



(11) **EP 1 748 104 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
31.01.2007 Bulletin 2007/05

(51) Int Cl.:
D07B 1/16 (2006.01) **D07B 1/22** (2006.01)
B66B 7/06 (2006.01)

(21) Application number: **04742059.1**

(86) International application number:
PCT/ES2004/000331

(22) Date of filing: **12.07.2004**

(87) International publication number:
WO 2005/108672 (17.11.2005 Gazette 2005/46)

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PL PT RO SE SI SK TR**

- **MADOZ MICHAUS, Miguel, Angel**
E-20120 HERNANI (Guipuzcoa) (ES)
- **PAGALDAY ERAÑA, Juan, Manuel**
E-20500 Arrasate-Mondragon (Guipuzcoa) (ES)

(30) Priority: **10.05.2004 ES 200401118**

(71) Applicant: **Coop, Orona S.**
E-20120 Hernani (Guipuzcoa) (ES)

(74) Representative: **Carpintero Lopez, Francisco et al**
Herrero & Asociados, S.L.,
Alcalá, 35
28014 Madrid (ES)

(72) Inventors:
• **ARANBURU AGIRRE, Iñaki**
E-20120 HERNANI (Guipuzcoa) (ES)

(54) **CABLE AND BELT FOR A LIFT SPEED LIMITER AND ASSOCIATED PULLEYS**

(57) The present invention relates to a rope and belt for a speed governor for elevators and associated sheaves that is applicable to speed governors for elevators. The rope comprises high-strength steel wires clustered in strands among which a core is in turn formed which is completely coated by a polymeric material which is introduced in the gaps defined between the strands, obtaining an outer polymeric surface with a diameter that is slightly greater than the diameter of the core. The belts

cluster at least two metallic ropes comprising high-strength steel wires completely coated with a polymeric material. The sheaves designed for the ropes are semi-circular or notched semicircular sheaves having a low aggression and reduced diameter and high level of adherence, determining a high coefficient of friction between the coated rope and the sheave, and a high strength of the rope against fatigue due to bending and wear is also obtained.

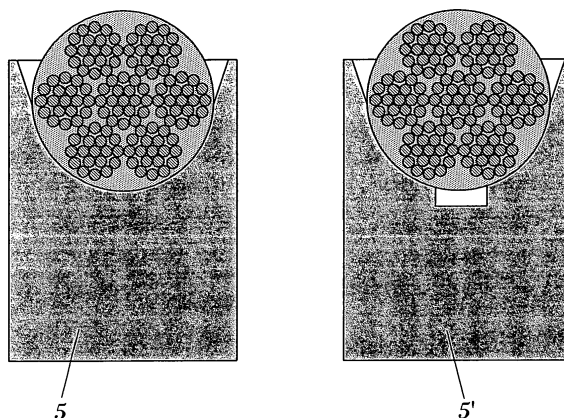


FIG.3

EP 1 748 104 A1

Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a rope, a belt and their associated sheaves which are applicable in a speed governor system for lifting installations the function of which consists of transmitting stress from the speed governor system to the mechanical means in charge of stopping the elevator with its passengers due to any type of uncontrolled movement.

[0002] It is an object of the invention that the rope or belt has a high tensile strength so as to reduce the diameter of said rope without compromising the operating reliability of the governor and therefore of the installation, achieving that lighter, less expensive and more manageable tension transmitting elements (ropes or belts), and generally smaller, lighter and less expensive governor systems, are used.

[0003] It is also object of the invention that the rope or belt has a high fatigue strength under bending cycles such as those occurring when it passes through the sheave or sheaves included in the governor system so as to reduce the diameter of said sheaves and thus reduce the space occupied by the governor, gaining space occupied by the installation in the shaft and hence in the building, reducing the weight of all the components as well as achieving that the reliability of the systems is greater when the sheave rotates at a higher speed.

[0004] Another object of the invention is that the rope or belt has a coefficient of friction with the sheave of the governor which is clearly greater than that of conventional systems so as to use sheaves with less aggressive grooves maintaining the necessary traction capacity in the sheave, thereby achieving that the rope or belt is affected less by said sheave, increasing its useful life, possibly becoming a maintenance-free system.

BACKGROUND OF THE INVENTION

[0005] Speed governor elements normally consist of a sheave joined to a fixed shaft through which a rope passes, the ends of which are joined to the element the safety of which is to be protected, and further having a second sheave joined to a second point fixed in the other end of the shaft, which is used to tense the connecting rope. Therefore, the first of the described sheaves rotates at a speed w given by:

$$w = v / R$$

where v is the linear speed of the car or counterweight to be controlled and R is the radius of the sheave of the overspeed governor. The safety device is triggered when w exceeds a pre-established value.

[0006] Reducing the radius R of the sheave makes the

rotating speed of the safety element higher, which makes the calibration thereof easier given that the calibration of these elements with the usual speeds and diameters, especially at low speeds, is complex, specific speed governor elements for rated speeds of less than $v = 0.5$ m/s being common on the market.

[0007] Speed governors are currently assembled in two types of design:

[0008] In a first type of design, which has traditionally been the most used design, a speed governor system is located at a fixed point of the installation. The governor system has a main sheave on which the rope in charge of transmitting the actuation stress circulates, and it may also have deflection sheaves. They also have tension sheaves ensuring tension in the rope of the system. After the rope passes through the entire sheave assembly, it is finally fixed to the moving element the overspeed of which is to be protected. This tension will at least be the minimum required so that in the moment that the system is activated, the rope (usually by friction in the groove of the governor system) is able to transmit the necessary stress to the component in charge of stopping the moving unit (usually a safety gear the activation of which stops the moving unit and keeps it in the elevator guide rails). The rope therefore forms a closed loop which starts and ends in the moving unit such that the linear movement of the moving unit causes the rotation of the sheaves of the governor system and the deflection sheaves.

[0009] In other designs, such as those described in patents EP 1175367 B1 of Thyssenkrupp Elevator Manufacturing (France), WO 03070615 A1 of JUNG, Insook (Korea) and WO 03091142 A1 of Mitsubishi Denki Kabushikikaisha (Japan), the governor is integrally joined to the element to be controlled (moving unit) and the rope is arranged in a single length with a weight at the lower end which is the weight that will provide tension thereto. In this case, the translation of the moving element also makes the speed governor system rotate. This same governor system is able to activate itself the safety gear element, i.e. by means of a rotation and translation which would occur in the governor element in the event of overspeed, translation and/or rotation movements would occur in the governor system which would directly activate the safety gear element.

[0010] This design allows obtaining a contact angle of the rope on the sheave of values between 180 and 300° increasing the system traction capacity (T_1/T_2).

[0011] There are other devices using fixed elements such as, for example, the guides of the installation described in US patent 645,756 of James M. Draper et al.

[0012] To date, the traditional ropes used in speed governor systems must have a minimum diameter $d = 6$ mm which is determined by regulatory considerations, and the ratio D/d must be greater than or equal to 30, where D is the diameter of the sheave, which will determine the minimum value $D = 180$ mm, and accordingly the general size of the device.

[0013] There are different applications in lifting for

ropes such as those described in the present invention which are described for traction ropes in European patent EP 1273695, and even traction elements with non-circular sections such as those described in WO 9942589, WO 9943885, WO 0037738 and WO 0114630.

[0014] The activation of the emergency braking elements (safety gear) requires the governor to exert a minimum force on said elements, which is 300 N or twice the force necessary to activate the braking elements. This makes it necessary to use aggressive grooves ensuring adherence in conventional systems, which is achieved by cutting the grooves of the sheave of the governor system with shapes, usually semi-cut with BETA groove angles between 100° and 105°, and V-shaped notched grooves or V-shaped grooves without notches with GAMMA groove angles between 35 and 40°, the latter requiring a surface hardening process to reach hardnesses of about 50 HRC or higher. This process is expensive since it requires specific materials due to its very nature and due to the quality control required after it is applied. The use of this type of grooves involves an inevitable wear of the grooves of the sheaves in the governor systems and of the rope, forcing the periodic replacement of those components, which is expensive and if it is not carried out with precaution may cause dangerous situations in the installation. Speed governor systems are subject to CE Certification and Marking, which complicates administrative work in the competent notified agencies in the event that they are replaced.

[0015] On the other hand, the use of large sheaves makes governors rotate at relatively low speeds, which translates into a slow movement of the elements which are to be activated and low kinetic energies, which makes calibrating them difficult especially in centrifugal-type governors.

DESCRIPTION OF THE INVENTION

[0016] The present invention relates to a high-strength steel wire rope or belt coated with a polymeric material, for example polyurethane, applicable for speed governors detecting the overspeed in lifting installations and transmitting the necessary stress to activate the emergency braking means associated to said lifting installations.

[0017] The use of high-strength ropes in speed governors allows reducing the diameter of the rope maintaining a high safety level. A conventional system incorporates a rope with diameter $d = 6$ mm or greater, while the metallic rope object of the present invention has a lower outer diameter of 5 mm and is formed by wires with a strength greater than 2000 N/mm².

[0018] The wires can be in turn clustered into strands which are clustered around a central strand consisting of wires or of a high-strength textile or synthetic material such as Kevlar.

[0019] There can be multiple designs of the rope, some of which show greater flexibility than others, and some

making better use of the cross section than others, but in any case the present invention can be carried out with any of them.

[0020] In the case of belts, the present invention contemplates them having at least two metallic ropes comprising high-strength steel wires with strength greater than 2000 N/mm² clustered into strands forming a metallic core having a diameter comprised between 0.01 and 2 mm and which are completely coated by a polymeric material. It has been provided that the outer surface of polymeric material of the belt can have a planar surface or an undulated surface.

[0021] By means of the use of a rope or belt such as those described above, the sheave of the safety system can have a reduced diameter. The reduction of the diameter of the sheave of the safety system makes the entire system smaller, occupying less space in the shaft and also in the building. The size reduction further makes all the elements be lighter and less expensive. A traditional system with a metallic rope having a rated diameter of $d = 6$ mm has a pitch diameter of the sheave $D = 180$ mm or greater. The present invention operates correctly with acceptable safety levels or safety levels exceeding said traditional systems with sheave pitch diameters that are less than or equal to 150 mm in the case of rope with a circular section and pitch diameters of less than 100 mm in the case of belts of any type.

[0022] On the other hand, high-strength steel ropes allow a smaller D/d ratio than usual, also maintaining an acceptable safety level, further contributing to the reduction of the sheave pitch diameter D . In the current state of the art, it can be seen that the sheave diameter is subject to a minimum $D/d = 30$ ratio. The present invention makes an assembly formed by rope (or belt) and sheave work with the rope (or belt) provided with polymeric material coating. As a result of the polymeric coating, the coefficient of friction between the materials of the rope (or belt) and sheave is much greater than in traditional systems, being able to use planar surfaces for the belts and sheaves with semicircular grooves for a circular rope, obtaining internal pressures in the rope which are clearly less than those of a traditional system. This allows reducing the D/d parameter to values less than 30, obtaining safety levels which are equal to or greater than conventional systems with ratios between 20 and 30.

[0023] Furthermore, using this type of ropes or belts the lubrication remains inside and is not dispersed by the installation with time and in the course of the cycles of the rope on the sheave, contributing to better lubricating the inner wires and strands, increasing fatigue strength of the rope + governor system. The polymeric coating prevents the outer metallic strands from rubbing against the groove of the sheave, preventing any abrasion and wear of the outer wires as a result of the intermediate layer of elastic material, increasing the life of the rope and sheave to levels which imply a maintenance-free system in practice.

[0024] In the present invention, the use of circular rope

implies the use of a sheave with a planar, convex or concave surface. The mentioned circular rope can be used with different groove geometries, but the fact that it is a rope coated with a polymeric material provides it with a high coefficient of friction with the groove of the sheave of the speed governor element to which it is associated, which means that grooves which are rather non-aggressive with the rope can be used, such as semicircular or perforated semicircular grooves. The use of this type of grooves prolongs the life of the rope given that the pressure between rope and sheave is more uniformly distributed than with other geometries, and pressure concentration areas which can damage the cable after a low number of cycles are not produced. This greatly increases the expected life of the rope and allows reducing or even eliminating the cost of maintenance activities.

[0025] This is the opposite of conventional governor systems which have in their sheave semi-notched or V-shaped grooves similar to those used in the grooves of traction sheaves, and therefore they will experience wear, inspection and maintenance tasks being required to ensure the traction capacity of the governor system, and hence its replacement due to excessive wear levels. As a result of the design and materials used, the present governor system prevents any possible wear of the groove of the sheave of the governor system, ensuring a much greater useful life than conventional systems and reducing maintenance tasks to a minimum, even possibly being maintenance free.

[0026] The sheaves of the governor element used for a rope may be of a metallic or non-metallic material with a semicircular or notched semicircular design with a BETA groove angle = 0° and a contact arc of the rope on the sheave ALPHA = $25-50^\circ$. In the case of the belt, the sheaves can have a planar, concave or convex surface.

[0027] Therefore, the diameter of the metallic core of the rope is acceptable at values of less than or equal to 5 mm, preferably between $d=2$ and 4 mm and the pitch diameter of the sheave of the governor element is acceptable at values less than or equal to 150 mm, preferably between $D=75$ and $D=100$ mm.

[0028] For the case of planar belts, they have at least two inner metallic ropes with a diameter comprised between $d=0.01$ and 2 mm, and a pitch diameter of the sheave less than or equal to 100 mm.

[0029] In a possible alternative embodiment, it is contemplated that the sheave can be made of a metallic material and can have in its groove a synthetic material coating, and that the metallic rope has no coating.

DESCRIPTION OF THE DRAWINGS

[0030] To complement the description being made and for the purpose of aiding to better understand the features of the invention according to a preferred practical embodiment thereof, a set of drawings is attached as an integral part of said description in which the following is shown with an illustrative and non-limiting character:

Figure 1 shows a section of one type of rope.

Figure 2 shows another possible rope section in which the central strand has been replaced with a central strand of a textile material or of a high-strength material, such as Kevlar or the like.

Figure 3 shows the rope shown in Figure 1 as it passes through two sheaves with different types of grooves, in this case semicircular or notched semicircular grooves.

Figures 4a to 4c show different possible rope designs.

Figures 4d to 4e show different possible belt designs. Figure 5 shows possible speed governor system designs in which the rope loop starts and ends in the safety gear element located in the body of the moving unit, although other designs are possible without the main features of the system being affected. The speed governor element is in a fixed point of the installation.

Figure 6 shows possible overspeed governor system designs in which the rope loop starts and ends in the safety gear element located in the body of the moving unit, although other designs are possible without the main features of the system being affected. In this case the governor element moves integrally with the moving unit.

Figure 7 shows possible rope tensing element designs, although other designs are possible without the main features of the system being affected.

Figure 8 shows a speed governor system in which the speed governor element moves integrally with the moving unit, but unlike the previously mentioned systems, the stress is transmitted to the safety gear element directly by the governor element. The rope in this case has the function of rotating the sheave of the governor element so as to thus detect the linear speed at which the elevator is moving, to generate the signal due to an overspeed event and to provide the necessary force to the governor element to activate the safety gear element.

Figure 9 shows the scheme of forces acting in the moment the governor system is actuated.

Figure 10 shows another possibility of the second type of governor system.

PREFERRED EMBODIMENT OF THE INVENTION

[0031] Figure 1 shows a metallic wire rope coated with a polymeric material layer. The rope comprises an assembly of metallic wires (1), usually made of steel, clustered according to geometric designs having certain sections which are subsequently rotated to form a helix, forming a strand (3). The wires (1) forming a strand (3) can be identical, as shown in Figure 1, or different. It is common for the wires to be concentrically clustered, forming layers.

[0032] The different strands (3) are in turn clustered following a clustering scheme parallel to the one de-

scribed in the previous paragraph, i.e. being arranged in a certain fashion in a section and subsequently rotating to form a helix of strands in the same fashion that a strand is formed by means of a helix of wires.

[0033] Figure 1 shows the strands of wires distributed around a central strand of wires, whereas in Figure 2 the central metallic strand has been replaced with a central strand (4) of a textile material or of a high-strength synthetic material such as Kevlar or the like.

[0034] The metallic core of the rope formed by the cluster of strands (3) is surrounded by a polymeric material coating (2), for example polyurethane, having a circular outer section with a diameter close to but somewhat greater than the larger diameter of the metallic core, and therefore completely coating it without significantly increasing the diameter of the core.

[0035] Figure 3 represents the rope shown in Figure 1 as it passes through the grooves (5, 5') of different metallic sheaves (2, 2') belonging to an speed governor of the type used in lifting apparatuses. These sheaves can have different groove (5, 5') geometries, although given the features of the rope object of the invention, the use of grooves that are not aggressive, such as semicircular grooves (5) or notched semicircular grooves (5'), is preferred.

[0036] In Figure 4c, a design can be seen in which the diameter of the central strand of the metallic part of the rope has a diameter greater than the outer strands. This ensures that the polymeric material enters the spaces generated between the outer strands, increasing system integrity and the physical union between the metallic part and the polymeric material of the coating.

[0037] A comparison of the typical parameters relating to rope-sheave assemblies used in conventional speed governors with those corresponding to rope-sheave assemblies object of the present invention shall be carried out below.

[0038] The grooves normally used in the conventional speed governor element are notched semicircular grooves with BETA groove angles between 100° and 105°, V-shaped grooves with or without surface hardening treatment with a GAMMA groove angle between 35 and 40°.

[0039] In a conventional system with a sheave having a semi-notched groove with BETA groove angle=105° and a pitch diameter of 200 mm, a specific pressure in the cable is provided having a value between 3.5 and 7 N/mm², depending on the tension coming from the tension sheave. Coefficient of friction "f" values between 0.4 and 0.5 are achieved with this design (considering a coefficient of friction between the rope and cast groove of $\mu=0.2$), achieving a traction capacity of T1/T2 of values between 3.5 and 4.

[0040] In a conventional system with a sheave having a non-hardened V-shaped groove of 40° and BETA notch angle=105° and pitch diameter of 200 mm, a specific pressure is provoked in the rope having a value between 4 and 8.5 N/mm² depending on the tension coming from

the tension sheave and the wear of the groove of the sheave. Coefficient of friction "f" values between 0.5 and 0.6 are achieved with this design (considering a coefficient of friction between the rope and the cast groove of $\mu=0.2$), achieving a traction capacity of T1/T2 having values between 6 and 6.5.

[0041] In a conventional system with a hardened V-shaped groove with a GAMMA angle=40° and a pitch diameter of 200 mm, a specific pressure is provoked in the rope having a value between 3.5 and 6.5 N/mm² depending on the tension coming from the tension sheave. Coefficient of friction "f" values between 0.5 and 0.6 are achieved with this design (considering a coefficient of friction between the rope and the cast groove of $\mu=0.2$) achieving a traction capacity of T1/T2 with values between 6 and 6.5.

[0042] By using planar belts with metallic ropes inside them, the present invention has specific pressures on said inner ropes having a value between 3 to 5 times less under the same use conditions as the previously described practical cases so as to obtain a traction capacity similar to that obtained in said examples. The belt shall preferably have at least two internal metallic ropes having a diameter with values between $d=0.01$ and 2 mm, and the sheave of the governor element would have a smooth, concave or convex surface having a pitch diameter with values less than or equal to 100 mm

[0043] By using metallic ropes with wires having a strength greater than 2000 N/mm², and coated with a polymeric material, such as polyurethane for example, the present invention has a coefficient of friction greater than the traditional systems reaching values greater than $\mu=0.4$. Experimental tests have given results greater than $\mu=0.5$. This provides the system with a traction capacity T1/T2 having a value greater than 8, being possible to reduce the tension on the cable and therefore reduce the specific pressure on the rope, increasing the useful life of the rope.

[0044] A governor mechanism according to this invention having a sheave of a cast material with a semicircular groove with an ALPHA winding angle of the ropes on the sheave=30° and a pitch diameter of the sheave of 200 mm provokes a specific pressure in the metallic part of a rope with diameter $d=2$ mm of a value between 1.2 and 1.5 N/mm² depending on the tension coming from the tension sheave, which in this case would be less than that normally used in conventional systems, this value being clearly less than those reached in conventional systems, and this together with the benefits of being a coated rope would ensure a virtually maintenance-free useful life of the governor system.

[0045] A governor mechanism according to this invention having a sheave of a cast material with a semicircular groove with ALPHA angle=30° and a pitch diameter of 80 mm provokes a specific pressure in the metallic part of a rope with $d=2$ mm, of a value between 3 and 4 N/mm² depending on the tension coming from the tension sheave, which in this case would be less than that nor-

mally used in conventional systems. This value is similar to or less than those obtained in traditional systems, and this together with the benefits of being a coated rope would ensure a useful life of the system which is similar to or greater than a conventional governor system.

[0046] A governor system with a design such as the one shown in Figure 6, in which the governor system moves with the moving assembly but the rope is stationary with a fixed fixing point in its upper part and a weight in its lower part with a semicircular groove with ALPHA angle=30° of a cast material and a pitch diameter of 80 mm, provokes a specific pressure in the metallic part of a rope with d=2 mm, having a value between 1 and 3 N/mm² depending on the tension coming from the tension sheave, which in this case would be less than that normally used in conventional systems and even less than the previously described designs. This value less than those obtained in traditional systems together with the benefits of being a coated rope would ensure a useful life of the system exceeding a conventional governor system.

[0047] Figures 5 and 6 show a metallic rope of a governor system formed by wires with a strength greater than 2000 N/mm² and the outer diameter of which is less than or equal to 5 mm and is not coated with any material. This rope passes through the groove of the sheave of the governor element which is metallic with a coating of a synthetic material, such as polyurethane or resins for example, with a design increasing the coefficient of friction between rope and sheave.

[0048] As can be seen in Figure 9, the present invention requires a tension in the rope that is less than conventional systems normally requiring a tension between G=50 kg and 100 kg for designs such as those represented in Figure 5 and between G=25 kg and 50 kg for designs such as those represented in Figure 6.

[0049] In Figure 9, the following is obtained for the loop design type:

$$F1+GR+G/2-T2=0$$

[0050] When considering experimental data indicating T1/T2=8, a tension in the rope with values between 10 and 12 kg is required, depending on the path of the installation. The weight of a rope or belt object of the present invention is less than that of conventional ropes and has values between 0.04 and 0.1 kg/m. This reduces the effects of inertia for moving the mass of the rope in the acceleration and deceleration of the elevator.

[0051] In Figure 9, the following is obtained for the design type in which there is only one rope length:

$$F1+GR+G-T2=0$$

[0052] When considering experimental data indicating

T1/T2=10 (greater than the previous case due to the fact that it is possible to increase the contact angle of the rope on the sheave of the governor element), a tension in the rope with values between 5 and 8 kg is required depending on the path of the installation. This tension is clearly less than conventional systems contributing to the fact that the effects of inertia are minimized and decreasing the specific pressure on the cable when it passes through the sheaves. Therefore, the present invention implies a virtually maintenance-free system in practice.

[0053] The use of high-strength steel in the ropes also contributes to prolonging the life thereof, given that their mechanical fatigue performance and wear improve, contributing to the previously described effect.

Claims

1. A rope for a speed governor for elevators, **characterized in that** it comprises high-strength steel wires (1) having a strength greater than 2000 N/mm² clustered in strands (3) among which a core is in turn formed having a diameter less than or equal to 5 mm which is completely coated by a polymeric material (2) which is introduced in the gaps defined between strands (3), obtaining an outer polymeric surface with a diameter slightly greater than the diameter of the core.
2. A rope for a speed governor according to claim 1, **characterized in that** the diameter of the core is comprised between 2 and 4 mm.
3. A rope for a speed governor according to claim 1, **characterized in that** the core incorporates a central strand (4) of textile material.
4. A rope for a speed governor according to claim 1, **characterized in that** the core incorporates a central strand (4) of a composite material.
5. A belt for a speed governor, **characterized in that** it has at least two metallic ropes comprising high-strength steel wires (1) having a strength greater than 2000 N/mm² clustered in strands (3) forming corresponding metallic cores having a diameter comprised between 0.01 mm and 2 mm and which are completely coated by a polymeric material (2).
6. A belt for a speed governor according to claim 5, **characterized in that** the outer polymeric material surface of the belt consists of a planar surface.
7. A belt for a speed governor according to claim 5, **characterized in that** the outer polymeric material surface of the belt consists of an undulated surface.
8. A sheave for a speed governor for elevators used

with the rope described in claims 1 to 4, **characterized in that** it has a groove with a semicircular design with a high level of adherence with BETA groove angle=0° and an ALPHA contact arc of the rope on the sheave comprised between 25 and 50°, as well as having a pitch diameter that is less than or equal to 150 mm. 5

9. A sheave for a speed governor for elevators according to claim 8, **characterized in that** the groove has a notch in its semicircular design. 10

10. A sheave for a speed governor for elevators according to claim 8, **characterized in that** its pitch diameter is less than 100 mm. 15

11. A sheave for a speed governor for elevators used with the belt described in claims 5 to 7, **characterized in that** its pitch diameter is less than or equal to 100 mm 20

12. An assembly formed by a rope and sheave for a speed governor, **characterized in that** the sheave has a synthetic material coating layer in its groove and has a pitch diameter less than or equal to 150 mm, and **in that** the rope comprises high-strength steel wires with a strength greater than 2000 N/mm² clustered in strands among which a core is in turn formed having a diameter less than or equal to 5 mm. 25
30

35

40

45

50

55

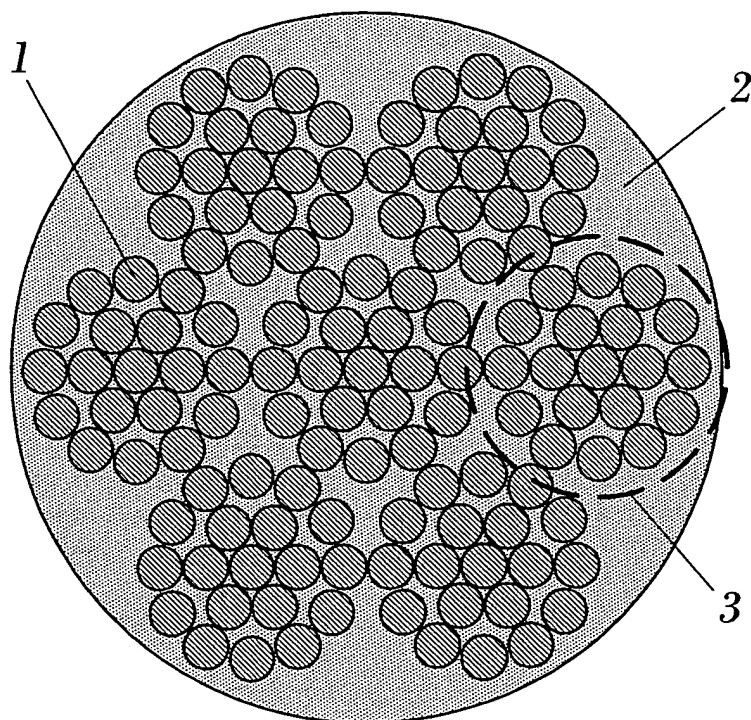


FIG.1

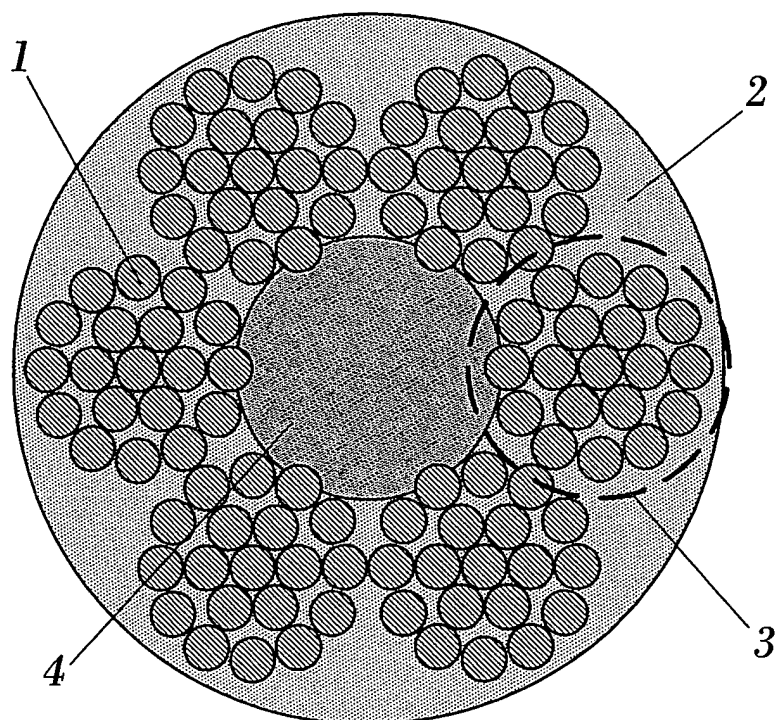


FIG.2

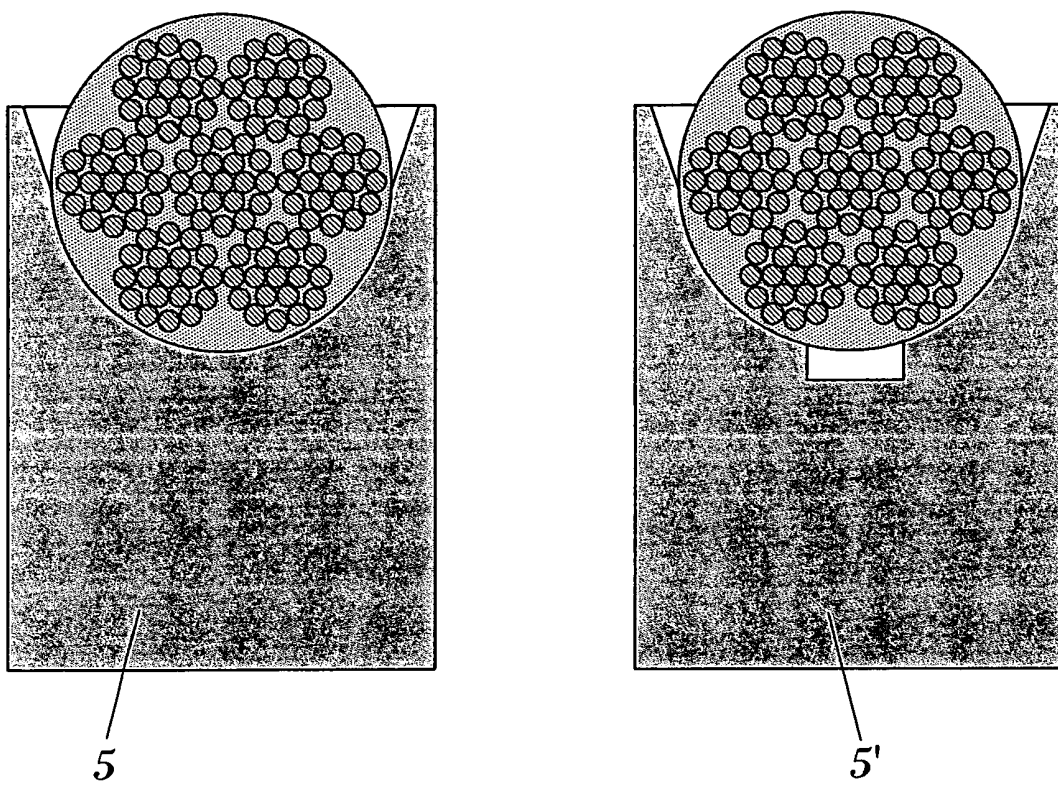


FIG.3

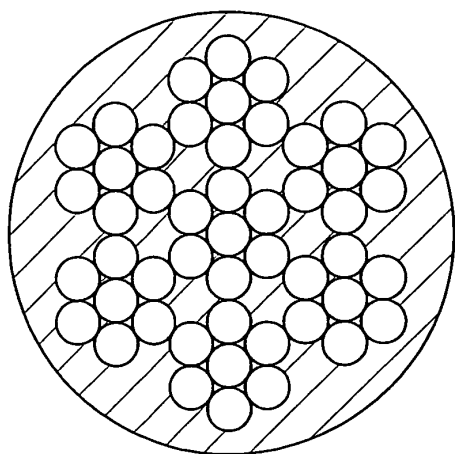


FIG. 4a

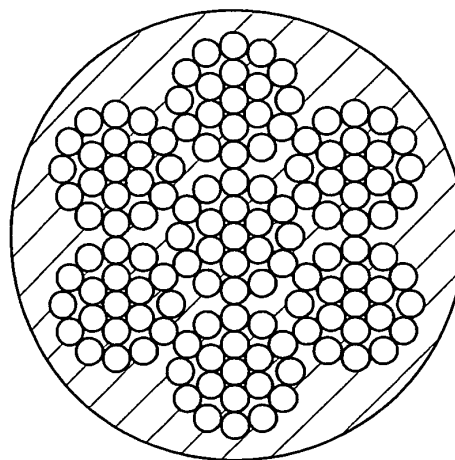


FIG. 4b

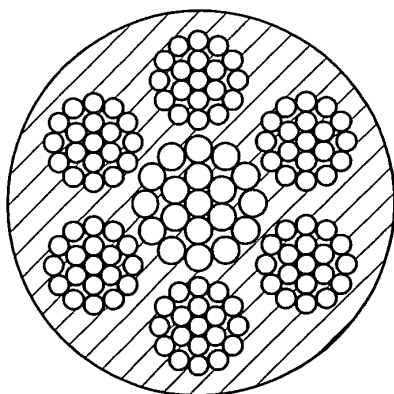


FIG. 4c

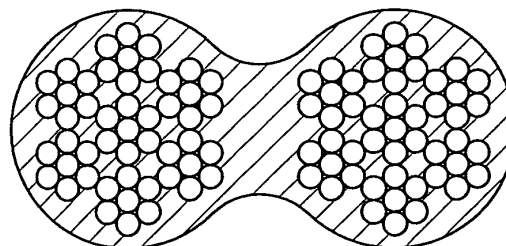


FIG. 4d

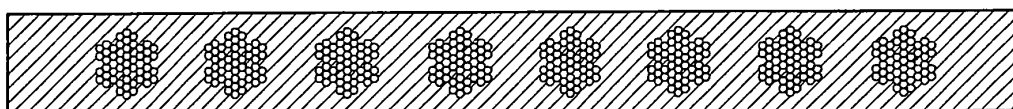


FIG. 4e

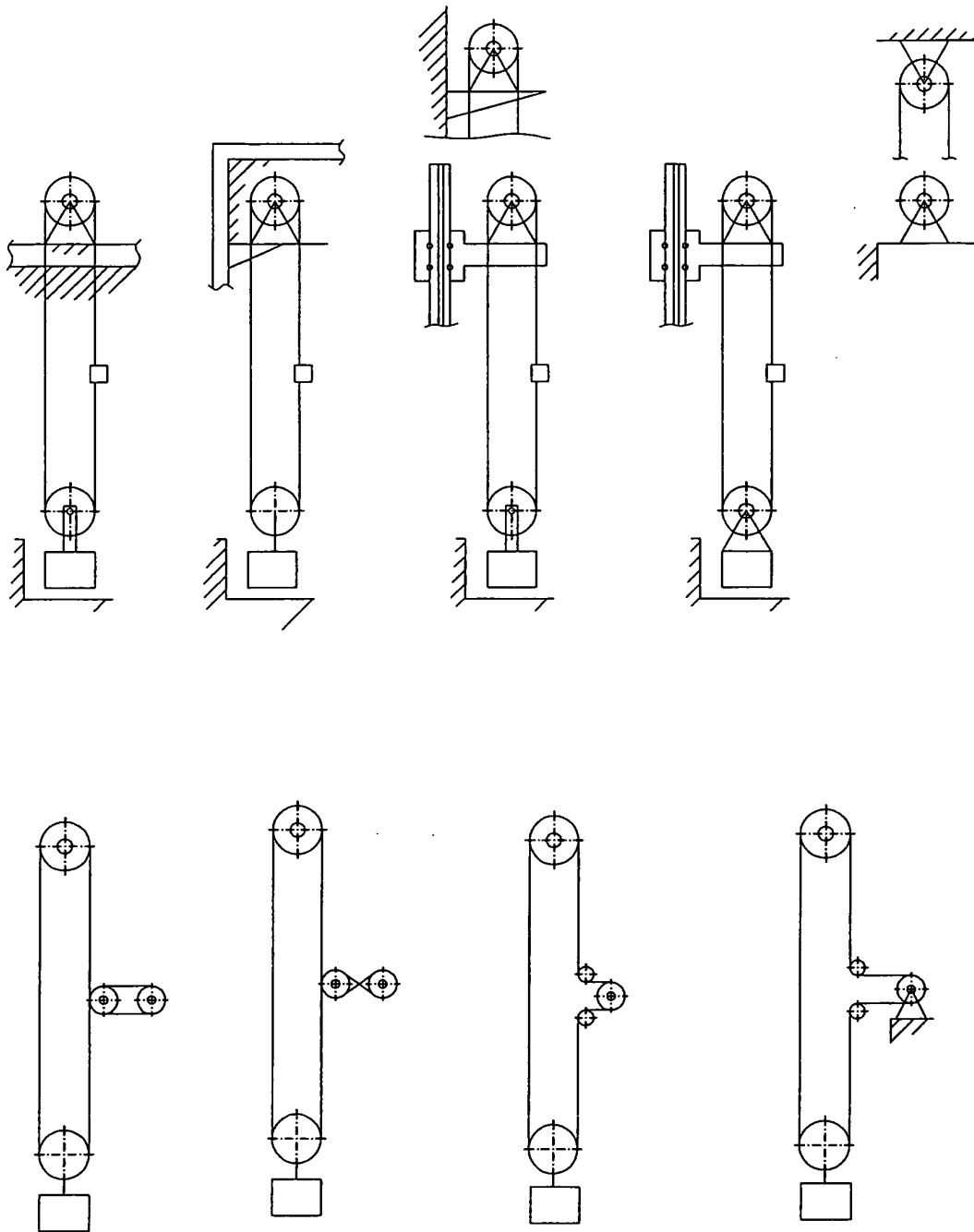


FIG. 5

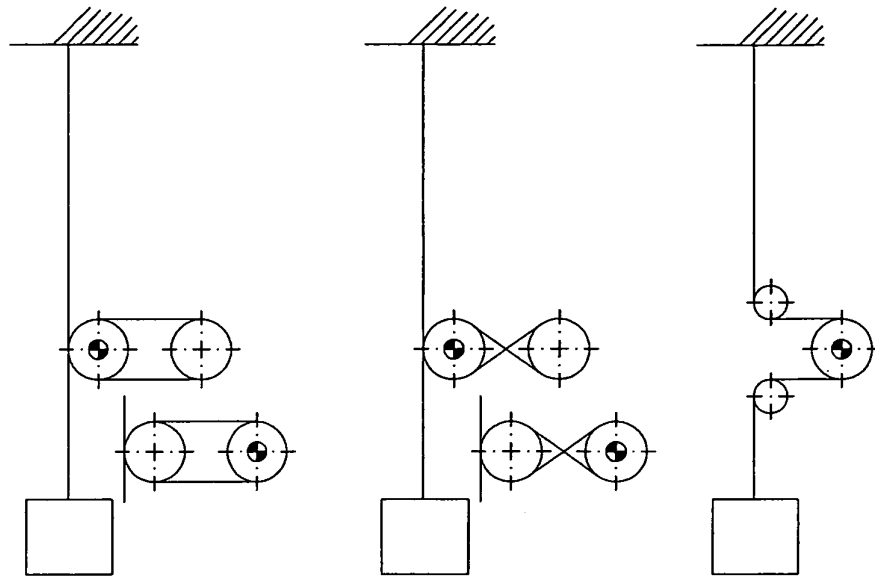


FIG. 6

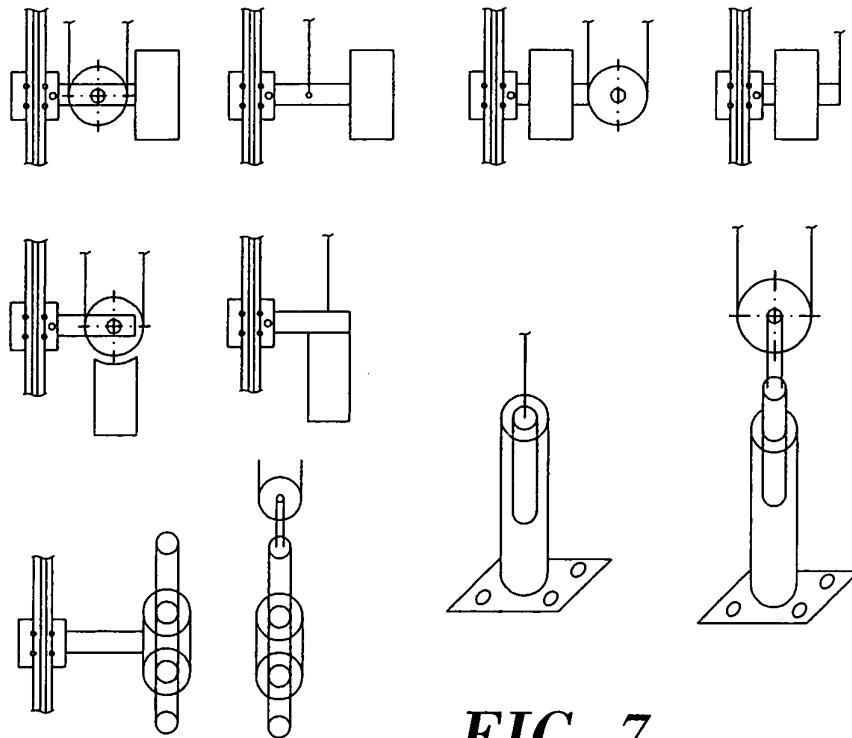


FIG. 7

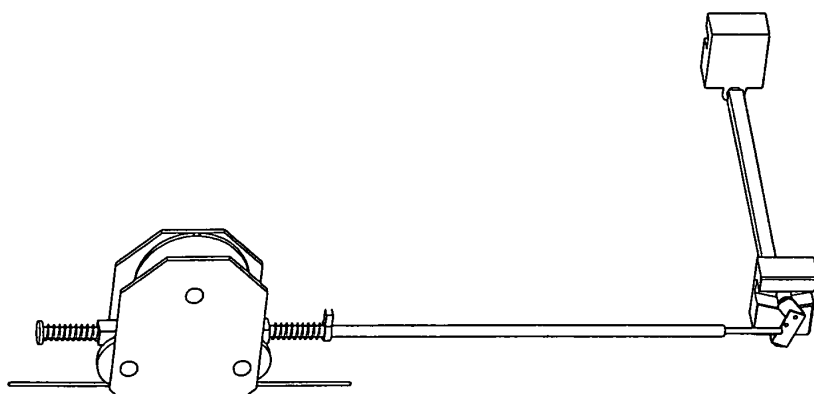
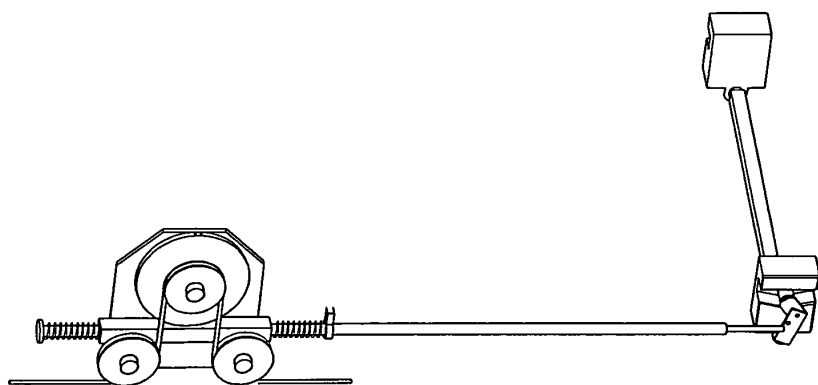
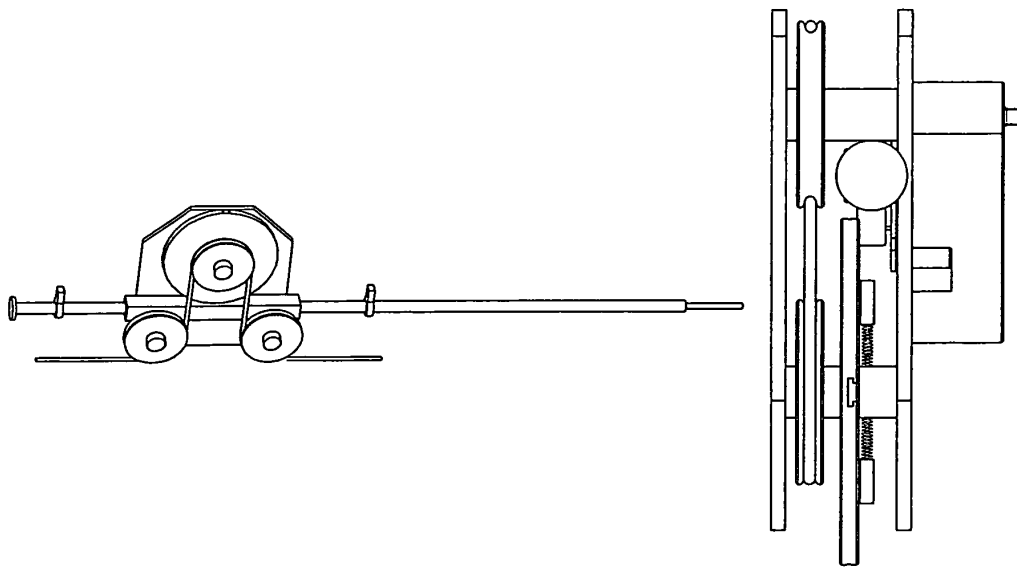


FIG. 8

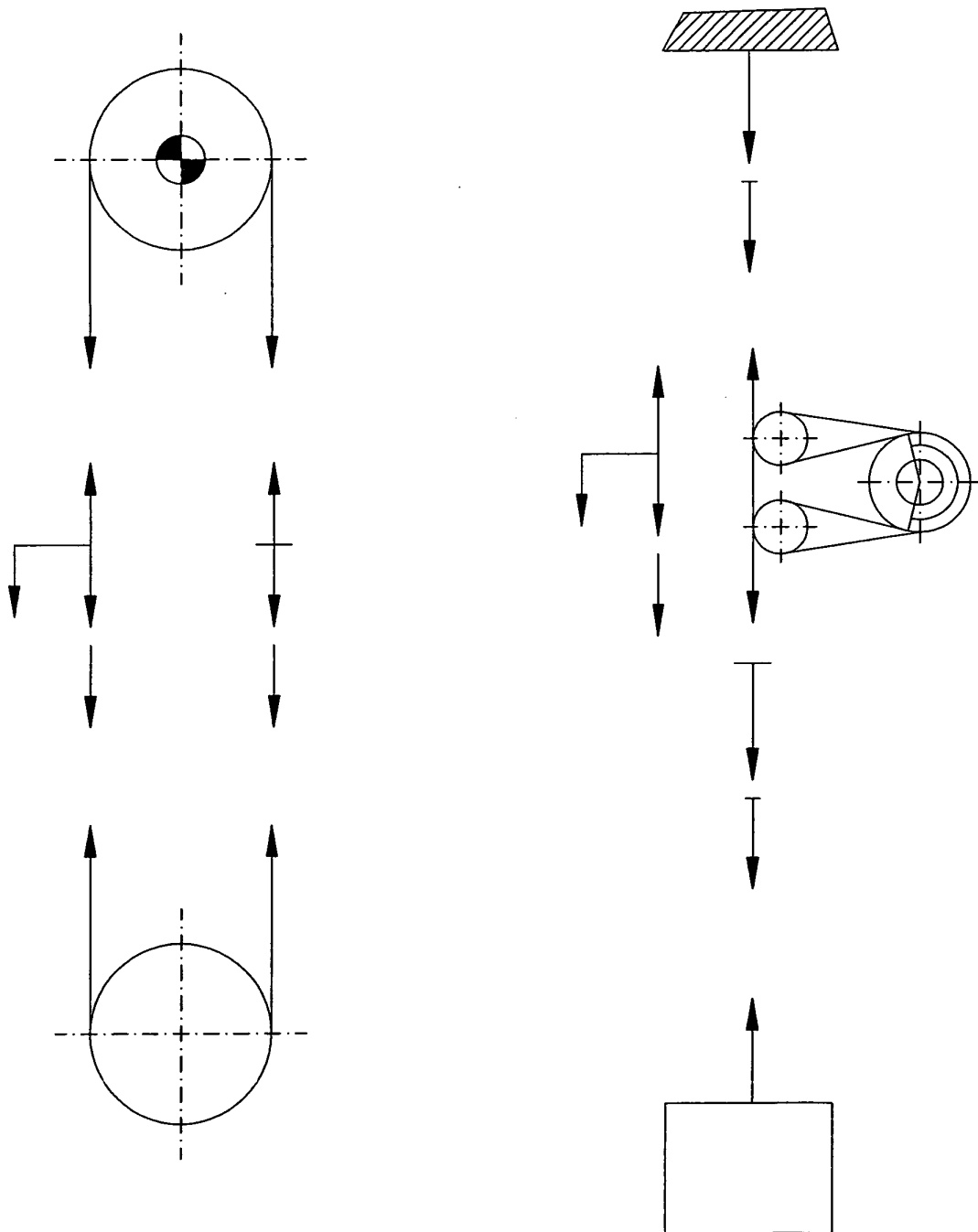


FIG. 9

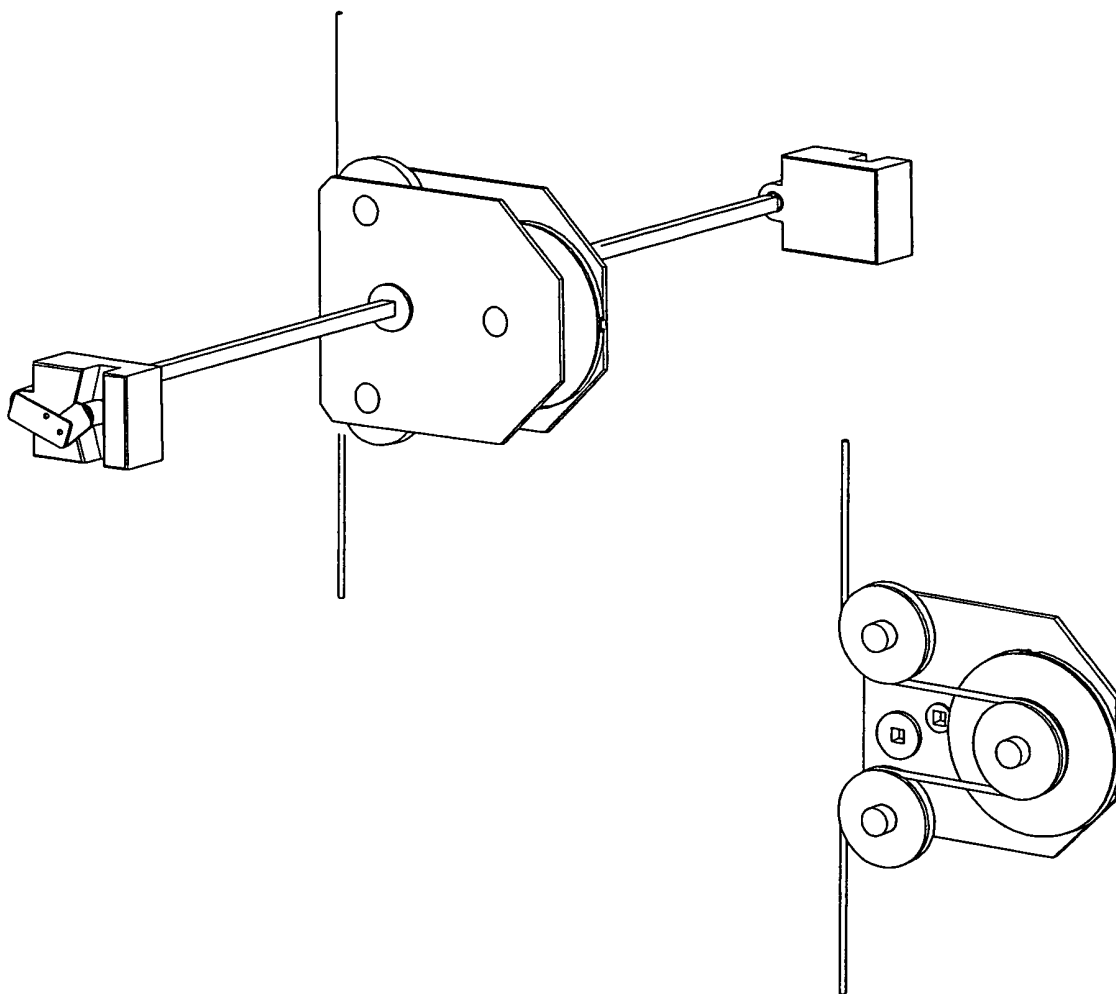


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ ES 2004/000331

A. CLASSIFICATION OF SUBJECT MATTER		
IPC 7 D07B 1/16, 1/22; B66B 7/06		
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)		
IPC 7 D07B, B66B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
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.
A	Patent Abstracts of Japan, vol 1997, num 05 (30.05.1997) & JP 9021084 A (YAMAMORI GIKEN KOGYO KK) 21.01.1997 the abstract, figures 1, 2, 4, 5, 6	1,2,5,6,10-12
A	DE 10215419 A1 (OSMA AUFZÜGE ALBERT SCHENK GmbH & CO) 30.10.2003 claims, figures 1, 2	1,2,5,6,8,9,12
A	US 4202164 A (SIMPSON et al.) 13.05.1980 column 2, lines 15-20	3,4
A	US 6364061 B2 (BARANDA et al.) 02.04.2002, column 6, lines 59-64; figure 5	7,12
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" 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) "O" document referring to an oral disclosure, use, exhibition or other means "P" 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		Date of mailing of the international search report
26 October 2004 (26.10.04)		11 NOV 2004 11. 11. 2004
Name and mailing address of the ISA/ S.P.T.O.		Authorized officer
Facsimile No.		Telephone No.

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/ES 2004/000331

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 9021084 A	21.01.1997	NONE	
DE 10215419 A1	30.10.2003	NONE	
US 4202164 A	13.05.1980	GB 2067615 AB	30.07.1981
		DE 3002405 A	30.07.1981
		AT 22080 AB	15.11.1981
		CH 644413 A	31.07.1984
US 6364061 B2	02.04.2002	WO 9943885 A	02.09.1999
		BR 9908228 A	31.10.2000
		EP 1060305 A	20.12.2000
		US 2002000347 A	03.01.2002
		US 2002000346 A	03.01.2002
		JP 2002505240 T	19.02.2002
		US 6739433 B	25.05.2004
		RU2211888 C2	02.04.2002

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

- EP 1175367 B1 [0009]
- WO 03070615 A1 [0009]
- WO 03091142 A1 [0009]
- US 645756 A [0011]
- EP 1273695 A [0013]
- WO 9942589 A [0013]
- WO 9943885 A [0013]
- WO 0037738 A [0013]
- WO 0114630 A [0013]