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(54) **ELECTRIC CABLE COLORING DEVICE AND ELECTRIC CABLE MACHINING DEVICE**

(57) The invention provides a cable coloring unit, which maintains correct positioning of a mark on a predetermined length of the cable, even when the coloring unit has a cable travel measuring means separately provided from another cable travel measuring means provided on a cable cutting installation. To achieve the foregoing object, an electrical cable coloring unit 9 is mounted on a cable cutting installation 8. The cutting installation 8 cuts the electrical cable in predetermined lengths. The coloring unit 9 has an encoder 33 and a switch 82. The

switch 82 outputs a signal showing the cutting of the cable. The coloring unit 9 has an encoder 33, a colorant jet unit 32, and a control unit 34. The colorant jet unit 32 jets a liquid colorant by a predetermined amount toward an outer surface of the cable to color the cable. The control unit 34 has a CPU 62 that determines whether there is a difference between cable travel distances obtained from the encoders 21, 33 in connection with the cutting timing of the cable. CPU 62 corrects the jetting timing of the colorant jet unit 32 based on the difference between information obtained from the encoders 21, 33.

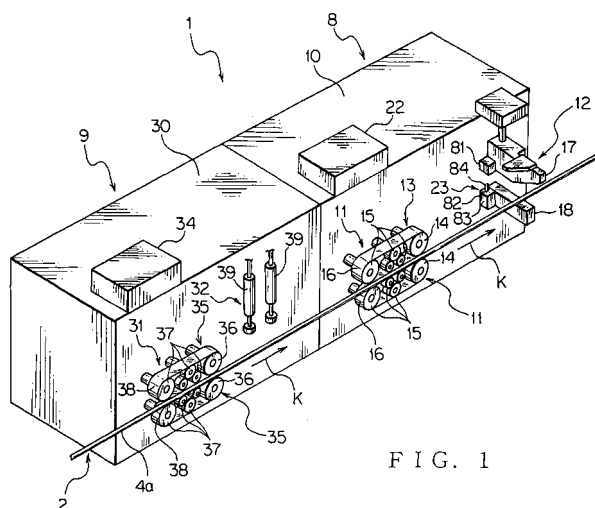


FIG. 1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an electrical cable coloring unit for providing a mark on an outer surface of an electrical cable and a cable finishing apparatus having the coloring unit. The electrical cable has an electrically conductive core and an insulating sheathing layer to cover the core.

2. Related Art

[0002] An automotive vehicle is equipped with various kinds of electronic instruments. Therefore, the automotive vehicle is arranged with wiring harnesses for transmitting electrical powers from a power source and control signals from a computer to the electronic instruments. Each wiring harness has a plurality of electrical cables and connectors fitted to ends of the cables.

[0003] The electrical cable has an electrically conductive core and a sheathing layer made of an insulating synthetic resin for covering the core. Each connector has an electrically conductive terminal fitting and a dielectric connector housing. The terminal fitting is fitted to an end of the electrical cable to electrically connect to the core of the cable. The connector housing has a box shape to accommodate the terminal fitting. The cables electrically connect to the electronic instruments via the terminals of the connectors to transmit powers and signals to the instruments.

[0004] To assemble the wiring harness, each electrical cable is cut to have an appropriate length, and then a terminal fitting is fitted to a stripped end of the cable. If desired, the cables are connected to each other. Thereafter, the terminal fitting is inserted into the connector housing to assemble the wiring harness.

[0005] Each electrical cable of the wiring harness shall be discerned in core sizes, a material of the sheathing layer that is selected based on a heat resistance performance, and its application. The applications of the cables are systems of the vehicle such as an air bag, an anti-lock brake system (ABS), and a vehicle speed detecting system, which require electrical cables for transmitting control signals and for supplying electrical powers.

[0006] In order to discern the cables in their applications, a colorant having a desired color is mixed with a synthetic resin material defining the sheathing layer of the cable, before the resin material is extruded around the core of the cable to cover the core (refer to Japanese Patent Application Laid-open No. H-5-111947, H-6-119833, or H-9-92056). However, a resin extruding machine must stop even when a colorant is changed to color the cables in different colors. This increases laborious processes for completing the cables, decreasing

productivity of the cables.

[0007] Alternatively, a colorant has been changed in hue with the resin material being extruded. This contaminates colors used in a previous step and in a present step, decreasing an available percentage of finished cables.

[0008] To eliminate the decreases of productivity and an available percentage of the cables, the applicant of the present invention proposed a method for assembling a wiring harness in International Patent Application Publication No. 03-019580. The method colors partially an outer surface of a mono-color electrical cable with a desired color to obtain a wiring harness.

[0009] To obtain a wiring harness, a cable finishing apparatus mounted with a coloring or marking unit is prepared to color partially an outer surface of an electrical cable with a desired color. The marking unit colors the outer surface of the electrical cable while the cable is being moved in a longitudinal direction of the cable. Furthermore, a cutting installation cuts the cable into desired lengths.

[0010] The cutting installation and the coloring unit each may have a measuring means for measuring a travel distance of the cable, particularly when the cutting installation is a conventional one.

[0011] However, marking positions of the cable tend to gradually shift not to be in conformity with the timing of the cable cutting installation. This causes an adverse effect to distinguish the cables from each other. Because, the cable travel measuring means of the cutting installation and the coloring unit accumulate errors.

[0012] Therefore, an object of the invention is to provide a cable coloring unit and a cable finishing apparatus, which maintains correct positioning of a mark on a predetermined length of the cable, even when the coloring unit has a cable travel measuring means separately provided from another cable travel measuring means provided on the cable cutting installation.

SUMMARY OF THE INVENTION

[0013] To achieve the foregoing object, an aspect of the present invention is an electrical cable marking unit for coloring an outer surface of an electrical cable which is moving along a longitudinal direction of the cable. The cable has a conductor core and a sheathing layer covering the core. The sheathing layer is made of a synthetic resin material. The coloring unit is mounted in a cable cutting installation. The cable cutting installation includes:

a first measuring means for measuring a travel distance of the cable,
an output means for outputting a signal showing that the cutting installation has cut the cable, the cable cutting installation cutting the cable in a desired length based on information from the first measuring means,

a second measuring means for measuring a travel distance of the cable, the second measuring means provided separately from the first measuring means, a coloring means for providing a mark on an outer surface of the cable,

a control means for controlling the coloring means to provide the mark on the outer surface of the cable based on information from the second measuring means, and

a correction means for correcting timing with which the coloring means provides the mark on the outer surface,

wherein, based on a difference between the travel distances measured by the first and second measuring means, the correction means corrects the timing after the output mean outputs a signal showing that the cutting installation has cut the cable.

[0014] In a second aspect of the present invention, the timing is delayed based on the difference when the travel distance measured by the first measuring means is smaller than the travel distance measured by the second measuring means, and the timing is expedited based on the difference when the travel distance measured by the first measuring means is larger than the travel distance measured by the second measuring means.

[0015] A third aspect of the present invention is a cable finishing apparatus having the electrical cable marking unit described in the first or second aspect.

[0016] In the coloring unit of the first aspect, based on the difference between the travel distances measured by the first and second measuring means, the correction means corrects the marking timing of the coloring unit.

[0017] Preferably, a given amount of a liquid colorant is jetted at regular intervals on the outer surface of the electrical cable to deposit the colorant on the outer surface.

[0018] The colorant referred in this specification is a liquid-like material including a coloring material (an industrial organic material) distributed in a solution such as water. The colorant is a die or a pigment, which is generally organic and synthetic. A pigment is sometimes used as a die, and vice versa. More specifically, the colorant referred in this specification is either of a coloring liquid and a coating material. The coloring liquid includes a die dispersed in a solution liquid, and the coating material includes a pigment dispersed in a liquid. Thus, the die soaks into a sheathing layer when the sheathing layer is coated with the colorant. In the meantime, the pigment deposits on an outer surface of a sheathing layer without soaking into the sheathing layer when the sheathing layer is coated with the coating material. However, the process for depositing a colorant on an outer surface of a sheathing layer shows coloring a partial outer surface of a sheathing layer with a die and also painting a partial outer surface of a sheathing layer with a pigment.

[0019] Preferably, the solvent and the dispersion liquid are affinitive to a synthetic resin material defining the

sheathing layer of the cable. This makes it sure that the die soaks into the sheathing layer and that the pigment adheres to the outer surface of the sheathing layer.

[0020] When the coloring nozzle jets the colorant toward the cable outer surface, the colorant advances in drops.

[0021] In the present invention described in the second aspect, the timing is delayed based on the difference when the travel distance measured by the first measuring means is smaller than the travel distance measured by the second measuring means, and the timing is expedited based on the difference when the travel distance measured by the first measuring means is larger than the travel distance measured by the second measuring means. Thus, the coloring unit can surely maintain correct positioning of the marks on the cable even when the cutting of the cable is repeated.

[0022] In the cable finishing apparatus of the third aspect, the correction means corrects the marking timing of the coloring unit based on the difference between the travel distances measured by the first and second measuring means. Thus, the coloring unit can surely maintain correctly positioning of the marks on the cable even when the cutting of the cable is repeated.

[0023] Next, advantageous effects of the present invention will be discussed.

[0024] In the first aspect of the present invention, the correction means corrects the marking timing of the coloring unit. Thus, the coloring unit can surely maintain correct positioning of the marks on the cable even when the cutting of the cable is repeated to provide given length ones thereof.

[0025] In the second aspect of the present invention, the coloring unit can surely maintain correct positioning of the marks on the cable even when the cutting of the cable is repeated to provide given length ones thereof.

[0026] In third aspect of the present invention, the correction means corrects the marking timing of the coloring unit. Thus, the coloring unit can surely maintain correct positioning of the marks on the cable even when the cutting of the cable is repeated to provide given length ones thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a perspective view showing a configuration of an electrical cable finishing apparatus according to an embodiment of the present invention;

FIG. 2 is a perspective view showing a configuration of a coloring unit of the finishing apparatus of FIG. 1; FIG. 3 is an explanatory view showing a configuration of the coloring unit of FIG. 2;

FIG. 4 is an explanatory view primarily showing a control unit of the coloring unit of FIG. 3;

FIG. 5 is a perspective view showing a configuration of a cutting installation of the finishing apparatus

shown in FIG. 1;

FIG. 6 is an explanatory view showing a configuration of the cutting installation of FIG. 5;

FIG. 7 is an explanatory view primarily showing a control unit of the cutting installation shown in FIG. 6; FIG. 8 is a perspective view showing an electrical cable completed by the finishing apparatus shown in FIG. 1; and

FIG. 9 is a plan view showing the electrical cable of FIG. 8.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0028] Referring to FIGS. 1 to 9, an electrical cable finishing apparatus 1 (called as a finishing apparatus hereinafter) that is an embodiment of the present invention will be discussed. The finishing apparatus 1 completes an electrical cable 2 shown in FIGS. 8 and 9.

[0029] A plurality of the electrical cables 2 compose a wiring harness arranged in an automotive vehicle. As shown in FIG. 8, the electrical cable 2 has an electrically conductive core 3 and an insulating sheathing layer 4. The core 3 is defined by a plurality of electrically conductive stranded wires. The wire core 3 is made of an electrically conductive metal. The core 3 may be defined by a single wire. The sheathing layer 4 is made of, for example, a synthetic resin material such as polyvinyl chloride (PVC). The sheathing layer 4 covers the core 4. An outside surface of the electrical cable 2 is an outer surface 4a of the sheathing layer 4.

[0030] The sheathing layer 4 has a single color P. A desirable colorant may be mixed with a synthetic resin defining the sheathing layer 4 to provide the single color P of the outer surface 4a of the electrical cable 2. The colorant may be white in hue. The color P may be an original color of the synthetic resin without mixing the colorant into the resin of the sheathing layer 4. The outer surface 4a of the sheathing layer 4 of the electrical cable 2 is referred as a non-colored cable, when no colorant is mixed into the synthetic resin. In the non-colored cable, the outer surface 4a of the electrical cable 2 has its original color.

[0031] The outer surface 4a of the electrical cable 2 has a mark 7 that includes a plurality of first dots 5 and second dots 6. Each first dot 5 has a first color B (shown by parallel chain lines in FIGS. 8 and 9). Each second dot 6 has a second color R (shown by parallel chain lines in FIGS. 8 and 9). The second color R is different from each of the first color B and the color P.

[0032] Each of the first and second dots 5, 6 is a circle in a plan view as illustrated in FIG. 9. The plurality of the first and second dots 5, 6 are aligned with each other in a longitudinal direction to define a predetermined pattern.

[0033] In the illustrated example, a mark 7 is provided at each longitudinal end of the cable 2. There are six of the first dots 5 positioned at one end of the cable and four of the second dots 6 positioned at a middle part of

the cable along the longitudinal direction of the cable 2. The distance D1, D2, D3, ..., or Dn between the center of each dot 5 or 6 and a right end of the cable 2 of FIGS. 8 and 9 is predetermined as well as a predetermined length L of the cable 2.

[0034] A plurality of the electrical cables 2 are bundled, and connectors are fitted to ends of the electrical cables 2, completing the aforementioned wiring harness. The connectors are coupled to connectors of various kinds of electronic instruments of an automobile vehicle so that the electrical cables 3 of the wiring harness transmit various kinds of signals and powers to the electronic instruments.

[0035] The cables 2 are provided with the dots 5, 6 having the color B or R that can be various in hue, so that the cables 2 are distinguished from each other. The colors B and R of the mark 7 of the cables 2 are used to recognize types or applications of the cables.

[0036] The electrical finishing apparatus 1 cuts a long electrical cable 2 into desired lengths L while the cable has an outer surface 4a with a mono-color P. Then, the apparatus provides marks 7 on the outer surface 4a of the cables. As illustrated in FIG. 1, the apparatus 1 has an electrical cable cutting installation 8 and a cable coloring unit (called as a coloring unit hereinafter).

[0037] The cable cutting installation 8 cuts a long electrical cable into predetermined lengths L while the cable is running in its longitudinal direction. The cable cutting installation 8, as illustrated in FIG. 1, has a main body 10 disposed on a floor in a factory, a cable feeding unit 11, and a cutting unit 12, an encoder 21 (FIG. 6) as a first measuring means, and a control unit 22 (FIGS. 6 and 7), and a switch section 23.

[0038] The main body 10 is configured in a box shape. The cable feeding unit 11 has a motor 19 (FIG. 7) as a driving unit and a pair of belt feeding units 13. The motor 19 is received in the main body 10.

[0039] Each belt feeding unit 13 has a driving pulley 14, a plurality of follower pulleys 15, and an endless belt 16. The driving pulley 14 is driven to rotate by the motor 19. Each follower pulley 15 is rotatably supported on the main body 10. The endless belt 16 is a ring one that surrounds the driving pulley 14 and the follower pulleys 15 such that the endless belt 16 moves along the driving pulley 14 and the follower pulleys 15.

[0040] The pair of belt feeding units 13 are vertically disposed parallel with each other. The pair of belt feeding units 13 pinch the electrical cable 2 therebetween, and the two driving pulleys 14 rotate at the same speed as each other but each in a direction opposed to each other based on an instruction of the control unit 22. This rotates the endless belts 16 to feed the electrical cable 2 as much as a given length. The belt feeding units 13 feed the electrical cable 2 in a longitudinal direction of the cable which is shown by an arrow K in FIG. 5. The arrow K is along a horizontal direction.

[0041] The cutting unit 12 is positioned downstream from the pair of belt feeding units 13 in the arrow direction

K. As shown in FIG. 5, the cutting unit 12 has a cylinder 20 (FIG. 7) and a pair of cutting blades 17 and 18 which align with each other vertically. The cylinder 20 is received in the main body 7. The cylinder 20 has an extendable rod to which the blade 17 is joined.

[0042] The cutting blades 17 and 18 come close to and apart from each other vertically with the movement of the extendable rod of the cylinder 20. The pair of cutting blades 17 and 18 come close to each other to pinch the electrical cable 2 fed by the pair of belt feeding units 13 therebetween to cut the cable. The pair of cutting blades 17 and 18 come apart from each other to leave the electrical cable 2.

[0043] As illustrated in FIG. 6, the encoder 21 has a rotor 24 which can turn around its central axis. An outer peripheral surface of the rotor 24 contacts an outer surface 4a of the electrical cable 2 pinched between the pair of belt feeding units 13. The movement of the electrical cable 2 (core 3) along the arrow K rotates the rotor 24 around the central axis. Of course, the moving distance of the electrical cable 2 along the arrow K is proportional to the rotation number of the rotor 24.

[0044] The encoder 21 electrically connects to the control unit 22. The encoder 21 outputs a pulse signal to the control unit 22 every given angle rotation of the rotor 24. That is, the encoder 21 outputs information corresponding to the moving speed of the electrical cable 2 to the control unit 22.

[0045] Usually, the encoder 21 is mounted on a roll (rotation number counting rotor) 57 that rotates by friction between the rotor 57 and the electrical cable 2. However, when the pulse number is not proportional to the moving distance of the electrical cable 2 due to the condition of the outer surface 4a of the electrical cable 2, a moving speed data of the cable 2 may be obtained at another position to feed back the data to compare with the information obtained by the encoder 21.

[0046] As illustrated in FIG. 7, the control unit 22 has a memory 25 which is a storage means, a known ROM (Read-only Memory) 26, a RAM (Random Access Memory) 27, a CPU (Central Processing Unit) 28, a plurality of valve driver circuits 29, and a plurality of interfaces (shown as I/F in FIG. 3 and called as I/F hereinafter) 80. The control unit 22 is a computer.

[0047] The control unit 22 is electrically connected to the encoder 22, the motor 19, the cylinder 20, and etc. to control the whole cutting installation 8. The memory 25 is a known non-volatile memory such as an EEPROM. The memory 25 stores predetermined lengths L of the cables 2 and the number of the cables having each of the predetermined lengths.

[0048] ROM 26 stores execution programs of CPU 28, and RAM 27 stores temporarily data required for execution of CPU 28.

[0049] CPU 28 is a control means. CPU 28 receives information of the moving speed of the electrical cable 2 from the encoder 21. Furthermore, CPU 28 receives the cutting lengths L and the number of the cables having

each cutting length L. CPU 28 controls the motor 19 and the cylinder 20 based on the moving speed and travel distance of the electrical cable 2 which are obtained by the encoder 21.

[0050] CPU 28 controls the motor 19 such that the cable feeding unit 11 feeds the cable 2 as much as the predetermined length L based on the moving speed and travel distance of the electrical cable 2 which are obtained by the encoder 21 while the rod of the cylinder 20 is retracted. CPU 28 stops the motor 19 and extends the rod of the cylinder 20 when the predetermined length L of the cable is fed. That is, CPU 28 controls the cable feeding unit 11 to intermittently feed the cable 2 as much as the predetermined length L based on signals from the encoder 21 so that the cutting unit 12 cuts the cable 2.

[0051] The driver circuit 29 and I/F 80 are provided for each of the motor 19 and the cylinder 20. The driver circuits 29 are connected to CPU 28. Each driver circuit 29 electrically connects to each of the motor 19 and the cylinder 20 via each I/F 80. When the driver circuit 29 receives a signal from CPU 28 to drive the motor 19 or the cylinder 20, the driver circuit 29 outputs the signal to the motor 19 or the cylinder 20 through each I/F 80 to drive it.

[0052] The switch section 23, as shown in FIG. 5, has a contact 81 and a switch 82. The contact 81 is mounted on one of the cutting blades 17, 18 while the switch 82 is mounted on the other. In the illustrated example, the contact 81 is positioned in the cutting blade 17 while the switch 82 is positioned in the cutting blade 18.

[0053] The switch 82 has a body 83 and a contact 84. The contact 84 can extend from and retreat in the body 83. The body 83 is fitted on the cutting blade 18 with the contact 84 opposing to the contact 81. The contact 84 is pushed by the cutting blade 17 to retract in the body 83, when the cutting blades 17, 18 come close to each other to cut the cable 2. The switch 82 outputs a signal showing the retraction of the switch to a control unit 34 (discussed later) of the coloring unit 9. Thus, the switch 82 outputs a signal showing the cutting of the cable 2 to the control unit 34 of the coloring unit 9.

[0054] The cutting installation 8 feeds the cable 2 as much as the predetermined length L in the longitudinal direction K of the cable 2 based on a signal from the encoder 21 with the cable 2 being pinched between the pair of belt feeding units 13. Then, the cutting installation 8 stops the motor 19 and the driving pulleys 14 of the pair of belt feeding units 13, and the rod of the cylinder 20 extends when the predetermined length L of the cable is fed. Thereby, the pair of cutting blades 17, 18 come close to each other to pinch and cut the cable 2. That is, the cutting installation 8 feeds the cable 2 as much as the predetermined length L in the direction K based on signals from the encoder 21 to cut the cable 2.

[0055] The cable coloring unit 9 is positioned upstream of the cutting installation 8 in the traveling direction or in the direction K of FIG. 1. The cable coloring unit 9 is fitted to the cutting installation 8. The cable coloring unit 9 defines the dots 5, 6 on the outer surface 4a of the sheathing

layer 4. That is, the coloring unit 9 partially colors the outer surface 4a of the sheathing layer 4.

[0056] The coloring unit 9, as illustrated in FIG. 2, has a main body 30 disposed on a floor in a factory, a cable feeding unit 31, a colorant jet unit 32 as a coloring means, an encoder 33 as a second measuring means, and a control unit 34.

[0057] The main body 30 is configured in a box shape. The cable feeding unit 31 has a motor 58 (FIG. 4) and a pair of belt feeding units 35. The motor 58 is received in the main body 30.

[0058] Each belt feeding unit 35 has a driving pulley 36, a plurality of follower pulleys 37, and an endless belt 38. The driving pulley 36 is driven to rotate by the motor 58. Each follower pulley 37 is rotatably supported on the main body 30. The endless belt 38 is a ring one that surrounds the driving pulley 36 and the follower pulleys 37 such that the endless belt 38 moves along the driving pulley 36 and the follower pulleys 37.

[0059] The pair of belt feeding units 35 are vertically disposed parallel with each other. The pair of belt feeding units 35 pinch the electrical cable 2 therebetween, and the two driving pulleys 36 rotate at the same speed as each other but each in a direction opposed to each other with the rotation of the motor 58. This rotates the endless belts 38 to feed the electrical cable 2 as much as given length. The belt feeding units 35 feed the electrical cable 2 in a longitudinal direction of the cable which is shown by an arrow K in FIG. 2. The arrow K is along a horizontal direction.

[0060] The coloring jet unit 32, as shown in FIG. 3, has a plurality of nozzles 39, a plurality of colorant supplies 40, and a compressed gas supply 41. The nozzles 39 are positioned downstream of the belt feeding units 35 of the cable feeding unit 31 in the direction K. The nozzles 39 are spaced from each other along the arrow. The nozzles 39 are positioned above the cable 2 moved by the belt feeding units 35 of the cable feeding unit 31. Each nozzle 39 receives a colorant from a colorant supply 40.

[0061] Each nozzle 39 jets a colorant toward the outer surface 4a of the electrical cable 2 by a given amount in response to an instruction of the control unit 34. The jetted colorant adheres to the outer surface 4a of the electrical cable 2 to partially color the outer surface 4a.

[0062] The colorant supply 40 contains a colorant to supply it to the nozzle 39. Each colorant supply 40 corresponds to each nozzle 39. Each colorant supply 40 supplies a colorant having a color B or R. The colors B and R are different from each other.

[0063] The compressed gas supply 41 supplies a pressurized gas to the colorant supplies 40 so that the nozzles 39 can jet the colorants.

[0064] As illustrated in FIG. 3, the encoder 33 is provided separately from the encoder 21 and has a rotor 57 which can turn around its central axis. An outer peripheral surface of the rotor 57 contacts an outer surface 4a of the electrical cable 2 pinched between the pair of belt feeding units 35. The movement of the electrical cable 2

(core 3) along the arrow K rotates the rotor 57 around the central axis. Of course, the moving distance of the electrical cable 2 along the arrow K is proportional to the rotation number of the rotor 57.

[0065] The encoder 33 electrically connects to the control unit 34. The encoder 33 outputs a pulse signal to the control unit 34 every given angle rotation of the encoder 33. That is, the encoder 33 outputs information corresponding to the moving speed of the electrical cable 2 to the control unit 34.

[0066] Usually, the encoder 33 is mounted on a roll (rotation number counting rotor) 57 that rotates by friction between the rotor 57 and the electrical cable 2. However, when the pulse number is not proportional to the moving distance of the electrical cable 2 due to the condition of the outer surface 4a of the electrical cable 2, the moving speed data may be obtained at another position to feed back the data to compare with the information obtained by the encoder 33.

[0067] As illustrated in FIG. 4, the control unit 34 has a memory 59 which is a storage means, a known ROM (Read-Only Memory) 60, a RAM (Random Access Memory) 61, a CPU (Central Processing Unit) 62, a plurality of driver circuits 63, and a plurality of interfaces (shown as I/F in FIG. 4 and called as I/F hereinafter) 64. The control unit 34 is a computer.

[0068] The control unit 34 is electrically connected to the encoder 33, the motor 58 of the belt feeding unit 31, etc. to control the whole coloring unit 9. The memory 59 is a known non-volatile memory such as an EEPROM. The memory 59 stores a pattern the marks 7 provided on the outer surface 4a of the cable 2.

[0069] More specifically, the memory 59 stores the distances D1, D2, D3, ..., Dn of the dots 5, 6 of the mark 7 of the cable 2. Furthermore, the memory 59 stores the travel distance of the cable 2 to obtain a timing for jetting a colorant from the nozzle 39 to define the mark 7. Moreover, the memory 59 stores an open degree and an open state duration of the nozzle 39 to provide the dots 5, 6. The memory 59 also stores the predetermined length L (shown in FIGS. 8, 9) of the cable 2.

[0070] ROM 60 stores execution programs of CPU 62, and RAM 61 stores temporarily data required for execution of CPU 62.

[0071] CPU 62 includes the control means and the correction means which are described in the specification. CPU 62 receives information showing the running speed and the travel distance of the cable 2 from the encoder 33. CPU 62 also receives a pattern of the mark 7 and the length L. CPU 62 receives a travel distance of the cable 2 from the memory 59 to determine timing for jetting a colorant by each coloring nozzle 39 to define the mark 7 on the cable 2. CPU 62 intermittently operates the motor 58 based on information from the encoder 33 to intermittently feed the cable 2 by the predetermined length L.

[0072] CPU 62 controls a selected coloring nozzle 39 to jet a colorant based on the travel distance of the cable 2 and the jetting timing of the colorant.

[0073] That is, CPU 62 controls the selected coloring nozzle 39 to jet a liquid colorant when the cable travel distance obtained from the encoder 33 is equal to a travel distance corresponding to the colorant jetting timing of the nozzle 39. The nozzle 39 jets the colorant with a valve open degree stored in the memory 59 such that the dots 5, 6 defined on the outer surface 4a of the cable 2 can have a predetermined size. Thus, CPU 62 controls the colorant jet unit to provide the mark on the outer surface 4a of the cable 2 based on information from the encoder 33.

[0074] Furthermore, CPU 62 receives information from the encoder 21 of the cutting installation 8 and receives information showing the cutting of the cable 2 from the switch 82 of the switch section 23. CPU 62 determines whether there is a difference between cable travel distances obtained from the encoders 21, 33. Based on the difference, CPU 62 corrects the timing with which the nozzle 39 jets a liquid colorant. CPU 62 delays the timing based on the difference when the cable travel distance obtained from the encoder 21 is larger than that obtained from the encoder 33. On the contrary, CPU 62 expedites the timing based on the difference when the cable travel distance obtained from the encoder 21 is smaller than that obtained from the encoder 33.

[0075] The driver circuits 63 and the I/F 64 are provided for each of the nozzle 39 and the motor 58. The driver circuits 63 are electrically connected to CPU 62. The nozzle 39 electrically connects to one of the driver circuits 63 via one I/F. The driver circuit 63 receives signals for jetting a colorant from the nozzle 39 and for operating the motor 58, and the driver circuit 63 outputs the signals to a valve 46 and the motor 58 via the I/F 64. Thereby, the corresponding nozzle 39 jets a colorant and the motor 58 operates.

[0076] The I/F circuits 64 are used for electrically connecting the driver circuits 63 to the corresponding nozzles 39 and the motor 58.

[0077] Thus configured coloring unit 9 operates any one of the nozzles 39 to jet a colorant by a predetermined amount toward the cable 2 according to a pattern stored in the memory 59 based on the information obtained from the encoder 33. The coloring unit 9 defines the mark 7 on the outer surface 4a of the cable 2. Then, the cutting installation 8 receives a signal showing the cutting of the cable 2 from the switch 82 of the switch section 23. CPU 62 corrects the timing with which the nozzle 39 jets a colorant when there is a difference between the cable travel distances obtained from the encoders 21, 23. The travel distances correspond to a cable running period. In the illustrated example, the coloring unit 9 has two sets of the nozzles 39 and colorant supplies 40.

[0078] In this specification, the colorant has a viscosity not more than 10 mPa·s (milli-pascal-second). The colorant is a liquid-like material including a coloring material (industrial organic material dispersedly dissolved in a solvent such as water. The colorant is a die or a pigment, which is generally organic and synthetic. A pigment is

sometimes used as a die, and vice versa. More specifically, the colorant may be either of a coloring liquid and a coating material.

[0079] The coloring liquid includes a die dispersed in a solution liquid, and the coating material includes a pigment dispersed in a dispersion liquid. Thus, the die soaks into a sheathing layer 4 when the sheathing layer 4 is coated with the colorant. In the meantime, the pigment deposits on an outer surface 4a of a sheathing layer 4 without soaking into the sheathing layer 4 when the sheathing layer 4 is coated with the coating material. However, the process for depositing a colorant on an outer surface of a sheathing layer means coloring of a partial outer surface of a sheathing layer with a die and also painting of a partial outer surface 4a of a sheathing layer 4 with a pigment.

[0080] Preferably, the solvent and the dispersion liquid are affinitive to a synthetic resin material defining the sheathing layer. This makes it sure that the die soaks into the sheathing layer 4 and that the pigment deposits on the outer surface 4a of the sheathing layer 4.

[0081] The jetting process means that the nozzle 39 jets the liquid colorant on the outer surface 4a of the cable 2 with the colorant constituting a plurality of drops.

[0082] The cable finishing apparatus 1 cuts the cable 2 in the predetermined lengths L and defines the mark 7 on the outer surface 4a of the cable 2. Then, the cable finishing apparatus 1 feeds the cable 2 into the belt feeding unit 31 of the coloring unit 9 and into the cable feeding unit 11 of the cutting installation 8 sequentially. The cutting installation 8 and the coloring unit 9 operate synchronously with each other based on the signals obtained from the encoders 21, 33. The predetermined lengths L of the cable 2 are intermittently fed.

[0083] At this time, the control unit 34 receives information from the switch 82 of the switch section 23. CPU 62 corrects the timing with which the nozzle 39 jets a colorant when there is a difference between the cable travel distances obtained from the encoders 21, 33.

[0084] The jetted colorant adheres to the outer surface 4a of the cable 2, and with vaporization of the solvent or dispersion liquid, the die soaks into the sheathing layer 4 or the pigment deposits on the outer surface 4a of the sheathing layer 4. This provides the cables 2 constituting the wiring harness.

[0085] In the embodiment, CPU 62 receives information showing a cable travel distance from the encoder 21 of a first measuring device and receives information showing another cable travel distance from the encoder 33 of a second measuring device. CPU 62 corrects the marking timing of the nozzles 39 of the colorant jet unit 32 based on the differences of the obtained travel distances. This keeps correct positions of the dots 5, 6 of the mark 7 even when the cutting of the cable 2 is repeated to obtain a plurality of the cables having the predetermined length.

[0086] CPU 62 delays the making timing of the nozzle 39 of the colorant jet unit 32 when the cable travel dis-

tance obtained from the encoder 21 of the first measuring device is larger. On the contrary, CPU 62 expedites the making timing of the nozzle 39 when the cable travel distance obtained from the encoder 33 of the second measuring device is larger. This surely keeps correct positions of the dots 5, 6 of the mark 7 even when the cutting of the cable 2 is repeated to obtain a plurality of the cables having the predetermined length.

[0087] In the present invention, the coloring liquid and the paint material may be aryl paints, inks used as dyes or pigments, UV (ultra violet) inks, etc.

[0088] The discussed embodiment relates to the electrical cable 2 used to assemble a wiring harness arranged in an automobile vehicle. However, of course, the electrical cable 2 may be used for electronic instruments like a portable computer and various types of electric machines.

[0089] The discussed embodiment jets the liquid colorant by a predetermined amount to color the outer surface 4a of the cable 2. However, according to the present invention, the outer surface 4a of the cable 2 is colored by spraying of a liquid colorant or dipping in another liquid colorant.

[0090] The discussed embodiment utilizes the compressed gas supply 41 for pressuring the colorant. The compressed gas supply 41 supplies a pressurized gas to the colorant supply 40 to directly pressurize the colorant. Alternatively, the compressed gas supply 41 may have a gas pressurizing means such as a piston with a cylinder to pressurize a gas to supply a pressurized gas to the colorant supply 40. Furthermore, the colorant supply 40 itself may have a piston pressure device to pressurize the colorant.

[0091] The cutting installation 8 according to the present invention may press-fit terminals to ends of the cable after the cutting installation 8 cuts the cable in a predetermined length.

[0092] The discussed embodiments do not intend to limit the present invention but may be modified variously within the spirit of the present invention.

desired length based on information from the first measuring means,

a second measuring means for measuring a travel distance of the cable, the second measuring means provided separately from the first measuring means,

a coloring means for providing a mark on the outer surface of the cable,

a control means for controlling the coloring means to provide the mark on the outer surface of the cable based on information from the second measuring means, and

a correction means for correcting timing with which the coloring means provides the mark on the outer surface,

wherein, based on a difference between the travel distances measured by the first and second measuring means, the correction means corrects the timing after the output mean outputs a signal showing that the cutting installation has cut the cable.

2. The electrical cable coloring unit described in claim 1, wherein the timing is delayed based on the difference when the travel distance measured by the first measuring means is smaller than the travel distance measured by the second measuring means, and the timing is expedited based on the difference when the travel distance measured by the first measuring means is larger than the travel distance measured by the second measuring means.
3. A cable finishing apparatus having the electrical cable marking unit described in claim 1 or 2.

Claims

1. An electrical cable coloring unit for coloring an outer surface of an electrical cable which is moving along a longitudinal direction of the cable, the cable having a conductor core and a sheathing layer covering the core, the sheathing layer made of a synthetic resin material, the coloring unit mounted in a cable cutting installation, wherein the cable cutting installation comprises:

a first measuring means for measuring a travel distance of the cable,

an output means for outputting a signal showing that the cutting installation has cut the cable, the cable cutting installation cutting the cable in a

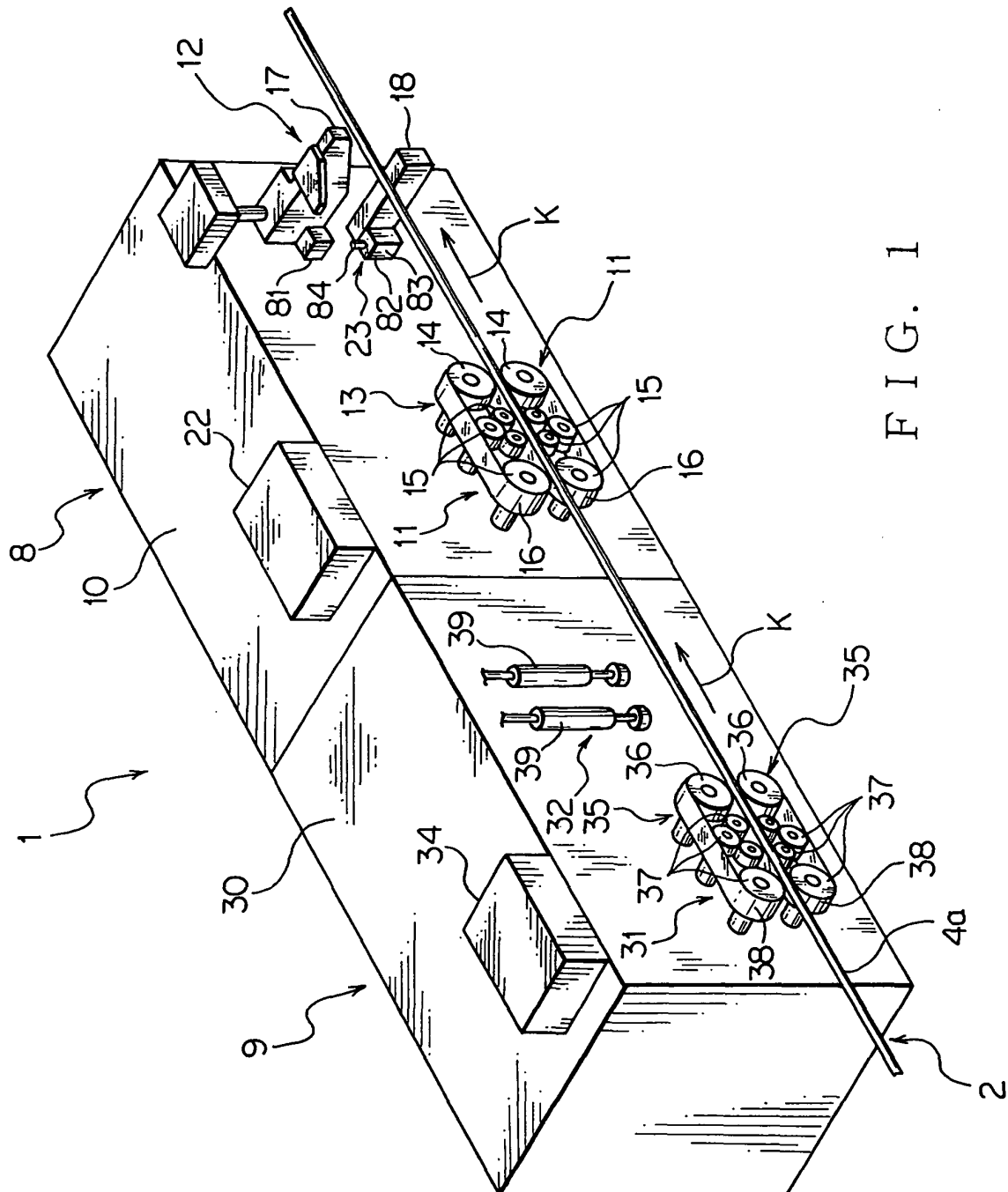


FIG. 1

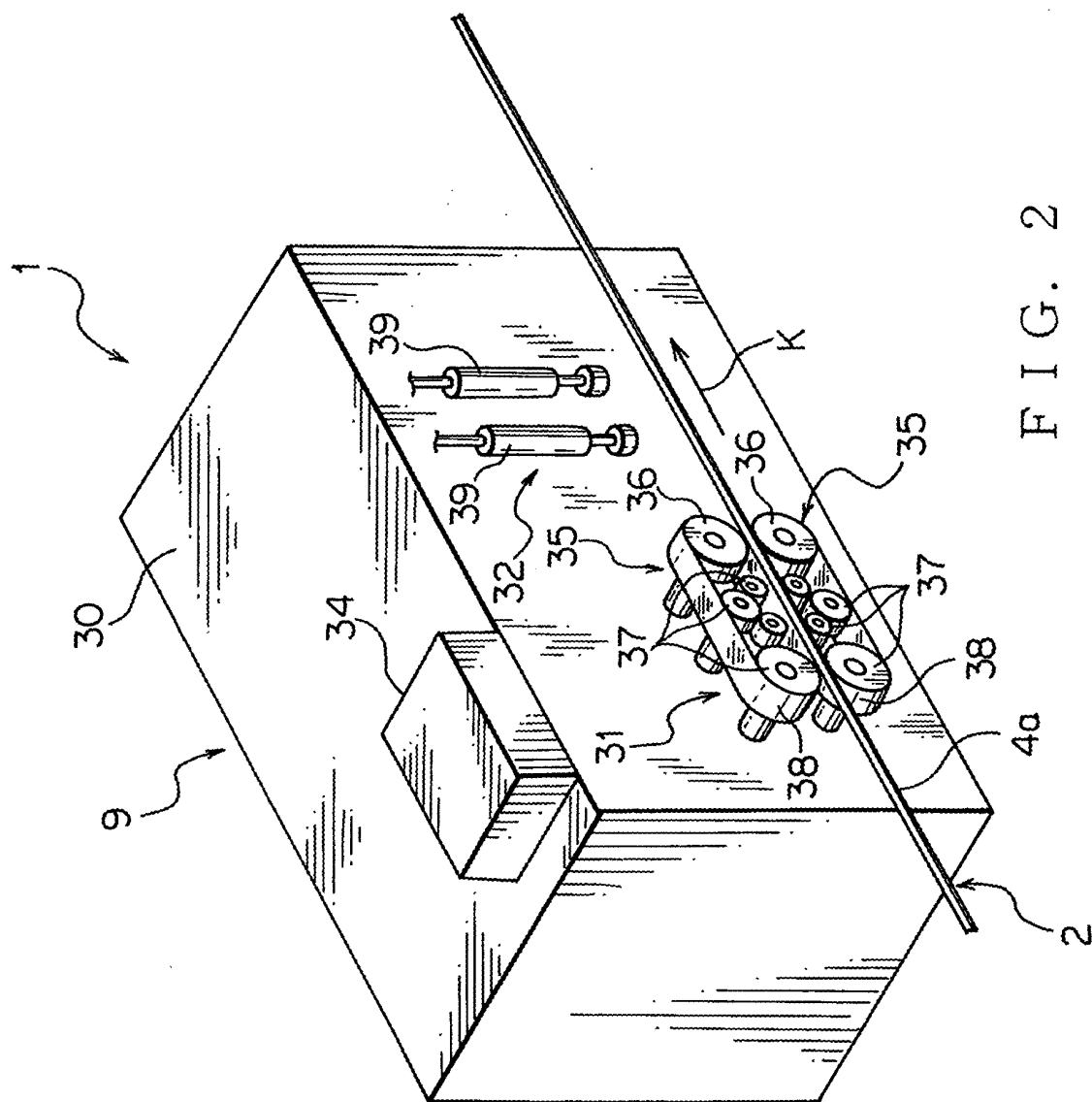


FIG. 2

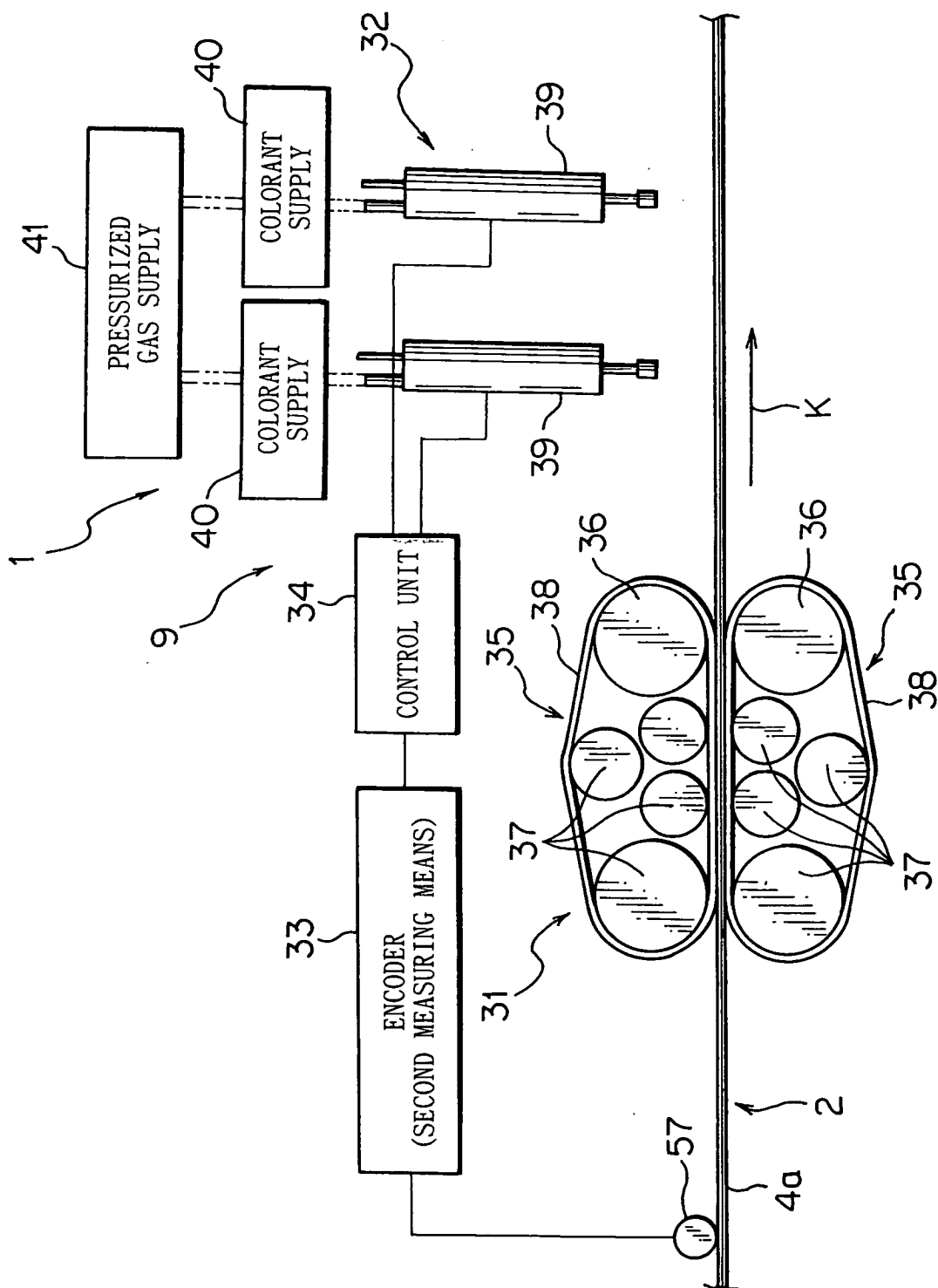


FIG. 3

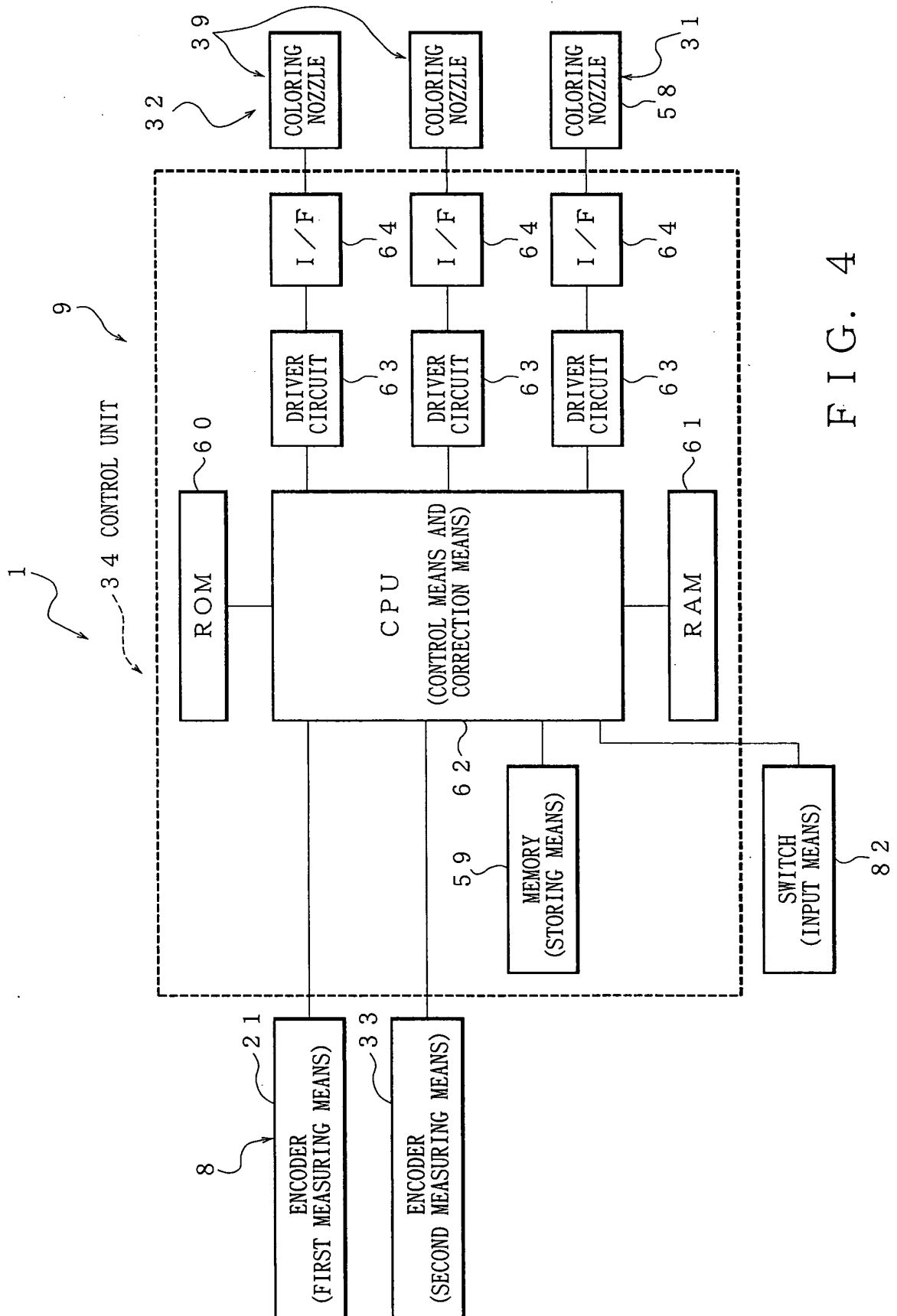


FIG. 4

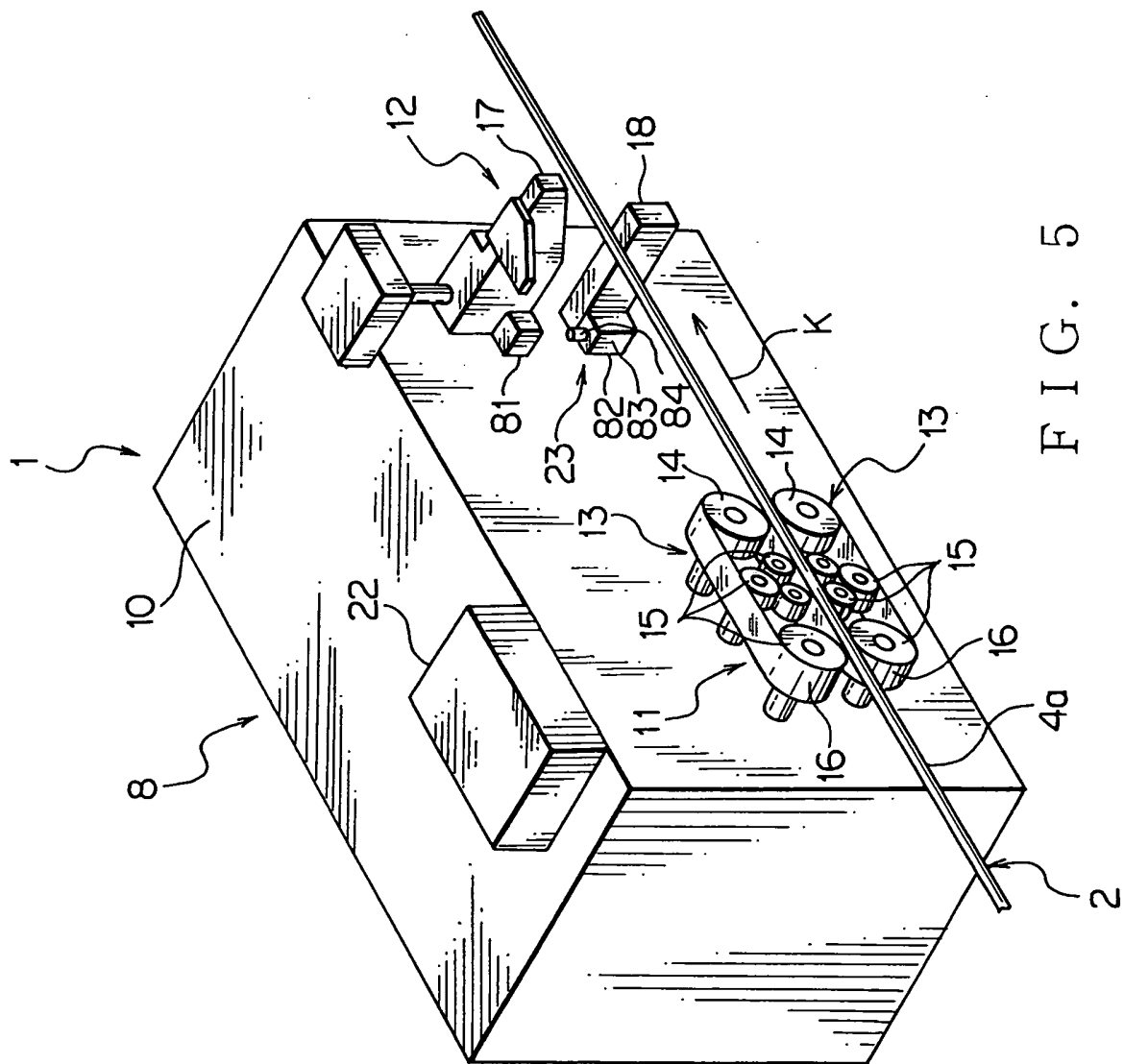


FIG. 5

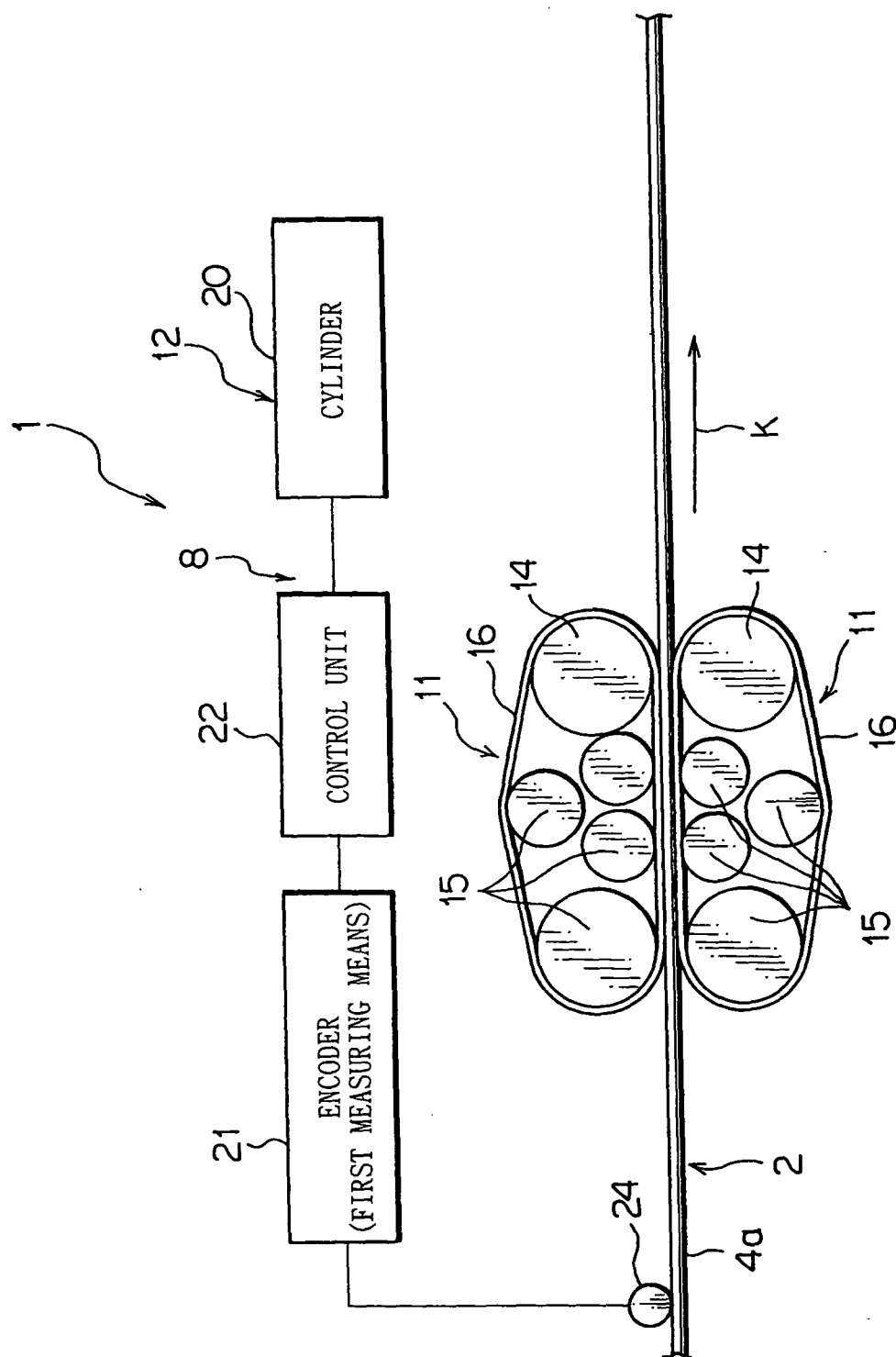


FIG. 6

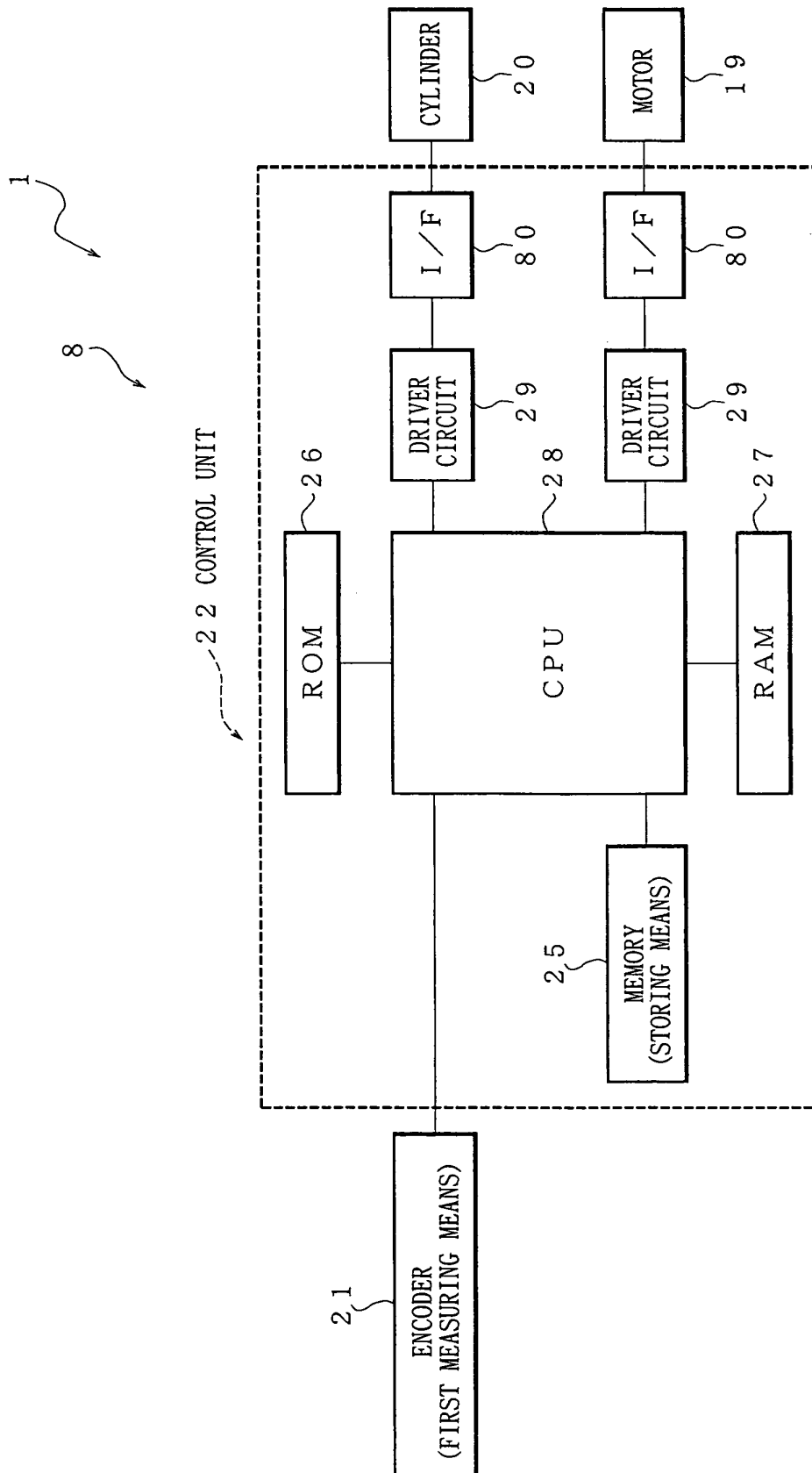


FIG. 7

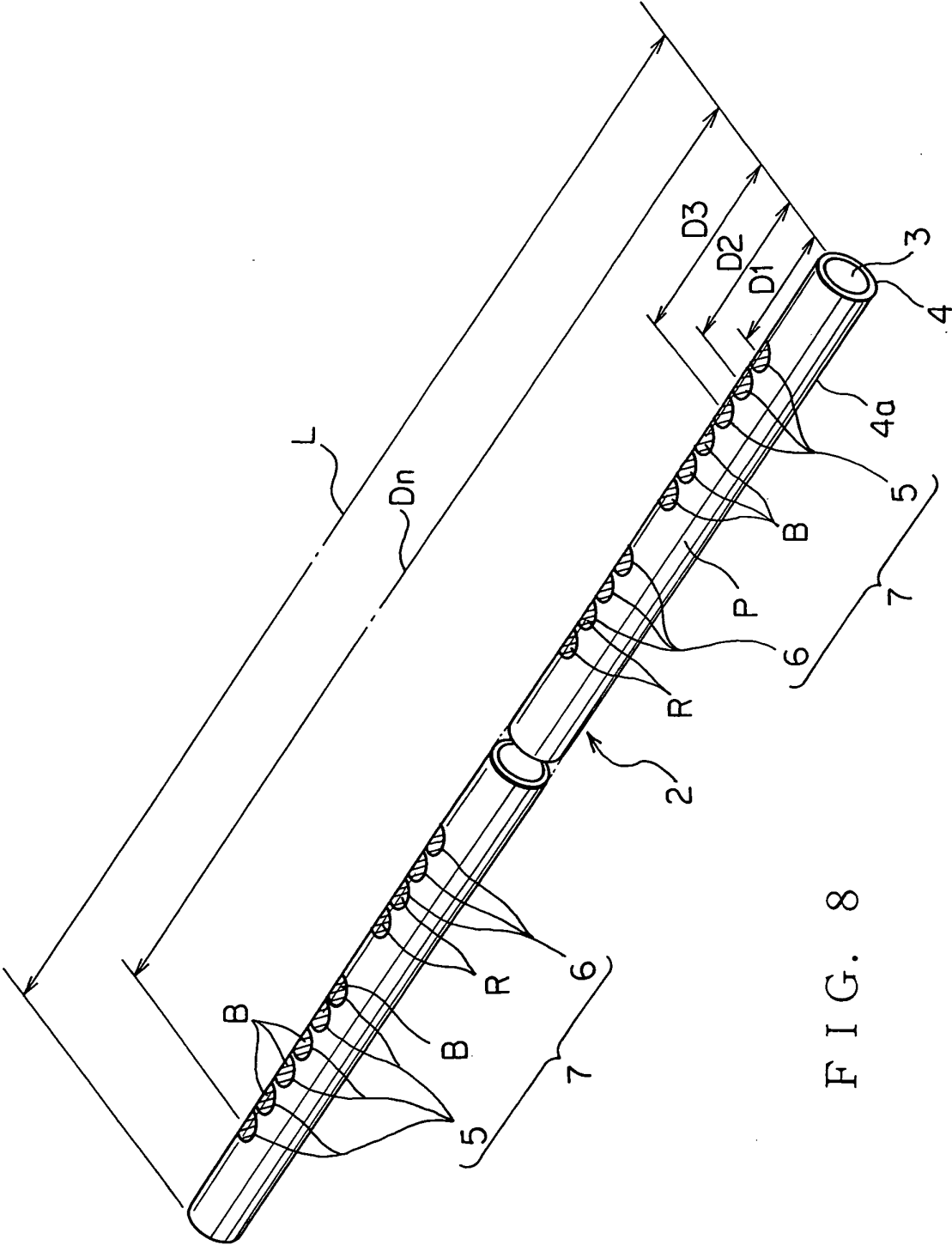


FIG. 8

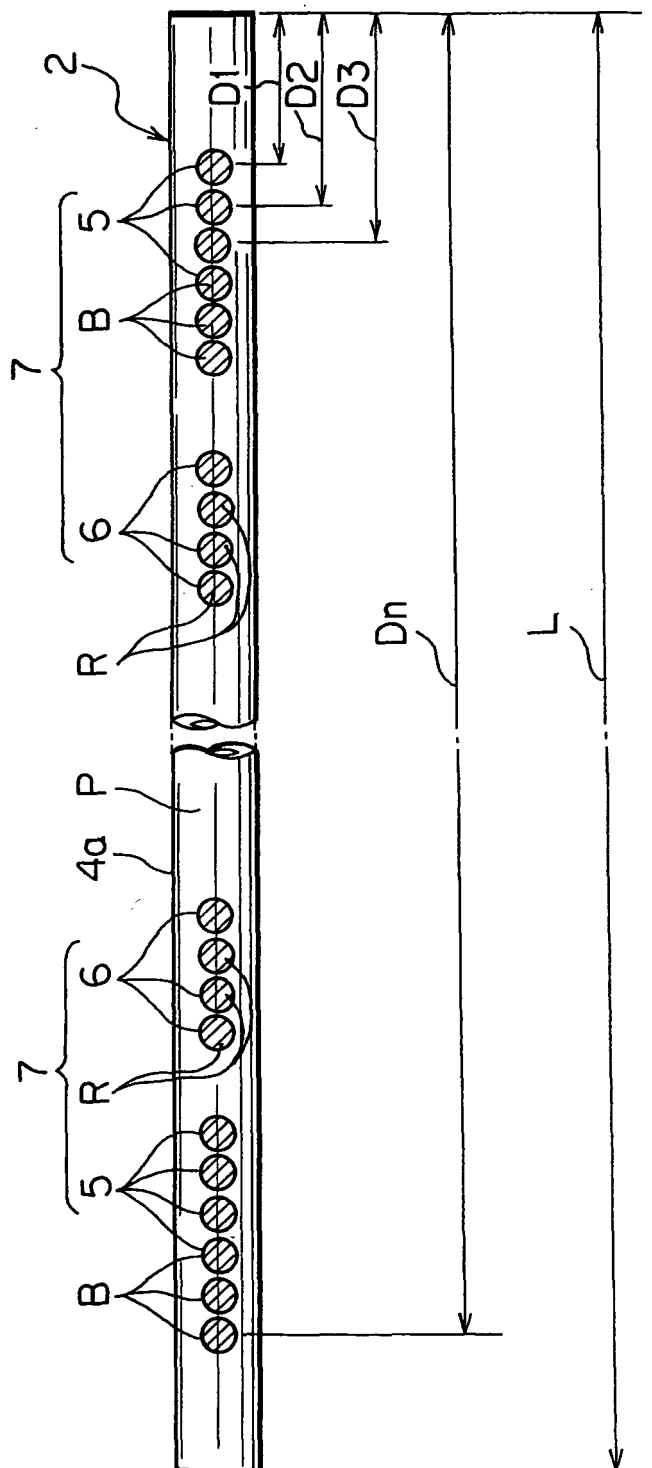


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/009785

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

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2005
Kokai Jitsuyo Shinan Koho	1971-2005	Toroku Jitsuyo Shinan Koho	1994-2005

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-134371 A (Yazaki Corp.), 30 April, 2004 (30.04.04), & WO 2004/015722 A1	1-3
A	JP 60-90720 U (Miura Co., Ltd.), 21 June, 1985 (21.06.85), (Family: none)	1-3

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

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search

16 August, 2005 (16.08.05)

Date of mailing of the international search report

30 August, 2005 (30.08.05)

Name and mailing address of the ISA/

Japanese Patent Office

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H5111947 A [0006]
- JP H6119833 A [0006]
- JP H992056 A [0006]