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(71) Applicant: **Yazaki Corporation**
Minato-ku, Tokyo 108-0073 (JP)

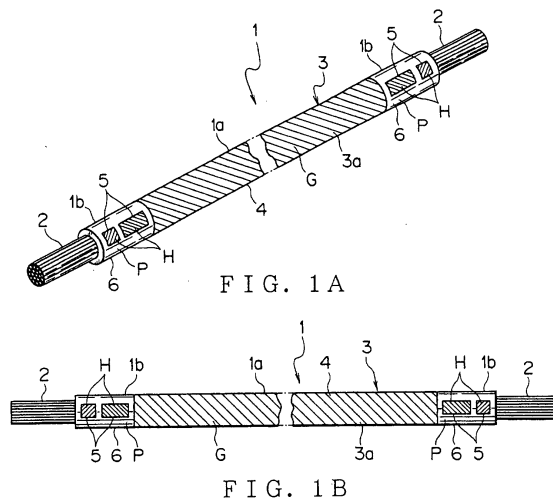
(72) Inventors:
• **KAMATA, Takeshi, c/o Yazaki Parts Co., Ltd.
Susono-shi, Shizuoka 410-1107 (JP)**
• **SUZUKI, Shigeharu, c/o Yazaki Parts Co., Ltd.
Susono-shi, Shizuoka 410-1107 (JP)**
• **SUGIMURA, Keigo, c/o Yazaki Parts Co., Ltd.
Susono-shi, Shizuoka 410-1107 (JP)**
• **YAGI, Kiyoshi, c/o Yazaki Parts Co., Ltd.
Susono-shi, Shizuoka 410-1107 (JP)**

(74) Representative: **Viering, Jentschura & Partner**
Steinsdorfstrasse 6
80538 München (DE)

(54) **ELECTRIC WIRE AND WIRE COLORING APPARATUS**

(57) An electric wire, which can be easily distinguished from each other and can prevent the deterioration in the quality of the wiring harness to be assembled, and an apparatus for coloring an electric wire are provided. The wire 1 includes a core wire 2 and a coating 3. The coating 3 coats the core wire 2 and a coating 3a of the coating 3 is provided with a first distinguishable part 4 and marks 5. The first distinguishable part 4 is formed on the whole circumference of the outer surface

3a of the coating 3, which is located near the central part in the longitudinal direction of the wire 1. The outer surface 3a of the first distinguishable part 4 is colored with a first color G, which is different from a color P of non-colored synthetic resin constituting the coating 3. The marks 5 are formed on a non-colored section 6 provided at both ends 1b of the wire 1. A non-colored coating 3 is bared in the non-colored section 6. The mark 5 is formed by coloring a part of the non-colored section 6 with a second color H.



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Description

[TECHNICAL FIELD]

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

[BACKGROUND ART]

[0002] Various electronic devices are mounted on a motor vehicle as a mobile unit. Therefore, the motor vehicle is provided with a wiring harness for transmitting power from a power source and control signals from a computer to the electronic devices. The wiring harness includes a plurality of electric wires 100 (shown in Figs. 4 and 5) and connectors attached to an end of the wires 100.

[0003] As shown in Figs. 4 and 5, the wire 100 includes an electrically conductive core wire 101 and a coating 102 made of insulating synthetic resin, which coats the core wire 101. The wire 100 is a so-called coated wire. The wire 100 is manufactured by extrusion-coating insulating synthetic resin around the core wire 101. The wire 100 is colored to a desired color by mixing a desired coloring agent with the synthetic resin upon the extrusion coating.

[0004] A connector includes an electrically conductive terminal fitting and an insulating connector housing. The terminal fitting is attached to an end of the wire 100 and comes into electrical contact with the core wire 101 of the wire 100. The connector housing is formed in a box-shape and receives the terminal fitting.

[0005] When the wiring harness is assembled, first the wire 100 is cut into a specific length and then the terminal fitting is attached to an end of the wire 100. A wire 100 is connected to another wire 100 according to the need. Afterward, the terminal fitting is inserted into the connector housing, thereby assembling the wiring harness.

[0006] The wire 100 of the wiring harness must be distinguished in terms of the size of the core wire 101, the material of the coating 102 (concerning with alteration in the materials depending upon heat-resisting property), and a purpose of use. The purpose of use means, for example, an air bag, antilock brake system (ABS), control signal such as speed data, and system in a motor vehicle in which the wire 100 is used, such as a power transmission system.

[0007] In order to distinguish the purpose of use (system) as described above, the wire 100 of the wiring harness has been colored to various colors by mixing various coloring agents with the synthetic resin which constitutes the coating 102 and subjected to various marking. As for a wire 100 shown in Figs. 4A and 4B, the outer surface 102a of the coating 102 is colored in a stripe pattern with two different colors A and B (shown

with parallel diagonal lines in the figures).

[0008] As for a wire 100 shown in Figs. 5A and 5B, a desired coloring agent is mixed with the synthetic resin constituting the coating 102 upon extrusion-coating, so that the outer surface 102a of the coating 102 is colored to a desired color C (shown with parallel diagonal lines in the figures). Marks 103 are formed on the outer surface 102a of the coating 102 located both ends in the longitudinal direction thereof. As for the marks 103, portions of the outer surface 102a of the coating 102 are colored to a color D and color E (shown with parallel diagonal lines in the figures), which are different from the color C.

[0009] Generally, users of a motor vehicle have various demands, therefore a motor vehicle must mount much more various electronic devices. Sometimes the wiring harness includes, for example, one hundred types of wires 100, forcing to use the wires 100 having various different colors.

[0010] Consequently, the wire 100 shown in Figs. 4A and 4B is colored in a stripe pattern by using various combinations of colors A and B. The wire 100 shown in Figs. 5A and 5B is colored by using various combinations of colors C, D and E.

[0011] The wiring harness, which is mounted in a motor vehicle, tends to increase in its weight since various electronic devices are mounted on the motor vehicle, therefore the wire 100 is forced to become thin. In this sense, as for the wire 100 shown in Figs. 4A and 4B having a stripe pattern in its color, when the wire 100 becomes thin, the pattern constituting the stripe becomes thin of course, thereby rendering the discrimination of the combination of two colors A and B difficult. As a result, the wires 100 tends to be arranged in error upon assembly of the wiring harness, causing the deterioration in the quality of the wiring harness.

[0012] As for the wire 100 shown in Figs. 5A and 5B, the wire 100 is in advance colored to a specific color by mixing a coloring agent with the synthetic resin which constitute the coating 102. Then, the marks 103 having the color D and E, which is different from the color C of the coating 102, are formed at both ends of the wire 100. When the wire 100 becomes thin, it may be difficult to distinguish the marks 103 depending upon the combination of the color C, D and E. As a result, the wires 100 tends to be arranged in error upon assembly of the wiring harness, causing the deterioration in the quality of the wiring harness.

[0013] In order to make various wires to be distinguished easily, the outer surface of the wire may be colored by using combination of various colors. However, upon extrusion coating of the coating, when the coloring agent is mixed with the synthetic resin that constitutes the coating, it has been necessary to once halt an operation of an apparatus for manufacturing the wire upon changing the color. Alternatively, the coloring agent to be mixed has been replaced without halting an operation of an apparatus for manufacturing the wire. In such

a case, a wire, in which a coloring agent before the replacement and a coloring agent after the replacement are mixed, has been inevitably manufactured, causing the deterioration in the yield of the wire. Therefore, a conventional apparatus for manufacturing the wire has not been capable of manufacturing the wire having various colors.

[0014] As for various apparatuses for coloring the wire, which have been proposed so far, only a mark or the like is formed at the end of the wire. Therefore, there is a limit for combination of the colors with such a conventional apparatus, which is not capable of manufacturing the wire having various colors.

[0015] It is therefore a first objective of the present invention to provide a wire, which can be easily distinguished from each other and can prevent the deterioration in the quality of the wiring harness to be assembled.

[0016] It is therefore a second objective of the present invention to provide an apparatus for coloring an electric wire, by which the wire having various colors on its outer surface can be easily obtained.

[DISCLOSURE OF INVENTION]

[0017] In order to attain the first objective, the present invention is to provide an electric wire comprising:

an electrically conductive core wire;
a coating made of synthetic resin for coating the core wire;
a first distinguishable part formed by coloring an outer surface of the central part in the longitudinal direction of the coating with a first color, which is different from a color of the synthetic resin; and
a second distinguishable part formed by coloring a part of each end in the longitudinal direction of the coating with a second color, which is different from the color of the synthetic resin.

[0018] With the construction described above, the first distinguishable part is formed on the outer surface of the central part of the coating. The first color of the first distinguishable part is different from the color of the synthetic resin. Therefore, even if the wire becomes thin, since the first distinguishable part is formed on the central part of the coating, the first color of the first distinguishable part can be easily distinguished. Moreover, the second distinguishable part is formed at a part of each end of the coating. The second distinguishable part is formed on the outer surface of the coating. The second color of the second distinguishable part is different from the color of the synthetic resin. Therefore, the second color of the second distinguishable part can be easily distinguished.

[0019] In this specification, "to color the outer surface of the coating" is to color the outer surface of the coating of the wire with a coloring agent. The coloring agent means a liquid substance, in which a coloring material

(organic substance for use in industry) is dissolved and dispersed in water or other solvent. The organic substance described above is a dye or a pigment. Sometimes, a dye is used as a pigment and a pigment is used as a dye. As an example, the coloring agent may be a coloring liquid or coating material.

[0020] The coloring liquid is a liquid, in which a dye is dissolved or dispersed in a solvent. The coating material is a material, in which a pigment is dispersed in a liquid dispersion. When the outer surface of the coating is colored with a coloring liquid, the dye permeates into the coating. When the outer surface of the coating is colored with a coating material, the pigment adheres to the outer surface without permeating into the coating. In the specification, "to color the outer surface of the coating" means to dye at least a part of the outer surface of the coating of the wire with a dye or to coat at least a part of the outer surface of the coating of the wire with a pigment.

[0021] Preferably, the solvent and liquid dispersion have an affinity to the synthetic resin constituting the coating in order to securely permeate the dye into the coating or to make the pigment securely adhere to the outer surface of the coating.

[0022] Preferably, there is provided a section, in which an outer surface of the synthetic resin is bared, between the first and second distinguishable parts.

[0023] With the construction described above, the section is formed between the first and second distinguishable parts. Therefore, the first and second distinguishable parts can be more easily distinguished from each other.

[0024] Preferably, each end of the coating is provided with a plurality of the second distinguishable parts and each second distinguishable part has a different color from that of the other second distinguishable part.

[0025] With the construction described above, a plurality of the second distinguishable parts are provided at each end of the coating. Therefore, by using combinations among the second colors of a plurality of the second distinguishable parts and the first color of the first distinguishable part, kinds of the wire to be distinguished from each other can be increased.

[0026] In order to attain the second objective, the present invention is to provide an apparatus for coloring an outer surface of a coating of an electric wire, which includes an electrically conductive core wire and the coating made of synthetic resin for coating the core wire, the apparatus comprising:

first coloring means for coloring an outer surface of the central part in the longitudinal direction of the coating with a first color, which is different from a color of the outer surface of the coating; and
second coloring means for coloring a part of each end in the longitudinal direction of the coating with a second color, which is different from a color of the outer surface of the coating.

[0027] With the construction described above, the first coloring means colors the central part in the longitudinal direction of the coating with the first color. The second coloring means colors a part of each end in the longitudinal direction of the coating with the second color. Therefore, by combination of the first color and the second color, kinds of the wire to be distinguished from each other can be increased.

[0028] The first and second coloring means color the outer surface of the coating with the first and second colors, respectively, which are different from a color of the outer surface of the coating. Therefore, by changing the first and second colors, the color of the wire can be easily changed.

[0029] The first coloring means preferably colors the whole circumference of the outer surface of the central part of the coating with the first color. In such a case, even if the wire becomes thin, the first color can be easily distinguished and the wire can be easily distinguished. Further, the wire, which is colored by the first and second coloring means, is preferably non-colored. In this case, the first and second coloring means securely color the wire with the first and second colors, respectively. Therefore, the wire, the outer surface of which has various colors, can be securely obtained.

[0030] Preferably, the apparatus further comprises:

transferring means for transfer the electric wire along the longitudinal direction of the electric wire;
measuring means for measuring a specific position of the electric wire; and
control means for controlling action of the first and second coloring means on the basis of the specific position of the electric wire measured by the measuring means.

[0031] With the construction described above, the outer surface of the wire is colored while the wire is transferred in the longitudinal direction thereof. On the basis of the specific position of the wire measured by the measuring means, the control means controls the action of the first coloring means and the second coloring means. Therefore, a predetermined position can be colored with the first color and the second color by using the first coloring means and the second coloring means, respectively.

[0032] The specific position can be any position of the wire provided that the specific position can be a reference position when the wire is transferred to be colored. For example, the specific position may be an end of the wire, or the end of the first distinguishable part where the wire is colored with the first color by the first coloring means.

[0033] Preferably, the second coloring means is disposed downstream from the first coloring means in the transferring direction of the electric wire and colors a section with the second color, wherein the section is located at a distance from a portion colored by the first

coloring means and the synthetic resin of each end of the coating is bared in the section.

[0034] With the construction described above, the second coloring means colors a portion, which has a distance from a portion colored by the first coloring means, with the second color. The second coloring means colors a part of the non-colored section which is bared with the second color. Therefore, in the wire, there is an outer surface of the synthetic resin' between the first color and the second color.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0035]

Figure 1A is a perspective view of an electric wire according to a preferred embodiment of the present invention.

Figure 1B is a plan view of the wire shown in Fig. 1A. Figure 2 illustrates a construction of an apparatus for coloring and cutting the wire shown in Figs. 1A and 1B.

Figure 3 is a plan view illustrating a primary part of the wire shown in Figs. 1A and 1B.

Figure 4A is a perspective view illustrating an example of a conventional wire.

Figure 4B is a plan view of the wire shown in Fig. 4A. Figure 5A is a perspective view illustrating another example of a conventional wire.

Figure 5B is a plan view of the wire shown in Fig. 5A.

[BEST MODE FOR CARRYING OUT THE INVENTION]

[0036] In the following, an electric wire and an apparatus for coloring the electric wire according to a preferred embodiment of the present invention will be explained with reference to Figs. 1 - 3.

[0037] An electric wire 1 constitutes a wiring harness to be mounted on a motor vehicle or the like as a mobile unit. As shown in Figs. 1A and 1B, the wire 1 includes an electrically conductive core wire 2 and an electrically insulating coating 3. A plurality of element wires are bundled up to form the core wire 2. Each element wire of the core wire 2 is made of electrically conductive metal. The core wire 2 may be constituted by a single element wire.

[0038] The coating 3 is made of synthetic resin such as polyvinyl chloride (PVC). The synthetic resin, which constitutes the coating 3, does not contain a coloring agent. Therefore, the synthetic resin is not colored, that is, an outer surface 3a of the coating 3 has a color P (shown with a white background in Figs. 1A and 1B) of the synthetic resin. The outer surface 3a of the coating 3 is an outer surface of the wire 1. In this specification, "not to be colored" means that a coloring agent is not mixed with the synthetic resin, which constitutes the coating 3 of the wire 1. That is, "not to be colored" means that the outer surface 3a of the coating 3 has the color

P of the synthetic resin itself.

[0039] The coating 3 coats the core wire 2. The outer surface 3a of the coating 3 is provided with a first distinguishable part 4, which is colored by a first coloring unit 12 (explained later on), and marks 5 as a second distinguishable part. The first distinguishable part 4 is formed on the outer surface 3a of the central part 1a in the longitudinal direction of the wire 1. The central part 1a is a central part in the longitudinal direction of the coating 3.

[0040] The outer surface 3a of the coating 3 consisting of the synthetic resin having the color P (shown with a white background in Figs. 1A and 1B) is colored with a first coloring agent of a first color G (shown with parallel diagonal lines in Figs. 1A and 1B) for the whole circumference of the central part 1a, thereby the first distinguishable part 4 is formed. The first color G is different from the color P of the synthetic resin. That is, the first distinguishable part 4 is formed by coloring the whole circumference of the outer surface 3a of the central part 1a in the longitudinal direction of the coating 3 with the first color G.

[0041] The marks 5 are formed on the outer surface 3a of the coating 3 located at both ends 1b in the longitudinal direction of the wire 1. Each end 1b is an end in the longitudinal direction of the coating 3. The marks 5 are formed on a non-colored section 6 located at both ends 1b. The outer surface 3a of the coating 3 consisting of the synthetic resin having the color P is bared, thereby the non-colored section 6 is formed. That is, the non-colored section 6 is not colored with a coloring agent and the outer surface of the synthetic resin having the color P is bared.

[0042] A part of the non-colored section 6, which is located at each end 1b, is colored with a second coloring agent of a second color H, which is different from the color P and from the color G, thereby the marks 5 are formed. That is, a part of each end 1b is colored with the second color H, which is different from both of the color P and the color G, thereby the marks 5 are formed.

[0043] In Figs. 1A and 1B, as an example, each mark 5 is formed in a rectangular shape in its plan view. Two marks 5 are formed per the end 1b of the wire 5, as an example. If a plurality of marks 5 are formed per the end 1b, the second color H of these marks 5 is preferably different from each other. More than two marks 5 may be formed per the end 1b of the wire 1. Thus, a part of each end 1b of the coating 3 is colored with the second color H, thereby the marks 5 are formed. The second color H may be the same as the first color G provided that the second color H is different from the color P of the synthetic resin, which constitutes the coating 3.

[0044] In this specification, "to color the outer surface 3a of the coating 3" is to color the outer surface 3a of the coating 3 of the wire 1 with a coloring agent. The coloring agent means a liquid substance, in which a coloring material (organic substance for use in industry) is dissolved and dispersed in water or other solvent. The organic substance described above is a dye or a pig-

ment. Sometimes, a dye is used as a pigment and a pigment is used as a dye. As an example, the coloring agent may be a coloring liquid or coating material.

[0045] The coloring liquid is a liquid, in which a dye is dissolved or dispersed in a solvent. The coating material is a material, in which a pigment is dispersed in a liquid dispersion. When the outer surface 3a of the coating 3 is colored with a coloring liquid, the dye permeates into the coating 3. When the outer surface 3a of the coating 3 is colored with a coating material, the pigment adheres to the outer surface 3a without permeating into the coating 3. In the specification, "to color the outer surface 3a of the coating 3" means to dye at least a part of the outer surface 3a of the coating 3 of the wire 1 with a dye or to coat at least a part of the outer surface 3a of the coating 3 of the wire 1 with a pigment.

[0046] Preferably, the solvent and liquid dispersion have an affinity to the synthetic resin constituting the coating 3 in order to securely permeate the dye into the coating 3 or to make the pigment securely adhere to the outer surface 3a of the coating 3.

[0047] The marks 5 as the second distinguishable part are formed in the non-colored section 6 located at each end 1b. That is, on the outer surface 3a of the coating 3, the non-colored section 6 (the outer surface of the synthetic resin constituting the coating 3) is formed between the first distinguishable part 4 and the marks 5. That is, the outer surface of the synthetic resin is bared between the first distinguishable part 4 and the marks 5.

[0048] Moreover, as shown in Fig. 3, as for the wire 1, the length L of the coating 3 along the longitudinal direction of the wire 1, the length L2 of the first distinguishable part 4 along the longitudinal direction of the wire 1, and the length L1 of the non-colored section 6 along the longitudinal direction of the wire 1 are determined in advance.

[0049] Furthermore, in one non-colored section 6 located at the right side in Fig. 3 (located at the downstream side in the direction of arrow K explained later on), the distance La between the one mark 5 near to the end of the wire 1 and the end of the wire 1 is determined in advance. In both of the non-colored sections 6, the length Lb of the one mark 5 located near to the end of the wire 1 along the longitudinal direction of the wire 1, the distance Lc between the marks 5 mutually adjacent to each other, and the length Ld of the other mark 5 located near to the central part of the wire 1 along the longitudinal direction of the wire 1 are determined in advance. Furthermore, In the other non-colored section 6 located at the left side in Fig. 3 (located at the upstream side in the direction of arrow K explained later on), the distance Le between the first distinguishable part 4 and the other mark 5 located near to the central part of the wire 1 is determined in advance.

[0050] A plurality of the wires 1 are bundled and a connector or the like is attached to the end of the bundled wires, thereby constructing the wiring harness. The connector is coupled with a mating connector of various

electronic devices in the motor vehicle, thereby the wiring harness, i.e., the wire 1 transfers various signals or electric power to various devices. At that time, the first distinguishable part 4 indicates a system in the motor vehicle as described above. The marks 5 indicate a position of a terminal-receiving chamber of the connector, into which a terminal fitting attached to the end is inserted. The wire 1 can be distinguished from each other by the combination of the first color G and the second color H.

[0051] The wire 1 is obtained by using an apparatus 10 for coloring and cutting the wire shown in Fig. 2. In this specification, the wire before being processed by the apparatus 10 is shown by the reference numeral 30, while the wire after being processed by the apparatus 10 is shown by the reference numeral 1.

[0052] The apparatus 10 cuts the very long and non-colored wire 30, which is rolled up with a drum 11 or the like, to a desired length on the basis of the length L as described above. The outer surface 3a of the coating 3 is colored with the first coloring agent on the basis of the length L1 and the length L2, thereby forming the first distinguishable part 4. A part of the non-colored section 6 is colored with the second coloring agent on the basis of the distances La, Lc and Le, the length Lb and the length Ld, thereby forming the marks 5. Thus, the apparatus 10 colors the outer surface 3a of the non-colored wire, thereby manufacturing the wire, in which the outer surface 3a of the coating 3 is colored. The non-colored wire means a wire, in which the whole outer surface 3a of the coating 3 is not colored with a coloring agent.

[0053] As shown in Fig. 2, the apparatus 10 for coloring and cutting the wire includes a first coloring unit 12 as the first coloring means, a second coloring unit 13 as the second coloring means, a cutting unit 14, encoder 17 as the measuring means, and control unit 18 as the control means.

[0054] In the apparatus 10, the non-colored wire is transferred in the direction shown by arrow K passing through the first coloring unit 12, the second coloring unit 13 and the cutting unit 14 in sequence, thereby the colored wire is manufactured. In order to move the wire, the apparatus 10 has a plurality of driving rollers 15 and a plurality of follower rollers 16. The follower roller 16 guides the transfer direction of the wire.

[0055] The first coloring unit 12 includes an impregnation tank 20, hoist roller 21, and squeegee 22. The impregnation tank 20 is formed in a box-shape having an opening upward. The impregnation tank 20 receives the first coloring agent of the first color G. The wire is moved above the impregnation tank 20 by the roller 15, 16. The hoist roller 21 is provided movable in the vertical direction.

[0056] When the hoist roller 21 descends, the wire being moved by the rollers 15, 16 is immersed into the first coloring agent in the impregnation tank 20. When the hoist roller 21 ascends, the wire being moved by the rollers 15, 16 is taken out from the first coloring agent in

the impregnation tank 20. Thus, the wire being moved by the rollers 15, 16 can be displaced between a position where the wire is immersed in the first coloring agent (shown by continuous lines in Fig. 2) and another position where the wire is taken out from the first coloring agent (shown by alternate long and two short dashes lines in Fig. 2).

[0057] The squeegee 22 is disposed at the downstream side of the impregnation tank 20. The squeegee 22 removes an excess of the first coloring agent adhering to the outer surface 3a of the wire from the outer surface 3a. Thus, the first coloring unit 12 colors the outer surface 3a of the central part 1a in the longitudinal direction of the coating 3 with the first color G, which is different from the color P, thereby forming the first distinguishable part 4.

[0058] The second coloring unit 13 is disposed downstream from the first coloring unit 12. The second coloring unit 13 has a spray 23. The second coloring units 13 are provided according to the number of marks 5. In Fig. 2, as an example, since one end 1b is provided with two marks 5 (in other words, totally four marks 5 being formed per wire 1), four sprays 23 are provided. The spray 23 sprays the second coloring agent of the second color H onto a part of the non-colored section 6, thereby forming the mark 5.

[0059] Thus, the second coloring unit 13 colors a part of the non-colored section 6 where the synthetic resin at each end 1b is bared with the second color H with leaving a space from the first distinguishable part 4. That is, the second coloring unit 13 colors at least a part of each end 1b in the longitudinal direction of the coating 3 with the second color H, which is different from the color P.

[0060] The cutting unit 14 is disposed downstream from the second coloring unit 13. The cutting unit 14 has a pair of cutting blades 24. These cutting blades 24 situate the wire being moved by the roller 15, 16 therebetween. The cutting blade 24 approaches or leaves each other. The cutting blade 24 approaches each other, nips the wire therebetween, and cuts the wire, thereby the wire 1 is obtained.

[0061] The encoder 17 has a rotor 25, which is rotatable around a rotation axis. The outer circumferential surface of the rotor 25 comes in contact with the coating 3 of the wire. When the wire moves in the direction of arrow K, the rotor 25 rotates around the rotation axis. The traveling distance of the wire in the direction of arrow K is proportional to the number of revolutions of the rotor 25.

[0062] The encoder 17 is connected to the control unit 18. When the rotor 25 rotates by every predetermined angle, the encoder 17 outputs a pulse signal to the control unit 18. That is, the encoder 17 outputs an information corresponding to the traveling distance of the wire to the control unit 18. Thus, the encoder 17 measures the information corresponding to the traveling distance of the wire and outputs the information as to an optional

position of the wire to the control unit 18.

[0063] Thus, the encoder 17 measures a specific position of the wire, which is moved by the rollers 15, 16. The specific position can be any position of the wire provided that the specific position can be a reference position when the wire is moved to be colored. For example, the specific position may be an end of the wire, or the end of the first distinguishable part 4 where the wire is colored with the first color G by the first coloring unit 12.

[0064] The control unit 18 is a computer including known RAM, ROM, CPU and so forth and control the whole apparatus 10. The control unit 18 is connected to an input unit 19. The control unit 18 stores the length L, L1, L2, Lb and Ld and the distances La, Lc and Le described above.

[0065] On the basis of command inputted from the input unit 19, a program stored in the ROM and so on described above, the length L, L1, L2, Lb and Ld and the distances La, Lc and Le, and the information from the encoder 17, the control unit 18 hoists the hoist roller 21 of the first coloring unit 12, operates the spray 23 of the second coloring unit 13, and operates the movement of the pair of blades 24 of the cutting unit 14. Thus, the control unit 18 controls the action of the first coloring unit 12 and the second coloring unit 13 on the basis of the specific position of the wire, which is measured by the encoder 17.

[0066] The input unit 19 is used to carry out various operations of the apparatus 10. The input unit 19 may be various units for inputting information such as a known keyboard, switch, and recording medium drive unit such as a CD-ROM drive unit.

[0067] In the apparatus 10, the encoder 17 measures the movement of the wire, which is moved by the rollers 15, 16. On the basis of the information measured by the encoder 17, the length L, L1, L2, Lb and Ld and the distances La, Lc and Le, the apparatus 10 hoists the hoist roller 21 of the first coloring unit 12, operates the spray 23 of the second coloring unit 13, and operates the movement of the pair of blades 24 of the cutting unit 14. Thus, the apparatus 10 processes the non-colored wire 30 being wound by the drum 11 to the wire 1 shown in Fig. 1.

[0068] According to the preferred embodiment, the first color G of the first distinguishable part 4 is different from the color P of the synthetic resin constituting the coating 3. Therefore, even if the wire becomes thin, since the first distinguishable part 4 is formed for the whole circumference of the central part 1a of the coating 3, the first color G of the first distinguishable part 4 can be easily distinguished.

[0069] Moreover, the marks 5 as the second distinguishable part are formed on the part of each end 1b of the coating 3. The synthetic resin has the color P. That is, the marks 5 are formed in the non-colored section 6 having the color P. The color H of the marks 5 is different from both of the color P of the synthetic resin and the first color G. Therefore, the marks 5 can be easily dis-

tinguished. The non-colored section 6 is provided between the first distinguishable part 4 and the marks 5. Therefore, the first distinguishable part 4 can be easily distinguished from the marks 5.

[0070] Consequently, the first distinguishable part 4 and the marks 5 can be easily distinguished from each other, thereby the wire 1 can be easily distinguished from the other wire 1. Therefore, by assembling a wiring harness using the wires 1 thus processed as described in the above preferred embodiment, an error in mounting the wires 1 can be prevented and the deterioration in the quality of the wiring harness can be prevented from occurring.

[0071] A plurality of marks 5 are formed at each end 1b of the coating 3. Therefore, by using combinations among the second colors H of a plurality of the marks 5 and the first color G of the first distinguishable part 4, kinds of the wire 1 to be distinguished from each other can be increased. Accordingly, it can be possible to deal with more various electronic devices.

[0072] In the preferred embodiment described above, the non-colored wire 30 is colored by the first coloring unit 12 and the second coloring unit 13. Therefore, the first color G and the second color H can be easily changed compared to a case, in which various coloring agents are mixed with the synthetic resin constituting the coating 3 when the coating 3 is formed. That is, the wire 1, the outer surface 3a of which has various colors, can be easily quickly obtained.

[0073] The first coloring unit 12 colors the central part 1a in the longitudinal direction of the coating 3 with the first color G. The second coloring unit 13 colors a part of each end 1b in the longitudinal direction of the coating 3 with the second color H. Therefore, by combination of the first color G and the second color H, kinds of the wire 1 to be distinguished from each other can be increased. That is, the wire 1, the outer surface 3a of which has various colors, can be obtained.

[0074] Moreover, the first and second coloring units 12, 13 color the outer surface 3a to the first and second colors G, H, respectively, which are different from the color of the outer surface 3a of the coating 3. Therefore, by changing the first and second colors G, H, the wire 1, the outer surface 3a of which has various colors, can be easily obtained.

[0075] The outer surface of the wire is colored while the wire is moved in the longitudinal direction thereof. On the basis of the specific position of the wire measured by the encoder 17, the control unit 18 controls the action of the first coloring unit 12 and the second coloring unit 13. Therefore, a predetermined position can be colored with the first color G and the second color H by using the first coloring unit 12 and the second coloring units 13, respectively. Therefore, the wire 1, the outer surface 3a of which is colored with a desired color, can be securely obtained.

[0076] The second coloring unit 13 colors a portion, which has a distance from a portion colored by the first

coloring unit 12, with the second color H. The second coloring unit 13 colors a part of the non-colored section 6 which is bared with the second color. Therefore, in the wire 1, there is a surface of the synthetic resin between the first color G and the second color H. Therefore, the first color G and the second color H can be easily distinguished from each other. That is, the wire 1, the outer surface 3a of which can be easily distinguished and has various colors, can be more securely obtained.

[0077] In the preferred embodiment described above, the encoder 17 measures the specific position of the wire. In the present invention, image-pickup means such as a CCD camera and distinguishing means for distinguishing an optional position of the wire from an image obtained by the image-pickup means can be used instead of the encoder 14.

[0078] In the preferred embodiment described above, the wire 1 is mentioned, which constitutes the wiring harness to be mounted in a motor vehicle. However, the wire 1 of the present invention can also be applied to various electric machines and electronic devices such as a portable computer.

[0079] In the preferred embodiment described above, the non-colored outer surface of the wire 30 is colored with the first color G and the second color H. Instead, in the present invention, the wire 1 may be produced starting from a wire, the coating of which is colored with a specific color after mixing a coloring agent with the synthetic resin, which coats the core wire. In such a case, a color of the outer surface of the colored wire is different from both of the first color G and the second color H. In this case, a wire, which is not often used or is in stock because of its limited use, can be reused.

[0080] In the present invention, as the means for forming the first distinguishable part 4 and the marks 5 as the second distinguishable part by coloring the outer surface 3a of the non-colored coating 3, various means may be used, such as dipping, spraying, injection, printing and transcription. As the coloring liquid or coating material, various material may be used, such as acrylic coating material, ink (dye or pigment) and UV-ink.

[0081] In the preferred embodiment described above, the whole circumference of the outer surface 3a of the central part 1a in the longitudinal direction of the coating 3 is colored with the first color G, thereby forming the first distinguishable part 4. Instead, in the present invention, a part of the outer surface 3a of the central part 1a in the longitudinal direction of the coating 3 may be colored with the first color G and the first distinguishable part 4 may be formed in a stripe pattern or a spiral pattern with the first color G and the color P.

[INDUSTRIAL APPLICABILITY]

[0082] As explained above, in the present invention described in claim 1, the first distinguishable part is formed on the outer surface of the central part of the coating. The first color of the first distinguishable part is

different from the color of the synthetic resin. Therefore, even if the wire becomes thin, since the first distinguishable part is formed on the central part of the coating, the first color of the first distinguishable part can be easily distinguished.

[0083] Moreover, the second distinguishable part is formed at a part of each end of the coating. The second distinguishable part is formed on the outer surface of the coating. The second color of the second distinguishable part is different from the color of the synthetic resin. Therefore, the second color of the second distinguishable part can be easily distinguished.

[0084] Consequently, the first and second distinguishable parts can be easily distinguished from each other, thereby the wires can be easily distinguished from each other. By assembling a wiring harness using the wires defined in the claim of the present invention, an error in mounting the wires can be prevented and the deterioration in the quality of the wiring harness can be prevented from occurring.

[0085] In the invention described in claim 2, the section is formed between the first and second distinguishable parts. Therefore, the first and second distinguishable parts can be more easily distinguished from each other.

[0086] Therefore, the wires can be easily distinguished from each other. By assembling a wiring harness using the wires defined in the claim of the present invention, an error in mounting the wires can be more securely prevented and the deterioration in the quality of the wiring harness can be more securely prevented from occurring.

[0087] In the invention described in claim 3, a plurality of the second distinguishable parts are provided at each end of the coating. Therefore, by using combinations among the second colors of a plurality of the second distinguishable parts and the first color of the first distinguishable part, kinds of the wire to be distinguished from each other can be increased. Accordingly, it can be possible to deal with more various electronic devices.

[0088] In the invention described in claim 4, the first coloring means colors the central part in the longitudinal direction of the coating with the first color. The second coloring means colors a part of each end in the longitudinal direction of the coating with the second color. Therefore, by combination of the first color and the second color, kinds of the wire to be distinguished from each other can be increased. That is, the wire having various colors can be obtained. Moreover, upon extrusion-coating, the outer surface of the wire colored by mixing a coloring agent is colored with the first color and the second color, thereby the wire is obtained. Therefore, a wire, which is not often used or is in stock because of its limited use, can be reused.

[0089] The first and second coloring means color the outer surface of the coating with the first and second colors, respectively, which are different from a color of the outer surface of the coating. Therefore, by changing

the first and second colors, the color of the wire can be easily changed. That is, the wire, the outer surface of which has various colors, can be easily obtained.

[0090] In the invention described in claim 5, the outer surface of the wire is colored while the wire is moved in the longitudinal direction thereof. On the basis of the specific position of the wire measured by the measuring means, the control means controls the action of the first coloring means and the second coloring means. Therefore, a predetermined position can be colored with the first color and the second color by using the first coloring means and the second coloring means, respectively. Therefore, the wire, the outer surface of which is colored with a desired color, can be securely obtained.

[0091] In the invention described in claim 6, the second coloring means colors a portion, which has a distance from a portion colored by the first coloring means, with the second color. The second coloring means colors a part of the non-colored section which is bared with the second color. Therefore, in the wire, there is an outer surface of the synthetic resin between the first color and the second color. Therefore, the first color and the second color can be easily distinguished from each other. That is, the wire, the outer surface of which can be easily distinguished and has various colors, can be more securely obtained.

Claims

1. An electric wire comprising:

an electrically conductive core wire;
a coating made of synthetic resin for coating the core wire;
a first distinguishable part formed by coloring an outer surface of the central part in the longitudinal direction of the coating with a first color, which is different from a color of the synthetic resin; and
a second distinguishable part formed by coloring a part of each end in the longitudinal direction of the coating with a second color, which is different from the color of the synthetic resin.

2. The electric wire according to claim 1, wherein there is provided a section, in which an outer surface of the synthetic resin is bared, between the first and second distinguishable parts.

3. The electric wire according to claim 1 or 2, wherein each end of the coating is provided with a plurality of the second distinguishable parts and each second distinguishable part has a different color from that of the other second distinguishable part.

4. An apparatus for coloring an outer surface of a coating of an electric wire, which includes an electrically

conductive core wire and the coating made of synthetic resin for coating the core wire, the apparatus comprising:

first coloring means for coloring an outer surface of the central part in the longitudinal direction of the coating with a first color, which is different from a color of the outer surface of the coating; and
second coloring means for coloring a part of each end in the longitudinal direction of the coating with a second color, which is different from a color of the outer surface of the coating.

5. The apparatus according to claim 4 further comprising:

transferring means for transfer the electric wire along the longitudinal direction of the electric wire;
measuring means for measuring a specific position of the electric wire; and
control means for controlling action of the first and second coloring means on the basis of the specific position of the electric wire measured by the measuring means.

6. The apparatus according to claim 5, wherein the second coloring means is disposed downstream from the first coloring means in the transferring direction of the electric wire and colors a section with the second color, wherein the section is located at a distance from a portion colored by the first coloring means and the synthetic resin of each end of the coating is bared in the section.

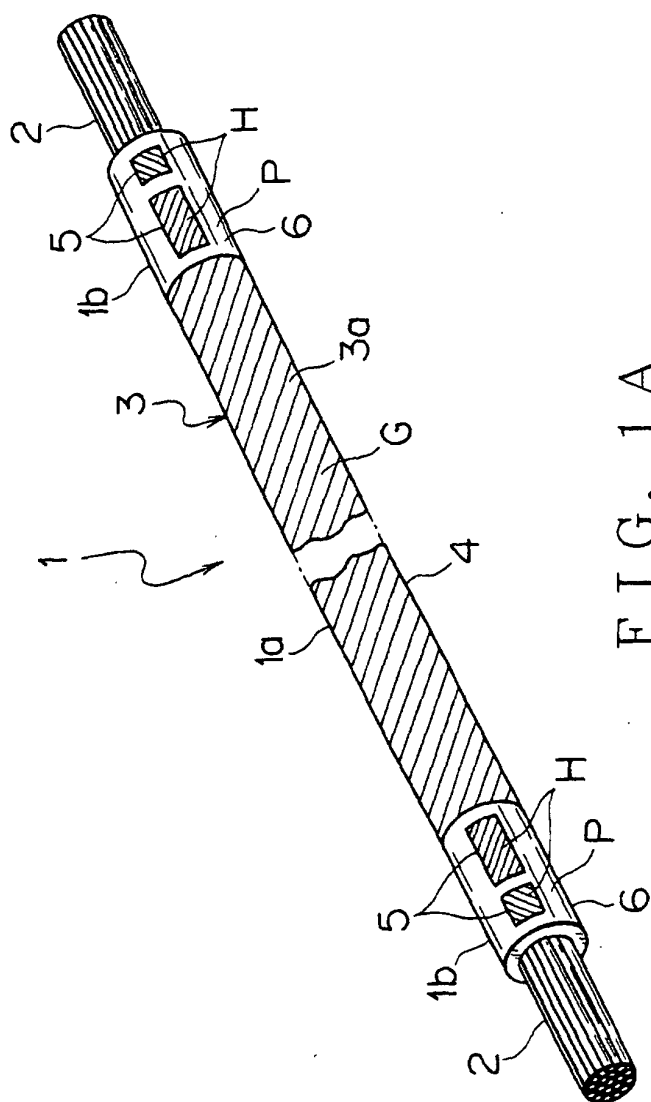


FIG. 1A

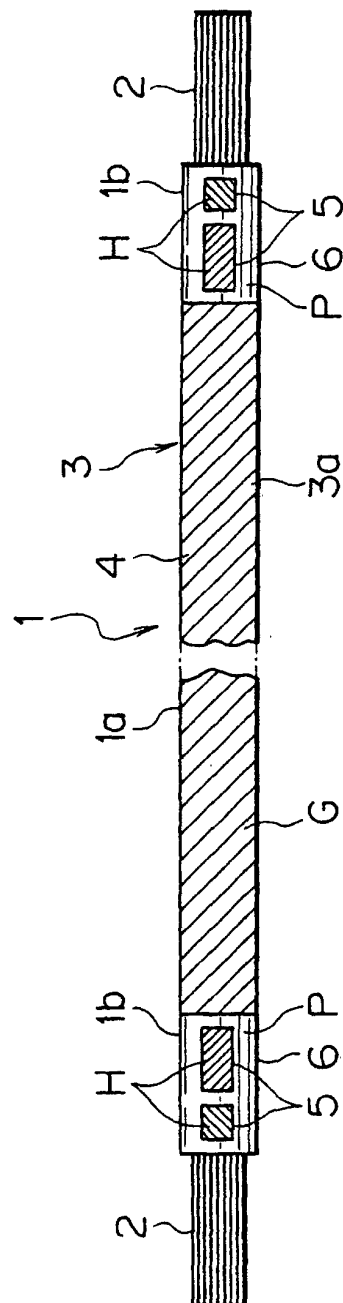


FIG. 1B

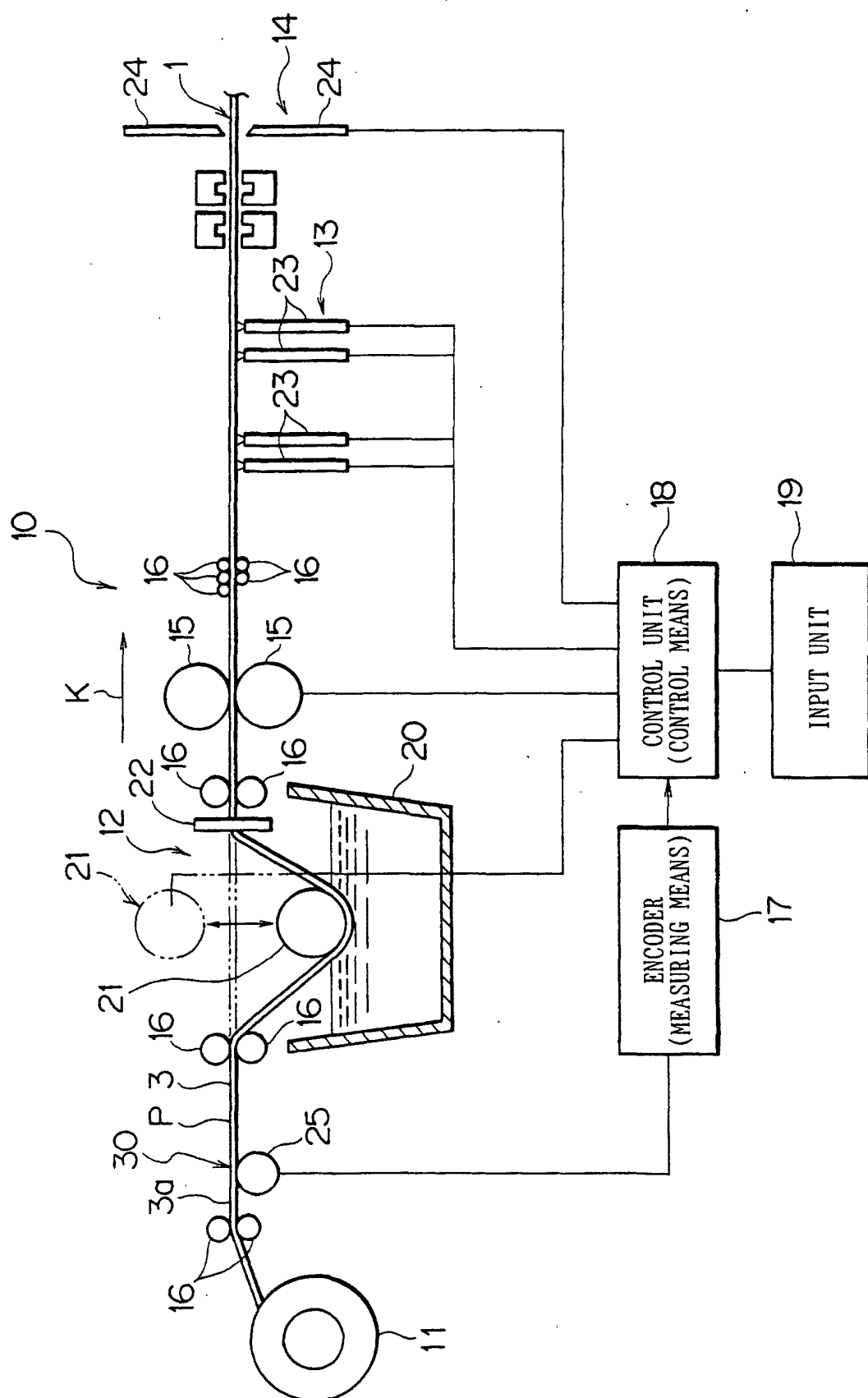


FIG. 2

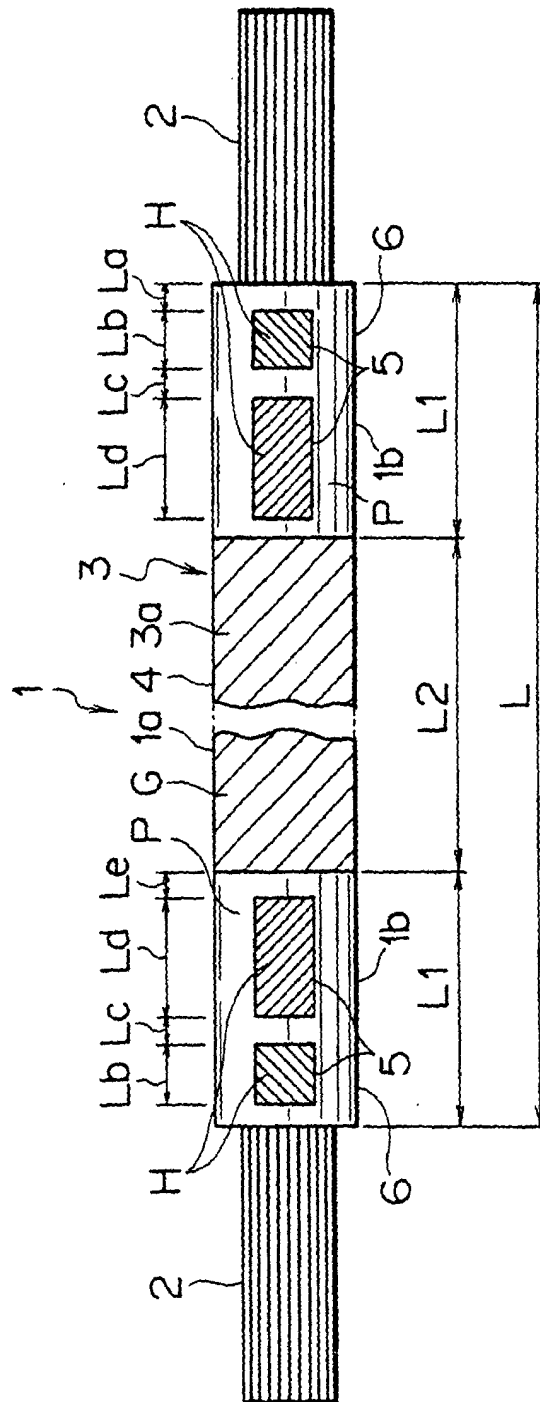


FIG. 3

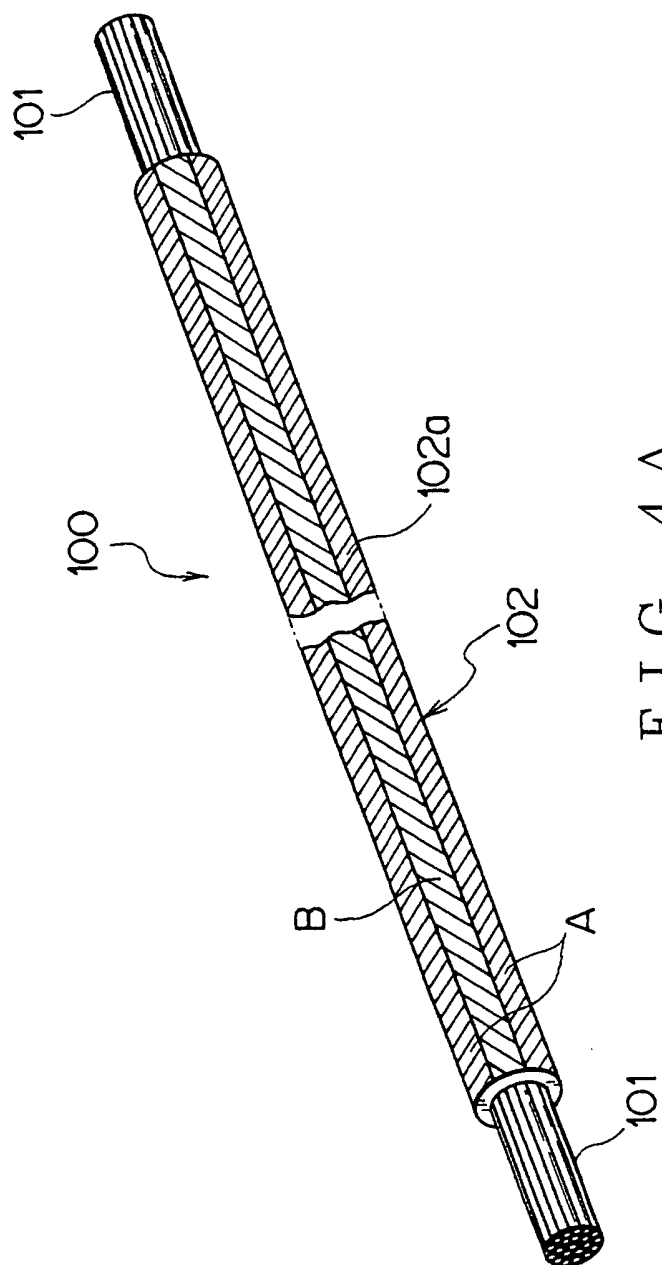


FIG. 4A

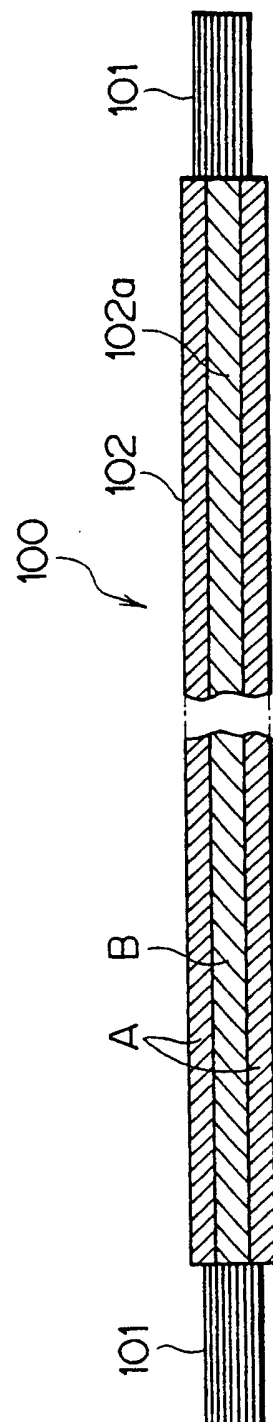


FIG. 4B

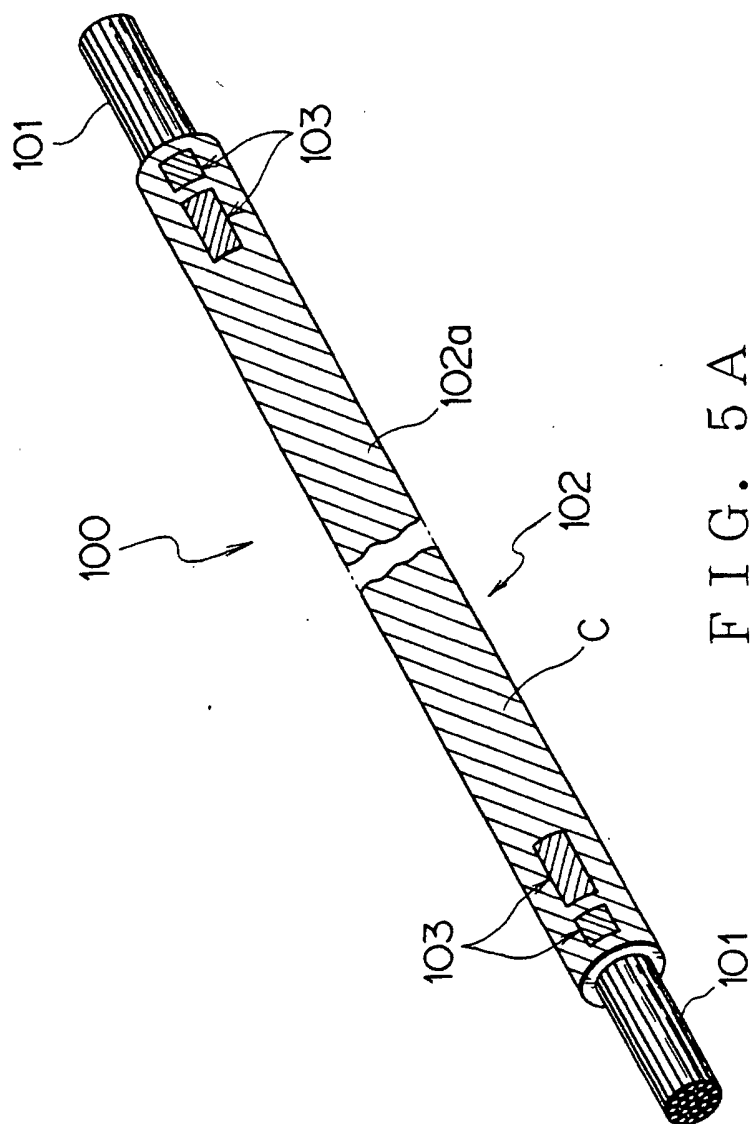


FIG. 5 A

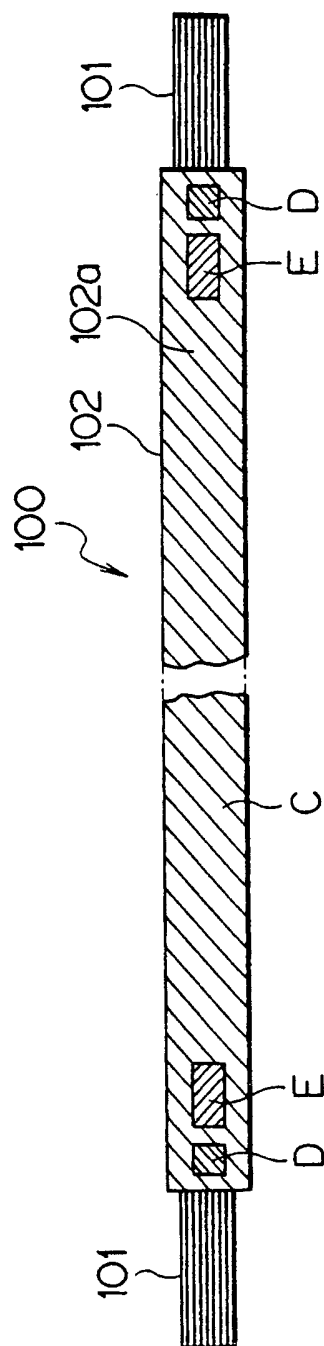


FIG. 5 B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/00149

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ H01B7/36, 7/00, 13/00, H01R13/642, 43/01 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 H01B7/36, 7/00, 13/00 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Jitsuyo Shinan Toroku Koho 1996-2003 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 37802/1990 (Laid-open No. 130116/1991) (Kanto Seiki Kabushiki Kaisha), 26 December, 1991 (26.12.91), Claim 1; Fig. 1 (Family: none)	1-3
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 186319/1984 (Laid-open No. 100827/1986) (Showa Electric Wire & Cable Co., Ltd.), 27 June, 1986 (27.06.86), Page 4, line 10 to page 6, line 5; Figs. 1, 2	4-6
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
Date of the actual completion of the international search 10 March, 2003 (10.03.03)		Date of mailing of the international search report 25 March, 2003 (25.03.03)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)