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(54) ELECTRIC WIRE-COLORING DEVICE

(57) A device for coloring an electric wire, by which the electric wire can be continuously colored without a lowering of work efficiency, is provided. A device 1 for coloring an electric wire includes a delivery roll 12, correction unit 13, slack-absorbing unit 14, coloring unit 15, encoder 17 and control device 19. The delivery roll 12 stretches an electric wire 3 and transfers the electric wire in a longitudinal direction thereof. The correction unit 13 imparts first bias force H1 as friction force having a direction reverse to a transferring direction K of the electric wire to the electric wire 3. The slack-absorbing unit 14 is arranged between the correction unit 13 and the delivery roll 12 and absorbs a slack of the electric wire 3. The coloring unit 15 is arranged between the correction unit 13 and the delivery roll 12 and spouts a coloring agent with a predetermined amount thereof per spouting toward the electric wire 3. The encoder 17 measures transferring length of the electric wire 3. The control device 19 causes the coloring unit 15 to spout the coloring agent on the basis of information from the encoder 17.

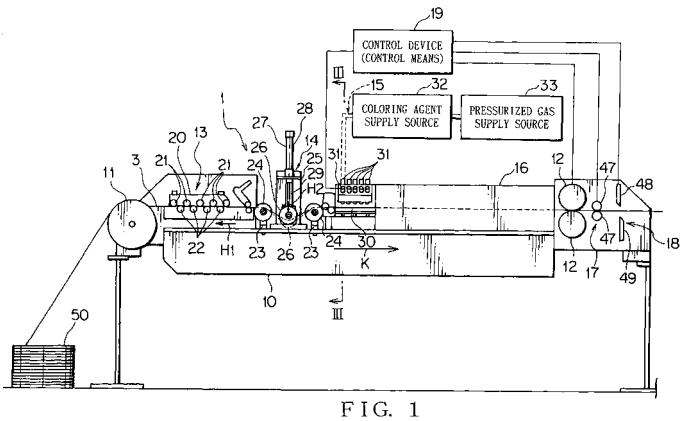

FIG. 1

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Description

[TECHNICAL FIELD]

[0001] The present invention relates to a device for coloring an electric wire, which includes an electrically conductive core wire and an electrically insulating coating that coats the core wire.

[BACKGROUND ART]

[0002] Various electronic instruments are mounted on a motor vehicle as a mobile unit. Therefore, the motor vehicle is provided with a wiring harness for transmitting power from a power source and control signals from a computer to the electronic instruments. The wiring harness includes a plurality of electric wires and connectors attached to ends of the electric wires.

[0003] The electric wire (i.e. wire) includes an electrically conductive core wire and a coating made of insulating synthetic resin, which coats the core wire. The wire is a so-called coated wire. A connector includes a terminal fitting and a connector housing for receiving the terminal fitting. The terminal fitting is made of electrically conductive plate metal and attached to an end of the wire so as to be electrically connected to the core wire of the wire. The connector housing is made of insulating synthetic resin and formed in a box-shape. When the connector housing is coupled with the aforementioned electronic instrument, each wire in the wiring harness is electrically connected to the corresponding electronic instrument through the terminal fitting, thereby transmitting the desired electric power and signals to the electronic instruments.

[0004] When the wiring harness is assembled, first the wire is cut into a predetermined length, then the terminal fitting is attached to an end of the wire after the coating at the end of the wire is removed. The wires are connected to each other according to a need. Thereafter, the terminal fitting is inserted into the connector housing. Thus, the wiring harness is assembled.

[0005] The wire of the wiring harness must be distinguished in terms of the size of the core wire, the material of the coating (concerning with alteration in the materials depending upon heat-resisting property), and a purpose of use. The purpose of use means, for example, an air bag, antilock brake system (ABS), control signal such as speed data, and system in a motor vehicle in which the wire is used, such as a power transmission system.

[0006] Therefore, an outer surface of the wire to be used in a wiring harness has been colored in a desired color with various harness manufacturing devices (for example, see Japanese Patent Application Laid-Open No. H6-162839) that performs the cutting of the wire and removing of the coating in order to distinguish the purposes of use or the systems. In a harness manufacturing device described in Japanese Patent Application Laid-Open No. H6-162839, the wire is transferred in the length direction of the wire and the wire is nipped between a pair of stamps, then the wire is colored, and thereafter the wire is nipped between a pair of blades and then, the wire is colored in a desired color and cut into a desired length.

[DISCLOSURE OF THE INVENTION]

[PROBLEMS THAT THE INVENTION IS TO SOLVE]

[0007] In the conventional harness manufacturing device as described above, since the wire is nipped between a pair of the stamps to color the wire, it has been necessary to once halt the movement of the wire upon coloring the wire. Therefore, a time required for processing the wire becomes long, causing a lowering of work efficiency.

[0008] Moreover, in the conventional harness manufacturing device, since the wire is colored with nipping the wire between a pair of the stamps, it is not possible to color the wire continuously. For example, if the wire is colored with the stamps for a distance between the cutting blades and the stamps and then cut after the wire is transferred, a position colored by the stamps is located at an end portion of the wire. Thus, in the conventional harness manufacturing device, only a part of the wire, for example, only an end portion of the wire can be colored. In order to color the wire continuously, it is necessary to repeat the transfer and halt of the wire frequently, causing a lowering of work efficiency.

[0009] It is therefore an objective of the present invention to solve the above problem and to provide a device for coloring an electric wire, by which the wire can be continuously colored without a lowering of work efficiency.

[MEANS OF SOLVING THE PROBLEMS]

[0010] In order to solve the above problem and to achieve the above objective, a device for coloring an electric wire according to the present invention as defined in claim 1 is a device for coloring an electric wire including:

> tension imparting means for imparting tension to an electric wire in a longitudinal direction of the electric wire to stretch the electric wire;
> coloring means for spouting a coloring agent with a predetermined amount thereof per spouting toward an outer surface of the electric wire stretched by the tension imparting means; and
> transfer means for transferring the electric wire and the coloring means relatively to each other in the longitudinal direction of the electric wire,

wherein the coloring means spouts the coloring agent with the predetermined amount thereof per spouting toward the outer surface of the electric wire while the transfer means transfers the electric wire and the coloring

means relatively to each other in the longitudinal direction of the electric wire.

[0011] The device for coloring an electric wire according to the present invention as defined in claim 2 is the device defined in claim 1, wherein the device further includes:

measuring means for measuring a relative transferring length of the electric wire and the coloring means; and

control means for causing the coloring means to spout the coloring agent with the predetermined amount thereof per spouting on the basis of the transferring length measured by the measuring means.

[0012] The device for coloring an electric wire according to the present invention as defined in claim 3 is the device defined in claim 1 or 2, wherein the transfer means is stretch means for stretching the electric wire in the longitudinal direction of the electric wire so as to transfer the electric wire, the tension imparting means is arranged on the upstream side of the stretch means in a transferring direction of the electric wire and imparts friction force having a direction reverse to a direction in which the stretch means stretches the electric wire to the electric wire, and the coloring means is arranged between the stretch means and the tension imparting means.

[0013] The device for coloring an electric wire according to the present invention as defined in claim 4 is the device defined in claim 3, wherein the device further includes slack-absorbing means for absorbing a slack of the electric wire when the slack of the electric wire occurs.

[0014] The device for coloring an electric wire according to the present invention as defined in claim 5 is the device defined in claim 4, wherein the slack-absorbing means is arranged between the tension imparting means and the coloring means.

[0015] The device for coloring an electric wire according to the present invention as defined in claim 6 is the device defined in claim 5, wherein the tension imparting means imparts first bias force as the friction force to the electric wire and the slack-absorbing means biases the electric wire with second bias force smaller than the first bias force in a direction crossing the longitudinal direction of the electric wire.

[0016] The device for coloring an electric wire according to the present invention as defined in claim 7 is the device defined in claim 6, wherein the slack-absorbing means includes:

a pair of guiding rollers for guiding the electric wire in the transferring direction thereof;

a transfer roller which is arranged between the pair of the guiding rollers coming in contact with the electric wire and movably supported in the direction crossing the longitudinal direction of the electric wire; and

bias means for biasing the transfer roller with the second bias force in a direction in which the transfer roller comes in contact with the electric wire.

[0017] The device for coloring an electric wire according to the present invention as defined in claim 8 is the device defined in claim 7, wherein the transfer roller is arranged at the center between the pair of the guiding rollers.

[0018] The device for coloring an electric wire according to the present invention as defined in claim 9 is the device defined in claim 7, wherein the transfer roller is arranged on the upstream side of the center between the pair of the guiding rollers in the transferring direction of the electric wire.

[0019] The device for coloring an electric wire according to the present invention as defined in claim 10 is the device defined in any one of claims 1 - 9, wherein a plurality of the coloring means are arranged along a circumferential direction around the electric wire.

[0020] The device for coloring an electric wire according to the present invention as defined in claim 11 is the device defined in any one of claims 1 - 10, wherein the device further includes processing means for processing the electric wire.

[0021] According to the present invention defined in claim 1, the coloring means spouts the coloring agent with the predetermined amount thereof per spouting toward the electric wire while the transfer means transfers the electric wire and the coloring means relatively to each other in the longitudinal direction of the electric wire. That is, the wire is colored while the electric wire and the coloring means are moved relatively to each other. Since it is not necessary to halt the movement of the wire to color the wire, therefore no lowering of work efficiency results.

[0022] Further, since the coloring means spouts the coloring agent with the predetermined amount thereof per spouting toward the electric wire while the transfer means transfers the electric wire and the coloring means relatively to each other, therefore any portion (i.e. position) of the wire can be colored and the wire can be colored continuously.

[0023] In this specification, the coloring agent means a liquid substance, in which a coloring material (organic substance for use in industry) is dissolved and dispersed in water or other solvent. The organic substance described above is a dye or a pigment (most of them being organic substances, i.e. synthetic substances). Sometimes, a dye is used as a pigment and a pigment is used as a dye. As an example, the coloring agent may be a coloring liquid or coating material. The coloring liquid is a liquid, in which a dye is dissolved or dispersed in a solvent. The coating material is a material, in which a pigment is dispersed in a liquid dispersion. When the outer surface of the coating is colored with a coloring liquid, the dye permeates into the coating. When the outer surface of the coating is colored with a coating material, the pigment adheres to the outer surface without permeating into the coating. In the specification, "to color the

outer surface of the (electric) wire" means to dye a part of the outer surface of the wire with a dye or to coat a part of the outer surface of the wire with a pigment.

[0024] Preferably, the solvent and liquid dispersion have an affinity to the synthetic resin that constitutes the coating in order to allow the dye to securely permeate into the coating or to allow the pigment to securely adhere to the outer surface of the coating.

[0025] According to the present invention defined in claim 2, the measuring means measures the transferring length of the electric wire and the control means controls the coloring means in response to the transferring length of the wire. Therefore, a time interval of the spouting of the coloring agent can be shortened when the transfer speed of the wire increases, while a time interval of the spouting of the coloring agent can be elongated when the transfer speed of the wire decreases. In this case, even if the transfer speed of the wire changes, a distance between spots (i.e. marks) adjacent to each other of the coloring agent adhering to the outer surface of the wire can be maintained to be a predetermined value.

[0026] According to the present invention defined in claim 3, the coloring means is arranged between the stretch means as the transfer means and the tension imparting means. Since the tension imparting means imparts friction force having a direction reverse to a direction in which the stretch means stretches the electric wire to the electric wire, therefore the wire can be securely stretched. Therefore, the coloring agent can be securely spouted toward the wire, which is stretched by the stretch means and also stretched by the tension imparting means.

[0027] According to the present invention defined in claim 4, the slack-absorbing means absorbs a slack of the electric wire when the slack of the electric wire occurs. Therefore, the coloring agent can be securely spouted toward the wire, which is stretched by the stretch means and also stretched by the tension imparting means.

[0028] According to the present invention defined in claim 5, the slack-absorbing means is arranged between the tension imparting means and the coloring means. Therefore, the wire can be securely stretched in the proximity of the coloring means. Therefore, the coloring agent can be securely spouted toward the wire, which is stretched by the stretch means and also stretched by the tension imparting means.

[0029] According to the present invention defined in claim 6, the tension imparting means imparts first bias force to the electric wire and the slack-absorbing means biases the electric wire with second bias force. Therefore, when a slack of the electric wire does not occur, the slack-absorbing means never prevents the wire from moving. When a slack of the electric wire occurs, the wire is pushed in a direction crossing the longitudinal direction of the electric wire by the second bias force of the slack-absorbing means, so that the wire is stretched.

[0030] According to the present invention defined in claim 7, the slack-absorbing means includes the pair of guiding rollers and the transfer roller arranged between the pair of the guiding rollers. Also, the transfer roller is provided to be movable in the direction crossing the longitudinal direction of the electric wire and biased with the second bias force by the bias means.

[0031] Therefore, the slack-absorbing means can always stretch the wire. Therefore, the coloring agent can securely adhere to any portion (i.e. position) of the wire.

[0032] According to the present invention defined in claim 8, the transfer roller is arranged at the center between the pair of the guiding rollers. Therefore, when the transfer roller moves, counterforce from the wire situated at the upstream side of the transfer roller becomes about the same as that from the wire situated at the downstream side of the transfer roller. Therefore, the transfer roller quickly moves in a direction crossing the longitudinal direction of the electric wire. Therefore, the slack-absorbing means can always stretch the wire.

[0033] According to the present invention defined in claim 9, the transfer roller is arranged on the upstream side of the center between the pair of the guiding rollers in the transferring direction of the electric wire. Therefore, a bend of the wire situated at the downstream side of the transfer roller becomes more moderate than that of the wire situated at the upstream side of the transfer roller. Therefore, a bend of the wire forwarded to the coloring means can be controlled and the tension imparted to the wire can be controlled. Therefore, the wire can be prevented from abruptly being damaged.

[0034] According to the present invention defined in claim 10, a plurality of the coloring means are arranged along a circumferential direction around the electric wire. Therefore, the outer surface of the wire can be securely colored by a plurality of the coloring means. Since a distance between the tension imparting means and the stretch means in the longitudinal direction of the wire in the coloring means can be set short, so that the size of the device for coloring the wire can be reduced.

[0035] According to the present invention defined in claim 11, the device further includes processing means for processing the electric wire. That is, the wire can be colored in a desired color at the processing step of the wire. Therefore, the number of steps for processing the wire, that is, the number of steps for assembling a product in which the wires such as a wiring harness are used is prevented from increasing.

[EFFECTS OF THE INVENTION]

[0036] According to the present invention defined in claim 1, the wire is colored while the electric wire and the coloring means are moved relatively to each other. Since it is not necessary to halt the movement of the wire to color the wire, therefore no lowering of work efficiency results. Further, since the coloring means spouts the coloring agent with the predetermined amount thereof per spouting toward the electric wire while the transfer means transfers the electric wire and the coloring means

relatively to each other, therefore any portion (i.e. position) of the wire can be colored and the wire can be colored continuously.

[0037] According to the present invention defined in claim 2, the measuring means measures the transferring length of the electric wire and the control means controls the coloring means in response to the transferring length of the wire. Therefore, even if the transfer speed of the wire changes, a distance between spots (i.e. marks) adjacent to each other of the coloring agent adhering to the outer surface of the wire can be maintained to be a predetermined value, that is, the coloring agent can adhere to the outer surface of the wire according to a predetermined pattern.

[0038] According to the present invention defined in claim 3, the coloring means is arranged between the stretch means as the transfer means and the tension imparting means. Since the tension imparting means imparts friction force having a direction reverse to a direction in which the stretch means stretches the electric wire to the electric wire, therefore the wire can be securely stretched. Therefore, the coloring means securely spouts the coloring agent toward the wire and the spouted coloring agent can securely adheres to the wire. Therefore, any portion (i.e. position) of the wire can be securely colored and the wire can be securely colored according to a predetermined pattern.

[0039] According to the present invention defined in claim 4, the slack-absorbing means absorbs a slack of the electric wire when the slack of the electric wire occurs. Therefore, the wire can be prevented from being positionally shifted, the coloring means securely spouts the coloring agent toward the wire, and the spouted coloring agent can securely adheres to the wire. Therefore, any portion (i.e. position) of the wire can be securely colored and the wire can be securely colored according to a predetermined pattern.

[0040] According to the present invention defined in claim 5, the slack-absorbing means is arranged between the tension imparting means and the coloring means. Therefore, the wire can be securely stretched in the proximity of the coloring means and the wire can be prevented from being positionally shifted. Therefore, the coloring means securely spouts the coloring agent toward the wire and the spouted coloring agent can securely adheres to the wire. Therefore, any portion (i.e. position) of the wire can be securely colored and the wire can be securely colored according to a predetermined pattern.

[0041] According to the present invention defined in claim 6, the tension imparting means imparts first bias force to the electric wire and the slack-absorbing means biases the electric wire with second bias force. Therefore, when a slack of the electric wire does not occur, the slack-absorbing means never prevents the wire from moving. When a slack of the electric wire occurs, the wire is pushed in a direction crossing the longitudinal direction of the electric wire by the second bias force of the slack-absorbing means, so that the wire is stretched. Therefore, the wire can be always stretched and the wire can be prevented from being positionally shifted. Therefore, the spouted coloring agent can securely adheres to the wire. Therefore, any portion (i.e. position) of the wire can be securely colored and the wire can be securely colored according to a predetermined pattern.

[0042] According to the present invention defined in claim 7, the slack-absorbing means includes the pair of guiding rollers and the transfer roller arranged between the pair of the guiding rollers. Also, the transfer roller is provided to be movable in the direction crossing the longitudinal direction of the electric wire and biased with the second bias force by the bias means.

[0043] Therefore, the slack-absorbing means can always stretch the wire and the wire can be prevented from being positionally shifted. Therefore, any portion (i.e. position) of the wire can be securely colored and the wire can be securely colored according to a predetermined pattern.

[0044] According to the present invention defined in claim 8, the transfer roller is arranged at the center between the pair of the guiding rollers. Therefore, when the transfer roller moves, counterforce from the wire situated at the upstream side of the transfer roller becomes about the same as that from the wire situated at the downstream side of the transfer roller. Therefore, the transfer roller quickly moves in a direction crossing the longitudinal direction of the electric wire. Therefore, the slack-absorbing means can always stretch the wire and the wire can be prevented from being positionally shifted. Therefore, any portion (i.e. position) of the wire can be securely colored and the wire can be securely colored according to a predetermined pattern.

[0045] According to the present invention defined in claim 9, the transfer roller is arranged on the upstream side of the center between the pair of the guiding rollers in the transferring direction of the electric wire. Therefore, a bend of the wire situated at the downstream side of the transfer roller becomes more moderate than that of the wire situated at the upstream side of the transfer roller. Therefore, a bend of the wire forwarded to the coloring means can be controlled and the tension imparted to the wire can be controlled. Therefore, the wire can be prevented from abruptly being damaged.

[0046] According to the present invention defined in claim 10, a plurality of the coloring means are arranged along a circumferential direction around the electric wire. Therefore, the outer surface of the wire can be securely colored by a plurality of the coloring means. Since a distance between the tension imparting means and the stretch means in the longitudinal direction of the wire in the coloring means can be set short, so that the size of the device for coloring the wire can be reduced.

[0047] According to the present invention defined in claim 11, the device further includes processing means for processing the electric wire. That is, the wire can be colored in a desired color at the processing step of the wire. Therefore, a processing step such as a step for

cutting the wire, which is separately provided from the step for coloring the wire, is not necessary. That is, the number of steps for processing the wire, that is, the number of steps for assembling a product in which the wires such as a wiring harness are used is prevented from increasing.

[BEST MODE FOR CARRING OUT THE INVENTION]

[0048] In the following, a device for coloring an electric wire (hereinafter, a coloring device) according to a preferred embodiment of the present invention will be explained with reference to Figs. 1 - 6. A coloring device 1 is a device, in which a wire 3 is cut into a predetermined length and a mark 6 is formed on a portion of an outer surface 3a of the wire 3. That is, the coloring device 1 colors, i.e. marks the outer surface 3a of the wire 3.

[0049] The wires 3 constitute a wiring harness mounted on a motor vehicle as a mobile unit. As shown in Fig. 6A, the wire 3 includes an electrically conductive core wire 4 and an electrically insulating coating 5. A plurality of element wires are bundled up to form the core wire 4. Each element wire of the core wire 4 is made of electrically conductive metal. The core wire 4 may be constituted by a single element wire. The coating 5 is made of synthetic resin such as polyvinyl chloride (PVC). The coating 5 coats the core wire 4. Therefore, an outer surface 3a of the wire 3 is an outer surface of the coating 5.

[0050] The coating 5 has a monochrome color P, for example, a white color. A desired coloring agent may be mixed with the synthetic resin of the coating 5 so as to make the color of the outer surface 3a of the wire 3 be a monochrome color P, or alternatively, the monochrome color P may be set as the color of the synthetic resin itself without adding a coloring agent to the synthetic resin of the coating 5. In the latter case, the outer surface 3a of the wire 3 is not colored, i.e. the coating 5 is not colored.

[0051] A mark 6 having a plurality of spots 7 is formed on the outer surface 3a of the wire 3. The spot 7 has a color B (shown with parallel lines in Figs. 6A and 6B). The color B is different from the monochrome color P. A shape of the spot 7 in a plan view is round as shown in Fig. 6B. The spots 7 are lined up along the longitudinal direction of the wire 3 according to a predetermined pattern. In an example shown in the figure, the spots 7 are lined up at regular intervals in the longitudinal direction of the wire 3. A distance between centers of the spots 7 adjacent to each other is predetermined.

[0052] A plurality of the wires 3 are bundled up and then attach connectors to ends thereof so as to construct a wiring harness. The connectors are coupled with mating connectors of various electronic instruments mounted on a motor vehicle, so that the wires 3, i.e. the wiring harness transmit electric power or signals to the electronic instruments.

[0053] Colors B of the respective spots 7 of the mark 6 are changed into various colors, so that the wires 3 can be distinguished from each other. In an example shown in the figure, the colors of all the spots 7 of a wire 3 are the same color. However, the color B may be changed depending on spot 7 according to a need, so that the colors B of the spots 7 are different from each other. The colors B of the respective spots 7 of the mark 6 are used to distinguish types of the wires 3 in the wiring harness or to distinguish systems. That is, the colors B of the respective spots 7 of the mark 6 are used to distinguish the purposes of use of the respective wires 3 in the wiring harness.

[0054] As shown in Fig. 1, the coloring device 1 includes a frame 10 as a body of the device, guide roll 11, delivery rolls 12 as transfer means, correction unit 13 as tension imparting means, slack absorbing unit 14 as slack-absorbing means, coloring unit 15, duct 16, encoder 17 as measuring means, cutting mechanism 18 as processing means, and control device 19 as control means.

[0055] The frame 10 is placed on a floor in a plant. The frame 10 extends in a horizontal direction. The guide roll 11 is rotatably attached to an end of the frame 10. The guide roll 11 is a guide for guiding the long wire 3 having no mark 6 formed thereon from a wire bundle 50 to the correction unit 13. The guide roll 11 forwards the wire 3 by way of the correction unit 13, slack absorbing unit 14, coloring unit 15, duct 16, encoder 17 and cutting mechanism 18 in sequence.

[0056] A pair of the delivery rolls 12 is placed at an opposite end of the frame 10. The pair of the delivery rolls 12 is rotatably supported by the frame 10 and arranged in a vertical direction. The delivery rolls 12 are rotated by a motor (not shown in the figure) with the same number of revolutions in respective directions, which are reverse to each other. The delivery rolls 12 put the wire 3 therebetween and pull the wire 3 in the longitudinal direction of the wire 3 from the guide roll 11.

[0057] The delivery rolls 12 are pulling means, which pull and transfer the wire 3 in the longitudinal direction of the wire 3. Thus, the delivery rolls 12 transfer the wire 3 in the longitudinal direction of the wire 3, so that the delivery roll 12 move a coloring nozzle 31 (explained later on) of the coloring unit 15 and the wire 3 relatively to each other in the longitudinal direction of the wire 3. That is, the wire 3 is transferred from the guide roll 11 toward the delivery roll 12 in a direction of an arrow K shown in Fig. 1. That is, the arrow K shows the transferring direction of the wire 3.

[0058] The correction unit 13 is placed on the delivery roll 12-side of the guide roll 11. That is, the correction unit 13 is placed between the guide roll 11 and the delivery roll 12. That is, the correction unit 13 is placed on the downstream side of the guide roll 11 in the transferring direction K of the wire 3. That is, the correction unit 13 is placed on the upstream side of the delivery roll 12 in the transferring direction K of the wire 3. The correction unit 13 includes a plate-shaped unit body 20, a plurality of first rollers 21 and a plurality of second rollers 22. The unit body 20 is fixed on the frame 10.

[0059] A plurality of the respective first and second rollers 21, 22 are rotatably supported by the unit body 20. A plurality of the first rollers 21 are arranged in a horizontal direction (in the transferring direction K) above the wire 3. A plurality of the second rollers 22 are arranged in a horizontal direction (in the transferring direction K) below the wire 3. As shown in Fig. 1, the first and second rollers 21 and 22 are arranged zigzag.

[0060] The correction unit 13 puts the wire 3, which is forwarded by the delivery roll 12 from the guide roll 11, between the first rollers 21 and the second rollers 22, thereby making the wire 3 straight. By putting the wire 3 between the first rollers 21 and the second rollers 22, the correction unit 13 gives friction force to the wire 3. That is, the correction unit 13 gives first bias force H1 as friction force having a direction reverse to the direction, in which the delivery roll 12 pulls the wire 3 (i.e. the transferring direction K), to the wire 3. The first bias force H1 is smaller than the force that the delivery roll 12 pulls the wire 3. Therefore, the correction unit 13 gives the tension having a direction, which is along the longitudinal direction of the wire 3, to the wire 3 so as to stretch the wire 3.

[0061] The slack absorbing unit 14 is placed on the delivery roll 12-side of the correction unit 13. That is, the slack absorbing unit 14 is placed between the correction unit 13 and the delivery roll 12. That is, the slack absorbing unit 14 is placed on the downstream side of the correction unit 13 in the transferring direction K of the wire 3. The slack absorbing unit 14 is placed on the upstream side of the delivery roll 12 in the transferring direction K of the wire 3. The slack absorbing unit 14 is placed between the correction unit 13 and a coloring nozzle 31 (explained later on) of the coloring unit 15.

[0062] As shown in Figs. 1 and 2, the slack absorbing unit 14 includes a pair of guiding roller supporting frames 23, a pair of guiding rollers 24, transfer roller supporting frame 25, transfer roller 26, and air cylinder 27 as bias means (i.e. energizing means). The pair of the guiding roller supporting frames 23 is fixed on the frame 10. The pair of the guiding roller supporting frames 23 stands up from the frame 10. The guiding roller supporting frames 23 are arranged having a distance therebetween in the transferring direction K of the wire 3.

[0063] The pair of the guiding rollers 24 is rotatably supported by the pair of the guiding roller supporting frames 23. The guiding roller 24 is arranged below the wire 3 and comes in contact with the wire 3 on the outer peripheral surface thereof so as to guide the wire 3 in the transferring direction K of the wire 3 preventing the wire 3 from coming off from the transferring direction K.

[0064] The transfer roller supporting frame 25 is fixed on the frame 10. The transfer roller supporting frame 25 stands up from the frame 10. The transfer roller supporting frame 25 is placed between the pair of the guiding roller supporting frames 23.

[0065] The transfer roller 26 is rotatably supported by the transfer roller supporting frame 25 movably in the vertical direction. The transfer roller 26 is arranged above the wire 3. The transfer roller 26 is supported movably in the vertical direction, that is, the transfer roller 26 is supported movably in a direction crossing (at right angles) the transferring direction K of the wire 3. The transfer roller 26 is placed in the middle of the pair of the guiding rollers 24.

[0066] The air cylinder 27 includes a cylinder body 28 and stretchable rod 29 stretchable from the cylinder body 28. The cylinder body 28 is fixed to the transfer roller supporting frame 25 and arranged above the wire 3. The stretchable rod 29 extends downward from the cylinder body 28. That is, the stretchable rod 29 extends from the cylinder body 28 in a direction in which the stretchable rod 29 approaches toward the wire 3.

[0067] The transfer roller 26 is attached to the stretchable rod 29. By receiving pressurized gas in the cylinder body 28, the air cylinder 27 biases the stretchable rod 29 (or the transfer roller 26) downward in a direction crossing (at right angles) the transferring direction K of the wire 3 with a second bias force H2 (shown in Figs. 1 and 2). That is, the air cylinder 27 biases the transfer roller 26 in a direction in which the transfer roller 26 approaches toward the wire 3 with the second bias force H2. The second bias force H2 is smaller than the first bias force H1.

[0068] Since cutting blades 48 and 49 of a pair of the cutting blades 48, 49 (explained later on) in the cutting mechanism 18 approach each other so as to cut the wire 3, if the wire 3 advances in the transferring direction K with inertia when the wire 3 is stopped to be cut, the wire 3 slackens between the pair of the guiding rollers 24. At this time, in the slack absorbing unit 14, since the air cylinder 27 biases the transfer roller 26 with the second bias force H2, the stretchable rod 29 of the air cylinder 27 extends, so that the transfer roller 26 is displaced to, for example, a position, which is indicated by an alternate long and two short dashes line in Fig. 2. Then, the slack absorbing unit 14 biases the wire 3, which slackens between the pair of the guiding rollers 24, in the direction crossing (at right angles) the transferring direction K of the wire 3 so as to absorb the slack, thereby keeping the wire 3 stretched.

[0069] The coloring unit 15 is placed on the delivery roll 12-side of the slack absorbing unit 14. That is, the coloring unit 15 is placed between the slack absorbing unit 14 and the delivery roll 12. That is, the coloring unit 15 is placed on the downstream side of the slack absorbing unit 14 in the transferring direction K of the wire 3. The coloring unit 15 is placed on the upstream side of the delivery roll 12 in the transferring direction K of the wire 3. That is, the coloring unit 15 (i.e. the coloring nozzle 31 explained later on) is placed between the delivery roll 12 and the correction unit 13.

[0070] As shown in Fig. 3, the coloring unit 15 includes a unit body 30, a plurality of coloring nozzles 31, a plurality of coloring agent supply source 32 (only one source 32 being drawn in the figure and other sources 32 being omitted to be drawn) and pressurized gas supply source 33. The unit body 30 is fixed on the frame 10. The unit

body 30 supports a plurality of the coloring nozzles 31.

[0071] As shown in Fig. 5, the coloring nozzle 31 includes a cylindrical nozzle body 34, insert member 35 received in the nozzle body 34, inlet pipe 36, spouting pipe 37 and valve mechanism 38. The insert member 35 is formed in a cylindrical shape and provided with a channel 39 to let the coloring agent pass therethrough. That is, the channel 39 is filled with the coloring agent supplied from the coloring agent supply source 32. The insert member 35 is a receiver for receiving the liquid coloring agent. The inlet pipe 36 communicates with the channel 39 to guide the coloring agent supplied from the coloring agent supply source 32 into the channel 39.

[0072] The spouting pipe 37 is formed in a cylindrical shape and communicates with the channel 39 so as to guide the coloring agent in the channel 39 to the outside of the coloring nozzle 31. An inner diameter of the spouting pipe 37 is smaller than an inner diameter of the insert member 35, i.e. an outer diameter of the channel 39. The spouting pipe 37 is aligned with the nozzle body 34 and made of stainless steel. The valve mechanism 38 includes a coil 40, valve body 41, and coil spring 42. The coil 40 is provided outside the channel 39 and embedded in the insert member 35. A current is applied to the coil 40 from the outside. The valve body 41 includes an electrically conductive body part 43 and valve element 44. The body part 43 integrally includes a cylindrical cylinder part 45 and disc-shaped disc part 46 which continues to an end of the cylinder part 45.

[0073] The disc part 46 of the body part 43 faces a base end 37a of the spouting pipe 37. The body part 43 is received in the channel 39 in a state that the longitudinal direction of the cylinder part 45 is parallel to that of the nozzle body 34. The body part 43 (or the valve body 41) is provided movably in the longitudinal direction of the cylinder part 45, i.e. the longitudinal direction of the nozzle body 34.

[0074] The valve element 44 is attached to the disc part 46 of the body part 43. That is, the valve element 44 is received in the insert member 35. The valve element 44 faces the base end 37a of the spouting pipe 37. The valve element 44 approaches or leaves the base end 37a of the spouting pipe 37. When the valve element 44 comes in contact with the base end 37a of the spouting pipe 37, the coloring agent in the channel 39 is prevented from entering into the spouting pipe 37, that is, the watertight condition between the valve element 44 and the base end 37a is attained. When the valve element 44 leaves the base end 37a of the spouting pipe 37, the coloring agent is allowed to pass through the spouting pipe 37 so as to be spouted toward the outer surface 3a of the wire 3. Thus, the valve element 44 approaches or leaves the base end 37a between the opening position (not shown in the figure) and the closing position shown with a solid line in Fig. 5. At the opening position, the valve element 44 leaves the base end 37a, so that the coloring agent is allowed to pass through the spouting pipe 37 so as to be spouted toward the outer surface 3a of the wire 3. At the closing position, the valve element 44 comes in contact with the base end 37a, so that the coloring agent is not allowed to pass through the spouting pipe 37 to be spouted toward the outer surface 3a of the wire 3. The coil spring 42 biases the disc part 46 in such a direction that the valve element 44 approaches the base end 37a of the spouting pipe 37.

[0075] The coloring nozzle 31 allows the coloring agent supplied from the coloring agent supply source 32 to flow through the inlet pipe 36 and guides the coloring agent into the channel 39. On a condition that a current is not applied to the coil 40, the valve element 44 comes in contact with the base end 37a of the spouting pipe 37 due to the bias force by the coil spring 42, thereby the coloring agent stays within the channel 39. When a current is applied to the coil 40, the valve element 44 attached to the disc part 46 leaves the base end 37a of the spouting pipe 37 against the bias force by the coil spring 42, thereby allowing the coloring agent existing in the channel 39 to spout from the spouting pipe 37. A current is applied to the coil 40 for a predetermined period of time on the basis of a command from the control device 19. Therefore, the coloring nozzle 31 spouts the coloring agent with a predetermined amount of the coloring agent per spouting.

[0076] When a plurality of the coloring nozzles 31 are attached to the unit body 30, the coloring nozzles 31 are arranged in the transferring direction K of the wire 3 and also arranged in a peripheral direction around the wire 3. In an example shown in the figure, five coloring nozzles 31 are arranged in the transferring direction K of the wire 3 in the unit body 30. Three coloring nozzles 31 are arranged in the circumferential direction around the wire 3 in the unit body 30.

[0077] As shown in Fig. 4, each coloring nozzle 31 is supported by the unit body 30 on a condition that the uppermost part 3b of the wire 3 is positioned on an extension line of an axis R (shown with alternate long and short dash line in Fig. 4) of the spouting pipe 37. The coloring nozzle 31 spouts the coloring agent along the axis R. That is, the coloring nozzle 31 spouts the coloring agent with a predetermined amount thereof per spouting toward the uppermost part 3b of the wire 3. The coloring nozzle 31 is the coloring means.

[0078] The coloring agent supply source 32 receives the coloring agent and supplies the coloring agent into an inlet pipe 36 of the coloring nozzle 31. Each coloring agent supply sources 32 mates with a coloring nozzles 31. The colors B of the coloring agents supplied from the coloring agent supply sources 32 to the coloring nozzles 31 may be different from each other or, alternatively, the same with each other.

[0079] The pressurized gas supply source 33 supplies pressurized gas into the coloring agent supply sources 32. After the pressurized gas is supplied into the coloring agent supply sources 32, when a valve element 44 of the coloring nozzle 31 leaves a base end 37a of the spouting pipe 37, the coloring agent contained in a channel 39 is

spouted rapidly from the spouting pipe 37.

[0080] In the coloring unit 15, on the basis of a command from the control device 19, a current flows into a coil 40 of the coloring nozzle 31 so that the valve element 44 leaves the base end 37a of the spouting pipe 37. Then, the coloring unit 15 spouts the coloring agent contained in the channel 39 of the coloring nozzle 31 with a predetermined amount thereof per spouting toward the electric wire 3.

[0081] The coloring agent means a liquid substance, in which a coloring material (organic substance for use in industry) is dissolved and dispersed in water or other solvent. The organic substance described above is a dye or a pigment (most of them being organic substances and synthetic substances). Sometimes, a dye is used as a pigment and a pigment is used as a dye. As an example, the coloring agent may be a coloring liquid or coating material.

[0082] The coloring liquid is a liquid, in which a dye is dissolved or dispersed in a solvent. The coating material is a material, in which a pigment is dispersed in a liquid dispersion. When the coloring liquid adheres to the outer surface 3a of the wire 3, the dye permeates into the coating 5. When the coating material adheres to the outer surface 3a of the wire 3, the pigment adheres to the outer surface 3a without permeating into the coating 5. That is, the coloring unit 15 dyes a part of the outer surface 3a of the wire 3 with a dye or, alternatively, coat a part of the outer surface 3a of the wire 3 with a pigment. In the specification, "to color the outer surface 3a of the electric wire 3" means to dye a part of the outer surface 3a of the coating 5 of the wire 3 with a dye or to coat a part of the outer surface 3a of the coating 5 of the wire 3 with a pigment.

[0083] Preferably, the solvent and liquid dispersion have an affinity to the synthetic resin that constitutes the coating 5 in order to securely permeate the dye into the coating 5 or to allow the pigment to securely adhere to the outer surface 3a of the coating 5. In this specification, "spouting" means that the liquid coloring agent in a form of a liquid drop (or liquid drops) with a predetermined amount thereof per spouting is ejected vigorously from the coloring nozzle 31 toward the outer surface 3a of the wire 3.

[0084] The duct 16 is placed on the delivery roll 12-side of the coloring unit 15. That is, the duct 16 is placed between the coloring unit 15 and the delivery roll 12. That is, the duct 16 is placed on the downstream side of the coloring unit 15 in the transferring direction K of the wire 3. The duct 16 is placed on the upstream side of the delivery roll 12 in the transferring direction K of the wire 3. The duct 16 is formed in a tube shape and allows the wire 3 to pass therethrough. The duct 16 is connected to suction means (not shown in the figure) such as a vacuum pump. The suction means sucks gas existing in the duct 16 so as to prevent solvent or liquid dispersion existing in the coloring agent from being filled outside the coloring device 1.

[0085] The encoder 17 is placed on the downstream side of the delivery roll 12 in the transferring direction K of the wire 3. As shown in Fig. 1, the encoder 17 includes a pair of rotors 47. Each rotor 47 is rotatably supported around the axis. The outer peripheral surface of the rotor 47 comes in contact with the outer surface 3a of the wire 3, which is put between the pair of the delivery rolls 12. When the wire 3 (i.e. core wire 4) is transferred in the direction K, the rotor 47 rotates around the axis. The amount of transfer of the wire 3 in the direction K is proportional to the number of revolutions of the rotor 47.

[0086] The encoder 17 is connected to the control device 19. When the rotor 47 rotates by a predetermined angle per rotation, the encoder 17 outputs a pulse signal to the control device 19. That is, the encoder 17 outputs an information in response to the transfer amount of the wire 3 in the direction K to the control device 19. Thus, the encoder 17 measures an information in response to the transfer amount of the wire 3 and outputs the information in response to the transfer amount of the wire 3 to the control device 19. Normally, the encoder 17 outputs a pulse signal in response to the transfer amount of the wire 3 on the basis of friction between the wire 3 and the rotor 47. However, in the event that the amount of the transfer of the wire 3 does not coincide with the number of the pulse due to a condition of the outer surface 3a of the wire 3, the speed information of the transfer of the wire 3 may be obtained from another position so that thus obtained speed information is subjected to feedback so as to make the output to be outputted to the control device 19.

[0087] The cutting mechanism 18 is placed on the downstream side of the pair of the rotors 47 of the encoder 17 in the transferring direction K of the wire 3. The cutting mechanism 18 includes a pair of cutting blades 48 and 49, each of which is arranged in the vertical direction. The cutting blades 48 and 49 approach or leave each other in the vertical direction. When the cutting blades 48 and 49 approach each other, they put the wire 3, which is delivered by the pair of the delivery rolls 12, therebetween and cut the wire 3. When the cutting blades 48 and 49 leave each other, they leave the wire 3.

[0088] The control device 19 is a computer including a known RAM, ROM and CPU. The control device 19 is connected to the delivery rolls 12, encoder 17, cutting mechanism 18, coloring nozzles 31 and so on. The control device 19 control the whole of the coloring device 1 by controlling actions of these components described above.

[0089] The control device 19 stores a pattern of the mark 6 in advance. When the control device 19 receives a predetermined pulse signal from the encoder 17, i.e. an information in response to the amount of transfer of the wire 3, the control device 19 applies a current to the coil 40 of the predetermined coloring nozzle 31 for a predetermined period of time so that the coloring agent is spouted from the coloring nozzle 31 toward the wire 3 with a predetermined amount of the coloring agent per

spouting. According to the pattern of the mark 6 stored in advance, the control device 19 shortens a time interval of the spouting of the coloring agent from the coloring nozzle 31 when the transfer speed of the wire 3 increases, while the control device 19 elongates a time interval of the spouting of the coloring agent from the coloring nozzle 31 when the transfer speed of the wire 3 decreases. Thus, the control device 19 performs the coloring of the wire 3 according to the pattern stored in advance. The control device 19 allows the coloring nozzle 31 to spout the coloring agent with a predetermined amount thereof per spouting on the basis of the amount of the transfer of the wire 3, which amount of the transfer is measured by the encoder 17.

[0090] When the control device 19 judges that the wire 3 is transferred by a predetermined amount (i.e. distance) on the basis of the information from the encoder 17, the control device 19 halts the delivery roll 12, then allows the pair of the cutting blades 48 and 49 to approach each other so as to cut the wire 3.

[0091] When the mark 6 is to be formed on the outer surface 3a of the wire 3, i.e. the outer surface 3a of the wire 3 is colored, in the coloring device 1, first the guide roll 11 is attached to the frame 10. Keeping the cutting blades 48 and 49 apart from each other, the wire 3 transferred from the wire bundle 50 is passed through the correction unit 13, slack absorbing unit 14, coloring unit 15 and duct 16 in sequence through the guide roll 11 and is put between the pair of the delivery rolls 12. Then, the coloring nozzle 31 is attached to a predetermined position of the unit body 30 of the coloring unit 15 and the coloring agent supply sources 32 are connected to the respective coloring nozzles 31. Further, the pressurized gas supply source 33 is connected to the coloring agent supply sources 32 and the gas existed in the duct 16 is sucked by the suction means.

[0092] Then, the delivery rolls 12 are driven so that the wire 3 is pulled from the guide roll 11 so as to be transferred in the longitudinal direction of the wire 3. The correction unit 13 gives friction force of the first bias force H1 to the wire 3 so as to stretch the wire 3. Then, the air cylinder 27 gives the second bias force H2 to the transfer roller 26, that is, to the wire 3.

[0093] When a pulse signal of predetermined sequence is inputted to the control device 19 from the encoder 17, the control device 19 applies a current to the coil 40 of the coloring nozzle 31 for a predetermined period of time per predetermined time interval. Then, the coloring nozzle 31 spouts the coloring agent with a predetermined amount thereof per spouting toward the outer surface 3a of the wire 3.

[0094] Then, the solvent or liquid dispersion is evaporated from the coloring agent adhered to the outer surface 3a of the wire 3, so that the outer surface 3a is dyed with a dye or coated with a pigment. The solvent or liquid dispersion evaporated from the coloring agent adhered to the outer surface 3a is sucked by the suction means from the duct 16. Thus, the outer surface 3a of the wire 3 is colored.

[0095] When the control device 19 judges that the wire 3 is transferred by a predetermined amount (i.e. distance) on the basis of the information from the encoder 17, the control device 19 halts the delivery roll 12. Then, the wire 3 slackens between the pair of the guiding rollers 24 in the slack absorbing unit 14 and then, the transfer roller 26, which is biased with the second bias force H2, is shifted to a position indicated by an alternate long and two short dashes line in Figs. 1 and 2. Then, the stretchable rod 29 of the air cylinder 27 in the slack absorbing unit 14 stretches. Thus, the slack absorbing unit 14 absorbs the slack of the wire 3.

[0096] Then, the cutting blades 48 and 49 approach each other, put the wire 3 therebetween and cut the wire 3. Thus, the wire 3 is obtained, in which the mark 6 is formed on the outer surface 3a.

[0097] According to the preferred embodiment, the coloring nozzle 31 spouts the coloring agent with the predetermined amount thereof per spouting toward the electric wire 3 while electric wire 3 and the coloring nozzle 31 are transferred relatively to each other. That is, the wire 3 is colored while the electric wire 3 and the coloring nozzle 31 are moved relatively to each other. Since it is not necessary to halt the movement of the wire 3 to color the wire 3, therefore no lowering of work efficiency results. Further, since the coloring nozzle 31 spouts the coloring agent with the predetermined amount thereof per spouting toward the electric wire 3 while the electric wire 3 and the coloring nozzle 31 are moved relatively to each other, therefore any portion (i.e. position) of the wire 3 can be colored and the wire 3 can be colored continuously.

[0098] The encoder 17 measures the transferring length of the electric wire 3 and the control device 19 controls the coloring nozzle 31 in response to the transferring length of the wire 3. Therefore, a time interval of the spouting of the coloring agent can be shortened when the transfer speed of the wire 3 increases, while a time interval of the spouting of the coloring agent can be elongated when the transfer speed of the wire 3 decreases. Thus, even if the transfer speed of the wire 3 changes, a distance between spots (i.e. marks) adjacent to each other of the coloring agent adhering to the outer surface of the wire 3 can be maintained to be a predetermined value.

[0099] Therefore, even if the transfer speed of the wire 3 changes, the coloring agent can adhere to the outer surface 3a of the wire 3 according to a predetermined pattern. That is, even if the transfer speed of the wire 3 changes, the wire 3 can be colored according to a predetermined pattern.

[0100] The coloring nozzle 31 is arranged between the delivery roll 12 and the correction unit 13. Since the correction unit 13 imparts friction force having a direction reverse to a direction in which the delivery roll 12 stretches the electric wire 3 to the electric wire 3, therefore the wire 3 can be securely stretched. Therefore, the coloring

agent can securely adhere to the wire 3, which is stretched by the delivery roll 12 and also stretched by the correction unit 13. Therefore, any portion (i.e. position) of the wire 3 can be securely colored and the wire 3 can be securely colored according to a predetermined pattern.

[0101] The slack-absorbing unit 14 absorbs a slack when such a slack of the wire 3 occurs. Therefore, the wire 3, which is stretched by the delivery roll 12 and also stretched by the correction unit 13, is prevented from being positionally shifted. Since the coloring agent is spouted toward the stretched wire 3, any portion (i.e. position) of the wire 3 can be securely colored. Therefore, any portion (i.e. position) of the wire 3 can be securely colored and the wire 3 can be securely colored according to a predetermined pattern.

[0102] The slack-absorbing unit 14 is arranged between the correction unit 13 and the coloring nozzle 31. Therefore, the wire 3 can be securely stretched in the proximity of the coloring nozzle 31. That is, the wire 3 is prevented from being positionally shifted in the proximity of the coloring nozzle 31. Therefore, the coloring agent can securely adhere to the wire 3, which is stretched by the correction unit 13. Therefore, any portion (i.e. position) of the wire 3 can be securely colored and the wire 3 can be securely colored according to a predetermined pattern.

[0103] The correction unit 13 imparts first bias force H1 as friction force to the electric wire 3 and the slack-absorbing unit 14 biases the electric wire 3 with second bias force H2. Therefore, when a slack of the electric wire 3 does not occur, the slack-absorbing unit 14 never displaces the wire 3 abruptly, that is, the slack-absorbing unit 14 never prevents the wire from moving.

[0104] When a slack of the electric wire 3 occurs, the wire 3 is pushed in a direction crossing the longitudinal direction of the electric wire 3 by the second bias force H2 of the slack-absorbing unit 14, so that the wire is stretched. Therefore, the wire 3 can be always stretched and the wire 3 can be prevented from being positionally shifted. Therefore, the spouted coloring agent can securely adhere to the wire 3, which is stretched by the correction unit 13. Therefore, any portion (i.e. position) of the wire 3 can be securely colored and the wire 3 can be securely colored according to a predetermined pattern.

[0105] The slack-absorbing unit 14 includes the pair of guiding rollers 24 and the transfer roller 26 arranged between the pair of the guiding rollers 24. Also, the transfer roller 26 is provided to be movable in the direction crossing the longitudinal direction of the electric wire 3 and biased with the second bias force H2 by the air cylinder 27.

[0106] Therefore, the slack-absorbing unit 14 biases the wire 3 with the second bias force H2 so as to always stretch the wire 3, thereby preventing the wire 3 from being positionally shifted. Therefore, the spouted coloring agent can securely adhere to the wire 3, which is stretched by the correction unit 13. Therefore, any portion (i.e. position) of the wire 3 can be securely colored and the wire 3 can be securely colored according to a predetermined pattern.

[0107] The transfer roller 26 is arranged at the center between the pair of the guiding rollers 24. Therefore, when the transfer roller 26 moves, counterforce from the wire 3 situated at the upstream side of the transfer roller 26 becomes about the same as that from the wire 3 situated at the downstream side of the transfer roller 26. Therefore, the transfer roller 26 quickly moves in a direction crossing the longitudinal direction of the electric wire 3. Therefore, the slack-absorbing unit 14 can always stretch the wire 3. Therefore, any portion (i.e. position) of the wire 3 can be securely colored and the wire 3 can be securely colored according to a predetermined pattern.

[0108] A plurality of the coloring nozzles 31 are arranged along a circumferential direction around the electric wire 3. Therefore, the outer surface 3a of the wire 3 can be securely colored by a plurality of the coloring nozzles 31. Since a distance between the correction unit 13 and the delivery roll 12 along the transferring direction K of the wire 3 can be set short, so that the size of the device 1 for coloring the wire can be reduced.

[0109] The device 1 further includes the cutting mechanism 18 as the processing means for processing the electric wire 3. That is, the wire 3 can be colored in a desired color at the cutting step (i.e. processing step) of the wire 3. Therefore, a processing step such as a step for cutting the wire 3, which is separately provided from the step for coloring the wire 3, is not necessary. That is, the number of steps for processing the wire 3, that is, the number of steps for assembling a product in which the wires 3 such as a wiring harness are used is prevented from increasing.

[0110] In the preferred embodiment described above, the wire 3 is moved so that the coloring nozzle 31 of the coloring unit 15 and the wire 3 are moved relatively to each other. However, instead, each coloring nozzle 31 of the coloring unit 15 may be moved or, alternatively, both of the wire 3 and the coloring nozzle 31 of the coloring unit 15 may be moved.

[0111] In the preferred embodiment described above, the transfer roller 16 is arranged at the center between the pair of the guiding rollers 24. However, instead, as shown in Fig. 7, the transfer roller 16 may be arranged on the upstream side of the center in the transferring direction K of the wire 3 between the pair of the guiding rollers 24. In this case, a bend of the wire 3 situated at the downstream side of the transfer roller 26 in the transferring direction K of the wire 3 becomes more moderate than that of the wire 3 situated at the upstream side of the transfer roller 26 in the transferring direction K of the wire 3. Therefore, a bend of the wire 3 to be forwarded to the coloring unit 15 can be restricted and a tension to be imparted to the wire 3 can be restricted. Therefore, the wire 3 can be prevented from being abruptly dam-

aged.

[0112] In the preferred embodiment described above, the cutting mechanism 18 for cutting the wire 3 into a predetermined length is provided as the processing means. However, instead, the processing means may be selected from various processing units for applying various processings to the wire 3 such as a mechanism for removing a coating 5 from an end portion of the wire 3 or a mechanism for applying a crimp terminal to the wire 3.

[0113] In the preferred embodiment described above, the delivery rolls 12 are arranged in a perpendicular direction. However, the delivery rolls 12 may be arranged in any direction such as a horizontal direction instead of the perpendicular direction. In short, in the present invention, the arrangement of the delivery rolls 12 and the respective units 13, 14 and 15 is not necessarily limited to that of the preferred embodiment described above and may be modified according to a need.

[0114] In the preferred embodiment described above, the wires 3 that constitute a wiring harness to be mounted on a motor vehicle are described. However, in the present invention, the wires 3 can be used for various electronic instruments or electrical machines such as a portable computer besides a motor vehicle.

[0115] Further, in the present invention, as the coloring liquid or coating material, various material may be used, such as acrylic coating material, ink (dye or pigment) and UV-ink.

[0116] The aforementioned preferred embodiments are described to aid in understanding the present invention and variations may be made by one skilled in the art without departing from the spirit and scope of the present invention.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0117]

Figure 1 is a side view illustrating a construction of a device for coloring an electric wire according to a preferred embodiment of the present invention;
Figure 2 illustrates a construction of a slack-absorbing unit in the device for coloring an electric wire shown in Fig. 1;
Figure 3 is a cross sectional view of a coloring unit in the device for coloring an electric wire taken along III - III line in Fig. 1;
Figure 4 illustrates a positional relation between respective coloring nozzles of the coloring unit and the electric wire;
Figure 5 is a cross sectional view illustrating a construction of the respective coloring nozzles of the coloring unit shown in Fig. 3;
Figure 6A is a perspective view of an electric wire colored by the device for coloring an electric wire shown in Fig. 1;
Figure 6B is a plan view of the electric wire shown in Fig. 6A; and
Figure 7 illustrates a construction of another example of the slack-absorbing unit shown in Fig. 2.

[ABBREVIATION NUMERALS]

[0118]

1: device for coloring electric wire
3: electric wire (i.e. wire)
3a: outer surface of electric wire
12: delivery roll (transfer means, stretch means)
13: correction unit (tension imparting means)
14: slack-absorbing unit (slack-absorbing means)
17: encoder (measuring means)
18: cutting mechanism (processing means)
19: control device (control means)
24: guiding roller
26: transfer roller
27: air cylinder (bias means)
31: coloring nozzle (coloring means)
K: transferring direction of electric wire
H1: first bias force
H2: second bias force

Claims

1. A device for coloring an electric wire comprising:

tension imparting means for imparting tension to an electric wire in a longitudinal direction of the electric wire to stretch the electric wire;
coloring means for spouting a coloring agent with a predetermined amount thereof per spouting toward an outer surface of the electric wire stretched by the tension imparting means; and
transfer means for transferring the electric wire and the coloring means relatively to each other in the longitudinal direction of the electric wire,

wherein the coloring means spouts the coloring agent with the predetermined amount thereof per spouting toward the outer surface of the electric wire while the transfer means transfers the electric wire and the coloring means relatively to each other in the longitudinal direction of the electric wire.

2. The device according to claim 1 further comprising:

measuring means for measuring a relative transferring length of the electric wire and the coloring means; and
control means for causing the coloring means to spout the coloring agent with the predetermined amount thereof per spouting on the basis of the transferring length measured by the measuring means.

3. The device according to claim 1 or 2, wherein the transfer means is stretch means for stretching the electric wire in the longitudinal direction of the electric wire so as to transfer the electric wire, the tension imparting means is arranged on the upstream side of the stretch means in a transferring direction of the electric wire and imparts friction force having a direction reverse to a direction in which the stretch means stretches the electric wire to the electric wire, and the coloring means is arranged between the stretch means and the tension imparting means.

4. The device according to claim 3 further comprising slack-absorbing means for absorbing a slack of the electric wire when the slack of the electric wire occurs.

5. The device according to claim 4, wherein the slack-absorbing means is arranged between the tension imparting means and the coloring means.

6. The device according to claim 5, wherein the tension imparting means imparts first bias force as the friction force to the electric wire and the slack-absorbing means biases the electric wire with second bias force smaller than the first bias force in a direction crossing the longitudinal direction of the electric wire.

7. The device according to claim 6, wherein the slack-absorbing means includes:

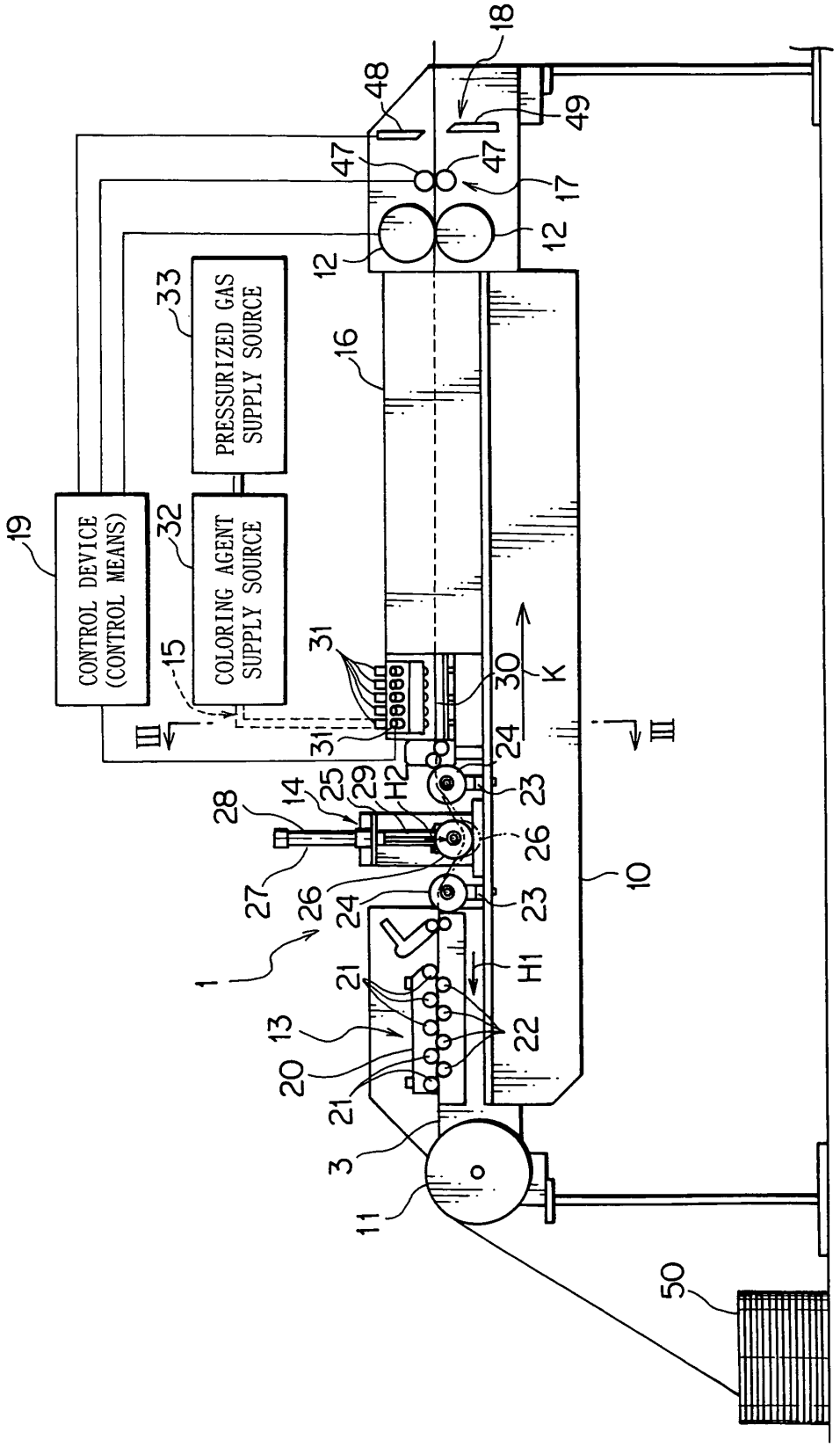
    a pair of guiding rollers for guiding the electric wire in the transferring direction thereof;
    a transfer roller which is arranged between the pair of the guiding rollers coming in contact with the electric wire and movably supported in the direction crossing the longitudinal direction of the electric wire; and
    bias means for biasing the transfer roller with the second bias force in a direction in which the transfer roller comes in contact with the electric wire.

8. The device according to claim 7, wherein the transfer roller is arranged at the center between the pair of the guiding rollers.

9. The device according to claim 7, wherein the transfer roller is arranged on the upstream side of the center between the pair of the guiding rollers in the transferring direction of the electric wire.

10. The device as claimed in any one of claims 1 - 9, wherein a plurality of the coloring means are arranged along a circumferential direction around the electric wire.

11. The device as claimed in any one of claims 1 - 10 further comprising processing means for processing the electric wire.


CONTROL DEVICE (CONTROL MEANS)
19
COLORING AGENT SUPPLY SOURCE
32
PRESSURIZED GAS SUPPLY SOURCE
33
15
16
17
18
48
49
47
12
31
30
K
III
24
25
29
H2
23
28
14
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1
H1
21
22
13
20
3
11
50

FIG. 1

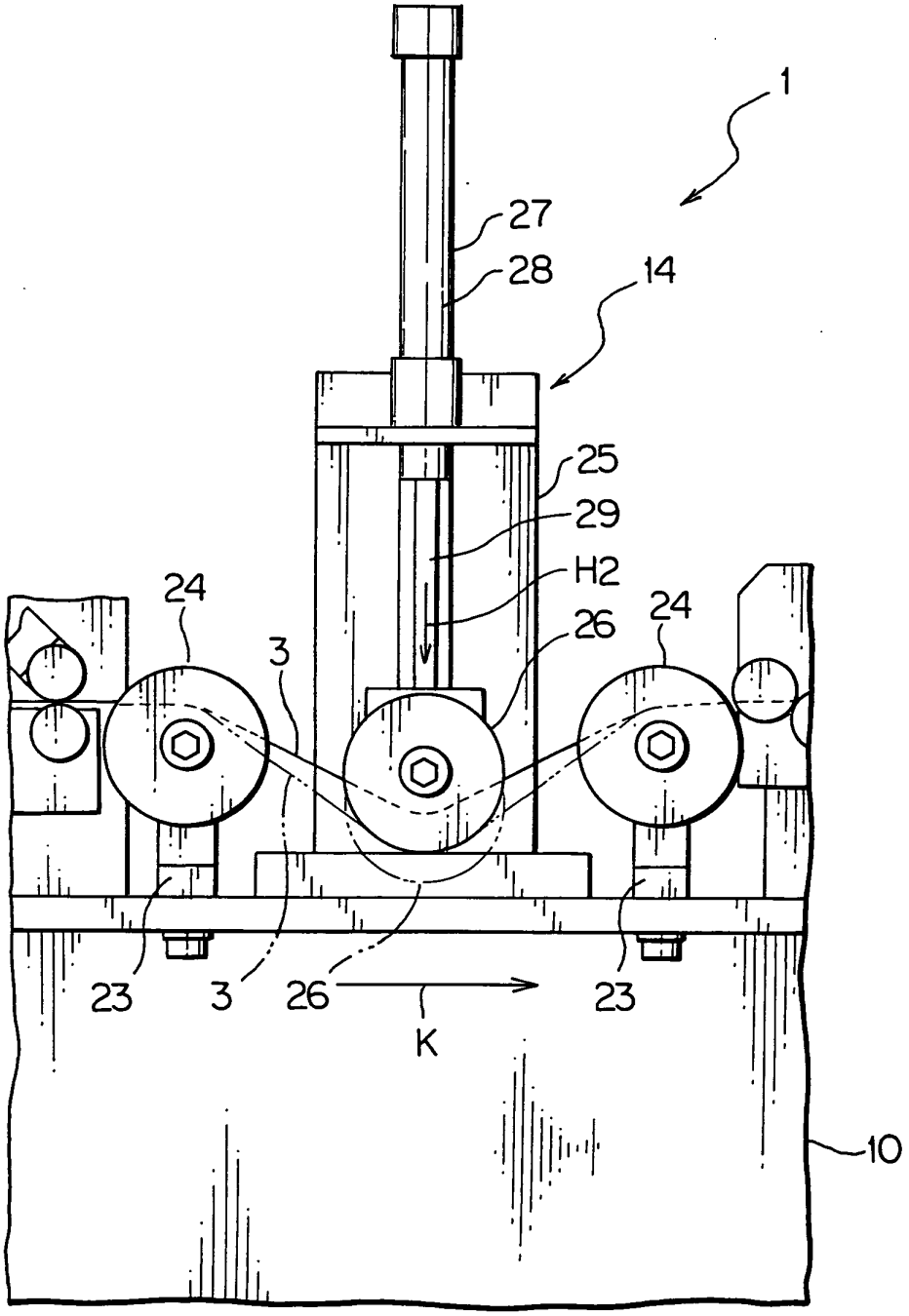


FIG. 2

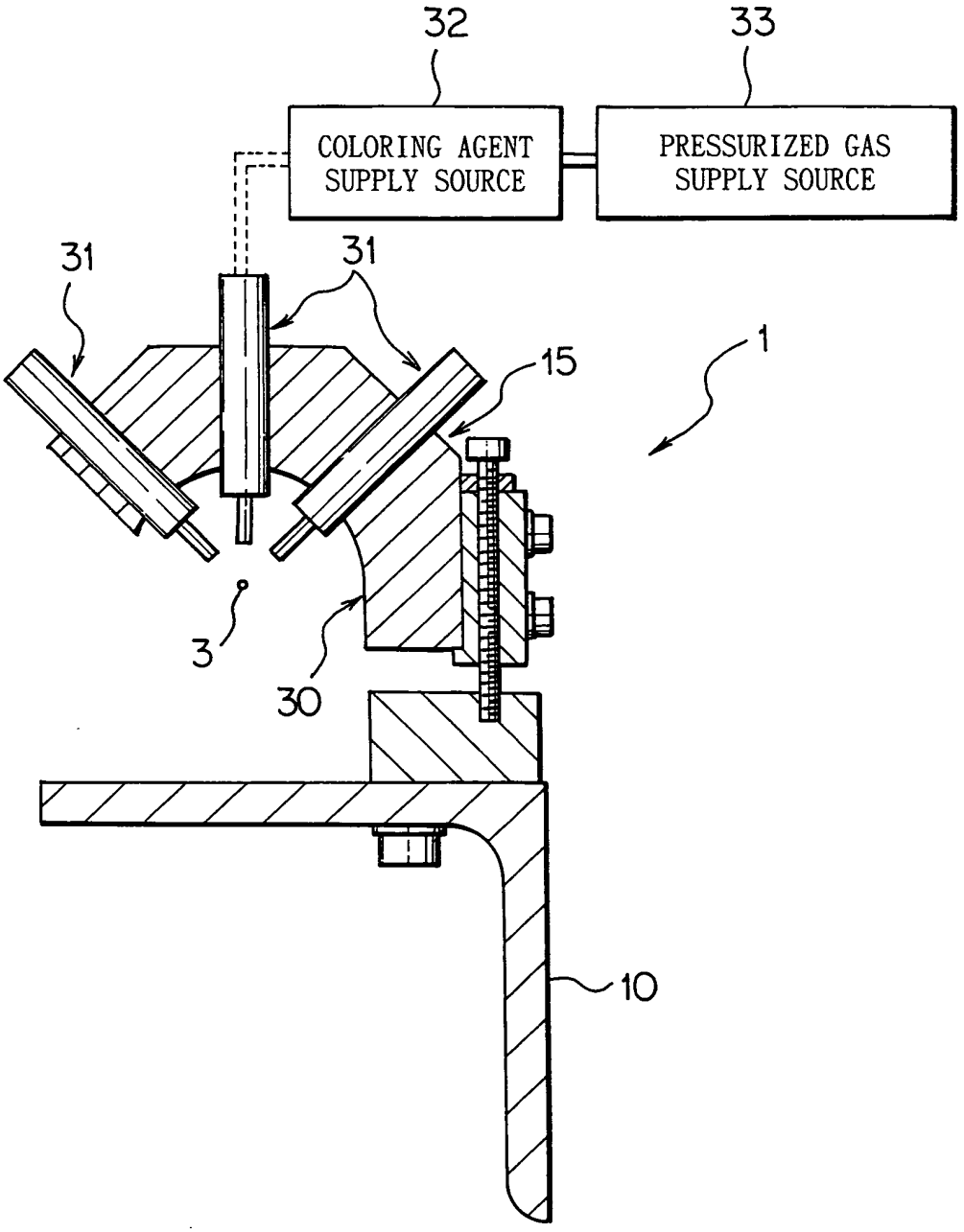

32
33
COLORING AGENT SUPPLY SOURCE
PRESSURIZED GAS SUPPLY SOURCE
31
31
15
1
3
30
10

FIG. 3

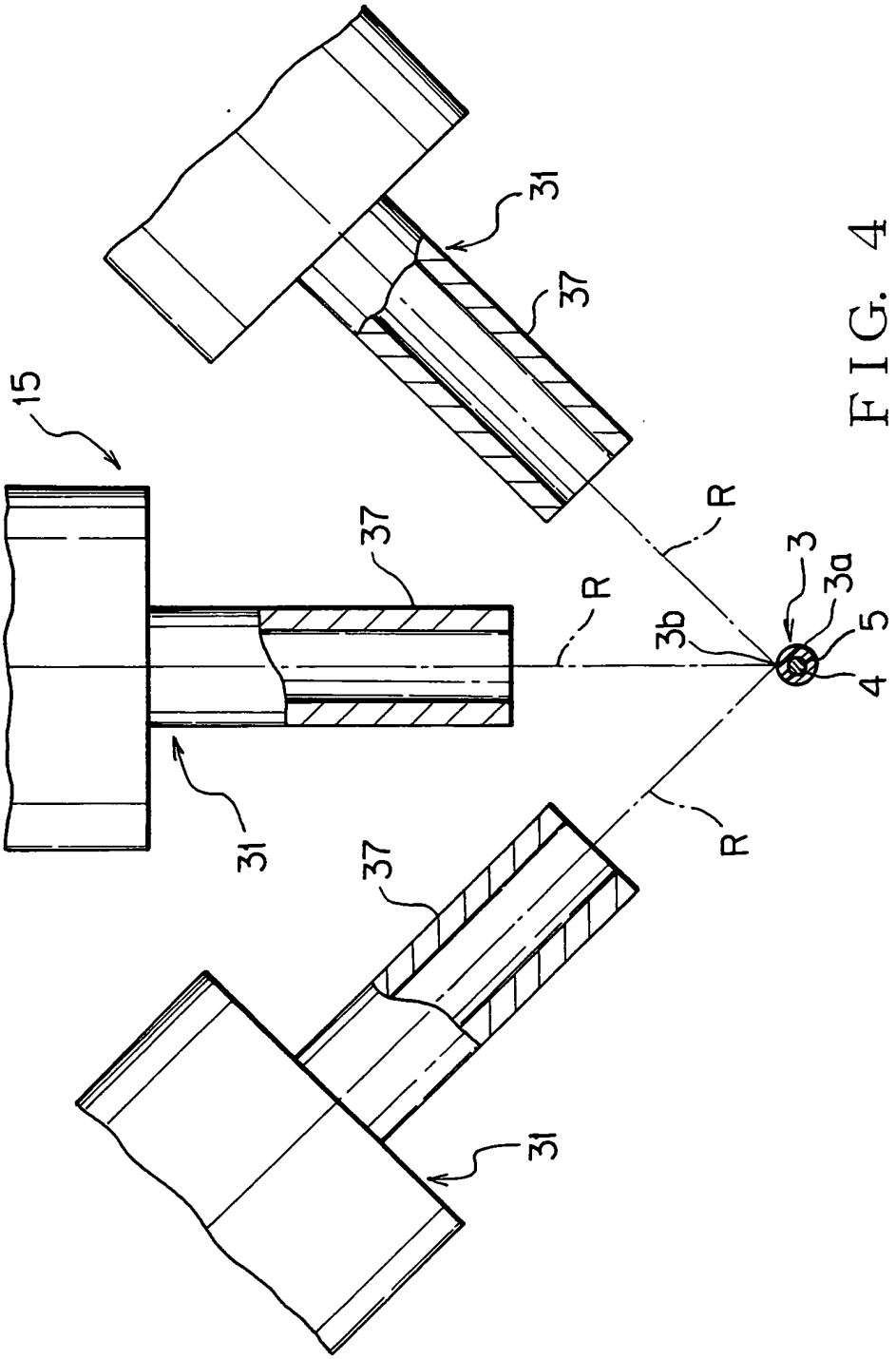
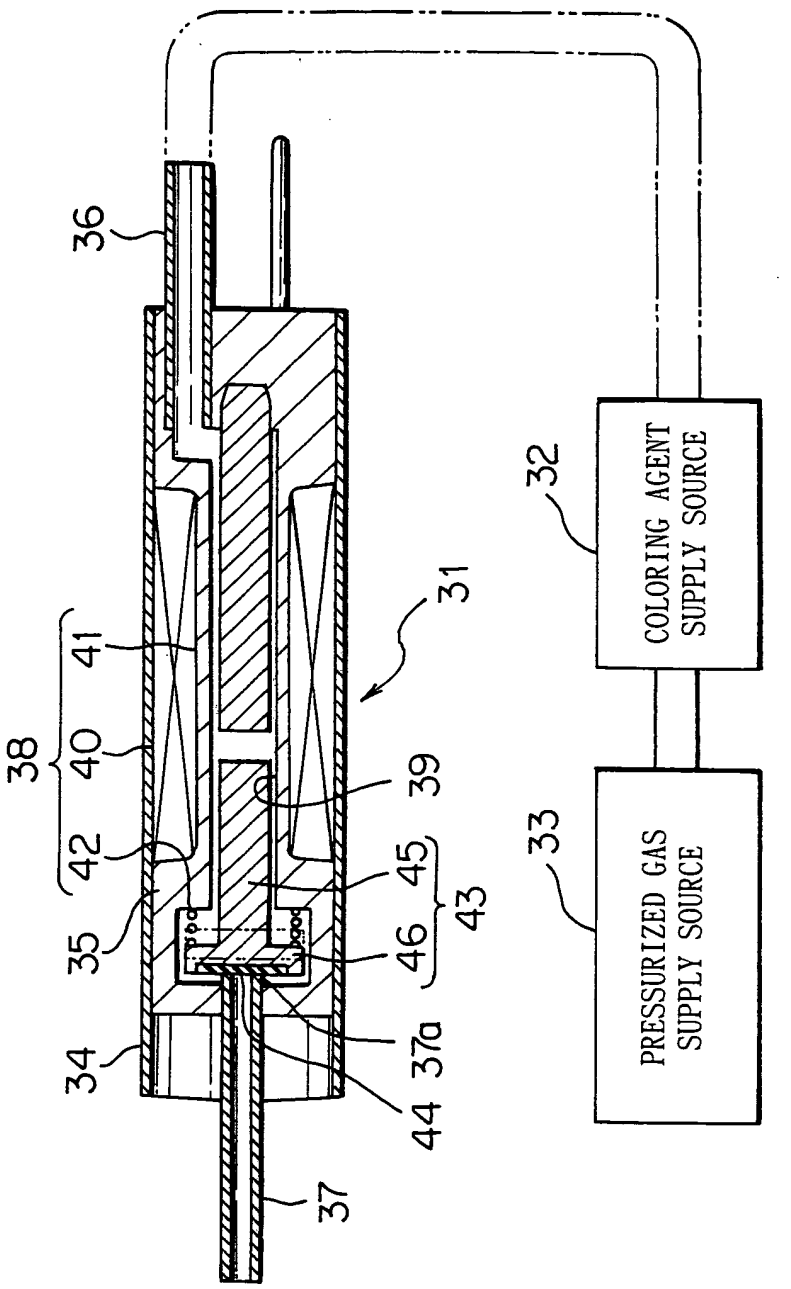


FIG. 4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46
43
31
32
COLORING AGENT SUPPLY SOURCE
33
PRESSURIZED GAS SUPPLY SOURCE

FIG. 5

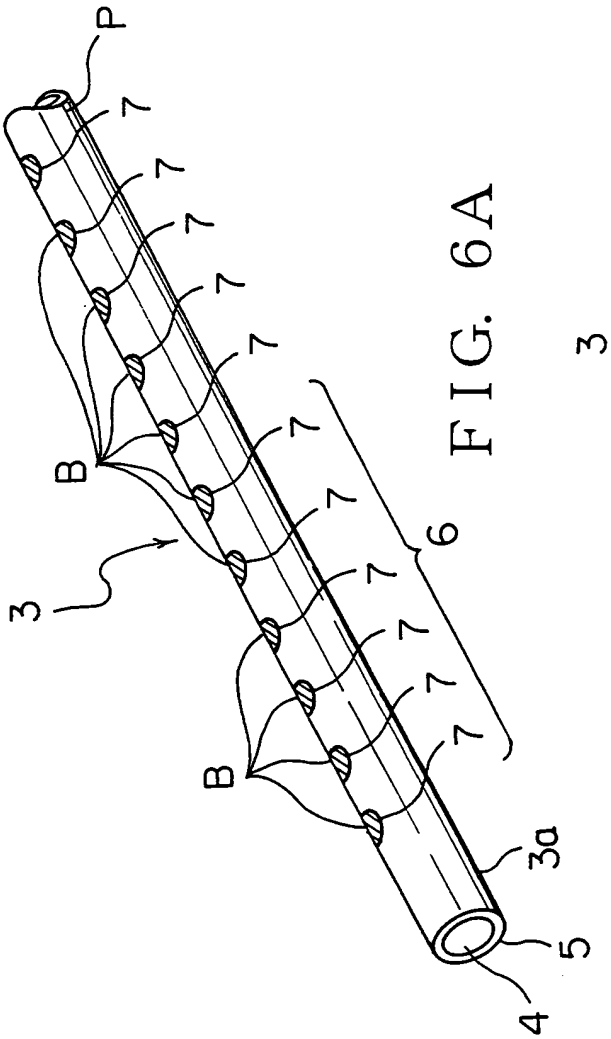

FIG. 6A

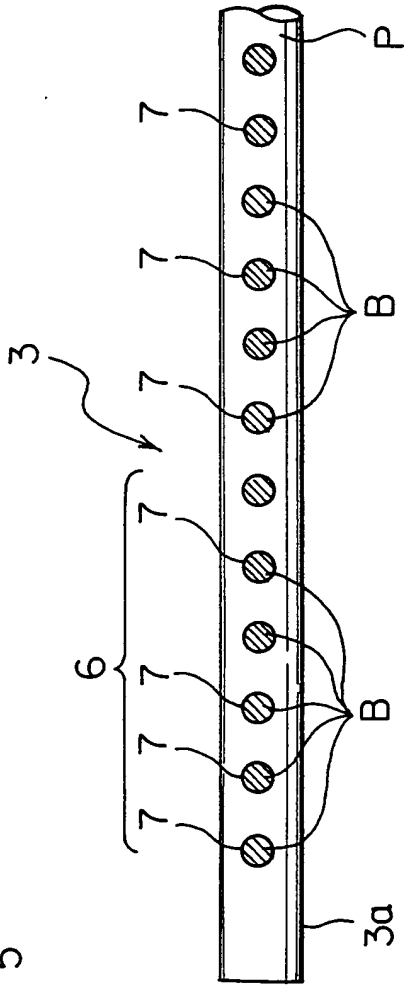

FIG. 6B

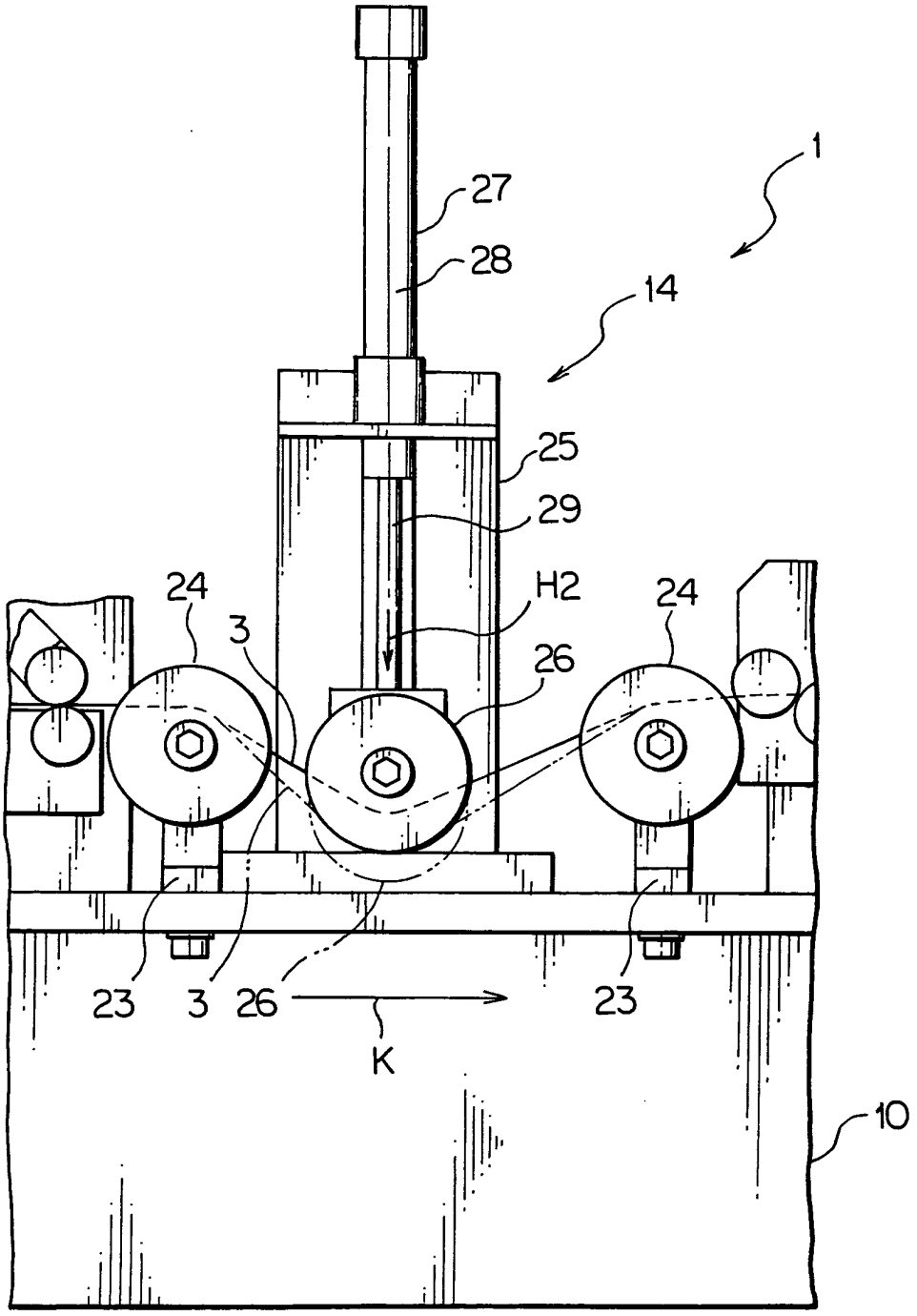

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/008628

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01B13/34

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)
Int.Cl[7] H01B13/00-13/34, B65H59/00-59/40

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

Jitsuyo Shinan Koho	1926-1996	Jitsuyo Shinan Toroku Koho	1996-2004
Kokai Jitsuyo Shinan Koho	1971-2004	Toroku Jitsuyo Shinan Koho	1994-2004

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.
Y	JP 10-31918 A (Sumitomo Wiring Systems, Ltd.), 03 February, 1998 (03.02.98), Claims 5, 6; Par. Nos. [0025], [0028]; Figs. 3, 5 (Family: none)	1-11
Y	JP 2001-229753 A (Kabushiki Kaisha Kyowa Ekushio), 24 August, 2001 (24.08.01), Claim 1; Par. No. [0013] (Family: none)	1-11
Y	JP 9-77373 A (Yazaki Corp.), 25 March, 1997 (25.03.97), Claim 1; Figs. 1 to 5 (Family: none)	7-11

☐ 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
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Date of the actual completion of the international search 07 September, 2004 (07.09.04)	Date of mailing of the international search report 28 September, 2004 (28.09.04)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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