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(54) **SAFETY BRAKE FOR ELEVATOR, LIFTING DEVICE INCLUDING SAFETY BRAKE, AND METHOD FOR BRAKING A LIFTING DEVICE BY SAID SAFETY BRAKE**

(57) The present invention relates to a safety brake for an elevator and provides an alternative solution with respect to current elevator parachute electronic activation systems, without the need to incorporate a speed limiter, standing out for its reliability, robustness and applicability. Furthermore, the present invention also stands out for its great simplicity, reducing the number of components to a minimum, while also constituting a low energy consumption solution, thus minimizing associated costs.

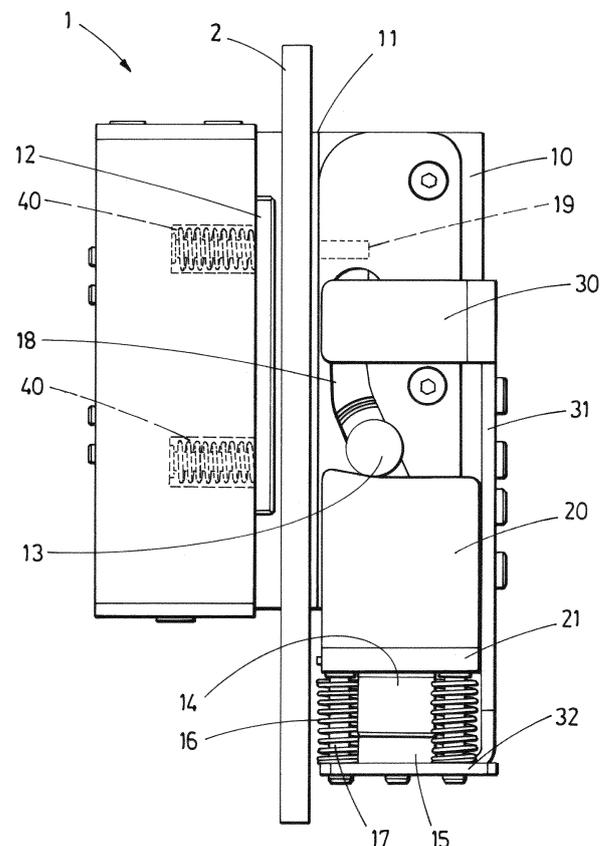


FIG.1

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Description

OBJECT OF THE INVENTION

[0001] The present invention belongs to the field of elevators, and more specifically to safety devices for elevators that act between the car and the elevator guiding elements, exerting friction braking.

[0002] The object of the present invention is a safety brake for an elevator, a lifting device comprising the safety brake, and a method of braking a lifting device by means of said safety brake.

BACKGROUND OF THE INVENTION

[0003] At present, the safety systems responsible for braking elevators in case of different events or events recognized as "emergency situations" are widely known, said safety systems also known as "parachutes".

[0004] More particularly, these safety systems consist of braking devices used to brake an elevator car, for those cases in which it reaches high speeds, which may occur, for example, due to defects in the control or actuation of its brake, due to breaks and sags in the cable, etc. Emergency braking devices are also used to prevent uncontrolled movements of the car, such as slow sliding out of the stop position. They can also be activated to lock the car in a certain position, such as, for example, for the temporary protection of the safety space during the performance of inspection or maintenance tasks of the elevator by qualified technical personnel.

[0005] One of the key elements of the safety systems is the actuator installed in the elevator car, which, tied to the chassis of the traveling assembly, is in charge of braking said traveling assembly in an emergency situation. Specifically, the parachute has the functions of allowing a safe operation of the elevator in the event of any risk event detected by the positioning system, having to guarantee a braking of the elevator, as a conventional wedging.

[0006] Traditionally, the activation of these safety systems or parachute has been carried out through the use of a speed limiter, which, in case of detecting an excess of speed, is blocked and causes the activation of said parachute, as described for example in European patents EP2408701B1 and EP2490971B1.

[0007] However, other solutions are currently emerging, configured to work without the need to incorporate a speed limiter, using electronic means to detect emergency situations. This leads to the need to use a parachute that is electronically activated, to work together with said electronics.

[0008] Indeed, the use of electronics in the technical field of safety systems for lifts is becoming more and more frequent. Thus, these electronic security systems can be classified into two types: a) those of the active type, which require an energy supply for positive activation of the security mechanism; and b) those of the passive type,

which require the contribution of power to keep the safety system in a retention operating state.

[0009] In this sense, although passive security systems offer an increase in functionality, they present the great disadvantage of needing a continuous power supply to be operational, with the increase in energy expenditure that this implies, thus increasing the operating costs of the machine. In addition, these passive systems generally have larger components due to the high power requirements during operation, which negatively affects the overall size, weight and efficiency of the machine.

[0010] In the current state of the art, some safety systems for elevators are known that manage to dispense with the speed limiter, such as the PCT international patent application with publication number WO2017 / 098299 A1. This application describes a wedging system for elevators, which includes a locking mechanism that can be an electromagnetic element, a first element with two positions and a second element with two other positions, with direct contact between both elements, at least in their first operating state, and after disengagement, as shown in Figures 6A, 6B and 6E of said PCT application. Furthermore, the system incorporates a reset mechanism, configured in the form of an electric piston or cylinder, to force the passage of the first element from a first state to a second state. Thus, under a certain condition, the safety chain opens, the locking mechanism releases the first element and it moves to its second position, pushing the second element with it, which in turn drags the braking element. Once all the elements are in the second position, the reset mechanism acts on the first element and returns it to its first position. In this way, the locking mechanism can retain said first element. When the device is disengaged the second element falls on the first element.

[0011] Therefore, the structural complexity of this type of known systems is noteworthy, wherein due to the large number of existing elements and mechanisms (resetting, blocking, guides, chambers, connecting rod, etc.), problems due to failures and breakdowns are multiplied, reducing their reliability and robustness, and thereby increasing repair, maintenance and / or replacement of parts, with the consequent economic cost that all this implies.

DESCRIPTION OF THE INVENTION

[0012] By means of the present invention an alternative solution is provided with respect to the current electronic activation systems for elevator parachutes, without the need to incorporate a speed limiter, standing out for its reliability, robustness and applicability, the invention being applicable to all types of elevators, provided that they have electronic means to activate the parachute. In addition to the above, the present invention also stands out for its great simplicity, reducing the number of components to a minimum, while constituting a low energy consumption solution, thus minimizing associated costs.

[0013] According to a first object of the invention, the invention refers to a safety brake for an elevator, the elevator having a movable car through a vertical guide. Specifically, the safety brake comprises a wedging block that can be coupled to the elevator car; a shoe attached to the wedge block; a braking element with two positions, an initial rest position and an active position, wherein said braking element is located between the wedging block and the vertical guide, such that when an emergency situation occurs said braking element simultaneously contacts the wedging block and the vertical guide in their active position, causing a safety braking of the elevator; an electrically powered activation element for activating and deactivating the safety brake.

[0014] Furthermore, the safety brake of the invention comprises a first element located in a lower position with respect to the braking element, said first element being vertically movable with respect to the wedging block, wherein the first element has two positions, a first rest position and a second active position, wherein in the event of a power failure of the activation element, a vertical movement of the first element to its second active position occurs, pushing and in turn moving the braking element from its initial rest position to its active position. In said active position of the braking element, it reaches a point such that autonomous emergency braking is ensured, that is to say, from this point on it is no longer necessary to push the braking element further by means of the first element.

[0015] On the other hand, the safety brake described herein also comprises a second element located in a higher position with respect to the braking element, wherein the second element has two positions, a first rest position and a second active position, wherein said second element is movable vertically with respect to the wedging block, such that in the second active position of the second element and the first element in its second active position, the activating element simultaneously contacts the first element and the second element, leaving the vertical guide trapped between the braking element and the shoe, generating a maximum braking force of the elevator.

[0016] In this way, a resettable electronic activation parachute is provided in a simple and effective way under the condition of wedging, being a reliable and robust solution, as well as simple and involving low energy consumption.

[0017] Preferably, both the first element and the second element are movable only in the vertical direction.

[0018] According to a preferred embodiment, the activation element is integrally attached to the first element, such that both elements are in physical contact at all times, regardless of the rest or active position in which the first element and the second element are

[0019] According to another preferred embodiment, the activation element is integrally attached to the second element, such that in the first rest position the first element is in physical contact with the activation element,

and wherein in the event of a power failure of the activation element, the contact between both elements, activation element and first element, is lost. Preferably, this integral connection between the activation element and the second element includes an elastic element with compression capacity, said elastic element allowing absorbing the existing deformations between the first element and the activation element.

[0020] According to a second object of the invention, a lifting device comprising the elevator safety brake, described above, will be described below.

[0021] According to a third object of the invention, a braking method of a lifting device is described, by means of the safety brake described above. This method will be described later in detail with reference to the figures, to facilitate their follow-up and understanding by the reader.

DESCRIPTION OF THE DRAWINGS

[0022] To complement the description that is being made and in order to help a better understanding of the features of the invention, according to a preferred example of a practical embodiment thereof, a set of drawings is attached as an integral part of said description in which, for illustrative and non-limiting purposes, the following has been represented:

Figure 1.- Shows a front view of the safety brake of the present invention.

Figure 2.- Shows a perspective view of the safety brake object of the invention.

Figure 3.- Shows a side perspective view of the safety brake object of the invention, where the special configuration of the second element can be seen.

Figures 4A - 4E.- Show the different steps of the braking method of the present invention.

PREFERRED EMBODIMENT OF THE INVENTION

[0023] An example of a preferred embodiment is described below with reference to the figures cited above, without limiting or reducing the scope of protection of the present invention.

[0024] Figure 1 shows the safety brake (1) of the invention according to a possible preferred embodiment. Thus, this safety brake (1) is applicable to all types of elevators equipped with electronic means for activating the parachute, without the need to include any speed limiter, with the elevators having a car movable through a vertical guide (2), said vertical guide (2) being housed in a central rail (11), as shown in figure 1. More specifically, the safety brake (1) comprises:

- a wedging block (10) attachable to the elevator car;
- a shoe (12) attached to the wedging block (10);

- a braking element (13) which in the present embodiment is a roller, having two positions, an initial rest position and an active position, wherein said braking element (13) is located between the wedging block (10) and the vertical guide (2), such that when an emergency situation occurs said braking element (13) simultaneously contacts the wedging block (10) and the vertical guide (2) in their active position, causing a safety braking of the elevator;
- an activation element (14), such as an electromagnet, electrically powered for activating and deactivating the safety brake (1);
- an elastic element (15), such as a rubber, attached to the activation element (14), said elastic element (15) being located, in the example of this embodiment, in a lower position with respect to the activation element (14), as shown in Figures 1, 2 and 4;
- first compression springs (16) configured to push the first element (20) in a vertical upward movement,
- a first element (20) located in a lower position with respect to the braking element (13), as shown in figure 1, said first element (20) being vertically movable with respect to the wedging block (10), and
- a second element (30) located in an upper position with respect to the braking element (13), said second element (30) being vertically movable with respect to the wedging block (10), and
- second compression springs (40) configured to push the shoe (12) and exert a force against the vertical guide (2).

[0025] With respect to the first element (20), it has two positions, a first rest position, shown in Figures 1 and 4A, and a second active position, shown in Figure 4B, wherein in the event of a power failure of the activation element (14) there occurs a vertical movement of the first element (20) to its second active position, pushing and moving the braking element (13) from its initial rest position to its active position in which the actuation of said braking element (13) becomes autonomous, that is, from this point on it is no longer necessary to continue pushing the braking element (13) by means of the first element (20).

[0026] For its part, with respect to the second element (30), it also has two positions, a first rest position, shown in figure 4A, and a second active position, shown in figure 4D, wherein said second element (30) is vertically movable with respect to the wedging block (10), such that in its second active position and the first element (20) being in its second active position, the activation element (14) simultaneously contacts the first element (20) and the second element (30), in the preferred embodiment of figure 4D through the intermediate elastic element (15). In this way, as can be seen in figure 4D, the vertical guide (2) is trapped between the braking element (13) and the shoe (12), generating a maximum braking force for the elevator.

[0027] According to the present preferred embodiment, the activation element (14) is integrally connected

to the second element (30), such that in the first rest position the first element (20) is in physical contact with the activation element (14), and where in the event of a power failure of the activation element (14), the contact between both elements, the activation element (14) and the first element (20), is lost, as shown in Figures 4A and 4B. This special arrangement is not trivial or random, but allows a well-identified double objective to be obtained:

- avoid increasing the force of the first springs (16);
- avoid increasing the size of the activation element (14) and consequently its electrical consumption, due to the fact of having to drag its weight.

[0028] As can be seen in Figures 1 and 4A, in the rest position of the first element (20), the activation element (14) is configured to exert a force of attraction between the first element (20) and the second element (30), wherein said force of attraction is greater than the force exerted by the first compression springs (16). This allows the activation element (14) to remain in contact with the first element (20) during the rest position of the first element (20), the normal operating state of the elevator.

[0029] On the other hand, in the preferred embodiment of Figures 2 and 3 it can be seen that the first element (20) is a metal sheet in an "L" configuration, such that it has a lower horizontal base (21) in contact with the activation element (14) in the rest position. This particularity of the first element (20) makes it possible to obtain a double functionality through a single piece, since at the same time that said first element (20) pushes the braking element (13), it is also possible to keep the latter in its position with respect to the activation element (14). Furthermore, this preferred embodiment of the first element (20) also has the advantage of being cheap and simple to manufacture.

[0030] For its part, the second element (30) is a metal sheet that has at least two folded sections, a vertical lateral surface (31) and a horizontal lower surface (32) preferably located in contact with the elastic element (15), as shown in figure 2. More particularly, in figure 3 it is observed that the vertical lateral surface (31) has screws (33) for guiding and moving the second element (30) through vertical grooves (34). Therefore, by means of this particular embodiment of the second element (30) it is possible to obtain an increase in functionalities from a single manufactured part.

[0031] From the foregoing, it has been envisaged that the safety brake (1) of the invention may additionally have vertical pins (17), located inside the first compression springs (16) as shown in Figures 1 and 4B for guiding said springs (16), the pins (17) being fixed below the lower horizontal surface (32) of the second element (30), traversing the lower horizontal base (21) of the first element (20).

[0032] Furthermore, according to the present preferred embodiment example, it is provided that the safety brake (1) described herein may have an internal stop (19), pref-

erably made of brass, to limit the movement of the braking element (13), as depicted in Figures 1 and 4D.

[0033] We now proceed to describe, step by step, the braking method of a lifting device, by means of the safety brake (1) of the invention, making reference to Figures 4A-4E for a better understanding and monitoring thereof. The method comprises at least the following steps:

- In an initial rest state, corresponding to the normal operating state of the car, as shown in figure 4A, the activation element (14) is kept electrically powered, such that the activation element (14) exerts a force of attraction between the first element (20) and the second element (30), keeping them in direct contact,
- when an emergency situation occurs, such as an excess speed of the elevator, an uncontrolled movement of the car or a fall of the elevator, the following sequence of steps is carried out:
 - a) the activation element (14) is no longer electrically powered,
 - b) first compression springs (16) push the first element (20) in a vertical movement with respect to the lower horizontal surface (32) of the second element (30), as seen in figure 4B;
 - c) the first element (20) in turn pushes the braking element (13), see figure 4B
 - d) the braking element (13), pushed by the first element (20), moves until it reaches a point such that autonomous emergency braking is ensured, that is, from that point on it is no longer necessary to continue pushing the braking element (13) by means of the first element (20);
 - e) the braking element (13) in its own inertia, continues to advance until it contacts a second element (30), as shown in figure 4C, that is, the braking element (13) has overcome any gap between the guide vertical (2), the wedging block (10) and the braking element (13) itself, such that the braking element (13), due to the relative movement between the vertical guide (2) and the wedging block (10), tends to roll towards the wedging state;
 - f) the forward movement of the braking element (13) causes the second element (30) to be pushed upwards, as can be seen in figure 4D;
 - g) at this moment, the vertical guide (2) is trapped between the braking element (13) and the shoe (12), generating a maximum braking force, as shown in figure 4D;

h) as a consequence of the previous step g), the shoe (12) is moved horizontally, causing the compression of the second springs (40), shown in figure 1, which exert force against the vertical guide (2).

[0034] For the purpose of clarity, it is intended to indicate that when the expression "a point such that autonomous emergency braking is ensured" is mentioned in step d), it refers to a point of movement of the braking element such that it is guaranteed that emergency braking will take place, independently of external actions, without requiring any additional thrust from the braking element.

[0035] Similarly, it should also be clarified that when the term "inertia" of the braking element (13) is mentioned in step e) of the method, it is referring to the vertical movement suffered by the latter as a consequence of the thrust movement made by the first element (20) on said braking element (13).

[0036] As previously mentioned, in the initial rest state, the first compression springs (16) exert a force on the first element (20), said compression springs (16) remaining in a compressed position, such that the force of attraction exerted by the activation element (14) between the first element (20) and the second element (30) is greater than the force exerted by the first compression springs (16) on the first element (20), remaining in contact the three elements (14, 20, 30).

[0037] More specifically, in step b) the first element (20) moves upwards to a maximum point where its lower horizontal base (21) contacts the wedging block (10), as shown in Figures 3 and 4B.

[0038] For its part, in step d) the braking element (13) moves along a groove (18) made on a guide plate of the wedging block (10), as shown in Figures 4A, 4B, 4C.

[0039] According to this preferred embodiment, where the activation element (14) is integrally joined to the second element (30), as shown in Figure 2, following step h), the method also comprises the following steps:

i) the activation element (14) is dragged and moved upwards until contacting the first element (20), as shown in figure 4D, precisely due to the integral connection between the second element (30) and the activation element (14);

j) the users trapped in the elevator car are evacuated, if any;

k) the activation element (14) is powered again; and

l) wedge is removed from the lifting device, in a conventional and known way, such that the assembly formed by the first and second elements (20, 30) and the braking element (13) is lowered downwards, recovering again the initial rest state, as seen in figure 4E.

[0040] Finally, it has been envisaged that during step i) described above, see figure 4D, an absorption of the existing deformations between the first element (20) and the activation element (14) is carried out by means of an elastic element (15) having compression capacity.

Claims

1. Safety brake (1) for elevator, the elevator having a movable car through a vertical guide (2), wherein the safety brake (1) comprises:

- a wedging block (10) attachable to the elevator car;
- a shoe (12) attached to the wedging block (10);
- a braking element (13) with two positions, an initial rest position and an active position, wherein said braking element (13) is located between the wedging block (10) and the vertical guide (2), such that when an emergency situation occurs, said braking element (13) simultaneously contacts the wedging block (10) and the vertical guide (2) in their active position, causing a safety braking of the elevator;
- an activation element (14) electrically powered for activating and deactivating the safety brake (1);

characterized in that the safety brake (1) additionally comprises:

- a first element (20) located in a lower position with respect to the braking element (13), said first element (20) being vertically movable with respect to the wedging block (10), wherein the first element (20) has two positions, a first rest position and a second active position, wherein in the event of a power failure of the activation element (14) there is a vertical movement of the first element (20) to its second active position, pushing and moving in turn the braking element (13) from its initial rest position to its active position in which the actuation of said braking element (13) is autonomous, that is, from this point on it is no longer necessary to continue pushing the braking element (13) through the first element (20);
- a second element (30) located in a higher position with respect to the braking element (13), wherein the second element (30) has two positions, a first rest position and a second active position, wherein said second element (30) is movable vertically with respect to the wedging block (10), such that in the second active position of the second element (30) and the first element (20) being in its second active position, the activation element (14) contacts simultane-

ously the first element (20) and the second element (30), the vertical guide (2) being trapped between the braking element (13) and the shoe (12), generating a maximum braking force for the elevator.

2. Safety brake (1) for elevator, according to claim 1, **characterized in that** the activation element (14) is integrally connected to the first element (20), such that both elements (14, 20) are in physical contact in at all times, regardless of the position, rest or active, in which the first element (20) and the second element (30) are.

3. Safety brake (1) for elevator, according to claim 1, **characterized in that** the second element (30) has at least two folded sections, a vertical lateral surface (31) and a horizontal lower surface (32).

4. Safety brake (1) for elevator, according to claim 3, **characterized in that** the activation element (14) is integrally connected to the lower horizontal surface (32) of the second element (30), such that in the first rest position, the first element (20) is in physical contact with the activation element (14), and wherein in the event of a power failure of the activation element (14), the contact between both elements, activation element (14) and first element (20), is lost.

5. Safety brake (1) for elevator, according to claim 1, **characterized in that** it additionally comprises an elastic element (15) attached to the activation element (14).

6. Safety brake (1) for elevator, according to claim 3, **characterized in that** it additionally comprises first compression springs (16) configured to push the first element (20) in a vertical movement, with respect to the lower horizontal surface (32) of the second element (30).

7. Safety brake (1) for elevator, according to claim 6, **characterized in that** in the rest position of the first element (20), the activation element (14) is configured to exert a force of attraction between the first element (20) and the second element (30), wherein said force of attraction is greater than the force exerted by the first compression springs (16).

8. Safety brake (1) for elevator, according to claim 1, **characterized in that** both the first element (20) and the second element (30) are movable only vertically.

9. Lifting device comprising the safety brake (1) for elevator, described in any one of the preceding claims 1-8.

10. Braking method of a lifting device, by means of the

safety brake (1) for elevator described in any one of claims 1-8, **characterized in that** it comprises at least the following steps:

- In an initial rest state, corresponding to the normal operating state of the car, the activation element (14) is kept electrically powered, such that the activation element (14) exerts a force of attraction between the first element (20) and the second element (30), keeping them in direct contact,
- when an emergency situation occurs, the following sequence of steps is carried out:

- a) the activation element (14) is no longer electrically powered,
- b) first compression springs (16) push the first element (20) in a vertical movement;
- c) the first element (20) in turn pushes the braking element (13);
- d) the braking element (13), pushed by the first element (20), moves until it reaches a point such that autonomous emergency braking is ensured, that is, from that point on it is no longer necessary to continue pushing the braking element (13) by means of the first element (20);
- e) the braking element (13) in its own inertia, continues advancing until it contacts a second element (30), wherein the braking element (13) has overcome any gap between the vertical guide (2), the wedging block (10) and the braking element (13) itself, such that the braking element (13), due to the relative movement between the vertical guide (2) and the wedging block (10), tends to roll towards the wedging state;
- f) the forward movement of the braking element (13) causes the second element (30) to be pushed upwards;
- g) the vertical guide (2) is trapped between the braking element (13) and the shoe (12), generating a maximum braking force; and
- h) the shoe (12) is displaced horizontally, causing the compression of second springs (40) that exert force against the vertical guide (2).

11. Braking method according to claim 10, **characterized in that** in the initial rest state, the first compression springs (16) exert a force on the first element (20), said compression springs (16) remaining in a compressed position, such that the force of attraction exerted by the activation element (14) between the first element (20) and the second element (30) is greater than the force exerted by the first compression springs (16) on the first element (20), the three elements remaining in contact (14, 20, 30).

12. Braking method according to claim 10, **characterized in that** both the first element (20) and the second element (30) are movable only in the vertical direction.

13. Braking method according to claim 10, **characterized in that** in step d) the braking element (13) moves along a groove (18) made on a guide plate of the wedging block (10).

14. Braking method according to claim 10, **characterized in that** the activation element (14) is integrally connected to the second element (30), such that after step h) the method additionally comprises the following steps:

- i) the activation element (14) is dragged and moved upwards until contacting the first element (20), precisely due to the integral connection between the second element (30) and the activation element (14);
- j) the users trapped in the elevator car are evacuated, if any;
- k) the activation element (14) is powered again; and
- l) wedge is removed from the lifting device, such that the assembly formed by the first and second elements (20, 30) and the braking element (13) is lowered downwards, recovering again the initial rest state.

15. Braking method according to claim 14, **characterized in that** during step i) the deformations existing between the first element (20) and the activation element (14) are absorbed by means of an elastic element (15) having compression capacity.

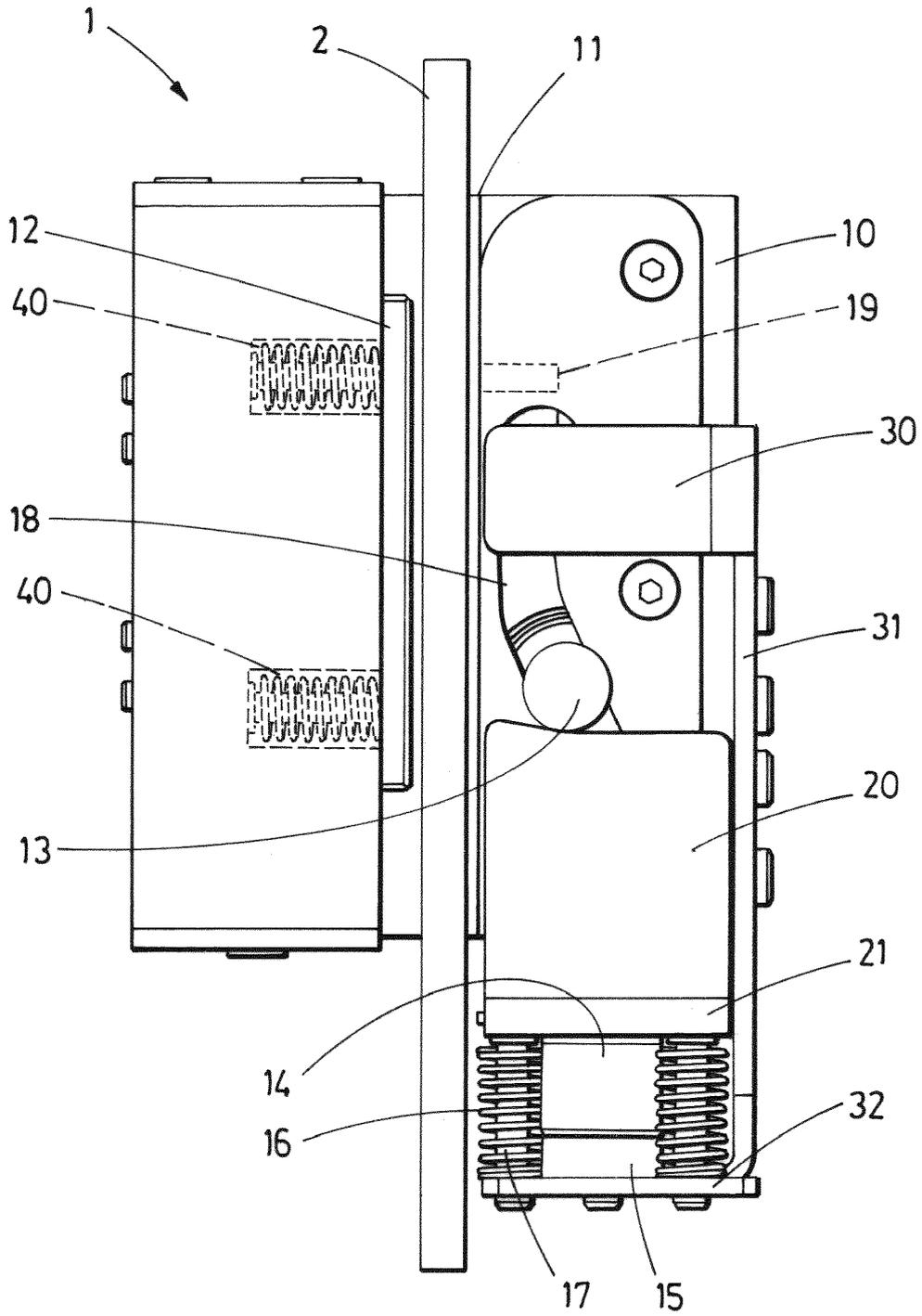


FIG.1

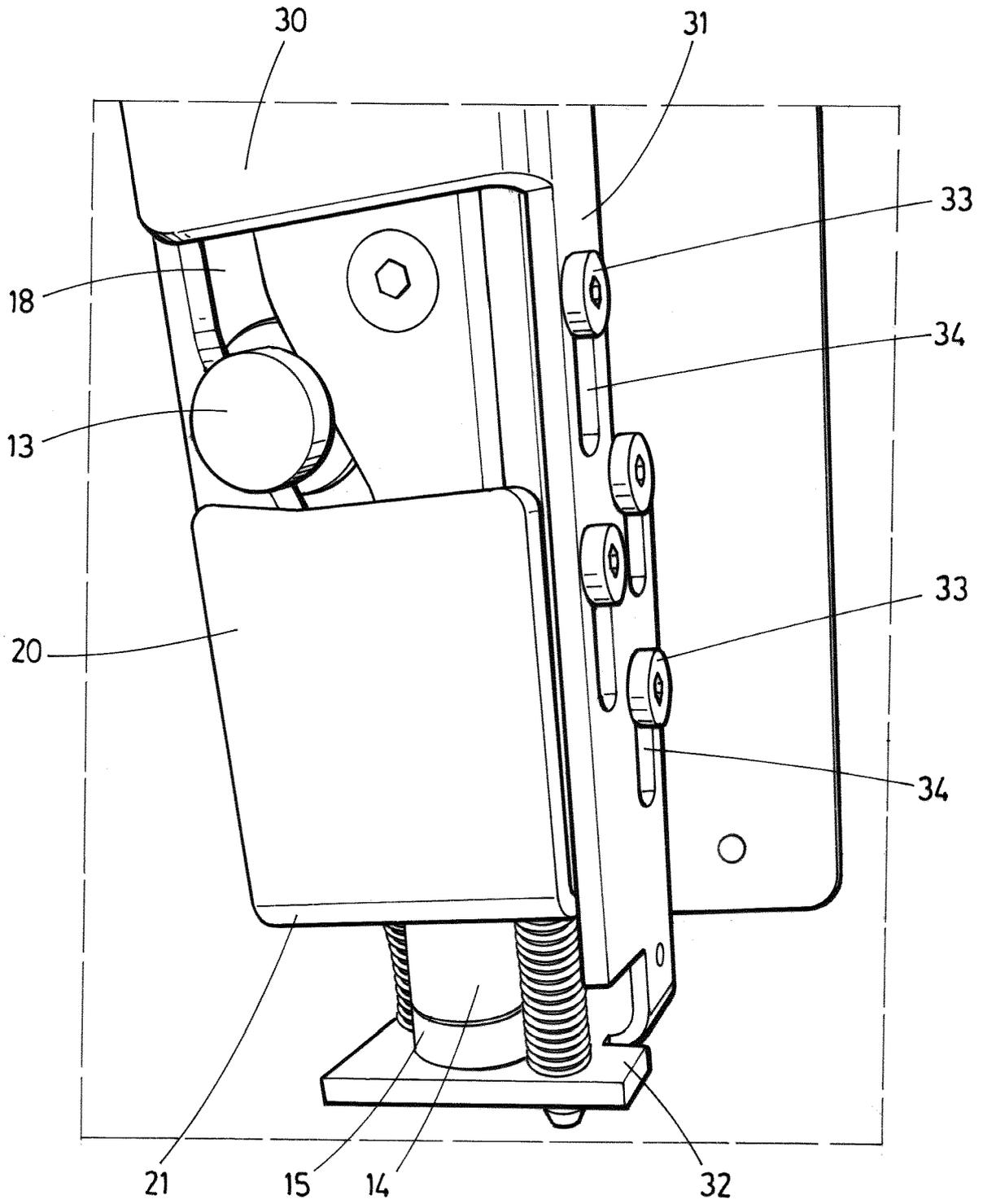


FIG.2

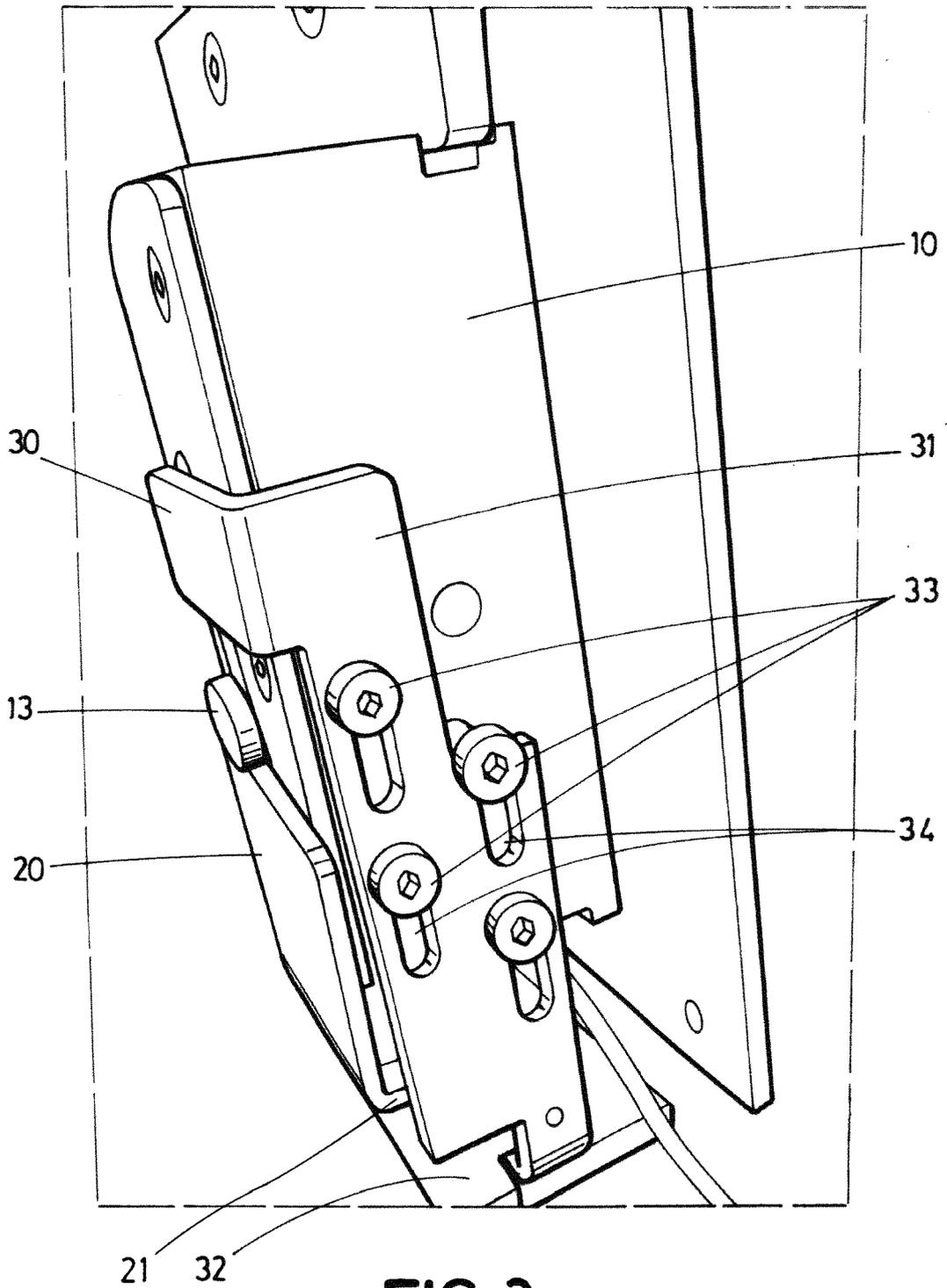


FIG. 3

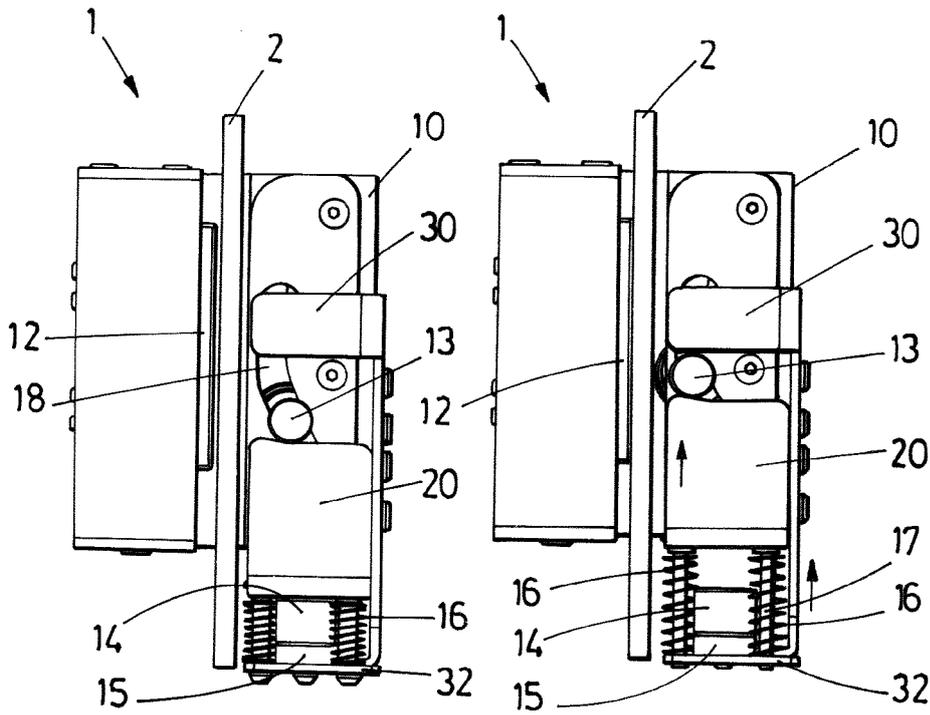


FIG. 4A

FIG. 4B

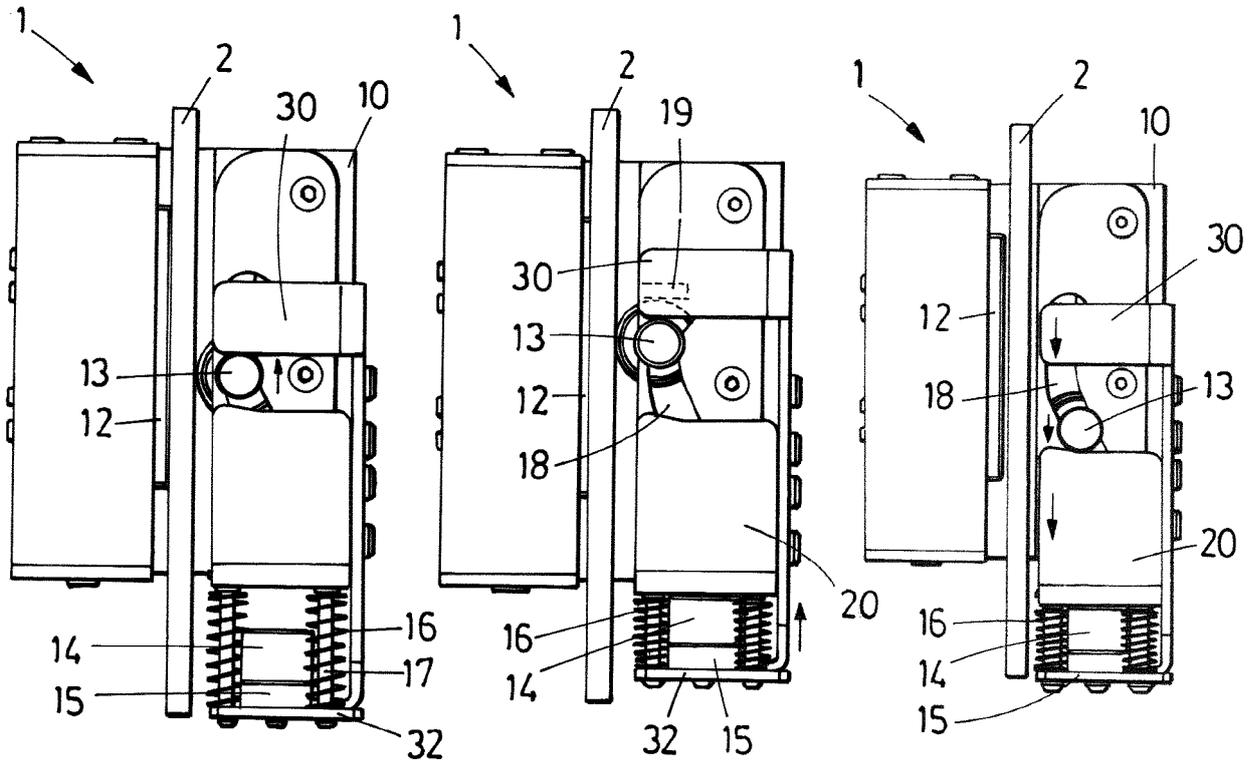


FIG. 4C

FIG. 4D

FIG. 4E



EUROPEAN SEARCH REPORT

Application Number
EP 21 38 2552

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2016/289045 A1 (OSMANBASIC FARUK [CH] ET AL) 6 October 2016 (2016-10-06) * abstract; figures 1-6 * * paragraphs [0048] - [0063] * -----	1-15	INV. B66B5/18 B66B5/22
A	EP 1 902 993 A1 (WITTUR AG [DE]) 26 March 2008 (2008-03-26) * abstract; figures 1-8 * * paragraphs [0021] - [0042] * -----	1-15	
A	US 2007/051563 A1 (OH JAE-HYUK [US] ET AL) 8 March 2007 (2007-03-08) * abstract; figures 5-9 * * paragraphs [0031] - [0037] * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B66B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 21 October 2021	Examiner Bleys, Philip
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