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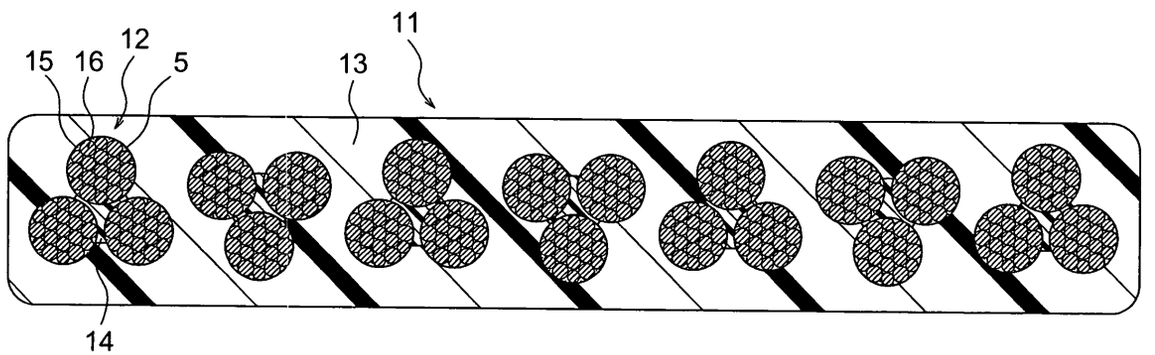
(54) ROPE FOR ELEVATOR

(57) An elevator rope is provided with a belt-shaped rope main body. The rope main body has a plurality of strands and a coating body made of a resin for covering and integrating the strands. The strands include a plurality of wires. These wires are laid parallel to each other. The strands are disposed side by side in a cross section perpendicular to a longitudinal direction of the rope main body.

FIG. 2



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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] 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

[0003] 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.

[0004] 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.

[0005] 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

[0006]

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

[0007] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0008] 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.

[0009] 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.

[0010] 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.

[0011] 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.

[0012] 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.

[0013] 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.

[0014] 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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

[0029] 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.

[0030] 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.

[0031] 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.

Embodiment 4

[0032] Next, Figure 4 is a cross section of an elevator rope according to Embodiment 4 of the present invention. In this example, a coating body 21 made of a rubber is used. Adhesive is not applied to the strands 18, and a film 22 is instead formed on outer peripheral portions of the core wire 16 and the outer peripheral wires 17 by a Parker process such as a phosphate film process or a galvanizing process, etc. The rest of the construction is similar to that of Embodiment 3.

[0033] In an elevator rope of this kind, because adhesion of the strands 18 to the coating body 21 is ensured by the film 22, adhesion can be ensured more easily than with a process in which an adhesive is applied.

[0034] Moreover, by forming film on the wires by a Parker process instead of using an adhesive, adhesion between the strands and the coating body can also be ensured if the coating body in Embodiments 1 and 2 above is made of a rubber.

Claims

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

said 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 said strands; and
said strands are disposed side by side in a cross section perpendicular to a longitudinal direction of said rope main body.

2. The elevator rope according to Claim 1, wherein all of said wires in all of said strands are laid parallel.

3. The elevator rope according to Claim 1, wherein said wires are made of a steel, said coating body is made of a thermoplastic ether-based polyurethane resin, and said strands and said coating body are bonded to each other by means of an adhesive.

4. The elevator rope according to Claim 1, wherein seven of said strands 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.

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

said rope main body has:

a plurality of strand assemblies including a core member made of a resin extending in a longitudinal direction of said rope main body, and a plurality of strands disposed around said core member and laid together with said core member; and
a coating body made of a resin for covering and integrating said strand assemblies;
said strands include a plurality of wires laid parallel to each other; and
said strand assemblies are disposed side by side in a cross section perpendicular to a longitudinal direction of said rope main body.

6. The elevator rope according to Claim 5, wherein said core member is made of a polyethylene resin.

7. The elevator rope according to Claim 5, wherein said core member is made of a synthetic resin fiber.

8. The elevator rope according to Claim 5, wherein:

each of said strand assemblies has one of said core member and three of said strands disposed around said core member in a triangular cross-sectional shape; and
said strand assemblies are disposed such that said disposed cross-sectional shapes of said strands are alternately reversed in direction.

9. The elevator rope according to Claim 5, wherein each of said strands includes a steel core wire functioning as one of said wires; and six outer peripheral wires functioning as said wires disposed around said core wire.

10. The elevator rope according to Claim 5, wherein said coating body is made of a rubber, and a film is formed on an outer peripheral portion of said wires by a Parker process.

FIG. 1

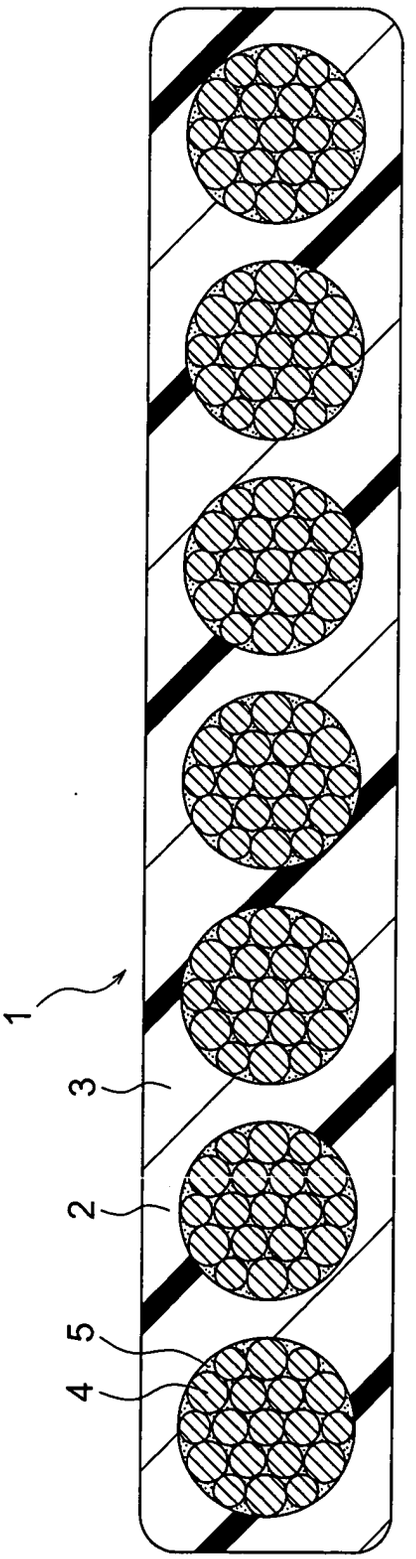


FIG. 2

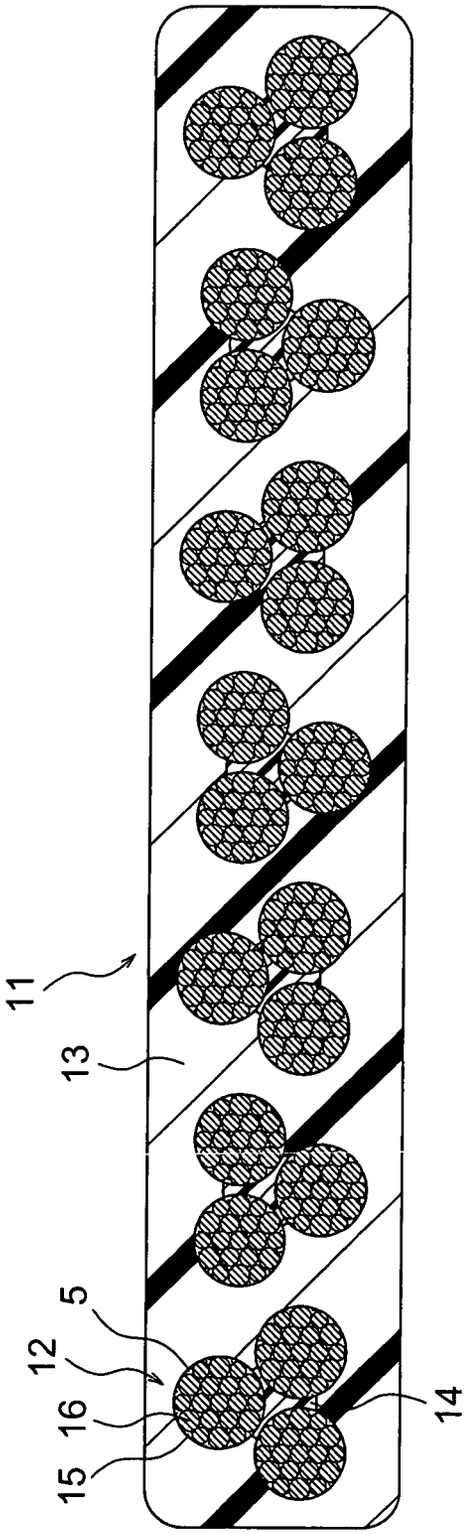


FIG. 3

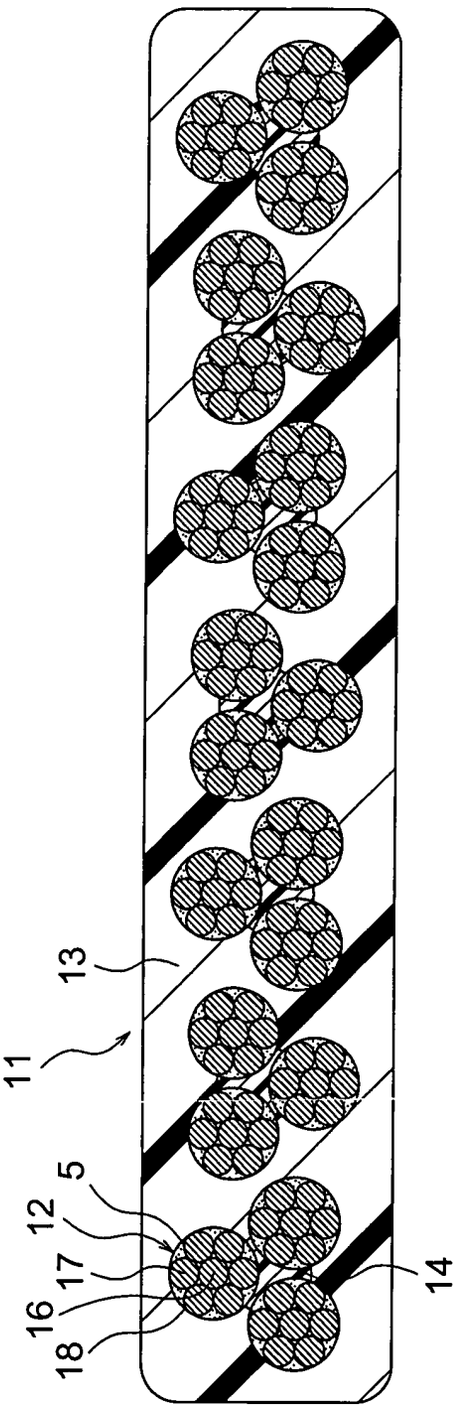
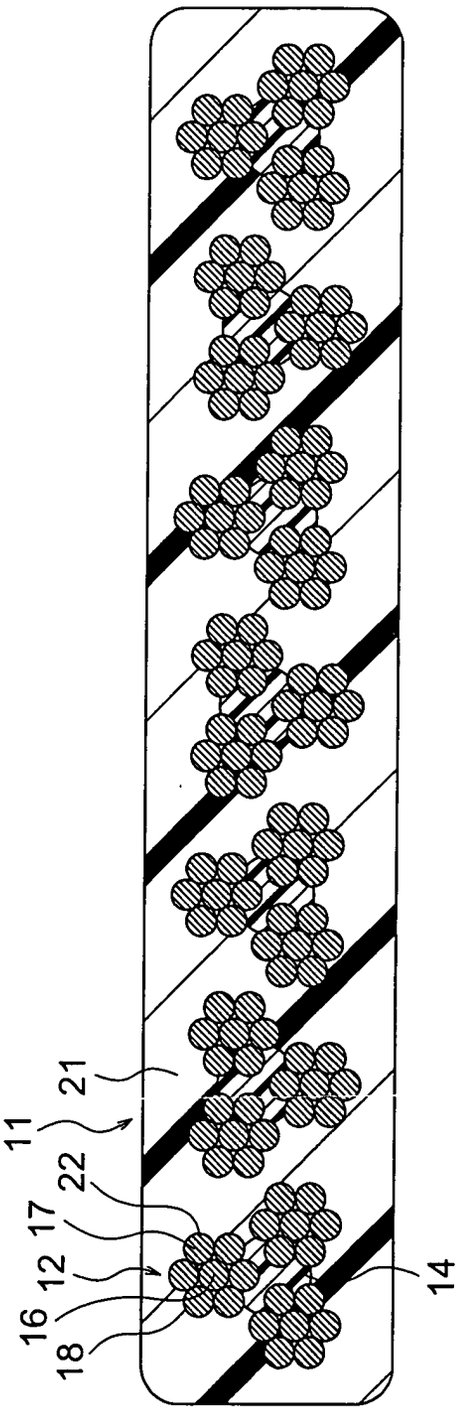


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/11008

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01M8/02, 8/10

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] H01M8/02, 8/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Jitsuyo Shinan Toroku Koho	1996-2003

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.
X Y	JP 10-172585 A (Honda Motor Co., Ltd.), 26 June, 1998 (26.06.98), Full text (Family: none)	1-2 3-4
Y	JP 9-161827 A (Fuji Electric Co., Ltd.), 20 June, 1997 (20.06.97), Claims; drawings (Family: none)	1-4
Y	JP 6-96781 A (Fuji Electric Co., Ltd.), 08 April, 1994 (08.04.94), Claims; drawings (Family: none)	1-4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 56-138876 A (Tokyo Shibaura Electric Co., Ltd.), 29 October, 1981 (29.10.81), Full text (Family: none)	1-4
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Y	JP 2001-32056 A (Sumitomo Metal Industries, Ltd.), 06 February, 2001 (06.02.01), Full text & EP 1046723 A1 & US 6379476 B1	3-4
A	JP 6-96777 A (Fuji Electric Co., Ltd.), 08 April, 1994 (08.04.94), (Family: none)	1-4

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