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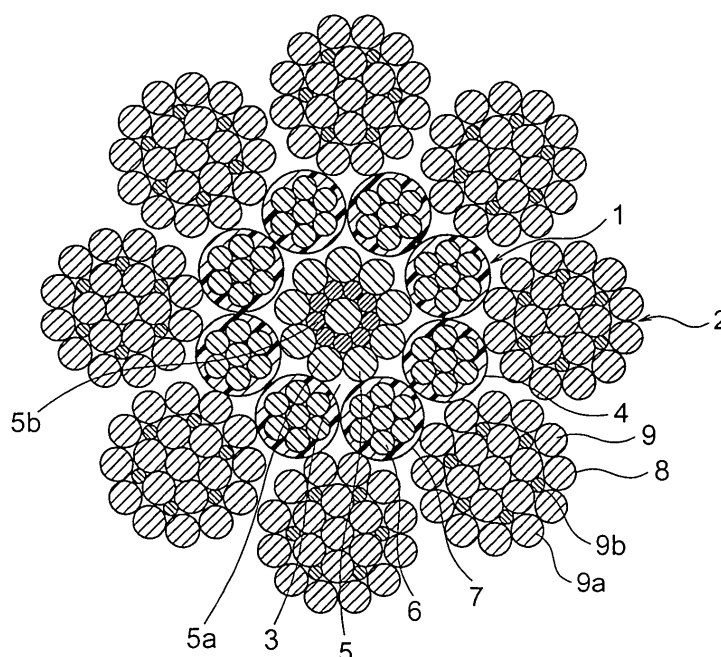
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(54) **ELEVATOR ROPE**

(57) An elevator rope for suspending a car of an elevator apparatus has a core rope and a second strand layer. The core rope has a plurality of first strands laid together with each other. Each of the first strands has a plurality of steel first wires laid together with each other,

and a first strand coating body made of a resin coated on an outer periphery. Second strands each have a plurality of steel second wires laid together with each other. The second strands are laid together on an outer periphery of the core rope.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator rope used in an elevator to suspend a car.

BACKGROUND ART

[0002] In conventional elevator apparatuses, steel ropes are wound around cast-iron or steel sheaves. Sheaves having a diameter greater than or equal to forty (40) times a diameter of a rope are used in order to prevent early abrasion and wire breakage in the ropes. Consequently, in order to reduce the diameter of the sheaves, it is also necessary to reduce the diameter of the ropes. However, if the rope diameter is reduced, there is a risk that a car may be easily vibrated by load fluctuations due to baggage loaded onto the car, or passengers getting on and off, etc., or that vibrations in the ropes at the sheaves may propagate to the car. Furthermore, the number of ropes must be increased, making the construction of the elevator apparatus complicated.

DISCLOSURE OF THE INVENTION

[0003] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator rope enabling extension of service life while using steel wires.

[0004] In order to achieve the above object, according to one aspect of the present invention, there is provided an elevator rope including: a core rope; and a second strand layer surrounding an outer periphery of the core rope, wherein: the core rope includes a plurality of first strands laid together with each other; each of the first strands includes: a plurality of steel first wires laid together with each other; and a first strand coating body made of a resin individually coating an outer periphery of a group of the plurality of first wires laid together; the second strand layer includes a plurality of second strands laid together on an outer periphery of the core rope; and each of the second strands includes a plurality of steel second wires laid together with each other.

[0005] According to another aspect of the present invention, there is provided an elevator rope including: a core rope including a plurality of first strands laid together with each other; a second strand layer main body including a plurality of second strands laid together on an outer periphery of the core rope; a plurality of auxiliary strands disposed on an outer peripheral portion of the second strand layer main body in gaps between mutually-adjacent second strands; and a second strand layer coating body coating an outer periphery of the second strand layer main body and the auxiliary strands.

[0006] According to yet another aspect of the present invention, there is provided an elevator rope including: a rope main body including a plurality of strands laid to-

gether with each other, the strands including a plurality of steel wires laid together with each other; and a coating body made of a resin coated on an outer periphery of the rope main body, wherein: the coating body includes: an inner layer; and an outer layer coated on an outer periphery of the inner layer; and a coefficient of friction of the inner layer is greater than a coefficient of friction of the outer layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Figure 1 is a cross section of an elevator rope according to Embodiment 1 of the present invention; Figure 2 is a cross section of an elevator rope according to Embodiment 2 of the present invention; Figure 3 is a cross section of an elevator rope according to Embodiment 3 of the present invention; Figure 4 is a side elevation showing the elevator rope in Figure 3 cut away in layers; Figure 5 is a cross section showing the elevator rope in Figure 3 wound around a sheave; Figure 6 is a cross section showing an abraded state of an outer peripheral portion of the elevator rope in Figure 5; and Figure 7 is a cross section of an elevator rope according to Embodiment 4 of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

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

Embodiment 1

[0009] Figure 1 is a cross section of an elevator rope according to Embodiment 1 of the present invention.

[0010] In the figure, the elevator rope has: a core rope 1; and a second strand layer 2 surrounding an outer periphery of the core rope 1. The core rope 1 has: a centrally-positioned core strand 3; and a plurality of first strands 4 (in this case eight) laid together on an outer periphery of the core strand 3. The core strand 3 is constituted by three or more layers.

[0011] The core strand 3 has a plurality of steel core wires 5 laid together with each other. A plurality of wires having different diameters than each other are used for the core wires 5. Specifically, a plurality of large core wires 5a, and small core wires 5b having a smaller diameter than the large core wires 5a disposed in gaps between the large core wires 5a are used.

[0012] Lay lengths of the core wires 5 are equal to each other. The core wires 5 are laid together parallel to each other so as to be in mutual line contact with adjacent core wires 5 (Japanese Industrial Standards (JIS) G 3525 12.2 b).

[0013] In addition, the cross-sectional construction of the core strand 3 in Embodiment 1 is seale, but it may also be warrington, warrington-seale, or filler wire (JIS G 3525).

[0014] Each of the first strands 4 has: a plurality of steel first wires 6 (in this case a total of seven wires constituted by one central wire and six outer peripheral wires) laid together with each other; and a first strand coating body 7 made of a resin independently coated on an outer periphery of this group of first wires 6 laid together. The first strand coating bodies 7 are composed of a polyethylene resin, for example.

[0015] The second strand layer 2 has a plurality of second strands 8 (in this case eight) laid together on an outer periphery of the core rope 1. Each of the second strands 8 has a plurality of steel second wires 9 laid together with each other. A plurality of wires having different diameters than each other are used for the second wires 9. Specifically, a plurality of large second wires 9a, and small second wires 9b having a smaller diameter than the large second wires 9a disposed in gaps between the large second wires 9a are used for the second wires 9.

[0016] The number of second strands 8 is equal to the number of first strands 4. The lay lengths of the second strands 8 are also equal to the lay lengths of the first strands 4. In addition, the second strands 8 are laid parallel to the first strands 4 so as to be in mutual line contact with adjacent first strands 4.

[0017] In an elevator rope of this kind, because first strand coating bodies 7 are disposed on the first strands 4, abrasion of the core strand 3 and the first strands 4 is suppressed and bending stresses can be alleviated by a buffer action, enabling extension of service life.

[0018] Because the number of first strands 4 and the number of second strands 8 are equal, and the lay lengths of the first strands 4 and the lay lengths of the second strands 8 are equal, and the second strands 8 are laid parallel to the first strands 4 so as to be in mutual line contact with adjacent first strands 4, wire fill factor can be increased and disarray of the core rope 1 over periods of extended use can be suppressed.

[0019] In addition, because the core rope 1 has a core strand 3, and the lay lengths of the core wires 5 are equal to each other, and the core wires 5 are laid together parallel to each other so as to be in mutual line contact with adjacent core wires 5, deterioration of the core wires 5 due to abrasion can be suppressed, enabling stable strength to be ensured.

Embodiment 2

[0020] Next, Figure 2 is a cross section of an elevator rope according to Embodiment 2 of the present invention. In the figure, the elevator rope has: a core rope 1; and a second strand layer 11 surrounding an outer periphery of the core rope 1. The core rope 1 is constructed in a similar manner to that of Embodiment 1. A second

strand layer main body 16 is constituted by a plurality of second strands 8 (in this case eight) laid together on an outer periphery of the core rope 1. Each of the second strands 8 is constructed in a similar manner to those of Embodiment 1.

[0021] The second strand layer 11 has: a second strand layer main body 16; a plurality of auxiliary strands 13 (in this case eight) disposed on an outer peripheral portion of the second strand layer main body 16 in gaps between mutually-adjacent second strands 8; and a second strand layer coating body 12 made of a resin coating an outer periphery of the second strand layer main body 16 and the auxiliary strands 13. The second strand layer coating body 12 is constituted by a high-friction resin material having a coefficient of friction greater than or equal to 0.2, such as a polyurethane resin, for example.

[0022] Each of the auxiliary strands 13 has: a plurality of steel auxiliary strand wires 14 (in this case seven) laid together with each other; and an auxiliary strand coating body 15 made of a resin coated on an outer periphery. The auxiliary strand coating bodies 15 are composed of a polyethylene resin, for example. A diameter of the auxiliary strands 13 is set so as to be smaller than a diameter of the second strands 8. A lay length of the auxiliary strands 13 and a lay length of the second strands 8 are equal. In addition, the auxiliary strands 13 are laid parallel to the second strands 8 so as to be in mutual line contact with adjacent second strands 8.

[0023] In an elevator rope of this kind, since the second strand layer coating body 12 is disposed on a portion contacting sheaves (not shown), the second strands 8 are prevented from being abraded by direct contact with the sheaves. Furthermore, bending stresses arising due to the second wires 9 being crushed against the sheaves can also be alleviated, thereby enabling extension of the service life of the elevator rope and enabling reductions in diameters of the sheaves.

[0024] In addition, since the second strand layer coating body 12 is disposed on an outermost periphery, abrasion of the sheaves can also be prevented, enabling a degree of freedom in selecting materials for the second wires 9 and the sheaves to be improved. Consequently, overall strength can be raised further and the sheaves can be constructed inexpensively.

[0025] Because the second strand layer coating body 12, which comes into contact with a drive sheave, is constituted by a high-friction resin material such as a polyurethane resin, for example, sufficient transfer efficiency of the driving force can be ensured even if the diameter of the drive sheave is reduced.

[0026] Because the auxiliary strands 13 are disposed in the gaps between the second strands 8, the packing density of the wires can be increased, enabling overall strength to be increased and also enabling extension of service life by preventing disarray of the ropes.

[0027] Because the auxiliary strand coating bodies 15 are disposed on the auxiliary strands 13, the auxiliary

strand wires 14 and the second wires 9 are not in direct contact with each other, enabling abrasion of the auxiliary strand wires 14 and the second wires 9 to be suppressed, thereby enabling extension of service life.

[0028] Because the lay lengths of the auxiliary strands 13 and the lay lengths of the second strands 8 are equal, and the auxiliary strands 13 are laid parallel to the second strands 8, deterioration of the second strands 8 and the auxiliary strands 13 due to abrasion can be suppressed, enabling extension of the service life of the elevator rope.

Embodiment 3

[0029] Next, Figure 3 is a cross section of an elevator rope according to Embodiment 3 of the present invention. Moreover, the constructions of a core rope 1 and a second strand layer 11 are similar to those of Embodiment 2 except for the material used for the second strand layer coating body 12.

[0030] In the figure, a third strand layer 21 is disposed on an outer periphery of the second strand layer 11. The third strand layer 21 has: a plurality of third strands 22 (in this case twenty) laid together on an outer periphery of the second strand layer 11; and a third strand layer coating body 23 made of a resin coated on an outer periphery.

[0031] A rope main body 27 according to Embodiment 3 includes: the core rope 1; the second strand layer 11; and the third strands 22. The third strand layer coating body 23 is coated on an outer periphery of the rope main body 27.

[0032] Each of the third strands 22 has a plurality of steel third wires 24 (in this case seven) laid together with each other. Central wires 24a disposed centrally among the third strands 22 and six outer peripheral wires 24b disposed on an outer periphery of the central wire 24a are used for the third wires 24. A diameter of the third strands 22 is set so as to be smaller than a diameter of the second strands 8.

[0033] The third strand layer coating body 23 has: an inner layer 25; and an outer layer 26 coated on an outer periphery of the inner layer 25. The third strands 22 are disposed further inward than the outer peripheral surface of the inner layer 25. In other words, the third strands 22 are covered by the inner layer 25 so as not to be exposed outside the inner layer 25.

[0034] High-friction resin materials such as polyurethane resins, for example, can be used for the materials for the inner layer 25 and the outer layer 26. It is preferable for the high-friction resins to have a coefficient of friction greater than or equal to 0.2 to enable sufficient transfer efficiency of driving force to be ensured.

[0035] In addition, the coefficient of friction of the inner layer 25 is greater than the coefficient of friction of the outer layer 26 by twenty percent (20%) or more. Furthermore, the hardness of the outer layer 26 is greater

than the hardness of the inner layer 25. The color of the inner layer 25 is also different than the color of the outer layer 26. In addition, the third strand layer coating body 23 is constituted by flame-retarded resins.

[0036] In Embodiment 2, a polyurethane resin was used as the material for the second strand layer coating body 12, but in Embodiment 3, because the second strand layer coating body 12 is not the outermost layer, a polyethylene resin, for example, can be used for the material for the second strand layer coating body 12. Specifically, it is desirable that the material for the second strand layer coating body 12 be a similar material to that of the first strand coating bodies 7, or a resin having a low melting temperature.

[0037] A diameter of an inner layer rope constituted by the core rope 1 and the second strand layer 11 is set so as to be less than or equal to 1/27 of a diameter of the sheaves with which it is used, in other words, the sheaves around which this elevator main rope is wound.

Diameters of all of the wires 5, 6, 9, 14, and 24 are set to less than or equal to 1/400 of the diameter of the sheaves with which they are used.

[0038] Figure 4 is a side elevation showing the elevator rope in Figure 3 cut away in layers. The direction of lay of the core strand 3 and the third strands 22 and the direction of lay of the first strands 4 and the second strands 8 are in opposite directions to each other.

[0039] Using this kind of construction, the packing density of the steel wires 5, 6, 9, 14, and 24 can be increased, while suppressing the overall diameter, enabling increases in strength.

[0040] Since first strand coating bodies 7, a second strand layer coating body 12, and auxiliary strand coating bodies 15 are used, the core wires 5 and the first wires 6, the first wires 6 and the second wires 9, the second wires 9 and the auxiliary strand wires 14, the auxiliary strand wires 14 and the third wires 24, and the second wires 9 and the third wires 24 are respectively prevented from contacting each other directly, enabling deterioration due to abrasion to be prevented and bending stresses to be alleviated by a buffer action, thereby enabling extension of the service life of the elevator rope.

[0041] In addition, since the third strand layer coating body 23 is disposed on a portion contacting the sheaves, the third strands 22 can be prevented from being abraded by direct contact with the sheaves. Furthermore, bending stresses arising due to the third wires 24 being crushed by the sheaves can also be alleviated, enabling extension of the service life of the elevator rope and also enabling reductions in the diameters of the sheaves.

[0042] Furthermore, since the third strand layer coating body 23 is disposed on an outermost periphery, abrasion of the sheaves can also be prevented, enabling a degree of freedom in selecting materials for the third wires 24 and the sheaves to be improved. Consequently, overall strength can be increased further and

the sheaves can be constructed inexpensively.

[0043] Because the third strand layer coating body 23, which comes into contact with the drive sheave, is constituted by high-friction resin materials, sufficient transfer efficiency of the driving force can be ensured even if the diameter of the drive sheave is reduced.

[0044] Soft or hard polyurethane resins can also be selected freely for the third strand layer coating body 23, but in order to ensure abrasion resistance performance against minute slippage on the surface of the sheaves, it is preferable to use hard polyurethane resins having a hardness of 90 or more. In addition, in order to prevent hydrolysis from occurring in the service environment, it is also desirable that the resins be ether-based rather than ester-based.

[0045] In addition, flexing resistance can be reduced by selecting as the materials for the first strand coating bodies 7, the second strand layer coating body 12, and the auxiliary strand coating bodies 15 a material that slides freely and easily when the elevator rope is bent at the sheaves. Furthermore, the first strand coating bodies 7, the second strand layer coating body 12, and the auxiliary strand coating bodies 15 require a hardness that can resist being crushed between the wires. Hard, low-friction polyethylene materials are suitable as these materials.

[0046] The first strand coating bodies 7, the second strand layer coating body 12, and the auxiliary strand coating bodies 15 do not require such a large coefficient of friction as the third strand layer coating body 23, and since bending by the sheaves is not as great, they do not necessarily require superior elongation characteristics. Consequently, resins such as nylon, silicon, polypropylene, or polyvinyl chloride, etc., for example, may also be used as the materials for the first strand coating bodies 7, the second strand layer coating body 12, and the auxiliary strand coating bodies 15.

[0047] In addition, since the third strands 22 have a simple seven-wire construction including a central wire 24a and six outer peripheral wires 24b, the diameter of the elevator rope can be reduced and disarray is less likely to occur, enabling coating of the third strand layer coating body 23 to be performed easily.

[0048] In an elevator rope having a multilayered construction, rotational torque in a direction in which the lay returns may occur in interior portions due to repetitive bending by the sheaves and tension due to loads over time, and there is a risk that the load burden balance of each of the layers may collapse, reducing breaking strength and service life.

[0049] In regard to this, by laying the first strands 4 in a reverse direction to the core strand 3, and laying the third strands 22 in a reverse direction to the second strands 8, the rotational torque in the interior portions can be balanced, enabling the overall lay-returning torque of the rope to be reduced.

[0050] In addition, in a rope having no coating body on the outermost layer, service life is determined by the

number of cycles of tension and bending stresses at the sheaves, and wire breakage occurs first in the wires at the rope surface. However, in a rope using a third strand layer coating body 23, wires in interior portions, rather than at the surface of the rope, are preferentially more likely to break due to bending fatigue since contact pressure with the sheaves is reduced.

[0051] The number of service life cycles determined by bending fatigue of this kind, according to experimental research by the inventors, was found to have a relationship represented by the following expressions:

Service life formulas

[0052] Formula for breakage of wires contacting sheaves:

Number of service life cycles $N_c = 10.0 \times k \times 1.05^{D/d}$

[0053] Formula for breakage of wires inside rope:

Number of service life cycles $N_n = 19.1 \times k \times 1.05^{D/d}$

(k is a coefficient determined by rope construction and rope strength).

[0054] Here, the value of D/d required to make the number of service life cycles N_n equal to the value of N_c when $D/d = 40$ is found to be 26.7. Consequently, if a service life equivalent to conditions under which general conventional elevator ropes have been used, that is, when $D/d = 40$, is to be ensured, the diameter of the inner layer rope must be made less than or equal to 1/27 of the diameter of the sheaves. In other words, sheaves having a diameter greater than or equal to twenty-seven (27) times that of the inner layer rope must be used.

[0055] In the above elevator rope, because the diameters of all of the wires 5, 6, 9, 14, and 24 are set to less than or equal to 1/400 of the diameter of the sheaves with which they are used, there is no loss of bending fatigue service life even if the diameter of the sheaves with which they are used is reduced.

[0056] Next, Figure 5 is a cross section showing the elevator rope in Figure 3 wound around a sheave, and Figure 6 is a cross section showing an abraded state of an outer peripheral portion of the elevator rope in Figure 5. Abrasion of the outer peripheral portion is caused by sustained operation or by abnormalities. In the state in Figure 6, there is a risk that traction capacity will decrease since the state of contact of the rope with a rope groove 30 is looser than the state in Figure 5.

[0057] Traction capacity can be calculated by the following expression:

$$\text{Traction capacity} = e^{K2\theta\mu}$$

where:

K_2 is a coefficient dependent on the state of contact with the rope groove (normally the shape of the groove);

θ is a contact angle of the elevator rope on the sheave; and

μ is a coefficient of friction.

[0058] Now, in a normal state of contact with a rope groove having a U-shaped cross section, K_2 is approximately 1.2, but K_2 decreases with the abrasion of the outer peripheral portion of the rope. Thus, it can be seen that if K_2 hypothetically decreases to 1.0, since the contact angle θ is constant, traction capacity cannot be ensured unless the coefficient of friction μ is made twenty percent (20%) larger.

[0059] Judging only from the viewpoint of traction capacity, it might seem advantageous for the coefficient of friction of the elevator rope to be made as high as possible. However, if for some reason, the car goes past the uppermost floor, and the counterweight collides with buffers in a bottom portion of the hoistway, it is desirable to make the elevator rope slip relative to the sheaves so that the car is not raised any further, and such performance may also be required by law.

[0060] In Embodiment 3, since the coefficient of friction of the inner layer 25 is greater than the coefficient of friction of the outer layer 26, reductions in traction capacity can be suppressed even if the outer layer 26 is abraded and the inner layer 25 is exposed. In particular, because the coefficient of friction of the inner layer 25 is greater than the coefficient of friction of the outer layer 26 by twenty percent (20%) or more, sufficient traction capacity can be maintained even if the inner layer 25 is exposed.

[0061] Furthermore, because the lower the hardness of the polyurethane is, the greater its coefficient of friction is, the coefficient of friction of the inner layer 25 can easily be made greater than the coefficient of friction of the outer layer 26 by setting the hardness of the outer layer 26 so as to be greater than the hardness of the inner layer 25.

[0062] In addition, by making the color of the inner layer 25 a different color than that of the outer layer 26, exposure of the inner layer 25 due to abrasion of the outer layer 26 can be easily checked by visual inspection, enabling the necessity of rope replacement to be easily determined.

[0063] Furthermore, because the third strand layer coating body 23 is constituted by flame-retarded resins, if a fire occurs in the building, even if flames somehow get inside the hoistway, the fire can be prevented from spreading via the elevator rope. Spreading of the fire via the elevator rope can also be prevented if the third strand layer coating body 23 is constituted by flame-retardant materials.

Embodiment 4

[0064] Next, Figure 7 is a cross section of an elevator rope according to Embodiment 4 of the present invention. In the figure, first strands 4 are each constituted by a plurality of first wires 6 without a first strand coating body. Thus, the first strands 4 are in direct contact with core wires 5 and second wires 9.

[0065] A cross section of at least some of the core wires 5 is modified by compressing a core strand 3 from an outer periphery. A cross section of the first wires 6 is also modified by compressing the first strands 4 from an outer periphery. In addition, a cross section of at least some of the second wires 9 is modified by compressing second strands 8 from an outer periphery. The rest of the construction is similar to that of Embodiment 1.

[0066] In an elevator rope of this kind, the modified wires 5, 6, and 9 come into contact with each other at surfaces or lines rather than points, thus enabling the wire packing density to be increased. Furthermore, contact pressure among the core wires 5, among the first wires 6, and among the second wires 9 is reduced, suppressing abrasion of the wires 5, 6, and 9. In addition, disarray of the core strand 3, the first strands 4, and the second strands 8 is prevented, enabling extension of service life.

Claims

1. An elevator rope comprising:

a core rope; and
a second strand layer surrounding an outer periphery of said core rope,

wherein:

said core rope comprises a plurality of first strands laid together with each other, each of said first strands comprises a plurality of steel first wires laid together with each other, and a first strand coating body made of a resin individually coating an outer periphery of a group of said plurality of first wires laid together; and said second strand layer comprises a plurality of second strands laid together on an outer periphery of said core rope, and each of said second strands comprises a plurality of steel second wires laid together with each other.

2. The elevator rope according to Claim 1, wherein:

said first strands and said second strands are equal in number;
a lay length of said first strands and a lay length of said second strands are equal; and
said second strands are laid parallel to said first

strands so as to be in mutual line contact with adjacent first strands.

3. The elevator rope according to Claim 1, wherein:

said core rope further comprises a core strand including a plurality of steel core wires laid together with each other;
said first strands are laid together on an outer periphery of said core strand;
lay lengths of said core wires are equal to each other; and
said core wires are laid together parallel to each other so as to be in mutual line contact with adjacent core wires.

4. The elevator rope according to Claim 1, wherein said second strand layer further comprises a second strand layer coating body made of a resin coated on an outer periphery thereof.

5. The elevator rope according to Claim 4, further comprising:

a third strand layer comprising:

a plurality of third strands each including a plurality of steel third wires laid together with each other, said third strands being laid together on an outer periphery of said second strand layer; and
a third strand layer coating body made of a resin coated on an outer periphery.

6. The elevator rope according to Claim 1, further comprising:

a third strand layer comprising:

a plurality of third strands each including a plurality of steel third wires laid together with each other, said third strands being laid together on an outer periphery of said second strand layer; and
a third strand layer coating body made of a resin coated on an outer periphery;

wherein:

said core rope further comprises a core strand including a plurality of steel core wires laid together with each other;
said first strands are laid together on an outer periphery of said core strand;
said second strand layer further comprises a second strand layer coating body made of a resin coated on an outer periphery thereof; and
a direction of lay of said core strand and said

third strands and a direction of lay of said first strands and said second strands are in opposite directions to each other.

7. An elevator rope comprising:

a core rope comprising a plurality of first strands laid together with each other;
a second strand layer main body comprising a plurality of second strands laid together on an outer periphery of said core rope;
a plurality of auxiliary strands disposed on an outer peripheral portion of said second strand layer main body in gaps between mutually-adjacent second strands; and
a second strand layer coating body coating an outer periphery of said second strand layer main body and said auxiliary strands.

8. The elevator rope according to Claim 7, wherein:

each of said auxiliary strands comprises:

a plurality of steel auxiliary strand wires laid together with each other; and
an auxiliary strand coating body made of a resin coated on an outer periphery.

9. The elevator rope according to Claim 7, wherein:

a lay length of said auxiliary strands and a lay length of said second strands are equal; and
said auxiliary strands are laid parallel to said second strands so as to be in mutual line contact with adjacent second strands.

10. An elevator rope comprising:

a rope main body comprising a plurality of strands laid together with each other, said strands including a plurality of steel wires laid together with each other; and
a coating body made of a resin coated on an outer periphery of said rope main body,

wherein:

said coating body comprises:

an inner layer; and
an outer layer coated on an outer periphery of said inner layer; and
a coefficient of friction of said inner layer is greater than a coefficient of friction of said outer layer.

11. The elevator rope according to Claim 10, wherein said coefficient of friction of said inner layer is great-

er than said coefficient of friction of said outer layer
by twenty percent (20%) or more.

12. The elevator rope according to Claim 10, wherein a
hardness of said outer layer is greater than a hard- 5
ness of said inner layer.
13. The elevator rope according to Claim 10, wherein a
color of said inner layer is different than a color of
said outer layer. 10

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FIG. 1

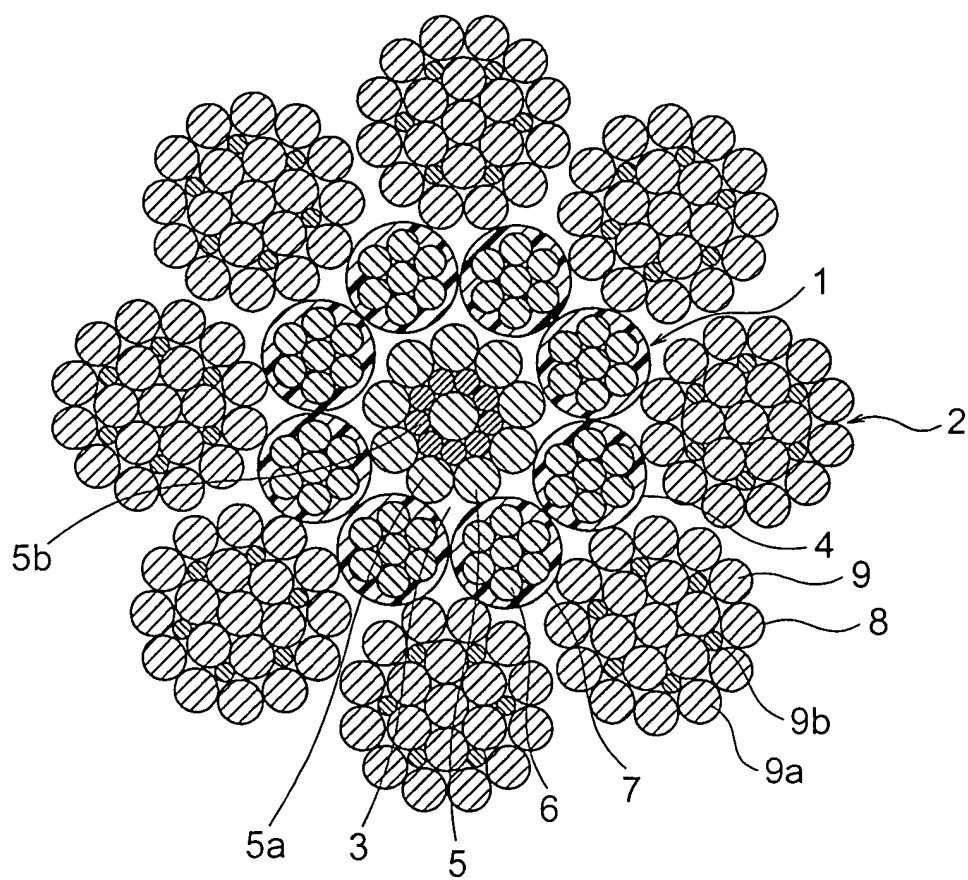


FIG. 2

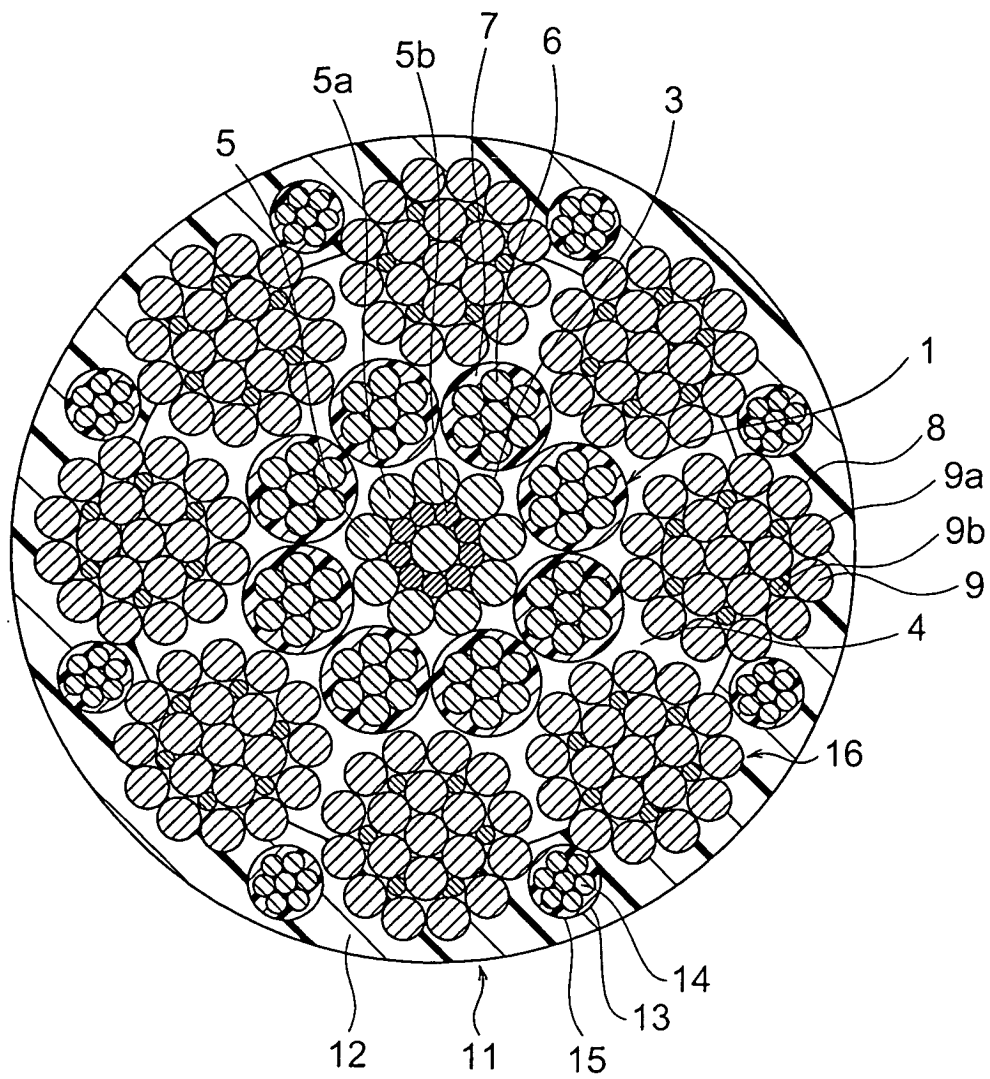


FIG. 3

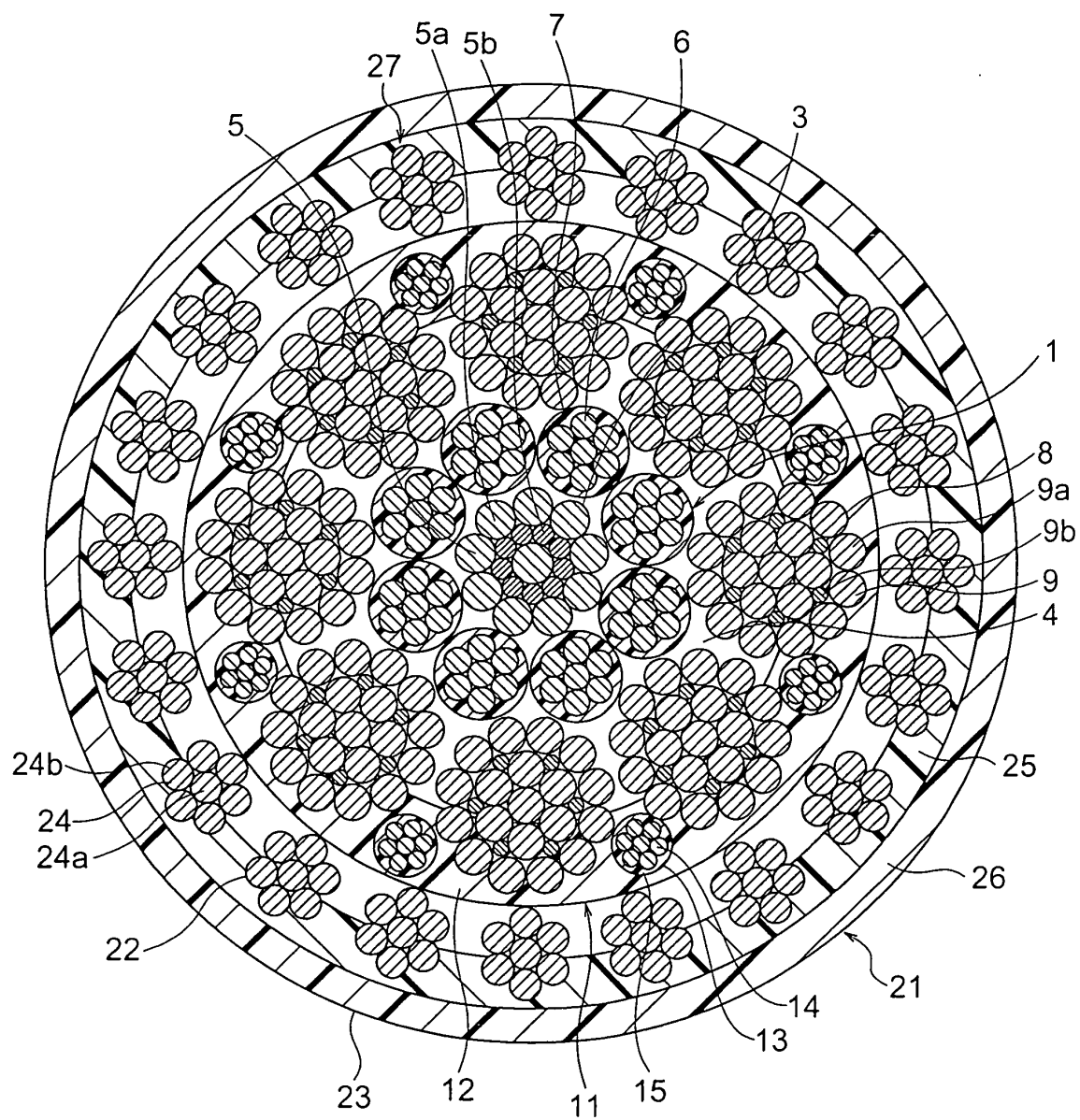


FIG. 4

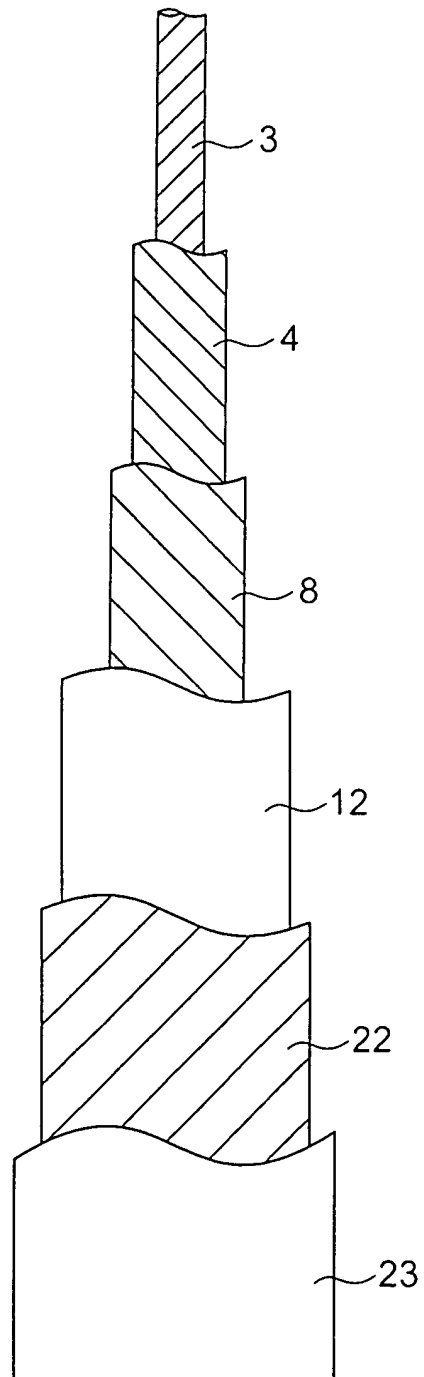


FIG. 5

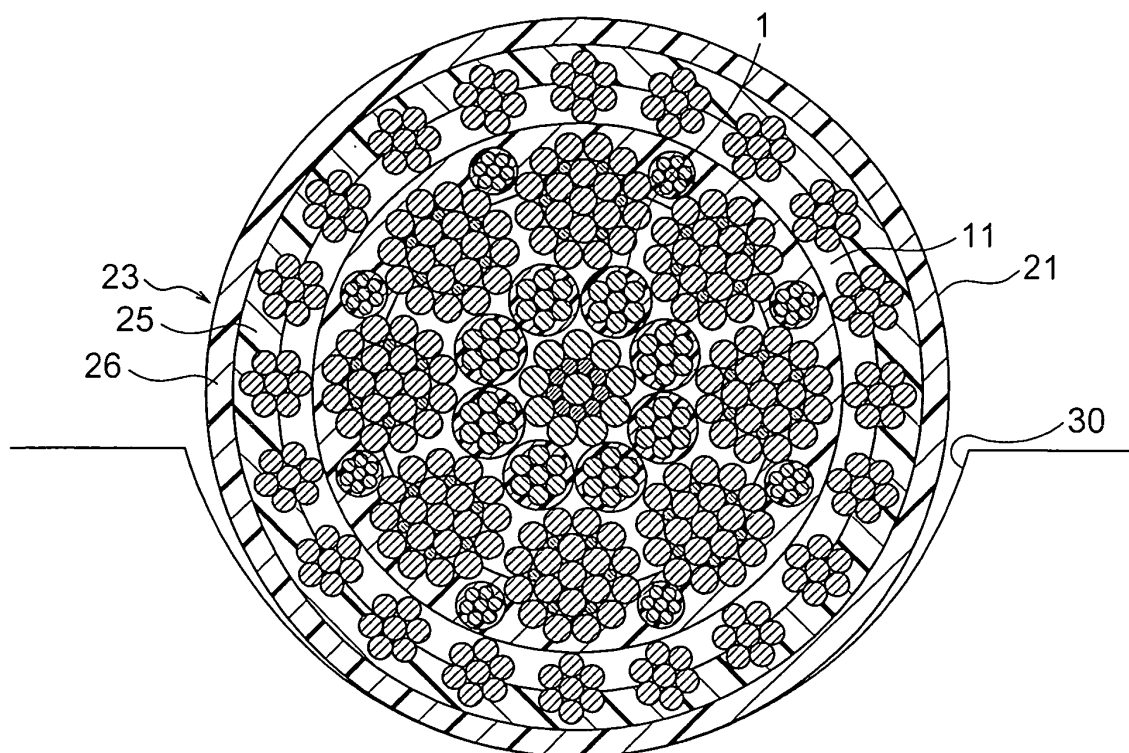


FIG. 6

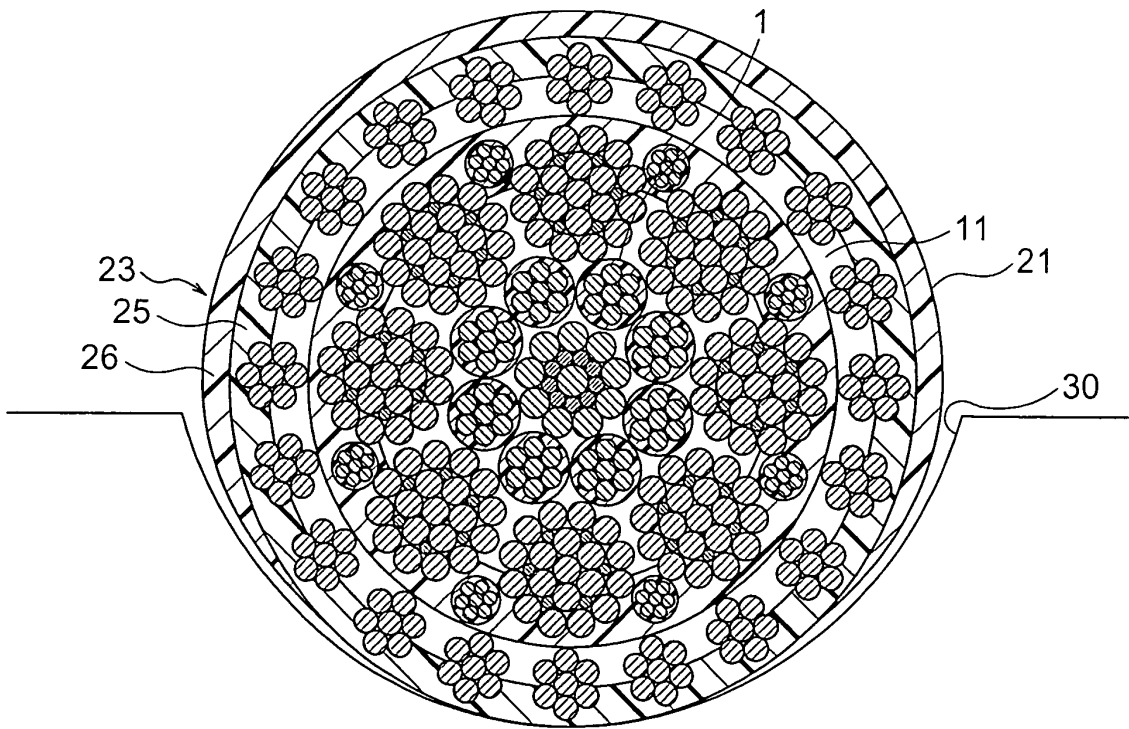
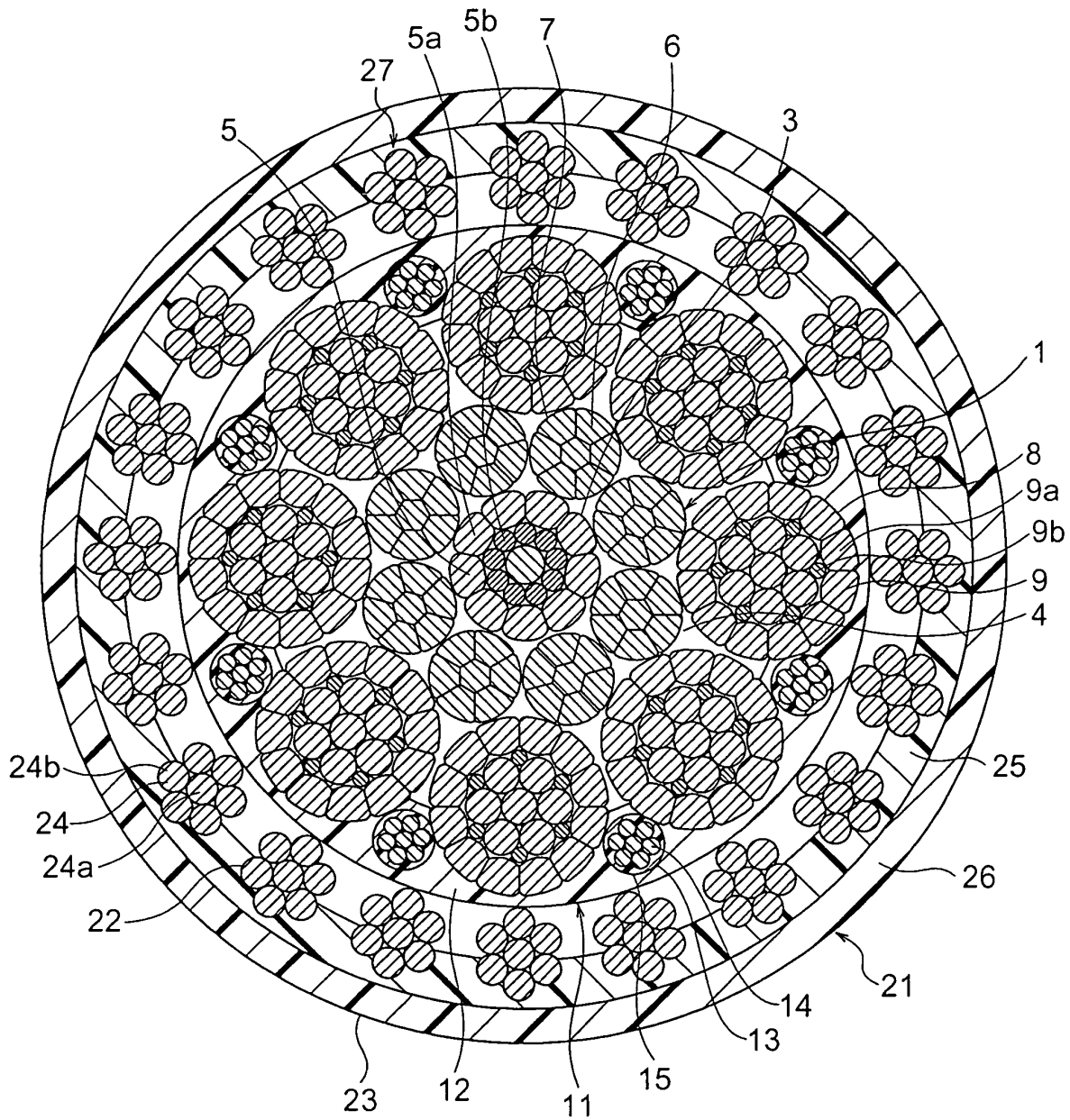


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/00690

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, 7/06, D07B1/06, 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 1996-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Toroku Jitsuyo Shinan Koho 1994-2003		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E, X E, A	JP 2003-201688 A (Tokyo Rope Manufacturing Co., Ltd.), 18 July, 2003 (18.07.03), (Family: none)	1-7, 9 8, 10-13
E, X E, A	JP 2003-268685 A (Tokyo Rope Manufacturing Co., Ltd.), 25 September, 2003 (25.09.03), (Family: none)	1-4, 7-9 5-6, 10-13
X Y A	JP 2002-275773 A (Tokyo Rope Manufacturing Co., Ltd.), 25 September, 2002 (25.09.02), (Family: none)	1-4 5-9 10-13
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* "A" "E" "L" "O" "P"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance earlier document but published on or after the international filing date document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
Date of the actual completion of the international search 15 October, 2003 (15.10.03)		Date of mailing of the international search report 04 November, 2003 (04.11.03)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/00690

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2002-275773 A (Tokyo Rope Manufacturing Co., Ltd.), 25 September, 2002 (25.09.02), (Family: none)	1, 3-4 5-9 2, 10-13
Y	JP 2001-192989 A (Tokyo Rope Manufacturing Co., Ltd.), 17 July, 2001 (17.07.01), (Family: none)	5-6
Y	JP 49-45732 B1 (Bethlehem Steel, Corp.), 05 December, 1974 (05.12.74), & US 3457717 A & FR 2014896 A & DE 1921095 A & CH 516693 A & GB 1268681 A	7-9

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