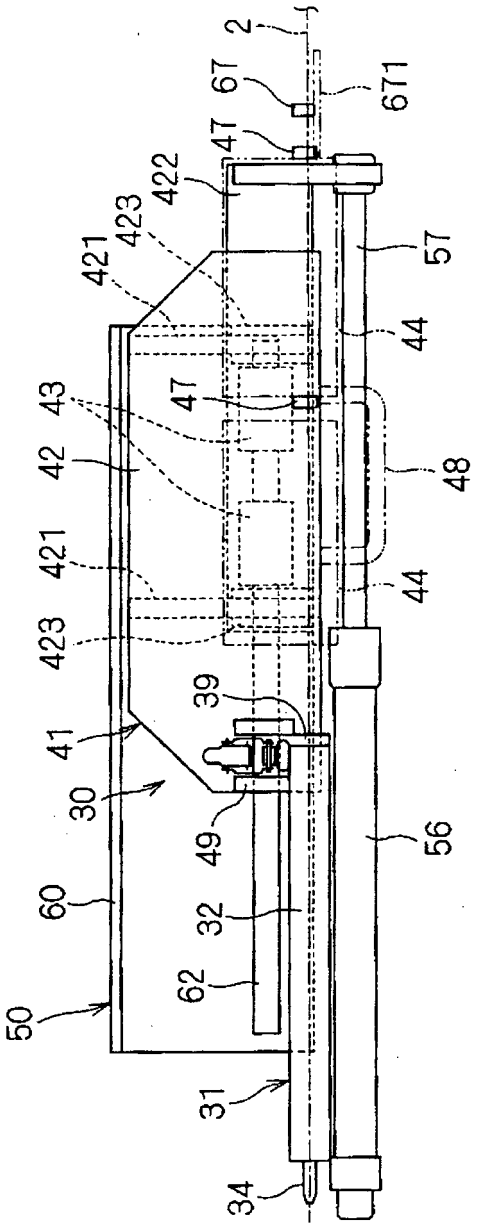
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FIG. 10

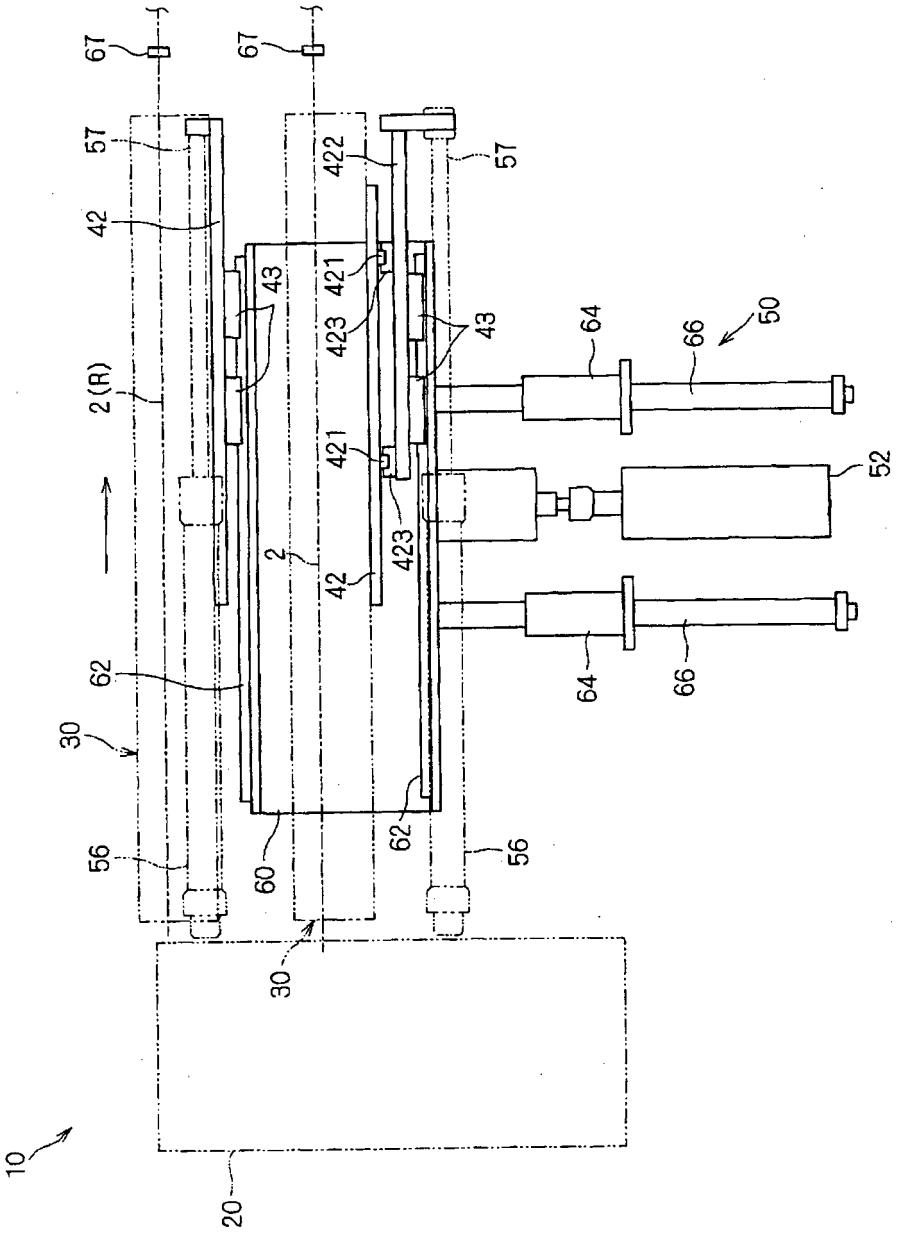
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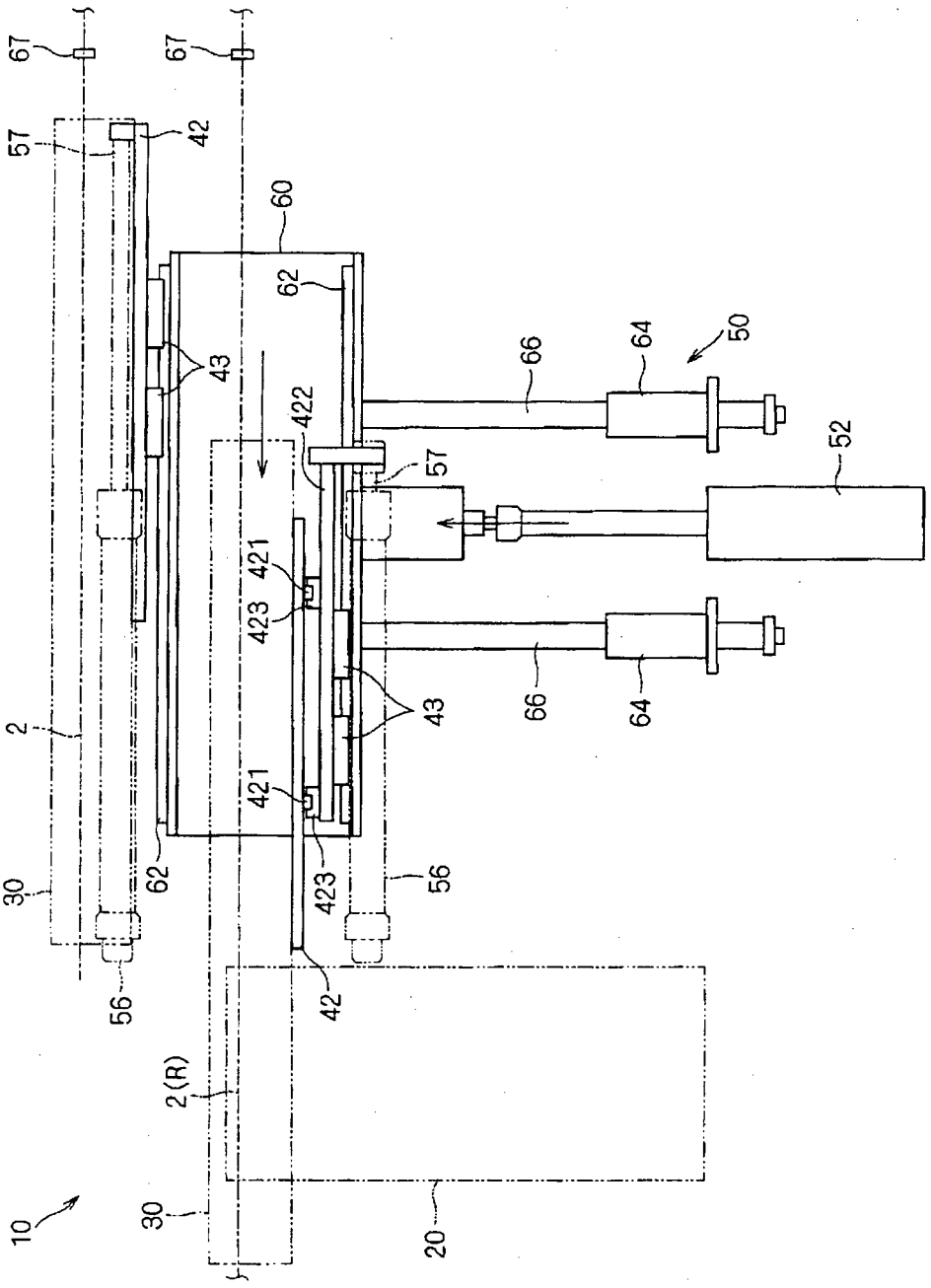
FIG. 11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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/055159

A. CLASSIFICATION OF SUBJECT MATTER
H01B13/00(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)
H01B13/00

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 2011-54391 A (Sumitomo Wiring Systems, Ltd.), 17 March 2011 (17.03.2011), entire text & CN 102005684 A	1-4
A	JP 2001-210154 A (ShinMaywa Industries, Ltd.), 03 August 2001 (03.08.2001), entire text (Family: none)	1-4
A	JP 2008-4556 A (Furukawa Automotive Systems Inc.), 10 January 2008 (10.01.2008), entire text (Family: none)	1-4

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

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 May, 2012 (23.05.12)	05 June, 2012 (05.06.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

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Patent documents cited in the description

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