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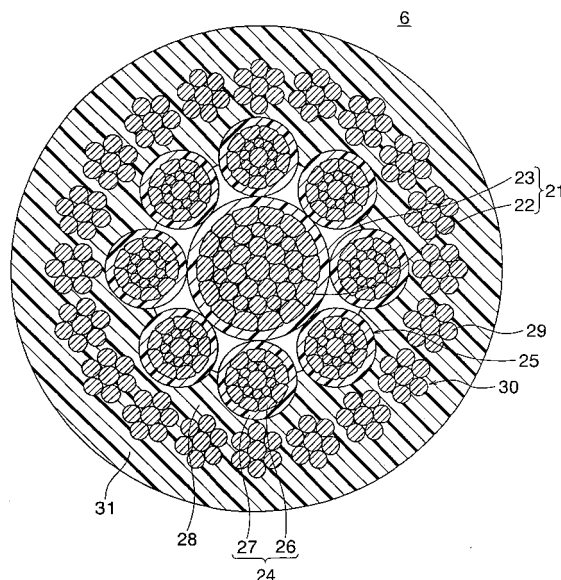
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(54) **ROPE FOR ELEVATOR AND METHOD FOR PRODUCING THE SAME**

(57) An elevator rope includes a core strand, which has a core strand main body and a resin core strand covering body covering the core strand main body. An inner layer strand assembly is composed of a plurality of inner layer strands twisted together in the outer periphery of the core strand around the core strand. Each inner layer strand has an inner layer strand main body and a resin inner layer strand covering body covering the inner layer strand main body. An outer layer strand assembly is composed of a plurality of outer layer strands twisted together in the outer periphery of the inner layer strand assembly. Each outer layer strand has an outer layer strand main body. The outer layer strand assembly is covered with a resin outer layer covering body. The inner layer strand main bodies and the inner layer strand covering bodies are glued to each other through the intermediation of an adhesive, and the outer layer strand and the outer layer covering body are glued to each other through the intermediation of an adhesive.

FIG. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator rope having a resin outer layer covering body provided in an outer peripheral portion thereof, and to a method of manufacturing the same.

BACKGROUND ART

[0002] In the conventional elevator ropes, an inner layer rope has a plurality of inner layer strands formed of a plurality of steel wires twisted together. The outer periphery of the inner layer rope is covered with an inner layer covering body formed of a resin. An outer layer is provided in the outer peripheral portion of the inner layer covering body. The outer layer has a plurality of outer layer strands formed of a plurality of steel wires twisted together. The outer periphery of the outer layer is covered with an outer layer covering body formed of a high-friction resin material (see, for example, Patent Document 1).

[0003] Patent Document 1: WO 03/050348 A1

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] In such the conventional elevator rope, the strands of the layers come into contact with each other to cause wear and breakage of the wires, so there is a fear of the service life of the rope as a whole being reduced. Further, at the time of manufacture, it is rather difficult to secure a stable resin thickness between the layers and between the strands.

[0005] The present invention has been made with a view toward solving the above problems. It is an object of the present invention to provide an elevator rope which makes it possible to secure a stable resin thickness between the layers and between the strands and which helps to more reliably prevent the strands from coming into contact with each other, to thereby achieve an increase in the service life, and a method of manufacturing such an elevator rope.

MEANS FOR SOLVING PROBLEMS

[0006] An elevator rope according to the present invention includes: a core strand having a core strand main body formed of a plurality of steel wires twisted together, and a resin strand covering body covering the core strand main body; an inner layer strand assembly composed of a plurality of inner layer strands twisted together in an outer periphery of the core strand around the core strand, each inner layer strand having an inner layer strand main body formed of a plurality of steel wires twisted together and a resin inner layer covering body covering the inner layer strand main body; an outer layer strand assembly

composed of a plurality of outer layer strands twisted together in an outer periphery of the inner layer strand assembly, each outer layer strand having an outer layer strand main body formed of a plurality of steel wires twisted together; and a resin outer layer covering body covering the outer layer strand assembly, in which the inner layer strand main bodies and the inner strand covering bodies are glued to each other through the intermediation of an adhesive, and the outer layer strands and the outer layer covering body are glued to each other through the intermediation of an adhesive.

Further, the elevator rope according to the present invention includes: a core strand having a core strand main body formed of a plurality of steel wires twisted together, and a resin strand covering body covering the core strand main body; an inner layer strand assembly composed of a plurality of inner layer strands twisted together in an outer periphery of the core strand around the core strand, each inner layer strand having an inner layer strand main body formed of a plurality of steel wires twisted together and a resin inner layer covering body covering the inner layer strand main body; an outer layer strand assembly composed of a plurality of outer layer strands twisted together in an outer periphery of the inner layer strand assembly, each outer layer strand having an outer layer strand main body formed of a plurality of steel wires twisted together; and a resin outer layer covering body covering the outer layer strand assembly, in which the inner layer strand main bodies and the inner strand covering bodies are glued to each other through the intermediation of an adhesive, and the outer layer strand main body and the outer layer strand covering body are glued to each other through the intermediation of an adhesive.

Further, a method of manufacturing the elevator rope includes: a first step of producing a plurality of strands by covering strand main bodies, each of which is formed of a plurality of steel wires twisted together, with resin strand covering bodies; a second step of twisting together the strands; and a third step of covering an assembly of the strands with a resin outer covering body after the second step.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Fig. 1 is a front view of an elevator apparatus according to Embodiment 1 of the present invention.

Fig. 2 is a cross-sectional view of a main rope of Fig. 1.

Fig. 3 is a cross-sectional view of an elevator rope according to Embodiment 2 of the present invention. Fig. 4 is an enlarged sectional view of an outer layer strand of Fig. 3.

Fig. 5 is a sectional view of the outer layer strand of Fig. 4 with an adhesive applied to the outer periphery thereof.

Fig. 6 is a cross-sectional view of an elevator rope

according to Embodiment 3 of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0008] Preferred embodiments of the present invention will now be described with reference to the drawings.

Embodiment 1

[0009] Fig. 1 is a diagram schematically showing the construction of an elevator apparatus according to Embodiment 1 of the present invention. In the drawing; a support beam 2 is horizontally fixed to the upper portion of the interior of a hoistway 1. A driving machine (hoist) 3 is mounted on the support beam 2. The driving machine 3 has a driving machine main body 4 including a motor, and a driving sheave 5 rotated by the driving machine main body 4. The driving machine 3 is arranged horizontally so that a rotation shaft of the driving sheave 5 may extend vertically.

[0010] A plurality of main ropes 6, serving as elevator ropes, are wrapped around the driving sheave 5. For the sake of simplicity, Fig. 1 only shows one main rope 6. The end portions of the main ropes 6 are connected to the support beam 2. A car 7 and a counterweight 8 are suspended in the hoistway 1 by the main ropes 6, and are caused to ascend and descend by the driving machine 3.

[0011] Under the car 7, there are provided a pair of car sash pulleys 9 around which the main ropes 6 are wrapped. On top of the counterweight 8, there are provided a pair of counterweight sash pulleys 10 around which the main ropes 6 are wrapped. Mounted on the support beam 2 are a first pulley 11 for guiding the main ropes 6 from the driving sheave 5 to the car sash pulleys 9 and a second pulley 12 for guiding the main ropes 6 from the driving sheave 5 to the counterweight sash pulleys 10.

[0012] Fig. 2 is a cross-sectional view of the main rope 6 of Fig. 1. At the center of the main rope 6, there is arranged a core strand 21. The core strand 21 has a core strand main body 22 formed of a plurality of steel wires twisted together, and a resin core strand covering body 23 covering the core strand main body 22. The sectional configuration of the steel wires situated in the outer peripheral portion of the core strand main body 22 is deformed by compressing the core strand main body 22 from the outer periphery thereof. The core strand covering body 23 is formed of a hard resin, such as polyethylene resin.

[0013] In the outer periphery of the core strand 21, there is arranged an inner layer strand assembly 25 composed of a plurality of (eight, in this example) inner layer strands 24. The inner layer strands 24 are twisted together around the core strand 21, that is, in the outer periphery of the core strand 21. Each inner layer core strand 24 has an inner layer strand main body 26 formed of a plurality of steel wires twisted together, and a resin inner

layer strand covering body 27 covering the inner layer strand main body 26. The sectional configuration of the steel wires situated in the outer peripheral portion of the inner layer strand main body 26 is deformed by compressing the inner layer strand main body 26 from the outer periphery thereof.

[0014] An adhesive is applied to the outer periphery of the inner layer strand main body 26, and the inner layer strand main body 26 and the inner layer strand covering body 27 are glued to each other through the intermediation of the adhesive. Further, after the inner layer strand main body 26 has been with the inner layer strand covering body 27, each inner layer strand 24 undergoes a stabilization treatment for causing the adhesion performance of the adhesive to be exerted more reliably. The stabilization treatment is a treatment in which the inner layer strand is heated by being left to stand for several minutes to several days in a furnace at a temperature of approximately 50 to 150°C to thereby enhance the adhesion force. The diameter of each inner layer strand 24 is smaller than that of the core strand 21. That is, the number of steel wires contained in each inner layer strand main body 26 is smaller than the number of constituent strands contained in the core strand main body 22.

[0015] Furthermore, after the core strand main body 22 has been covered with the core strand covering body 23, and the inner layer strand main bodies 26 have been covered with the inner layer strand covering bodies 27, the inner layer strands 24 are twisted together in the outer periphery of the core strand 21. The inner layer strand covering bodies 27 are formed of a hard resin, such as polyethylene resin.

[0016] The outer periphery of an inner layer strand assembly 25 is covered with a resin inner layer covering body 28. In the outer periphery of the inner layer covering body 28, there is arranged an outer layer strand assembly 30 composed of a plurality of (twenty, in this example) outer layer strands 29. The outer layer strands 29 are twisted together in the outer periphery of the inner layer covering body 28. In Embodiment 1, each outer layer strand 29 is composed solely of an outer layer strand main body, which is formed of a plurality of steel wires twisted together. The diameter of each outer layer strand 29 is smaller than that of the inner layer strands 24. That is, the number of constituent wires contained in the outer layer strands 29 is smaller than the number of constituent wires contained in the inner layer strand main bodies 26.

[0017] The outer periphery of the outer layer strand assembly 30 is covered with a resin outer layer covering body 31. The inner layer covering body 28 is formed of the same kind of material as the outer layer covering body 31 (a material whose ingredients and mechanical characteristics are the same or alike), and is integrated with the outer layer covering body 31. That is, the inner layer covering body 28 and the outer layer covering body 31 are formed of a high-friction resin material exhibiting high wear resistance and a coefficient of friction of 0.2 or more, for example, polyurethane resin.

[0018] An adhesive is applied to the outer periphery of each outer layer strands 29, and the outer layer strands 29, the inner layer covering body 28, and the outer layer covering body 31 are glued to each other through the intermediation of the adhesive. It is also possible to apply an adhesive to the outer periphery of each inner layer strand 24, gluing the inner layer strands 24 and the inner layer covering body 28 to each other through the intermediation of the adhesive. Like the inner layer strands 24, the outer layer strands 29 undergo a stabilization treatment after the application of the adhesive.

[0019] When using polyurethane resin for the inner layer covering body 28 and the outer layer covering body 31, suitable examples of the adhesive to be used for the gluing of the covering bodies 28, 31 and the strands 24, 29 include an epoxy type adhesive, a phenol type adhesive, and an urethane type adhesive.

[0020] In this elevator rope, the core strand 21 is provided with the core strand covering body 23, the inner layer strands 24 are provided with the inner layer strand covering bodies 27, and the outer layer strand assembly 30 is covered with the outer layer covering body 31, so that it is possible to secure a stable resin thickness between the layers and between the strands, and the strands are more reliably prevented from coming into contact with each other, thereby achieving an increase in service life.

[0021] Further, the inner layer strand main bodies 26 and the inner layer strand covering bodies 27 are glued to each other through the intermediation of the adhesive, and the outer layer strands 29 and the outer layer covering body 31 are glued to each other through the intermediation of the adhesive, which also helps to secure a stable resin thickness between the layers and between the strands, thereby achieving an increase in service life. That is, even if the main rope 6 is repeatedly bent and stretched, the covering bodies 27, 28, 31 are not deviated in position, making it possible to maintain a stable sectional configuration.

[0022] Further, due to the strand structure which does not easily get out of shape and due to the arrangement at the section center of the core strand 21 covered with a hard resin, the rope as a whole does not easily get out of shape either, so it is also possible to secure a stable resin thickness between the layers and between the strands, making it possible to achieve an increase in service life.

[0023] Here, after covering the core strand main body 22 with the core strand covering body 23 (first step), and after covering the inner layer strand main bodies 26 with the inner layer strand covering bodies 27 (first step), the inner layer strands 24 are twisted together in the outer periphery of the core strand 21 (second step), and further, the outermost layer is covered with the outer layer covering body 31 (third step). That is, after the strands 21, 24 have been respectively covered with the covering bodies 23, 27, the inner layer strands 24 are twisted together around the core strand 21. As a result, it is possible to

secure a stable resin thickness between the core strand 21 and the inner layer strands 24 and between the adjacent inner layer strands 24.

[0024] Due to a thickness error in the inner layer strand covering bodies 27, and due to an error in the pressing force applied when twisting together the inner layer strands 24, some protrusions and recesses may be generated in the outer periphery of the inner layer strand assembly 25. However, since the outer periphery of the inner layer strand assembly 25 is covered with the inner layer covering body 28, it is possible to achieve a stable sectional configuration (circular configuration) for the core rope. As a result, it is also possible to stabilize the sectional configuration of the rope as a whole.

[0025] Further, due to the heat when effecting covering with the inner layer covering body 28, the inner layer covering body 28 and the inner layer strand covering bodies 27 are fusion-bonded to each other, so that it is possible to further stabilize the sectional configuration of the rope as a whole.

Furthermore, the inner layer covering body 28 is formed of the same kind of material as the outer layer covering body 31, and is integrated with the outer layer covering body 31, so that it is possible to further stabilize the sectional configuration and to achieve an increase in the service life of the rope as a whole. Further, the outer layer and the inner layer are integrated with each other, making it possible to bear the load burden and geometrical deformation/displacement with respect to external forces with the entire section.

Embodiment 2

[0026] Next, Fig. 3 is a sectional view of an elevator rope according to Embodiment 2 of the present invention. As shown in the drawing, in the outer periphery of the inner layer covering body 28, there is arranged an outer layer strand assembly 33 composed of a plurality of (twenty, in this example) outer layer strands 32. The outer layer strands 32 are twisted together in the outer periphery of the inner layer covering body 28. In Embodiment 2, each outer layer strand 32 has an outer layer strand main body 34 formed of a plurality of steel wires twisted together, and a resin outer layer strand covering body 35 covering the outer layer strand main body 34.

[0027] Fig. 4 is an enlarged sectional view of one of the outer layer strand 32 of Fig. 3. Between the outer layer strand main body 34 and the outer layer strand covering body 35, and between the steel wires constituting the outer layer strand main body 34, gluing is effected by an adhesive 36. Further, as shown in Fig. 5, prior to the twisting of the outer layer strands 32, the adhesive 36 is applied to the outer periphery of each outer layer strand 32, that is, to the outer periphery of each outer layer strand covering body 35. Further, a stabilization treatment is executed on the adhesive 36. Otherwise, this embodiment is of the same construction as Embodiment 1.

[0028] In such an elevator rope, the covering bodies 23, 27, 35 are provided in the outer periphery of all the strands 21, 24, 32, so that it is possible to secure a stable resin thickness between the layers and between the strands, thereby achieving an increase in service life. Further, due to the heat when effecting covering with the outer layer covering body 31, the outer layer covering body 31 and the outer layer strand covering bodies 35 are fusion-bonded to each other, so it is possible to stabilize the sectional configuration of the rope as a whole. Further, since the adhesive 36 is also applied to the outer periphery of each outer layer strand 32, it is possible to integrate the outer layer strands 32 and the covering bodies 28, 31 with each other more reliably.

[0029] While in Embodiments 1 and 2 no particular statement is given regarding the twisting directions of the inner layer strands 24 and the outer layer strands 29, 32, by twisting the inner layer strands 24 and the outer layer strands 29, 32 in directions opposite to each other, it is possible to achieve a well-balanced inner rotational torque, making it possible to reduce the backward twisting torque of the rope as a whole.

Embodiment 3

[0030] Next, Fig. 6 is a cross-sectional view of an elevator rope according to Embodiment 3 of the present invention. In this example, very thin resin films exist between the adjacent inner layer strands 24, or the adjacent inner layer strands 24 are in direct contact with each other. Further, very thin resin films exist between the adjacent outer layer strands 32, or the adjacent outer layer strands 32 are in direct contact with each other. The sectional configuration of the inner layer strand covering bodies 27 and the outer layer strand covering bodies 35 is a substantially trapezoidal configuration with the four corners thereof rounded in order to sufficiently secure the contact area between the adjacent covering bodies 27, 35. This sectional structure can be realized by, for example, applying heat and pressure when twisting together the inner layer strands 24 and the outer layer strands 32. Otherwise, this embodiment is of the same construction as Embodiment 2.

[0031] In this elevator rope, even if it is repeatedly bent and stretched, displacement of the inner layer strands 24 and the outer layer strands 32 is suppressed, and a change in the load burden balance in each layer is prevented. Further, a change in the sectional dimension is also suppressed, making it possible to maintain a stable strength for a long period of time and to achieve an increase in the service life of the rope as a whole.

[0032] While Fig. 1 shows an elevator apparatus of the 2:1 roping system, there are no particular limitations regarding the roping system. For example, the elevator rope of the present invention can also be applied to an elevator apparatus of the 1:1 roping system. Further, the position of the driving machine is not restricted to the upper portion of the hoistway; it may also be

arranged in the lower portion of the hoistway.

Further, the elevator rope of the present invention is applicable to both a machine-room-less elevator and an elevator with a machine room.

Claims

1. An elevator rope, comprising:

a core strand having a core strand main body formed of a plurality of steel wires twisted together, and a resin strand covering body covering the core strand main body;
an inner layer strand assembly composed of a plurality of inner layer strands twisted together in an outer periphery of the core strand around the core strand, each inner layer strand having an inner layer strand main body formed of a plurality of steel wires twisted together and a resin inner layer covering body covering the inner layer strand main body;
an outer layer strand assembly composed of a plurality of outer layer strands twisted together in an outer periphery of the inner layer strand assembly, each outer layer strand having an outer layer strand main body formed of a plurality of steel wires twisted together; and
a resin outer layer covering body covering the outer layer strand assembly,

wherein the inner layer strand main bodies and the inner strand covering bodies are glued to each other through the intermediation of an adhesive, and wherein the outer layer strands and the outer layer covering body are glued to each other through the intermediation of an adhesive.

2. An elevator rope, comprising:

a core strand having a core strand main body formed of a plurality of steel wires twisted together, and a resin strand covering body covering the core strand main body;
an inner layer strand assembly composed of a plurality of inner layer strands twisted together in an outer periphery of the core strand around the core strand, each inner layer strand having an inner layer strand main body formed of a plurality of steel wires twisted together and a resin inner layer covering body covering the inner layer strand main body;
an outer layer strand assembly composed of a plurality of outer layer strands twisted together in an outer periphery of the inner layer strand assembly, each outer layer strand having an outer layer strand main body formed of a plurality of steel wires twisted together and a resin outer

layer covering body covering the outer layer strand main body; and
a resin outer layer covering body covering the outer layer strand assembly,

through heating is conducted.

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wherein the inner layer strand main bodies and the inner strand covering bodies are glued to each other through the intermediation of an adhesive, and wherein the outer layer strand main body and the outer layer strand covering body are glued to each other through the intermediation of an adhesive.

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3. An elevator rope according to Claim 1 or 2, wherein, after covering the core strand main body with the core strand covering body, and after covering the inner layer strand main bodies with the inner layer strand covering bodies, the inner layer strands are twisted together in the outer periphery of the core strand.

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4. An elevator rope according to Claim 1 or 2, wherein the outer periphery of the inner layer strand assembly is covered with a resin inner layer covering body, and wherein the inner layer covering body is formed of the same kind of material as the outer layer covering body and is integrated with the outer layer covering body.

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5. An elevator rope according to Claim 1, wherein resin films are provided between the adjacent inner layer strands and between the outer layer strands.

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6. An elevator rope according to Claim 1, wherein the adjacent inner layer strands are in direct contact with each other, and wherein the adjacent outer layer strands are in direct contact with each other.

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7. An elevator rope manufacturing method, comprising:

a first step of producing a plurality of strands by covering strand main bodies, each of which is formed of a plurality of steel wires twisted together, with resin strand covering bodies;
a second step of twisting together the strands;
and
a third step of covering an assembly of the strands with a resin outer covering body after the second step.

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8. An elevator rope manufacturing method according to Claim 7, wherein, in the first step, the strand main bodies and the strand covering bodies are glued to each other through intermediation of an adhesive.

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9. An elevator rope manufacturing method according to Claim 8, wherein, after the strand main bodies and the strand covering bodies are glued to each other, a stabilizing treatment for stabilizing the adhesive

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FIG. 1

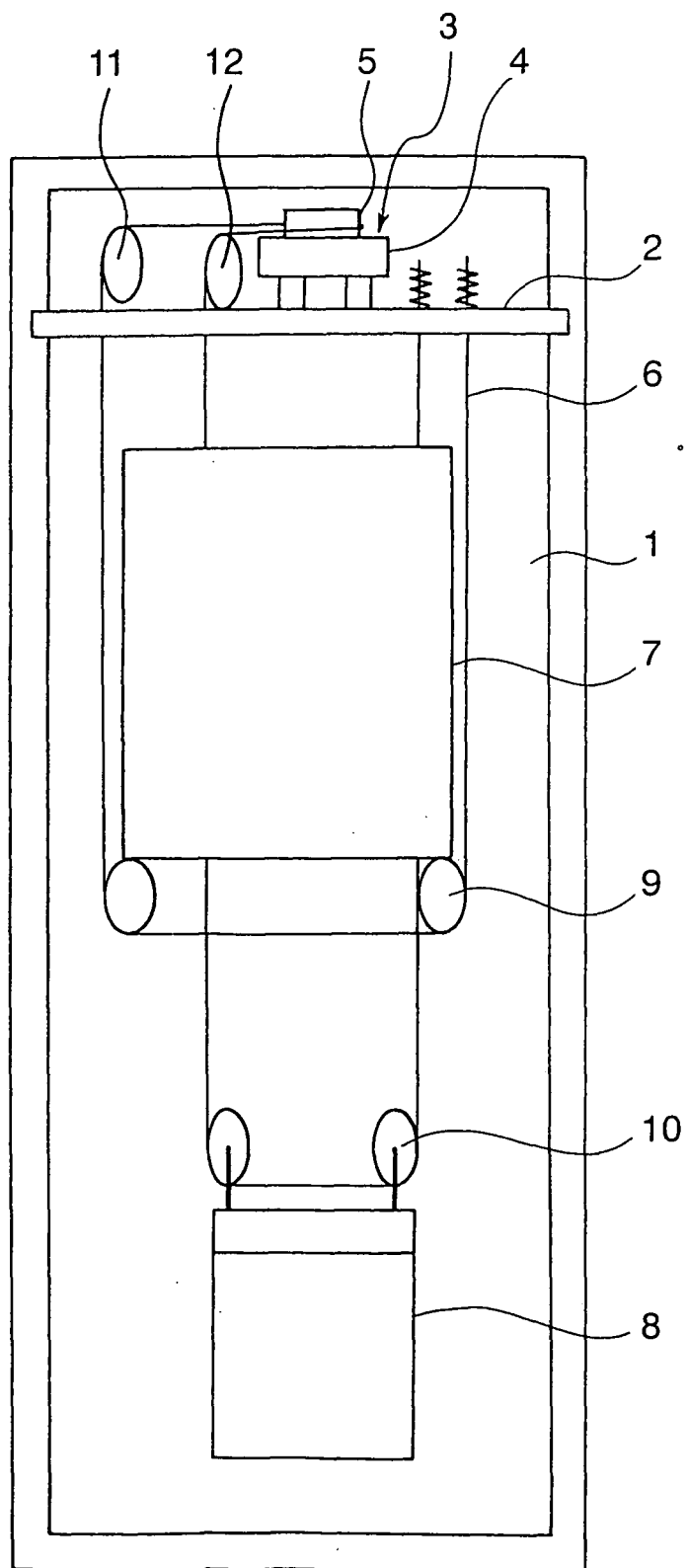


FIG. 2

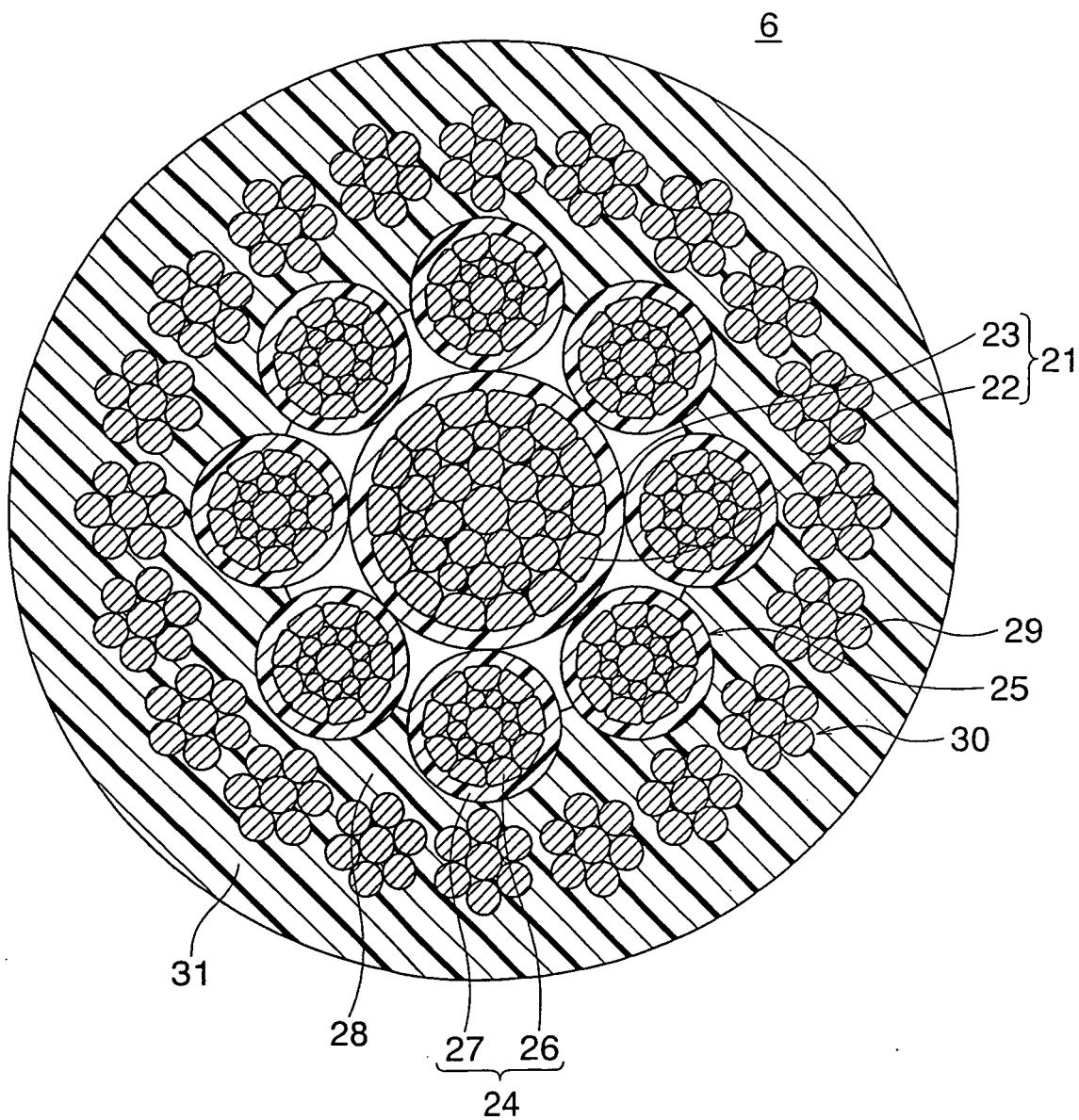


FIG. 3

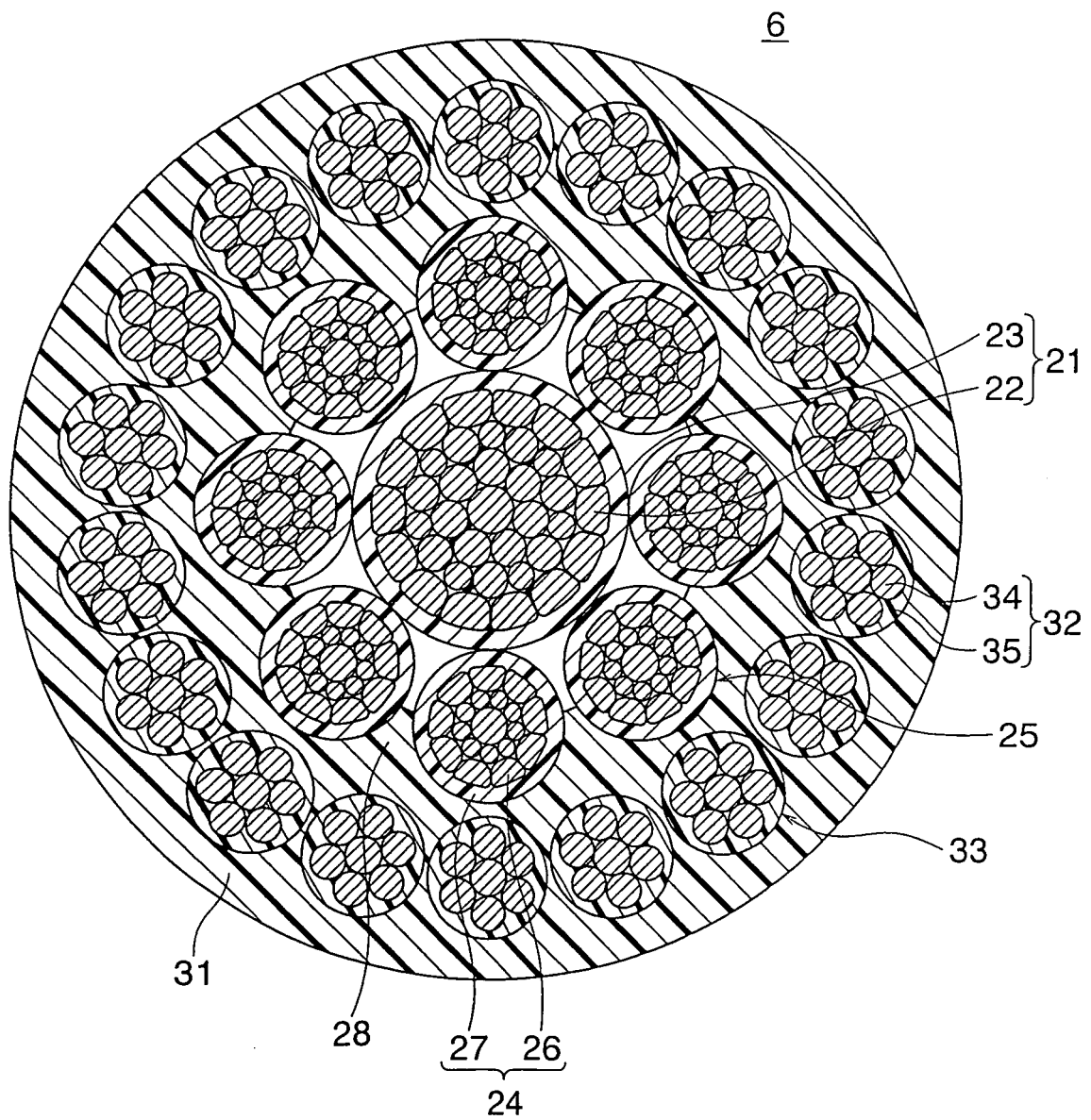


FIG. 4

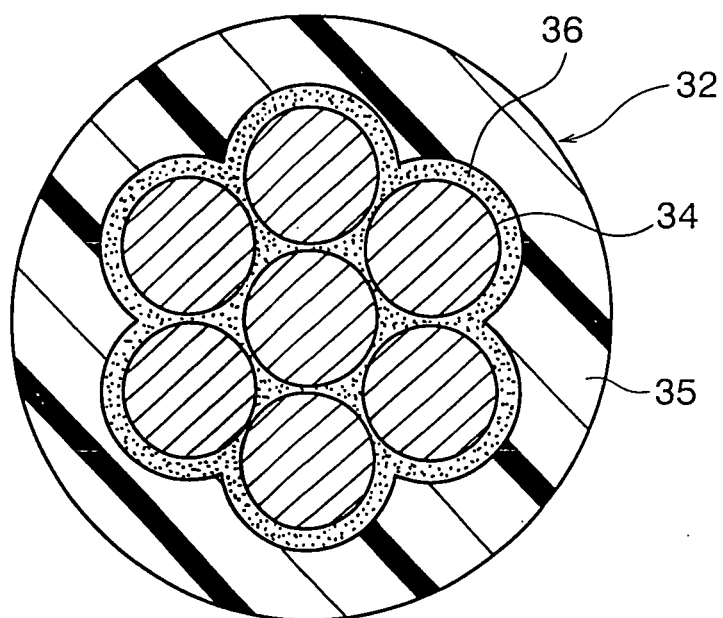


FIG. 5

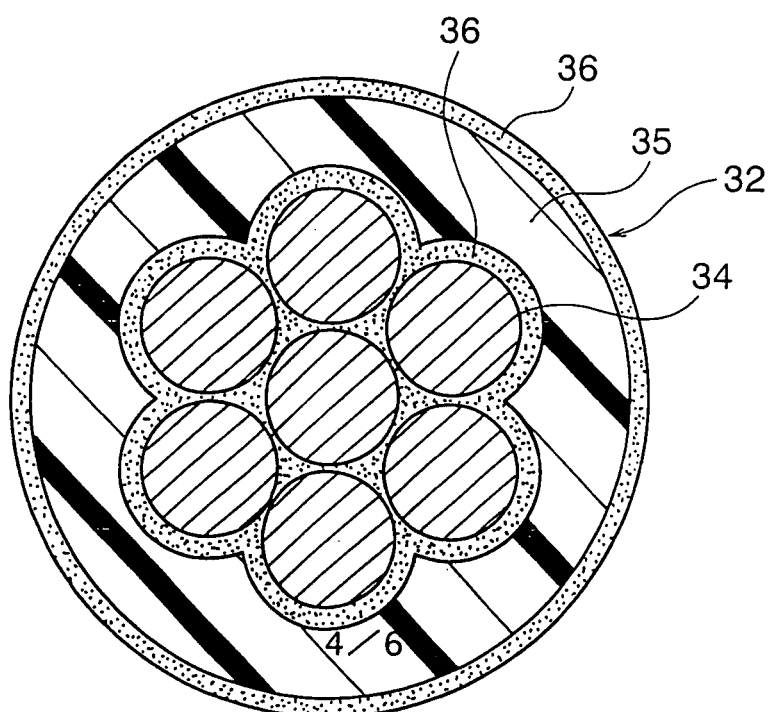
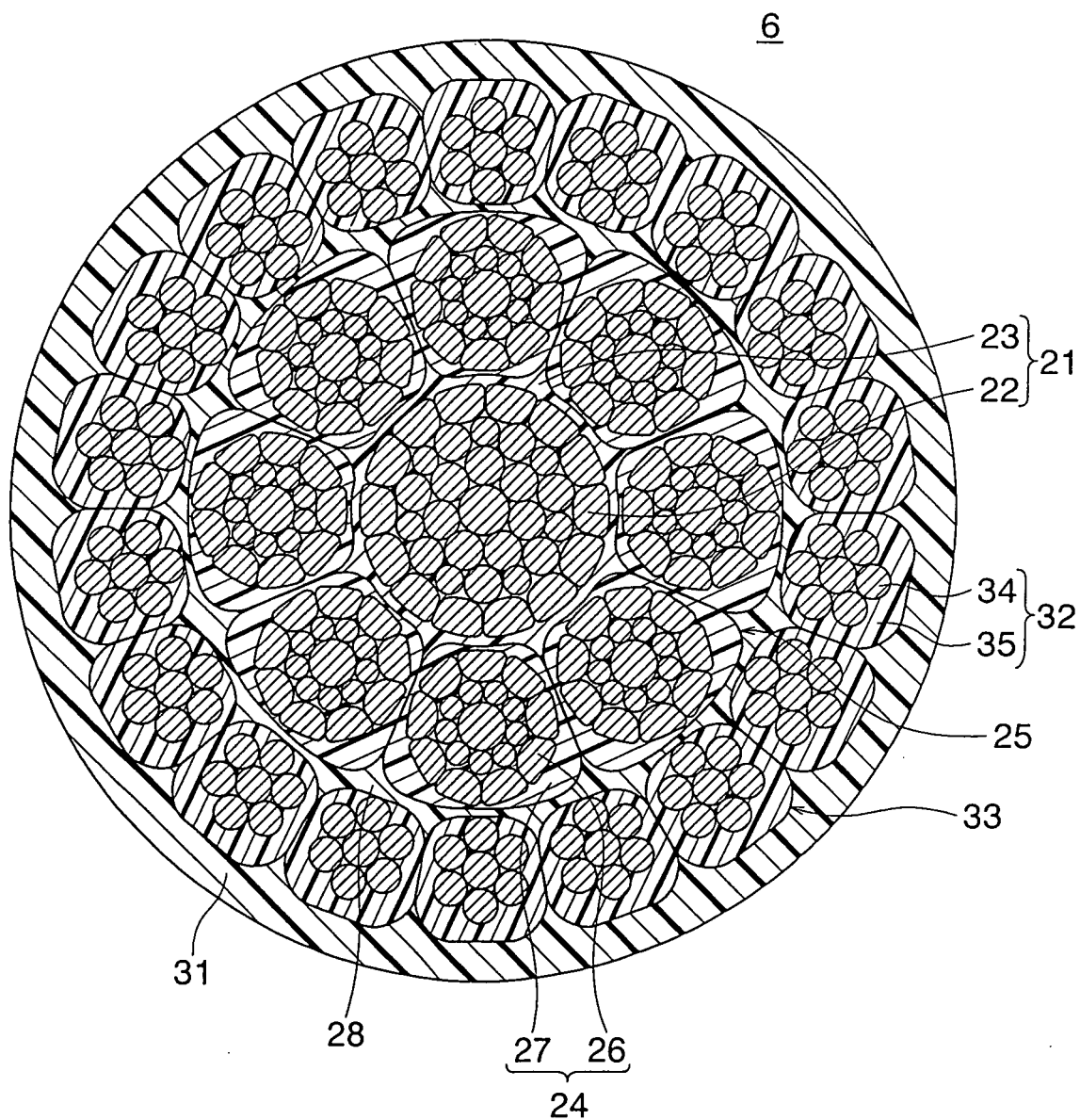


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/000390

A. CLASSIFICATION OF SUBJECT MATTER Int. Cl. ⁷ B66B7/06		
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 B66B7/06, D07B1/16		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	WO 03/050348 A1 (Mitsubishi Electric Corp.), 19 June, 2003 (19.06.03), Abstract; Fig. 1 & GB 2385867 A & US 2004/0026178 A1	1,5
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search 28 September, 2005 (28.09.05)		Date of mailing of the international search report 18 October, 2005 (18.10.05)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/000390

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Form PCT/ISA/210 (continuation of second sheet) (January 2004)

REFERENCES CITED IN THE DESCRIPTION

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