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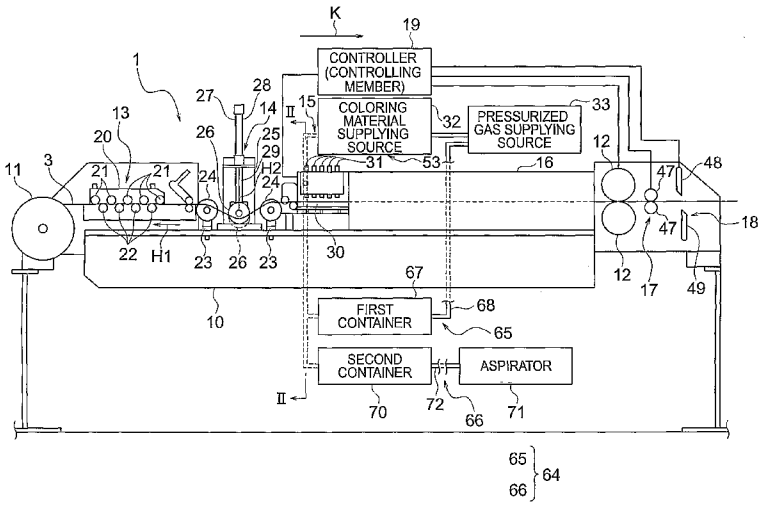

(57) Abstract: A coloring nozzle for coloring an electric wire includes an insert member for containing coloring material, a nozzle element 54 connected to the insert member, and the like. The nozzle element 54 includes a first nozzle member 37 disposed at the insert member side, a second nozzle member 50 disposed at the electric wire side, and a connecting pipe 51 for connecting the first nozzle member 37 and the second nozzle member 50. The second nozzle member 50 includes a second large diameter part 151 disposed near the first nozzle member 37, and of which inner diameter is smaller than that of the first nozzle member 37; a small diameter part 152 disposed nearer the electric wire than the second large diameter part 151, and of which inner diameter is smaller than that of the second large diameter part 151; and a first large diameter part 153 disposed nearer the electric wire than the small diameter part 152, and of which inner diameter is larger than the small diameter part 152. An inside of the second nozzle member 50 is formed in a step shape.

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DESCRIPTION

Coloring Nozzle

Technical field

This invention relates to a coloring nozzle used for coloring an object such as an electric wire having a conductive core wire and an insulating sheath for covering the core wire.

Back ground

Various electronic components are mounted on a vehicle. Therefore, a wiring harness is arranged in the vehicle for supplying electric power from a battery to the electronic components and supplying control signals from a computer to the electronic components. The wiring harness includes a plurality of electric wires and a connector attached to ends of the electric wires.

The electric wire includes a conductive core wire and a sheath made of insulating synthetic resin for covering the core wire. The electric wire is a so-called coated wire. The connector includes terminals and a connector housing for receiving the terminals. The terminals are made of conductive metallic plate, and connected to the ends of the electric wires and electrically connected to the core wires of the electric wires. The connector housing is made of insulating synthetic resin, and has a box shape. By connecting the connector housing to the electronic components to make the electric wires electrically connected to the electronic components via terminals, the wiring harness supplies the desired electric power or signals to the electronic components.

When assembling the wiring harness, firstly, the electric wires are cut in a specific length, the sheathes at the ends of the electric wires are removed, and then the terminals are attached to the ends of the electric wires. Then, if

necessary, the electric wires are connected to each other. Then, the terminals are inserted into the connector housing. Thus, the wiring harness is assembled.

A size of the core wire, material of the sheath (for example, heat resistance property) and a purpose of use of each electric wire in the wiring harness should be distinguished. The purpose of use is, for example, transmitting control signals of an air bag, ABS (Antilock Brake System), or a vehicle speed, or supplying electric power.

Conventionally, in the electric wire used for the wiring harness, before the sheath is made by extruding synthetic resin onto the core wire, coloring material having a desired color is mixed with the synthetic resin, so that the sheath has the desired color (see Patent Document 1 to 3). In this case, it is necessary to stop an extrusion machine for extruding to make the sheath before changing an outer surface of the electric wire. In this case, every time when changing the color of the electric wire, the extrusion machine should be stopped. Therefore, time and labor for producing the electric wire is increased, and productivity is decreased.

Alternatively, while the extrusion machine extruding the sheath, the coloring material to be mixed with the synthetic resin is changed. In this case, just after changing the color of the coloring material, the color of the synthetic resin is a mixture of the color before change and the color after change. Thus, a material yield of the electric wire is decreased.

For preventing a reduction of the productivity of the electric wire and a reduction of the material yield of the electric wire, an applicant of the present invention suggests that after producing mono color electric wires, outer surfaces of the electric wires are colored in desired colors, and then the wiring harness is

assembled (see Patent Document 4). The applicant further suggests an electric wire coloring apparatus in which when the mono color electric wire is colored, a specific amount of liquid coloring material is jetted to the outer surface of the electric wire to color the electric wire in a desired color by attaching a drop of the coloring material to the outer surface of the electric wire (see Patent Document 5). Figs. 9 and 10 are sectional views showing a main part of a coloring nozzle of the coloring apparatus.

As shown in Figs. 9 and 10, a coloring nozzle 254 is formed in a cylinder shape, and includes: a first nozzle member 237 to pouring the coloring material into an inner flow path 237A; a second nozzle member 250 disposed nearer the electric wire than the first nozzle member 237; and a connecting pipe to connect the first and the second nozzle member 237, 250. An inner diameter (about 100 micrometer) of a flow path 250A of the second nozzle member 250 is smaller than that of the flow path 237A of the first nozzle member 237. Further, a length of the coloring nozzle 254 in a longitudinal direction thereof is about 0.5 millimeter. Thus, when the coloring material is moved from the flow path 237A to the flow path 250A, a flow speed of the coloring material is increased. Therefore, a jetting amount of the coloring material is adjustable, and a sharpness of the jetted drop of the coloring material is increased.

Patent Document 1 Japanese published patent application No. Hei5-111947

Patent Document 2 Japanese published patent application No. Hei6-119833

Patent Document 3 Japanese published patent application No. Hei9-92056

Patent Document 4 International publication No. WO03/019580

Patent Document 5 Japanese patent application No. 2005-019081

Disclosure of the invention

Problem to be solved by the invention

However, conventional coloring nozzle 254 of the coloring apparatus has a following problem. As described the above, the coloring nozzle 254 is so formed that the flow speed is increased when the coloring material is moved from the flow path 237A to the flow path 250A. When the coloring apparatus stops jetting, namely, when a valve for sending the coloring material to the first nozzle member 237, the coloring material having an increased speed goes out of the coloring nozzle 254 owing to inertia (see Fig. 9), and a bubble flows into an inside of the flow paths 237A, 250A of the coloring nozzle 254 (see Fig. 10).

Owing to the bubble inside the flow paths 237A, 250A, even when the coloring apparatus has no signal to jet, the coloring material drips from the coloring nozzle 254. Further, owing to the bubble, the coloring material inside the coloring nozzle 254 is dried and solidified to block the coloring nozzle 254. Further, the coloring material dripped from the coloring nozzle 254 is attached to a top end surface 250b near the electric wire to make a jetting direction of the coloring material unstable.

Accordingly, an object of the present invention is to provide a coloring nozzle to prevent dripping of the coloring material, blocking the coloring nozzle, and making a jetting direction unstable by preventing a bubble flowing into an inside of a flow path of the coloring nozzle when a coloring apparatus stops jetting the coloring material.

Means for solving problem

For attaining the object, according to claim 1, there is provided a coloring nozzle through which a specific amount of liquid coloring material is jetted to an outer surface of an object to color the object by attaching the drop of the coloring material to the outer surface of the object, said coloring nozzle comprising:

a container for containing the coloring material;

a first nozzle member formed in a cylindrical shape and inside of which the coloring material flows, said first nozzle member communicating with the container; and

a second nozzle member formed in a cylindrical shape and inside of which the coloring material flows, said second nozzle member disposed nearer the object than the first nozzle member and connected to the first nozzle member,

wherein the second nozzle member includes a small diameter part of which inner diameter is smaller than that of the first nozzle member, and a first large diameter part disposed nearer the object than the small diameter part, and of which inner diameter is larger than that of the small diameter part.

According to claim 2, there is provided the coloring nozzle as claimed in claim 1, wherein the second nozzle member is disposed nearer the first nozzle member than the small diameter part, and further includes a second large diameter part of which inner diameter is larger than that of the small diameter part, and smaller than that of the first nozzle member.

Incidentally, in this specification, the coloring material means a liquid substance, in which a coloring agent (organic substance for use in industry) is dissolved and dispersed in water or other solvent. The organic substance 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 a more concrete example, the coloring material in this specification is a coloring liquid and 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 coloring liquid is deposited on the outer surface of the object, the dye permeates into the object. When the coating material is deposited on the outer surface of the object, the pigment is deposited on the outer surface without permeating into the object. That is, "to color the outer surface of the object" means to dye a part of the outer surface of the object with a dye or to coat a part of the outer surface of the object with a pigment.

Preferably, the solvent and liquid dispersion have an affinity to the synthetic resin that constitutes the object in order to securely permeate the dye into the object or to allow the pigment to securely be deposited on the outer surface of the object.

Effect of the invention

According to the present invention as claimed in claim 1, when the coloring material is jetted, a speed of the coloring material is increased by moving the coloring material from the first nozzle member to the small diameter part of the second nozzle member, and the coloring material is jetted from an end wall of the small diameter part near the object. Therefore, a jetting amount of the coloring material is adjustable, and a sharpness of the jetted drop of the coloring material is increased. Further, when stopping jetting the coloring material, the increased speed coloring material in the small diameter part is moved to the first large diameter part of the second nozzle member owing to

inertia. When the coloring material is moved from the small diameter part to the first diameter part, the speed of the coloring material is reduced, so that the coloring material is not jetted out of the coloring nozzle, and the coloring material is stopped so that a liquid surface of the coloring material disposed on the same surface of the end wall of the first large diameter part near the object. Then, the atmospheric pressure turns the coloring material back to the inside of the coloring nozzle, and the liquid surface of the coloring material is disposed at the same surface of the end wall of the small diameter part near the object. Therefore, a bubble is prevented from flowing into a flow path of the coloring nozzle, and resultingly, there can be provided a coloring nozzle to prevent dripping of the coloring material, blocking the coloring nozzle, and making a jetting direction unstable. Further, because the nozzle blocking is prevented, conventional preliminary jetting of the coloring material before starting jetting is unnecessary, so that usage of the coloring material can be reduced.

According to claim 2 of the present invention, because the second large diameter part is interposed between the first nozzle member and the small diameter part of the second nozzle member, inner diameters are gradually reduced from the first nozzle member to the small diameter part. Therefore, the flow speed of the coloring material through these flow paths can be finely adjustable.

Brief description of drawings

Fig. 1 a side view showing a structure of an electric wire coloring apparatus having a coloring nozzle according to an embodiment of the present invention.

Fig. 2 a sectional view of the coloring unit of the electric wire coloring

apparatus taken on line II-II of Fig. 1.

Fig. 3 an explanatory view showing a positional relationship between a coloring nozzle of the coloring unit shown in Fig. 2 and the electric wire.

Fig. 4 a sectional view showing a structure of a nozzle unit of the coloring nozzle of the coloring unit shown in Fig. 2.

Fig. 5 (a) a perspective view showing the electric wire colored by the electric wire coloring apparatus shown in Fig. 1. (b) a plan view of the electric wire shown in Fig. 5(a)

Fig. 6 an enlarged sectional view showing a main part of the coloring nozzle shown in Fig. 4.

Fig. 7 a sectional view showing coloring material when the coloring nozzle shown in Fig. 6 stops jetting the coloring material.

Fig. 8 a sectional view showing the coloring material pressed back into the coloring nozzle from a state shown in Fig. 7 when the coloring nozzle still stops jetting.

Fig. 9 a sectional view showing the coloring material when a conventional coloring nozzle stops jetting the coloring material.

Fig. 10 a sectional view showing a bubble flowing into a flow path of the conventional coloring nozzle shown in Fig. 9.

Explanations of letters or numerals

3 electric wire (object)

3a outer surface of the electric wire

31 coloring nozzle

35 insert member (container)

37 first nozzle member

50 second nozzle member

151 second large diameter part

152 small diameter part

153 first large diameter part

Best mode for carrying out the invention

A coloring nozzle 31 according to an embodiment of the present invention will be explained with reference to Figs. 1 to 8. The coloring nozzle 31 shown in Figs. 3 and 4 is mounted on an electric wire coloring apparatus 1 shown in Fig. 1 configured to color an electric wire 3 as an object. The coloring apparatus 1 cuts the electric wire 3 in a specific length, and forms a mark 6 on a part of an outer surface 3a of the electric wire 3. Namely, the coloring apparatus 1 colors, namely, marks the outer surface 3a of the electric wire 3 as the object.

The electric wire 3 as the object composes a wiring harness configured to be arranged in a vehicle as a moving body. As shown in Fig. 5(a), the electric wire 3 includes a conductive core wire 4 and an insulating sheath 5. The core wire 4 is formed by twisting a plurality of elemental wires. The elemental wire is made of conductive metal. The core wire 4 may be composed of a single elemental wire. The sheath 5 is made of synthetic resin such as polyvinylchloride (PVC). The sheath 5 covers the core wire 4. Therefore, the outer surface 3a of the electric wire 3 is a outer surface of the sheath 5.

The sheath 5 is a monochrome color P. A desired coloring material may be mixed with the synthetic resin of the sheath 5 so as to make the color of the outer surface 3a of the electric wire 3 be the monochrome color P, or alternatively, the monochrome color P may be set as the color of the synthetic resin itself without adding coloring material to the synthetic resin of the sheath

5. In the latter case, the outer surface 3a of the electric wire 3 is not colored, namely, the sheath 5 is not colored. The outer surface 3a of the electric wire 3 may be not colored, or have a monochrome color such as white.

A mark 6 composed of a plurality of spots 7 is formed on the outer surface 3a of the electric wire 3. The spot 7 has a color B (indicated with parallel oblique lines in Fig. 5), which is different from the monochrome color P. The spot 7 is round in the plan view as shown in Fig. 5. A plurality of the spots 7 are arranged in the longitudinal direction of the electric wire 3 according to a predetermined pattern. The distance between the centers of the spots 7 situated adjacently to each other is predetermined.

A plurality of wires 3 are bundled, and connectors are attached to respective ends of the wires 3, thereby constructing the wiring harness. The connectors are coupled with respective mating connectors of various electronic components in a vehicle and the like, thereby the wires 3 of the wiring harness transmit various signals and electric power to the electronic components.

The wires 3 are distinguishable from one another by changing the color B of each spot 7 of the mark 6. In the figure, as an example, the color B of all of the spots 7 of the electric wire 3 is set the same, however, the color B may be changed for the respective spots 7 as required. The color B is used to distinguish types of the wires 3 in the wiring harness or systems. That is, the color B is used to distinguish the types of the wires 3 in the wiring harness or the purposes of use.

As shown in Fig. 1, the coloring apparatus 1 includes a frame 10, a guide roll 11, a pair of delivery rolls 12, a straightening unit 13, a slack absorbing unit 14, a coloring unit 15, a duct 16, an encoder 17, a cutting machine 18, and a

controller 19.

The frame 10 is installed on a floor of such as a factory, and extends horizontally. The guide roll 11 is mounted rotatably on an end of the frame 10. The continuous wire 3 having no mark 6 is wound on to the guide roll 11. The guide roll 11 transfers the electric wire 3 to the straightening unit 13, the slack absorbing unit 14, the coloring unit 15, the duct 16, the encoder 17, and the cutting machine 18 in sequence.

The pair of delivery rolls 12 is mounted on the other end of the frame 10. The pair of delivery rolls 12 is rotatably supported by the frame 10, and arranged vertically. The delivery rolls 12 are rotated the same number of revolutions in a direction opposite to each other by such as a motor (not shown). The pair of delivery rolls 12 catches the electric wire 3, and pulls the electric wire 3 from the guide roll 11 in a longitudinal direction of the electric wire 3.

The delivery rolls 12 transfers the electric wire 3 in the longitudinal direction of the electric wire 3 to move the wire relatively to a later-described nozzle for coloring 31 of the coloring unit 15 in the longitudinal direction. Therefore, the electric wire 3 is transferred along an arrow K in Fig. 1 from the guide roll 11 to the delivery rolls 12. The arrow K indicates a transferring direction of the electric wire 3.

The straightening unit 13 is disposed downstream of the guide roll 11 and upstream of the delivery rolls 12 in the transferring direction K of the electric wire 3. The straightening unit 13 includes a plate-shaped unit body 20 fixed to the flame 10, a plurality of first rollers 21, and a plurality of second rollers 22.

The first and second rollers 21, 22 are supported rotatably by the unit

body 20, respectively. A plurality of the first rollers 21 are arranged horizontally (in the transferring direction K), over the electric wire 3. A plurality of the second roller 22 are arranged horizontally (in the transferring direction K), under the electric wire 3. As shown in Fig. 1, the first and second rollers 21, 22 are arranged in a staggered fashion.

The straightening unit 13 puts the electric wire 3, being transferred by the delivery rolls 12 from the guide roll 11, between the first and second rollers 21, 22 and makes the electric wire 3 straight. Further, the straightening unit 13 gives friction to the electric wire 3 by putting the electric wire 3 between the first and second rollers 21, 22. Namely, the straightening unit 13 gives to the electric wire 3 first energizing force H1 in a direction opposite to the pulling force applied from the delivery rolls 12 to the electric wire 3 (the transferring direction K). The first energizing force H1 is smaller than the pulling force applied from the delivery rolls 12 to the electric wire 3. Therefore, the straightening unit 13 tenses the electric wire 3 in the longitudinal direction of the electric wire 3.

The slack absorbing unit 14 is disposed downstream of the straightening unit 13 and upstream of the delivery rolls 12 in the transferring direction K of the electric wire 3. The slack absorbing unit 14 is arranged between the straightening unit 13 and the later-described coloring nozzle 31 of the coloring unit 15.

As shown in Fig. 1, the slack absorbing unit 14 includes: a pair of supporting frames 23 for supporting the pair of guiding rollers 24 fixed on the frame 10 and arranged with gaps along the transferring direction K of the electric wire 3;

a pair of guiding rollers 24 rotatably supported by the supporting frames 23; a supporting frame 25 for supporting the movable roller 26 fixed to the frame 10 and interposed between the pair of supporting frames 23; and a movable roller 26 interposed between the guiding rollers 24.

The guiding rollers 24 are disposed under the electric wire 3, and guide the electric wire 3 so as not to make the electric wire 3 swerve from the transferring direction K by outer peripheral walls of the guiding rollers 24 contacting the electric wire 3. Thus, the guiding rollers 24 guide the electric wire 3 in the transferring direction K.

The movable roller 26 is supported rotatably by the supporting frame 25 for the movable roller 26 and movably in a vertical direction along the supporting frame 25. The movable roller 26 is disposed over the electric wire 3. The movable roller 26 is supported movably in the vertical direction, namely, supported movably in a direction orthogonal to the transferring direction K of the electric wire 3.

The air cylinder 27 includes: a cylinder body 28 fixed on the supporting frame 25 for the movable roller 26, and disposed over the electric wire 3; and an extendable rod 29 being extendable from the cylinder body 28. The extendable rod 29 is expandable from the cylinder body 28 toward the electric wire 3. The movable roller 26 is attached to the extendable rod 29. By supplying a compressed gas to an interior of the cylinder body 28, the air cylinder 27 energizes the extendable rod 29, namely, the movable roller 26 with second energizing force H2 (shown in Fig. 1) downward in a direction orthogonal to the transferring direction K. The second energizing force H2 is smaller than the first energizing force H1.

When the delivery rolls 12 temporally stops transferring the electric wire 3 for cutting the electric wire 3 by a pair of later-described cutting blades 48, 49 of the cutting machine 18 approaching each other, the electric wire 3 still transfers along the arrow K by an inertia force, so that the electric wire 3 slacks in between the pair of guiding rollers 24. In this moment, since the air cylinder 27 is energizing the movable roller 26 with the second energizing force H2 in the slack absorbing unit 14 having above-described constitution, the extendable rod 29 of the air cylinder 27 extends to move the movable roller 26, for example, to a position shown as a two-dot chain line in Fig. 1. Then, the slack absorbing unit 14 energizes the electric wire 3 slacking in between the pair of guiding rollers 24 as described above in the direction orthogonal to the transferring direction K and absorbs the slack to keep the electric wire 3 under tension.

The coloring unit 15 is disposed downstream of the slack absorbing unit 14 and upstream of the delivery rolls 12 in the transferring direction K of the electric wire 3. Therefore, the coloring unit 15, namely, the later-described coloring nozzle 31 is disposed between the pair of delivery rolls 12 and the straightening unit 13.

As shown in Fig. 2, the coloring unit 15 includes a unit body 30 fixed to the frame 10, and a plurality of coloring nozzle 31 supported by the unit body 30. The coloring nozzle 31 having the constitution described above jets a specific amount of the liquid coloring material supplied from the coloring material source 32 toward the outer surface 3a of the electric wire 3 so as to color (or mark) at least a part of the outer surface 3a of the electric wire 3. A detailed constitution of this coloring nozzle 31 will be explained later.

The nozzles for coloring 31 are arranged in the transferring direction K

of the electric wire 3. As shown in Fig. 1, five nozzles for coloring 31 of the unit body 30 are arranged in the transferring direction K of the electric wire 3. As shown in Fig. 3, each coloring nozzle 31 is held by the unit body 30 on a condition that the most upper part 3b of the electric wire 3 is situated on an extension of an axis R (shown with an alternate long and short dash line in Fig. 3) of later-described first nozzle members 37. Each coloring nozzle 31 jets the coloring material along the axis R. That is, each coloring nozzle 31 jets a specific amount of the coloring material onto the most upper part 3b of the electric wire 3.

In this description, the coloring material of which consistency is equal to or lower than 10 millipascal second (mPa*s) is used. The coloring material 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 a more concrete example, the coloring material is 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 coloring liquid is deposited on the outer surface 3a of the electric wire 3, the dye permeates into the coating 5. When the coating material is deposited on the outer surface 3a of the electric wire 3, the pigment is deposited on the outer surface 3a without permeating into the coating 5. Thus, "to color the outer surface 3a of the electric wire 3" means to dye a part of the outer surface 3a of the electric wire 3 with a dye or to coat a part of the outer surface 3a of the

electric wire 3 with a pigment. 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 be deposited on the outer surface 3a. The "jetting" described above means that the liquid coloring material in a state of the liquid drop is ejected vigorously from the coloring nozzle 31 toward the outer surface 3a of the electric wire 3.

The duct 16 is disposed downstream of the coloring unit 15 and upstream of the delivery rolls 12 in the transferring direction K of the electric wire 3. The duct 16 has a cylinder shape, and the electric wire 3 is passed through the duct 16. A not-shown aspirating member such as a vacuum pump is connected to the duct 16. The aspirating member aspirates a gas in the duct 16 to prevent the solvent or the liquid dispersion of the coloring material from filling the outside of the coloring apparatus 1.

The encoder 17 is disposed downstream of the delivery rolls 12 in the transferring direction K of the electric wire 3. As shown in Fig. 1, the encoder 17 includes a pair of rotors 47. The rotors 47 are supported rotatably around axes of the rotors 47. Outer circumferential surfaces of the rotors 47 contact the outer surface 3a of the electric wire 3, which is held between the pair of delivery rolls 12. When the core wire 4, namely, the electric wire 3 is forwarded along the arrow K, the rotors 47 are rotated. The transferred length of the electric wire 3 along the arrow K is proportional to the number of revolutions of the rotors 47.

The encoder 17 is connected to the controller 19. When the rotors 47 rotate by a specific angle, the encoder 17 outputs a pulse signal to the controller 19. That is, the encoder 17 measures data corresponding to the transferred length of the electric wire 3 along the arrow K and outputs the data to the

controller 19. Thus, the encoder 17 measures data corresponding to the transferred length of the electric wire 3 and outputs the data corresponding to the transferred length of the electric wire 3 to the controller 19. Normally, the encoder 17 outputs the pulse signal corresponding to the transferred length of the electric wire 3 with the aid of the friction between the electric wire 3 and the rotor 47. However, when the transferred length of the electric wire 3 does not coincide with the number of the pulse due to a condition of the outer surface 3a of the electric wire 3, the speed data of the movement of the electric wire 3 may be obtained from another way for feedback or carry out a comparative operation.

The cutting machine 18 is disposed downstream of the pair of rotors 47 of the encoder 17 in the transferring direction K of the electric wire 3. The cutting machine 18 includes the pair of cutting blades 48, 49. The pair of cutting blades 48, 49 is arranged in a vertical direction. The pair of cutting blades 48, 49 is attached to and detached from each other at the same time vertically. When approaching each other, the pair of cutting blades 48, 49 catches and cuts the electric wire 3 transferred by the delivery rolls 12 in between the cutting blades 48, 49. Then, the pair of cutting blades 48, 49 detaches from each other and detaches from the electric wire 3.

The controller 19 is a computer that includes a well-known ROM, a ROM, a CPU and the like. The controller 19 is connected to the delivery rolls 12, the encoder 17, the cutting machine 18, the nozzles for coloring 31, and the like, namely, the coloring unit 15. By controlling them, the controller 19 controls the whole coloring apparatus 1.

The controller 19 stores a predetermined pattern of the mark 6. When

specific pulse signals, namely, data corresponding to the transferred length of the electric wire 3 is inputted from the encoder 17, the controller 19 applies voltage to the coil 40 of a predetermined coloring nozzle 31 for a predetermined time interval to make the coloring nozzle 31 spout a specific amount of the coloring material onto the electric wire 3. According to the stored predetermined pattern of the mark 6, the controller 19 makes the intervals for spouting shorter when the transfer speed of the electric wire 3 becomes faster, and the intervals longer when the transfer speed of the electric wire 3 becomes slower. Thus, the controller 19 colors the electric wire 3 according to the stored predetermined pattern. Further, when the controller 19 judges that the electric wire 3 has moved a predetermined length based on the data from the encoder 17, the controller 19 stops the delivery roll 12 and makes the pair of the cutting blades 48, 49 approach each other and cuts the electric wire 3. Further, the controller 19 controls a later-described cleaning part 64 of the coloring nozzle 31 which does not color the outer surface 3a of the electric wire 3 among the coloring nozzles 31 so as to make the cleaning part 64 clean a nozzle element 54 of the coloring nozzle 31 within every specific time interval.

Next, the coloring nozzle 31 will be explained in detail. As shown in Figs. 1 and 3, the coloring nozzle 31 includes a nozzle unit 52, a coloring material supplying unit 53, and the cleaning part 64. As shown in Fig. 4, the nozzle unit 52 includes a cylindrical nozzle body 34, an insert member 35 received by the nozzle body 34, an inlet pipe 36, a nozzle element 54, a valve mechanism 38 and a nozzle cover 55.

The insert member 35 is formed in a cylindrical shape. A flow pass 39 through which the coloring material is passed is formed in the insert member

35. The flow pass 39 is filled with the coloring material supplied from a later-described coloring material source 32. The insert member 35 is a receiver for receiving the liquid coloring material described in this description. The inlet pipe 36 communicates with the flow pass 39, and leads the coloring material from the coloring material source 32 to an inside of the flow pass 39.

As shown in Fig. 6, the nozzle element 54 includes the first nozzle member 37, a second nozzle member 50, and a connecting pipe 51. The first nozzle member 37 is formed in a cylindrical shape and communicates with the flow pass 39. The first nozzle member 37 leads the coloring material in the flow pass 39 to an outside of the coloring nozzle 31. An inner diameter of the first nozzle member 37 is smaller than an inner diameter of the nozzle body 34, namely, an outer diameter of the flow pass 39. The first nozzle member 37 is coaxial to the nozzle body 34. The first nozzle member 37 is made of stainless steel.

The second nozzle member 50 is nearer to the electric wire 3 than the first nozzle member 37, and formed in a cylinder-like shape. The second nozzle member 50 is made of Polyetheretherketone (hereafter referred to as "PEEK). An outer diameter of the second nozzle member 50 is equal to that of the first nozzle member 37. Thus, the nozzle element 54 is formed in a tubular shape, inside of which the coloring material flows through, and communicates with the insert member 35.

Further, the second nozzle member 50 is composed of: a second large diameter part 151, of which inner diameter is smaller than the first nozzle member 37; a small diameter part 152 disposed nearer the electric wire 3 than the second large diameter part 151, and of which inner diameter is smaller than

the second large diameter part 151; and a first large diameter part 153 disposed nearer the electric wire 3 than the small diameter part 152, and of which inner diameter is larger than the small diameter part 152. As shown in Fig. 6, an inner wall of the second nozzle member 50 is formed in a step shape. Therefore, an end wall 50a of the second nozzle member 50 near the first nozzle member 37 is projected toward an inside of the first nozzle member 37 from an inner wall of the first nozzle member 37. Further, in this embodiment, an inner diameter of the small diameter part 152 is 90 micrometer, and inner diameters of the second large diameter part 151 and the first large diameter part 153 are 125 micrometer. Further, lengths of the small diameter part 152, the second large diameter part 151, and the first large diameter part 153 in a longitudinal direction of the nozzle element 54 are 0.5 millimeter. The second nozzle member 50 is coaxial to, and connected to the first nozzle member 37.

A watertight seal exists between the first nozzle member 37 and the second nozzle 50. The coloring material flows through the first nozzle member 37 and the second nozzle member 50 in a longitudinal direction of the first nozzle member 37 indicated by an arrow Q. Namely, the small diameter part 152, the second large diameter part 151, and the first large diameter part 153 compose a flow pass of the second nozzle member 50. The arrow Q shows a flowing direction of the coloring material.

The connecting pipe 51 is formed in a cylindrical shape, and made of synthetic resin. An inner diameter of the connecting pipe 51 is substantially equal to those of the first nozzle member 37 and the second nozzle 50. The connecting pipe 51 is fitted with both outer walls of the first nozzle member 37 and the second nozzle 50, and connects the first nozzle member 37 and the

second nozzle 50. Further, the connecting pipe 51 makes the second nozzle member 50 detachable from the first nozzle member 37.

The valve mechanism 38 includes the coil 40, the valve body 41 and the coil spring 42. The coil 40 is formed outside the flow pass 39 and embedded inside the insert member 35. An electric current is applied to the coil 40 from an outside. The valve body 41 includes an electrically conductive main body 43 and a valve 44. The main body 43 integrally includes a cylinder 45 and a disc 46 continuing to an end of the cylinder 45.

The disc 46 of the main body 43 faces the base end 37a of the first nozzle member 37. The main body 43 is received in the flow pass 39 in a state that the longitudinal direction of the cylinder 45 is parallel to that of the nozzle body 34. The main body 43, namely, the valve body 41 is formed movably in the longitudinal direction of the cylinder 45, namely, the longitudinal direction of the nozzle body 34.

The valve 44 is attached to the disc 46 of the main body 43. That is, the valve 44 is received in the insert member 35. The valve element 44 faces the base end 37a of the first nozzle member 37. Because the valve 44 is attached to the disc 46 of the main body 43, the valve 44 is allowed to be attached to or detached from the base end 37a of the first nozzle member 37.

Thus, the valve element 44 is attached to or detached from the base end 37a between the opening position shown as a two-dot chain line in Fig. 4 and the closing position shown as a solid line in Fig. 4. At the opening position, the valve 44 is detached from the base end 37a, so that the coloring material may flow through the nozzle member 37 and the second nozzle member 50 so as to be jetted toward the outer surface 3a of the electric wire 3. At the closing

position, the valve 44 is attached to the base end 37a, so that the coloring material may not flow through the nozzle member 37 to be jetted toward the outer surface 3a of the electric wire 3. Thus, the valve 44 is attached to and detached from the base end 37a to control the jetting of the coloring material from the nozzle element 54.

The coil spring 42 energizes the disc 46 in such a direction that the valve 44 is attached to the base end 37a of the first nozzle member 37.

The nozzle cover 55 includes: a cover body 56, of which an outer diameter is constant in an axial direction thereof, and an inner diameter changes in steps; and a nozzle fixing member 57. The cover body 56 is attached to the unit body 30. The cover body 56 receives the nozzle unit 52 in a manner that the nozzle body 34 of the nozzle unit 52 is mounted on a step 59, the inlet pipe 36 of the nozzle unit 52 is positioned upward, and the nozzle members 37, 50 are positioned downward.

In the cover body 56, a packing 60 is mounted between the step 59 and the nozzle body 34 of the nozzle unit 52 for keeping them watertight. A space 61 is formed between the cover body 56 and the nozzle members 37, 51, namely, the nozzle element 54. The space 61 is open therebelow. Therefore, the nozzle cover 55 allows the coloring material being jetted through the nozzle element 54 to be deposited on the electric wire 3. An end wall 56a of the cover body 56 facing the electric wire 3 is disposed nearer the electric wire 3 than a top end wall 50b of the second nozzle member 50 facing the electric wire 3.

As shown in Fig. 2, the nozzle-fixing member 57 is mounted on the cover body 56 and fixes the nozzle unit 52 to the cover body 56. The nozzle-fixing member 57 holds the cover body 56 and the nozzle unit 52 coaxially.

As shown in Figs. 2 and 3, the coloring material supplying unit 53 includes a plurality of coloring material sources 32 as a coloring liquid supplying member. Each coloring material source 32 is a receiver for receiving the coloring material, and supplies the coloring material to the inlet pipe 36 of the coloring nozzle 31. Each coloring material source 32 corresponds to each coloring nozzle 31. The colors B of the coloring material supplied to the coloring nozzle 31 may be different or the same among the coloring material sources 32. The pressurized gas from the later-described pressurized air source 33 is supplied to the coloring material source 32.

As shown in Fig. 3, the cleaning part 64 includes a cleaning liquid supplying part 65 and a cleaning liquid discharging part 66. The cleaning liquid supplying part 65 includes a first container 67, the pressurized air source 33, a first piping 68, and a first valve 69.

The first container 67 is a receiver for receiving the cleaning liquid, and supplies the cleaning liquid to the space 61 between the cover body 56 of the nozzle cover 55 and the nozzle element 54, namely, an inside of the nozzle cover 55. The first container 67 may be mounted corresponding to each coloring nozzle 31, or solely to all coloring nozzles 31. The cleaning liquid means a liquid substance such as a solvent or a dispersion liquid, in which an organic substance for use in industry constituting the coloring material can be dissolved or dispersed. Preferably, the cleaning liquid is nonvolatile in room temperature.

The pressurized gas source 33 supplies the pressurized gas to each of the coloring material sources 32 and the first container 67. Accordingly, the pressurized gas source 33 pressurizes the coloring material received in the coloring material sources 32 and in the insert members 35 of the coloring nozzle

31, and the cleaning liquid received in the first container 67 and in the space 61 inside the coloring nozzle 31.

Because the pressurized gas source 33 pressurizes the coloring material received in the coloring material sources 32 and the insert members 35 of the coloring nozzle 31, when the valve 44 detaches from the base end 37a of the first nozzle member 37 in one of the coloring nozzle 31, the coloring material received in the flow pass 39 is rapidly jetted through the first nozzle member 37 and the second nozzle 50.

The first piping 68 connects the pressurized air source 33 to the first container 67, and communicates with the space 61, namely, the inside of the nozzle cover 55. The first piping 68 leads the coloring liquid in the first container 67 to the space 61, namely, the inside of the nozzle cover 55.

The first valve 69 is mounted on the first piping 68 interposed between the first container 67 and the nozzle cover 55 of the coloring nozzle 31. When the first valve 69 is open, the cleaning liquid is supplied from the first container 67 to the space 61, namely, the inside of the nozzle cover 55. When the first valve 69 is closed, the cleaning liquid is stopped supplying from the first container 67 to the space 61, namely, the inside of the nozzle cover 55. With a structure described the above, the cleaning liquid supplying part 65 supplies the cleaning liquid from the first container 67 to the inside of the nozzle cover 55.

As shown in Fig. 3, the cleaning liquid discharging part 66 includes a second container 70, an aspirator 71, a second piping 72, and a second valve 73.

The second container 70 receives the cleaning liquid discharged from the space 61, namely, the inside of the nozzle cover 55. The second container 70

may be attached to each coloring nozzle 31, or may be solely attached to a plurality of coloring nozzles 31.

The aspirator 71 is made of such as a vacuum pump or a vacuum generator, and aspirates a gas inside the second container 70. The aspirator 71 aspirates the cleaning liquid inside the nozzle cover 55 toward the second container 70 by aspirating the gas in the second container 70.

The second piping 72 connects the aspirator 71 and the second container 70, and communicates with the space 61, namely, the inside of the nozzle cover 55. The second piping 72 leads the cleaning liquid inside the space 61, namely, the inside of the nozzle cover 55 to the second container 70.

The second valve 73 is mounted on the second piping 72 interposed between the second container 70 and the nozzle cover 55 of each coloring nozzle 31. When the second valve 73 is open, the second valve 73 leads the cleaning liquid in the space 61, namely, the inside of the nozzle cover 55 to the second container 70. When the second valve 73 is closed, the cleaning liquid is stopped leading from the space 61, namely, the inside of the nozzle cover 55 to the second container 70. With a structure described the above, the cleaning liquid discharging part 66 discharges the cleaning liquid in the space 61, namely, the inside of the nozzle cover 55 into an outside of the nozzle cover 55. The cleaning part 64 at least cleans a tip of the nozzle element 54 near the electric wire 3 by supplying the cleaning liquid into the inside of the nozzle cover 55.

The nozzle for coloring 31 having the above-described structure leads the coloring material from the coloring material source 32 to the flow pass 39 through the inlet pipe 36. Further, with the energizing force of the coil spring 42 and without applying voltage to the coil 40, the valve 44 contacts the base end

37a of the first nozzle member 37to set the coloring material in the flow pass 39. When coloring the outer surface 3a of the electric wire 3, according to the instruction from the controller 19, the electric current is applied to the coil 40, and the valve 44 attached to the disc 46 detaches from the base end 37a of the first nozzle member 37 against the energizing force of the coil spring 42. Then, the coloring material stored in the flow pass 39 flows through the interior of the first nozzle member 37 and the second nozzle member 50 along the arrow Q. Then, the coloring nozzle 31 jets the coloring material from the second nozzle 50.

When jetting the coloring material, the coloring material flowing through the first nozzle member 37 and the second nozzle member 50 along the axis R and the arrow Q collides partially with the end wall 50a of the second nozzle 50. Then, a part of the coloring material colliding with the end wall 50a generates a swirl to stir the coloring material. Therefore, a concentration of the coloring material is held uniform throughout the interior of the second nozzle 50.

Further, because a cross-sectional area of the flow pass is gradually decreased, when jetting the coloring material, a flow velocity of the coloring material flowing from the first nozzle member 37 to the small diameter part 152 of the second nozzle member 50 is increased when the coloring material flows from the inside of the first nozzle member 37 to the second large diameter part 151 of the second nozzle member 50. When the coloring material flows from the second large diameter part 151 to the small diameter part 152, the flow velocity is further increased. Then, the liquid coloring material having a large flow velocity is jetted from an end wall 50c of the small diameter part 152 near the electric wire 3 toward the outer surface 3a of the electric wire 3. Thus, by

decreasing the cross-sectional area of the flow pass from the first nozzle member 37 to the small diameter part 152 of the second nozzle member 50, the flow velocity of the coloring material is adjusted to an optimum value for jetting, and a jetting amount of the coloring material is also adjusted. Further, because the flow speed is increased, the sharpness of the jetted drop of the coloring material is increased.

Incidentally, when coloring the outer surface 3a of the electric wire 3, both the first valve 69 and the second valve 73 are closed, and the cleaning liquid is not filled in the inside of the nozzle cover 55.

Further, in the coloring nozzle 31, when stopping coloring the outer surface 3a of the electric wire 3, namely, when stopping jetting the coloring material, according to the instruction of the controller 19, the electric current is stopped applying to the coil 40, and the valve body 44 contacts the base end 37a of the first nozzle member 37. Then, the coloring material having the increased flow speed disposed at the second large diameter part 151 and the small diameter part 152 of the second nozzle member 50 is moved to the inside of the first large diameter part 153 owing to inertia.

At this moment, the flow velocity of the coloring material is decreased because the coloring material is moved to the first large diameter part 153 having a larger inner diameter than that of the small diameter part 152. Thus, the coloring material having a decreased flow speed stops so that a liquid surface of the coloring material is at the same surface as the top end wall 50b of the second nozzle member 50. Thus, the coloring material is prevented from jumping out of the second nozzle member 50.

Incidentally, an amount of the coloring material received in the inside of

the nozzle element 54 when the jetting of the coloring material is stopped is an amount of the coloring material for disposing the liquid surface of the coloring material at the same surface as the end wall 50c of the small diameter part 152 without inertia. Namely, owing to the inertia, the coloring material moved from the second large diameter part 151 and the small diameter part 152 is once received in the inside of the first large diameter part 153.

After the flow speed of the coloring material is decreased, and the liquid surface of the coloring material is at the same surface as the top end wall 50b of the second nozzle member 50, the pressure of the atmosphere pushes the coloring material moved to the inside of the first large diameter part 153 back to the small diameter part 152. As shown in Fig. 8, the liquid surface of the pushed coloring material is at the same surface of the end wall 50c of the small diameter part 152. In this state, only the liquid surface of the coloring material disposed at the same surface as the end wall 50c of the small diameter part 152 touches the air. Thus, the bubble is prevented from flowing into an inside of the nozzle element 54, namely, a side nearer the first nozzle member 37 than the end wall 50c.

Further, in the coloring nozzle 31, after the valve body 44 is at the closed position to stop jetting the coloring material, both the first valve 69 and the second valve 73 are open, the aspirator 71 aspirates the gas inside the second container 70, and the pressurized air source 33 supplies the pressurized gas to the inside of the first container 67. Then, the cleaning liquid is supplied from the first container 67 to the space 61, namely, the inside of the nozzle cover 55. The cleaning liquid supplied to the space 61 does not leak downward from the lower part of the cover body 56 owing to, for example, surface tension of the

cleaning liquid, and the space between the nozzle element 54 and the cover body 56 is gradually filled with the cleaning liquid. After the space 61 is filled with the cleaning liquid, the cleaning liquid is led to the second container 70.

Then, by opening the valves 69, 73 in a specific time previously stored in the controller 19 such as ten or twenty minutes, the coloring nozzle 31 supplies the cleaning liquid into the space 61 via the first container 67, and then the second container 70 receives the cleaning liquid from the space 61. Thus, the coloring nozzle 31 rinses the tip of the nozzle element 54 in the nozzle cover 55 at the electric wire 3 side with the cleaning liquid.

Then, according to the instruction from the controller 19, the coloring nozzle 31 closes the valves 69, 73 simultaneously. Then, according to the instruction from the controller 19, the coloring nozzle 31 opens the first valve 69 in a second specific time which is a very short time such as tem millisecond, and previously stored in the controller 19, and then closes the first valve 69 again. Thus, a liquid surface (interface) of the cleaning liquid in the space 61 and the end wall 56a of the cover body 56 of the nozzle cover 55 are arranged on the same plane. Then, according to the instruction from the controller 19, the coloring nozzle 31 holds this state in a third specific time previously stored in the controller 19. Further, at this time, according to the instruction from the controller 19, the coloring nozzle 31 may close the second valve 73 and after the second specific time, the coloring nozzle 31 may close the first valve 69, instead of closing the valves 69, 73 simultaneously.

Then, the cleaning liquid dissolves or disperses the coloring material being deposited on the nozzle element 54 of the coloring nozzle 31 at the electric wire 3 side, and removes the coloring material from the tip of the nozzle

element 54. Thus, the cleaning liquid removes the coloring material being deposited on the nozzle element 54 from the nozzle element 54 to clean the nozzle element 54.

Then, according to the instruction from the controller 19, while the first valve 69 is closed, the coloring nozzle 31 opens the second valve 73, and the aspirator 71 aspirates the gas in the second container 70. Then, the cleaning liquid in the space 61, namely, the inside of the nozzle cover 55 is led into the second container 70. Then, as shown in Fig. 9, the cleaning liquid disposed in the space 61, namely, the inside of the nozzle cover 55 is discharged to an outside of the nozzle cover 55. Thus, the cleaning part 64 cleans the tip of the nozzle element 54 of the coloring nozzle 31 in the nozzle cover 55 at the electric wire 3 side. When the discharge of the cleaning liquid from the space 61 is finished, the coloring nozzle 31 closes the second valve 73. Then, the coloring nozzle 31 cleans the space 61, namely, the inside of the nozzle cover 55 with the cleaning liquid in a fourth specific time stored in the controller 19, for example, two minutes until coloring the outer surface 3a of the electric wire 3.

When the coloring apparatus 1 having the constitution described above forms the mark 6 on the outer surface 3a of the electric wire 3, namely, colors the outer surface 3a of the electric wire 3, firstly the guide roll 11 is mounted on the frame 10. After cutting blades 48, 49 are set apart from each other, the electric wire 3 rolled on the guide roll 11 is passed through the straightening unit 13, the slack absorbing unit 14, the coloring unit 15 and the duct 16 sequentially and caught in between the pair of delivery rolls 12. Then, each of the coloring nozzle 31 is attached to a predetermined position of the corresponding unit body 30 of the coloring unit 15, and connected to the

corresponding coloring material source 32 and the first container 67. Then, the pressurized gas source 33 is connected to the coloring material sources 32 and the first container 67. Then, the aspirating member aspirates the gas in the duct 16.

Then, by rotating the delivery rolls 12, the electric wire 3 is pulled out of the guide roll 11, and transferred in the longitudinal direction of the electric wire 3. Simultaneously, the straightening unit 13 gives friction owing to the first energizing force H1 to hold the electric wire 3 in tension. Then, the air cylinder 27 energizes the movable roller 26, namely, the electric wire 3 with the second energizing force H2. Then, as described above, the coloring material is supplied to the flow pass 39 of the coloring nozzle 31 from the coloring material sources 32, and the cleaning liquid is supplied to the space 61 from the first container 67.

Then, when pulse signals in a specific pattern is inputted from the encoder 17 to the controller 19, the controller 19 applies the current for a specific time in a specific interval to the coil 40 of the predetermined nozzle for coloring 31. Accordingly, the coloring nozzle 31 spouts a specific amount of the coloring material onto the outer surface 3a of the electric wire 3. Then, the solvent or the liquid dispersion is evaporated from the coloring material deposited on the outer surface 3a of the electric wire 3, thereby the outer surface 3a of the electric wire 3 is dyed with the dye or coated with the pigment. The aspirating member aspirates the solvent or the liquid dispersion evaporated from the coloring material deposited on the outer surface 3a of the electric wire 3 through the duct 16. Thus, the surface 3a of the electric wire 3 is colored. Then, the inside of the nozzle cover 55 is cleaned.

When judging that a specific length of the electric wire 3 is delivered according to the data from, for example, the encoder 17, the controller 19 stops the rolling of the delivery roll 12. Then, the electric wire 3 slacks particularly in between the pair of guiding rollers 24 of the slack absorbing unit 14, and the movable roller 26 energized with the second energizing force H2 is transferred to the position shown as a two-dot chain line in Fig. 1. Then, the extendable rod 29 of the air cylinder 27 of the slack absorbing unit 14 extends. Thus, the slack absorbing unit 14 absorbs the slack of the electric wire 3.

Then, the pair of cutting blades 48, 49 approaches each other and cuts the electric wire 3. Thus, the electric wire 3 having a mark 6 on the outer surface 3a as shown in Fig. 5 is obtained.

According to this embodiment, when jetting the coloring material, the flow speed is increased when the coloring material is moved from the first nozzle member 37 to the small diameter part 152 of the second nozzle member 50, and the coloring material is jetted from the end wall 50c of the small diameter part 152 near the electric wire 3. Therefore, the amount of the coloring material is adjustable, and the sharpness of the drop of the coloring material is increased. Further, when stopping jetting the coloring material, the coloring material having an increased flow speed in the small diameter part 152 is moved to the inside of the first large diameter part 153 owing to inertia, and the flow speed is decreased when the coloring material is moved from the small diameter part 152 to the first large diameter part 153. Therefore, the liquid surface of the coloring material is stopped at the same plane as the end wall of the first large diameter part 153 near the object, namely, the top end wall 50b of the second nozzle member. Then, the atmospheric pressure turns the coloring

material back to the small diameter part 152, and the liquid surface of the coloring material is stopped at the same plane as the end wall 50c of the small diameter part 152. Therefore, the bubble is prevented from flowing into the inside of the coloring nozzle 31, namely, a side nearer the first nozzle member 37 than the end wall 50c. Resultingly, there can be provided a coloring nozzle to prevent dripping of the coloring material, blocking the coloring nozzle, and making a jetting direction unstable.

In the embodiment described above, the first nozzle member 37 and the second nozzle member 50 are separated from each other, however, according to the present invention, the first nozzle member 37 and the second nozzle member 50 may be integrated with each other. Further, according to the embodiment described above, the second nozzle member 50 is formed by one member. However, the second nozzle member 50 may be formed by a combination of a plurality of members having different inner diameters. Further, according to the embodiment described above, the inner wall of the second nozzle member 50 is formed in a step shape. However, according to the present invention, the inner wall of the second nozzle member 50 may be formed in a taper shape to vary the inner diameter. Further, according to the present invention, the second nozzle member 50 at least includes the small diameter part 152 and the first large diameter part 153. The second nozzle member 50 may not include the second large diameter part 151.

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.

In the embodiment described above, the electric wire 3 constituting a

wire harness arranged in a vehicle is described. However, the electric wire 3 is not only applied to a vehicle, but also applied to various electronic apparatuses such as a computer, or various electric machines.

In the embodiment described above, the nozzle for coloring 31 colors the outer surface 3a of the electric wire 3, however, the nozzle for coloring 31 may color other various objects.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention hereinafter defined, they should be construed as being included therein.

CLAIMS

1. A coloring nozzle through which a specific amount of liquid coloring material is jetted to an outer surface of an object to color the object by attaching the drop of the coloring material to the outer surface of the object, said coloring nozzle comprising:

a container for containing the coloring material;

a first nozzle member formed in a cylindrical shape and inside of which the coloring material flows, said first nozzle member communicating with the container; and

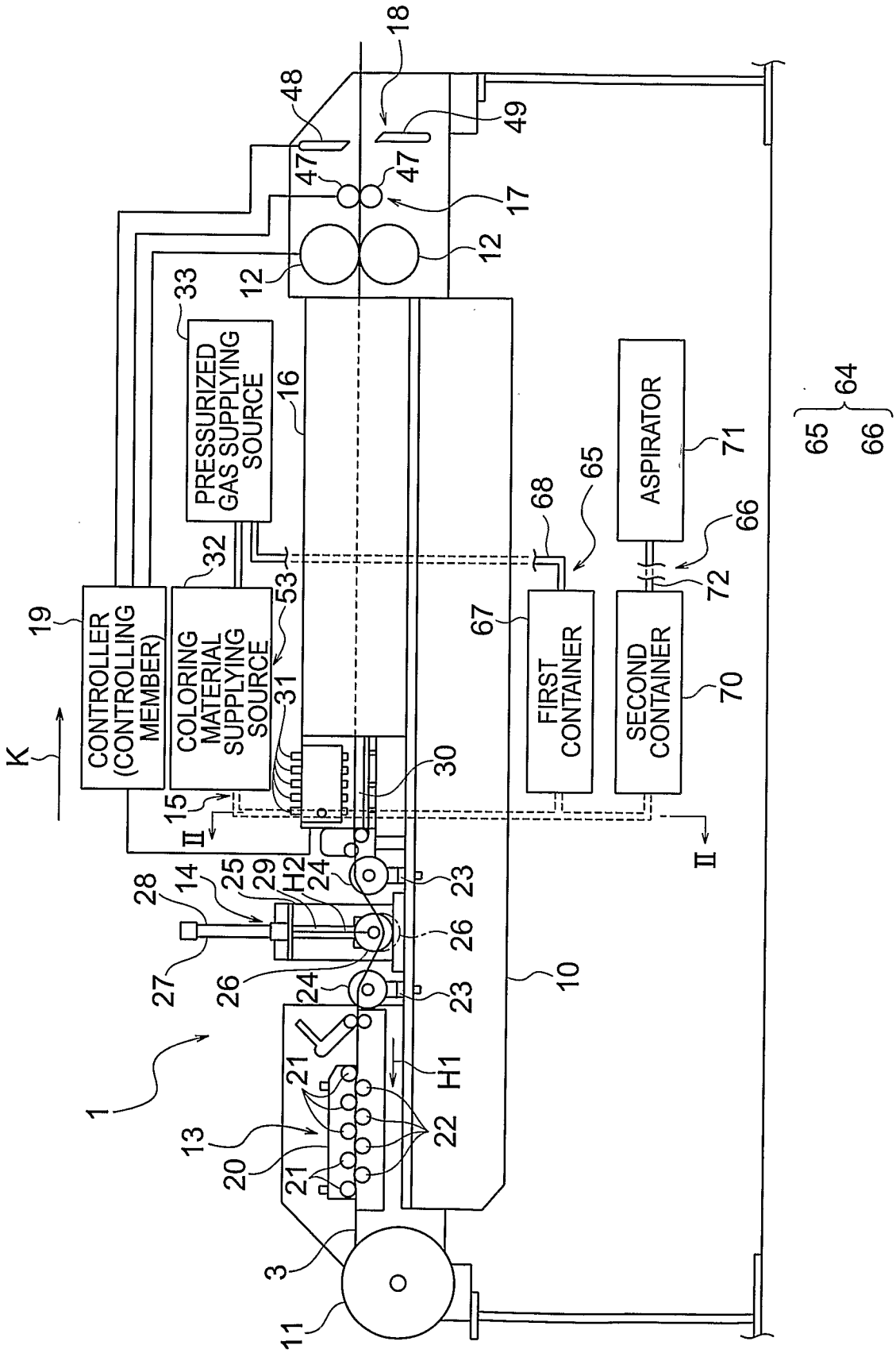
a second nozzle member formed in a cylindrical shape and inside of which the coloring material flows, said second nozzle member disposed nearer the object than the first nozzle member and connected to the first nozzle member,

wherein the second nozzle member includes a small diameter part of which inner diameter is smaller than that of the first nozzle member, and a first large diameter part disposed nearer the object than the small diameter part, and of which inner diameter is larger than that of the small diameter part.

2. The coloring nozzle as claimed in claim 1,

wherein the second nozzle member is disposed nearer the first nozzle member than the small diameter part, and further includes a second large diameter part of which inner diameter is larger than that of the small diameter part, and smaller than that of the first nozzle member.

FIG. 1


CONTROLLER (CONTROLLING MEMBER)
COLORING MATERIAL SUPPLYING SOURCE
PRESSURIZED GAS SUPPLYING SOURCE
FIRST CONTAINER
SECOND CONTAINER
ASPIRATOR
K
II
II
H1
H2
1
3
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
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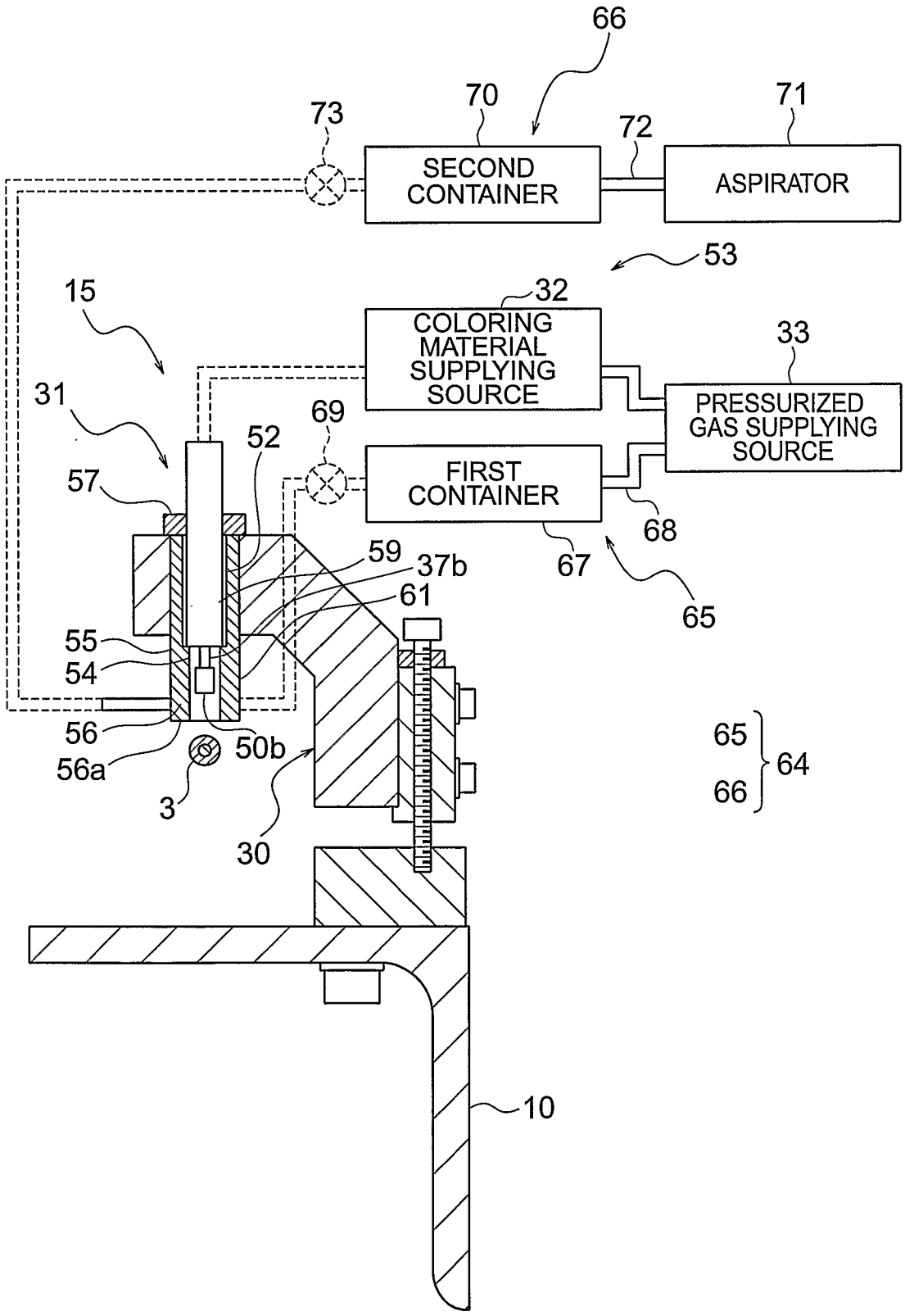
72

FIG. 2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71
73
72
SECOND CONTAINER
ASPIRATOR
53
15
32
COLORING MATERIAL SUPPLYING SOURCE
33
PRESSURIZED GAS SUPPLYING SOURCE
31
69
52
FIRST CONTAINER
57
68
59
37b
67
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61
55
54
56
50b
56a
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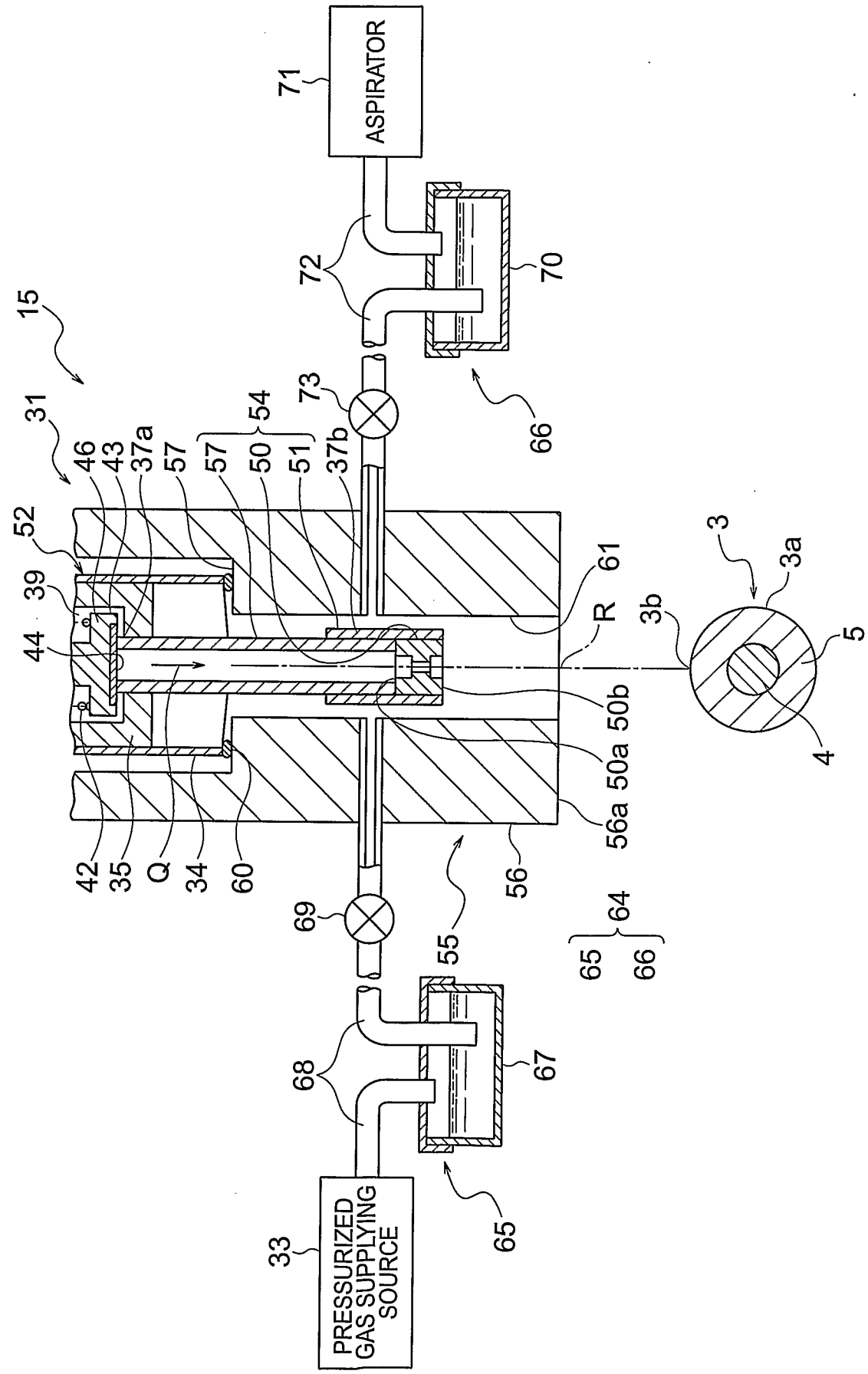
64
10

FIG. 3


ASPIRATOR
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72
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73
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43
37a
57
57
50
51
37b
52
39
44
61
R
3
3a
3b
5
4
50b
50a
56a
56
42
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Q
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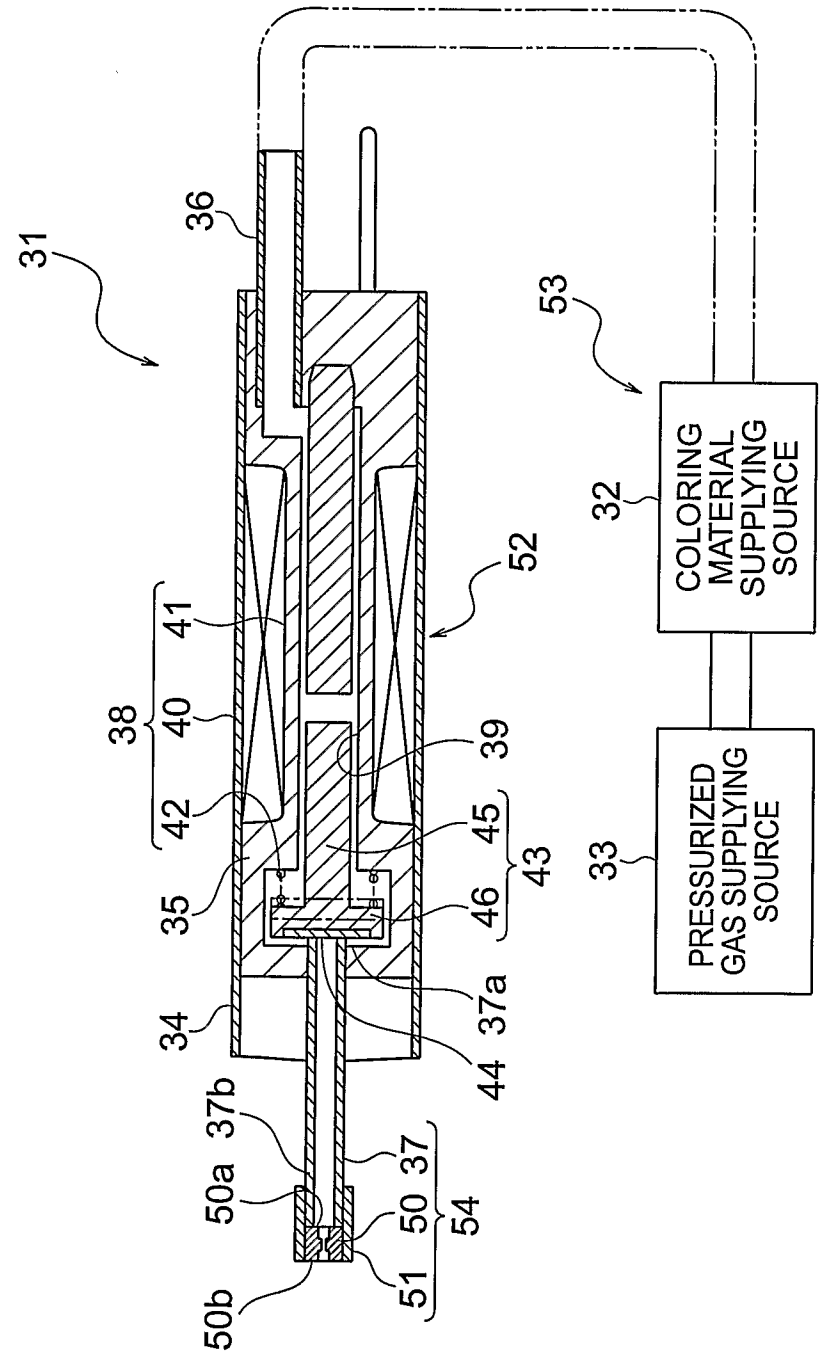
33
PRESSURIZED GAS SUPPLYING SOURCE

FIG. 4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36
53
COLORING MATERIAL SUPPLYING SOURCE
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52
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39
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45
43
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PRESSURIZED GAS SUPPLYING SOURCE
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34
37a
44
37b
50a
37
50
54
51
50b

FIG. 5

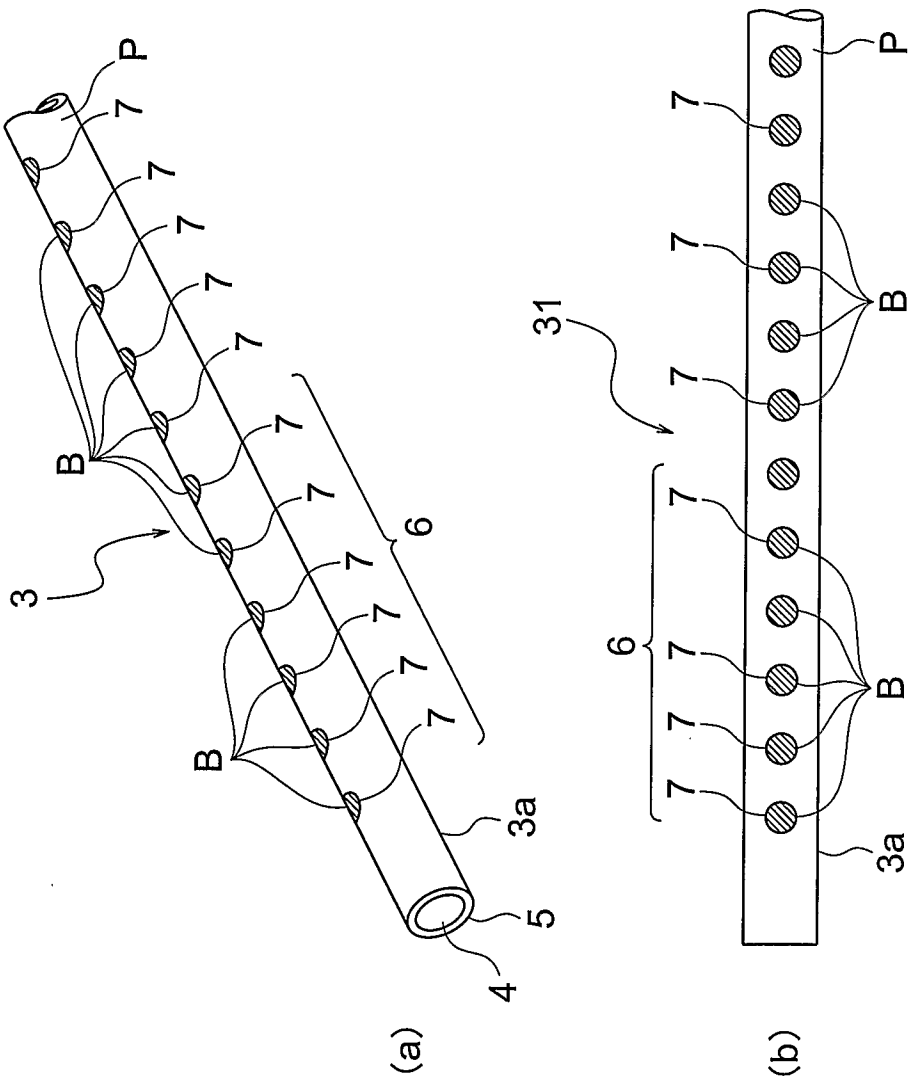


FIG. 6

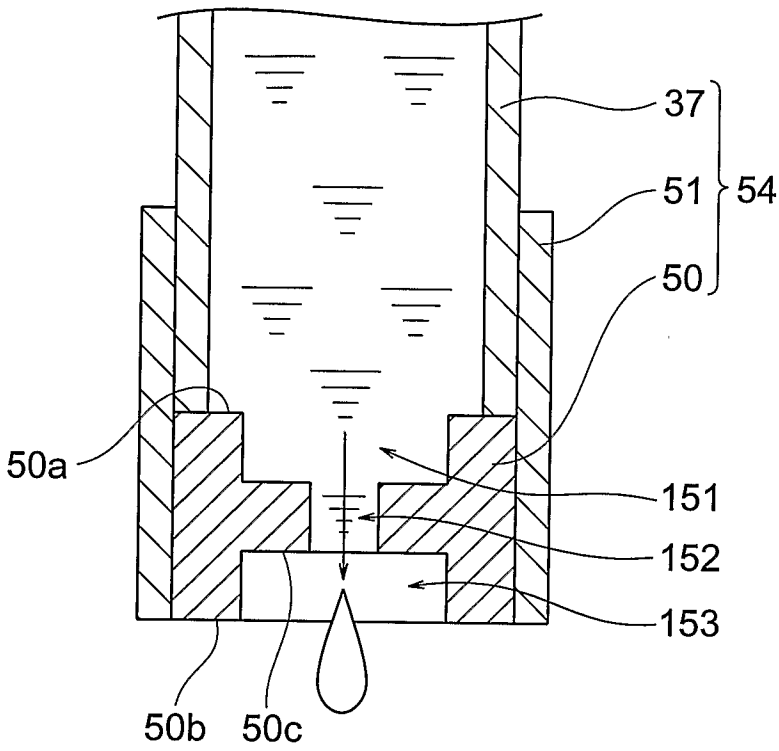


FIG. 7

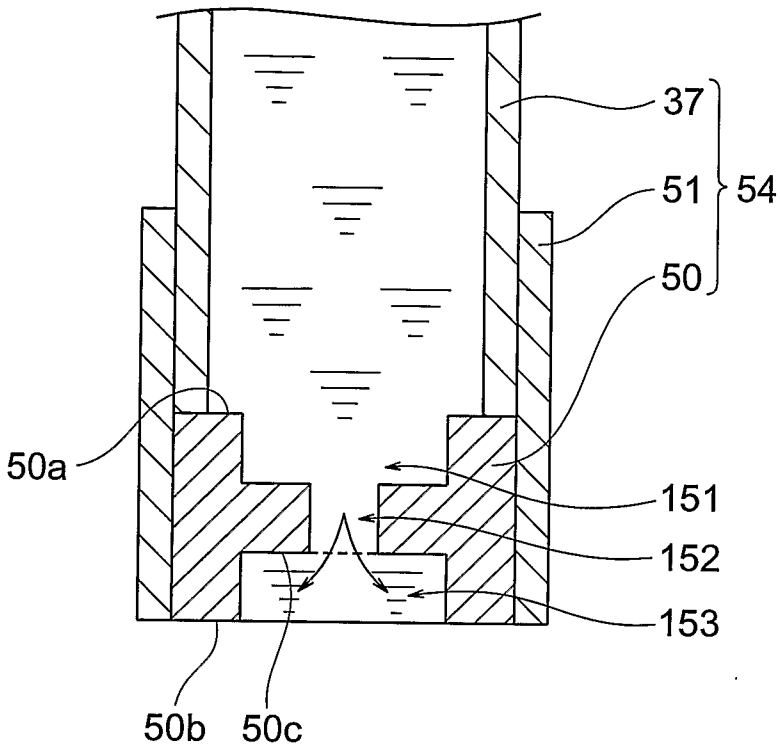

37
51
54
50
50a
151
152
153
50b
50c

FIG. 8

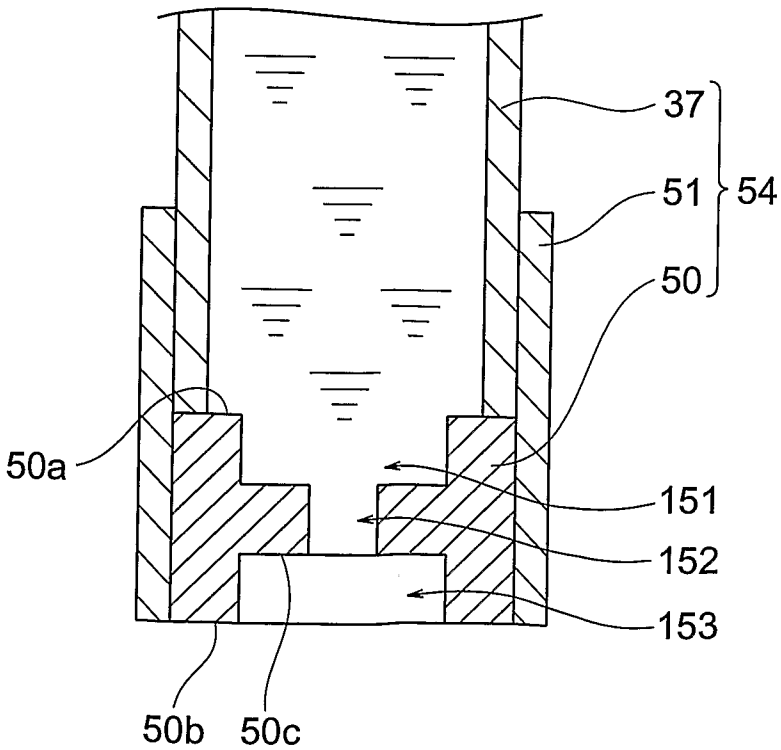

37
51
54
50
50a
151
152
153
50b
50c

FIG. 9

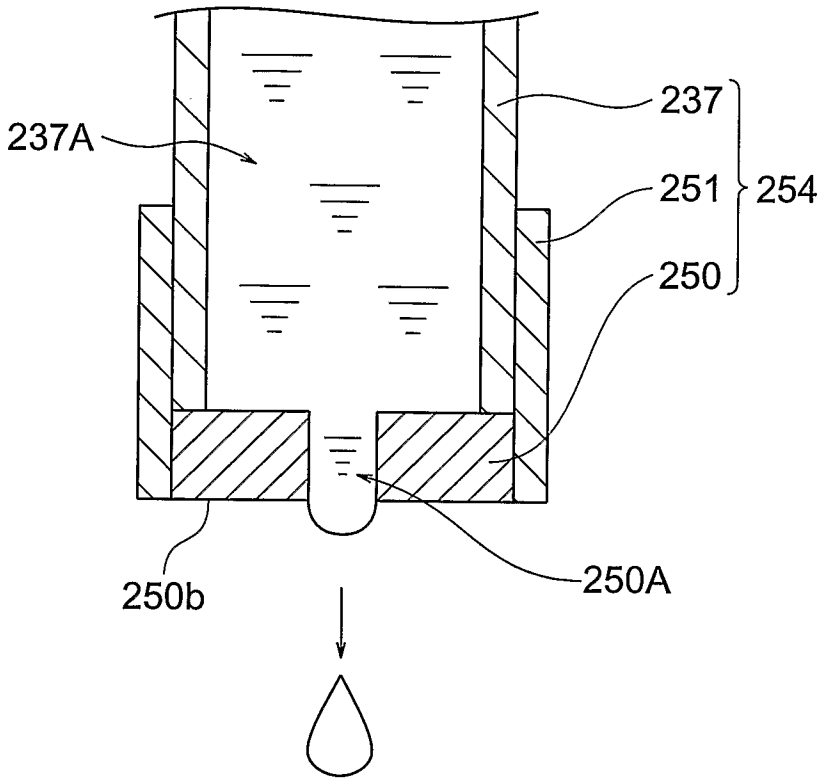
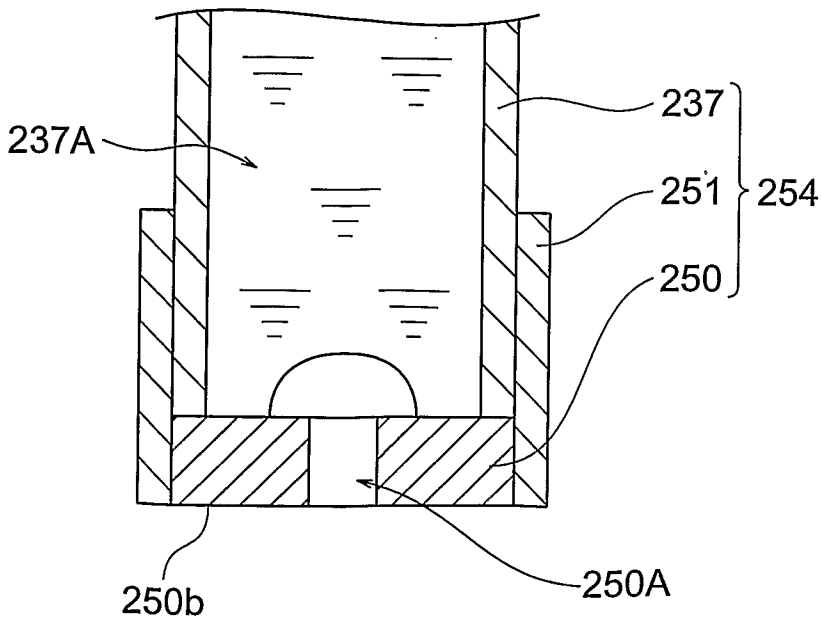


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2007/062067

A. CLASSIFICATION OF SUBJECT MATTER
INV. B05B1/02 B05B5/025

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)
B05B

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 138 499 A (NIPPON ELECTRIC CO [JP]) 4 October 2001 (2001-10-04) paragraphs [0002], [0003], [0007]; figures 1,4a-4c	1,2
X	WO 98/36864 A (MPM CORP [US]) 27 August 1998 (1998-08-27) page 10, lines 15-31 page 11, line 24 - page 12, line 10 figure 7	1
X	US 5 490 633 A (JEFFRIES ANDREW [GB] ET AL) 13 February 1996 (1996-02-13) column 7, lines 15-44 column 7, line 61 - column 8, line 4 figure 5	1

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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24 August 2007	30/08/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lostetter, Yorick

INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2007/062067

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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