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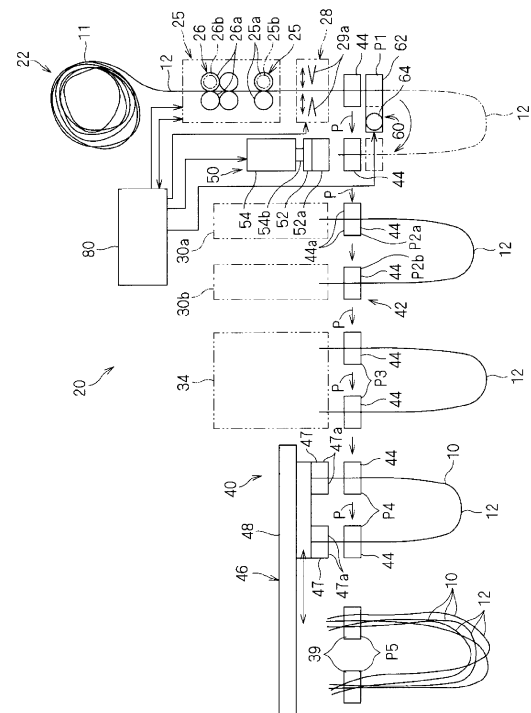
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(54) **WIRE PROCESSING DEVICE**

(57) It is an object of the present invention to prevent an electric wire from twisting. An electric wire processing device includes an electric wire supplying portion, a length-adjusting/feeding mechanism portion that feeds the electric wire from the electric wire supplying portion while adjusting its length, a cutting mechanism portion that cuts the electric wire, an end portion processing unit that performs end portion processing on the end portion of the electric wire, an electric wire transport mechanism portion that transports the electric wire by holding both end portion of the electric wire, and an electric wire end portion rotating mechanism portion. The electric wire end portion rotating mechanism portion rotates the end portion of the electric wire within a time period after feeding the electric wire from the length-adjusting/feeding mechanism portion up to discharging the electric wire to a discharging position of the electric wire with the electric wire transport mechanism portion.

Figure 2



Description

Technical Field

[0001] The present invention relates to technologies for transporting an electric wire by holding both end portions of the electric wire cut to a predetermined length.

Background Art

[0002] A wire harness for a vehicle is produced by bundling terminal-attached electric wires (i.e. electric wires to which terminals are attached). The terminal-attached electric wire is produced by drawing a long electric wire from an annular electric wire bundle, cutting the electric wire to a predetermined length and moreover performing a stripping process on coated portions at the end portions, a process of crimping on terminals, and the like.

[0003] It should be noted that examples of a device for producing a terminal-attached electric wire include a device disclosed in Patent Document 1.

Citation List

Patent Documents

[0004] Patent Document 1: JP 2009-152104A

Summary of the Invention

Technical Problem

[0005] However, long electric wires drawn from the annular electric wire bundle may twist, and there is a possibility that the terminal-attached electric wire also twists. If such a twisted terminal-attached electric wire is stretched, a middle portion of the terminal-attached electric wire may twist in the shape of an eight. When the wire harness is produced, there is a need to eliminate twisting in the shape of an eight of the terminal-attached electric wire and thus to bundle a plurality of terminal-attached electric wires, and therefore, the workability for producing the wire harness is deteriorated.

[0006] Accordingly, it is an object of the present invention to prevent an electric wire from twisting.

Solution to Problem

[0007] To solve the foregoing problems, an electric wire processing device according to the first aspect includes an electric wire supplying portion that continuously supplies an electric wire, a length-adjusting/feeding mechanism portion that feeds the electric wire from the electric wire supplying portion while adjusting its length, a cutting mechanism portion that cuts the electric wire fed from the length-adjusting/feeding mechanism portion, an end portion processing unit that performs end portion processing on an end portion of the cut electric

wire, an electric wire transport mechanism portion that transports the electric wire from a receiving position where the electric wire is received from the length-adjusting/feeding mechanism portion, via a processing position where the electric wire is processed by the end portion processing unit, to a discharging position, the electric wire transport mechanism portion holding both end portions of the electric wire that has been fed from the length-adjusting/feeding mechanism portion and has been cut, and an electric wire end portion rotating mechanism portion that rotates the end portion of the electric wire within a time period after feeding the electric wire from the length-adjusting/feeding mechanism portion up to discharging the electric wire to a discharging position with the electric wire transport mechanism portion.

[0008] The second aspect is the electric wire processing device according to the first aspect, in which the electric wire end portion rotating mechanism portion is configured to rotate the end portion of the electric wire within a time period after feeding the electric wire from the length-adjusting/feeding mechanism portion up to transporting the electric wire to the processing positions where the electric wire is processed by the end portion processing unit.

[0009] The third aspect is the electric wire processing device according to the first or second aspect, in which the electric wire end portion rotating mechanism portion includes a holding portion for rotation that holds the end portion of the electric wire fed from the length-adjusting/feeding mechanism portion, and a holding rotation driving portion that rotates the holding portion for rotation, the length-adjusting/feeding mechanism portion further feeds the electric wire while adjusting its length after the end portion of the fed electric wire is held by the holding portion for rotation, and the holding rotation driving portion rotates the holding portion for rotation during a length-adjusting process by the length-adjusting/feeding mechanism portion.

[0010] The fourth aspect is the electric wire processing device according to any one of the first to third aspects, in which the electric wire end portion rotating mechanism portion rotates the end portion of the electric wire by a rotation amount in accordance with a length of the electric wire.

Advantageous Effects of the Invention

[0011] In the first aspect, the end portion of the electric wire is rotated within a time period after feeding the electric wire from the length-adjusting/feeding mechanism portion up to discharging the electric wire at the discharging position with the electric wire transport mechanism portion. Therefore, the electric wire is prevented from twisting.

[0012] With the second aspect, the end portion of the electric wire is rotated before processing the end portion of the electric wire, and therefore, the states of the processed end portions of the discharged electric wire tend

to become uniform.

[0013] With the third aspect, the end portion of the electric wire is rotated when the length-adjusting/feeding mechanism portion feeds the electric wire while adjusting its length, and therefore, the electric wire can be transported rapidly.

[0014] In the fourth aspect, the electric wire can be prevented from twisting by rotating the end portion of the electric wire by a suitable rotation amount in accordance with the length of the electric wire.

Brief Description of Drawings

[0015]

FIG. 1 is a diagram illustrating a terminal-attached electric wire to be produced.

FIG. 2 is a schematic view of the entire configuration of an electric wire processing device.

FIG. 3 is a schematic front view of an electric wire end portion rotating mechanism portion and an electric wire end portion delivering mechanism portion.

FIG. 4 is a schematic plan view of the electric wire end portion rotating mechanism portion and the electric wire end portion delivering mechanism portion.

FIG. 5 is a flowchart illustrating feeding, cutting, delivering, and rotating processes of the electric wire.

FIG. 6 is a diagram illustrating an operation of the electric wire processing device.

FIG. 7 is a diagram illustrating an operation of the electric wire processing device.

FIG. 8 is a diagram illustrating an operation of the electric wire processing device.

FIG. 9 is a diagram illustrating a comparative example.

Description of Embodiments

[0016] Hereinafter, an electric wire processing device according to an embodiment will be described. FIG. 1 is a diagram illustrating a terminal-attached electric wire 10 produced by the electric wire processing device according to the embodiment, and FIG. 2 is a schematic view of the entire configuration of the electric wire processing device.

Entire configuration of electric wire processing device

[0017] This electric wire processing device 20 is a device for producing the terminal-attached electric wire 10 by cutting a long electric wire 12 to a predetermined length, stripping coated portions at both end portions of the electric wire 12 cut to the predetermined length, and crimping terminals 14 to respective core wires exposed at both end portions. It should be noted that it is also possible that a terminal is crimped to only one end portion of the electric wire 12. Moreover, other processes such as a process for passing the electric wire 12 through a

rubber stopper may be performed.

[0018] The electric wire processing device 20 includes an electric wire supplying portion 22, a length-adjusting/feeding mechanism portion 24, a cutting mechanism portion 28, end portion processing units 30a, 30b and 34, an electric wire transport mechanism portion 40, and an electric wire end portion rotating mechanism portion 50.

[0019] The electric wire supplying portion 22 is configured to be capable of continuously supplying the long electric wire 12. Here, the long electric wire 12 is bundled in an annular shape, and one end portion of the long electric wire 12 is drawn from a bundle 11 to continuously supply the long electric wire 12. It should be noted that the long electric wire 12 may be wound and accommodated in an electric wire accommodating reel or the like and be supplied from the electric wire accommodating reel.

[0020] The length-adjusting/feeding mechanism portion 24 is configured to be capable of feeding the electric wire 12 from the electric wire supplying portion 22 while adjusting the length of the electric wire 12. More specifically, the length-adjusting/feeding mechanism portion 24 includes a feeding mechanism portion 25 and a length-adjusting portion 26.

[0021] The feeding mechanism portion 25 includes, for example, a pair of feeding rollers 25a between which the electric wire 12 is interposed and a rotation driving portion 25b such as a motor for rotating at least one of the feeding rollers 25a. The electric wire 12 is drawn from the electric wire supplying portion 22 by rotating the feeding roller 25a with the rotation driving portion 25b, and is fed forward. It should be noted that an operation of the feeding mechanism portion 25 is controlled by a control unit 80 described later.

[0022] The length-adjusting portion 26 includes a pair of length-adjusting rollers 26a between which the electric wire 12 is interposed and a rotation amount detecting portion 26b, such as a rotary encoder, coupled to at least one of rotation axis portions of the length-adjusting rollers 26a. Here, the length-adjusting portion 26 is provided on the side of the electric wire supplying portion 22 with respect to the above-described feeding mechanism portion 25. The length-adjusting portion 26 may also be provided on the downstream side with respect to the above-described feeding mechanism portion 25. When feeding the electric wire 12, the pair of length-adjusting rollers 26a are driven to rotate as the electric wire 12 is drawn, and thus the rotation amount is detected by the rotation amount detecting portion 26b. Rotation amount detecting signals from this rotation amount detecting portion 26b are provided to the control unit 80.

[0023] It should be noted that a strainer in which a plurality of rollers are arranged alternately is incorporated in the length-adjusting/feeding mechanism portion 24. The electric wire 12 passes through this strainer to be out of curl (i.e. to relieve curling) to some extent.

[0024] The cutting mechanism portion 28 is configured

to be capable of cutting the electric wire 12 fed from the length-adjusting/feeding mechanism portion 24. Here, the cutting mechanism portion 28 includes a pair of cutting blades 29a between which the electric wire 12 fed from the length-adjusting/feeding mechanism portion 24 can be interposed and a forward/backward driving portion that moves the pair of cutting blades 29a in a direction in which the blades are moved close to or away from each other. The front end portions of the pair of cutting blades 29a are formed in the shape of a V-cutting blade. When an electric wire 12 as long as the terminal-attached electric wire 10 to be produced is fed by the above-described length-adjusting/feeding mechanism portion 24 in accordance with an instruction from the control unit 80, the pair of cutting blades 29a are moved close to each other to cut the electric wire 12 to the predetermined length.

[0025] The end portion processing units 30a, 30b and 34 are units for performing end portion processing on the end portion of the electric wire 12 having the predetermined length that is cut from the long electric wire 12.

[0026] Here, it is assumed that the end portion processing unit 30a is a rubber stopper attaching unit 30a, the end portion processing unit 30b is a stripping unit 30b, and the end portion processing unit 34 is a terminal crimping unit 34.

[0027] The rubber stopper attaching unit 30a is a unit for attaching a rubber stopper to the end portion of the electric wire 12, and is provided on the downstream side with respect to the above-described length-adjusting/feeding mechanism portion 24 and the cutting mechanism portion 28 in the electric wire 12 transport direction P. The rubber stopper attaching unit 30a may attach rubber stoppers to both end portions of the electric wire 12 or attach a rubber stopper only to one end portion thereof.

[0028] The stripping unit 30b is a unit for performing a process for stripping the coated portion at the end portion of the electric wire 12 and exposing a core wire portion at the end portion, and is provided on the downstream side with respect to the above-described rubber stopper attaching unit 30 in the electric wire 12 transport direction P. In this stripping unit 30b, for example, a pair of stripping blades are moved close to each other to an extent that the front end portions thereof are engaged only in the coated portion of the electric wire 12, and then, in this state, the pair of stripping blades are relatively moved toward the end portion of the electric wire 12 to strip the coated portion. It should be noted that the pair of stripping blades or the electric wire may be moved at that time.

[0029] The terminal crimping unit 34 is a unit for crimping a terminal 14 to the exposed core wire at the end portion of the electric wire 12, and is provided on the downstream side with respect to the above-described stripping unit 30b in the electric wire 12 transport direction P. The terminal crimping unit 34 may crimp terminals to both end portions of the electric wire 12 or crimp a terminal only to one end portion thereof.

[0030] It should be noted that one or more of the end

portion processing units 30a, 30b and 34 may be omitted. Moreover, the end portion processing unit is not limited to the above-described examples, and various end portion processing devices for performing processes on the end portion of the electric wire 12 can be used.

[0031] The electric wire transport mechanism portion 40 is configured to hold both end portions of the electric wire 12 having the predetermined length that has been fed from the above-described length-adjusting/feeding mechanism portion 24 and has been cut by the cutting mechanism portion 28, and to transport the electric wire 12 having the predetermined length in the predetermined transport direction P from a receiving position P1 where the electric wire is received from the length-adjusting/feeding mechanism portion 24, via processing positions P2a, P2b and P3 where the electric wire is processed by the respective end portion processing units 30a, 30b and 34 and a delivering position P4 for discharge, to a predetermined discharging position P5.

[0032] More specifically, the electric wire transport mechanism portion 40 includes a first electric wire transport mechanism portion 42 and a second electric wire transport mechanism portion 46.

[0033] The first electric wire transport mechanism portion 42 is a device for transporting the electric wire 12 from the above-described receiving position P1 via the processing positions P2a, P2b and P3 to the delivering position P4 for discharge, and the second electric wire transport mechanism portion 46 is a device for transporting the electric wire 12 from the delivering position P4 for discharge to the discharging position P5.

[0034] The first electric wire transport mechanism portion 42 includes a plurality of electric wire holding portions 44. The plurality of electric wire holding portions 44 are mounted, spaced apart from each other, on a circulating transport belt that is disposed so as to pass the above-described receiving position P1, processing positions P2a, P2b and P3, and delivering position P4 for discharge. The circulating transport belt is wound on a pair of rotation pulleys or a pair of gears provided at both end portions of the transport direction P that passes the receiving position P1, the processing positions P2a, P2b and P3, and the delivering position P4 for discharge, and is circulated while passing the receiving position P1, the processing positions P2a, P2b and P3, and the delivering position P4 for discharge by rotating the rotation pulleys or the gears with a rotation driving portion such as a motor. The electric wire holding portion 44 is constituted by an electromagnetic chuck using a solenoid, a chuck using an air cylinder, or the like, and is configured to be capable of holding or releasing holding of the end portion of the electric wire 12 by opening/closing a pair of holding claws 44a.

[0035] Then, the electric wire 12 is received, transported and discharged and the end portion of the electric wire 12 is processed by circulating the above-described circulating transport belt to move the plurality of electric wire holding portions 44 so as to pass the receiving position

P1, the processing positions P2a, P2b and P3, and the delivering position P4 for discharge, and by opening/closing the electric wire holding portions 44 as appropriate at the positions P1, P2a, P2b, P3 and P4 to hold or release holding of the electric wire 12.

[0036] Here, both end portions of the electric wire 12 that has been fed from the length-adjusting/feeding mechanism portion 24 and the cutting mechanism portion 28 and has been cut to the predetermined length are held by a pair of electric wire holding portions 44 of the plurality of electric wire holding portions 44 in the state where one of the pair of electric wire holding portion 44 is located at the receiving position P1 where the length-adjusting/feeding mechanism portion 24 and the cutting mechanism portion 28 feed the electric wire and the other of the pair of electric wire holding portions 44 is located on the downstream side with respect to the receiving position P1. In this state, the middle portion of the electric wire 12 having the predetermined length hangs down in a U-shape on a side opposite to the length-adjusting/feeding mechanism portion 24 and the cutting mechanism portion 28. The electric wire 12 having the predetermined length is transported in the state where both end portions thereof are held by the pair of electric wire holding portions 44 and the middle portion thereof hangs down in a U-shape. It should be noted that the operation in which the electric wire 12 is delivered from the length-adjusting/feeding mechanism portion 24 and the cutting mechanism portion 28 to the pair of electric wire holding portions 44 will be further described later.

[0037] The operation in which the electric wire holding portions 44 are fed by this electric wire transport mechanism portion 40 and the operation in which the electric wire holding portions 44 hold and release holding of the electric wire are controlled in accordance with instructions from the control unit 80.

[0038] Here, the transport operation is performed as follows. That is, the pair of electric wire holding portions 44 hold both end portions of the electric wire 12 having the predetermined length at the receiving position P1, are moved in this state in the transport direction P to the processing position P2a, and then, both end portions thereof are caused to face the end portion processing unit 30a. In this state, the end portion processing is performed by the end portion processing unit 30a. Next, at the processing position P2b, the stripping process is performed by the end portion processing unit 30b. Furthermore, when the pair of electric wire holding portions 44 is moved to the processing position P3, both end portions thereof are caused to face the end portion processing unit 34. In this state, the end portion processing is performed by the end portion processing unit 34.

[0039] Thereafter, the pair of electric wire holding portions 44 are moved in the transport direction P to the delivering position P4 for discharge.

[0040] The second electric wire transport mechanism portion 46 includes a pair of holding portions 47 for discharge and delivery and a reciprocation driving portion

48 for delivery. A pair of holding portions 47 for discharge and delivery is constituted by an electromagnetic chuck using a solenoid, a chuck using an air cylinder, or the like, and is configured to be capable of holding or releasing holding of the end portion of the electric wire 12 by opening/closing a pair of holding claws 47a. The reciprocation driving portion 48 for delivery is constituted by an air cylinder, a linear actuator such as a linear motor, or the like, and reciprocates the above-described pair of holding portions 47 for discharge and delivery between the delivering position P4 for discharge and the discharging position P5.

[0041] Here, a pair of holding portions 39 for discharge that can hold a plurality of the end portions of the electric wires 12 are provided at the discharging position P5. When the pair of electric wire holding portions 44 are moved to the delivering position P4 for discharge, both end portions of the electric wire 12 that are held by the pair of electric wire holding portions 44 are held by the pair of holding portions 47 for discharge and delivery. Thereafter, the reciprocation driving portion 48 for delivery is driven to move the pair of holding portion 47 for discharge and delivery (hand-over) from the delivering position P4 for discharge to the discharging position P5, and both end portions of the electric wire 12 are delivered to the pair of holding portions 39 for discharge.

[0042] The plurality of terminal-attached electric wires 10 are continuously produced by continuously performing the above-described processes, and the terminal-attached electric wires 10 continuously produced is transferred to the pair of holding portions 39 for discharge by the second electric wire transport mechanism portion 46. When a predetermined number of terminal-attached electric wires 10 are transferred to the pair of holding portions 39 for discharge, the terminal-attached electric wires 10 are bundled by hand to a predetermined number by workers or the like, and are stored and transported to the following place where wire harnesses are produced in a bundled form.

Electric wire end portion rotating mechanism portion

[0043] FIG. 3 is a schematic front view of the electric wire end portion rotating mechanism portion 50 and an electric wire end portion delivering mechanism portion 60, and FIG. 4 is a schematic plan view of the electric wire end portion rotating mechanism portion 50 and the electric wire end portion delivering mechanism portion 60.

[0044] That is, this electric wire processing device 20 includes the electric wire end portion rotating mechanism portion 50 that rotates the end portion of the electric wire 12 within a time period after feeding the electric wire 12 from the length-adjusting/feeding mechanism portion 24 up to discharging the electric wire 12 at the discharging position P5 with the electric wire transport mechanism portion 40.

[0045] Here, the electric wire end portion rotating

mechanism portion 50 is configured to rotate the end portion of the electric wire 12 within a time period after feeding the electric wire 12 from the length-adjusting/feeding mechanism portion 24 up to transporting the electric wire 12 to the processing positions P2a, P2b and P3 where the electric wire 12 is processed by the respective end portion processing units 30a, 30b and 34, and more specifically, when adjusting the length of the electric wire 12 after the end portion of the electric wire 12 on the front end side in a feeding direction is fed from the length-adjusting/feeding mechanism portion 24 and is held by the electric wire holding portions 44.

[0046] First, the configuration in which the end portion of the electric wire 12 on the front end side in a feeding direction is fed from the length-adjusting/feeding mechanism portion 24 and is held by the electric wire holding portions 44 will be described.

[0047] That is, the electric wire end portion delivering mechanism portion 60 is provided at a position corresponding to the above-described receiving position P1. The electric wire end portion delivering mechanism portion 60 is configured to hold the electric wire 12 fed from the length-adjusting/feeding mechanism portion 24 and deliver it to the electric wire end portion rotating mechanism portion 50.

[0048] More specifically, the electric wire end portion delivering mechanism portion 60 includes a holding portion 62 for delivery and a portion 64 for moving the holding portion for delivery.

[0049] The holding portion 62 for delivery is constituted by an electromagnetic chuck using a solenoid, a chuck using an air cylinder, or the like, and is configured to be capable of holding or releasing holding of the end portion of the electric wire 12 by opening/closing a pair of holding claws 62a.

[0050] The portion 64 for moving the holding portion for delivery is configured to move the above-described holding portion 62 for delivery from a position T1 (see FIG. 4) where the end portion of the electric wire 12 that is fed from the length-adjusting/feeding mechanism portion 24 via the cutting mechanism portion 28 is held to a position T2 (see FIG. 6) opposite to the electric wire end portion rotating mechanism portion 50.

[0051] More specifically, the portion 64 for moving the holding portion for delivery includes a rotation driving portion 64a and a turning arm 64c.

[0052] The rotation driving portion 64a is constituted by a motor or the like, and is supported by a device frame (not shown) in a hung state above a position between the above-described positions T1 and T2. A rotation shaft portion 64b is provided downward from the lower end portion of the rotation driving portion 64a.

[0053] The turning arm 64c is formed as an elongated member having a length dimension approximately half as long as the distance between the positions T1 and T2. One end portion of the turning arm 64c is coupled to the above-described rotation shaft portion 64b in the state where the turning arm 64c is horizontal. The turning arm

64c is configured to be turned around the above-described rotation shaft portion 64b (here, turned by 180 degrees) between a first attitude in which the other end portion of the turning arm 64c is disposed above the position T1 and a second attitude in which the other end portion of the turning arm 64c is disposed above the position T2.

[0054] In addition, a hung arm 64d is hung from the other end portion of the turning arm 64c, and the holding portion 62 for delivery is attached to the lower end portion of this hung arm 64d. The holding portion 62 for delivery is configured to be disposed at the position T1 in the state where the turning arm 64c is in the first attitude, and the holding portion 62 for delivery is configured to be disposed at the position T2 in the state where the turning arm 64c is in the second attitude.

[0055] The above-described electric wire end portion delivering mechanism portion 60 delivers the end portion of the electric wire 12 as follows. That is, in the state where the holding portion 62 for delivery is disposed at the position T1, the electric wire 12 is fed from the length-adjusting/feeding mechanism portion 24. The electric wire 12 is fed until the end portion of the electric wire 12 passes through between the pair of holding claws 62a of the holding portion 62 for delivery, and then feeding the electric wire 12 is stopped. In this state, the pair of holding claws 62a are closed, and the holding portion 62 for delivery holds the end portion of the electric wire 12.

[0056] Thereafter, when the rotation driving portion 64a is driven to rotate the turning arm 64c from the first attitude to the second attitude, the holding portion 62 for delivery is moved to the position T2 and is disposed at a position opposite to the electric wire end portion rotating mechanism portion 50. It should be noted that during turning of the turning arm 64c, the length-adjusting/feeding mechanism portion 24 freely draws the electric wire 12 or feeds the electric wire 12 in accordance with a speed and an amount of the electric wire drawn by the turning.

[0057] In the state where the holding portion 62 for delivery is moved to the position T2, the end portion of the electric wire 12 held by the holding portion 62 for delivery is disposed so as to face the electric wire end portion rotating mechanism portion 50, and thus the electric wire end portion rotating mechanism portion 50 can hold the end portion of the electric wire 12.

[0058] The electric wire end portion rotating mechanism portion 50 includes a holding portion 52 for rotation and a holding rotation driving portion 54.

[0059] The holding portion 52 for rotation is constituted by an electromagnetic chuck using a solenoid, a chuck using an air cylinder, or the like, and is configured to be capable of holding or releasing holding of the end portion of the electric wire 12 that is fed from the above-described length-adjusting/feeding mechanism portion 24 and is delivered by the electric wire end portion delivering mechanism portion 60 by opening/closing a pair of holding claws 52a.

[0060] The holding rotation driving portion 54 is configured to be capable of rotating the above-described holding portion 52 for rotation. More specifically, the holding rotation driving portion 54 includes a motor or the like, and is provided at the above-described position T2, which is a position on the side opposite to the electric wire end portion delivering mechanism portion 60, with the electric wire holding portion 44 being arranged between the position T2 and the electric wire end portion delivering mechanism portion 60. At that position, the holding rotation driving portion 54 is supported by a device frame (not shown) in a horizontal attitude facing the position T2. A rotation shaft portion 54b is provided at the end portion facing the position T2 of this holding rotation driving portion 54. The above-described holding portion 52 for rotation is attached to this rotation shaft portion 54b. In this attachment state, the front end portions of the pair of holding claws 62a face the side of the position T2. Therefore, when the above-described holding portion 62 for delivery is moved to the position T2, the end portion of the electric wire 12 that projects from the holding portion 62 for delivery is disposed between the pair of holding claws 62a. In this state, the pair of holding claws 62a are closed to hold the end portion of the electric wire 12. Moreover, in this state, when the holding rotation driving portion 54 is driven to rotate the holding portion 52 for rotation, the end portion of the electric wire 12 is rotated as a result. It should be noted that the holding rotation driving portion 54 includes an encoder or the like and signal indicating a rotation number is provided to the control unit 80.

[0061] The operations of both of the above-described electric wire end portion rotating mechanism portion 50 and electric wire end portion delivering mechanism portion 60 are controlled by the control unit 80.

[0062] Here, the control unit 80 is an ordinary micro-computer including a CPU, ROM, RAM and the like, and controls the operations of the electric wire processing device 20 in accordance with a software program stored in advance and predetermined set values. Here, in particular, the control unit 80 controls these operations so that after the end portion of the electric wire 12 fed from the length-adjusting/feeding mechanism portion 24 is held by the holding portion 52 for rotation, the length-adjusting/feeding mechanism portion 24 further feeds the electric wire 12 while adjusting its length and, meanwhile, the holding rotation driving portion 54 rotates the holding portion 52 for rotation. It should be noted that a portion or all of the functions of processes performed by the control unit 80 may be realized as hardware by a dedicated logical circuit or the like.

[0063] Feeding, cutting, delivering, and rotating processes of the electric wire 12 will be described with reference to the flowchart shown in FIG. 5.

[0064] First, in the initial state, the holding portion 52 for rotation is located at the position T1, and the end portion of the electric wire is disposed at a position beyond the holding portions 52 for rotation.

[0065] When the terminal-attached electric wire 10 is produced using the electric wire 12 having the predetermined length from this state, as shown in Step S1, the control unit 80 provides an electric wire end portion delivering operation instruction to the electric wire end portion delivering mechanism portion 60. It should be noted that the length dimension of the electric wire 12 is a dimension corresponding to the length of the terminal-attached electric wire 10 to be produced, which has been set by production workers in advance. In accordance with the above-described instruction, the electric wire end portion delivering mechanism portion 60 holds the end portion of the electric wire 12 by closing the pair of holding claws 62a, the rotation driving portion 64a is driven to turn the turning arm 64c, and thus the holding portion 62 for delivery is moved from the position T1 to the position T2. Then, the end portion of the electric wire 12 passes above the pair of holding claws 44a of the electric wire holding portion 44 and is disposed between the pair of holding claws 52a of the holding portion 52 for rotation.

[0066] In the following Step S2, the control unit 80 provides an electric wire end portion receiving operation instruction to the electric wire end portion rotating mechanism portion 50 and the electric wire end portion delivering mechanism portion 60. Then, the electric wire end portion rotating mechanism portion 50 holds the end portion of the electric wire 12 with the holding portion 52 for rotation by closing the pair of holding claws 52a, and the electric wire end portion delivering mechanism portion 60 releases holding of the end portion of the electric wire 12 by opening the pair of holding claws 62a.

[0067] In the following Step S3, the control unit 80 provides an electric wire end portion rotating operation starting instruction to the electric wire end portion rotating mechanism portion 50 and provides an electric wire length-adjusting/feeding operation starting instruction to the length-adjusting/feeding mechanism portion 24. Then, the electric wire end portion rotating mechanism portion 50 starts the rotation of the holding portion 52 for rotation by driving the holding rotation driving portion 54 (see FIG. 7). Moreover, the length-adjusting/feeding mechanism portion 24 further feeds the electric wire 12 while adjusting its length (see FIG. 7). The electric wire 12 that has been fed is disposed so as to hang down in a U-shape.

[0068] In the following Step S4, based on a rotation number signal from the holding rotation driving portion 54, the control unit 80 determines whether or not the rotation number exceeds a predetermined rotation number. The rotation number here may be set to a certain value in advance by workers or the like regardless of the length of the electric wire 12 to be rotated or to a rotation number that is set in accordance with the length of the electric wire 12 to be rotated. In the latter case, a predetermined coefficient may be set by workers or the like, and a value obtained by multiplying the length dimension of the electric wire 12 to be processed by the predetermined coefficient may be set to the predetermined rotation number.

Moreover, a table in which candidate values of the length dimension of the electric wire 12 to be processed are correlated with the rotation number in accordance with the length dimension may be made by workers or the like in advance, and thus the control unit 80 may refer to the table to set the rotation number in accordance with the length dimension of the electric wire 12. The predetermined coefficient or the rotation number to be registered in the table can be set empirically or experimentally. Generally, it is considered that the twisting of the electric wire 12 is caused by bundling the electric wire in an annular shape, and therefore, it is conceivable that the larger the length dimension of the electric wire 12 is, the larger the entire amount of the twisting caused in the electric wire 12 is. Accordingly, it is preferable that the rotation amount with which the electric wire is to be rotated is set to a value that positively correlates (for example, proportionally correlates) with the length dimension of the electric wire 12. The rotation amount may be set in accordance with other conditions such as the type (e.g., thickness and materials) of the electric wire and the state (e.g., a diameter) of the bundle of the electric wire. When it is determined in this Step S4 that the rotation number of the holding rotation driving portion 54 exceeds the predetermined rotation number, the process proceeds to the following Step S5. At that time, the end portion of the electric wire 12 is transferred from the holding portion 52 for rotation to the holding portion 62 for delivery. It should be noted that when the rotation number of the holding rotation driving portion 54 is the same as the predetermined rotation number, the process may repeat this Step S4 or proceed to the following Step S5.

[0069] In the following Step S5, the control unit 80 determines whether or not the electric wire 12 having the predetermined length has been fed, based on the rotation amount detecting signal from the rotation amount detecting portion 26b in the length-adjusting roller 26a of the length-adjusting/feeding mechanism portion 24. If this is determined as YES, the process proceeds to the following Step S6.

[0070] In the following Step S6, the control unit 80 provides an electric wire cutting instruction to the cutting mechanism portion 28. Thereby, the electric wire 12 having the predetermined length is cut out of the long electric wire 12 (FIG. 8). It should be noted that when the electric wire is cut, the end portion of the electric wire 12 is preferably held by an electric wire holding portion incorporated in the cutting mechanism portion 28.

[0071] In Step S6, the control unit 80 provides an instruction to hold both end portions of the electric wire 12 to the electric wire holding portions 44 at the positions T1 and T2 of a plurality of electric wire holding portions 44 in the electric wire transport mechanism portion 40. Then, the pair of electric wire holding portions 44 hold both end portions of the electric wire 12 having the predetermined length. It should be noted that the portions for holding the end portion of the electric wire in the holding portion 62 for delivery of the electric wire end portion

delivering mechanism portion 60 and the cutting mechanism portion 28 are respectively supported by a driving-up/down mechanism portion so as to be capable of being driven up/down and it is preferable that the electric wire holding portions in the holding portion 62 for delivery and the cutting mechanism portion 28 are lowered when the electric wire 12 is delivered to the electric wire holding portion 44 and are in the raised state in other cases. It should be noted that the holding portion 62 for delivery of the electric wire end portion delivering mechanism portion 60 returns to the position T1 thereafter.

[0072] Thereby, both end portions of the electric wire 12 having the predetermined length are held by the pair of electric wire holding portions 44 at the positions T1 and T2. The pair of electric wire holding portions 44 successively move in the transport direction P, so that the end portions of the electric wire 12 held by the pair of electric wire holding portions 44 are processed as described above and are discharged at the predetermined discharging position P5.

[0073] With the electric wire processing device 20 configured as described above, the end portion of the electric wire 12 is rotated within a time period after feeding the electric wire 12 from the length-adjusting/feeding mechanism portion 24 up to discharging the electric wire 12 at the discharging position P5 with the electric wire transport mechanism portion 40. Therefore, the processed electric wire 12 is prevented from twisting. Accordingly, when both end portions of the electric wire 12 are pulled, the electric wire 12 straightens, and therefore, the later operations for producing the wire harnesses, and the like can be smoothly performed.

[0074] Incidentally, if the end portion of the electric wire 12 is not rotated, the state of the electric wire 12 may become as shown in FIG. 9. That is, when the electric wire 12 is drawn from the bundle 11 in an annular shape, the electric wire 12 remains twisted. There is a possibility that the electric wire 12 cut therefrom remains twisted and twists in the shape of an eight. The electric wire 12 is transported in the transport direction P in the state where both end portions thereof are held by the electric wire holding portions 44, and then is discharged at the discharging position P5. When the above-described electric wires 12 are continuously processed, the electric wires 12 are stacked at the discharging position P5 in the state where the electric wires 12 twist in the shape of an eight. When all of the end portions of the plurality of electric wires 12 are pulled simultaneously, middle portions of the electric wires 12 twist in a shape of a small eight. If this electric wire 12 is used to produce the wire harness, twisting in the shape of a small eight in each electric wire 12 needs to be eliminated. In some cases, there is a possibility that the electric wire 12 remains twisted at its middle portion.

[0075] With this electric wire processing device 20, the electric wire is prevented from twisting as described above.

[0076] Moreover, in this electric wire processing device

20, the end portion of the electric wire 12 is rotated to eliminate twisting before the end portion thereof is processed, and more specifically, before the terminal is crimped thereto. Therefore, the processed end portions of the electric wires 12 tend to face in the same direction. Specifically, the terminal 14 has an asymmetric shape in its circumferential direction, and preferably faces in a certain direction when the operation for inserting a connector into a cavity is taken into consideration. Accordingly, the end portion of the electric wire 12 is rotated to eliminate twisting before the terminal 14 is crimped to the end portion of the electric wire 12, and thus the direction of the terminal 14 after the terminal is crimped tends to be maintained in the direction when the terminal is crimped. Thereby, the processed end portions of the electric wires 12 tend to face in the same direction, and thus the later operations can be smoothly performed.

[0077] In addition, since the end portion of the electric wire 12 is rotated while the length of the electric wire 12 is being adjusted and the electric wire 12 is being fed, the electric wire 12 can be transported rapidly. That is, while the length of the electric wire 12 is being adjusted, the end portion of the electric wire 12 on the front end side in a feeding direction is not transported by the electric wire transport mechanism portion 40 or the like, and is disposed at a certain position. Accordingly, the end portion of the electric wire 12 is rotated at this time, and thereby, the influence on the process for transporting the electric wire 12 can be reduced to eliminate twisting of the electric wire 12.

[0078] However, the rotation mechanism portion 50 is not necessarily provided at the above-described position. The rotation mechanism portion 50 needs only to be provided at a position where the end portion of the electric wire 12 is rotated within the time period after feeding the electric wire 12 from the length-adjusting/feeding mechanism portion 24 up to discharging the electric wire 12 at the discharging position P5 with the electric wire transport mechanism portion 40. For example, the rotation mechanism portion 50 may be configured to receive the end portion of the electric wire 12 from the electric wire holding portion 42 and rotate the end portion while the electric wire transport mechanism portion 40 transports the electric wire 12. Moreover, the electric wire holding portion 42 or the holding portion 47 for discharge and delivery itself is configured to include the same configuration as the rotation mechanism portion 50 and to rotate the end portion of the electric wire while holding it.

[0079] It should be noted that there is no need to rotate the end portion of the electric wire 12 and to perform the length-adjusting/feeding process on the electric wire 12 with the length-adjusting/feeding mechanism portion 24, simultaneously. A period of time during the rotation of the end portion of the electric wire 12 needs only to overlap with at least a portion of a period of time during the length-adjusting/feeding process by the length-adjusting/feeding mechanism portion 24.

[0080] Moreover, the end portion of the electric wire

12 is rotated with the rotation amount in accordance with the length of the electric wire 12, and therefore, the end portion of the electric wire 12 can be rotated with a suitable amount in accordance with the length of the electric wire 12 to eliminate twisting.

[0081] Having described the present invention 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.

List of Reference Numerals

[0082]

12	Electric wire
20	Electric wire processing device
22	Electric wire supplying portion
24	Length-adjusting/feeding mechanism portion
25	Feeding mechanism portion
26	Length-adjusting portion
28	Cutting mechanism portion
30a, 30b, 34	End portion processing unit
39	Holding portion for discharge
40	Electric wire transport mechanism portion
44	Electric wire holding portion
50	Electric wire end portion rotating mechanism portion
52	Holding portion for rotation
54	Holding rotation driving portion
60	Electric wire end portion delivering mechanism portion
80	Control unit
P	Transport direction
P1	Receiving position
P2a, P2b, P3	Processing position
P5	Discharging position

Claims

1. An electric wire processing device, comprising:

an electric wire supplying portion that continuously supplies an electric wire;
a length-adjusting/feeding mechanism portion that feeds the electric wire from the electric wire supplying portion while adjusting its length;
a cutting mechanism portion that cuts the electric wire fed from the length-adjusting/feeding mechanism portion;
an end portion processing unit that performs end portion processing on an end portion of the cut electric wire;
an electric wire transport mechanism portion

that transports the electric wire from a receiving position where the electric wire is received from the length-adjusting/feeding mechanism portion, via a processing position where the electric wire is processed by the end portion processing unit, to a discharging position, the electric wire transport mechanism portion holding both end portions of the electric wire that has been fed from the length-adjusting/feeding mechanism portion and has been cut; and
 an electric wire end portion rotating mechanism portion that rotates the end portion of the electric wire within a time period after feeding the electric wire from the length-adjusting/feeding mechanism portion up to discharging the electric wire to a discharging position with the electric wire transport mechanism portion.

2. The electric wire processing device according to claim 1,
 wherein the electric wire end portion rotating mechanism portion is configured to rotate the end portion of the electric wire within a time period after feeding the electric wire from the length-adjusting/feeding mechanism portion up to transporting the electric wire to the processing positions where the electric wire is processed by the end portion processing unit.
3. The electric wire processing device according to claim 1 or 2,
 wherein the electric wire end portion rotating mechanism portion includes a holding portion for rotation that holds the end portion of the electric wire fed from the length-adjusting/feeding mechanism portion, and a holding rotation driving portion that rotates the holding portion for rotation,
 the length-adjusting/feeding mechanism portion further feeds the electric wire while adjusting its length after the end portion of the fed electric wire is held by the holding portion for rotation, and
 the holding rotation driving portion rotates the holding portion for rotation during a length-adjusting process by the length-adjusting/feeding mechanism portion.
4. The electric wire processing device according to any one of claims 1 to 3,
 wherein the electric wire end portion rotating mechanism portion rotates the end portion of the electric wire by a rotation amount in accordance with a length of the electric wire.

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Figure 1

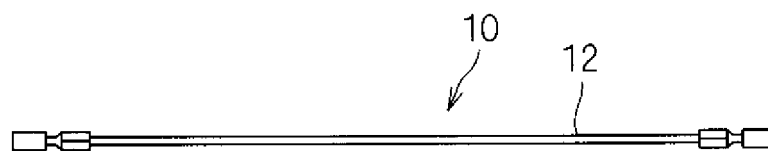


Figure 2

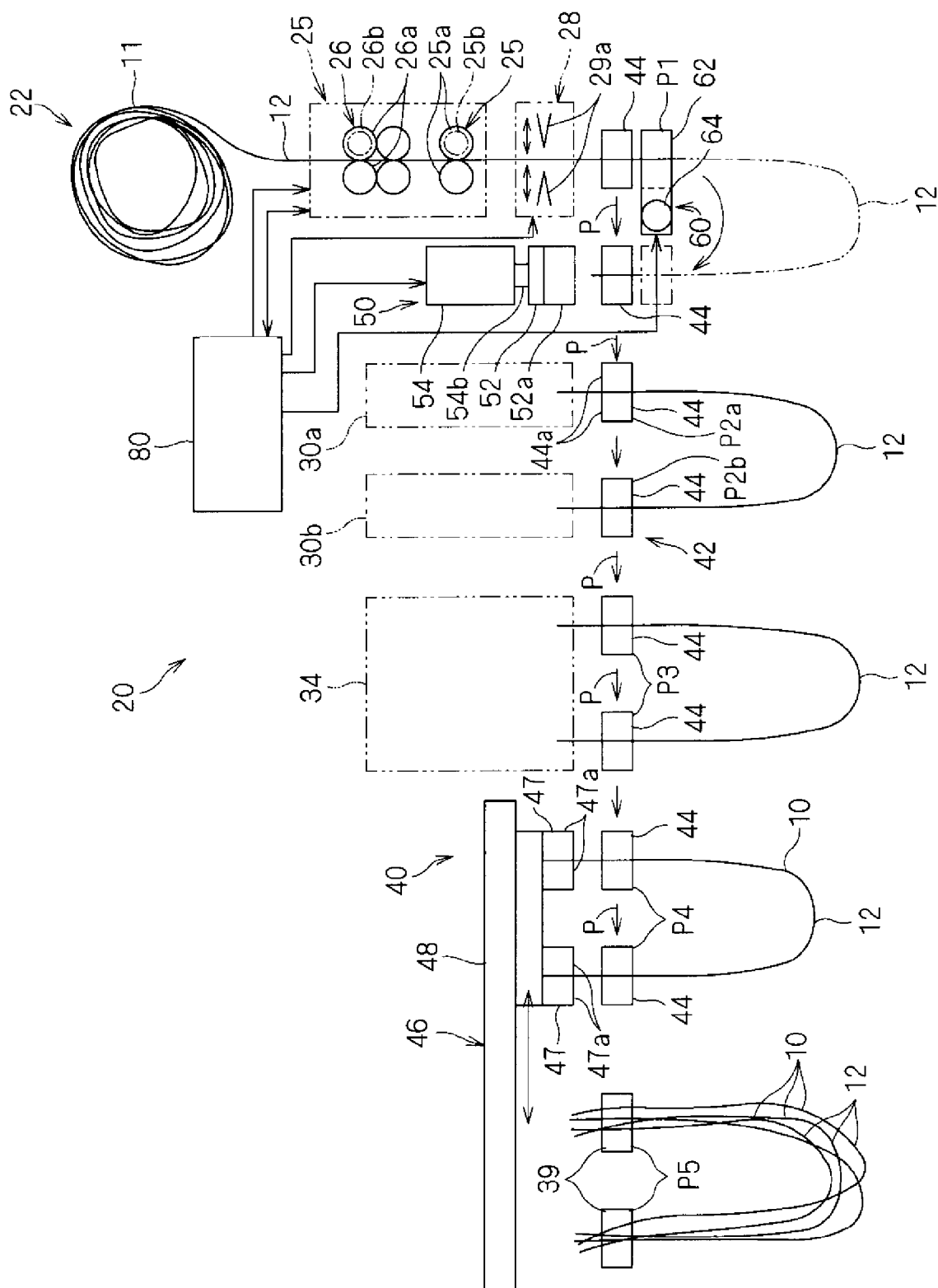


Figure 3

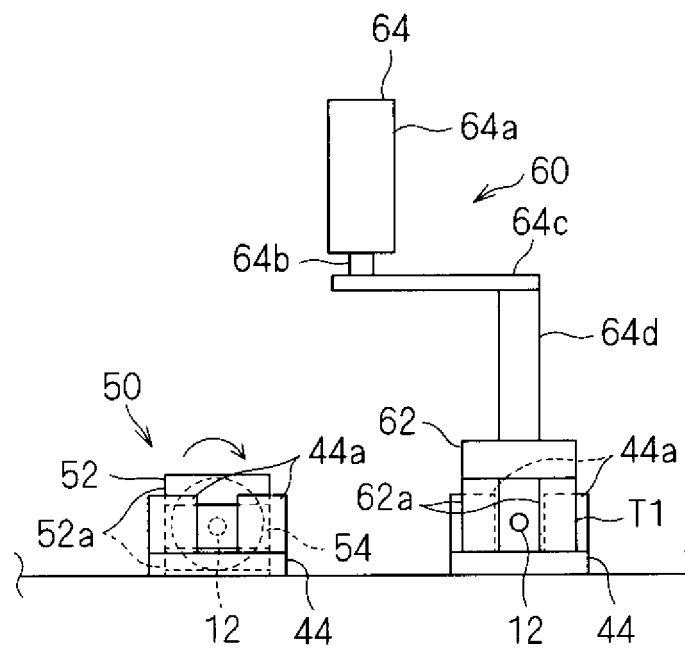


Figure 4

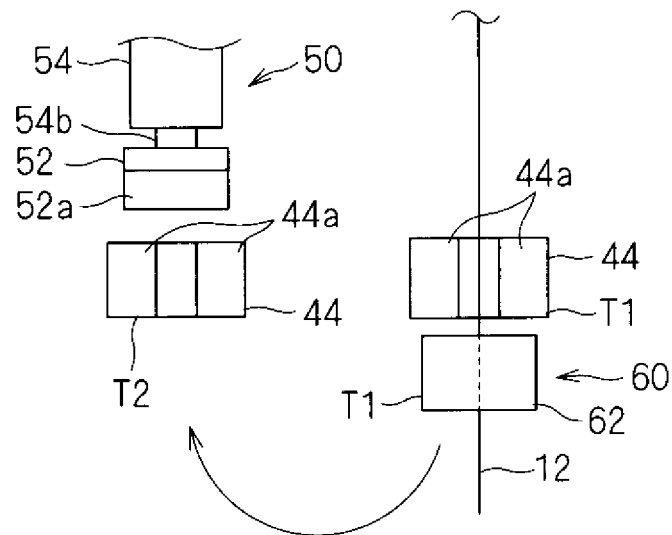


Figure 5

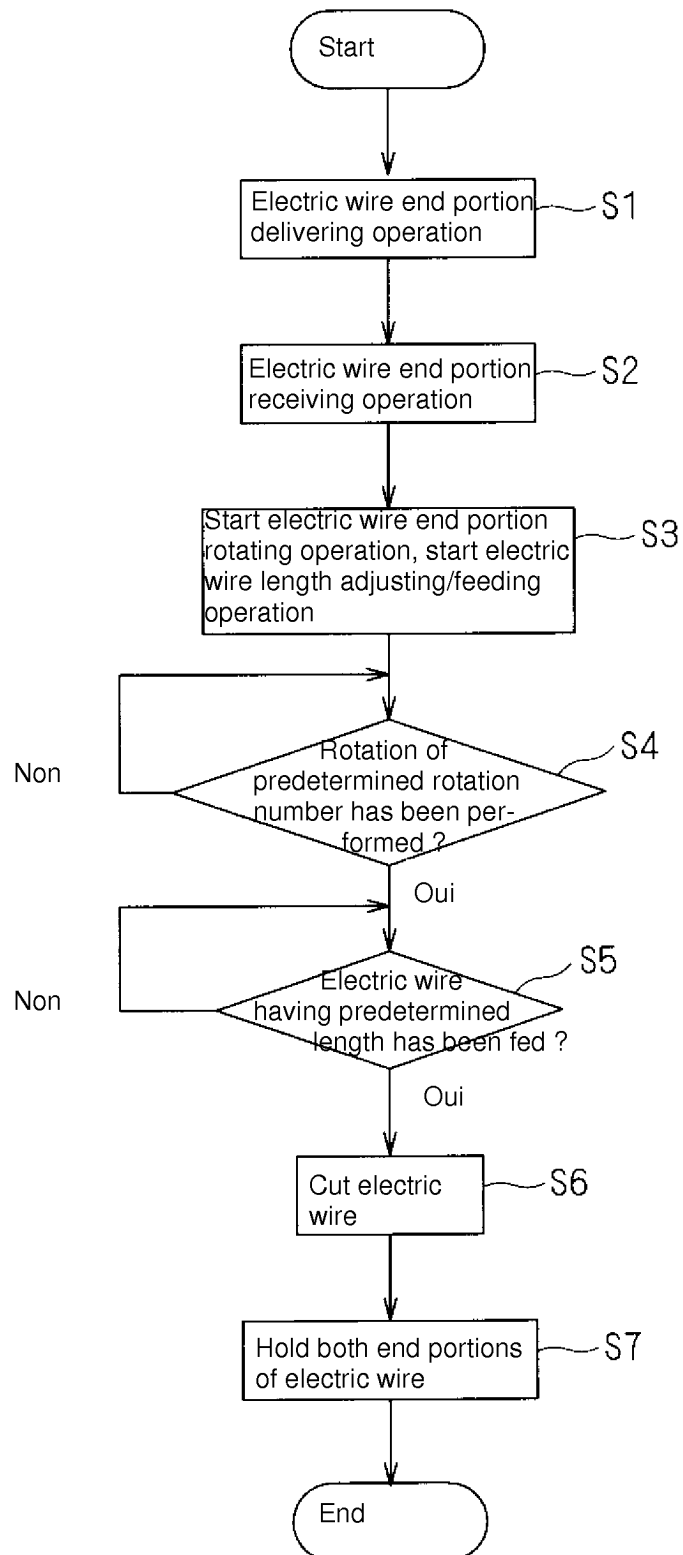


Figure 6

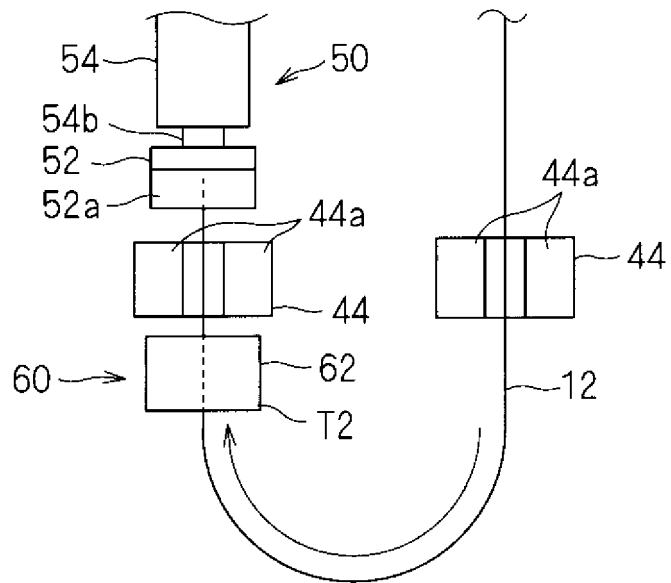


Figure 7

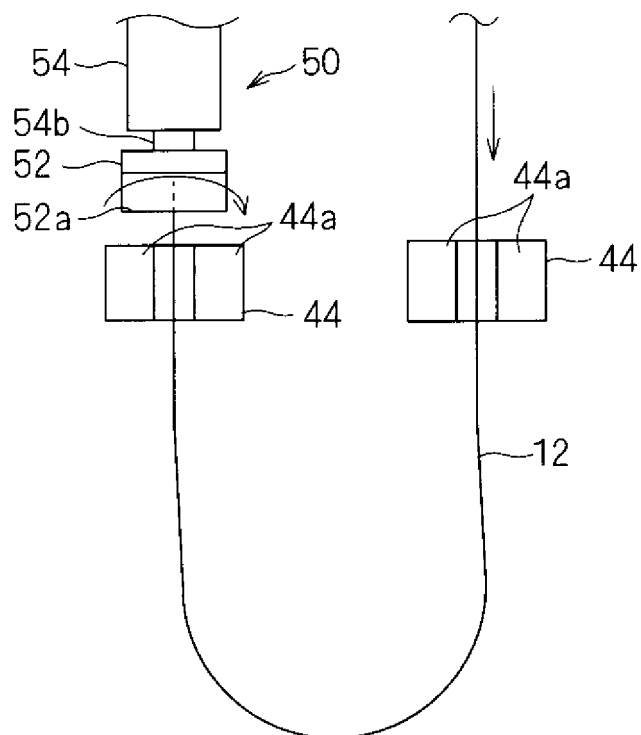


Figure 8

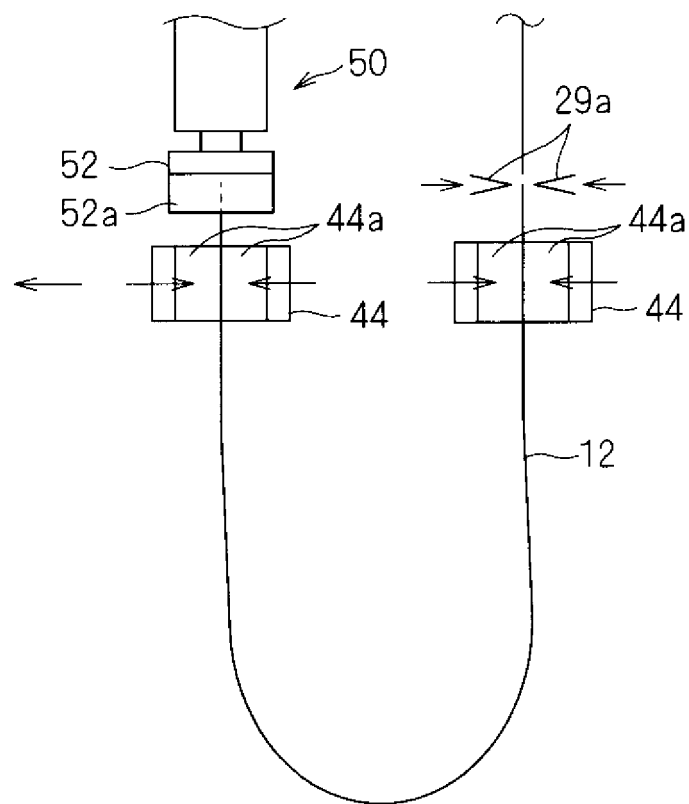
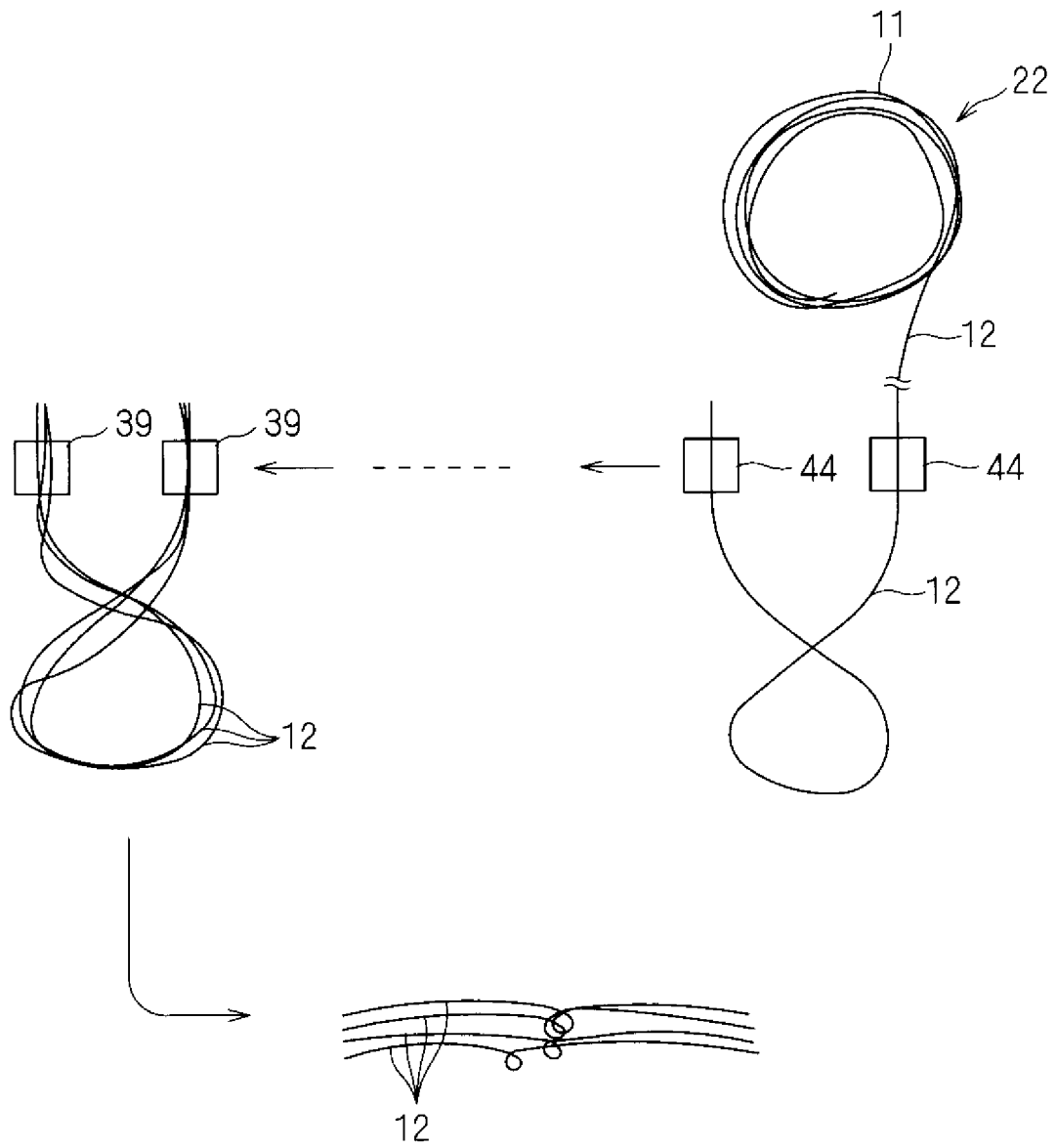


Figure 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/078581

A. CLASSIFICATION OF SUBJECT MATTER

H01B13/012(2006.01) i, H01R43/052(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, H01R43/052

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.
X A	JP 59-171410 A (ShinMaywa Industries, Ltd.), 27 September 1984 (27.09.1984), fig. 4 and the explanations thereof (Family: none)	1-3 4
X	JP 2008-140738 A (Japan Automatic Machine Co., Ltd.), 19 June 2008 (19.06.2008), fig. 1 to 6 and the explanations thereof (Family: none)	1-3
X	JP 55-144674 A (Yazaki Corp.), 11 November 1980 (11.11.1980), fig. 1, 10, 11 and the explanations thereof & US 4375229 A	1-3



Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 December, 2012 (27.12.12)

Date of mailing of the international search report

15 January, 2013 (15.01.13)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/078581

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 6-60956 A (Yazaki Corp.), 04 March 1994 (04.03.1994), entire text & US 5406692 A	1-3
E, X	JP 5079935 B1 (Japan Automatic Machine Co., Ltd.), 21 November 2012 (21.11.2012), entire text (Family: none)	1-3

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

REFERENCES CITED IN THE DESCRIPTION

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