

(19)



(11)

EP 1 555 233 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

06.06.2018 Bulletin 2018/23

(51) Int Cl.:

D07B 1/22 (2006.01)

B66B 7/06 (2006.01)

(86) International application number:

PCT/JP2002/011108

(21) Application number: **02777961.0**

(22) Date of filing: **25.10.2002**

(87) International publication number:

WO 2004/037702 (06.05.2004 Gazette 2004/19)

(54) **ROPE FOR ELEVATOR**

SEIL FÜR AUFZUG

CORDAGE POUR ASCENSEUR

(84) Designated Contracting States:
DE GB

(43) Date of publication of application:
20.07.2005 Bulletin 2005/29

(73) Proprietor: **MITSUBISHI DENKI KABUSHIKI
KAISHA
Chiyoda-ku
Tokyo 100-8310 (JP)**

(72) Inventor: **HONDA, Takenobu
Tokyo 100-8310 (JP)**

(74) Representative: **Hoffmann Eitle
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)**

(56) References cited:
**EP-A2- 1 061 172 WO-A1-00/37738
WO-A1-01/14630 WO-A1-01/86058
JP-A- 3 249 288 JP-A- 10 018 190
JP-A- 2001 524 060 JP-A- 2002 505 240
JP-A- 2002 533 276 JP-B2- 2 510 364
JP-B2- 2 876 140 US-A- 5 566 786**

EP 1 555 233 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description**TECHNICAL FIELD**

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

BACKGROUND ART

[0002] WO 00/37 738 A1 discloses an elevator rope for suspending an elevator car comprising a belt-shaped rope main body having a plurality of strands in which a plurality of wires are laid parallel, and a coating body made of a resin for covering the strands, the strands being disposed side by side in a cross section perpendicular to a longitudinal direction of the rope main body.

[0003] Various layouts for an elevator system in which a car and a counterweight are suspended by a belt-shaped rope are disclosed in Japanese Patent Publication No. 2002-504471 (Gazette), for example. However, the specific construction of the belt-shaped rope is not sufficiently disclosed, and a construction for a belt-shaped rope capable of ensuring stable strength and enabling extension of service life has been sought.

DISCLOSURE OF THE INVENTION

[0004] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator rope capable of ensuring stable strength and enabling extension of service life.

[0005] In order to achieve the above object, according to one aspect of the present invention, there is provided an elevator rope for suspending an elevator car, comprising a belt-shaped rope main body, wherein: the rope main body has a plurality of strands in which a plurality of wires are laid parallel; and a coating body made of a resin for covering and integrating the strands; and the strands are disposed side by side in a cross section perpendicular to a longitudinal direction of the rope main body.

[0006] According to another aspect of the present invention, there is provided an elevator rope for suspending an elevator car, comprising a belt-shaped rope main body, wherein: the rope main body has: a plurality of strand assemblies including a core member made of a resin extending in a longitudinal direction of the rope main body, and a plurality of strands disposed around the core member and laid together with the core member; and a coating body made of a resin for covering and integrating the strand assemblies; the strands include a plurality of wires laid parallel to each other; and the strand assemblies are disposed side by side in a cross section perpendicular to a longitudinal direction of the rope main body.

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; and Figure 4 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. In the figure, a belt-shaped rope main body 1 has: seven strands 2; and a coating body 3 made of a resin for covering and integrating the strands 2. Each of the strands 2 has a plurality of steel wires 4. The wires 4 are laid parallel to each other (See Japanese Industrial Standards (JIS) G 3525 12.2 b). All of the wires 4 are laid parallel in all of the strands 2. The strands 2 are disposed side by side in a cross section perpendicular to a longitudinal direction of the rope main body 1 (Figure 1). Specifically, the seven strands 2 are disposed so as to line up in a straight line at a distance from each other in a width direction of the rope main body 1 (left-to-right in Figure 1) in the cross section perpendicular to the longitudinal direction of the rope main body 1.

[0010] It is preferable for a diameter of the wires 4 to be made approximately 1/400 of a diameter of a sheave (not shown) around which the rope main body 1 is wound. In this manner, bending stresses generated by the sheave are reduced, enabling fatigue resistance to be improved. Furthermore, in order to avoid making the diameter of the wires 4 considerably slenderer, it is preferable for the cross-sectional construction of the strands 2 to be a Warrington type rather than a Seale type or a filler wire type as defined in JIS G 3525.

[0011] The coating body 3 is composed of a thermoplastic ether-based polyurethane resin, for example. An adhesive 5 is applied to at least an outer peripheral portion of each of the strands 2 to integrate the strands 2 with the coating body 3. That is, the strands 2 and the coating body 3 are bonded to each other by means of the adhesive 5. Timing of the application of the adhesive 5 may be either before or after the laying together of the wires 4.

[0012] In an elevator rope of this kind, because the strands 2 are disposed side by side and are covered by

the coating body 3 made of a resin, movement of the strands 2 can be prevented and the occurrence of friction between the strands 2 can be prevented, thereby enabling stable strength to be ensured and also enabling extension of service life.

[0013] Because the wires 4 constituting each of the strands 2 are laid parallel to each other, the wires 4 are in line contact with each other and restrain each other. Consequently, contact pressure among the wires 4 is reduced, making internal friction less likely to occur in the strands 2, thereby also enabling stable strength to be ensured and also enabling extension of service life.

[0014] Particularly in Embodiment 1, because all of the wires 4 in all of the strands 2 are laid parallel, uniform strength can be ensured across the entire cross section, also making it superior in shape stability.

[0015] In addition, because steel wires 4 and a coating body 3 made of a hard polyurethane resin are used and the strands 2 and the coating body 3 are bonded to each other by means of the adhesive 5, ample abrasion resistance can be ensured and stability of the belt shape and cohesion of the strands 2 can be improved.

[0016] Now, if the overall strength of the rope main body 1 decreases and damage progresses, the strands 2 will break in descending order of magnitude of load burden, or in descending order of severity of damage. In regard to this, even if the number of strands 2 is increased as a preventive measure, a strength increase proportional to the number of strands 2 cannot be expected since it is difficult to make the load burden on each of the strands 2 uniform.

[0017] Furthermore, in an elevator rope integrated by a coating body 3, it is difficult to detect to what extent a given wire 4 inside the coating body 3 is damaged. In other words, it is conceivable that the replacement period for the rope main body 1 cannot be determined until damage sufficient to deform an external surface of the coating body 3 occurs in the strands 2, or at least one of the strands 2 is broken completely.

[0018] In regard to this, it is necessary to use five or more strands 2 in order to ensure a residual strength of approximately 80 percent (80%) in the rope main body 1 at the point in time when it is to be replaced due to the expiration of its service life. However, if strength has degraded to the extent that one of the strands 2 breaks, it can be surmised that damage to the other strands 2 will also have progressed and their strength degraded. Normally, the residual strength at the point in time when JIS replacement criteria are reached is in the order of a 5 percent (5%) reduction from a standard value since a safety margin from a standard breaking load is provided.

[0019] A preferred number of strands 2 can be found from the above. Specifically, if we let a be a predetermined residual strength, b be the normal residual strength under the replacement criteria, N be the number of strands 2, and P be the breaking load of the strands 2, then an expression $a \times P \times N = b \times P (N - 1)$ is satisfied. If we assume that a is 80 percent (80%), and b is 95

percent (95%), then $0.8 \times P \times N = 0.95P(N - 1)$, and N is found to be 6.3, that is, approximately seven (7). Consequently, sufficient residual strength can be ensured if at least seven strands 2 are used.

[0020] Moreover, the material of the coating body 3 is not limited to a thermoplastic ether-based polyurethane resin, and appropriate selection in response to service conditions is possible. However, if used in a high-temperature, high-humidity environment, a hard ether-based polyurethane, in which hydrolysis is less likely to occur, is preferable to an ester-based polyurethane, in which hydrolysis occurs easily.

Embodiment 2

[0021] Next, Figure 2 is a cross section of an elevator rope according to Embodiment 2 of the present invention. In the figure, a belt-shaped rope main body 11 has: seven strand assemblies 12; and a coating body 13 made of a resin for covering and integrating the strand assemblies 12. The strand assemblies 12 are disposed side by side in a cross section perpendicular to a longitudinal direction of the rope main body 11. Specifically, the seven strand assemblies 12 are disposed so as to line up in a straight line at a distance from each other in a width direction of the rope main body 11 in a cross section perpendicular to the longitudinal direction of the rope main body 11.

[0022] Each of the strand assemblies 12 respectively includes: a core member 14 made of a resin extending in a longitudinal direction of the rope main body 11; and three strands 15 disposed around the core member 14 and laid together with the core member 14. Each of the strands 15 has a plurality of steel wires 16. The wires 16 are laid parallel to each other. All of the wires 16 are laid parallel in all of the strands 15.

[0023] In each of the strand assemblies 12, the three strands 15 are disposed in a triangular cross-sectional shape around the core member 14. The strand assemblies 12 are disposed such that the disposed cross-sectional shapes of the strands 15 are alternately reversed in direction.

[0024] A thermoplastic resin such as a polypropylene resin, a polyethylene resin, or a vinyl, etc., or synthetic resin fibers such as high-strength aramid fibers or polypropylene fibers, etc., laid together at a high density, for example, can be used for the material of the core member 14.

[0025] An adhesive 5 is applied to at least an outer peripheral portion of each of the strands 15 to integrate them with the coating body 13. That is, the strands 15 and the coating body 13 are bonded to each other by means of the adhesive 5.

[0026] In an elevator rope of this kind, because the strand assemblies 12 are disposed side by side and are covered by the coating body 13 made of a resin, movement of the strand assemblies 12 can be prevented and the occurrence of friction between the strand assemblies 12 can be prevented, thereby enabling stable strength

to be ensured and also enabling extension of service life.

[0027] Because the wires 16 constituting each of the strands 15 are laid parallel to each other, internal friction is less likely to occur in the strands 15, thereby also enabling stable strength to be ensured and also enabling extension of service life.

[0028] In addition, because the strand assemblies 12 are constituted by a core member 14 and three strands 15, slenderer wires 16 can be used, enabling reductions in a diameter of a sheave to which the present invention is applied.

[0029] Furthermore, because three strands 15 are disposed in a triangular cross-sectional shape around the core member 14, and the strand assemblies 12 are disposed such that the disposed cross-sectional shapes of the strands 15 are alternately reversed in direction, the strand assemblies 12 can be disposed at a high density, enabling strength to be increased while keeping the width of the rope main body 11 small, thereby enabling reductions in a width of a sheave to which the present invention is applied.

Embodiment 3

[0030] Next, Figure 3 is a cross section of an elevator rope according to Embodiment 3 of the present invention. In this example, strands 18 are used that include: a steel core wire 16 functioning as a wire; and six outer peripheral wires 17 functioning as wires disposed around the core wire 16 and laid parallel to each other. The rest of the construction is similar to that of Embodiment 2.

[0031] In an elevator rope of this kind, since the cross-sectional construction of the strands 18 is simple and stable, it is superior in the shape stability relative to external forces. Furthermore, a diameter of the outer peripheral wires 17 can be made comparatively large, enabling both flexibility and abrasion resistance to be ensured in a well-balanced manner. In addition, because only a single layer of the outer peripheral wires 17 is disposed around the core wire 16, movement among the outer peripheral wires 17 can be suppressed, enabling adhesion stability relative to the coating body 13 also to be improved. Thus, the service life of the outer peripheral wires 17 can be extended and fatigue resistance of portions bonded to the coating body 13 can be improved.

Claims

1. An elevator rope for suspending an elevator car, comprising a belt-shaped rope main body (1), wherein:

said rope main body (1) has a plurality of strands (2) in which a plurality of wires (4) are laid parallel; and a coating body (3) made of a resin for covering and integrating said strands (2); and said strands (2) are disposed side by side in a

cross section perpendicular to a longitudinal direction of said rope main body (1),

characterized in that

said strands (2) and said coating body (3) are bonded to each other by means of an adhesive (5).

2. The elevator rope according to Claim 1, **characterized in that** all of said wires (4) in all of said strands (2) are laid parallel.
3. The elevator rope according to Claim 1, **characterized in that** said wires (4) are made of a steel and said coating body (3) is made of a thermoplastic ether-based polyurethane resin.
4. The elevator rope according to Claim 1, **characterized in that** seven of said strands (2) are disposed so as to line up in a straight line at a distance from each other in said cross section perpendicular to said longitudinal direction of said rope main body (1).
5. An elevator rope for suspending an elevator car, comprising a belt-shaped rope main body (11), wherein:

said rope main body (11) has:

a plurality of strand assemblies (12) including a core member (14) made of a resin extending in a longitudinal direction of said rope main body (11), and a plurality of strands (15) disposed around said core member (14) and laid together with said core member (14); and

a coating body (13, 21) made of a resin for covering and integrating said strand assemblies (12);

said strands (15) include a plurality of wires laid parallel to each other; and

said strand assemblies (12) are disposed side by side in a cross section perpendicular to a longitudinal direction of said rope main body (11),

characterized in that

said strands (15) and said coating body (13, 21) are bonded to each other by means of an adhesive (5).

6. The elevator rope according to Claim 5, **characterized in that** said core member (14) is made of a polyethylene resin.
7. The elevator rope according to Claim 5, **characterized in that** said core member (14) is made of a synthetic resin fiber.
8. The elevator rope according to Claim 5, **characterized in that:**

each of said strand assemblies (12) has one of

said core member (14) and three of said strands (15) disposed around said core member (14) in a triangular cross-sectional shape; and said strand assemblies (12) are disposed such that said disposed cross-sectional shapes of said strands (15) are alternately reversed in direction.

9. The elevator rope according to Claim 5, **characterized in that** each of said strands (15) includes a steel core wire (16) functioning as one of said wires; and six outer peripheral wires (17) functioning as said wires disposed around said core wire (16).

Patentansprüche

1. Aufzugseil zum Aufhängen einer Aufzugskabine, mit einem gurtförmigen Seilhauptkörper (1), wobei:

der Seilhauptkörper (1) eine Vielzahl von Strängen (2), in denen mehrere Drähte (4) parallel verlegt sind; und einen aus einem Harz hergestellten Beschichtungskörper (3) zum Abdecken und Integrieren der Stränge (2) aufweist; und die Stränge (2) nebeneinander in einem Querschnitt senkrecht zu einer Längsrichtung des Seilhauptkörpers (1) angeordnet sind, **dadurch gekennzeichnet, dass** die Stränge (2) und der Beschichtungskörper (3) mittels eines Klebstoffs (5) miteinander verbunden sind.

2. Aufzugseil nach Anspruch 1, **dadurch gekennzeichnet, dass** alle Drähte (4) in allen Strängen (2) parallel verlegt sind.

3. Aufzugseil nach Anspruch 1, **dadurch gekennzeichnet, dass** die Drähte (4) aus einem Stahl hergestellt sind und der Beschichtungskörper (3) aus einem thermoplastischen Polyurethanharz auf Etherbasis hergestellt ist.

4. Aufzugseil nach Anspruch 1, **dadurch gekennzeichnet, dass** sieben der Drähte (2) so angeordnet sind, dass sie in einer Geraden in einem Abstand zueinander in dem Querschnitt senkrecht zu der Längsrichtung des Seilhauptkörpers (1) ausgerichtet sind.

5. Aufzugseil zum Aufhängen einer Aufzugskabine, mit einem gurtförmigen Seilhauptkörper (11), wobei:

der Seilhauptkörper (11) aufweist:

eine Vielzahl von Stranganordnungen (12) mit einem Kernelement (14) aus einem Harz, das sich in einer Längsrichtung des

Seilhauptkörpers (11) erstreckt, und mit einer Vielzahl von Strängen (15), die um das Kernelement (14) herum angeordnet und zusammen mit dem Kernelement (14) verlegt sind; und

einen aus einem Harz hergestellten Beschichtungskörper (13, 21) zum Abdecken und Integrieren der Stranganordnungen (12);

die Stränge (15) weisen eine Vielzahl von Drähten, die parallel zueinander verlegt sind, auf; und

die Stranganordnungen (12) sind nebeneinander in einem Querschnitt senkrecht zu einer Längsrichtung des Seilhauptkörpers (11) angeordnet,

dadurch gekennzeichnet, dass

die Stränge (15) und der Beschichtungskörper (13, 21) mittels eines Klebstoffs (5) miteinander verbunden sind.

6. Aufzugseil nach Anspruch 5, **dadurch gekennzeichnet, dass** das Kernelement (14) aus einem Polyethylenharz hergestellt ist.

7. Aufzugseil nach Anspruch 5, **dadurch gekennzeichnet, dass** das Kernelement (14) aus einer Kunstharzfaser hergestellt ist.

8. Aufzugseil nach Anspruch 5, **dadurch gekennzeichnet, dass:**

jede der Stranganordnungen (12) ein Kernelement (14) und drei Stränge (15) aufweist, die um das Kernelement (14) herum in einer dreieckigen Querschnittsform angeordnet sind; und die Stranganordnungen (12) so angeordnet sind, dass die angeordneten Querschnittsformen der Stränge (15) abwechselnd in der Richtung umgekehrt sind.

9. Aufzugseil nach Anspruch 5, **dadurch gekennzeichnet, dass** jeder der Stränge (15) einen aus Stahl bestehenden Kerndraht (16), der als einer der Drähte fungiert; und sechs äußere periphere Drähte (17) aufweist, die als die Drähte fungieren, die um den Kerndraht (16) angeordnet sind.

Revendications

1. Cordage pour ascenseur pour suspendre une cabine d'ascenseur, comprenant un corps principal de cordage en forme de courroie (1), dans lequel :

ledit corps principal de cordage (1) a une plura-

- lité de torons (2) dans lequel une pluralité de fils métalliques (4) sont déposés parallèlement ; et un corps de revêtement (3) constitué d'une résine pour recouvrir et intégrer lesdits torons (2) ; et lesdits torons (2) sont disposés côte à côte dans une section transversale perpendiculaire à une direction longitudinale dudit corps principal de cordage (1), **caractérisé en ce que** : lesdits torons (2) et ledit corps de revêtement (3) sont liés l'un à l'autre au moyen d'un adhésif (5).
2. Cordage pour ascenseur selon la revendication 1, **caractérisé en ce que** tous lesdits fils métalliques (4) de tous lesdits torons (2) sont déposés en parallèle.
3. Cordage pour ascenseur selon la revendication 1, **caractérisé en ce que** lesdits fils métalliques (4) sont constitués d'un acier et ledit corps de revêtement (3) est constitué d'une résine de polyuréthane à base d'éther thermoplastique.
4. Cordage pour ascenseur selon la revendication 1, **caractérisé en ce que** sept desdits torons (2) sont disposés de manière à s'aligner en ligne droite à une distance l'un de l'autre dans ladite section transversale perpendiculaire à ladite direction longitudinale dudit corps principal de cordage (1).
5. Cordage pour ascenseur pour suspendre une cabine d'ascenseur, comprenant un corps principal de cordage en forme de courroie (11), dans lequel : ledit corps principal de cordage (11) a :
- une pluralité d'ensembles de torons (12) comprenant un élément central (14) constitué d'une résine s'étendant dans une direction longitudinale dudit corps principal de cordage (11) et une pluralité de torons (15) disposés autour dudit élément central (14) et déposés conjointement avec ledit élément central (14) ; et un corps de revêtement (13, 21) constitué d'une résine pour recouvrir et intégrer lesdits ensembles de torons (12) ; lesdits torons (15) comprennent une pluralité de fils métalliques déposés parallèlement l'un à l'autre ; et lesdits ensembles de torons (12) sont disposés côte à côte dans une section transversale perpendiculaire à une direction longitudinale dudit corps principal de cordage (11), **caractérisé en ce que** : lesdits torons (15) et ledit corps de revêtement (13, 21) sont liés l'un à l'autre au moyen d'un adhésif (5).
6. Cordage pour ascenseur selon la revendication 5, **caractérisé en ce que** ledit élément central (14) est constitué d'une résine de polyéthylène.
7. Cordage pour ascenseur selon la revendication 5, **caractérisé en ce que** ledit élément central (14) est constitué d'une fibre de résine synthétique.
8. Cordage pour ascenseur selon la revendication 5, **caractérisé en ce que** : chacun desdits ensembles de torons (12) a l'un dudit élément central (14) et trois desdits torons (15) disposés autour dudit élément central (14) en forme triangulaire en coupe transversale ; et lesdits ensembles de torons (12) sont disposés de sorte que lesdites formes en coupe transversale disposées desdits torons (15) aient un sens inversé en alternance.
9. Cordage pour ascenseur selon la revendication 5, **caractérisé en ce que** chacun desdits torons (15) comprend un fil central d'acier (16) opérant comme l'un desdits fils métalliques ; et six fils métalliques périphériques externes (17) opérant comme lesdits fils métalliques disposés autour dudit fil métallique central (16).

FIG. 1

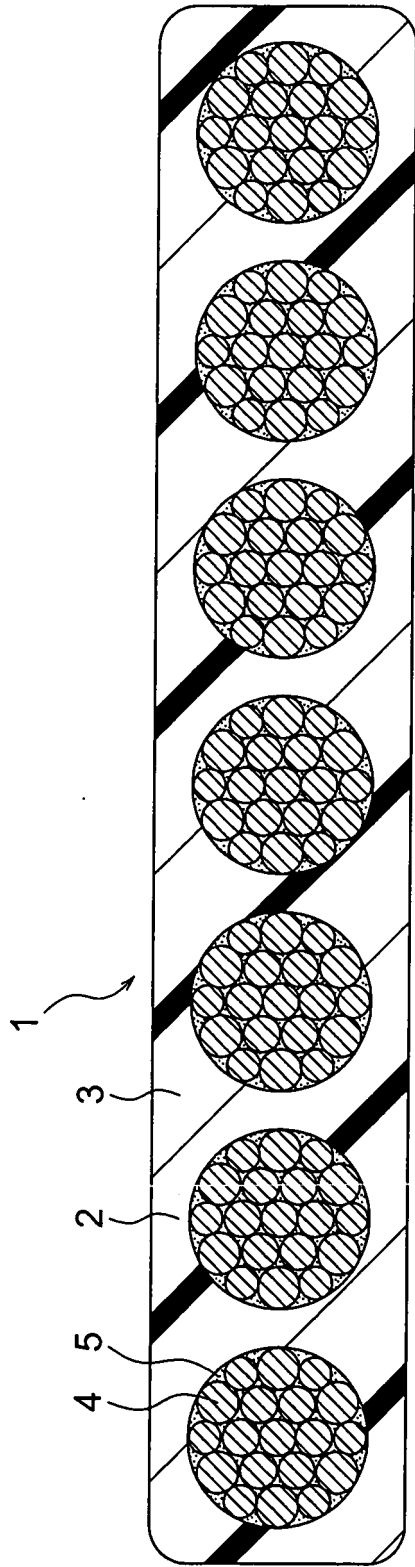


FIG. 2

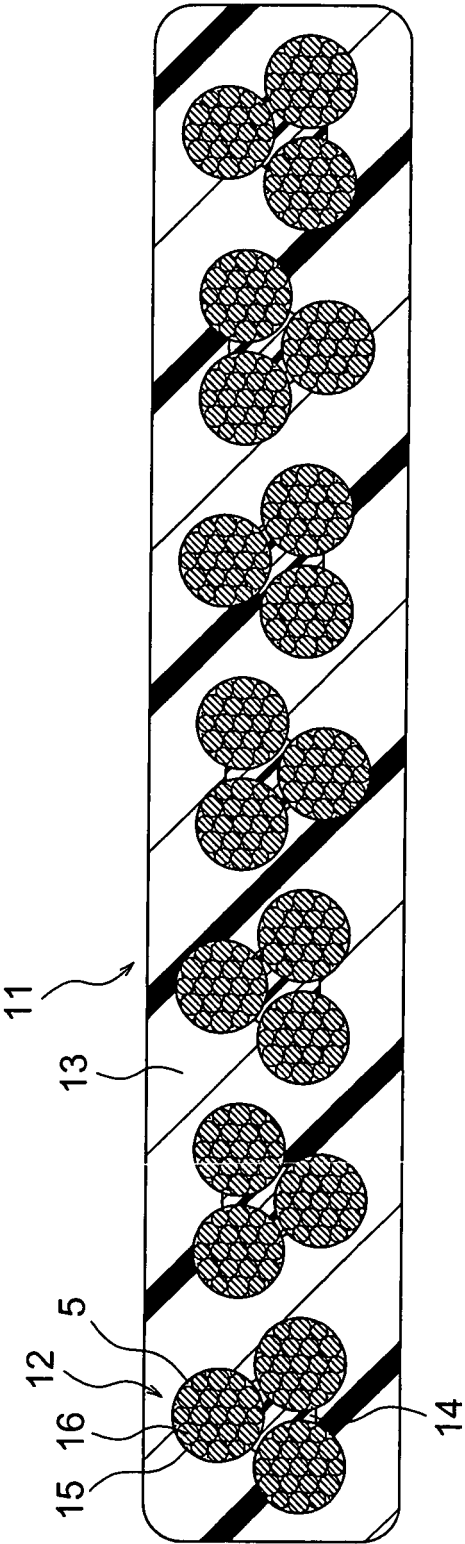


FIG. 3

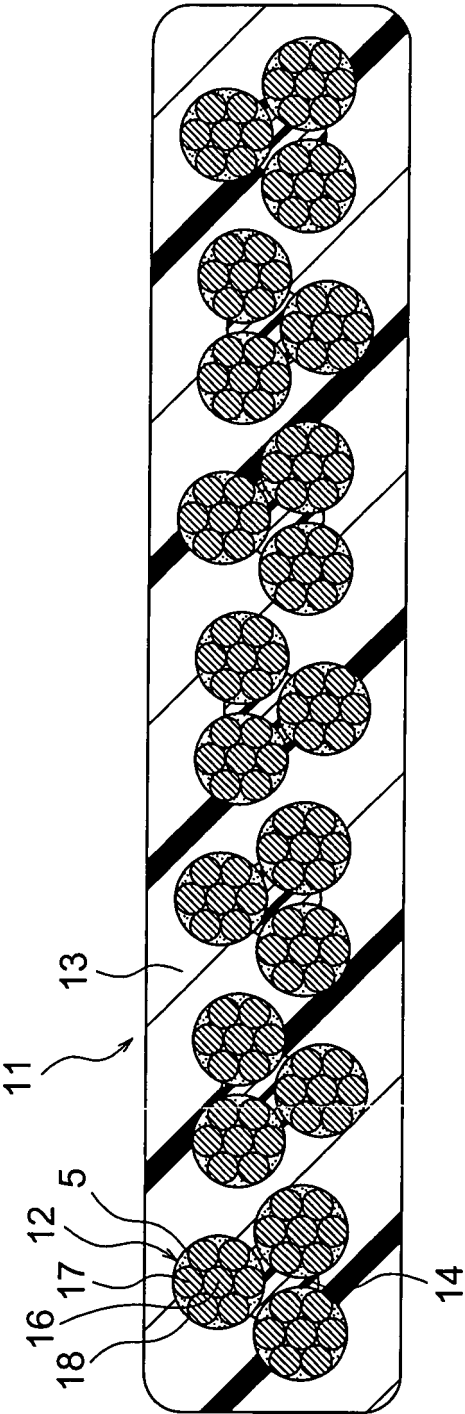
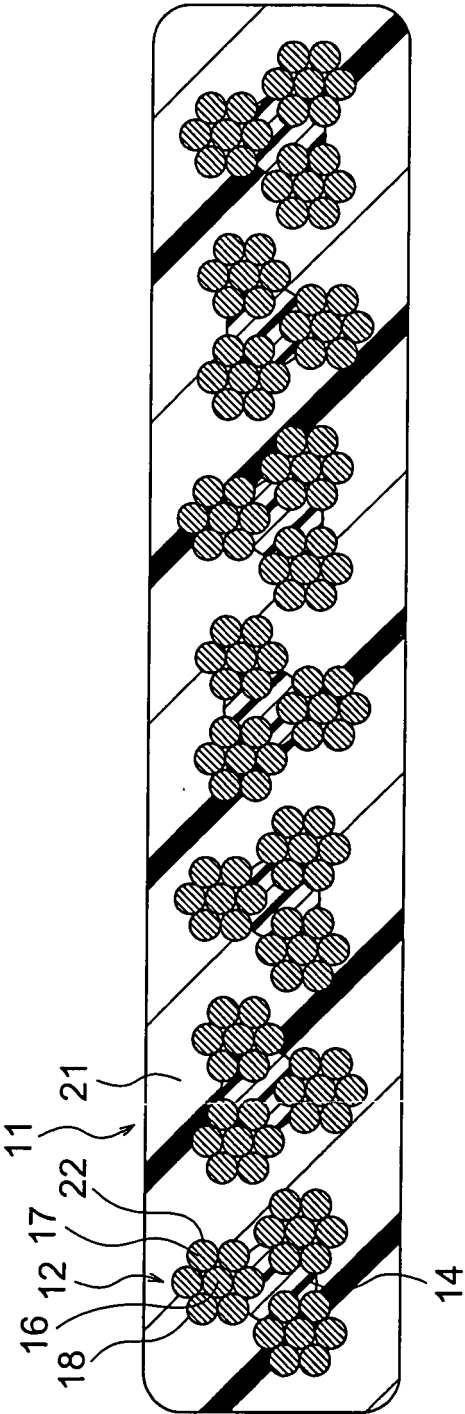


FIG. 4



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 0037738 A1 [0002]
- JP 2002504471 A, Gazette [0003]