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(54) WIRE HARNESS ASSEMBLING METHOD

(57) The present invention is to provide a method of assembling a wiring harness easily and assuredly on a wiring board. Electric wires are wired on a wiring pattern on the wiring board for assembling the wiring harness. The wiring pattern includes a main line portion, a plurality of first branch line portions, and a plurality of second branch line portions. The line portions are colored in colors A-J and formed on a surface of the wiring board. The colors A-J of the line portions are different from each other. Outer surfaces of the electric wires wired on the wiring board are colored with the colors corresponding to the colors of the each line portion disposed below the electric wires. The electric wires are wired on the wiring board in accord with the colors of the line portions to assemble the wiring harness.

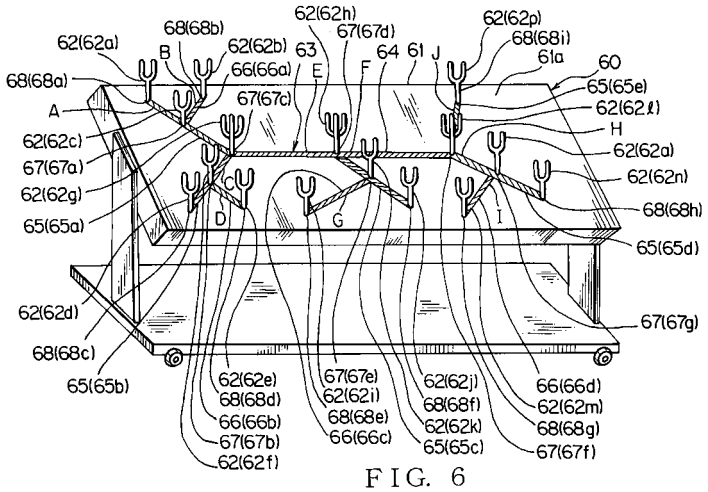

FIG. 6

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Description

Technical Field

[0001] The present invention relates to a method of assembling a wiring harness disposed in a motor vehicle.

Related Art

[0002] Various types of electronic units are mounted in a motor vehicle of a moving body. The motor vehicle includes wiring harnesses to provide electric power from a power source and control signals from a computer to the electronic units.

[0003] The wiring harnesses include a plurality of sub-harnesses. The sub-harnesses are provided each for a system control of the motor vehicle. The each sub-harness includes a plurality of electric wires and connectors attached to ends of the electric wires.

[0004] The each electric wire has a conductive core wire and a sheath made of an insulating synthetic resin covering the core wire. The electric wire is a so-called sheathed wire. The connector has terminals and a connector housing to receive the terminals. The terminals made of a conductive metal sheet are fixed to the ends of the electric wires to be connected with the core wires of the electric wires. The connector housing is made of a synthetic resin and has a box shape. The electronic units are connected to the terminals in the connector housing through the electric wires in order to provide the electric powers and signals.

[0005] The sub-harnesses are assembled prior to the assembling of the wiring harness. The sub-harnesses are wired sequentially on a wiring board to assemble the wiring harness. Then, wiring harness protectors or grommets are attached to the sub-harnesses. The sub-harnesses are joined together with a tape to assemble the wiring harness.

[0006] The wiring board includes a flat plane board and fixing devices on the board. The sub-harnesses and the electric wires are wired on the board. The board has a wiring pattern to wire the sub-harnesses and the electric wires on a surface of the board.

[0007] The fixing devices are capable of fixing the electric wires, or the sub-harnesses and arranged on the wiring pattern of the board. The each fixing device is placed at a position from which the fixed plurality of the electric wires extend toward different directions.

[0008] The fixing devices are arranged on the surface of the board according to the desired wiring pattern.

[0009] The motor vehicles are requested to include more electronic devices from users. Then, a number of the sub-harnesses of the wiring harness and a number of the electric wires in the sub-harness tend to increase.

[0010] It becomes more difficult to wire the sub-harnesses and observe the wiring pattern and the fixing devices on the board. The large number of the sub-harnesses and cables causes prolonged assembling time of the wiring harness.

[0011] Workers have to memory the positions of the fixing devices on the wiring board according to the connectors and the length of the electric wires. This causes time variations to set the sub-harnesses on the prescribed pattern on the wiring board depending on the skill of the workers. Then, the workers spend much time for assembling the wiring harness until they attain the skill.

Disclosure of the Invention

[0012] An object of the present invention is to provide a method of assembling a wiring harness by wiring easily and assuredly sub-harnesses on a wiring board.

[0013] According to a first aspect of the present invention, a method of assembling a wiring harness includes the steps of: forming a wiring pattern on a wiring board for wiring the wiring harness; disposing a main line portion, first branch line portions branched from the main line portion, and second branch line portions branched from the first branch line portions, to the wiring pattern; coloring the main line portion, the first and second line portions with colors different from each other; wiring electric wires for passing through at least one of the line portions of the main, first and second line portions; coloring outer surfaces of the electric wires with the colors in accord with colors of the each line portion on the wiring board; and wiring the electric wires so as to match the colors of the outer surfaces thereof with the colors of the corresponding line portions on the wiring board.

[0014] Thereby, the electric wires, or the sub-harnesses are easily wired on the wiring board.

[0015] According to a second aspect of the present invention, a method of assembling a wiring harness having a plurality of sub-harnesses includes the steps of: forming a wiring pattern on a wiring board for wiring the wiring harness; disposing a plurality of sub-harness line portions on the wiring pattern; coloring the plurality of the sub-harness line portions with colors different from each other; coloring outer surfaces of electric wires of the each sub-harness with the colors in accord with the colors of the each sub-harness line portion on the wiring board; and wiring the electric wires so as to match the colors of the outer surfaces thereof with the colors of the corresponding sub-harness line portions on the wiring board.

[0016] Thereby, the electric wires, or the sub-harnesses are easily wired on the wiring board.

[0017] Preferably, at least one of the sub-harness line portions includes branch portions branching the electric wires therefrom into different directions, a plurality of branch line portions branching from the branch portions, and identifiers for identifying the branch line portions each other, and wherein the sub-harness includes branch points branching the electric wires therefrom into different directions, a plurality of branch lines connected at the branch points and wired on the branch line portions, and second identifiers for identifying the branch lines each other.

[0018] Thereby, the desired branch lines are easily wired on the desired branch line portions.

[0019] Preferably, outer surfaces of connectors attached to end portions of the electric wires are colored with the colors of the corresponding sub-harness line portions.

[0020] Thereby, the sub-harnesses, or the wiring harness are/is easily wired on the wiring board.

[0021] According to a third aspect of the present invention, a method of assembling a wiring harness includes the steps of: forming a wiring pattern on a wiring board for wiring the wiring harness; disposing a plurality of branch portions for branching electric wires into different directions and end portions for positioning end portions of the electric wires; coloring the branch portions and end portions with colors different from each other; coloring outer surfaces of the electric wires with the colors in accord with the colors of the corresponding branch portions and end portions on the wiring board; and wiring the electric wires so as to match the colors of the outer surfaces thereof with the colors of the corresponding branch portions and end portions.

[0022] Thereby, the electric wires, or the wiring harness are/is easily wired on the wiring board.

[0023] Preferably, fixing devices are disposed on the branch portions and end portions for fixing the electric wires and are colored with the same colors as those of the corresponding branch portions and end portions.

[0024] Thereby, when the electric wires are wired on the wiring board, the fixing devices disposed at the branch and end portions are easily recognized.

[0025] According to a fourth aspect of the present invention, a method of assembling a wiring harness includes the steps of: forming a wiring pattern on a wiring board for wiring the wiring harness; disposing a plurality of branch portions for branching electric wires into different directions, end portions for positioning end portions of the electric wires, and fixing devices on the branch portions and the end portions for fixing the electric wires; coloring the fixing devices with colors different from each other; coloring outer surfaces of the electric wires with the colors in accord with the colors of the each corresponding fixing device on the wiring board; and wiring the electric wires so as to match the colors of the outer surfaces thereof with the colors of the corresponding fixing devices.

[0026] Thereby, when the electric wires are wired on the wiring board, the fixing devices disposed at the branch and end portions are easily recognized. Accordingly, the electric wires, or the wiring harness are/is easily wired on the wiring board.

[0027] Preferably, the outer surfaces of the electric wires are injected and colored with a constant amount of coloring materials.

[0028] Thereby, the colors of the outer surfaces of the electric wires are hardly peeled off. An increase of outer diameters of the electric wires is restrained.

[0029] The coloring material is liquid material consisting of color material (organic substance for industrial purpose) which is dissolved or dispersed in water or other solvent. As the organic substance, the coloring material includes dyes and pigments which are generally composites of the organic substances. The dyes may be used as the pigments, or the pigments may be used as the dyes according to cases. As more specific examples, the coloring material in the specification means both coloring liquid and paint. The coloring liquid means the dye which is dissolved or dispersed in the solvent, while the paint means the pigment which is dispersed in dispersion liquid. Therefore, when the coloring liquid has been adhered to the outer surface of the sheath, the dye will be infiltrated into the sheath. On the other hand, when the paint has been adhered to the outer surface of the sheath, the pigment will not be infiltrated into the sheath, but simply adhered to the outer surface. Therefore, the method for coloring the outer surface of the electric wire includes both dyeing a part of the outer surface of the electric wire with the dye, and applying the pigment to the part of the outer surface of the electric wire.

[0030] Preferably, the solvent and dispersion liquid are compatible with the synthetic resin which forms the sheath. In this case, the dye can be reliably infiltrated into the sheath, and the pigment can be reliably adhered to the outer surface of the sheath.

[0031] An injection means, in this specification, that the coloring material is energized from a coloring nozzle and injected onto the outer surface of the electric wire with a drop.

Brief Description of the Drawings

[0032]

FIG.1 is a perspective view of a wiring harness assembled by a method of a first embodiment of the present invention;

FIG. 2 is a perspective view showing a structure of a sub-harness of the wiring harness depicted in FIG. 1;

FIG. 3 is a side view of the sub-harness shown in FIG. 2;

FIG. 4 is a perspective view showing a structure of another sub-harness of the wiring harness depicted in FIG. 1;

FIG. 5 is a side view of the sub-harness shown in FIG. 4;

FIG. 6 is a perspective view of a wiring board utilized for assembling the wiring harness of FIG. 1;

FIG. 7 is a front view of the wiring board of FIG. 6;

FIG. 8 is a perspective view showing a fixing device disposed on the wiring board of FIG. 6;

FIG. 9 is a sectional view taken along lines IX-IX of FIG. 8;

FIG. 10 is a front view of a wiring pattern on the wiring board shown in FIG. 7;

FIG. 11 is a side view showing a coloring apparatus

for coloring an outer surface of an electric wire of the wiring harness shown in FIG. 1;
FIG. 12 is a sectional view of a coloring unit of the coloring apparatus taken along lines XII-XII of FIG. 11;
FIG. 13 is a sectional view of a coloring nozzle of the coloring unit depicted in FIG. 12;
FIG. 14 is a perspective view of a wiring board for assembling a wiring harness with a method of a second embodiment of the present invention;
FIG. 15 is a front view of the wiring board shown in FIG. 14;
FIG. 16 is a front view of a wiring pattern on the wiring board shown in FIG. 14;
FIG. 17 is a perspective view showing a structure of a sub-harness to be assembled with a method of the embodiment;
FIG. 18 is a perspective view showing a structure of another sub-harness to be assembled with the method of the embodiment;
FIG. 19 is a perspective view showing a structure of still another sub-harness to be assembled with the method of the embodiment;
FIG. 20 is a perspective view showing a structure of a further sub-harness to be assembled with the method of the embodiment;
FIG. 21 is a perspective view showing a structure of a modified sub-harness of FIG. 17;
FIG. 22 is a perspective view of a wiring board for assembling a wiring harness with a method of a third embodiment of the present invention;
FIG. 23 is a front view of the wiring board shown in FIG. 22;
FIG. 24 is a perspective view showing a fixing device disposed on the wiring board of FIG. 22;
FIG. 25 is a perspective view showing a structure of a sub-harness to be assembled with a method of the third embodiment;
FIG. 26 is a side view of the sub-harness of FIG. 25;
FIG. 27 is a perspective view showing a structure of another sub-harness to be assembled with the method of the third embodiment;
FIG. 28 is a side view of the sub-harness of FIG. 27;
FIG. 29 is a perspective view showing a modification of a fixing device disposed on the wiring board utilized for the assembly of the embodiment;
FIG. 30 is a perspective view showing a modification of the wiring board utilized for the assembly of the embodiment;
FIG. 31 is a front view of the wiring board of FIG. 30; and
FIG. 32 is a perspective view showing a fixing device disposed on the wiring board of FIG. 30.

Detailed Description of the Preferred Embodiments

[0033] A method of assembling of a wiring harness according to a first embodiment of the present invention is explained by referring to FIGS. 1-13. The present invention is the method to assemble a wiring harness 1 of FIG. 1.

[0034] The wiring harness 1 is arranged in a motor vehicle and transfers electric power and signals to electronic devices installed in the vehicle. As shown in FIG. 1, the wiring harness 1 includes a plurality of sub-harnesses 2a, 2b (FIGS. 2-5), harness protectors (hereafter called protector) 50, harness tubes (hereafter called tube) 51, a harness grommet (hereafter called grommet) 52, clips 53, and harness tapes (hereafter called tape) 54.

[0035] As shown in FIGS. 2-5, the sub-harnesses 2a, 2b each have a plurality of electric wires 3 and connectors 6 attached to end portions of the electric wires. The each electric wire 3 includes a conductive core wire and an insulating sheath. The each core wire is formed of a plurality of wires twisted together. The wires composing the core wires are made of electrically conductive metal. The core wires can be a single wire. The sheaths are formed of, for example, a synthetic resin such as polyvinyl chloride (PVC) . Since the sheaths cover the core wires, outer surfaces 3a of the sheaths become the outer surfaces of the electric wires 3.

[0036] The sheaths have a single color such as white. In order to give the single color to the outer surfaces 3a of the electric wires 3, a coloring material having a desired color may be admixed to the synthetic resin which forms the sheaths, or the synthetic resin may not be mixed with the coloring material so that the color of the synthetic resin itself may constitute the single color. In case where the color of the synthetic resin itself is the single color with no coloring material mixed to the synthetic resin forming the sheaths, the outer surfaces 3a of the sheaths, that is, the outer surfaces of the electric wires 3 are called as non-coloring. In this manner, the term "non-coloring" means that the outer surfaces 3a of the electric wires 3 have the color of the synthetic resin itself without mixing the coloring material into the synthetic resin.

[0037] When the sub-harness 2a shown in FIGS. 2, 3 is wired on a wiring board 60 of FIG. 6, the sub-harness 2a is colored with each color of E, A, H corresponding to the each color E, A, H of a main line portion 64, branch line portions 65a, 65d noted by parallel diagonal lines in FIGS. 6, 7, 10.

[0038] The sub-harness 2a is arranged to fixing devices 62a, 62c, 62g, 62h, 621, 62o, 62n placed on branch portions 67a, 67c, 67d, 67f, 67g and end portions 68a, 68h.

[0039] The first branch line portion 65a is colored with the color A denoted by parallel diagonal lines in FIG. 7 in accord to a wiring pattern 63. The outer surfaces 3a of the electric wires of the sub-harness 2a placed above the branch line portion 65a are colored with the color A. The main line portion 64 is colored with the color E in the wiring pattern 63. The outer surfaces 3a of the electric wires of the sub-harness 2a placed above the main line portion 64 are colored with the color E. The outer surfaces 3a of the electric wires of the sub-harness 2a placed

above the branch line portion 65d have the same color H as that of the branch line portion 65d.

[0040] The outer surfaces 3a of the electric wires 3 of the sub-harness of FIGS. 4, 5 have the same colors D, C, E, F, G arranged at the line portions 66b, 65b, 64, 65c, 66c of the wiring pattern 63 in the wiring board 60.

[0041] The sub-harness 2b of FIGS. 4 and 5, is arranged to the fixing devices 62e, 62f, 62g, 62h, 62k, 62i disposed at the end portions 68d, 68e and the branch portions 67b, 67c, 67d, 67e.

[0042] The outer surfaces 3a of the electric wires 3 of the sub-harness 2b above a second branch line portion 66b have the same color D as that of the same portion 66b. The sub-harness 2b above the branch line portion 65b has the same color C as that of the same portion 65b.

[0043] The sub-harness 2b above the main line portion 64 has the same color E as that of the same portion. The sub-harness 2b above the first branch line portion 65c has the same color F as that of the same portion 65c. The sub-harness 2b above the second branch line portion 66c has the same color G as that of the same portion 66c.

[0044] The colors of the outer surfaces 3a of the electric wires 3 of the sub-harnesses 2a, 2b correspond with the colors A, B, C, D, E, F, G, H, I, J of the main line portion 64 and the branch line portions 65a, 65b, 65c, 65d, 65e, 66a, 66b, 66c, 66d. The each of the colors A to J has a different color adjacent to each other. When the electric wires 3 of the sub-harnesses 2a, 2b are wired on the wiring board 60, the electric wires 3 pass over the main line portion 64 and at least one of the branch line portions 65a-65e (first branch line portions) and 66a-66d (second branch line portions).

[0045] The outer surfaces 3a of the electric wires 3 are colored with a coloring apparatus 8 by injecting a prescribed amount of the coloring materials onto the outer surfaces 3a as shown in FIG. 11.

[0046] As shown in FIGS. 2-5, the each connector 6 includes a connector housing 7 and metal terminals (not shown). The connector housings 7 are made of an insulating synthetic resin and have a box shape and receive the metal terminals electrically connected with the end portions of the electric wires 3.

[0047] The protectors 50, tubes 51, grommet 52, clips 53 are attached to the sub-harnesses 2a, 2b at the prescribed positions after the sub-harnesses 2a, 2b are assembled. The tape 54 is wound around the electric wires 3 of the sub-harness 2a and 2b each.

[0048] The coloring apparatus 8 includes, as shown in FIG. 11, a frame 10 (a main body), a guide roll 11, the take-rolls 12 to take-up the electric wire, a straighten unit 13 to straighten the electric wire, a slack absorbing unit 14 to absorb a slack of the electric wire, a coloring unit 15, a duct 16, an encoder 17 for measuring means, and a controller 19.

[0049] The frame 10 is installed on a floor of a factory and extends into a horizontal direction. The guide roll 11 is rotatably attached to one end of the frame 10. The guide roll 11 winds the long electric wire 3 with no mark 6 and sends the electric wire 3 to the straighten unit 13, the slack absorbing unit 14, the coloring unit 15, the duct 16, the encoder 17, and the cutter 18 in order.

[0050] The take-up rolls 12 are disposed in the other end of the frame 10. The pair of take-up rolls 12 are rotatably supported by the frame 10 and arranged vertically each other. The take-up rolls 12 are driven by a motor (not shown) and rotate in opposite direction each other with a same rotation number. The pair of take-up rolls 12 sandwich the electric wire 3 between them and pull out the electric wire 3 from the guide roll 11 along the longitudinal direction of the electric wire 3.

[0051] The take-up rolls 12 stretch and move the electric wire 3 along the longitudinal direction thereof. Thus, the take-up rolls 12 move the electric wire 3 relative to coloring nozzles 31 of the coloring unit 15 along the longitudinal direction thereof. The electric wire 3 is moved from the guide roll 11 to the take-up rolls 12 along an arrow X in FIG. 1, which is a moving direction of the electric wire 3.

[0052] The straighten unit 13 is disposed between the guide roll 11 and the take-up rolls 12. The straighten unit 13 is disposed in a downstream of the guide roll 11 and in a upstream of the take-up rolls 12 of the moving direction K. The straighten unit 13 includes a unit main body 20 with a plate shape, a plurality of first rolls 21, and a plurality of second rolls 22. The unit main body 20 is fixed to the frame 10.

[0053] The first and second rolls 21 and 22 are rotatably supported on the unit main body 20. The plurality of the first rolls 21 are arranged horizontally (along the moving direction X) and disposed above the electric wire 3. The plurality of the second rolls 22 are arranged horizontally (along the moving direction K) and disposed below the electric wire 3. The first rolls 21 and the second rolls 22 each are arranged in zigzag as shown in FIG. 11.

[0054] The straighten unit 13 sandwiches the electric wire 3, which is moved from the guide roll 11 by the take-up rolls 12, between the first rolls 21 and the second rolls 22. Hence, the straighten unit 13 straightens the electric wire 3 and provides a friction to the electric wire 3 by sandwiching the wire with the first and second rolls 21 and 22. Consequently, the straighten unit 13 provides a biasing force H1 in a direction opposite to a stretching direction (the moving direction X) to which the take-up rolls 12 pull out the electric wire 3. The first biasing force H1 is weaker than the tension pulled by the take-up rolls 12. Then, the straighten unit 13 provides the tension to the electric wire 3 in the longitudinal direction.

[0055] The slack absorbing unit 14 is disposed on the take-up rolls 12 side of the straighten unit 13. The slack absorbing unit 14 is disposed in a downstream of the straighten unit 13 and in the upstream of the take-up rolls 12 in the moving direction X of the electric wire 3. The slack absorbing unit 14 is disposed between the straighten unit 13 and the coloring nozzles 31 described below.

[0056] The slack absorbing unit 14 includes, as shown

in FIG. 11, a pair of guide roll support frames 23, a pair of guide rolls 24, a transfer roll support frame 25, a transfer roll 26, and an air cylinder 27 for biasing means. The guide roll support frames 23 are fixed to the frame 10 and extend upwardly from the frame 10. Each guide roll support frame 23 is separated each other along the moving direction X of the electric wire 3.

[0057] The pair of the guide rolls 24 are rotatably supported by the guide roll support frames 23 and disposed at under the electric wire 3 to make an outer circumferential surface in contact to the electric wire 3. It results that the guide rolls 24 guide the electric wire 3 not to escape from the moving direction X.

[0058] The transfer roll support frame 25 is fixed to the frame 10 and extends upwardly from the frame 10 and is disposed at between the pair of the guide roll support frames 23.

[0059] The transfer roll 26 is rotatably supported by the transfer roll support frame 25 and movable vertically. The transfer roll 26 is disposed above the electric wire 3 and movable in a direction perpendicular to the moving direction X of the electric wire 3. The transfer roll 26 is disposed at the middle position between the guide rolls 24.

[0060] The air cylinder 27 has a cylinder 28 and an extendable rod 29 in the cylinder 28. The cylinder 28 is fixed to the transfer roll support frame 25 and disposed above the electric wire 3. The extendable rod 29 extends downwardly from the cylinder 28 and approaches to the electric wire 3.

[0061] The transfer roll 26 is attached to the extendable rod 29. When a pressurized gas is supplied to inside the cylinder 28, the air cylinder 27 moves the extendable rod 29 downwardly, that is, the transfer roll 26 with a second biasing force H2 (shown in FIG. 11) in a direction perpendicular to the moving direction X. The air cylinder 27 biases the transfer roll 26 to the electric wire 3 with the second biasing force H2 which is weaker than the first biasing force H1.

[0062] When the pair of cutting blades 48 and 49 of the cutter 18 cut the electric wire 3, the electric wire 3 is once stopped. It causes a slack of the electric wire 3 between the pair of the guide rolls 24 due to the movement inertia of the electric wire 3 in the moving direction K. On this occasion, since the air cylinder 27 biases the transfer roll 26 with the second biasing force H2 in the slack absorbing unit 14, the extendable rod 29 in the air cylinder 27 extends and displaces the transfer roll 26 to the position shown by a dashed double-dotted line in FIG. 11.

[0063] The coloring unit 15 is disposed between the slack absorbing unit 14 and the take-up rolls 12. The coloring unit 15 is disposed in a downstream side of the slack absorbing unit 14 and the upstream side of the take-up rolls 12 of the moving direction X of the electric wire 3. The coloring unit 15, that is, the coloring nozzles 31 are arranged between the take-up rolls 12 and the straighten unit 13.

[0064] The coloring unit 15 includes, as shown in FIG. 12, a main body 30, the plurality of the coloring nozzles 31, a plurality of coloring material supply sources 32 (one source is shown in FIG. 2 and the others are omitted), and pressurized air supply sources 33. The main body 30 is fixed to the frame 10 and supports the plurality of the coloring nozzles 31.

[0065] The coloring nozzles 31 each inject a given amount of the liquid coloring material from the coloring material supply source 32 to the outer surface 3a of the electric wire 3. The injected drops of the coloring material from the coloring nozzles 31 are adhered to the outer surface 3a of the electric wire 3 and color (mark) a part of the outer surface 3a.

[0066] Each coloring nozzle 31, as shown in FIG. 13, has a cylindrical nozzle main body 34, an insertion member 35 received in the nozzle main body 34, the inlet tube 36, the nozzle member 37, and a valve mechanism 38.

[0067] The insertion member 35 is formed in a tubular shape and has the flow path 39 to flow the coloring material therein. The flow path 39 is filled with the coloring material supplied from the coloring material supply source 32 through the inlet tube 36. The insertion member 35 receives the liquid coloring material of the present invention. The inlet tube 36 is communicated with the flow path 39 and guides the coloring material from the coloring material supply source 32 to the flow path 39.

[0068] The nozzle member 37 is formed in a tubular shape and the base end 37a is disposed in the flow path 39 and communicated therewith. The nozzle member 37 guides the coloring material inside the flow path 39 to outside of the coloring nozzle 31. The inner diameter of the nozzle member 37 is smaller than an inner diameter of the nozzle main body 34, that is, an outer diameter of the flow path 39. The nozzle member 37 is coaxial with the nozzle main body 34 and made of stainless steel. The coloring material flows inside of the nozzle member 37 along the longitudinal direction parallel to an arrow Q. The arrow Q shows the flowing direction of the coloring material.

[0069] The valve mechanism 38 has a coil 40, a valve 41 and a coil spring 42. A voltage is applied to the coil 40 from outside. The valve main body 41 includes a conductive main body 43 and the valve 44. The main body 43 has a cylinder 45 and a circular disk 46 connected to one end of the cylinder 45.

[0070] The disk 46 opposes to the base end 37a of the nozzle member 37 and a longitudinal direction of the cylinder 45 is parallel to the longitudinal direction of the nozzle main body 34. The main body 43, that is, the valve main body 41 is movable in the longitudinal direction of the cylinder 45, that is, the nozzle main body 34.

[0071] The valve 44 is attached to the disk 46 of the main body 43. The valve 44 is received in the insertion member 35. The valve 44 opposes to the base end 37a of the nozzle member 37, and comes in contact to or departs from the base end 37a.

[0072] When the valve 44 comes in contact to the base

end 37a of the nozzle member 37, the boundary thereof is kept watertight to prevent the coloring material inside the nozzle member 37 from entering into the nozzle member 37. When the valve 44 departs from the base end 37a, the coloring material is allowed to be injected to the outer surface 3a of the electric wire 3 through the nozzle member 37.

[0073] In this manner, the valve 44 comes in contact to or departs from the base end 37a so that the valve 44 is positioned to the close position, shown by the solid line in FIG. 13, or to the open position, shown by the dashed double-dotted line in FIG. 13. When the valve 44 departs from the base end 37a and is positioned to the open position, the coloring material is injected to the electric wire 3 through the nozzle member 37. When the valve 44 comes in contact to the base end 37a and is positioned to the close position, the coloring material is regulated to be injected to the electric wire 3 through the nozzle member 37.

[0074] The coil spring 42 urges the disk 46, that is, the valve 44 to the base end 37a of the nozzle member 37.

[0075] The coloring material is introduced into the flow path 39 in the coloring nozzle 31 through the inlet tube 36 from the coloring material supply source 32. When the voltage is not applied to the coil 40, the valve 44 is in contact to the base end 37a of the nozzle member 37 with the biasing force of the coil spring 42 and keeps the coloring material inside the flow path 39.

[0076] When the voltage is applied to the coil 40, the valve 44 attached to the disk 46 departs from the base end 37a of the nozzle member 37 against to the biasing force of the coil spring 42. The coloring material in the flow path 39 flows inside the nozzle member 37 along the arrow Q. The coloring nozzle 31 injects the coloring material from the nozzle member 37. The voltage is applied to the coil 40 for the predetermined time a by the order from the controller 19. Then, the coloring nozzle 31 injects the given amount of the coloring material to the outer surface 3a of the electric wire 3.

[0077] The coloring nozzles 31 are attached to the main body 30. The plurality of the coloring nozzles 31 are arranged in the moving direction X and around the electric wire 3 as shown in FIG. 12.

[0078] Each coloring material supply source 32 receives the coloring material and supplies the coloring material to an inlet tube 36 of the corresponding coloring nozzle 31. The colors B supplied to the coloring nozzles 31 by the coloring material supply sources 32 can be different from each other or same.

[0079] Each pressurized air supply source 33 supplies the pressurized air to the coloring material supply source 32 so that a valve 44 described below is separated from a base end 37a of the nozzle member 37 and the coloring material in a flow path 39 is injected from the nozzle member 37.

[0080] In the coloring unit 15, a spike voltage A is applied to a coil 40 of the coloring nozzle 31 and the valve 44 is separated from the base end 37a of the nozzle member 37 responding to an order from the controller 19. Thereby, the coloring unit 15 injects to the electric wire 3 the given amount of the coloring material inside the flow path 39 of the coloring nozzle 31.

[0081] The coloring material is liquid material consisting of color material (organic substance for industrial purpose) dissolved or dispersed in water or other solvent. As the organic substance, the coloring material includes dyes and pigments which are generally composites of the organic substances. The dyes may be used as the pigments, or the pigments may be used as the dyes according to cases. More specifically, the coloring material is in a form of coloring liquid or paint.

[0082] The coloring liquid means the dye dissolved or dispersed in the solvent, while the paint means the pigment dispersed in dispersion liquid. Therefore, when the coloring liquid is adhered to the outer face 3a of the electric wire 3, the dye is infiltrated into the sheath 5. On the other hand, when the paint is adhered to the outer surface 3a of the electric wire 3, the pigment is not infiltrated into the sheath 5, but simply adhered to the outer surface 3a. In other words, the coloring unit 15 serves to dye the part of the outer surface 3a of the electric wire 3 with the dye, or alternatively, to apply the pigment to the part of the outer surface 3a of the electric wire 3. Therefore, a method for marking the outer surface 3a of the electric wire 3 includes both dyeing the part of the outer surface 3a of the electric wire with the dye, and applying the pigment to the part of the outer surface 3a of the electric wire 3.

[0083] Preferably, the solvent and dispersion liquid are compatible with the synthetic resin which forms the sheath 5. In this case, the dye can be reliably infiltrated into the sheath 5, and the pigment can be reliably adhered to the outer face 3a of the sheath 5.

[0084] The injection described means that the liquid coloring material is energized to be injected to the outer surface 3a of the electric wire 3 with the liquid drop, that is, droplet from the each coloring nozzle 31.

[0085] In the example illustrated, the coloring liquid is utilized for the coloring material.

[0086] The duct 16 is disposed to the take-up rolls side of the coloring unit 15 and between the coloring unit 15 and the take-up rolls 12. The duct 16 is disposed to a downstream side of the coloring unit 15 in the moving direction X of the electric wire 3 and the upstream side of the take-up rolls 12. The duct 16 is formed in a tubular shape and the electric wire 3 passes therein. Evacuating means (not shown) is connected to the duct 16. The evacuating means evacuates the gas in the duct 16 to prevent the solvent and dispersion liquid in the coloring material from being filled outside the coloring unit 8.

[0087] The encoder 17 is disposed to a downstream side of the take-up rolls 12 in the moving direction X of the electric wire 3. The encoder 17 has a pair of rotors 47 as shown in FIG. 11. Each rotor 47 can rotate around an axis of rotation. An outer circumferential face of each rotor 47 is in contact with the outer face 3a of the electric wire 3 sandwiched by the pair of the take-up rolls 12.

When the core wire 4, that is, the electric wire 3 runs (moves) in the direction of the arrow X, the rotors 47 rotate. In short, the rotors 47 each rotate around the axis with the running (moving) of the core wire 4, that is, the electric wire 3 along the direction of the arrow X. It is apparent that a number of the rotation of each rotor 43 is proportional to the moving distance of the electric wire 3 along the direction of the arrow X.

[0088] The encoder 17 is connected to the controller 19. When the rotors 43 rotate by a predetermined angle, the encoder 17 outputs pulse signals to the controller 19. More specifically, the encoder 17 outputs information corresponding to the moving velocity of the electric wire 3 along the direction of the arrow X. In this manner, the encoder 17 measures the information corresponding to the moving velocity of the electric wire 3, and outputs the information to the controller 19. Usually, the encoder 17 outputs the pulse signals according to the moving distance of the electric wire 3 by friction between the electric wire 3 and the rotors 47 of the encoder 17. However, in case where the moving distance is inconsistent with the number of the pulse signals, depending on condition of the outer face 3a of the electric wire 3, it would be possible to obtain the information of the moving velocity in other places, and to feedback the information for comparative calculation.

[0089] The cutter 18 is disposed to a downstream side of the rotors 47 of the encoder 17 in the moving direction X. The cutter 18 has a pair of cutting blades 48 and 49. The pair of the cutting blades 48 and 49 are arranged vertically, and approach or depart from each other in the vertical direction. The pair of the cutting blades 48 and 49 approach each other and sandwich to cut the electric wire 3 moved by the pair of the take-up rolls 12. After cutting, the cutting blades 48 and 49 depart from each other.

[0090] The controller 19 is a computer having known RAM, ROM, CPU, and so on. The controller 19 is connected to the take-up rolls 12, encoder 17, cutter 18, and coloring nozzles 31 to control their operations and thereby controls all the operations of the coloring apparatus 8.

[0091] The controller 19 stores a predetermined color pattern of the outer surface 3a of the electric wires 3. When the information of the pulse signals, that is, the amount of the moving distance of the electric wire 3, is input from the encoder 17 to the controller 19, a given time of the voltage is applied to the coil 40 of the predetermined coloring nozzles 31 and the coloring materials are injected to the electric wire 3 from the coloring nozzles 31.

[0092] The controller 19 can make the injection time of the coloring material from the coloring nozzles 31 shorter or longer depending on the moving speed of the electric wire 3 with being higher or slower, respectively according to the coloring pattern of the outer surface 3a of the electric wires 3 stored in the controller 19. Hence, the controller 19 colors the electric wire 3 according to the stored pattern. The controller 19 controls the coloring nozzles 31 to inject the given amount of the coloring material drop according to the moving distance of the electric wire 3 measured by the encoder 17.

[0093] When the controller 19 judges the given amount of the moving distance of the electric wire 3 from the information of the encoder 17, the controller 19 stops the operation of the take-up rolls 12 and brings the pair of the cutting blades 48 and 49 close together to cut the electric wire 3.

[0094] In order to assemble the sub-harnesses 2a and 2b, the outer surface 3a of the electric wires 3 are colored and cut into a prescribed length with the coloring apparatus 8. The guide roll 11 is attached to the frame 10. The pair of the cutting blades 48 and 49 are set separated each other. The electric wire 3 wound on the guide roll 11 is passed thorough the straighten unit 13, the slack absorbing unit 14, the coloring unit 15, and the duct 16 in order, and sandwiched between the pair of the take-up rolls 12. The coloring nozzles 31 are attached to a given position of the unit main body 30 of the coloring unit 15 and each coloring nozzle 31 is connected to the coloring material supply source 32. Each coloring material supply source 33 is connected to the corresponding pressurized air supply source 33 and the evacuating means is connected to the duct 16.

[0095] The take-up rolls 12 are driven to pull out the electric wire 3 from the guide roll 11 and moves the electric wire 3 along the longitudinal direction. The friction as the first biasing force H1 is provided to the electric wire 3 by the straighten unit 13 to pull out the electric wire 3. The air cylinder 27 biases the transfer roll 26, that is, the electric wire 3 with the second biasing force H2.

[0096] When the predetermined pulse signals are input to the controller 19 from the encoder 17, the controller 19 controls to apply the spike voltage for the given time with a given time interval to the coils 40 of the predetermined coloring nozzles 31. Hence, each coloring nozzle 31 injects the given amount of the coloring material to the outer surface 3a of the electric wire 3.

[0097] The solvent or dispersion liquid evaporates from the coloring material adhered to the outer surface 3a of the electric wire 3 and the outer surface 3a of the electric wire 3 is dyed with the dye or painted with the pigment. The evaporated solvent or dispersion liquid is evacuated by the evacuating means from the duct 16. Thereby, the outer surface 3a of the electric wire 3 is colored.

[0098] When the given length of the electric wire 3 is moved, the controller 19 judges it from the information of the encoder 17 and stops the take-up rolls 12. It causes the slack of the electric wire 3 especially between the pair of the guide rolls 24 of the slack absorbing unit 14 and the transfer roll 26 biased with the second biasing force H2 is displaced to a position shown by the dashed double-dotted line in FIG. 1. The extendable rod 29 of the air cylinder 27 of the slack absorbing unit 14 extends and absorbs the slack of the electric wire 3.

[0099] The pair of the cutting blades 48 and 49 come

close to each other and sandwich the electric wire 3 between them to cut. Thereby, the outer surfaces 3a of the electric wires 3 as shown in FIGS. 2 to 5 are colored.

[0100] The sheaths at both end portions of the electric wires 3 are removed. Electric terminals are attached to the exposed core wires and inserted into the connector housings 7 to assemble the sub-harnesses 2a, 2b.

[0101] As shown in FIG. 1, the wiring harness 1 includes a main line 55, first branch lines 56 branched from the main line 55, and second branch lines 57 branched from the first branch lines 56. The main line 55 and the branch lines 56, 57 have the plurality of the electric wires 3. The main line 55 and the branch lines 56, 57 each are branched at branch points 58. The plurality and the bundle of the electric wires 3 are branched at the branch points 58 into different directions.

[0102] For assembling the wiring harness 1, the sub-harnesses 2a, 2b are wired on the wiring board 60 (FIG. 6) and the exterior parts 50-53 are attached to the sub-harnesses at the prescribed positions and the tape 54 is wound around the electric wires 3 at the prescribed positions.

[0103] As shown in FIGS. 6 and 7, the wiring board 60 includes a plane board 61 and the plurality of the fixing devices 62. The wiring pattern 63 for the wiring harness 1 such as the sub-harnesses 2a, 2b is formed on a surface 61a of the board 61 as shown in FIG. 10. The wiring pattern 63 has the same pattern of the wiring harness 1 arranged in the motor vehicle.

[0104] The wiring pattern 63 has the plurality of the colored portions on the surface 61a of the board 61. In the embodiment, the colors are A, B, C, D, E, F, G, H, I, J. As shown in FIGS. 6, 7 and 10, the wiring pattern 63 includes the main line portion 64, the first branch line portions 65, the second branch line portions 66, the plurality of the branch portions 67, and the plurality of the end portions 68. When the sub-harnesses 2a, 2b are wired on the wiring board 60, the main line portion 64 of the wiring pattern 63 corresponds to the main lines 55 of the sub-harnesses 2a, 2b.

[0105] The first branch line portions 65 of the wiring pattern 63 correspond to the first branch lines 56 of the sub-harnesses 2a, 2b. The plurality of the branch line portions 65 are given as reference signs 65a-65e.

[0106] The second branch line portions 66 of the wiring pattern 63 correspond to the second branch lines 57 of the sub-harnesses 2a, 2b. The plurality of the branch line portions 66 are given as reference signs 66a-66d.

[0107] The plurality of the branch portions 67 connect the main line portion 64 and the first branch portions 65a-65e and the second line portions 66a-66d. Accordingly, the sub-harnesses 2a, 2b branch at the branch portions 67 in the different directions. The branch points 58 of the sub-harnesses 2a, 2b correspond to the branch portions 67 denoted by the reference signs 67a-67g.

[0108] The plurality of the end portions 68 are placed to ends of the first branch line portions 65a-65e and the second branch line portions 66a-66d. The end portions 68 of the wiring pattern 63 correspond to the end portions of the electric wires 3. The end portions 68 are given as the reference signs 68a-68i.

[0109] The main line portion 64 and the first and second line portions 65a-65e, 66a-66d are colored with the colors A-J on the surface 61a of the wiring board 60 as shown by the parallel diagonal lines in FIGS. 6, 7 and 10. The all colors of A-J are different to each other. The portions 64, 65a-65e and 66a-66d each have a different color with respect to the colors of the adjacent portions.

[0110] The fixing devices 62 are disposed on each of the branch portions 67a-67g and each of the end portions 68a-68i on the wiring board 60. As shown in FIGS. 8 and 9, the fixing devices 62 each have a supporting post 69 and a electric wire supporter 70. The supporting post 69 is upstanding at the wiring board 60. The each electric wire supporter 70 is disposed on the each supporting post 69 to support and fix the electric wires 3. The fixing devices 62 are disposed on the wiring pattern 63 on the wiring board 60 in accord with the branch portions 67a-67g and the end portions 68a-68i.

[0111] The fixing devices 62 wire the wiring harness 1, or the sub-harnesses 2a, 2b by hanging the electric wires 3 on the supporters 70. The wiring harness 1, or each sub-harness 2a, 2b is wired on the wiring board 60 according to the wiring pattern 63 by hanging at the fixing devices 62 and bending at the branch portions 67 the electric wires 1 to form the branch points 58. The fixing devices 62 are referenced by reference signs 62a-62p.

[0112] The electric wires 3 are cut into the prescribed length and colored with the coloring apparatus 8 and formed into the sub-harnesses 2a and 2b. For assembling the wiring harness 1, the each sub-harness 2a, 2b is wired on the wiring board 60 for the each color A-J of the outer surfaces 3a of the electric wires 3 to conform with the each color A-J of the lines 64, 65a-65e and 66a-66d of the wiring pattern 63. The electric wires 3 of the each sub-harness 2a, 2b is fixed to the fixing devices 62a-62p.

[0113] The connectors 6, shown by dashed double-dotted lines in FIG. 7, are hooked to the fixing devices 62a, 62b, 62d, 62e, 62i, 62j, 62m, 62n, 62p.

[0114] The exterior parts 50-53 are attached to the sub-harnesses 2a, 2b and the tape is wound. Finally, an appearance inspection and continuity test are carried out.

[0115] In the embodiment, the outer surfaces 3a of the electric wires 3 wired on the wiring board 60 have the same colors A-J as those of the line portions 64, 65a-65e, 66a-66d. The colors of the outer surfaces 3a correspond to those of the line portions. The electric wires 3 are wired on the wiring board 60 to accord the colors of the outer surfaces 3a thereof with those of the line potions.

[0116] Since the outer surfaces 3a of the electric wires 3 are colored with the coloring material and the colors A-J hardly fall off, the electric wires 3 are assuredly wired on the wiring board 60.

[0117] The injection of the constant amount of the

coloring material to the outer surfaces 3a of the electric wires 3 prevents an increase diameter of the electric wires 3a.

[0118] A second embodiment of the present invention is explained by referring to FIGS. 14-20. Same portions as the first embodiment have the same reference signs and the explanations are omitted. In the second embodiment, a wiring harness 1 includes 2c-2f as shown in FIGS. 17-20.

[0119] As shown in FIGS. 14-16, the wiring pattern 63 in the second embodiment includes a plurality of sub-harness line portions 63c-63f corresponding to the sub-harnesses 2c-2f. Colors L-O, denoted by parallel diagonal lines in FIGS. 14-16, of the sub-harness line portions 63c-63f in the wiring pattern 63 are different each other.

[0120] The sub-harness line portion 63c corresponds to the sub-harness 2c of FIG. 17 wired on the wiring board 60 and has the first branch line portion 65a, the branch portion 67a, the second branch line portion 66a. The first branch line portion 65a has a solid line and the second branch line portion 66a has a dotted line to identify the branch line portions 65a, 66a each other. The dotted line of the second branch line portion 66a provides an identifier in the wiring pattern 63 in the present invention.

[0121] The sub-harness 2c wired on the sub-harness line portion 63c has the first branch line 56, the second branch line 57, the branch point 58. The electric wires 3 branch into directions different from each other at the branch point 58. The first and second branch lines 56, 57 are joined to each other at the branch point 58. The first branch lines 56 of the sub-harness 2c have the same color L as that of the first branch line portion 65a of the sub-harness line portion 63c. The second branch lines 57 of the sub-harness 2c has the same color L as that of the second branch line portion 66a of the sub-harness line portion 63c. The dotted lines of the second branch lines 57 are second identifiers.

[0122] The sub-harness line portion 63d corresponds to the sub-harness 2d of FIG. 18 wired thereon and has the first branch line portion 65b, the branch portion 67b, the second branch line portion 66b. The first branch line portion 65b has a solid line and the second branch line portion 66b has a dotted line to identify each other and provide the identifier in the embodiment.

[0123] The sub-harness 2d wired on the sub-harness line portion 63d has the first branch line 56, the second branch line 57, the branch point 58. The electric wires 3 branch into directions different from each other at the branch point 58. The first and second branch lines 56, 57 are joined to each other at the branch point 58.

[0124] The first branch lines 56 of the sub-harness 2d have the same color M as that of the first branch line portion 65b of the sub-harness line portion 63d. The second branch lines 57 of the sub-harness 2d has the same color M as that of the second branch line portion 66b of the sub-harness line portion 63d. The dotted lines of the second branch lines 57 provide the second identifiers.

[0125] The sub-harness line portions 63e and 63f correspond to the sub-harness 2e, 2f of FIG. 19, 20 wired thereon and have the first branch line portions 65c and 65d, the branch portions 67e and 67g, the second branch line portions 66c and 66d, respectively. The first branch line portions 65c, 65d have solid lines and the second branch line portions 66c, 66d have dotted lines to identify each other and provide the identifiers in the embodiment.

[0126] The sub-harnesses 2e, 2f wired on the sub-harness line portions 63e, 63f have the first branch lines 56, the second branch lines 57, the branch points 58. The electric wires 3 branch into directions different from each other at the branch point 58. The first and second branch lines 56, 57 are joined to each other at the branch points 58.

[0127] The first branch lines 56 of the sub-harness 2e, 2f have the same colors N and O as those of the first branch line portions 65c, 65d of the sub-harness line portions 63e, 63f, respectively. The second branch lines 57 of the sub-harnesses 2e, 2f have the same colors N and O as those of the second branch line portion 66c, 66d of the sub-harness line portions 63e, 63f, respectively. The dotted lines of the second branch lines 57 provide the second identifiers.

[0128] The outer surfaces 3a of the electric wires 3 of the sub-harnesses 2c-2f are colored in L-O with the injection of the coloring materials, respectively.

[0129] The main line 55, not shown, of the wiring harness 1 is wired on the main line portion 64 of the wiring pattern 63 and the outer surfaces 3a thereof have the same color as that of the main line portion 64.

[0130] In the embodiment, the main line 55 is wired on the main line portion 64 of the wiring pattern 63 on the wiring board 60. The sub-harnesses 2c-2f having the colors L-O at the outer surfaces 3a thereof are wired on the sub-harness line portions 63c-63f, respectively.

[0131] Accordingly, the sub-harnesses 2c-2f are easily positioned to the sub-harness line portions 63c-63f.

[0132] The dotted lines of the branch line portions 66a-66d provide the identifiers to identify from the branch line portions 65a-65e.

[0133] The dotted lines of the sub-harnesses 2c-2f provide the second identifiers to identify the branch lines 56 and 57 each other.

[0134] Accordingly, the branch lines 56, 57 are easily wired on the desired branch line portions 65a-65e, 66a-66d. Thus the sub-harnesses 2c-2f, or the wiring harness 1 are assuredly wired on the wiring board 60.

In the embodiment, as shown in FIG. 21, the outer surfaces of the connectors 6 of the sub-harness 2c can be colored with the same color L as that of the sub-harness line portion 63c. The connectors can be colored with the same colors L-O of the sub-harness line portions 63c-63f, respectively.

[0135] The colors of the connectors 6 assist for the sub-harnesses 2c-2f to be easily wired on the sub-harness line portions 63c-63f.

[0136] A third embodiment of the present invention is explained by referring to FIGS. 22-28. The same refer-

ence signs are used for the same portions of the third embodiment as those of the first and second embodiments. The wiring harness 1 includes sub-harnesses 2a and 2b as shown in FIGS. 25-28.

[0137] As shown in FIGS. 22-24, the branch portions 67a-67g and the end portions 68a-68i are colored with the different colors of A-P denoted by parallel diagonal lines in FIGS. 22-24.

[0138] The outer surfaces 3a of the sub-harness 2a are colored with A, C, G, H, L, O, N and have the same colors of the portions 68a, 67a, 67c, 67d, 67f, 67g, 68h, respectively.

[0139] The outer surfaces 3a of the sub-harness 2b are colored with E, F, G, H, K, I and have the same colors of the portions 68d, 67b, 67c, 67d, 67k, 68e, respectively.

[0140] The outer surfaces 3a of the sub-harnesses 2a, 2b each have the colors A-P corresponding to the colors of the branch portions 67a-67g and the end portions 68a-68i.

[0141] The colors A-P of the outer surfaces 3a of the sub-harnesses 2a, 2b are colored with the injection of the coloring materials.

[0142] The branch points 58 and end points of the sub-harnesses 2a, 2b are wired on the branch portions 67a-67g and the end portions 68a-68i on the wiring board 60 to match both colors at the each portion.

[0143] As shown in FIG. 29, the fixing devices 62a-62p can be colored with the colors A-P, denoted by parallel diagonal lines in FIG. 29, of the branch portions 67a-67g and the end portions 68a-68i. The colored fixing devices 62a-62p can be easily recognized and the wiring harness 1 can be easily wired on the wiring board 60.

[0144] FIG. 30-32 show the fixing devices 62a-62p colored with the colors A-P, the uncolored branch portions 67a-67g, the uncolored end portions 68a-68i. The outer surfaces 3a of the electric wires 3 wired on the wiring board 60 have the same corresponding colors A-P with the colored fixing devices 62a-62p. The colored fixing devices 62a-62p can be easily recognized and the wiring harness 1 can be easily wired on the wiring board 60.

[0145] In the embodiments, the outer surfaces 3a of the electric wires 3 are colored by injecting the coloring materials. Other means, such as spray, are also adapted for coloring the outer surfaces 3a of the electric wires 3.

[0146] For the coloring materials, other coloring liquids or paints, such as acrylic lacquer, ink (dyes, pigments), and UV ink can be utilized.

[0147] The examples described above are only exemplary embodiments and are not limited thereto. Modifications and alterations are possible within the scope of the present invention.

Industrial Applicability

[0148] Desired branch lines are easily wired on desired branch line portions. Accordingly, electric wires, or sub-harnesses, and wiring harness are/is easily wired on a wiring board. When the electric wires are wired on the wiring board, fixing devices disposed at branch and end portions are easily recognized. Accordingly, the electric wires, or the wiring harness are/is easily wired on the wiring board. Colors of outer surfaces of the electric wires are hardly peeled off. An increase of outer diameters of the electric wires is restrained.

Claims

1. A method of assembling a wiring harness, comprising the steps of:

   forming a wiring pattern on a wiring board for wiring the wiring harness;
   disposing a main line portion, first branch line portions branched from the main line portion, and second branch line portions branched from the first branch line portions, to the wiring pattern;
   coloring the main line portion, the first and second line portions with colors different from each other;
   wiring electric wires for passing through at least one of the line portions of the main, first and second line portions;
   coloring outer surfaces of the electric wires with the colors in accord with colors of the each line portion on the wiring board; and
   wiring the electric wires so as to match the colors of the outer surfaces thereof with the colors of the corresponding line portions on the wiring board.

2. A method of assembling a wiring harness having a plurality of sub-harnesses, comprising the steps of:

   forming a wiring pattern on a wiring board for wiring the wiring harness;
   disposing a plurality of sub-harness line portions on the wiring pattern;
   coloring the plurality of the sub-harness line portions with colors different from each other;
   coloring outer surfaces of electric wires of the each sub-harness with the colors in accord with the colors of the each sub-harness line portion on the wiring board; and
   wiring the electric wires so as to match the colors of the outer surfaces thereof with the colors of the corresponding sub-harness line portions on the wiring board.

3. The method of assembling the wiring harness as claimed in claim 2,
   wherein at least one of the sub-harness line portions includes branch portions branching the electric wires therefrom into different directions, a plurality of

branch line portions branching from the branch portions, and identifiers for identifying the branch line portions each other, and
wherein the sub-harness includes branch points branching the electric wires therefrom into different directions, a plurality of branch lines connected at the branch points and wired on the branch line portions, and second identifiers for identifying the branch lines each other.

4. The method of assembling the wiring harness as claimed in claim 2 or 3, wherein outer surfaces of connectors attached to end portions of the electric wires are colored with the colors of the corresponding sub-harness line portions.

5. A method of assembling a wiring harness, comprising the steps of:

forming a wiring pattern on a wiring board for wiring the wiring harness;
disposing a plurality of branch portions for branching electric wires into different directions and end portions for positioning end portions of the electric wires;
coloring the branch portions and end portions with colors different from each other;
coloring outer surfaces of the electric wires with the colors in accord with the colors of the corresponding branch portions and end portions on the wiring board; and
wiring the electric wires so as to match the colors of the outer surfaces thereof with the colors of the corresponding branch portions and end portions.

6. The method of assembling the wiring harness as claimed in claim 5, wherein fixing devices are disposed on the branch portions and end portions for fixing the electric wires and are colored with the same colors as those of the corresponding branch portions and end portions.

7. A method of assembling a wiring harness, comprising the steps of:

forming a wiring pattern on a wiring board for wiring the wiring harness;
disposing a plurality of branch portions for branching electric wires into different directions, end portions for positioning end portions of the electric wires, and fixing devices on the branch portions and the end portions for fixing the electric wires;
coloring the fixing devices with colors different from each other;
coloring outer surfaces of the electric wires with the colors in accord with the colors of the each corresponding fixing device on the wiring board; and
wiring the electric wires so as to match the colors of the outer surfaces thereof with the colors of the corresponding fixing devices.

8. The method of assembling the wiring harness as claimed in any one of claims 1 to 7, wherein the outer surfaces of the electric wires are injected and colored with a constant amount of coloring materials.

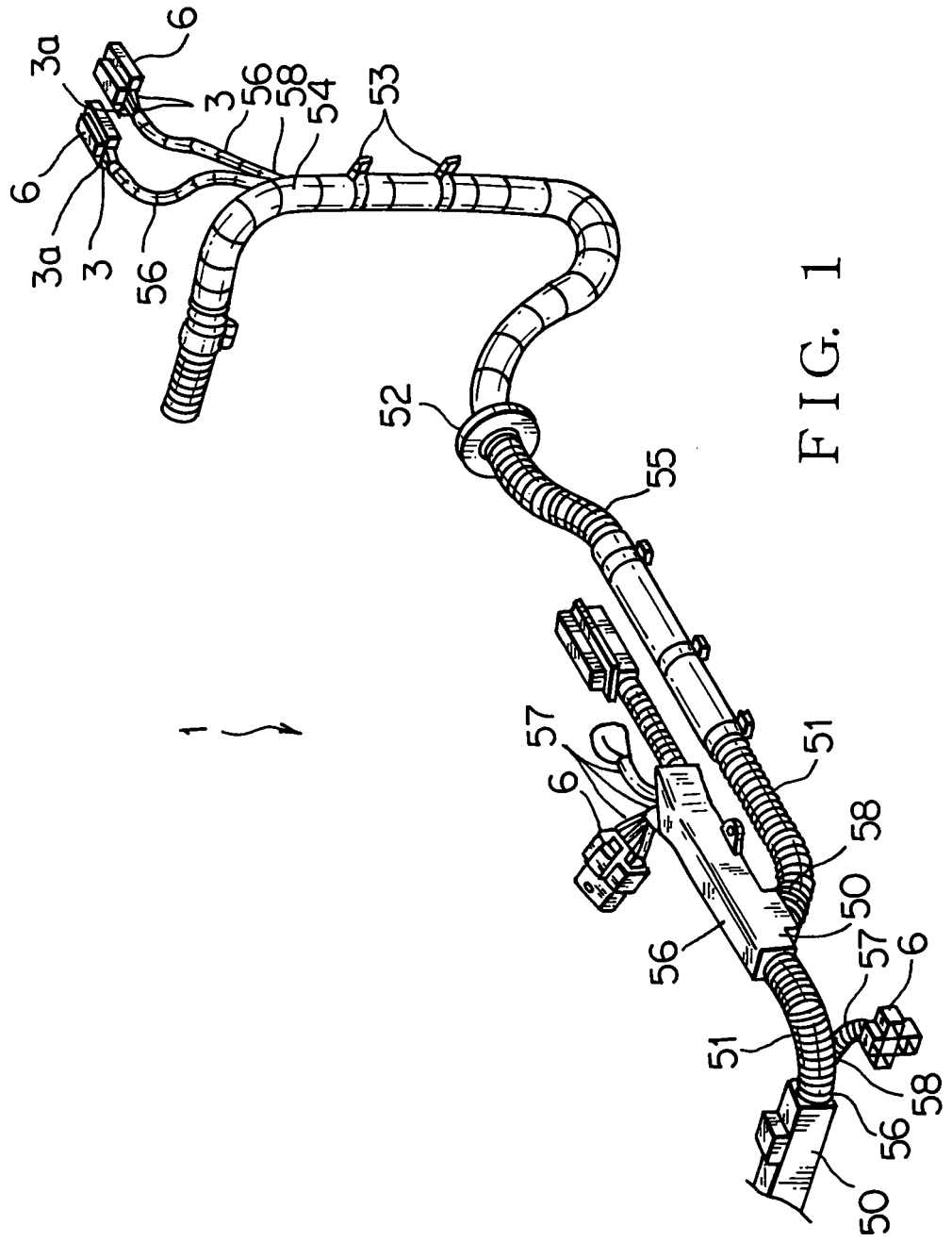


FIG. 1

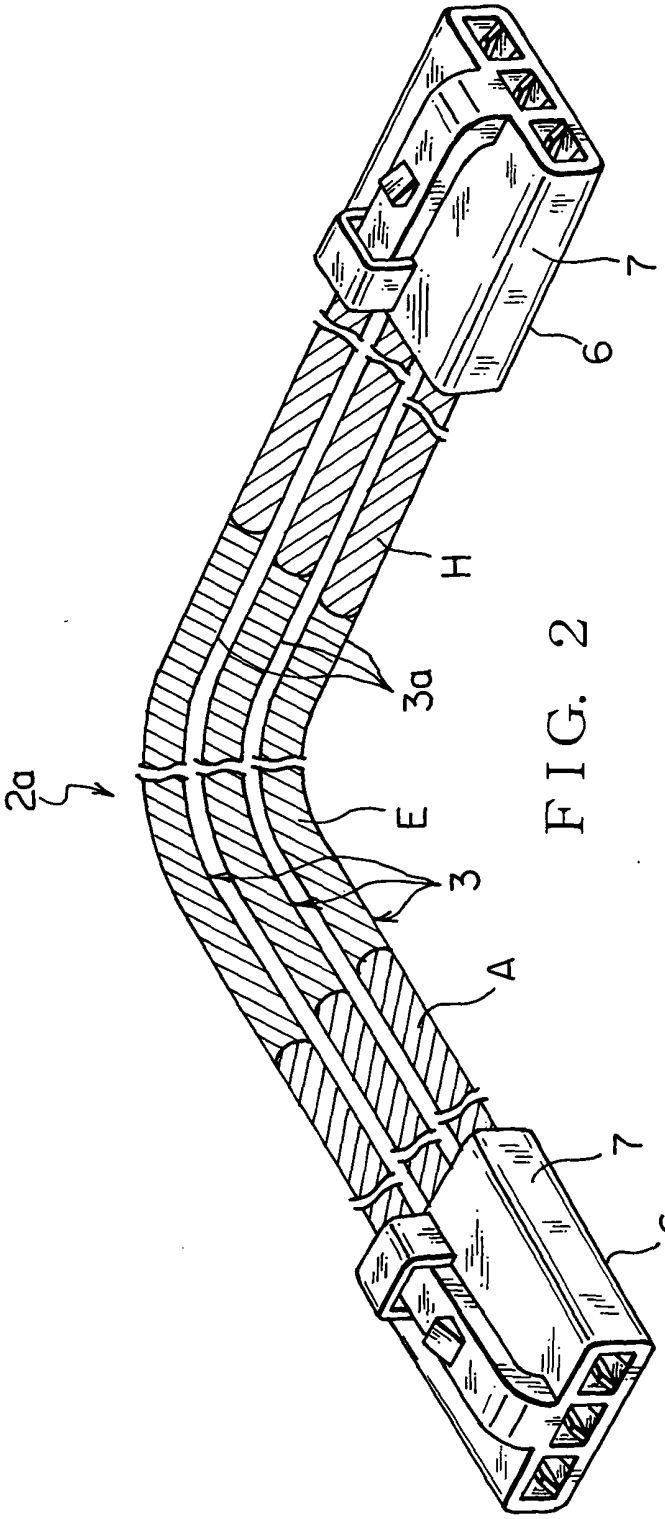


FIG. 2

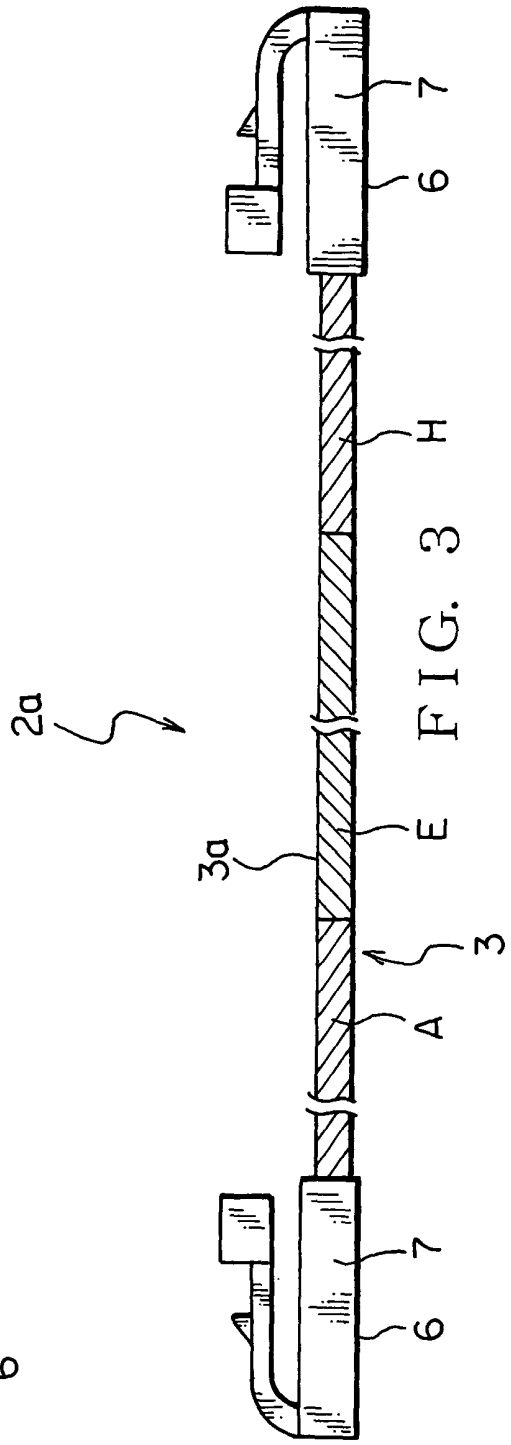


FIG. 3

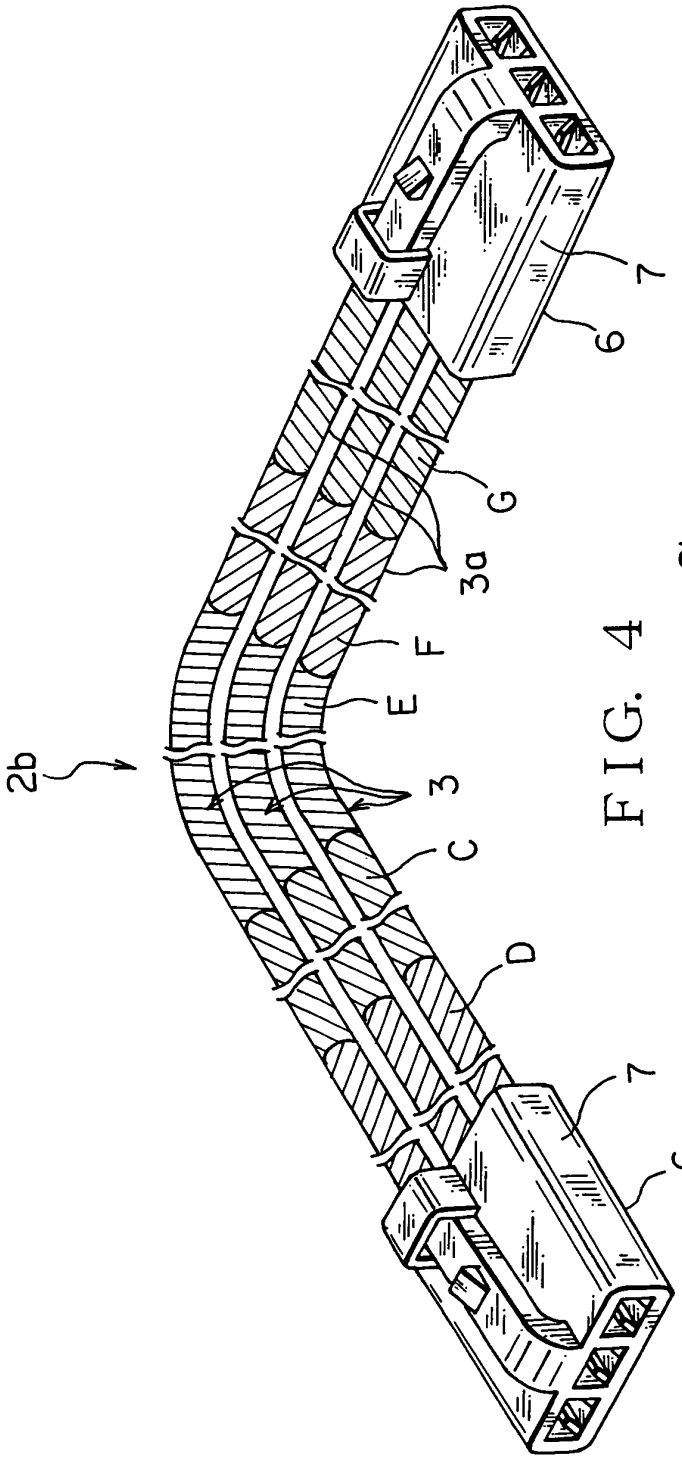


FIG. 4

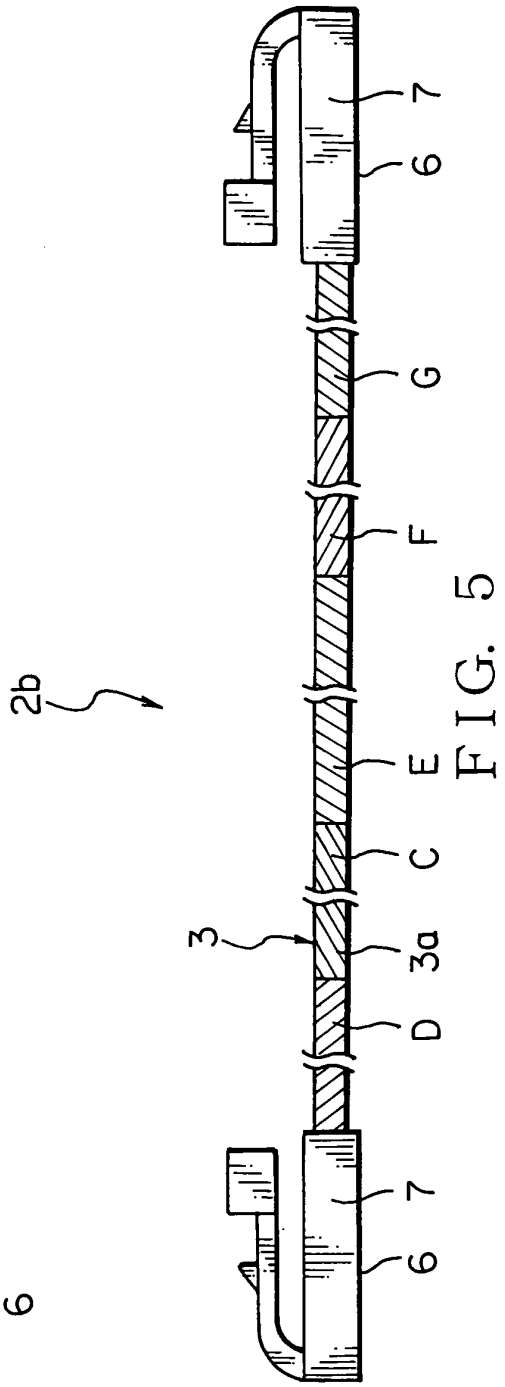


FIG. 5

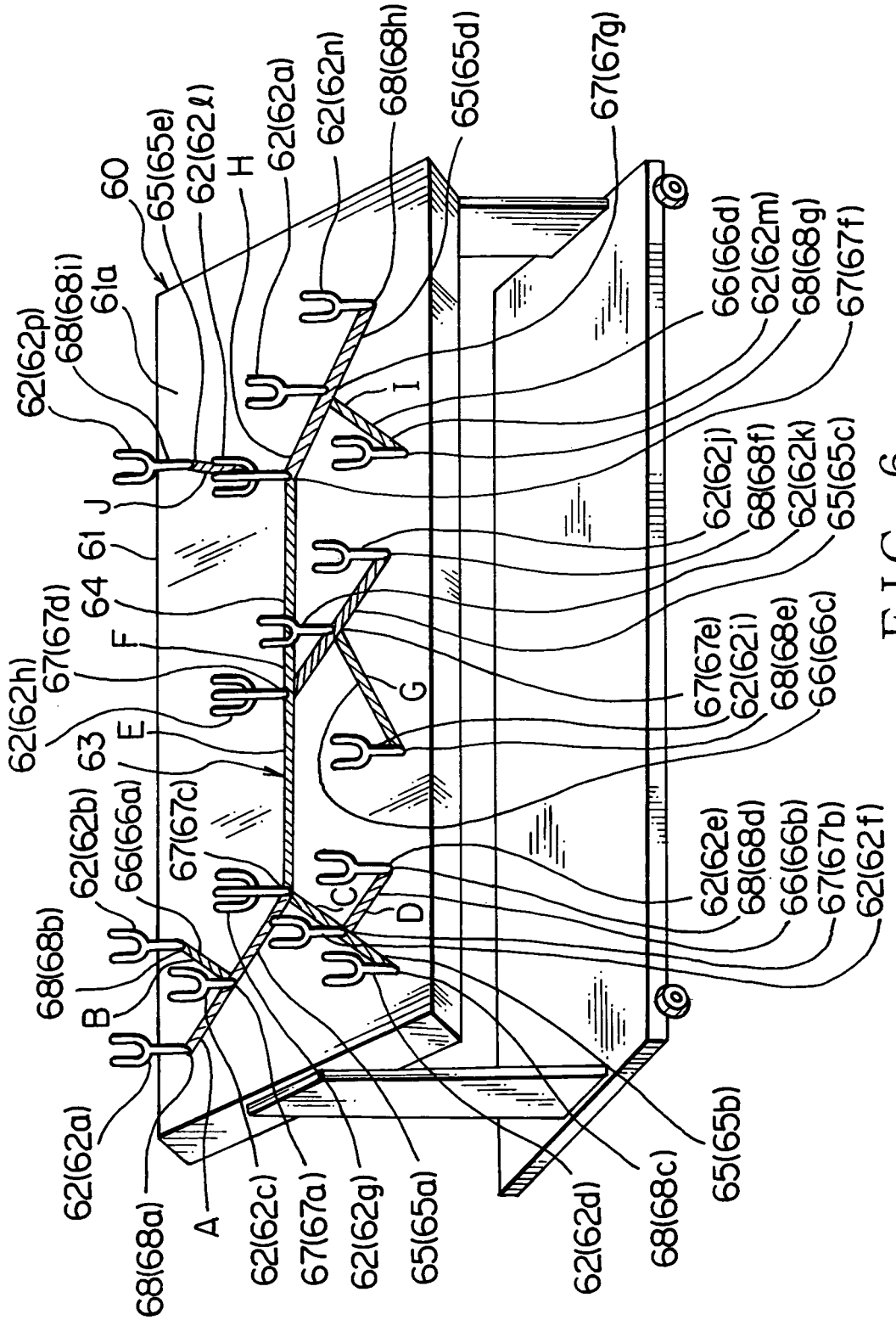
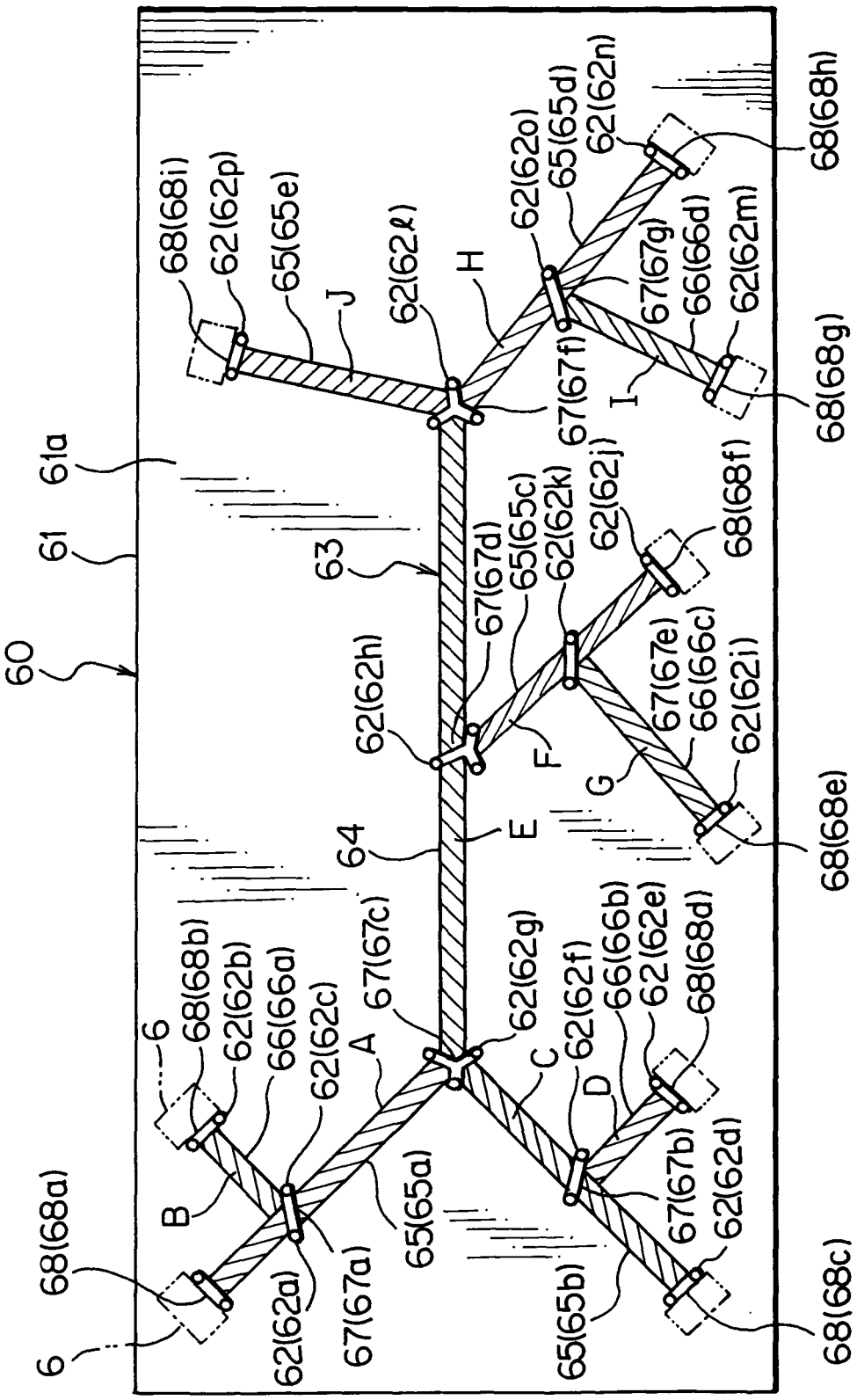

60
61
61a
62(62a)
62(62b)
62(62c)
62(62d)
62(62e)
62(62f)
62(62g)
62(62h)
62(62i)
62(62j)
62(62k)
62(62l)
62(62m)
62(62n)
62(62p)
63
64
65(65a)
65(65b)
65(65c)
65(65d)
65(65e)
66(66a)
66(66b)
66(66c)
66(66d)
67(67a)
67(67b)
67(67c)
67(67d)
67(67e)
67(67f)
67(67g)
68(68a)
68(68b)
68(68c)
68(68d)
68(68e)
68(68f)
68(68g)
68(68h)
68(68i)
A
B
C
D
E
F
G
H
I
J

FIG. 6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63
64
6
6
68(68a)
68(68b)
68(68c)
68(68d)
68(68e)
68(68f)
68(68g)
68(68h)
68(68i)
62(62a)
62(62b)
62(62c)
62(62d)
62(62e)
62(62f)
62(62g)
62(62h)
62(62i)
62(62j)
62(62k)
62(62ℓ)
62(62m)
62(62n)
62(62o)
62(62p)
65(65a)
65(65b)
65(65c)
65(65d)
65(65e)
66(66a)
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66(66d)
67(67a)
67(67b)
67(67c)
67(67d)
67(67e)
67(67f)
67(67g)
A
B
C
D
E
F
G
H
I
J

FIG. 7

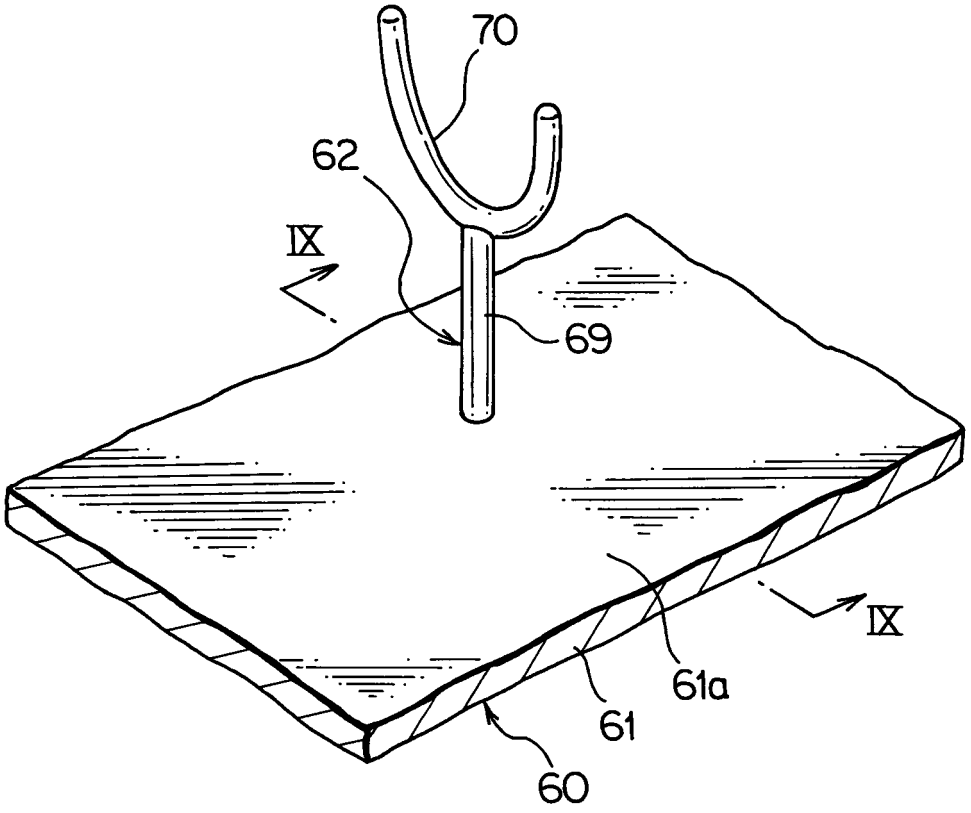


FIG. 8

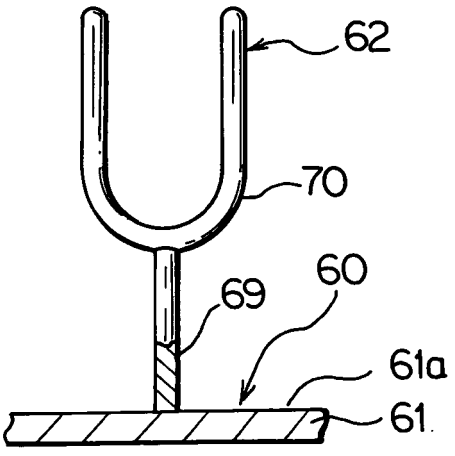


FIG. 9

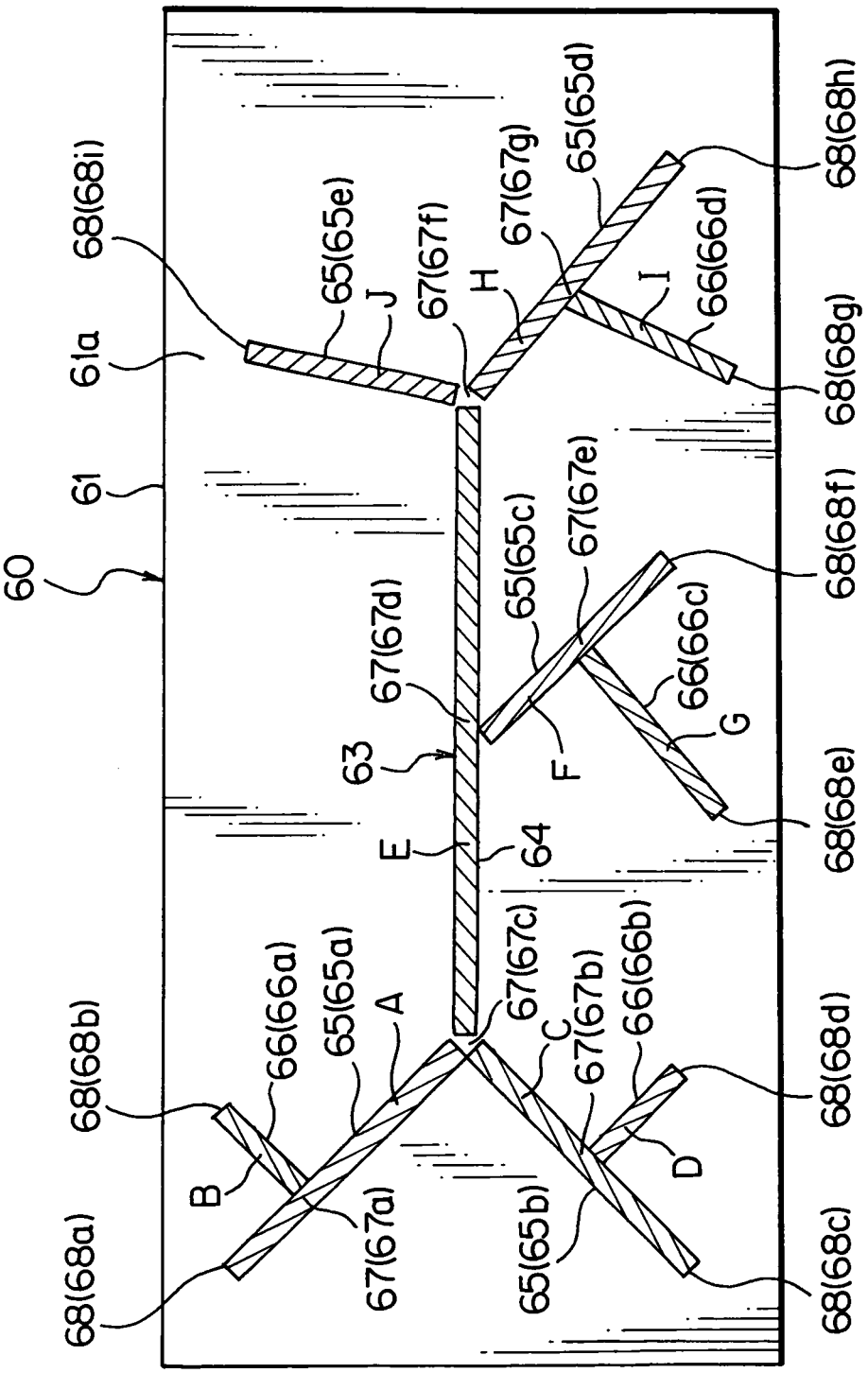

60
61
61a
68(68i)
65(65e)
J
67(67f)
H
67(67g)
65(65d)
68(68h)
I
66(66d)
68(68g)
68(68f)
67(67e)
65(65c)
67(67d)
66(66c)
G
63
F
68(68e)
E
64
67(67c)
C
67(67b)
66(66b)
68(68d)
D
66(66a)
65(65a)
A
68(68b)
B
67(67a)
65(65b)
68(68c)
68(68a)

FIG. 10

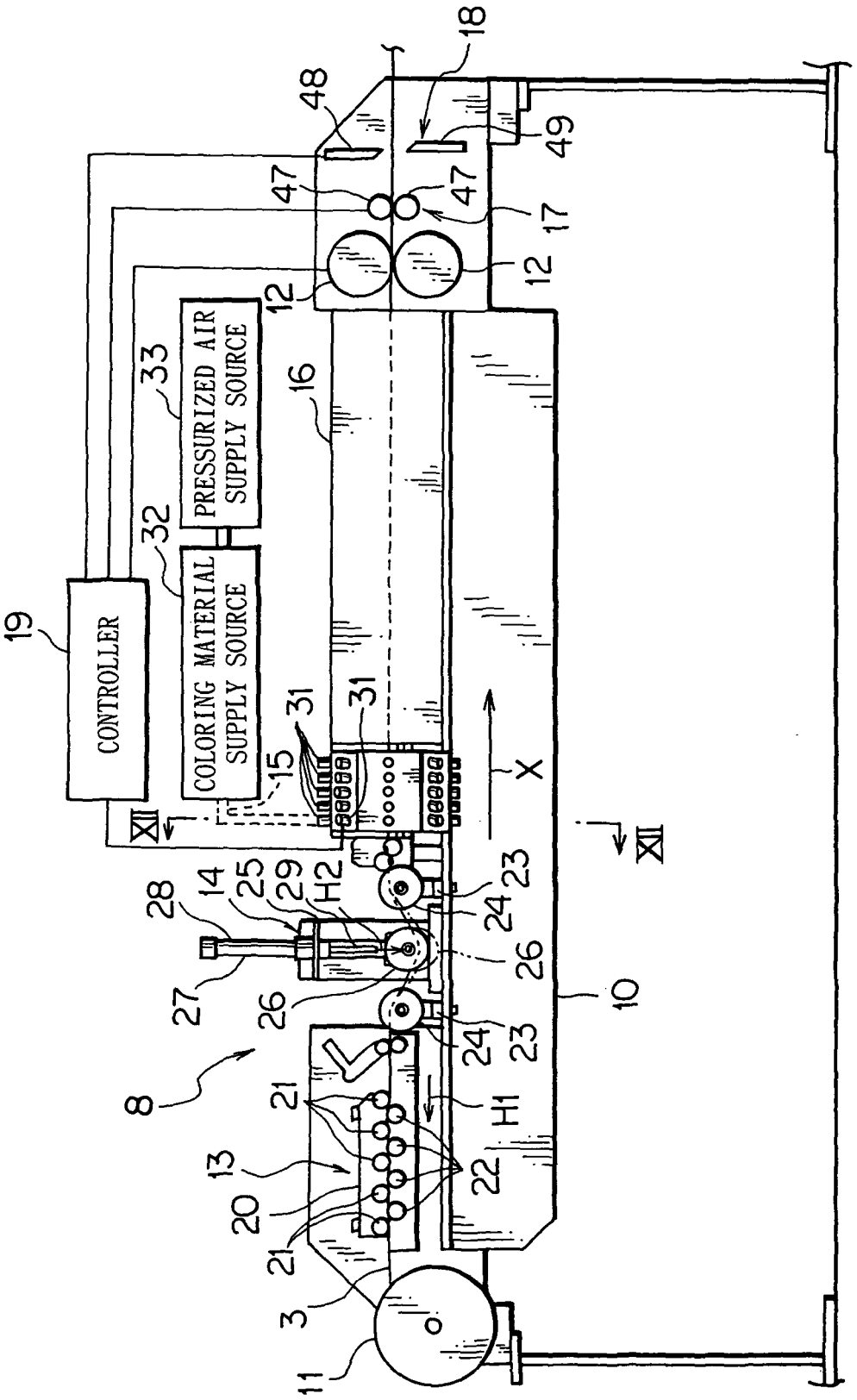

CONTROLLER
COLORING MATERIAL SUPPLY SOURCE
PRESSURIZED AIR SUPPLY SOURCE
X
H1
H2
XII
XII

FIG. 11

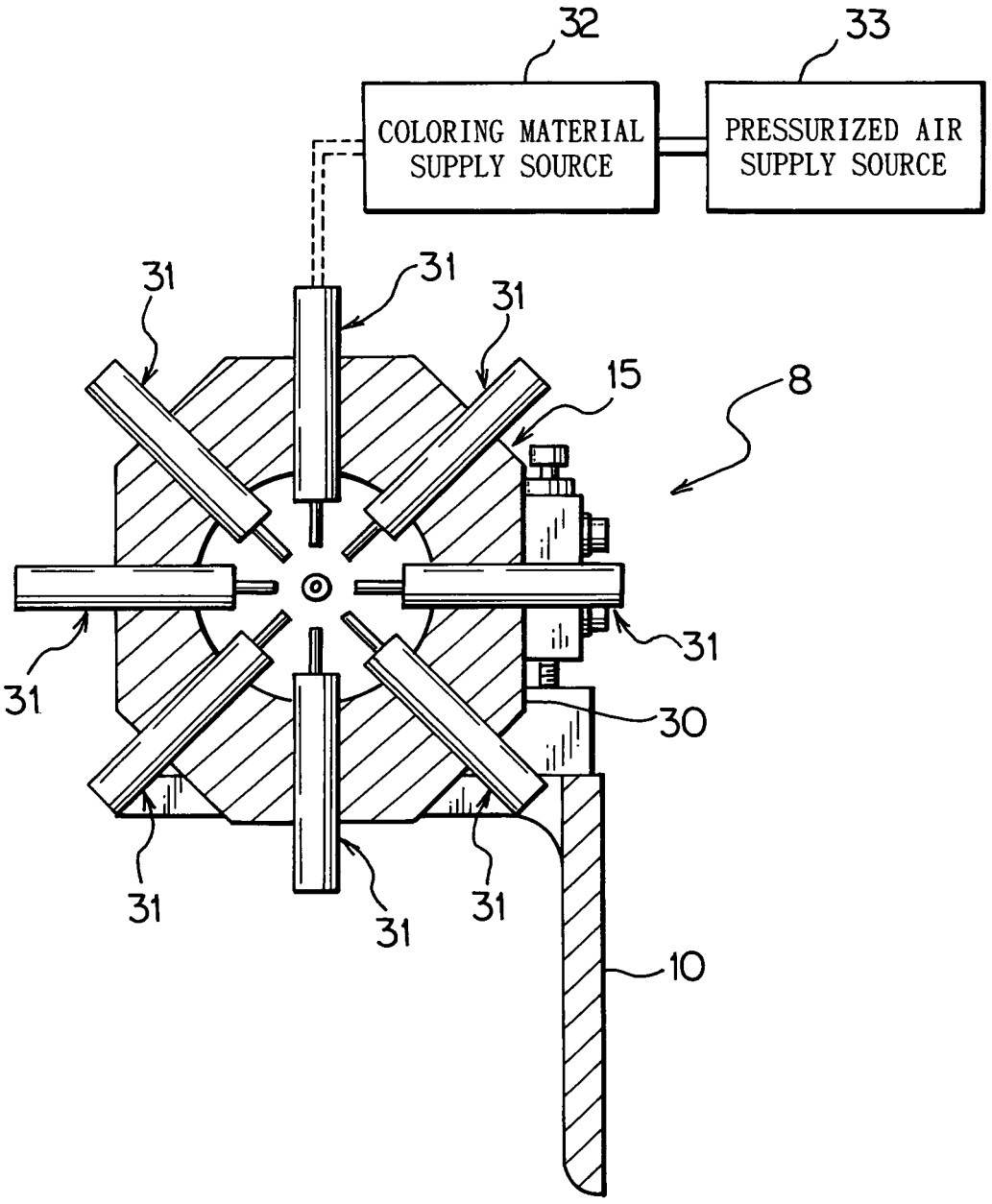

32
33
COLORING MATERIAL SUPPLY SOURCE
PRESSURIZED AIR SUPPLY SOURCE
31
31
31
15
8
31
31
30
31
31
31
10

FIG. 12

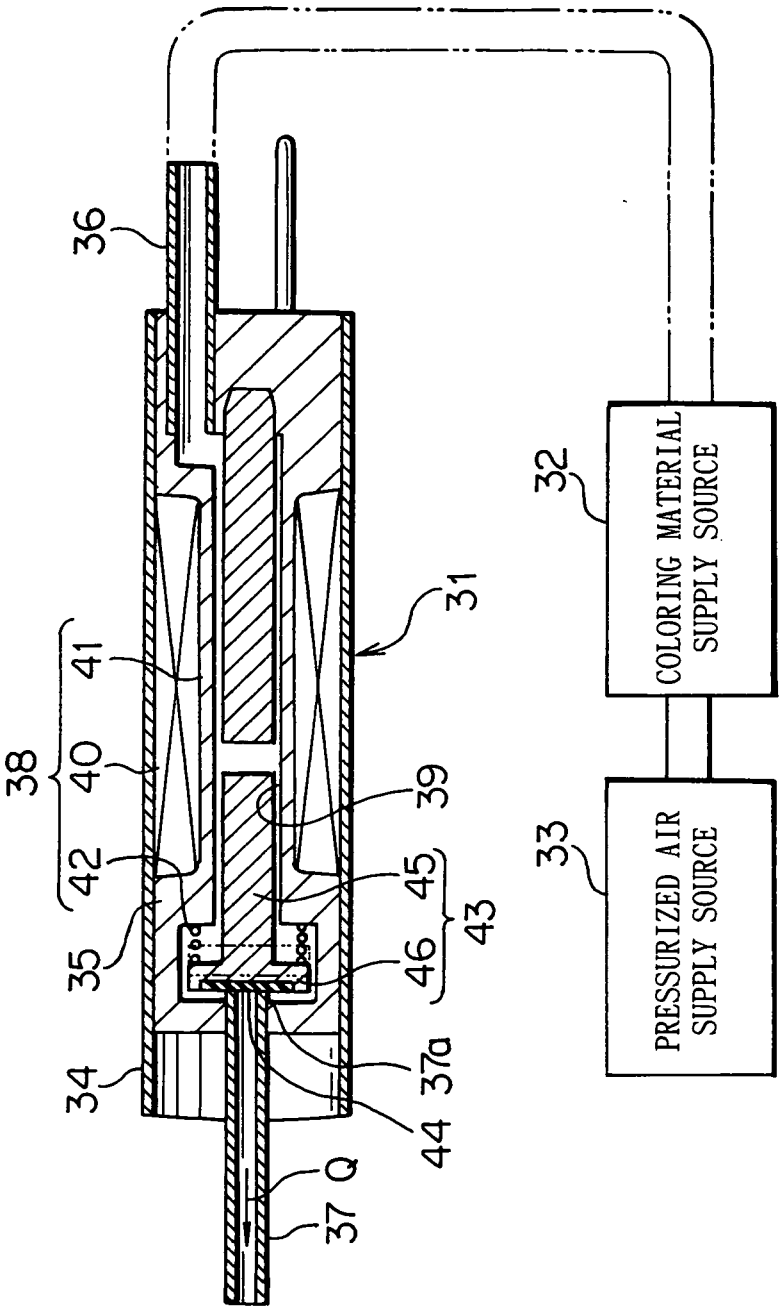
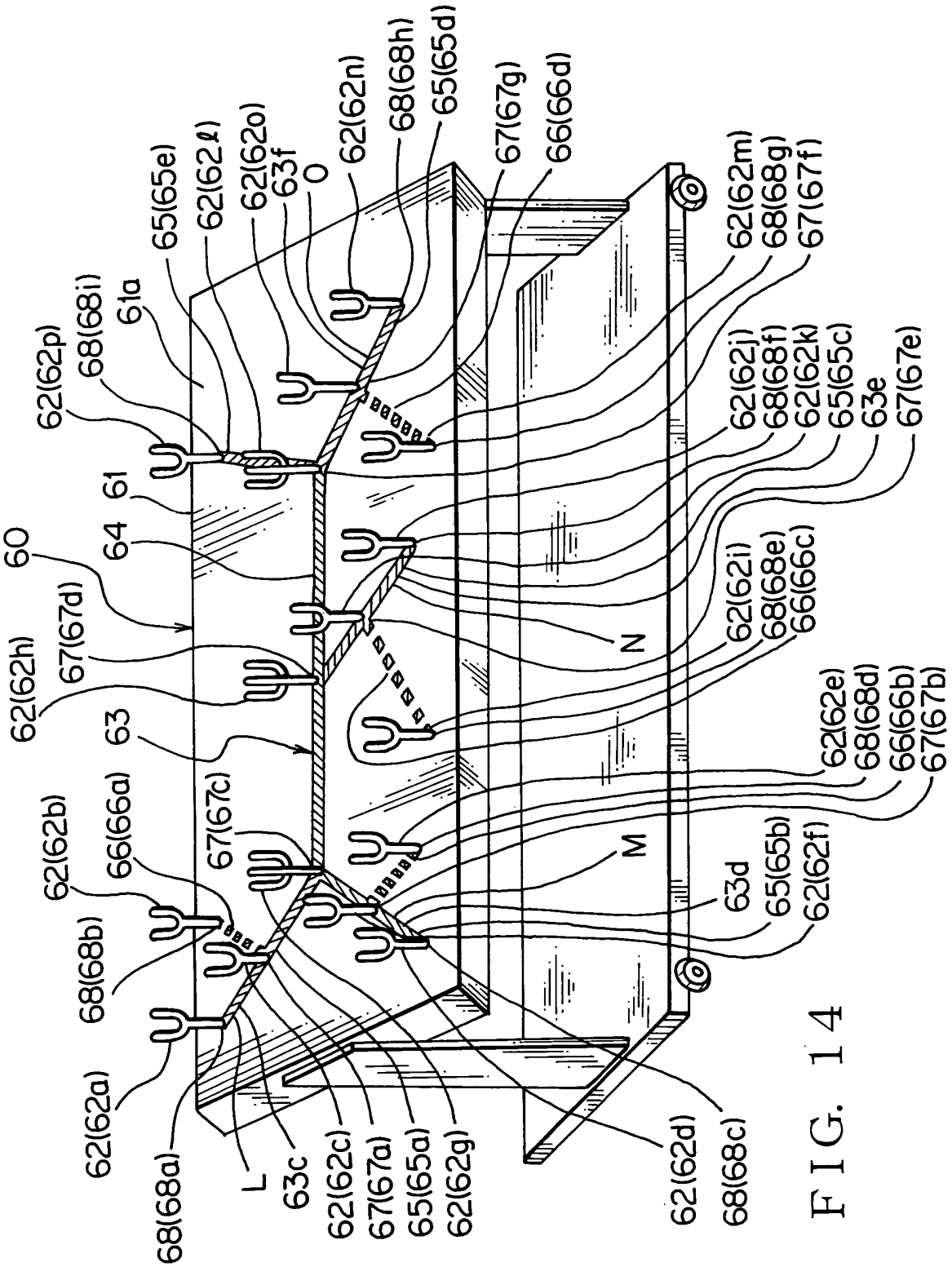

36
31
41
40
38
39
42
45
43
35
46
34
37a
44
Q
37
32
COLORING MATERIAL SUPPLY SOURCE
33
PRESSURIZED AIR SUPPLY SOURCE

FIG. 13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61
61a
62(62a)
62(62b)
62(62c)
62(62d)
62(62e)
62(62f)
62(62g)
62(62h)
62(62i)
62(62j)
62(62k)
62(62l)
62(62m)
62(62n)
62(62o)
62(62p)
63
63c
63d
63e
63f
64
65(65a)
65(65b)
65(65c)
65(65d)
65(65e)
66(66a)
66(66b)
66(66c)
66(66d)
67(67a)
67(67b)
67(67c)
67(67d)
67(67e)
67(67f)
67(67g)
68(68a)
68(68b)
68(68c)
68(68d)
68(68e)
68(68f)
68(68g)
68(68h)
68(68i)
L
M
N
O

FIG. 14

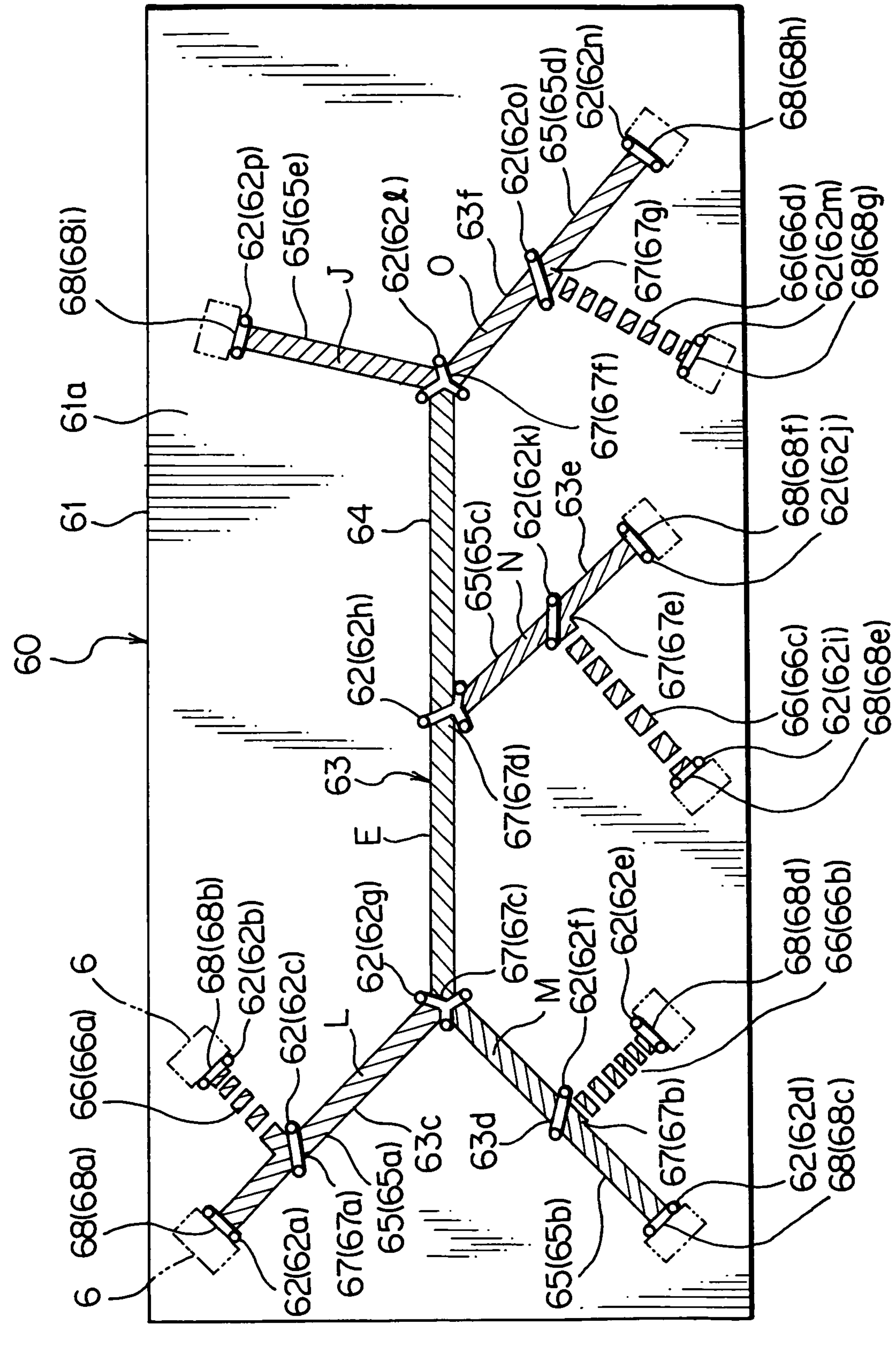

60
61
61a
63
64
E
J
L
M
N
O
6
63c
63d
63e
63f
62(62a)
62(62b)
62(62c)
62(62d)
62(62e)
62(62f)
62(62g)
62(62h)
62(62i)
62(62j)
62(62k)
62(62ℓ)
62(62m)
62(62n)
62(62o)
62(62p)
65(65a)
65(65b)
65(65c)
65(65d)
65(65e)
66(66a)
66(66b)
66(66c)
66(66d)
67(67a)
67(67b)
67(67c)
67(67d)
67(67e)
67(67f)
67(67g)
68(68a)
68(68b)
68(68c)
68(68d)
68(68e)
68(68f)
68(68g)
68(68h)
68(68i)

FIG. 15

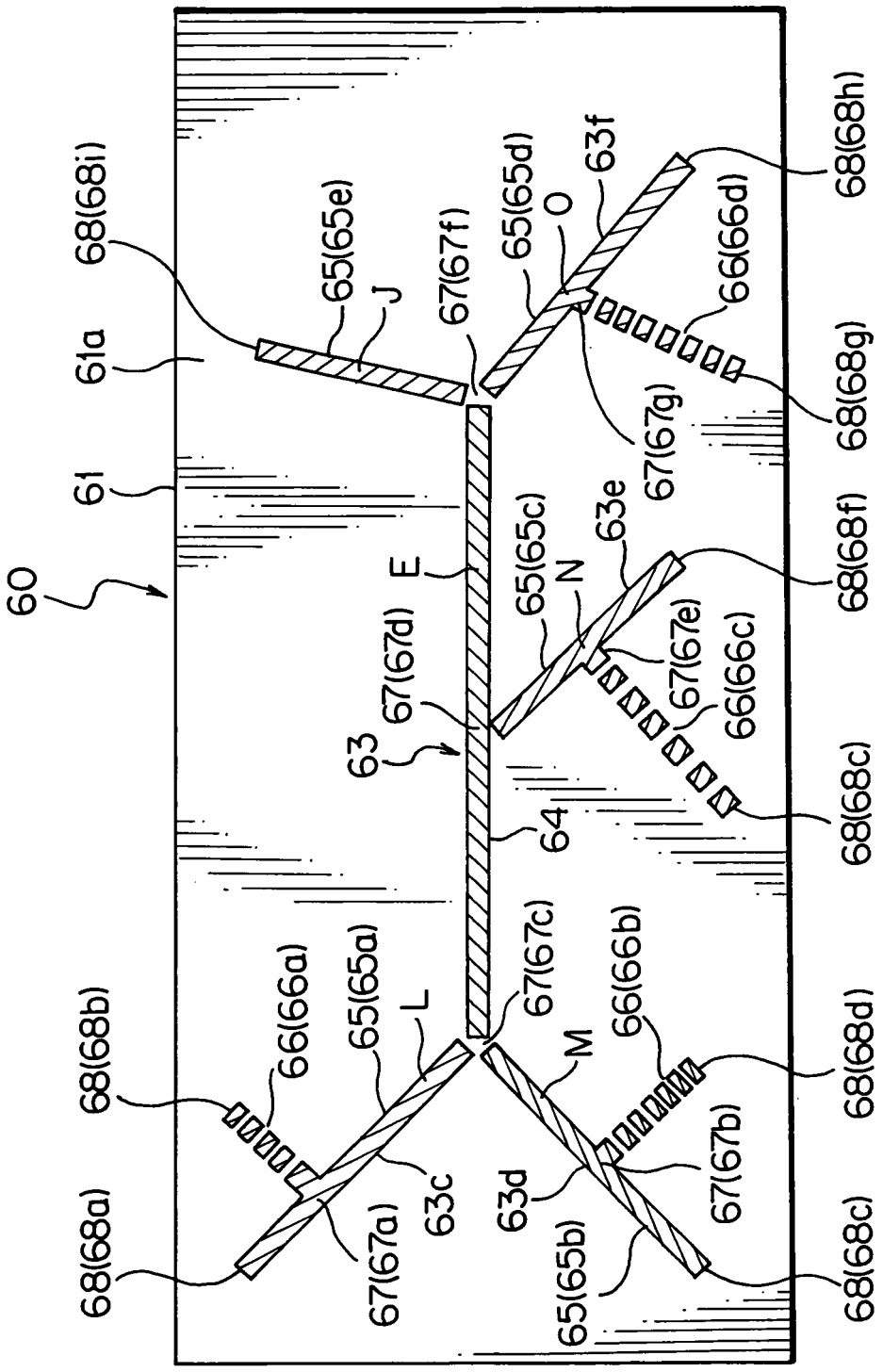

60
61
61a
68(68i)
65(65e)
J
67(67f)
65(65d)
O
63f
68(68h)
66(66d)
68(68g)
67(67g)
65(65c)
N
63e
68(68f)
E
67(67d)
67(67e)
66(66c)
63
64
68(68c)
68(68b)
66(66a)
65(65a)
L
67(67c)
66(66b)
68(68d)
M
63d
67(67b)
63c
68(68a)
67(67a)
65(65b)
68(68c)

FIG. 16

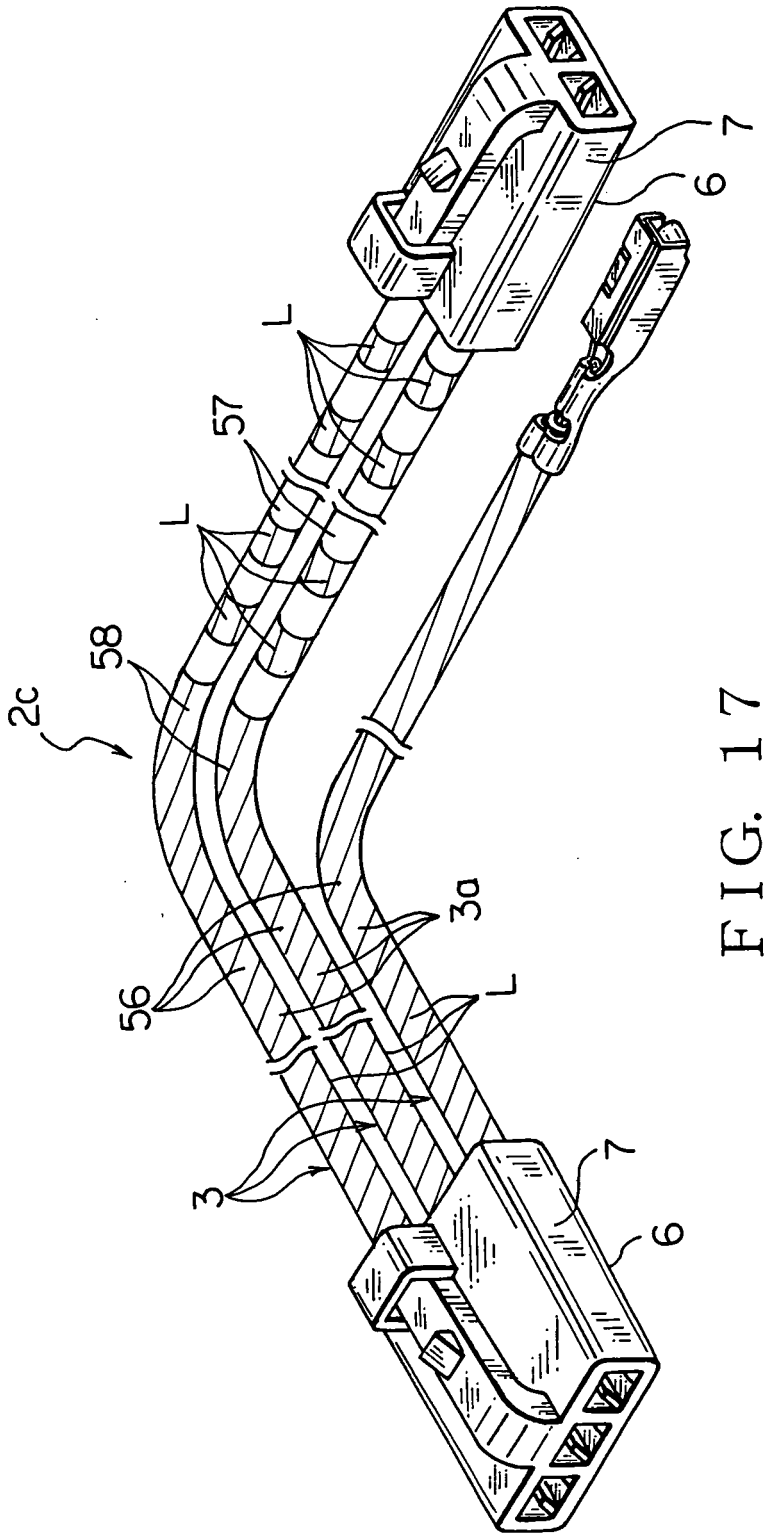


FIG. 17

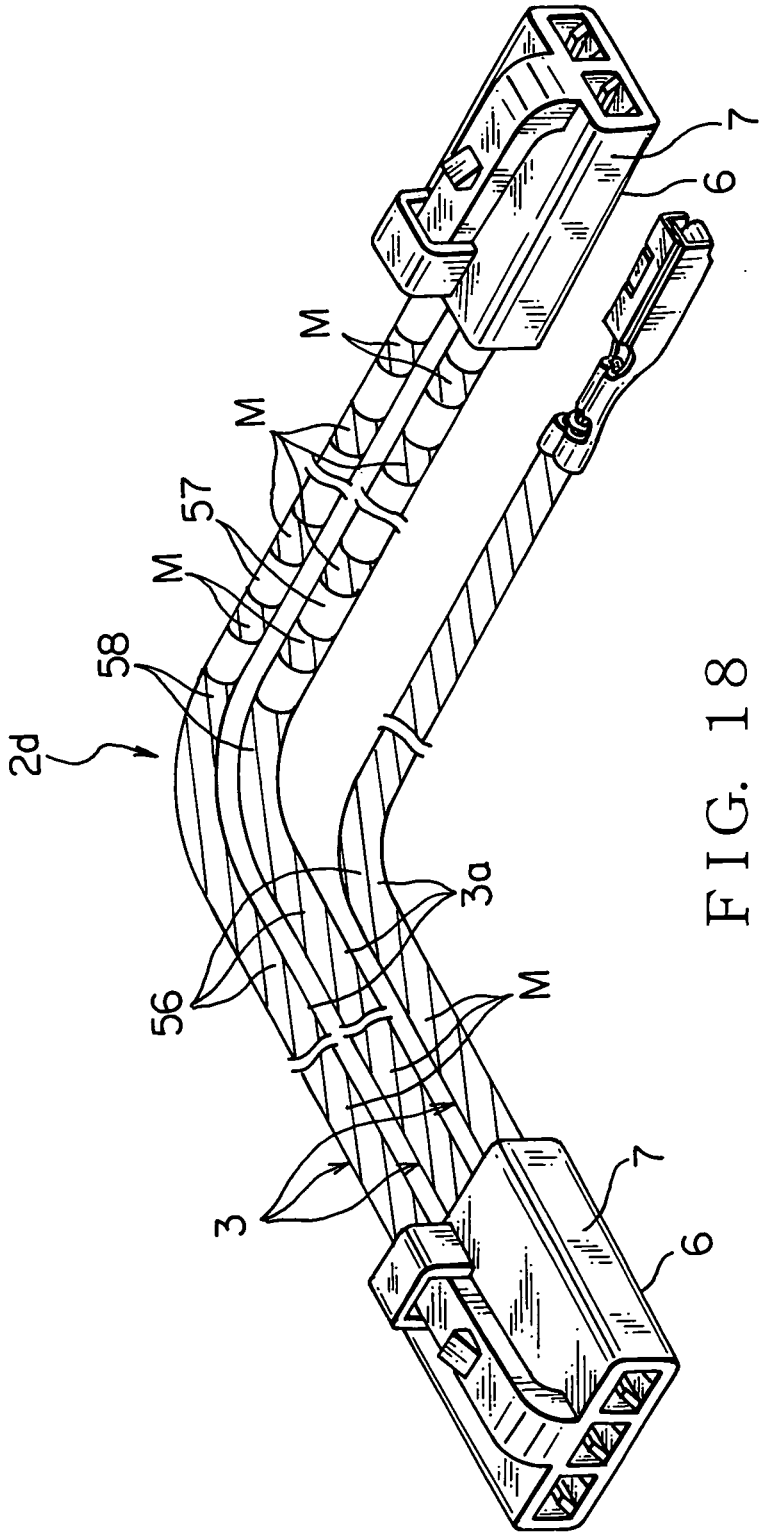


FIG. 18

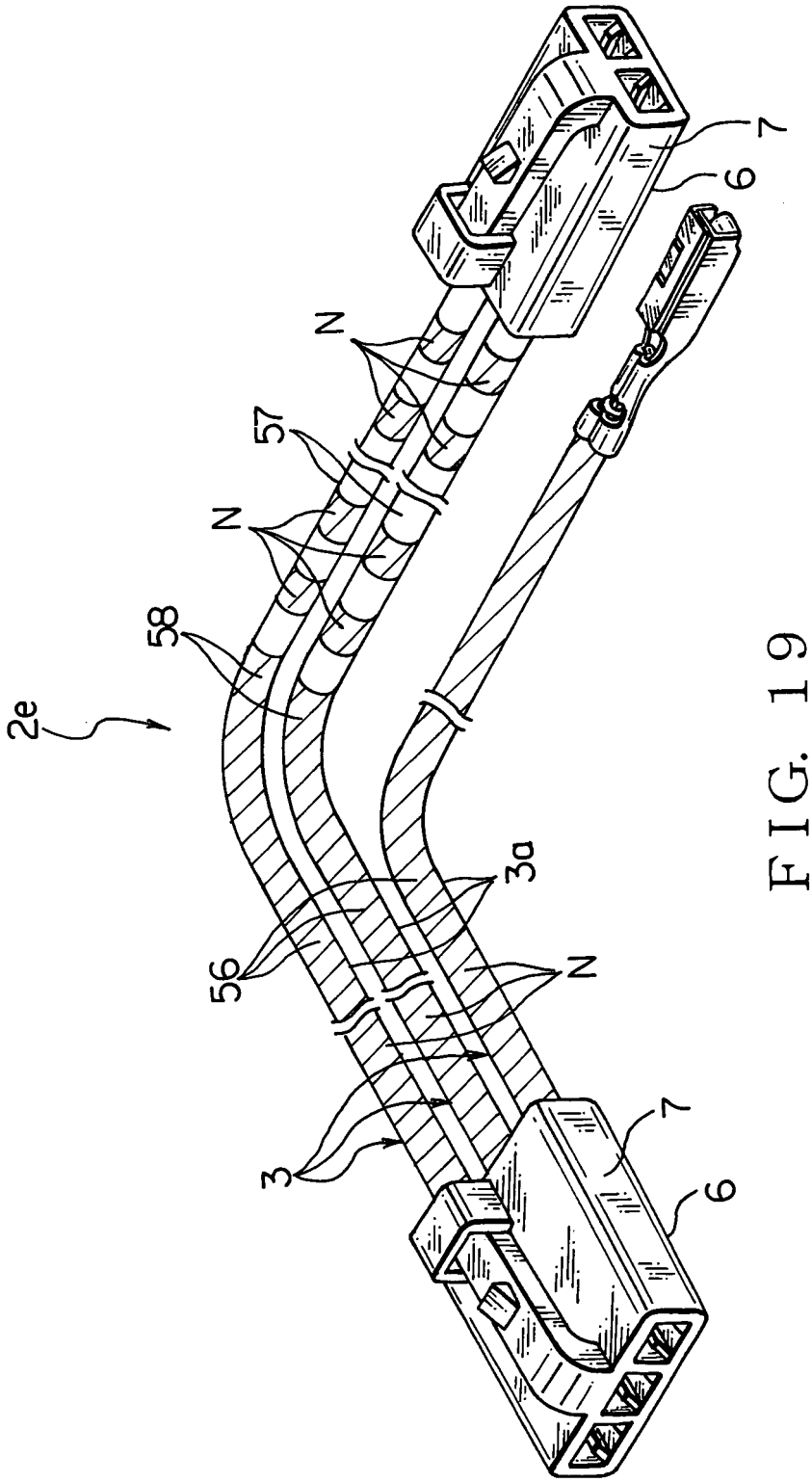


FIG. 19

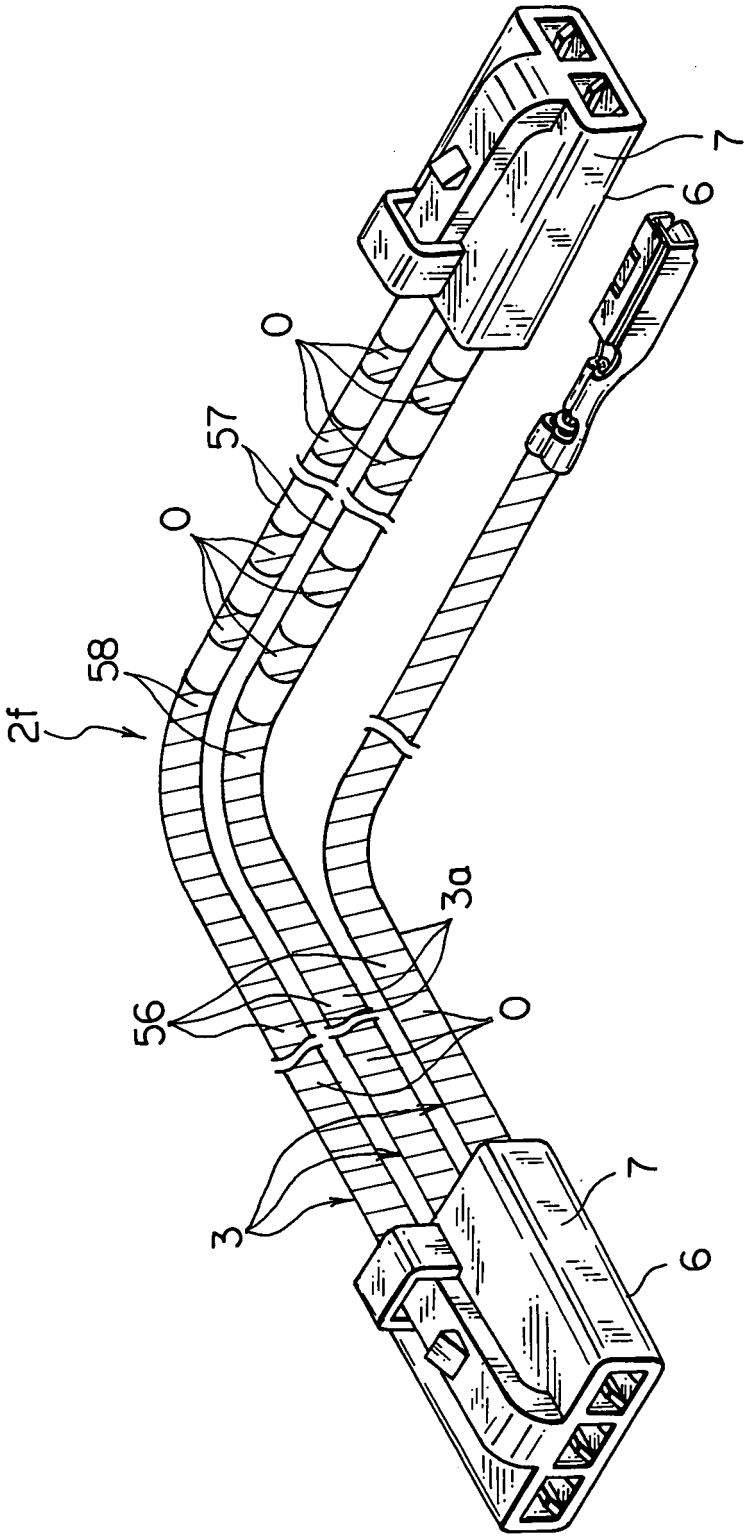


FIG. 20

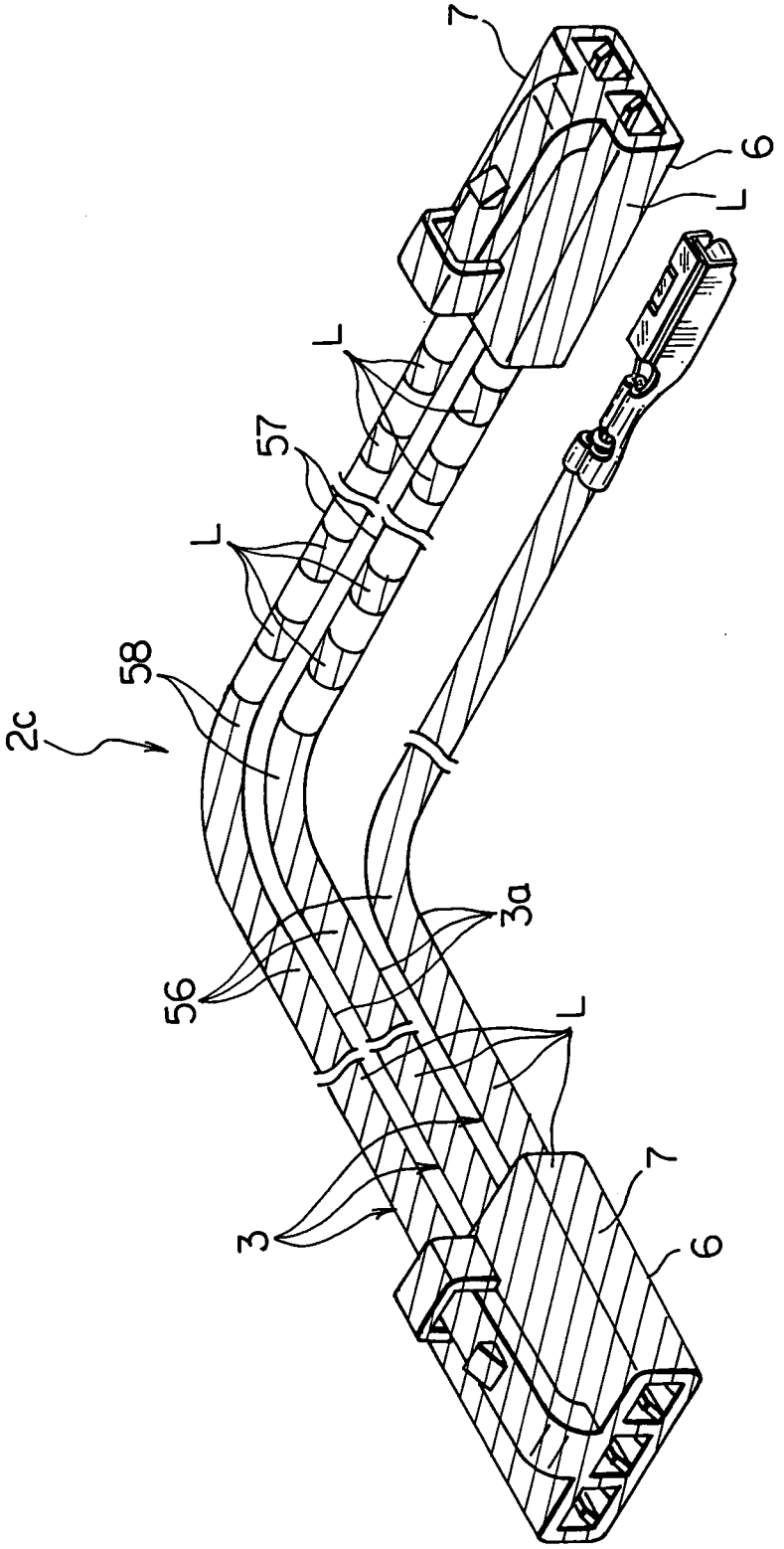


FIG. 21

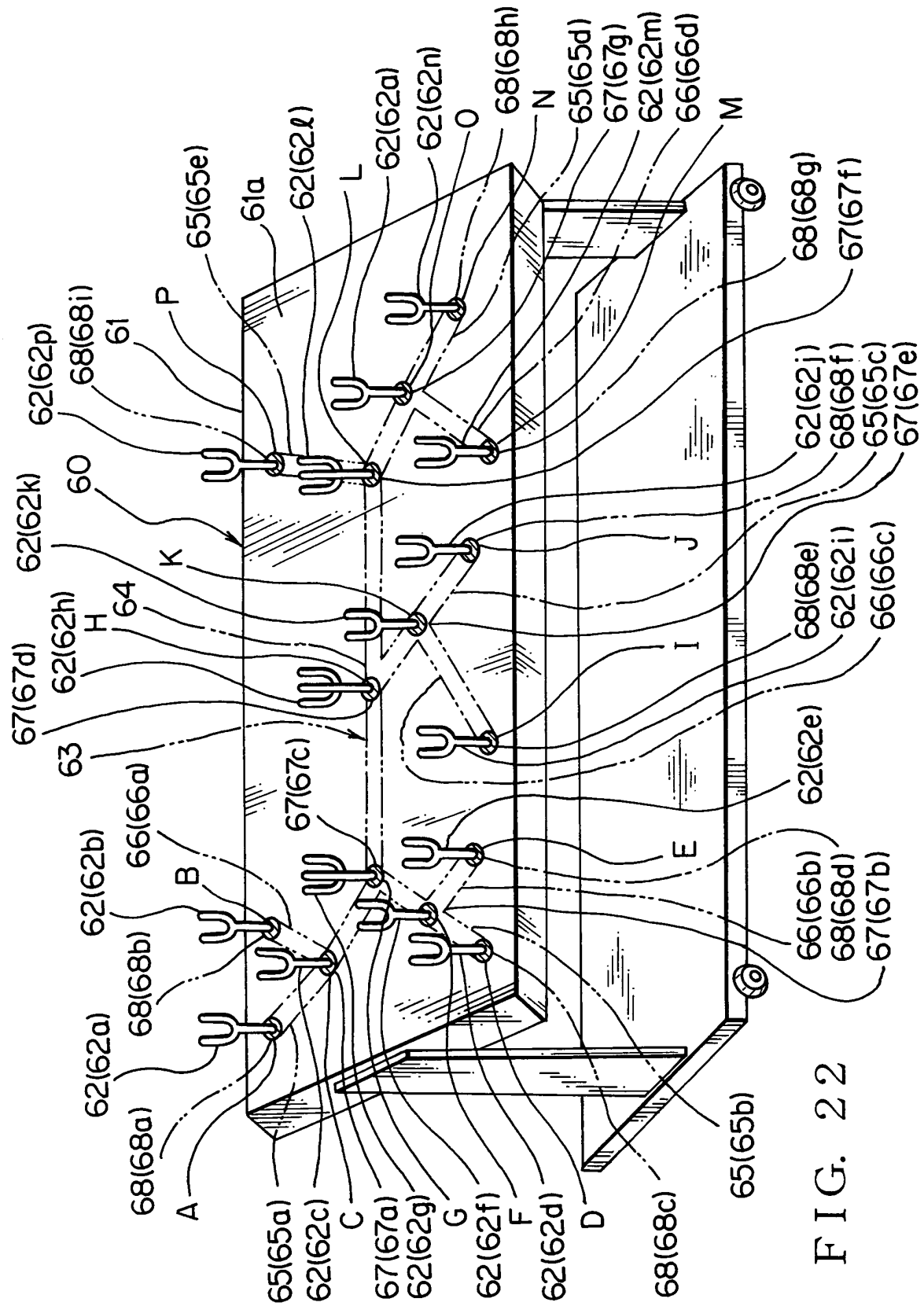

65(65e)
61a
62(62ℓ)
L
62(62a)
62(62n)
O
68(68h)
N
65(65d)
67(67g)
62(62m)
66(66d)
M
68(68g)
67(67f)
62(62p)
68(68i)
61
P
60
62(62k)
K
64
62(62h)
H
67(67d)
63
62(62j)
68(68f)
65(65c)
67(67e)
J
I
68(68e)
62(62i)
66(66c)
62(62e)
67(67c)
66(66a)
62(62b)
B
68(68b)
62(62a)
68(68a)
A
E
66(66b)
68(68d)
67(67b)
65(65b)
65(65a)
62(62c)
C
67(67a)
62(62g)
G
62(62f)
F
62(62d)
D
68(68c)

FIG. 22

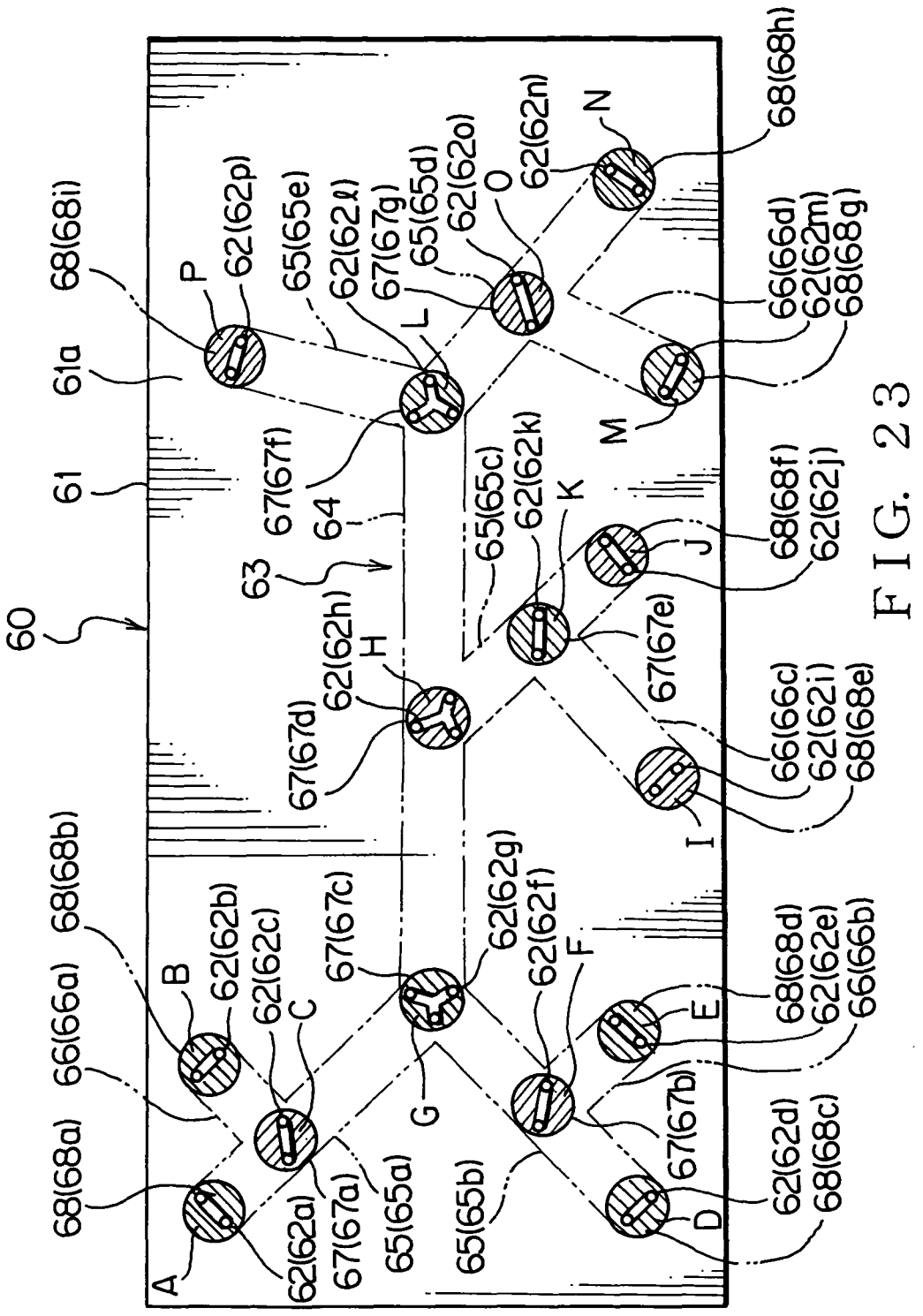

60
61
61a
63
64
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
68(68i)
68(68h)
68(68b)
66(66a)
68(68a)
62(62p)
65(65e)
62(62l)
67(67g)
65(65d)
62(62o)
62(62n)
66(66d)
62(62m)
68(68g)
67(67f)
65(65c)
62(62k)
68(68f)
62(62j)
67(67e)
67(67d)
62(62h)
66(66c)
62(62i)
68(68e)
62(62b)
62(62c)
67(67c)
62(62g)
62(62f)
68(68d)
62(62e)
66(66b)
62(62a)
67(67a)
65(65a)
65(65b)
67(67b)
62(62d)
68(68c)

FIG. 23

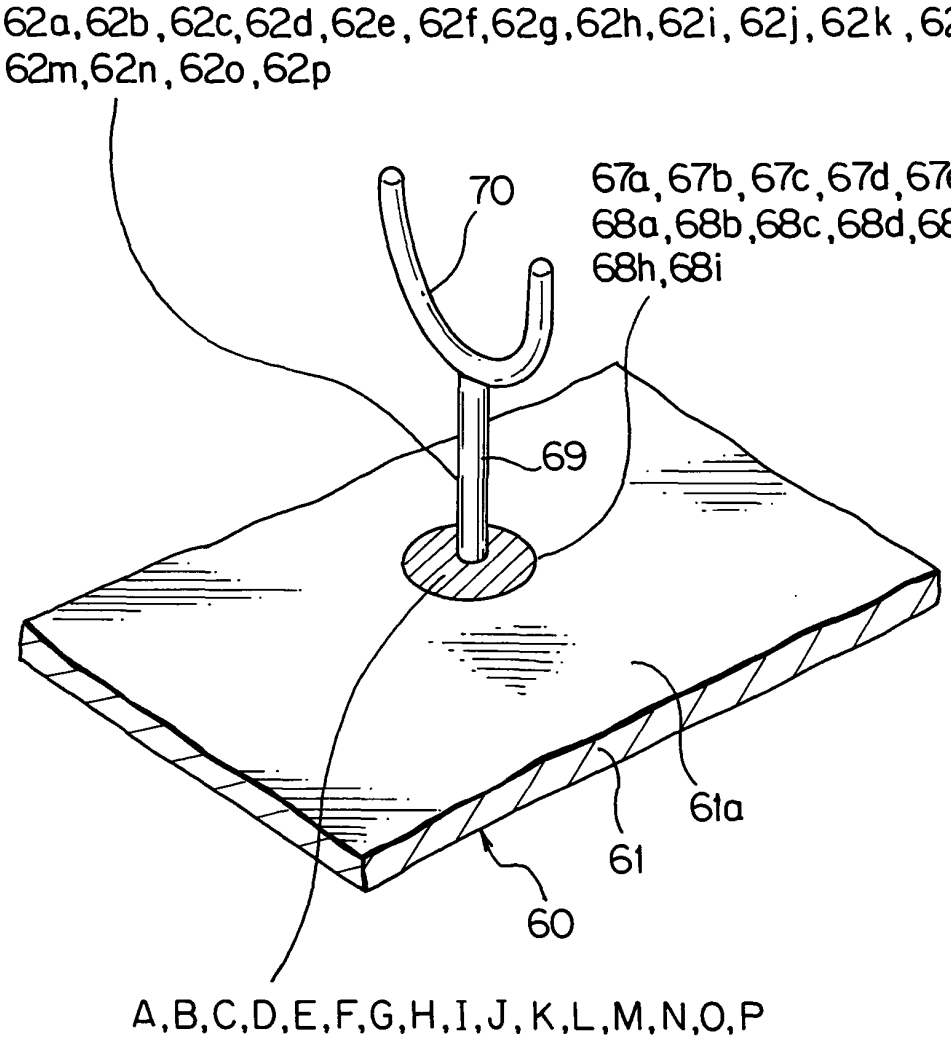

62a,62b,62c,62d,62e,62f,62g,62h,62i,62j,62k,62l,
62m,62n,62o,62p
70
67a,67b,67c,67d,67e,67f,67g
68a,68b,68c,68d,68e,68f,68g
68h,68i
69
61a
61
60
A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P

FIG. 24

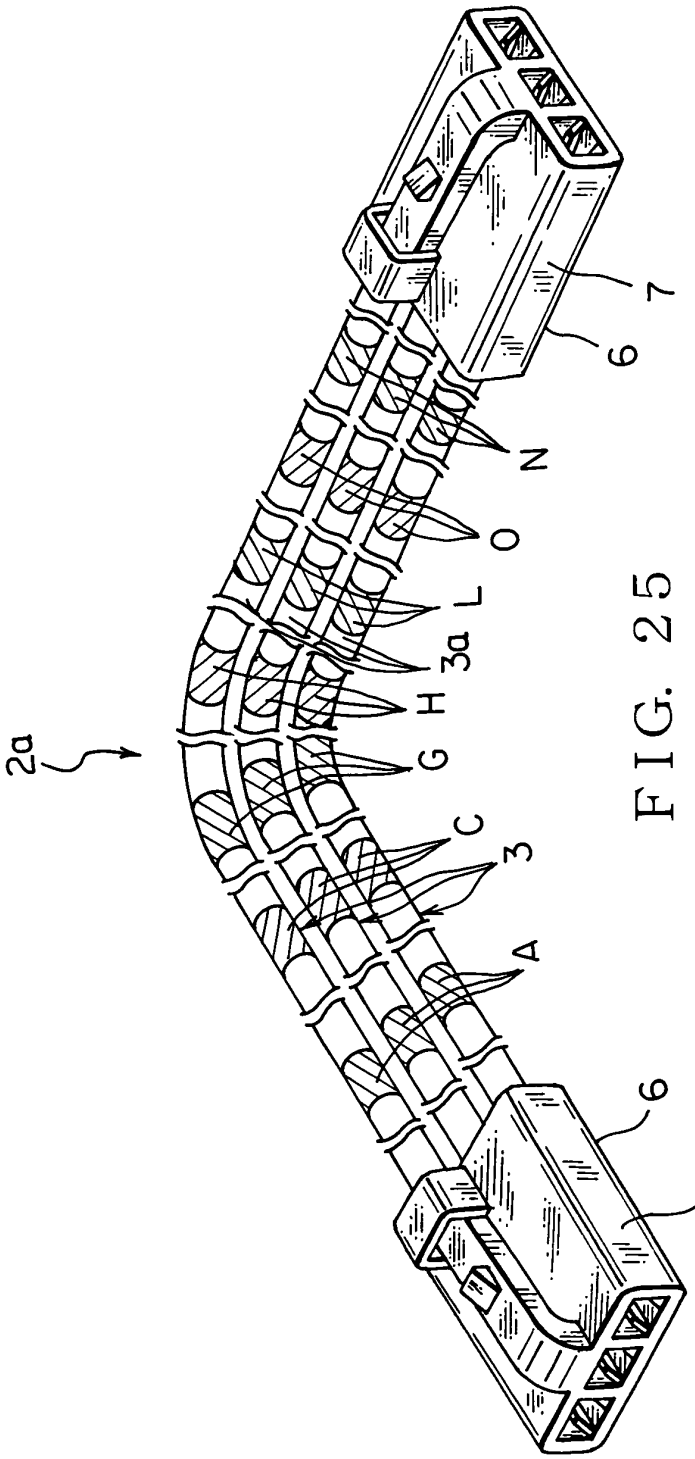


FIG. 25

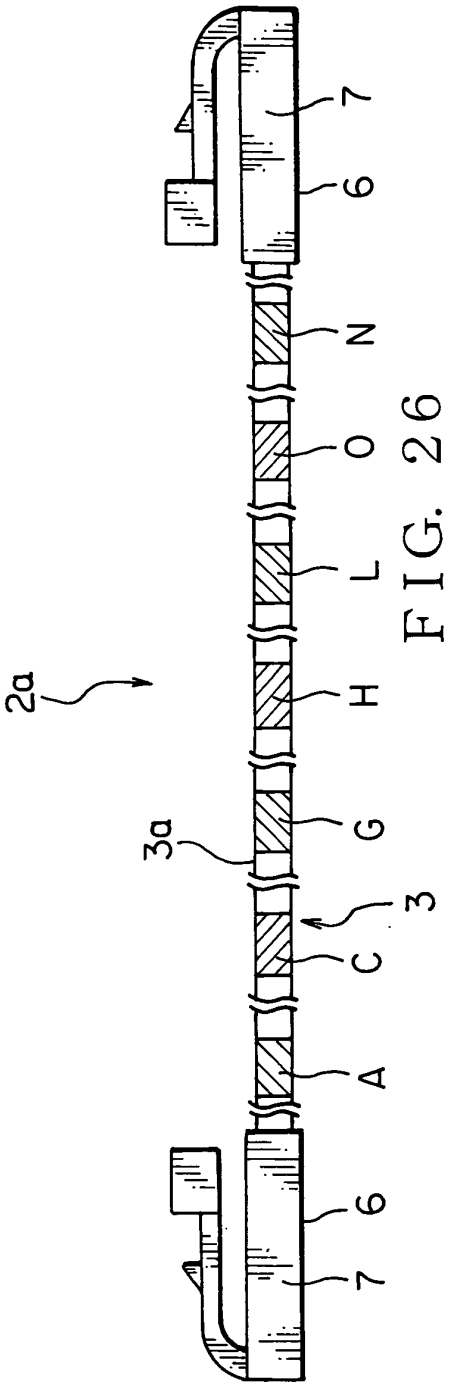


FIG. 26

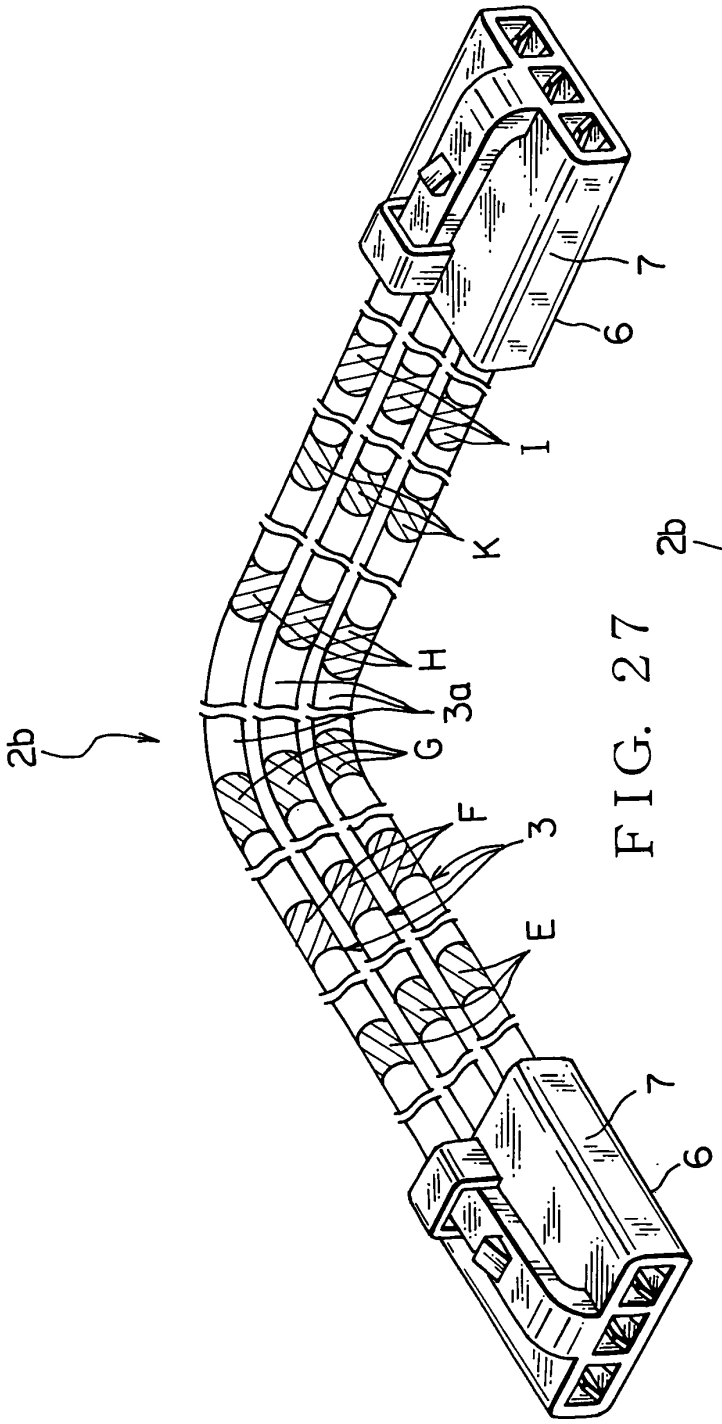


FIG. 27

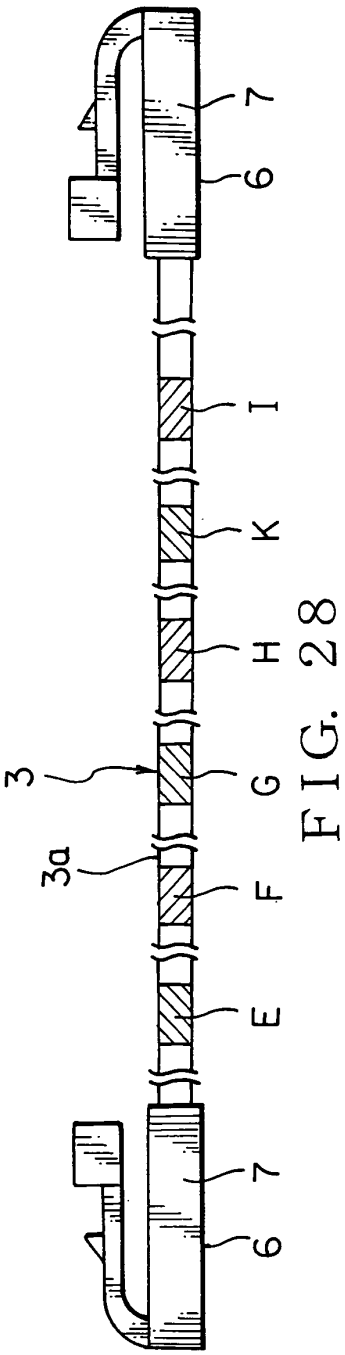


FIG. 28

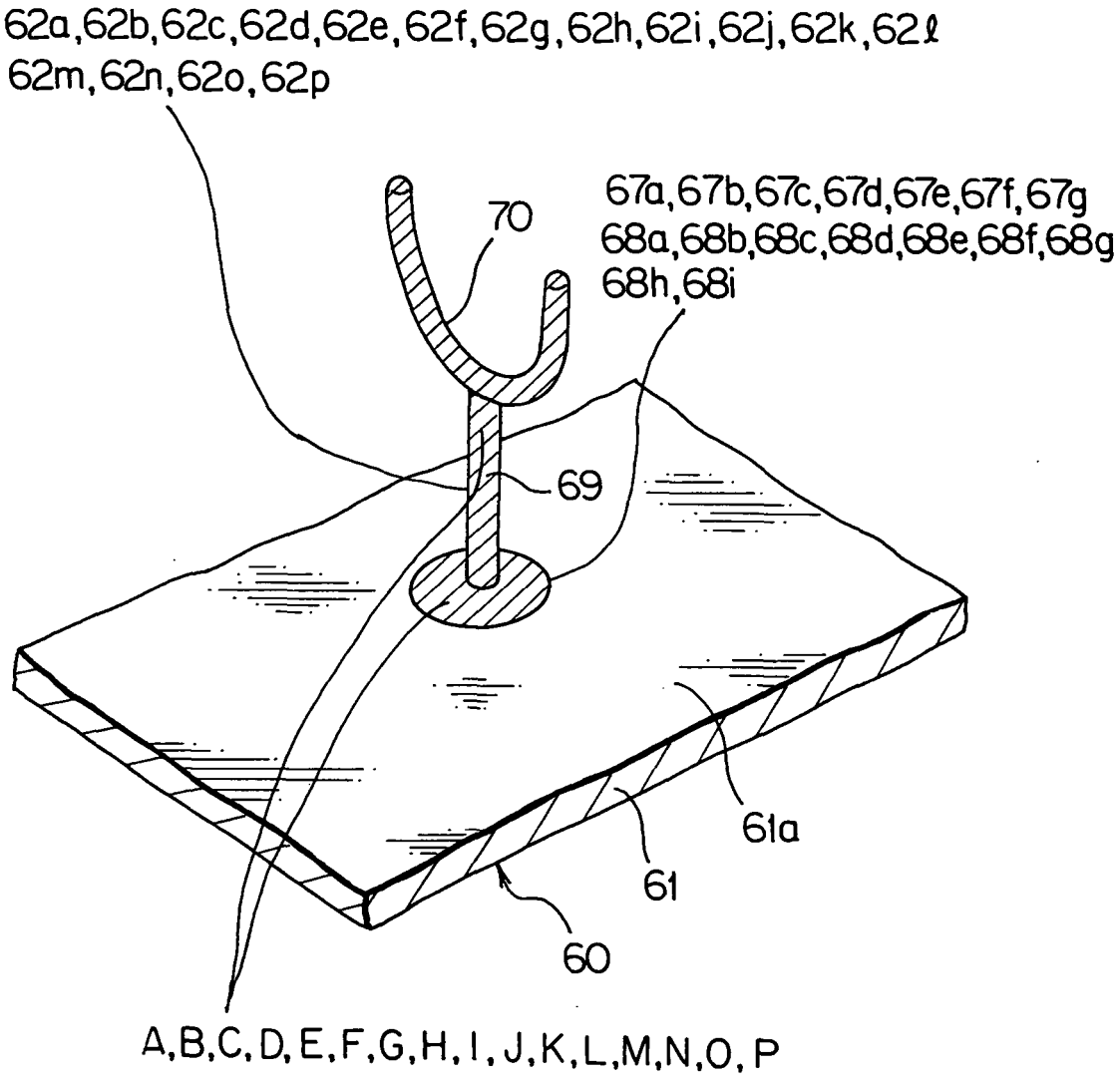
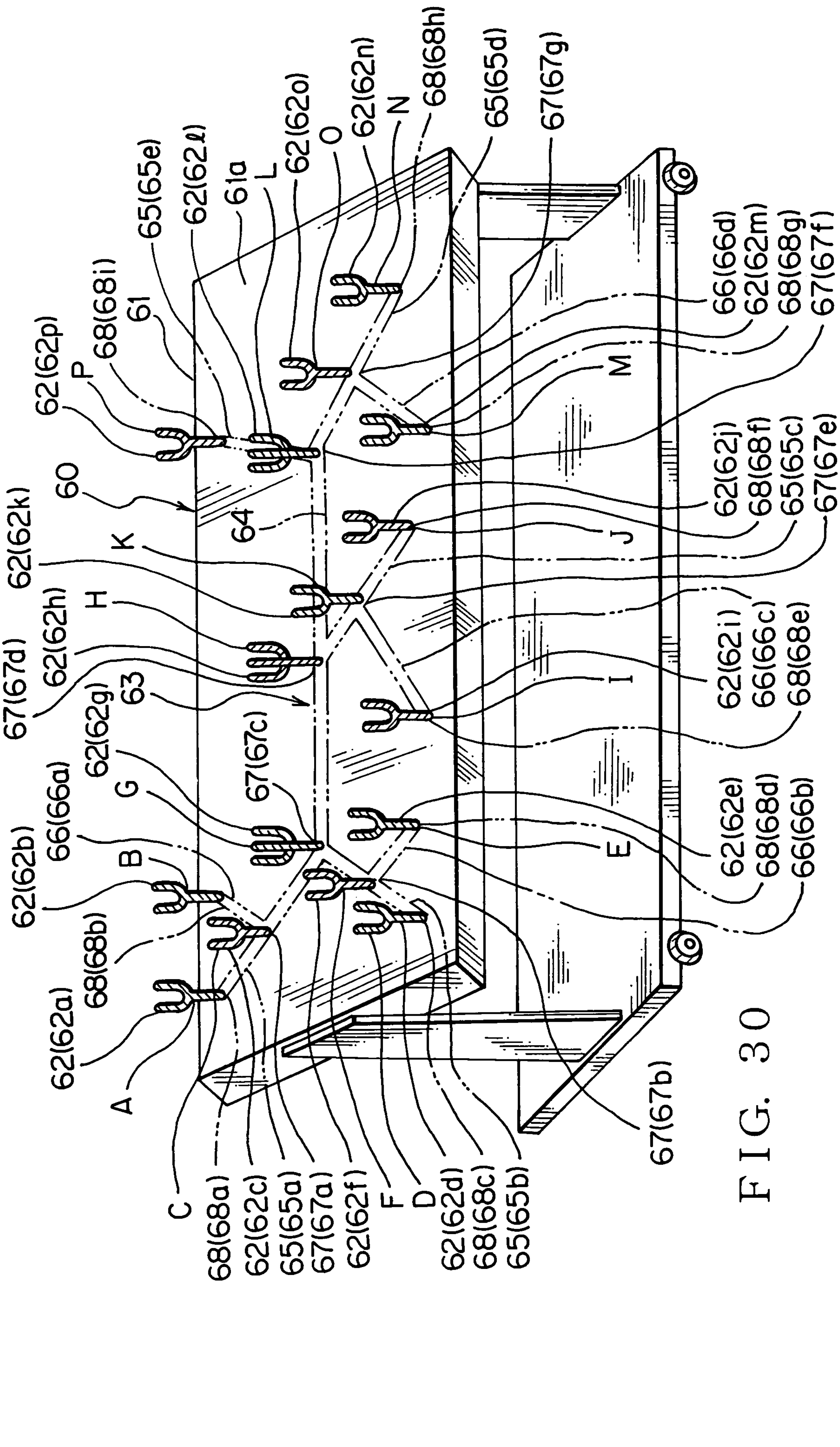

62a,62b,62c,62d,62e,62f,62g,62h,62i,62j,62k,62ℓ
62m,62n,62o,62p
70
67a,67b,67c,67d,67e,67f,67g
68a,68b,68c,68d,68e,68f,68g
68h,68i
69
61a
61
60
A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P

FIG. 29


62(62a)
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B
66(66a)
62(62g)
G
67(67c)
63
62(62h)
67(67d)
H
62(62k)
K
64
60
62(62p)
P
68(68i)
61
65(65e)
62(62ℓ)
61a
L
62(62o)
O
62(62n)
N
68(68h)
65(65d)
67(67g)
C
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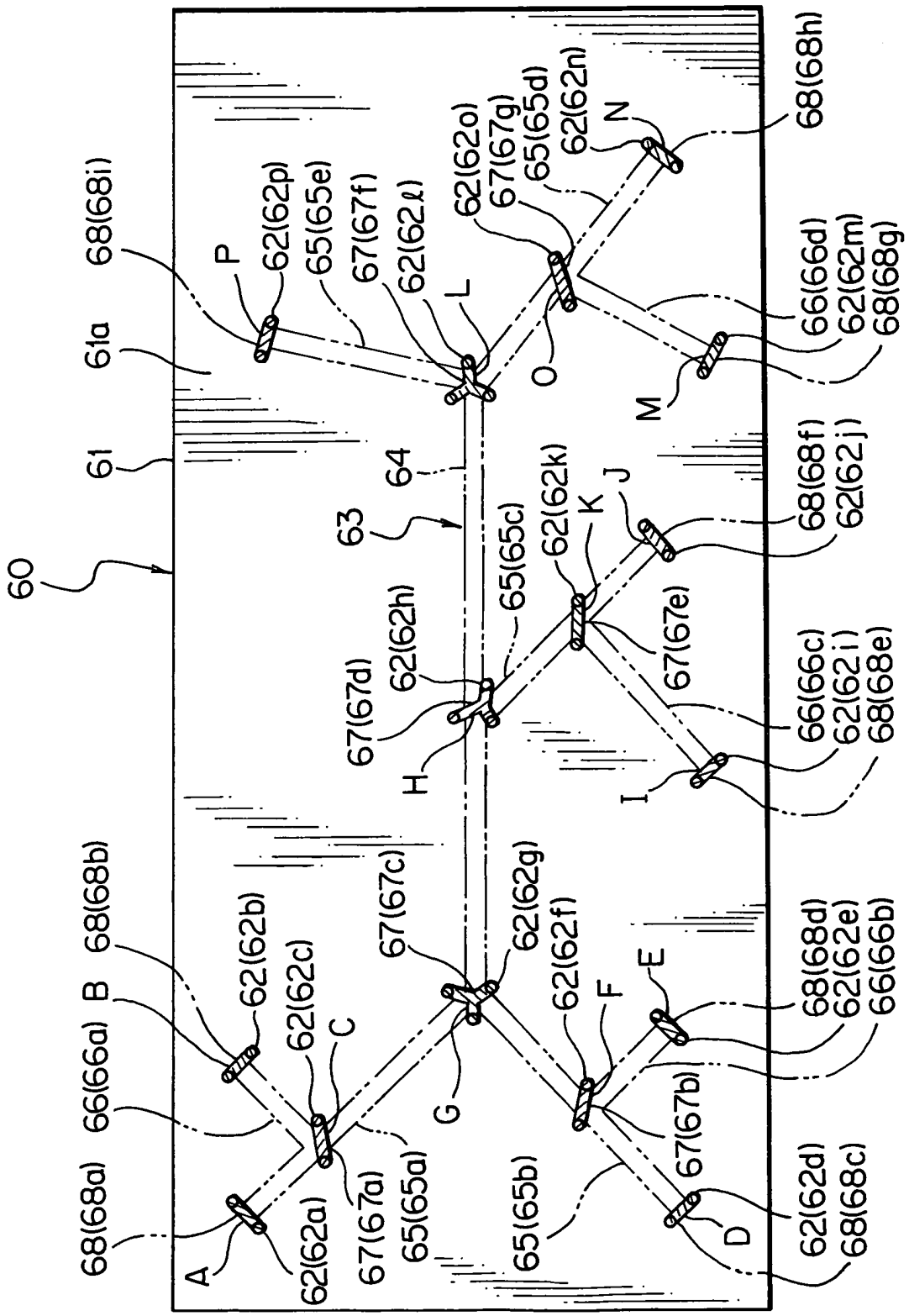
62(62c)
65(65a)
67(67a)
62(62f)
F
D
62(62d)
68(68c)
65(65b)
67(67b)
E
62(62e)
68(68d)
66(66b)
I
62(62i)
66(66c)
68(68e)
J
62(62j)
68(68f)
65(65c)
67(67e)
M
66(66d)
62(62m)
68(68g)
67(67f)

FIG. 30


60
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61a
63
64
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68(68h)
68(68g)
68(68f)
68(68e)
68(68d)
68(68c)
68(68b)
68(68a)
62(62p)
62(62o)
62(62n)
62(62m)
62(62l)
62(62k)
62(62j)
62(62i)
62(62h)
62(62g)
62(62f)
62(62e)
62(62d)
62(62c)
62(62b)
62(62a)
65(65e)
65(65d)
65(65c)
65(65b)
65(65a)
67(67g)
67(67f)
67(67e)
67(67d)
67(67c)
67(67b)
67(67a)
66(66d)
66(66c)
66(66b)
66(66a)
A
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K
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O
P

FIG. 31

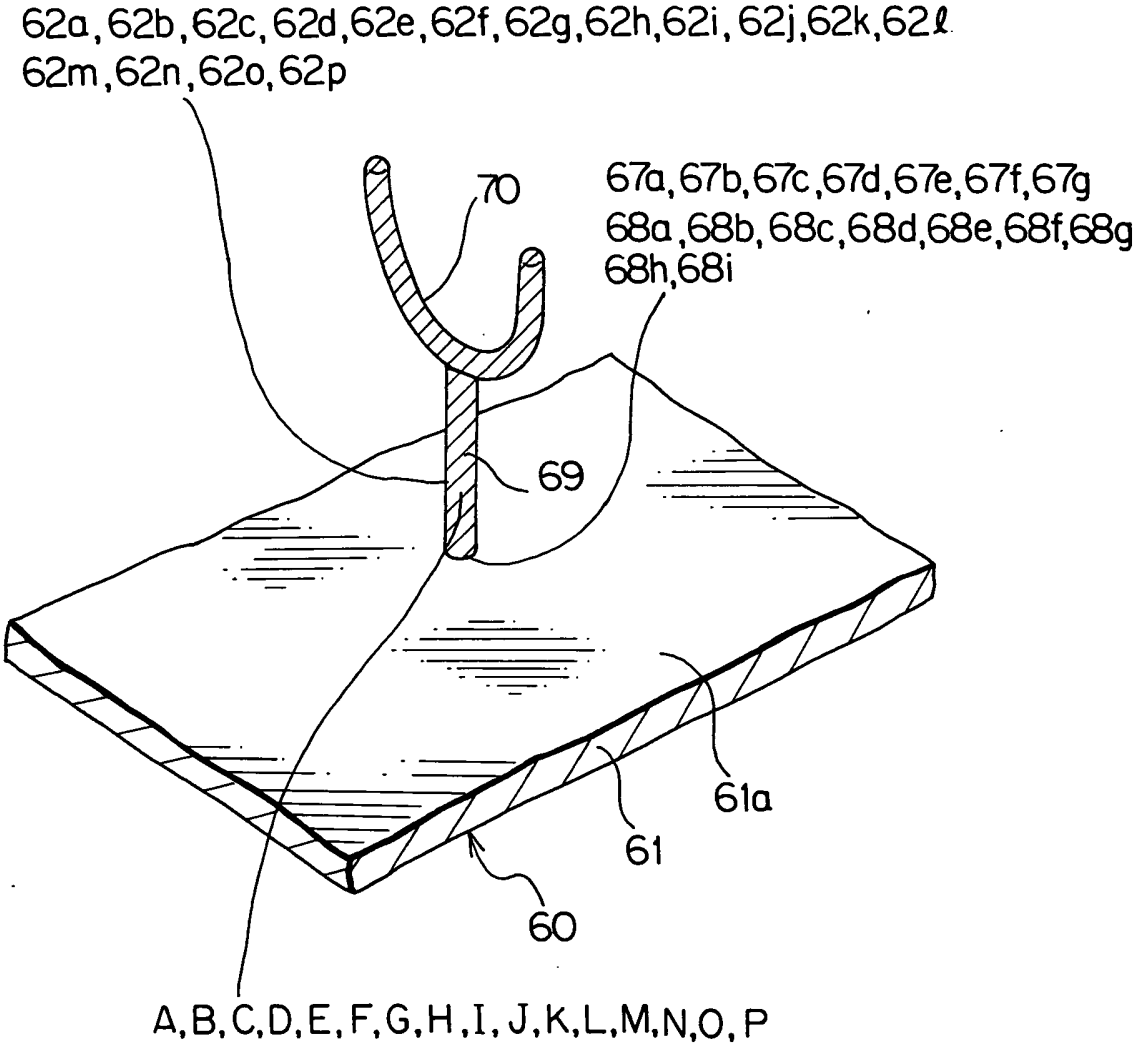
62a,62b,62c,62d,62e,62f,62g,62h,62i,62j,62k,62l
62m,62n,62o,62p
70
67a,67b,67c,67d,67e,67f,67g
68a,68b,68c,68d,68e,68f,68g
68h,68i
69
61a
61
60
A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P

FIG. 32