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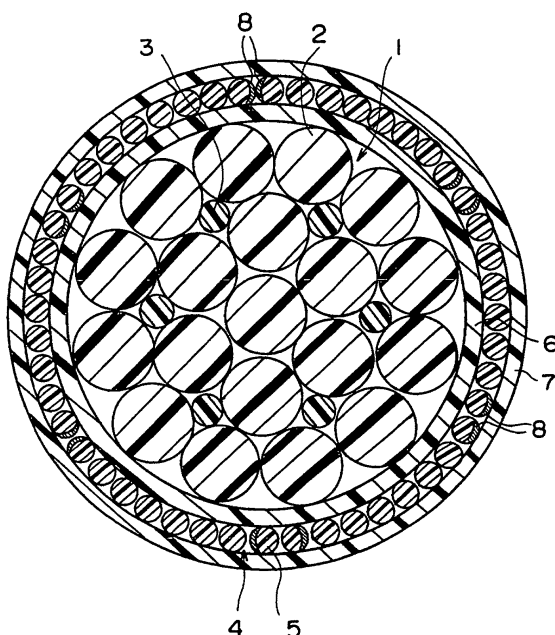
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(54) **MAIN CABLE OF ELEVATOR**

(57) In an elevator main rope, an outer layer portion is disposed so as to cover an outer circumference of an inner layer portion. The inner layer portion has a plurality of inner layer strands. The outer layer portion has a plurality of outer layer strands. The inner layer strands and

the outer layer strands are constructed by twisting together base strands made of synthetic resin fibers. A tensile strength of the outer layer portion is set lower than a tensile strength of the inner layer portion. The inner layer portion has a tensile strength equal to or greater than sixty percent of an overall tensile strength.

FIG. 1



EP 1 371 597 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator main rope made of a synthetic fiber rope for suspending a car inside a hoistway.

BACKGROUND ART

[0002] Figure 5 is a perspective showing a construction of a conventional elevator main rope, as shown in Japanese Patent Laid-Open No. HEI 7-267534, for example. In the figure, an inner layer portion 24 having a plurality of inner layer strands 22 and filler strands 23 disposed in gaps between these inner layer strands 22 is disposed around a core wire 21. Each of the inner layer strands 22 is composed of a plurality of base strands made of aramid fibers which are twisted together with each other and an impregnating material such as polyurethane or the like. The filler strands 23 are composed of polyamide, for example.

[0003] An outer layer portion 26 having a plurality of outer layer strands 25 is disposed so as to cover an outer circumference of the inner layer portion 24. Each of the outer layer strands 25 is composed of a plurality of base strands made of aramid fibers which are twisted together with each other and an impregnating material such as polyurethane or the like in a similar manner to the inner layer strands 22.

[0004] An inner layer coating (a friction-reducing coating) 27 for preventing abrasion of the strands 22 and 25 due to friction among the strands 22 and 25 in sheaves (not shown) such as a drive sheave is disposed between the inner layer portion 24 and the outer layer portion 26. An outer layer coating (a protective coating) 28 is disposed on an outer circumferential portion of the outer layer portion 26.

[0005] In a conventional elevator main rope constructed as described above, since the main rope is subjected to pressure due to contact with the sheaves during operation of the elevator and deformation and sliding arise in interior portions due to bending at the sheaves, snapping of the base strands occurs due to abrasion when the main rope is used for a long period. This kind of snapping of the base strands most often occurs in the outer layer strands 25.

[0006] In regard to this, in the conventional main rope, since a tensile strength of the inner layer portion 24 and a tensile strength of the outer layer portion 26 are set so as to be equivalent, when the base strands of the outer layer strands 25 are damaged by abrasion and the tensile strength of the outer layer portion 26 deteriorates significantly, a load is supported only by the inner layer portion 24 and only half of the overall tensile strength can be ensured.

[0007] In Japanese Patent Laid-Open No. HEI 8-261972, for example, a method for detecting damage

to the strands is described in which an electrically-conducting wire composed of a carbon fiber is twisted together with the strands, a current is passed through this electrically-conducting wire, and snapping of the electrically-conducting wire is detected by monitoring the state of the electric current.

[0008] However, because the carbon fiber has a higher strength than the aramid fibers, abrasion of the electrically-conducting wire does not necessarily occur first, and there was a possibility that the base strands made of the aramid fibers being strong members would be abraded and snap before the electrically-conducting wire, making determination of the service life of the strands difficult since damage to the strands could not be stably detected.

DISCLOSURE OF THE INVENTION

[0009] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator main rope enabling sufficient residual strength to be ensured when a portion of strands reach the end of their service life and enabling damage to the strands to be detected more stably.

[0010] To this end, according to one aspect of the present invention, there is provided an elevator main rope for suspending a car inside a hoistway, the elevator main rope comprising: an inner layer portion having a plurality of inner layer strands in each of which a plurality of base strands composed of synthetic resin fibers are twisted together; and an outer layer portion having a plurality of outer layer strands in each of which a plurality of base strands composed of synthetic resin fibers are twisted together, the outer layer portion being disposed so as to cover an outer circumference of the inner layer portion, wherein a tensile strength of the outer layer portion is set lower than a tensile strength of the inner layer portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Figure 1 is a cross section of an elevator main rope according to Embodiment 1 of the present invention;

Figure 2 is a side elevation showing an internal construction of the main rope in Figure 1;

Figure 3 is a cross section of an elevator main rope according to Embodiment 2 of the present invention;

Figure 4 is a cross section of an elevator main rope according to Embodiment 3 of the present invention; and

Figure 5 is a perspective showing an example of a construction of a conventional elevator main rope.

BEST MODE FOR CARRYING OUT THE INVENTION

[0012] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0013] Figure 1 is a cross section of an elevator main rope according to Embodiment 1 of the present invention, and Figure 2 is a side elevation showing an internal construction of the main rope in Figure 1.

[0014] In the figure, an inner layer portion 1 includes: a plurality of inner layer strands 2 twisted together with each other; and filler strands 3 disposed in gaps between and twisted together with these inner layer strands 2. Each of the inner layer strands 2 is composed of a plurality of base strands made of aramid fibers which are twisted together with each other and an impregnating material such as polyurethane or the like.

[0015] The filler strands 3 are composed of polyamide, for example. The strength of the filler strands 3 is not included in the tensile strength of the inner layer portion 1 from a design perspective.

[0016] An outer layer portion 4 includes a plurality of outer layer strands 5 disposed so as to be twisted together and cover an outer circumference of the inner layer portion 1. Each of the outer layer strands 5 is composed of a plurality of base strands made of aramid fibers which are twisted together with each other and an impregnating material such as polyurethane or the like in a similar manner to the inner layer strands 2.

[0017] An inner layer coating (a friction-reducing coating) 6 for preventing abrasion of the strands 2 and 5 due to friction among the strands 2 and 5 in sheaves (not shown) such as a drive sheave is disposed between the inner layer portion 1 and the outer layer portion 4. An outer layer coating (a protective coating) 7 is disposed on an outer circumferential portion of the outer layer portion 4.

[0018] The inner layer portion 1 and the outer layer portion 4 are separated by the inner layer coating 6. Furthermore, a direction of twisting of the outer layer strands 5 is opposite to a direction of twisting of the inner layer strands 2, the inner layer portion 1 and the outer layer portion also being separated thereby.

[0019] A tensile strength of the outer layer portion 4 is set lower than a tensile strength of the inner layer portion 1. Specifically, the inner layer portion 1 has a tensile strength equal to or greater than sixty percent of an overall tensile strength of the main rope. Consequently, the tensile strength of the outer layer portion 4 is less than forty percent of the overall tensile strength of the main rope.

[0020] Electrically-conducting wires 8 for detecting damage to the outer layer strands 5 by passage of an electric current being interrupted when the electrically-conducting wire 8 snaps are twisted together with each

of a portion of the outer layer strands 5. A wire formed by bundling electrically-conductive carbon fibers, for example, is used for the electrically-conducting wires 8. Furthermore, the electrically-conducting wires 8 are twisted together with each of at least one pair of outer layer strands 5 that are adjacent to each other.

[0021] As shown in Figure 2, twisting pitches of the electrically-conducting wires 8 differ from each other on the pair of outer layer strands 5 twisted together with the electrically-conducting wires 8. Furthermore, the twisting pitch of the electrically-conducting wire 8 on one of the outer layer strands 5 of the pair of outer layer strands 5 twisted together with the electrically-conducting wires 8 is set to a pitch less than twice a thickness of the electrically-conducting wire 8. For example, if an electrically-conducting wire 8 having a diameter of 2 mm is used, the twisting pitch of that electrically-conducting wire 8 is less than 4 mm.

[0022] In a main rope of this kind, since damage to the base strands due to abrasion occurs mainly in the outer layer strands 5, the service life of the outer layer portion 4 is shorter than that of the inner layer portion 1, but since the inner layer portion 1 which has a higher tensile strength than the outer layer portion 4 remains even if the strength of the outer layer portion 4 deteriorates significantly, sufficient residual strength can be ensured.

[0023] In a conventional elevator, the tensile strength of the main rope is designed to be ten times the safety factor. Furthermore, when safety devices such as emergency braking devices ("safeties"), etc., are applied, a load approximately two to six times that of the load acting during normal operation acts on the main rope. When the strength of the outer layer portion 4 has deteriorated due to expiration of service life and six times the load is applied, it is desirable that that load can be supported by the inner layer portion 1 alone. Consequently, the residual strength can be considered to be sufficient if the inner layer portion 1 is provided with a tensile strength equal to or greater than sixty percent of the overall tensile strength of the main rope.

[0024] In reality, a car is more often suspended by a plurality of main ropes, and since it can be considered unlikely that all of the main ropes will reach the end of their service lives simultaneously, it is sufficient for any one main rope to have a residual strength equal to or greater than sixty percent.

[0025] Furthermore, since the direction of twisting of the outer layer strands 5 is opposite to the direction of twisting of the inner layer strands 2, the outer layer strands 5 crisscross the inner layer strands 2. Thus, damage to the base strands due to abrasion is more likely to occur on the sides of the outer layer strands 5 near the inner layer portion 1, whereby the service life of the outer layer strands 5 governs the service life of the main rope as a whole. Consequently, unforeseen incidents due to damage to the main rope originating in unexpected portions can be prevented.

[0026] In addition, because the electrically-conducting wires 8 are disposed on the outer layer strands 5 which govern the overall service life of the main rope, damage can be detected more stably, enabling the service life of the main rope to be ascertained more accurately. Specifically, when the electrically-conducting wires 8 snap, interrupting the passage of the electric current, operation of the elevator is stopped and a warning is issued informing that the main rope has reached the end of its service life.

[0027] Still furthermore, since the electrically-conducting wires 8 normally have greater strength than the aramid fibers, the aramid fibers are mainly abraded in contact with the electrically-conducting wires 8 and the aramid fibers and the base strands snap before the electrically-conducting wires 8. In regard to this, in Embodiment 1, since the electrically-conducting wires 8 are each twisted together with a plurality of pairs of outer layer strands 5 which are adjacent to each other, the electrically-conducting wires 8 on adjacent outer layer strands 5 come into contact with each other and the electrically-conducting wires 8 are abraded due to mutual contact between the electrically-conducting wires 8, enabling damage to the outer layer strands 5 to be detected more stably.

[0028] Thus, it is preferable for the pairs of outer layer strands 5 twisted together with the electrically-conducting wires 8 to be disposed in at least three places in one main rope in order to stably detect damage to the outer layer strands 5.

[0029] Furthermore, if the electrically-conducting wires 8 on the adjacent outer layer strands 5 are twisted together at the same pitch as each other, there is a possibility that mutual contact between the electrically-conducting wires 8 might not arise. In regard to this, in Embodiment 1, since the twisting pitches of the electrically-conducting wires 8 on the adjacent outer layer strands 5 differ from each other, the electrically-conducting wires 8 can be placed in mutual contact more reliably while keeping to a minimum the amount of electrically-conducting wire 8 used since it is composed of carbon fiber, which is expensive.

[0030] In addition, since the twisting pitch of the electrically-conducting wire 8 on one of the outer layer strands 5 is set to a pitch less than twice the thickness of the electrically-conducting wires 8, the electrically-conducting wires 8 can be placed in mutual contact more reliably while keeping to a minimum the amount of electrically-conducting wire 8 used.

[0031] Here, "twisting pitch" means the twisting pitch relative to one outer layer strand 5, and for example, if two electrically-conducting wires 8 are twisted together on one outer layer strand 5, each of the two electrically-conducting wires 8 is twisted at a pitch less than four times the thickness of the electrically-conducting wires 8.

Embodiment 2

[0032] Next, Figure 3 is a cross section of an elevator main rope according to Embodiment 2 of the present invention.

[0033] In the figure, an outer layer portion 11 includes a plurality of outer layer strands 12 disposed so as to cover an outer circumference of the inner layer portion 1. Each of the outer layer strands 12 is composed of a plurality of base strands made of aramid fibers which are twisted together with each other and an impregnating material such as polyurethane or the like in a similar manner to the inner layer strands 2.

[0034] The direction of twisting of the outer layer strands 12 is opposite to the direction of twisting of the inner layer strands 2. Electrically-conducting wires 8 are twisted together with each of a portion of the outer layer strands 12.

[0035] The cross-sectional shape of the outer layer strands 12 is a flat shape extending in a circumferential direction of the outer layer portion 11. The inner layer portion 1 and the outer layer portion 11 are in direct contact with each other, contact wires 13 having a strength equal to or greater than the strength of the base strands of the outer layer strands 12 being twisted together with the inner layer strands 2 coming into contact with the outer layer strands 12 including the electrically-conducting wires 8. In this case, wires having a material construction similar to that of the electrically-conducting wires 8 are used for the contact wires 13.

[0036] In addition, the tensile strength of the outer layer portion 11 is set lower than the tensile strength of the inner layer portion 1. Specifically, the inner layer portion 1 has a tensile strength equal to or greater than sixty percent of an overall tensile strength of the main rope. Consequently, the tensile strength of the outer layer portion 11 is less than forty percent of the overall tensile strength of the main rope.

[0037] Still furthermore, the tensile strength per unit area of the outer layer portion 11 is set lower than that of the inner layer portion 1 by making the twisting pitch of the outer layer strands 12 larger than the twisting pitch of the inner layer strands 2.

[0038] In an elevator main rope of this kind, snapping of the base strands due to abrasion occurs mainly in the outer layer strands 12, and since the inner layer portion 1 which has a higher tensile strength than the outer layer portion 11 remains even if the strength of the outer layer portion 11 deteriorates significantly, sufficient residual strength can be ensured.

[0039] Furthermore, because the inner layer portion 1 and the outer layer portion 11 are placed in direct contact with each other and the contact wires 13 are twisted together with the inner layer strands 2 coming into contact with the outer layer strands 12 including the electrically-conducting wires 8, the electrically-conducting wires 8 are abraded by contact with the contact wires 13, enabling the service life of the outer layer strands 5

to be stably detected.

[0040] Moreover, since the contact wires 13 are wires for abrading the electrically-conducting wires 8, it is not necessary to pass a current through the contact wires 13. However, damage to the inner layer strands 2 can be detected by composing the contact wires 13 of an electrically-conductive material and passing a current through the contact wires 13.

[0041] Furthermore, if the strength of the contact wires 13 is equal to or greater than the strength of the base strands, the contact wires 13 abrade the electrically-conducting wires 8 more effectively than the base strands, but if the strength of the contact wires 13 is greater than or equal to the strength of the electrically-conducting wires 8, the contact wires 13 can abrade the electrically-conducting wires 8 even more effectively.

[0042] In addition, since the tensile strength of the outer layer portion 11 is set lower than that of the inner layer portion 1, when an excessive load acts on the main rope, the outer layer portion 11 snaps before the inner layer portion 1, snapping of the outer layer portion 11 being detected by the snapping of the electrically-conducting wires 8. In other words, snapping of the entire main rope by an excessive load can be prevented.

[0043] However, since there is a risk that damage to the outer layer portion 11 due to contact with the inner layer portion 1 during normal operation may become pronounced when the tensile strength per unit area of the outer layer portion 11 is lowered, it is preferable for the direction of twisting of the base strands of the inner layer strands 2 disposed radially outside the inner layer portion 1 and the direction of twisting of the base strands of the outer layer strands 12 to be parallel to each other. Basically, it is preferable for the direction of the fibers in both the inner layer strands 2 and the outer layer strands 12 to be close to parallel to the longitudinal direction of the main rope.

[0044] In addition, since the cross-sectional shape of the outer layer strands 12 is a flat shape extending in a circumferential direction of the outer layer portion 11, strength can be ensured while keeping the diameter of the main rope small. Furthermore, damage detection sensitivity can be increased and stresses arising due to bending can be reduced, enabling a main rope having a high packaging density to be provided. In addition, when lubricating oil is impregnated into the inner layer portion 1, outflow of the lubricating oil beyond the outer layer portion 11 can be prevented, enabling degradation of bonding between the outer layer strands 12 and the outer layer coating 7 to be prevented.

[0045] Moreover, the outer layer strands 12 are prepared with a circular cross section, then softened by heating and passed through a die to deform the cross-sectional shape when being wound onto the outer circumference of the inner layer portion 1. Furthermore, the cross-sectional shape may also be deformed by passage through a die after winding onto the inner layer portion 1.

Embodiment 3

[0046] Next, Figure 4 is a cross section of an elevator main rope according to Embodiment 3 of the present invention.

[0047] In the figure, an inner layer portion 15 includes: a plurality of inner layer strands 16 twisted together with each other; and filler strands 3 disposed in gaps between and twisted together with these inner layer strands 16. Each of the inner layer strands 16 is composed of a plurality of base strands made of aramid fibers which are twisted together with each other and an impregnating material such as polyurethane or the like.

[0048] The outer layer portion 11 is similar to that of Embodiment 2. The inner layer portion 15 and the outer layer portion 11 are in direct contact with each other. The direction of twisting of the outer layer strands 12 is opposite to the direction of twisting of the inner layer strands 16. Electrically-conducting wires 17 extending parallel to the longitudinal direction of the outer layer portion 11 are disposed on the side near the inner layer strands 16 of at least a portion of the outer layer strands 12. A wire formed by bundling electrically-conductive carbon fibers, for example, is used for the electrically-conducting wires 17.

[0049] Contact wires 13 having a strength equal to or greater than the strength of the base strands of the electrically-conducting wires 17 are twisted together with the inner layer strands 16 coming into contact with the outer layer strands 12 including the electrically-conducting wires 17. In this case, wires having a material construction similar to that of the electrically-conducting wires 17 are used for the contact wires 13.

[0050] Furthermore, the cross-sectional shape of the inner layer strands 16 coming into contact with the outer layer strands 12 is modified such that the contact surface area with the outer layer strands 12 is larger than for a circular cross section. The inner layer strands 16 are prepared with a circular cross section, then softened by heating and passed through a die to deform the cross-sectional shape when being twisted together as the inner layer portion 15. Furthermore, the cross-sectional shape may also be deformed by passage through a die after twisting all of the inner layer strands 16 together.

[0051] A lubricating oil is applied and impregnated between the inner layer strands 16. A silicone-base or paraffin-base synthetic oil, for example, is used for the lubricating oil. Furthermore, a petroleum-base lubricating oil may also be used in cases where a polyurethane resin having superior oil resistance is used as the material for the inner layer strands 16.

[0052] In addition, the tensile strength of the outer layer portion 11 is set lower than the tensile strength of the inner layer portion 15. Specifically, the inner layer portion 15 has a tensile strength equal to or greater than sixty percent of an overall tensile strength of the main rope. Consequently, the tensile strength of the outer layer

er portion 11 is less than forty percent of the overall tensile strength of the main rope.

[0053] In an elevator main rope of this kind, since the electrically-conducting wires 17 are disposed parallel to the longitudinal direction of the outer layer portion 11 on the side of the outer layer strands 12 near the inner layer strands 16, the contact wires 13 can be placed in contact with the electrically-conducting wires 17 more reliably, enabling detection sensitivity to damage to the outer layer strands 12 to be increased.

[0054] Because the cross-sectional shape of the inner layer strands 16 is modified, contact pressure between the inner layer strands 16 and the outer layer strands 12 can be reduced. Furthermore, when the inner layer strands have a circular cross section, the outer layer strands 12 come into contact with only a portion of the outer circumference of the inner layer strands, spanning the intervals between the inner layer strands, but when the modified inner layer strands 16 are used, since the outer layer strands 12 are twisted while coming into contact with the inner layer strands 16 over a larger surface area, bending stresses arising in the outer layer strands 12 can be reduced, enabling the service life of the outer layer strands 12 to be extended.

[0055] In addition, since the lubricating oil is applied and impregnated between the inner layer strands 16, sliding among the modified inner layer strands 16 is smoothed, enabling micromotion abrasion of the inner layer strands 16 due to fluctuating loads that the main rope is subjected to during operation of the elevator to be suppressed.

Claims

1. An elevator main rope for suspending a car inside a hoistway, said elevator main rope comprising:

an inner layer portion having a plurality of inner layer strands in each of which a plurality of base strands composed of synthetic resin fibers are twisted together; and

an outer layer portion having a plurality of outer layer strands in each of which a plurality of base strands composed of synthetic resin fibers are twisted together, said outer layer portion being disposed so as to cover an outer circumference of said inner layer portion,

wherein a tensile strength of said outer layer portion is set lower than a tensile strength of said inner layer portion.

2. The elevator main rope according to claim 1, wherein: said inner layer strands are twisted together with each other, said outer layer strands being twisted together with each other in an opposite direction to a direction of twisting of said inner layer strands.

3. The elevator main rope according to claim 1, wherein: an inner layer coating is disposed between said inner layer portion and said outer layer portion.

4. The elevator main rope according to claim 1, wherein: said inner layer portion has a tensile strength equal to or greater than sixty percent of an overall tensile strength of said elevator main rope.

5. The elevator main rope according to claim 1, wherein: an electrically-conducting wire for detecting damage to said outer layer strands by snapping and interrupting passage of an electric current is twisted together with at least a portion of said outer layer strands.

6. The elevator main rope according to claim 5, wherein: said electrically-conducting wire is twisted together with each of at least one pair of said outer layer strands that are adjacent to each other.

7. The elevator main rope according to claim 6, wherein: twisting pitches of said electrically-conducting wires differ from each other in said pair of outer layer strands.

8. The elevator main rope according to claim 6, wherein: a twisting pitch of said electrically-conducting wire on one outer layer strand of said pair of outer layer strands is set to a pitch less than twice a thickness of said electrically-conducting wire.

9. The elevator main rope according to claim 5, wherein: said inner layer portion and said outer layer portion are in direct contact with each other, a contact wire having a strength equal to or greater than a strength of said base strands of said outer layer strands being twisted together with an inner layer strand coming into contact with an outer layer strand including said electrically-conducting wire.

10. The elevator main rope according to claim 5, wherein: a tensile strength per unit area of said outer layer portion is set lower than that of said inner layer portion.

11. The elevator main rope according to claim 10, wherein:

a twisting pitch of said outer layer strands is set greater than a twisting pitch of said inner layer strands.

12. The elevator main rope according to claim 10, wherein:

a direction of twisting of base strands of inner layer strands disposed on a radially outer side

of said inner layer portion and a direction of twisting of said base strands of said outer layer strands are parallel to each other.

13. The elevator main rope according to claim 1, wherein: a cross-sectional shape of said outer layer strands is a flat shape extending in a circumferential direction of said outer layer portion. 5

14. The elevator main rope according to claim 13, wherein: 10

said inner layer portion and said outer layer portion are in direct contact with each other, an electrically-conducting wire for detecting damage to said outer layer strands by snapping and interrupting passage of an electric current being disposed so as to extend parallel to a longitudinal direction of said outer layer portion on a side near said inner layer strands of at least a portion of said outer layer strands, and a contact wire having a strength equal to or greater than a strength of said electrically-conducting wire being twisted together with an inner layer strand coming into contact with an outer layer strand including said electrically-conducting wire. 15 20 25

15. The elevator main rope according to claim 13, wherein: 30

said inner layer portion and said outer layer portion are in direct contact with each other, a cross-sectional shape of said inner layer strands coming into contact with said outer layer strands being modified such that a contact surface area with said outer layer strands is larger than for a circular cross section. 35

16. The elevator main rope according to claim 1, wherein: a lubricating oil is provided between said inner layer strands. 40

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FIG. 1

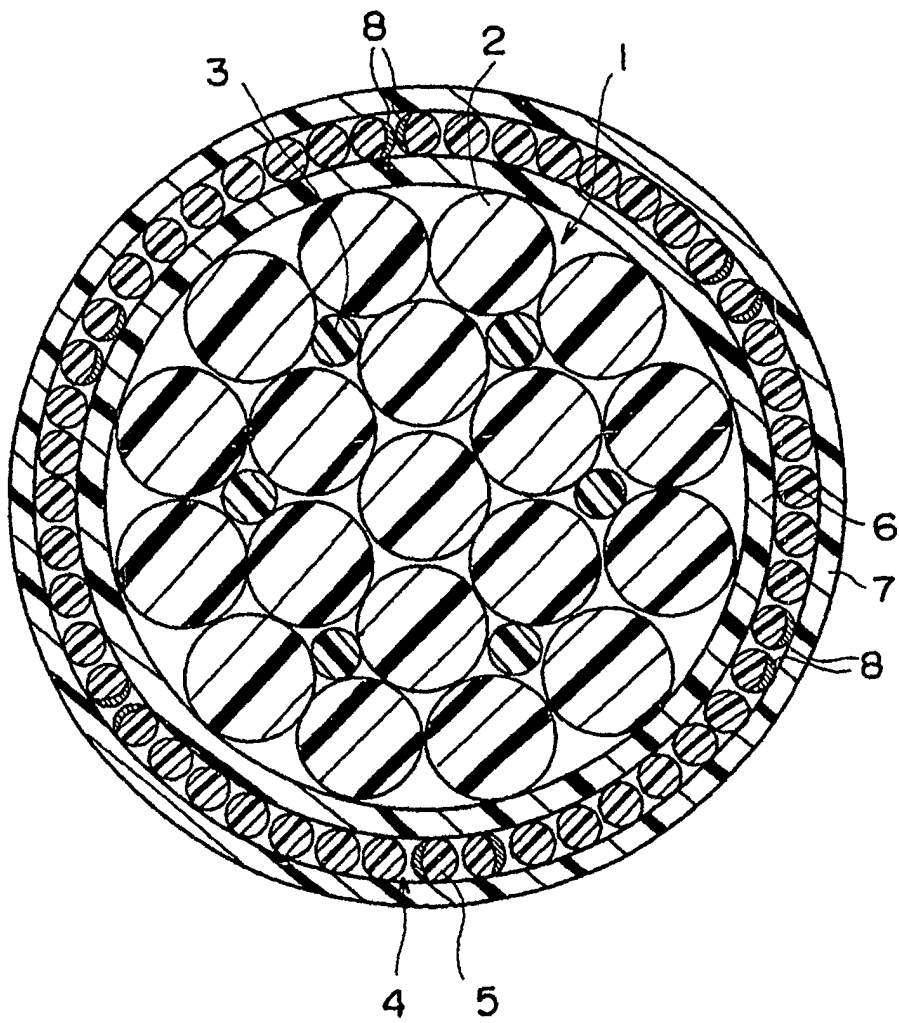


FIG. 2

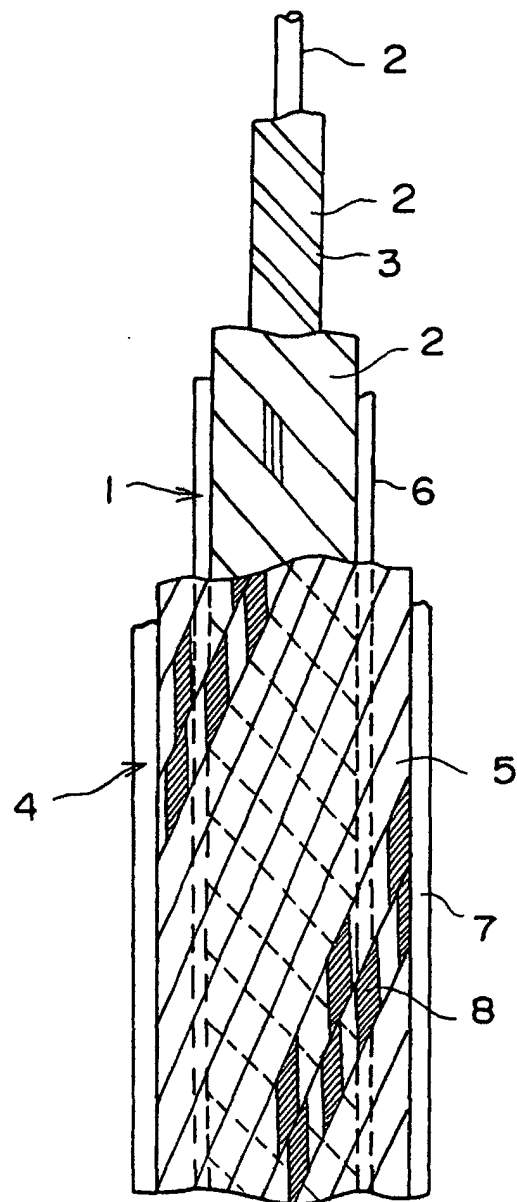


FIG. 3

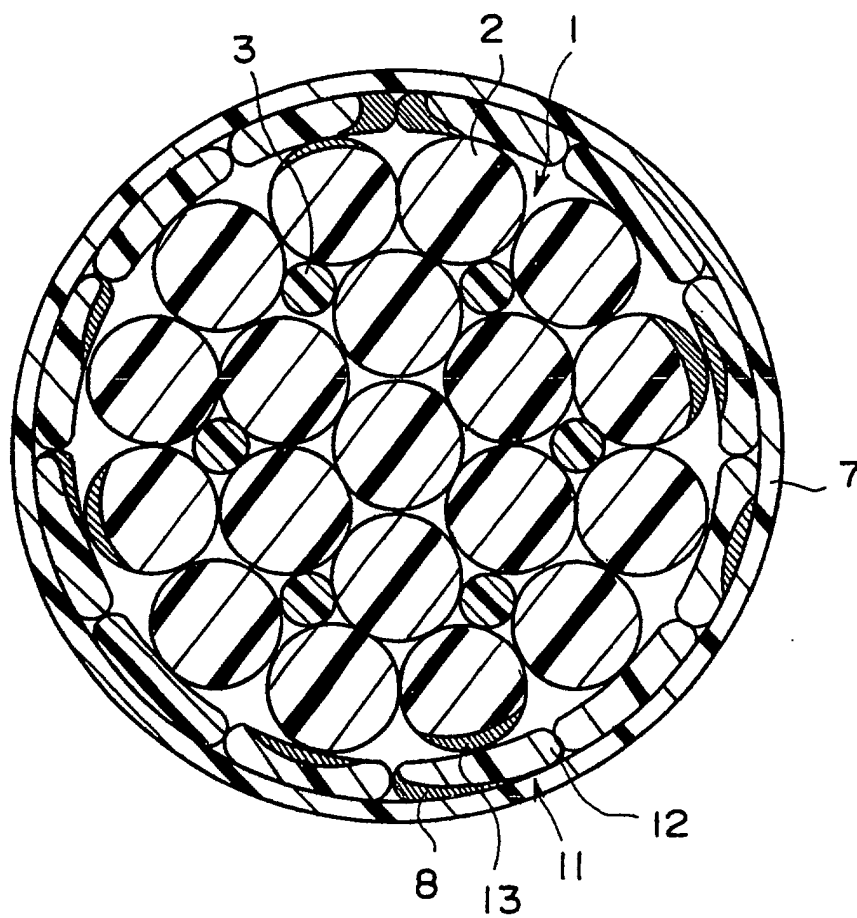


FIG. 4

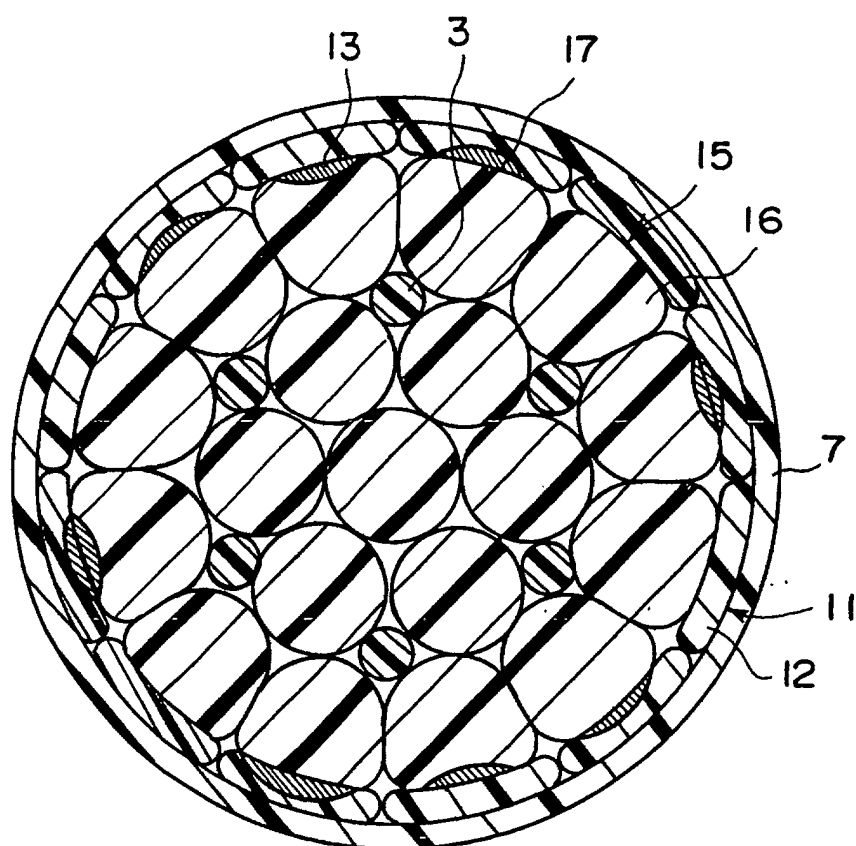
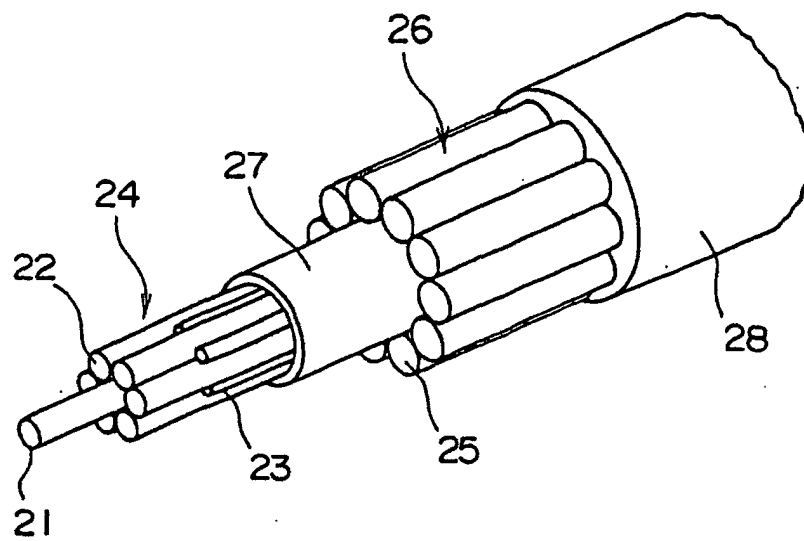


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/01130

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ B66B7/06, D07B1/02		
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 B66B1/00-B66B7/12 D07B1/00-D07B1/22		
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 1996-2001 Kokai Jitsuyo Shinan Koho 1971-2001 Toroku Jitsuyo Shinan Koho 1994-2001		
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.
Y A	JP 8-261972 A (Inventio AG), 11 October, 1996 (11.10.96), Par. Nos. [0010]-[0020]; Figs. 1-7 & AU 4584896 A & TR 960867 A & HK 1011391 A & CA 2169431 A & NO 960880 A & ZA 9601733 A & EP 0731209 A1 & CZ 9600649 A & PL 313088 A & CN 1134484 A & NZ 286035 A & BR 9600892 A & US 5834942 A & HU 9600548 A	1-8, 10-13, 15-16 9, 14
Y A	JP 7-21599 Y2 (Tokyo Seiko Seni Rope K.K.), 17 May, 1995 (17.05.95), Par. Nos. [0006]-[0009]; Figs. 1-3 & JP 4-114593 U JP 7-49635 B2 (Tokyo Seiko Seni Rope K.K.), 31 May, 1995 (31.05.95),	1-8, 10-13, 15-16 9, 14
☒ 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 09 November, 2001 (09.11.01)		Date of mailing of the international search report 27 November, 2001 (27.11.01)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/01130

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Y	Par. Nos. [0015] - [0027]; Figs. 1-2 & EP 0995832 A2 & TR 9902592 A & NO 995172 A & AU 5601199 A & CN 1252468 A & BR 9904960 A	2
	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 54092/1993 (Laid-open No. 19395/1995), (Tokyo Seiko K.K.), 07 April, 1995 (07.04.95),	
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Form PCT/ISA/210 (continuation of second sheet) (July 1992)