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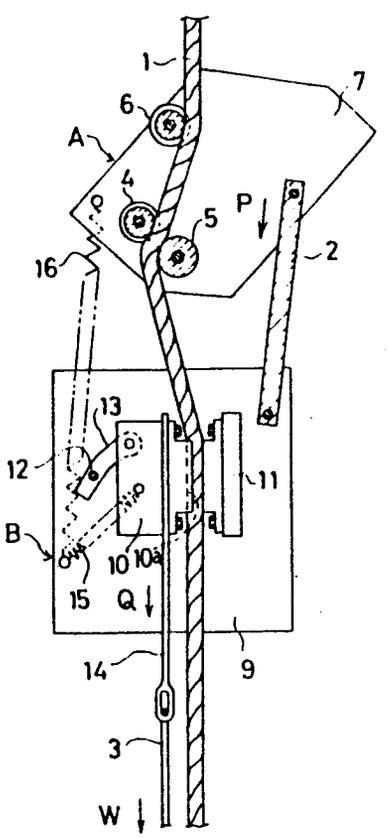
(54) **Descent device.**

(57) A descent device which, by connecting an upper descending means (A) which slides in frictional engagement with a rope (1) in a state of being bent as the descending means moves down with a tilt, and a lower descending means (B) the braking force of which increases relative to increases of load, enables a person who depends to obtain a safe, steady and smooth descending speed irrespective of differences in the body weight, without requiring him to regulate the descending speed by himself and without needing any mechanism for such operation.

FIG. 2.



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DESCENT DEVICE

The present invention relates to a descent device, for use, in an emergency, for descending from an escape opening located at an elevated position of a building.

Conventional devices of this kind consist, as is known from for instance Japan Utility Model Reg. No. 975147 (Japan Utility Model Publication No. 47-4227), essentially of a metal fixture provided at an escape opening of a building and a body which hangs down from the metal fixture when the device is to be used, the body comprising a built-in brake acting on centrifugal force and a rope passing therethrough, with hanging belts to be worn by descending persons connected to the two ends of the rope. With this conventional device, however, there reside problems in that the device is expensive because of its complicated construction and that, since the body weight varies from person to person, a person may sometimes suffer from an excessive speed or, on the contrary, it may sometimes be difficult for a person to descend smoothly.

With the above deficiencies of the conventional art in mind, the present inventor previously proposed, in Japanese Patent Application No. 60-53411, a descent device of simple construction which consists, as shown in Fig. 11 of the accompanying drawings, essentially of

a rope 1 which can be fastened to an escape opening 51 of a building 50 and a plurality of descending means 52 to which evacuees are hung through the medium of a hanging belt 53, permitting them to come down to the ground quickly one after another. The descending means 52 is, as shown in Fig. 12 of the accompanying drawings, provided with a braking mechanism consisting of a clasping plate spring body 54 which clasps the rope 1 and slides in frictional engagement therewith, or with another type of braking mechanism which regulates the rope-clasping force so as to suit the load of the descending person or object, such as a cam or lever mechanism.

With such a construction, however, wherein there is merely fitted onto the rope 1 a descending means 52 which clasps the rope and slides in frictional engagement therewith, it is not possible to satisfactorily stabilize the descending speed and there is liable to be a difference in the descending speed according to differences in the body weight of persons descending. When, in particular, a person's body weight is great, there arises a problem that the descending speed becomes too fast and it may occur that a person cannot alight on the ground in safety.

On the other hand, there are disclosed in U.S. Patent Nos. 4,474,262, 4,576,248 and 4,580,658 descent devices which are so constructed that there is provided

in the descending means a manually operable lever which clasps the rope and which regulates braking force by strengthening or weakening the clasping force, thereby permitting a person descending to regulate the descending speed by manually operating the lever.

Since, however, a descent device is for use at a time of emergency, it is extremely difficult for an evacuee to regulate the descending speed by manually operating the lever calmly and with accuracy. Therefore, safety will come into question and it may occur that due to an evacuee's mishandling of the lever, the clasping force will become too large and as a consequence he will not be able to descend, or that because of the lever being insufficiently tightly clasped there will arise the danger of an evacuee descending too fast. When, besides, there are irregularities in operation of the lever, differences arise in the largeness of clasping force, making it difficult for evacuees to descend smoothly at a steady speed.

The present invention aims to provide a descent device of simple construction which permits evacuees to descend from an elevated position of a building at a steady speed in safety.

The present invention provides a descent device which comprises a rope or the like the upper end of which is fastened at an escape opening located at an

elevated position of a building or the like, and a pair of descending means, the upper and lower, which are fitted onto the rope, the upper descending means having a plurality of rope-touching means which slide in frictional engagement with the rope in a state of being bent as the upper descending means moves down with a tilt relative to increases of load, and the lower descending means being so constructed as to increase its braking force relative to increases of load, and the lower descending means having a hanging means with which a descending person or object is to be held hanging from it, and these two units of the descending means being connected with a connecting means.

The lower descending means may be so constructed as to clasp the rope by clasping force which increases relative to increases of the load, or may be provided with a plurality of rope-touching means which slide in frictional engagement with the rope in a state of being bent as the lower descending means moves down with a tilt relative to increases of the load.

Accordingly, the upper desending means moves down with a tilt angle which becomes wider relative to increases of the load, the upper descending means being given, through the action of the said rope-touching means of bending the rope and by virtue of tension of the rope, a frictional resistance countering the said load. Therefore, when the weight of a person descending

(or the load of a descending object) is greater, the load working on the upper descending means becomes greater and the tilt angle of the upper descending means becomes wider, and hence the aforesaid frictional resistance becomes greater. When, on the contrary, the weight of a descending person is smaller, the aforesaid load becomes smaller and the tilt angle of the upper descending means becomes narrower, and hence the aforesaid frictional resistance becomes smaller.

With the lower descending means, on the other hand, it may clasp the rope by a clasping force which increases relative to increases of the load, or a plurality of rope-touching means provided therein may slide in frictional engagement with the rope in a state of being bent as it moves down with a tilt relative to increases of the load; and, by virtue of such actions, there is given, in either case, a frictional resistance countering the aforesaid load in the same manner.

The present inventor conducted an experiment using only one separate unit, the upper or lower respectively, of the pair of descending means. As a result, it was found that, in either case, perfect safety could not be ensured with a single unit, the descending means sometimes coming to a stop halfway or, on the contrary, sometimes coming down at an excessive speed. Thereupon, the inventor conducted a further experiment using a device consisting of the aforesaid upper descending

means and the aforesaid lower descending means connected together with a connecting means, as disclosed in the present invention. As a result, it was ascertained that the descent device of the invention permits a smooth and safe descent at a steady descending speed.

The reason for this is presumed to be as follows. That is, while the load of a person, or an object, descending with the device, which works on the hanging means, is distributed to the upper and lower units of the descending means through the medium of the connecting means, the difference in braking force between the two units of the descending means, corresponding to the ratio of distribution of the aforesaid load, fluctuates moment by moment in the course of descent. Accordingly, there is kept a balance of forces between the two units of the descending means as a whole, the two units mutually regulating the descending speed. Thus, a person using the device is enabled to descend smoothly and in safety at a steady descending speed, without regulating the descending speed by manual operation in the course of descent.

Another advantage of the present invention is that the descent device is of a simple structure, because it can be composed by merely connecting a pair of descending means, the upper and lower, with a connecting means, without requiring a manually-operated lever, or the like, for regulating the descending speed.

The invention will be further described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal, sectional side view of a first embodiment of a descent device of the present invention;

Fig. 2 is a longitudinal, sectional side view showing the action of the descent device of Fig. 1;

Fig. 3 is a transverse sectional view taken along the line III-III of Fig. 1;

Fig. 4 is a transverse sectional view taken along the line IV-IV of Fig. 1;

Fig. 5 is a longitudinal, sectional side view of a second embodiment of a descent device of the present invention;

Fig. 6 is a longitudinal, sectional side view showing the action of the descent device of Fig. 5;

Figs. 7, 8, 9 and 10 are longitudinal, sectional side views of other types of descent devices of the invention;

Fig. 11 is a side view showing a descent device of the prior art; and

Fig. 12 is a longitudinal, sectional side view of an essential part of the device shown in Fig. 11.

Figs. 1 to 4 show a first embodiment of a descent device of the present invention which consists essentially of a rope 1 the upper end of which is

fastened to an opening for escape 51 located at an elevated position of a building 50 or the like (see Fig. 11), a pair of descending means A and B (the upper and lower) which are fitted onto the rope 1, the upper descending means A and the lower descending means B being connected with a connecting rod (connecting means) 2, and a hanging belt (hanging means) 3 fitted to the lower descending means B for holding a person or an object descending hung therefrom. In this embodiment of the invention, the upper descending means A is provided with a pair (left and right) of braking rods (rope-touching means) 4 and 5, as well as with an upper braking rod (rope-touching means) 6; and the lower descending means B is so constructed as to clasp the rope 1 by a clasping force which increases relative to increases of load Q.

In the upper descending means A, there are disposed at a lower position inside a casing consisting of a pair of side plates 7 the left braking rod 4 and the right braking rod 5 in confronting relation, with the rope 1 inbetween, while at the upper position, on the left side, inside the casing, there is disposed the upper braking rod 6. The left braking rod 4 is provided with a guide groove 4a, and is fastened between the pair of side plates 7 with a bolt 8a and a nut 8b. While the right braking rod is not provided with a guide groove, it is also fastened between the pair of side plates 7

with a bolt 8a and a nut 8b in the same manner as the left braking rod 4. The upper braking rod 6 is provided with a guide groove 6a, and is fastened between the pair of side plates 7. While these braking rods 4, 5 and 6 constitute the rope-touching means in this embodiment of the invention, other types of rope-touching means, for example pads, may also be adopted. It may be added that the upper braking rod 6 is so disposed as to be kept apart from the rope 1, to the left of it, when a load P is not being exerted on the upper descending means A.

The lower descending means B is disposed underneath the upper descending means A. In this lower descending means B, there are disposed in a casing consisting of a pair of side plates 9 a movable friction plate 10 and a fixed friction plate 11. The movable friction plate 10 is connected, with a pin, to the end of a lever 13 which swings on a pivot 12, and is provided with a fitting means 14 to which a hanging belt 3 is to be fitted. On the braking surface of the movable friction plate 10 is formed a guide groove 10a; and the rope 1 is firmly embraced between this guide groove 10a and the braking surface of the fixed friction plate 11. Further, the movable friction plate 10 is given, by a pull spring 15, a force which acts to draw it nearer in the direction of the fixed friction plate 11. This movable friction plate 10 is so constructed that, when a load Q acts on

it, as illustrated in Fig. 2, it moves in the direction of the fixed friction plate 11, thereby exerting frictional braking force on the rope 1.

The upper descending means A and the lower descending means B are connected with a connecting rod 2. Further, the two descending means A and B are also connected with a spring 16, thereby preventing the upper descending means A from tilting more than is necessary, as illustrated in Fig. 2.

The descent device described above is used as follows.

When it has become necessary to escape from an opening 51 of a building for such reasons as the breakout of a fire, an evacuee hangs down the rope 1 from the escape opening 51 along the exterior wall of the building, fits the hanging belt 3 onto his body and descends along the rope 1. At this time of descent, the load W, that is the evacuee's weight, is distributed to the upper descending means A as the load P, and the lower descending means B as the load Q, through the medium of the connecting rod 2, and such divided loads act on the respective descending means A and B, as illustrated in Fig. 2.

Firstly, in the lower descending means B, the movable friction plate 10 draws nearer to the fixed friction plate 11 as the load Q works on it, thereby pressing the rope 1 inbetween. By virtue of this

clasping force and tension of the rope 1, there is produced a braking force countering the load Q, and the lower descending means B descends slidingly in frictional engagement with the rope 1. The greater the load Q, the larger will be said braking force.

At the same time, a portion of the load W works on the upper descending means A, as the load P, through the medium of the connecting rod 2, and declines it, as it slides down, in the clockwise direction in Figs. 1 and 2. With this tilt of the upper descending means A, as it slides down, the pair of left and right braking rods 4 and 5 cause the rope 1 to bend; and, simultaneously, the upper braking rod 6 comes into close contact with the rope 1 and bends it. By virtue of the bends of the rope 1 caused by these braking rods 4, 5 and 6, and of tension of the rope 1, there is generated frictional resistance which counters the load P, thereby imparting braking force to the descent device with which a person descends from an altitude.

Since, as described in the foregoing, each of the descending means A and B respectively slides in frictional engagement with the rope, a person may descend smoothly at a steady speed. When there is a difference in the load W (there are, naturally, heavy-weight persons and light-weight persons), the difference in braking force between the descending means A and B, relative to the ratio of distribution of the

load W between the two descending means A and B, fluctuates moment by moment in the course of descent, and there is maintained a balance of forces between the two units of the descending means as a whole, thereby permitting a person using the device to descend in a stabilized state, while ensuring a virtually constant and safe descending speed in either case.

Figs. 5 and 6 show a second embodiment of a descent device of the present invention. An upper descending means C and a lower descending means D, which are fitted onto the rope 1, are both provided with rope-touching means which slide in frictional engagement with the rope 1 in a state of being bent when they move down with a tilt. Since the construction of both the descending means C and D is essentially the same as that of the upper descending means A in the first embodiment of the invention, other details of the construction being the same as in the first embodiment, numbers and symbols common with those in the first embodiment are used in Figs. 5 and 6, and detailed description is not necessary. It is to be noted, however, that in the lower descending means D, there is disposed underneath the pair of left and right braking rods 4 and 5 an auxiliary braking rod 28 which is not provided in the upper descending means A in the first embodiment of the invention. When, in the initial stage of descent for instance, the effect of tilting of the lower descending

means D, namely the braking effect, is not sufficient, the auxiliary braking rod 28 cooperates with the pair of left and right braking rods 4 and 5 in bending the rope 1, thereby ensuring that there is produced a braking force required for safe and smooth descent.

In this embodiment of the invention, the ratio of distribution of the load W between the two descending means C and D, and the difference in tilt angle between the two descending means C and D, fluctuates moment by moment in the course of descent, and permits a person to descend in a balanced state as a whole. Consequently, heavy-weight and light-weight persons are likewise ensured a smooth descent at a safe speed.

The present invention may be embodied in various modes of construction other than those indicated in the above first and second embodiments.

As for descending means which slide in frictional engagement with a rope in a state of being bent as it slides with a tilt, there may for example, be employed the descending means E shown in Fig. 7. This descending means comprises a pair of left and right pin means (rope-touching means) 18 and 19, with the rope 1 inbetween, disposed inside a casing consisting of a pair of side plates 17, and brake pads 20 and 21 disposed respectively to the upper left of the left pin means 18 and to the lower right of the right pin means 19. By virtue of this construction, even when the tension of

the rope 1 is not sufficient, as in the initial stage of descent for instance, the brake pads 20 and 21 come into contact with the rope 1 as the descending means E moves with a tilt, as illustrated in Fig. 7, thereby ensuring that the required braking force is obtained. Such a construction is also effective in obtaining sufficient braking force when a person of especially heavy weight descends with the device.

In the case that a light-weight person cannot descend smoothly owing to an excessive braking force working for his weight, the descending means may be as described in the following. That is, as shown in Fig. 8, a descending means F is provided with a compensating ring 22 fitted round the rope 1 in such a manner that it can move both ways along an arched guide groove 24 formed at the upper part of a casing consisting of side plates 23 of the descending means, and between this compensating ring 22 and a spring fixture 25 disposed at the upper right-hand corner of the casing there is fitted a pull spring 26 to place restraint on tilting movement of the descending means F, thereby lowering the braking force.

On the other hand, as for descending means which clasp the rope with a clasping force increasing relative to increases of the load, there may for example be employed the descending means G shown in Fig. 7. This descending means comprises a movable pad 32 and a fixed

pad 33 disposed in confronting relation, with the rope 1 inbetween, inside a casing consisting of a pair of side plates 31, the upper end of a hanging means 3 being fitted onto the movable pad 32. The movable pad 32 is provided with a holding pin 34 which protrudes from both its sides, being engaged with inclined guide grooves 35 formed in the side plates 31. When the movable pad 32 receives a downward force, it is pressed against the rope 1, drawing nearer to the fixed pad 33. Further, the sliding surfaces of these pads 32 and 33 are coated with lining material 36 having a large coefficient of friction and a good abrasion resistance.

Still further, the pair of upper and lower descending means E and G, as shown in Fig. 7, are connected with a connecting rope (connecting means) 37. When connected with a rope 37 like this, it is possible to make a descent flexibly adapting the movement to the bending of the rope 1; and, besides, it affords convenience for the fitting of the descending means on the rope and their removal, as well as for the carriage and storing of them. Also, this connecting rope 37 is disposed sideways from the rope 1 by passing it through a hole 27a provided near the end of a guide means 27 in the shape of a half-inverted letter L which is connected to the lower descending means G, the guide means 27 being movably fitted on the rope 1 above the lower descending means G.

A descending means H as shown in Fig. 9 is constructed in such a manner that the rope 1 passed through rope-passing holes 39 of a body 38 of the descending means is pressed against the wall of the body 38 by a plate spring 40, and the back of that part of the plate spring 40 which is in contact with the rope 1 is pressed with a lever 41, the weight-applying end of which being connected, through the medium of a link 42, with a connecting ring 43 for hanging a means for holding a person, or an object, descending, thereby to increase pressure on the rope 1 in proportion to increases of the weight of the descending persons or objects.

Furthermore, a descending means I as shown in Fig. 10 is constructed in such a manner that the rope 1 passed through rope-passing holes 45 of a body 44 of the descending means is pressed against the wall of the body 44 by a cam 47 mounted on a cam shaft 46, to which cam shaft 46 is fastened a fan-shaped sheave 48, and to which fan-shaped sheave 48 is fastened an end 49a of a pull rope 49, the pull rope 49 being led out of the body 44 through a groove of the sheave 48, and the other end 49b of the pull rope 49 being so tied as to form a connecting ring 50 for hanging a means for holding a person, or an object, descending.

CLAIMS:

1. A descent device, characterized by comprising: a rope (1) or the like the upper end of which is fastened at an escape opening located at an elevated position of a building or the like, and a pair of upper (A; C; E; F) and lower (B; D; G; H; I) descending means fitted onto the said rope, the upper descending means having a plurality of rope-touching means (4, 5, 6; 18, 19) which slide in frictional engagement with the rope in a state of being bent as the upper descending means moves down with a tilt relative to increases of load, and the lower descending means being so constructed as to increase its braking force relative to increases of the load, and the lower descending means having a hanging means (3) with which a person or an object descending is to be held hanging from it, and a connecting means (2; 37) connecting the said upper and lower descending means.

2. A descent device as claimed in claim 1, characterized in that, beneath a rope-touching means disposed on the side where there is a connecting means which connects the two descending means, and above a rope-touching means on the opposite side, there are respectively provided a braking pad.

3. A descent device as claimed in claim 1 or 2, characterized by a compensating ring (22) fitted round the rope, being movably supported by an arched guide grove (24) formed at the upper part of the descending

means, with a pull spring (26) fitted between the said compensating ring and a spring fixture (25) disposed at an upper corner of the descending means.

4. A descent device, characterized by comprising: a rope (1) or the like the upper end of which is fastened at an escape opening located at an elevated position of a building or the like, and a pair of upper (C) and lower (D) descending means fitted onto the said rope, both said descending means having a plurality of rope-touching means (4, 5, 6) which slide in frictional engagement with the rope in a state of being bent as the two descending means move down with a tilt relative to increases of load, the lower descending means having a hanging means (3) with which a person or an object descending is to be held hanging from it, and a connecting means (2) connecting the said upper and lower descending means.

5. A descent device as claimed in claim 4, characterized in that, beneath a rope-touching means disposed on the side where there is a connecting means which connects the two descending means, and above a rope-touching means on the opposite side, there are respectively provided a braking pad.

6. A descent device as claimed in claim 4 or 5, characterized by a compensating ring (22) fitted round the rope, being movably supported by an arched guide groove (24) formed at the upper part of the descending

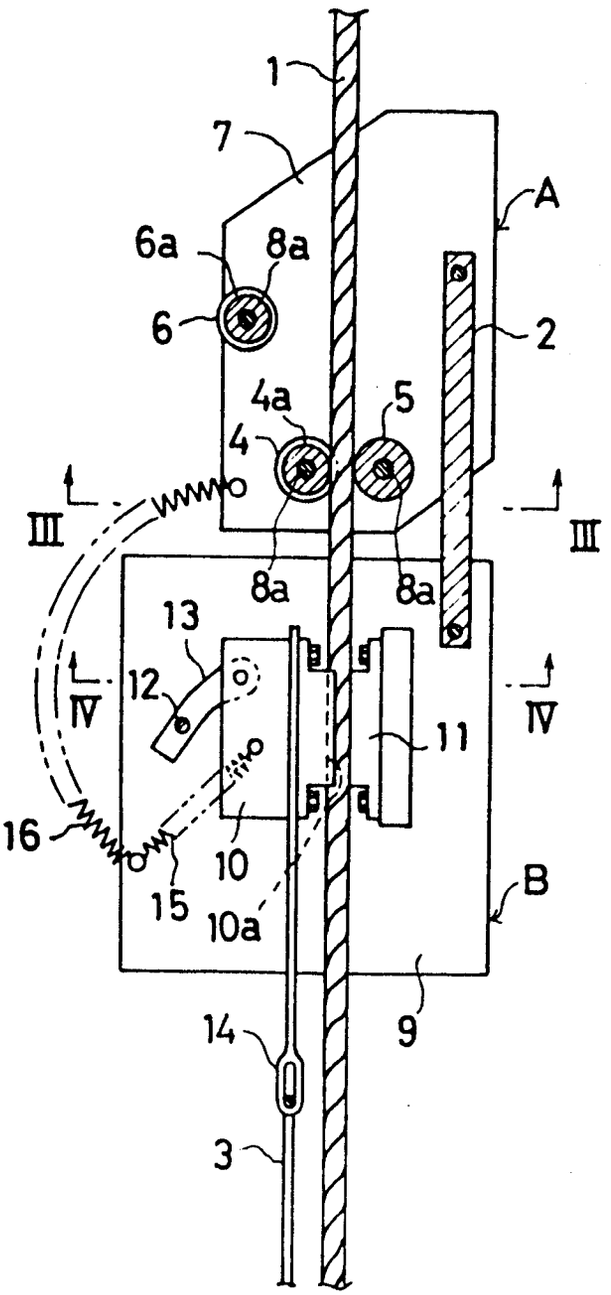
means, with a pull spring (26) fitted between the said compensating ring and a spring fixture (25) disposed at an upper corner of the descending means.

7. A descent device, characterized by comprising: a rope (1) or the like the upper end of which is fastened at an escape opening located at an elevated position of a building or the like, and a pair of upper and lower descending means fitted onto the said rope, the upper descending means having a plurality of rope-touching means which slide in frictional engagement with the rope in a state of being bent as the upper descending means moves down with a tilt relative to increases of load, and the lower descending means being so constructed as to clasp the rope by clasping force which increases relative to increases of the load, and the lower descending means having a hanging means (3) with which a person or an object descending is to be held hanging from it, and a connecting means connecting the said upper and lower descending means.

8. A descent device as claimed in claim 7, characterized in that, beneath a rope-touching means disposed on the side where there is a connecting means which connects the two descending means, and above a rope-touching means on the opposite side, there are respectively provided a braking pad.

9. A descent device as claimed in claim 7 or 8, characterized by a compensating ring (22) fitted round the rope, being movably supported by an arched guide groove (24) formed at the upper part of the descending means, with a pull spring (26) fitted between the said compensating ring and a spring fixture (25) disposed at an upper corner of the descending means.

FIG.1.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5
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III
III
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10
15
10a
B
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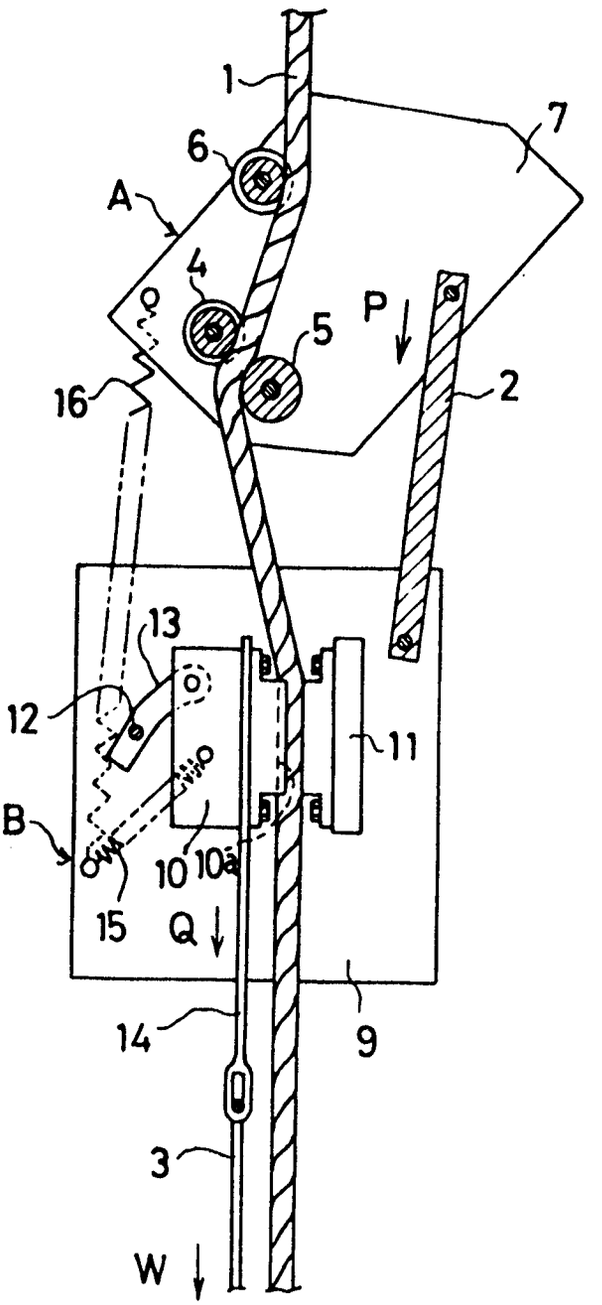
3

FIG. 2.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W

FIG. 3.

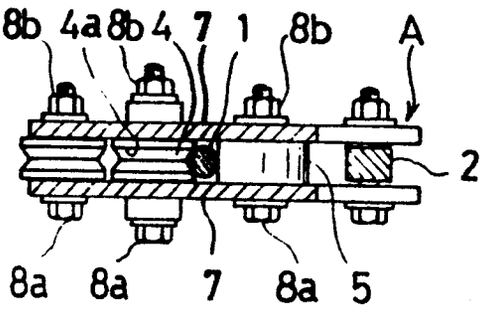
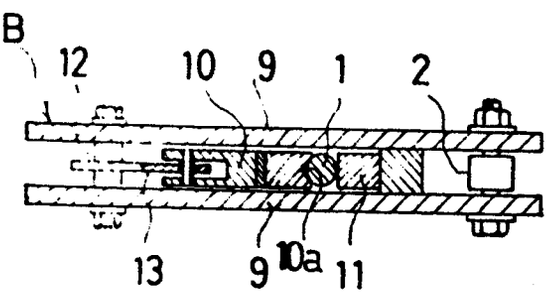


FIG. 4.



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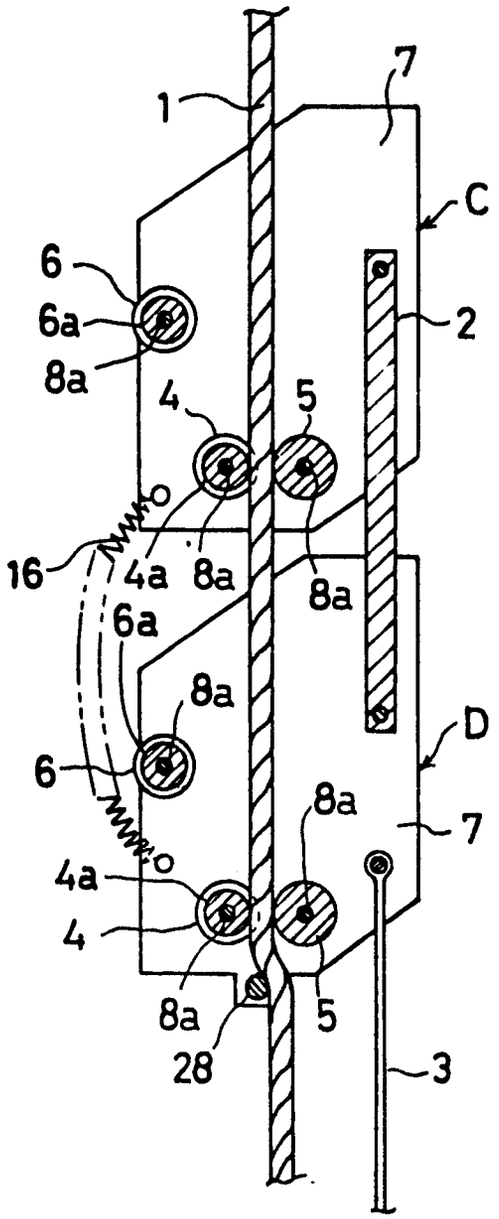
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FIG.6.

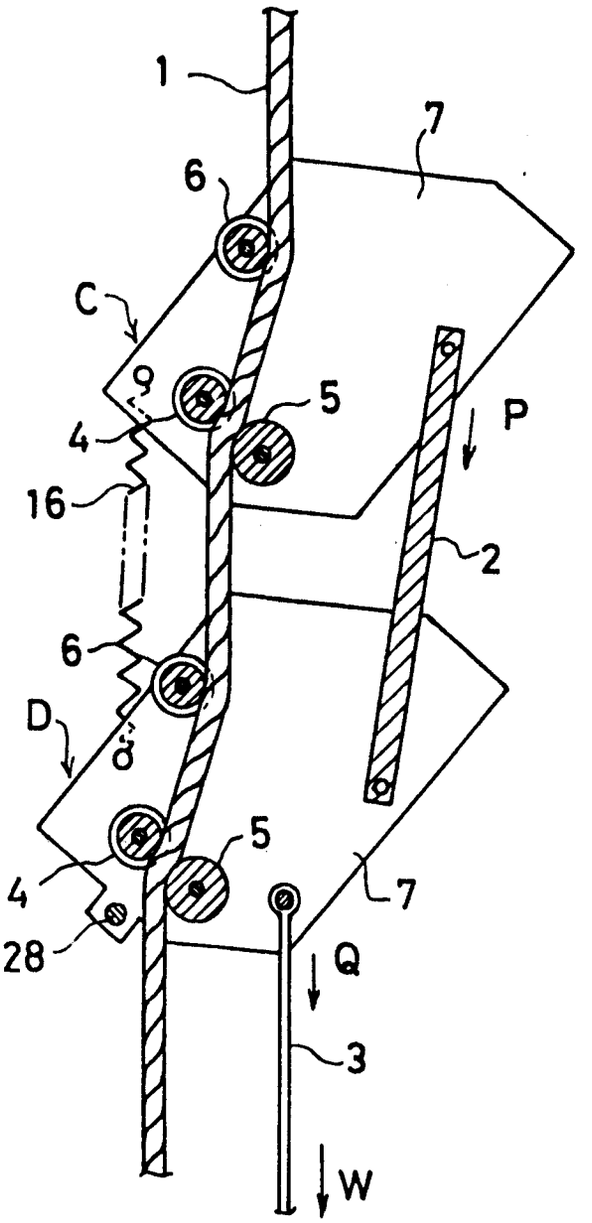
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FIG.7.

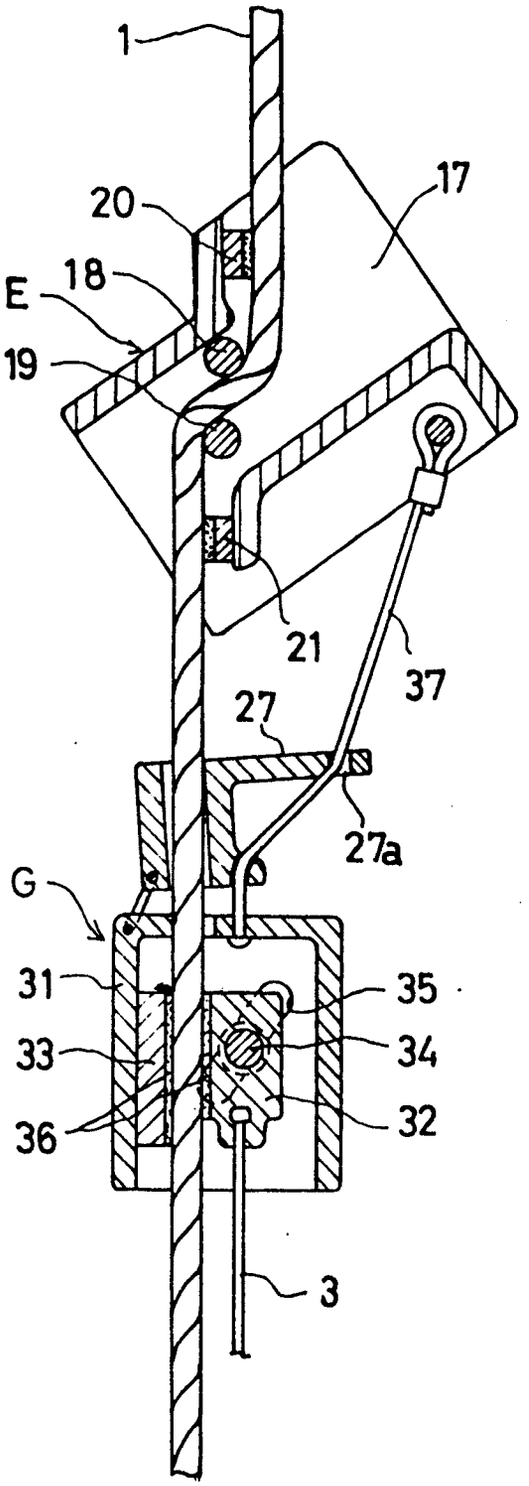


FIG.8.

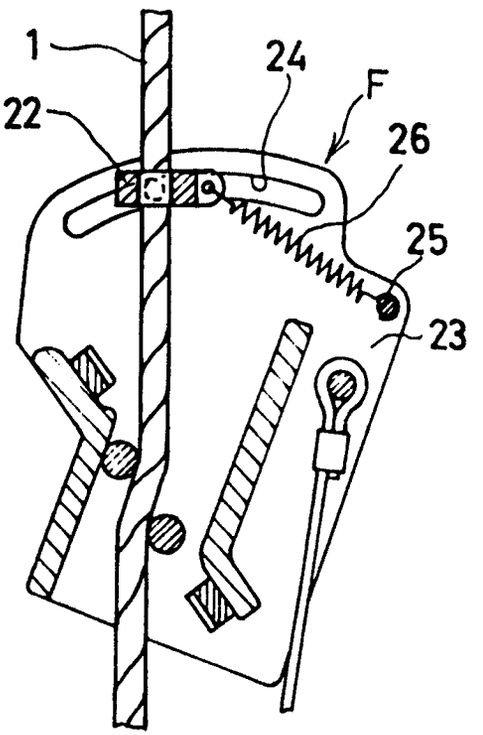


FIG.9.

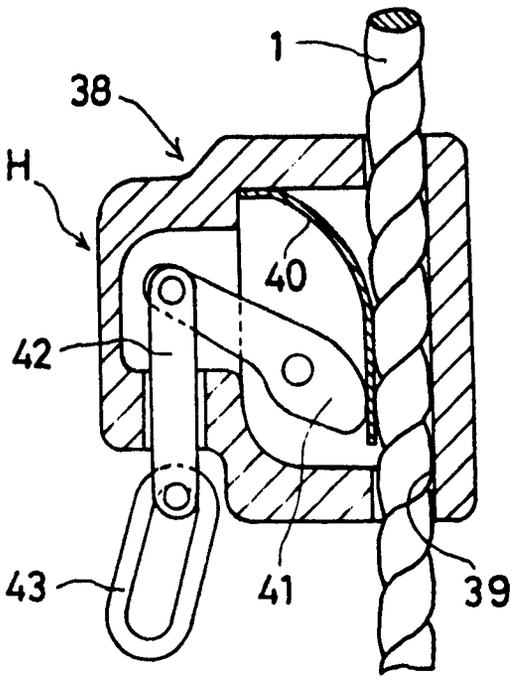


FIG.10.

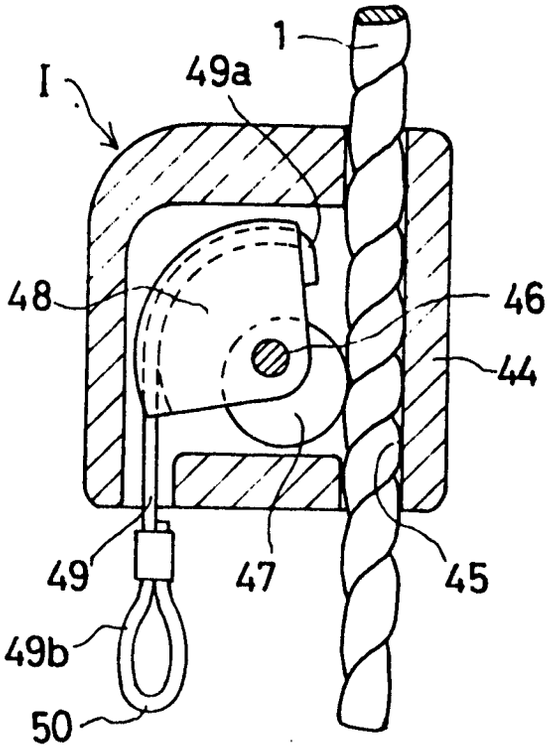


FIG. 11.

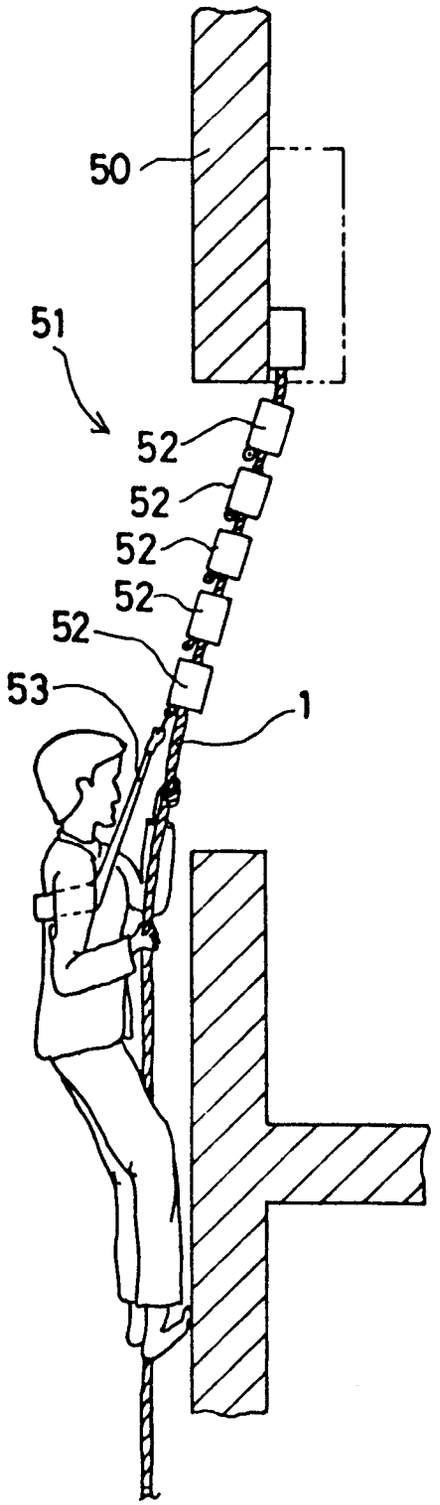
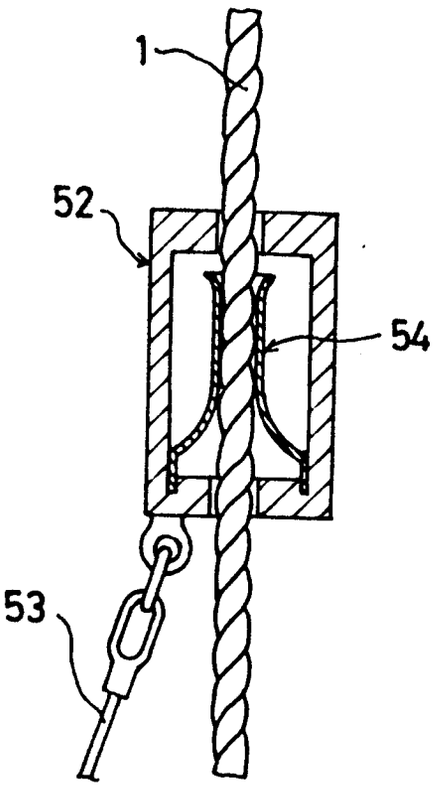


FIG. 12.



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EUROPEAN SEARCH REPORT

0220070
Application number

EP 86 30 8077

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
A	FR-A-2 304 564 (BUGAT et TERRE)		A 62 B 1/14 A 63 B 29/02
A	FR-A-1 429 441 (B. DRESSLER)		
A	CH-A- 526 308 (OTTO BRDA)		

TECHNICAL FIELDS SEARCHED (Int Cl 4)

A 62 B
A 63 B
B 66 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-01-1987	WOHLRAPP R.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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