



(11)

**EP 4 825 787 A1**

(12)

**EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 153(4) EPC

(43) Date of publication:  
**21.10.2026 Bulletin 2026/43**

(51) International Patent Classification (IPC):  
**B66F 17/00 (2006.01)**

(21) Application number: **24903029.7**

(52) Cooperative Patent Classification (CPC):  
**B66F 17/00**

(22) Date of filing: **13.12.2024**

(86) International application number:  
**PCT/ES2024/070783**

(87) International publication number:  
**WO 2025/125708 (19.06.2025 Gazette 2025/25)**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA**  
Designated Validation States:  
**GE KH MA MD TN**

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(30) Priority: **14.12.2023 ES 202332228 U**

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(54) **MODULE WITH A SYSTEM FOR MEASURING A LOAD IN A LIFTING TOWER**

(57) The present invention relates to a module with a system for measuring a load in a lifting tower comprising a telescopic movable segment (5) that can be displaced vertically. The module comprises a fixed support (1a) and a movable support (1b), which are linked to one another, forming an articulated quadrilateral device. The fixed support (1a) is configured to be joined to the movable segment (5) and the movable support (1b) is configured to be vertically displaced parallel to the fixed support (1a). The module (1) comprises at least one spring (6), located inside the fixed support (1a) in a vertical alignment, on which the movable support (1b) rests. The module (1) is configured to limit the relative vertical positioning of the movable support (1b) with respect to the fixed support (1a). The articulated quadrilateral device and the spring (6) limit the relative movement between the fixed support (1a) and the movable support (1b) ensuring that they are kept parallel in vertical alignments.

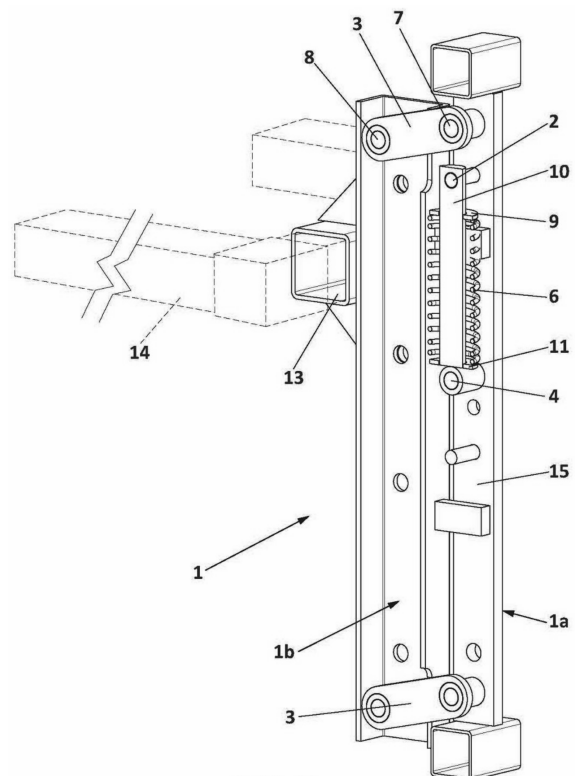


**FIG. 1**

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## Description

### Object of the invention

[0001] The present invention relates to a module with a system for measuring a load in a lifting tower used in musical or any other type of events for the installation of lighting and/or sound elements. The object of the present invention is to improve the functionality and safety of these towers by providing them with more efficient high lifting means thanks to the incorporation of a system for measuring a load that incorporates safety means to prevent the lifting tower from being initially overloaded before the load is activated and lifted, such that when a predetermined load weight considered dangerous is exceeded, the system for measuring shows or visualises in a very intuitive manner that the lifting of the load exceeds the recommended values.

[0002] It is therefore a load verification system for lifting towers for lighting and sound elements, without of course ruling out the loading of other elements.

[0003] Thus, with this module with a measurement and verification system of the invention, damage to the tower and, more importantly, possible accidents due to overloading of the lifting tower are avoided. Furthermore, it should be noted that with the module of the invention it is not necessary to resort to complex electronic systems to know the weight of the load before lifting it, as the invention solves this in a simple way using a mechanical system. It should also be noted that the module of the invention is compatible with other towers already on the market, although it will be necessary to make a measurement system model for each type of telescopic segment of the tower.

### Background of the invention

[0004] In the present state of the art, lifting towers used in the installation of lighting and sound systems comprise several telescopic segments, which are moved vertically using the action of a pulling/lifting mechanism.

[0005] Normally, a horizontal support structure where the different lighting elements are assembled is arranged between two towers. This configuration means that these towers must be able to support heavy weights.

[0006] Different types of structures intended for the construction or assembly of heavy equipment used for social events, such as theatre, cinema, concerts, sports events, etc., are known today. In this sense, towers intended for supporting lighting, cameras, and loudspeakers at different types of events are known.

[0007] Some structures of this type have lifting platforms or, otherwise, extendable platforms, which are actuated using a crank handle connected to a winch or the like and to a lifting pulley mechanism. In some

cases, the actuation is manual, and in other cases, there is a motorised actuation that does not require a manual crank handle and is equipped with a motor connected to a winch or the like and to the lifting mechanism of the movable parts or segments of the lifting tower.

[0008] The aforementioned lifting mechanism thus enables the towers to be lifted by one person using a crank handle or in a motorised manner, regardless of the load being supported by said platforms.

[0009] However, in relation to the above, each tower or platform structure is normally designed to operate below a maximum load level. If this maximum load level for which it has been designed is exceeded, faults or breakdowns may occur in said tower or platform structure, with the possibility of tension cables breaking and, ultimately, the risk of structural collapse and serious accidents.

[0010] One of the problems related to overloading these load-bearing structures is that, due to the lifting mechanism that reduces the torque required for its actuation, it is difficult for the user to perceive any difference in the torque that must be applied to the lifting mechanism to lift the platform, regardless of the variation in the load to be lifted.

[0011] Therefore, to ensure that the maximum load level preset for each structure is not exceeded, operators must weigh each piece they assemble on the structure beforehand or, alternatively, know with certainty the weight of the pieces they assemble on the platform. This is a drawback with respect to the pulling or lifting in the aforementioned load-bearing structures in the state of the art.

[0012] On the other hand, in order to know beforehand the weight of the load to be lifted in conventional lifting towers, there are complex mechanisms known in the state of the art, based on load cells or similar mechanisms, which offer solutions to excess weight, but normally require an electrical power supply for their operation, which greatly conditions their effectiveness, not to mention the possible breakdowns as it is a product subjected to quite demanding working conditions.

[0013] Traditional front-loading towers are provided a fork, which is usually fixed within guides integral with movable lifting segments and fixed with mechanical means such as a set of pins, screws, or mechanical retaining elements, such that the fork can be removed for transport, or some of these systems may even have a series of heights at which the system can be fixed in order to have a greater degree of adjustment for the equipment to be lifted and supported.

[0014] Similarly, the forks are usually composed of a body that is usually T-shaped to which there are fixed in a perpendicular manner, either with movable fixing mechanisms, hinges, etc., two symmetrically shaped segments which form the load-bearing surface of the fork; where said segments can be located in a horizontal active position to enable lifting the load, or in a vertical

inactive position.

[0015] Utility model U 202330698 discloses a system for measuring a load in a lifting tower comprising a vertical telescopic structure formed by at least a first segment, a movable second segment guided inside the first segment, a spring that works under compression, a control element integral with the movable second segment of the tower, and a graduated scale located on the outer surface of the first segment of the tower. The second segment of the tower rests on said spring, such that a first end of the spring is supported on a fixed base integral with the first segment of the tower, while a second end of said spring, opposite the first end, is supported on a plate integral with the movable second segment of the tower. During loading of the tower with a weight, the second movable segment of said tower is displaced downwards against the resistance of the spring, with the control element being displaced in parallel from an initial position to a final position, both positions being controlled using the graduated scale.

[0016] None of the cited documents discloses an independent module with a measurement system for controlling the load that can be assembled and disassembled for installation on lifting towers.

### Description of the invention

[0017] To achieve the objectives and prevent the drawbacks mentioned in the preceding sections, the invention proposes a module with a system for measuring a load in a lifting tower, which includes at least one telescopic movable segment that can be displaced vertically which is configured to enable lifting the load to the required height.

[0018] The module of the invention comprises a fixed support and a movable support which are both linked to each other by means of at least two connecting rods forming an articulated quadrilateral device; wherein the fixed support is configured to be joined to the telescopic movable segment of the lifting tower; and wherein the movable support can be displaced vertically upwards or downwards parallel to the fixed support as a result of the articulated connections by means of the two connecting rods.

[0019] The module of the invention further comprises at least one spring on which the movable support rests; wherein said spring is located inside an inner space of the fixed support in a vertical alignment.

[0020] With this described arrangement, the module with a system for measuring a load is configured to limit the relative vertical positioning of the movable support with respect to the fixed support, both when the movable support supports a load and when it does not support said load.

[0021] The spring is guided around a vertical rod which is coupled in an articulated manner at an upper segment to a first transverse shaft integral with the

fixed support, while a lower end of said vertical rod is supported on a bushing coupled around a second transverse shaft integral with the fixed support; wherein the first and second transverse shafts are arranged in horizontal alignments which are perpendicular to the vertical rod.

[0022] The movable support rests on an upper end of the spring by means of a pair of parallel extensions integral with said movable support located on both sides of the vertical rod.

[0023] On the upper end of each spring, as well as on its lower end, opposite the upper end, there are arranged an upper washer and a lower washer, which are both freely guided on the vertical rod; wherein the pair of extensions is supported on the spring by means of the upper washer, while the lower washer is supported on the bushing coupled around the second transverse shaft.

[0024] The movable support includes a polygonal opening in a horizontal alignment in which there is assembled a fork which is configured for supporting thereon the load to be lifted with the lifting tower.

[0025] Each of the connecting rods is coupled to the fixed support by means of a first articulated connection, and to the movable support by means of a second articulated connection.

[0026] Next, to help better understand this specification and as an integral part thereof, a series of figures is attached in which the object of the invention is depicted in an illustrative and non-limiting manner.

### Brief description of the figures

[0027]

**Figure 1** shows a perspective view of the module with a system for measuring a load in a lifting tower, object of the invention.

**Figure 2** shows another perspective view of the module of the invention.

**Figure 3** shows a perspective view of the module of the invention without a movable support.

**Figure 4** shows an elevational view of the module of the invention in a standby position.

**Figure 5** shows an elevational view of the module of the invention in an active position under load.

### Description of an exemplary embodiment of the invention

[0028] Considering the numbering used in the figures, the module 1 with a system for measuring a load in a lifting tower comprises a fixed support 1a and a movable support 1b, which are both linked to each other by means of at least two connecting rods 3 forming an articulated quadrilateral device; wherein the fixed support 1a is configured to be joined to a telescopic movable segment 5 of the lifting tower; and

wherein the movable support 1b can be displaced vertically upwards or downwards parallel to the fixed support 1a.

**[0029]** Each of the connecting rods 3 is coupled to the fixed support 1a by means of a first articulated connection 7, and to the movable support 1b by means of a second articulated connection 8.

**[0030]** Both the movable segment 5 of the lifting tower and the movable support 1b of the module 1 of the invention can be displaced upwards and/or downwards in a vertical direction.

**[0031]** The movable support 1b is displaced downwards against the resistance of two springs 6 that work under compression and that are located in one and the same vertical alignment; wherein each of said springs 6 is guided around a vertical rod 10 which is coupled in an articulated manner at an upper segment to a first transverse shaft 2 integral with the fixed support 1a, while a lower end of said vertical rod 10 is supported on a bushing coupled around a second transverse shaft 4 integral with the fixed support 1a; wherein the first transverse shaft 2 and the second transverse shaft 4 are arranged in horizontal alignments perpendicular to the vertical rod 10.

**[0032]** On the other hand, the movable support 1b includes two pairs of parallel extensions 12 resting on upper ends of the springs 6 under the first transverse shafts 2; wherein said extensions 12 are arranged on both sides of the vertical rod 10.

**[0033]** In the embodiment shown in the figures, both on the upper end of each spring 6 such that on its lower end, opposite the upper end, there are arranged an upper washer 9 and a lower washer 11, which are freely guided on the vertical rod 10, such that in this case each pair of extensions 12 is supported on the spring 6 by means of the upper washer 9, while the lower washer 11 is supported on the bushing coupled around the second transverse shaft 4. Therefore, the two opposite ends of each spring 6 are in contact with the upper washer 9 and the lower washer 11.

**[0034]** The movable support 1b includes a horizontal polygonal opening 13 where a fork 14, which is configured to directly support the load to be lifted with the telescopic tower, can be assembled.

**[0035]** The tower may include a single telescopic movable segment 5 or several telescopic movable segments linked through mechanical means to enable lifting the tower upwards until reaching the required height. Therefore, a movable segment can be coupled one after another and so on, such that considerable vertical lifting can be performed concatenating several of these movable segments.

**[0036]** The module 1 with a system for measuring includes the fixed support 1a and the movable support 1b, both linked by means of the connecting rods 3 which, like an articulated parallelogram, limit the distances and relative movements, such that both supports 1a, 1b are always located in parallel relative posi-

tions in vertical alignments.

**[0037]** As mentioned above, there is assembled on the movable support 1b the fork 14 which is configured to support the weight of the load to be lifted; wherein in an active position, the fork 14 is arranged in a horizontal plane, and in an inactive position the fork can be arranged in a vertical plane.

**[0038]** Therefore, the weight of the load is supported by the movable support 1b, which is in charge of transmitting stresses to the rest of the structure of the tower.

**[0039]** The movable support 1b is supported on the two springs 6 located inside an inner space of the fixed support 1a, such that when the load is deposited on the fork 14, it transmits the weight of said load to the springs 6. In this way, the load will compress the springs 6 which, having an elastic proportionality constant, will have a variation in length that will be proportional to the load placed on the fork 14.

**[0040]** To reduce any distorted deviation on load transmission due to the displacement of the movable support 1b in directions other than the vertical direction, the vertical downward displacement will be measured from the maximum separation of the movable support 1b with respect to the fixed support 1a, i.e., by taking as a reference the position of the connecting rods 3 when they form a substantially 90-degree angle with respect to the movable support 1b where the fork 14 is connected.

**[0041]** Therefore, the initial reference of 0° is obtained when the parallel connecting rods 3 are arranged in horizontal alignments forming 90 degrees both with respect to the fixed support 1a and with respect to the movable support 1b, such that the work area for which the control of the measurement of the displacement under load of the movable support has been designed will be around the mentioned initial reference of 0°.

**[0042]** With this described arrangement, in a first standby position of the movable support 1b (Figure 4), the support will have a slight upward displacement maintained by the springs 6, a second intermediate position with the initial reference of 0° when the connecting rods 3 are in horizontal alignments forming 90° with respect to the fixed support 1a, and the movable support 1b, and a loading position (Figure 5) will involve a downward displacement of the movable support 1b against the resistance of the springs 6.

**[0043]** On the other hand, in order to ensure that stresses only occur along said spring 6, there has been envisaged in the fixed support 1a where each of the springs 6 is housed the guiding system described above which, as mentioned, is formed by the vertical rod 10 that prevents the buckling of said spring 6 and opposite walls 15 of the fixed support 1a encapsulate said spring 6, minimising displacements in directions other than the longitudinal direction. Extensions 12 formed by pieces welded to the movable support 1b, which are supported on the upper end of the spring 6

by means of the upper washer 9, have been envisaged to transmit the stresses symmetrically and directly to the spring 6.

[0044] In a preferred embodiment of the invention, the profiles used for forming the fixed support 1a and the movable support 1b are hollow tubular profiles with a square section, such that all the fixing holes needed are machined on the fixed support 1a so that by means of mechanical elements such as nut and bolts or pins, among others, the different parts forming part of the guiding system or of the rest of the mechanical elements can be fixed.

[0045] The particular design of the module 1 for measuring a load prevents the measurement from being distorted due to friction with the guides in said module 1 such that, as a result of the connecting rods 3, the fixed support 1a and the movable support 1b do not have contact surfaces, and therefore there is no possibility of seizing or of a particular positioning of the load modifying the friction characteristics of the different parts and potentially affecting the measurement.

[0046] Furthermore, with the use of the two different supports 1a, 1b, it is possible to only change the loading fork 14, and even the assembly of the module 1 of the invention, sin having to make additional changes in the lifting tower, simplifying the structure thereof and being able to apply this improvement on towers that have already been constructed.

[0047] The system for measuring is completed with a visual scale (not depicted in the figures) that reflects the load status with respect to the limit thereof in an simple and intuitive manner for the users of the front load-bearing tower. In this way, by means of the displacement of the movable support 1b against the resistance of the springs 6, it will be possible to quantify whether or not the load is in tolerable ranges.

[0048] In an embodiment of the invention, it will be possible to include a load percentage scale which reflects whether the load is in a low-load zone (<50%), a moderate load zone (50-80%), a near-maximum load zone (80-100%), or whether it is in an overload zone (>100%); such that this system for measuring can be reflected in different ways, for example, the low-load zone including a green zone, the moderate load zone including a yellow zone, the near-maximum load zone including an orange zone, and the overload zone including a red zone.

[0049] Following this arrangement described in the preceding paragraph, it will also be possible to include a scale on which the approximate weight being loaded onto the module of the invention is indicated in order to simply know whether or not the load is safe.

## Claims

1. A module with a system for measuring a load in a lifting tower, which lifting tower comprises at

least one telescopic movable segment (5) that can be displaced vertically which is configured to enable lifting the load to the required height, characterised in that:

- it comprises a fixed support (1a) and a movable support (1b) which are both linked to each other by means of at least two connecting rods (3) forming an articulated quadrilateral device; wherein the fixed support (1a) is configured to be joined to the telescopic movable segment (5) of the lifting tower; and wherein the movable support (1b) is configured to be vertically displaced upwards or downwards parallel to the fixed support (1a);
- it further comprises at least one spring (6) on which the movable support (1b) rests; wherein said spring (6) is located inside an inner space of the fixed support (1a) in a vertical alignment;

wherein the module (1) is configured to limit the relative vertical positioning of the movable support (1b) with respect to the fixed support (1a), both when the movable support (1b) supports a load and when it does not support said load; and wherein the articulated quadrilateral device in combination with the spring (6) are configured to limit distances and relative movements, such that the fixed support (1a) and the movable support (1b) are always located in parallel relative positions in vertical alignments.

2. The module with a system for measuring a load in a lifting tower according to claim 1, wherein the spring (6) is guided around a vertical rod (10) which is coupled in an articulated manner at an upper segment to a first transverse shaft (2) integral with the fixed support (1a), while a lower end of said vertical rod (10) is supported on a bushing coupled around a second transverse shaft (4) integral with the fixed support (1a); wherein the first transverse shaft (2) and the second transverse shaft (4) are arranged in horizontal alignments which are perpendicular to the vertical rod (10).
3. The module with a system for measuring a load in a lifting tower according to any one of the preceding claims, wherein the movable support (1b) includes at least one pair of parallel extensions (12) resting on an upper end of the spring (6).
4. The module with a system for measuring a load in a lifting tower according to claims 2 and 3, wherein on the upper end of each spring (6), such that on its lower end, opposite the upper end, there are arranged an upper washer (9) and a lower washer (11), which are both freely guided on the vertical rod (10); wherein the pair of extensions

(12) is supported on the spring (6) by means of the upper washer (9), while the lower washer (11) is supported on the bushing coupled around the second transverse shaft (4).

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- 5. The module with a system for measuring a load in a lifting tower** according to any one of the preceding claims, wherein the movable support (1b) includes a polygonal opening (13) in a horizontal alignment in which there is assembled a fork (14) which is configured for supporting thereon the load to be lifted with the lifting tower.

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- 6. The module with a system for measuring a load in a lifting tower** according to any one of the preceding claims, wherein each of the connecting rods (3) is coupled to the fixed support (1a) by means of a first articulated connection (7), and to the movable support (1b) by means of a second articulated connection (8).

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- 7. The module with a system for measuring a load in a lifting tower** according to any one of the preceding claims, wherein it comprises two springs (6) aligned in one and the same vertical alignment.

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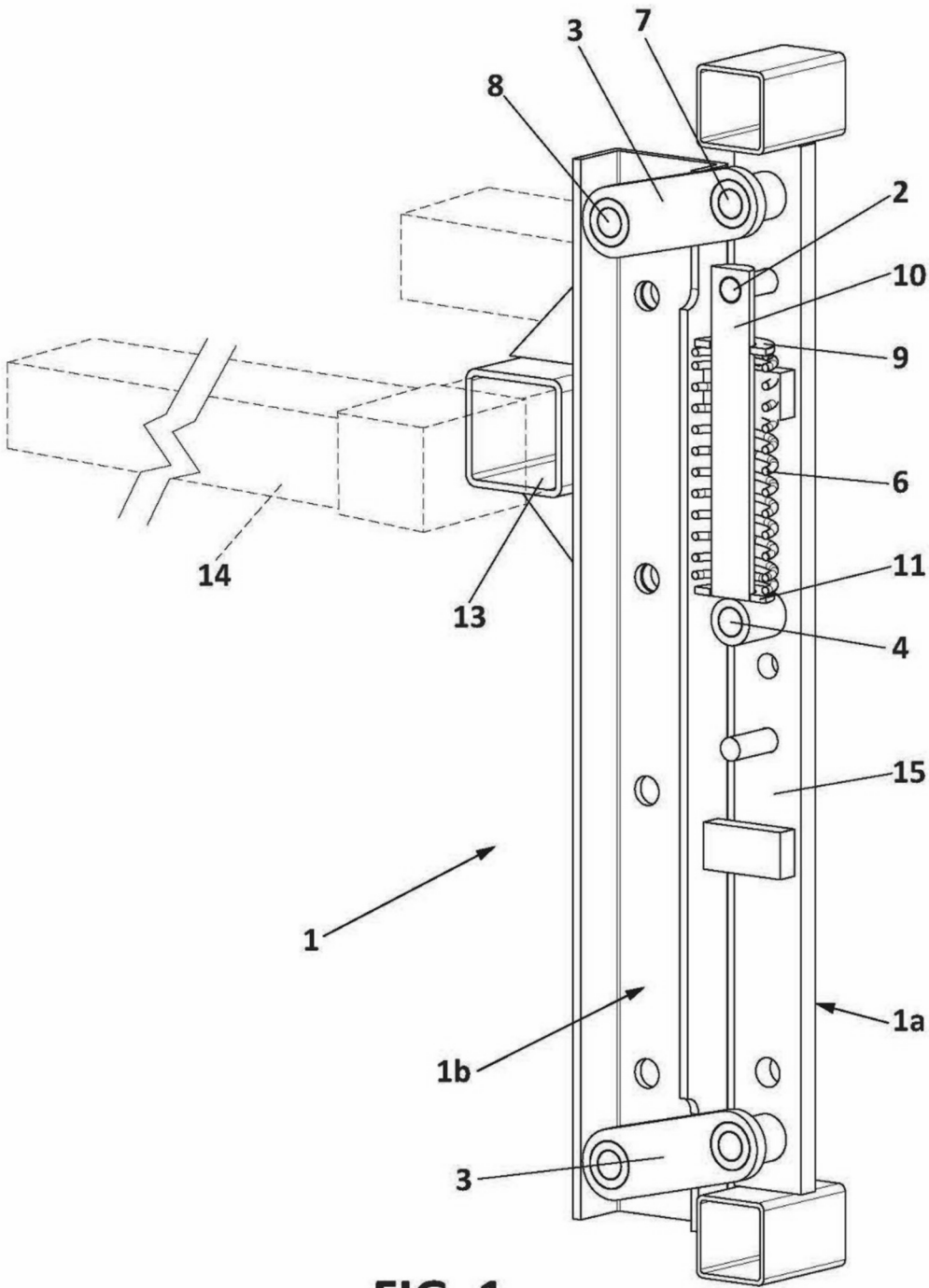


FIG. 1

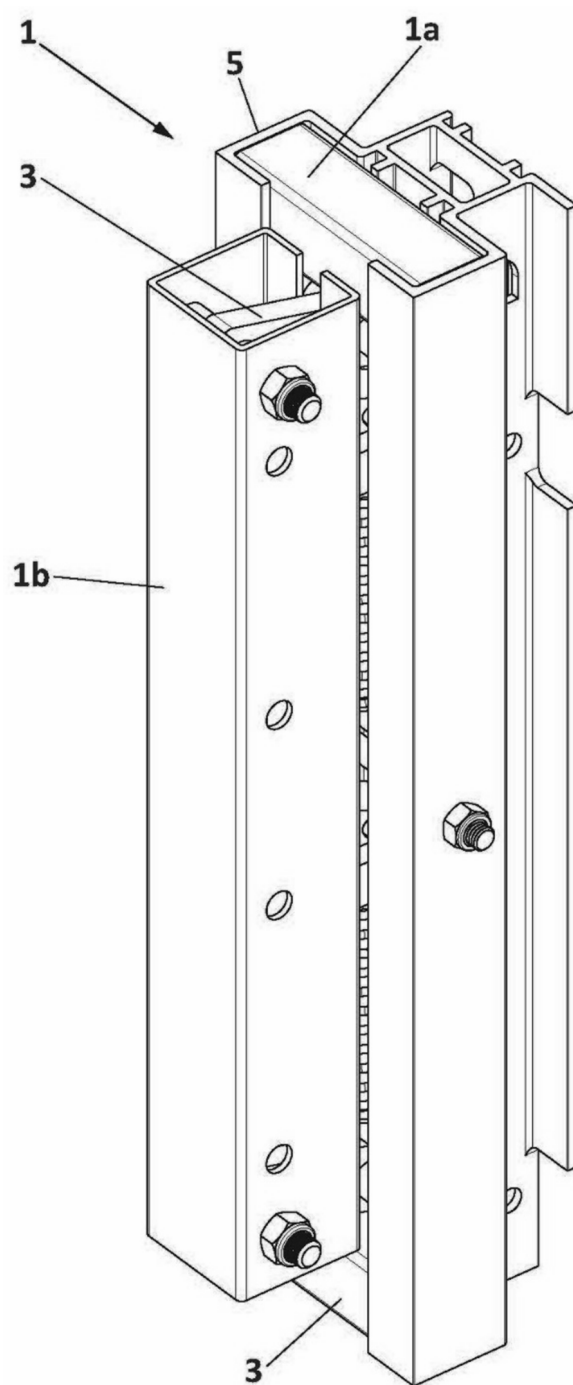


**FIG. 2**

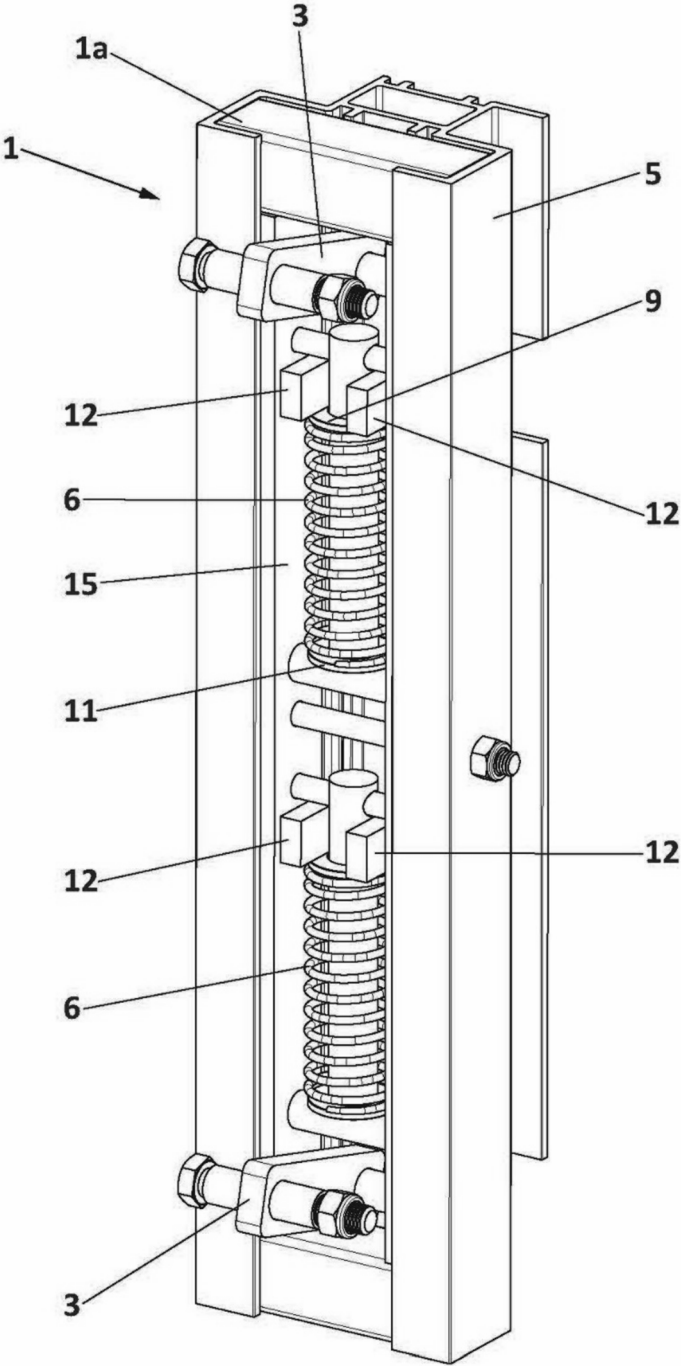


FIG. 3

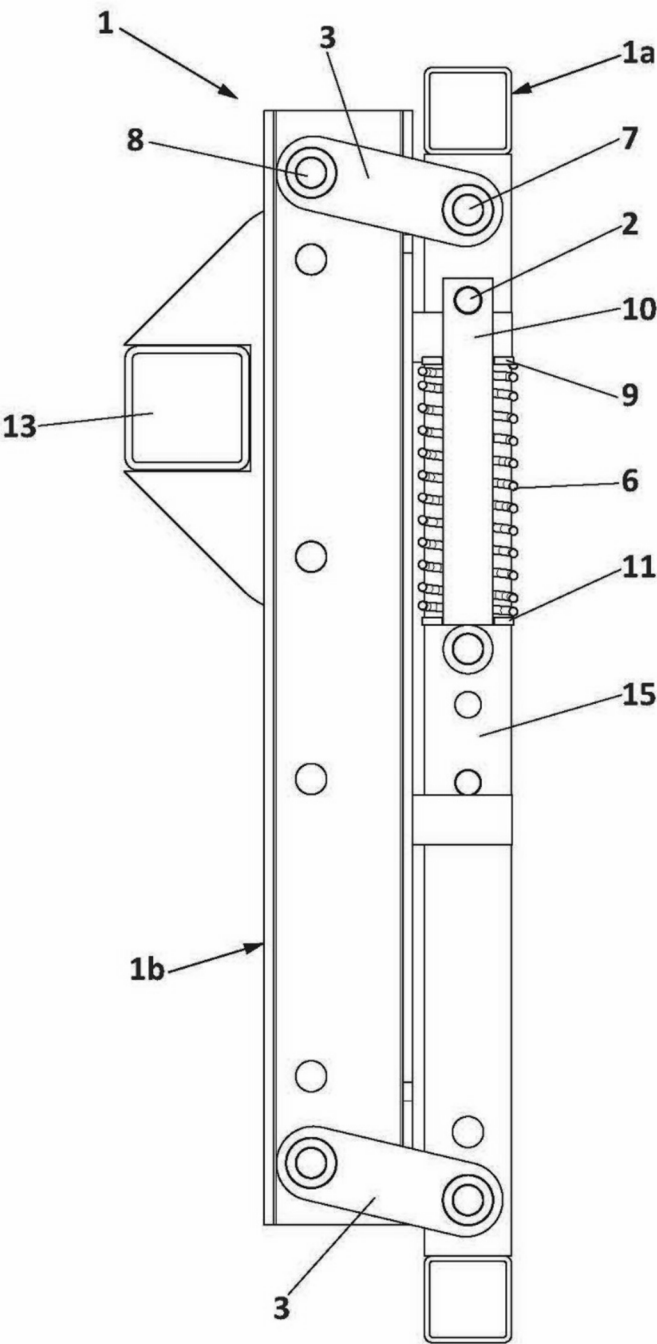


FIG. 4

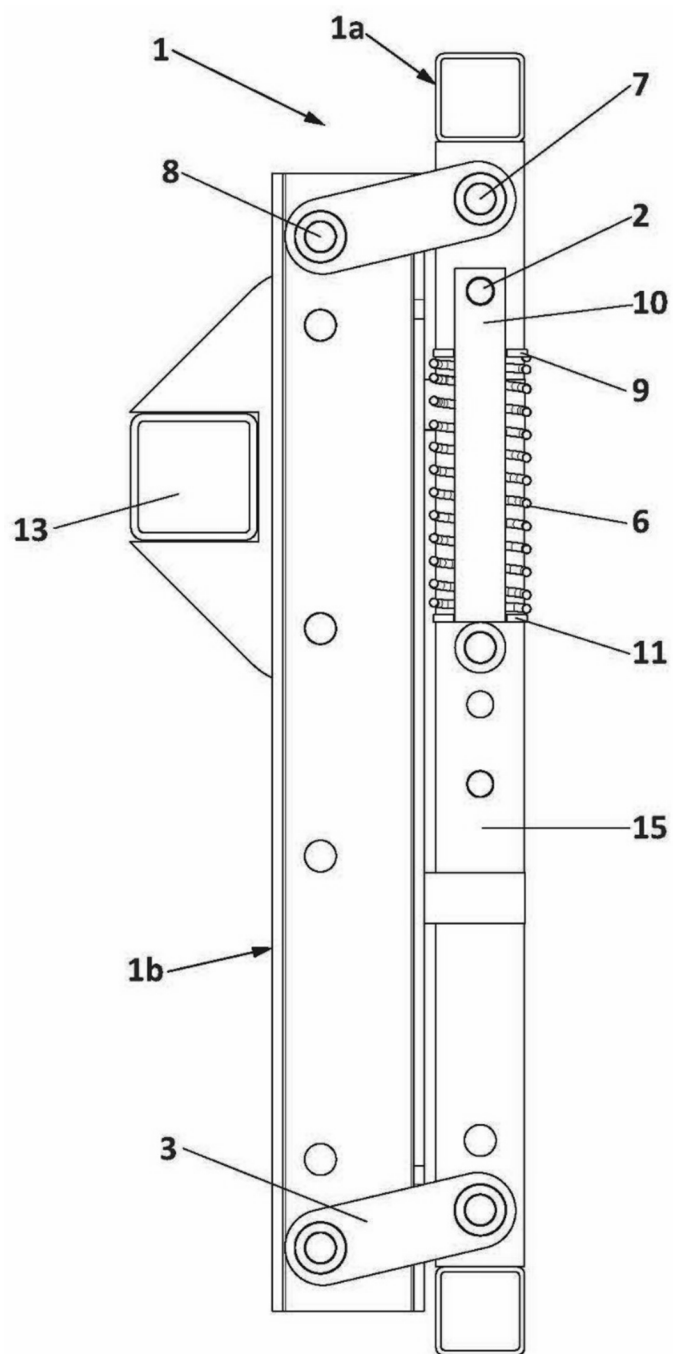


**FIG. 5**

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/ES2024/070783

## A. CLASSIFICATION OF SUBJECT MATTER

**B66F17/00** (2006.01)

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)

**B66F**

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)

EPODOC, INVENES

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages             | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------|-----------------------|
| A         | ES 1303192U U (EQUIPSON S A) 18/09/2023,<br>the whole the document.                            | 1-7                   |
| A         | ES 1211939U U (FANTEK IND S L) 09/05/2018,<br>the whole document.                              | 1-7                   |
| A         | US 2018072278 A1 (RIGHETTI VALTER) 15/03/2018,<br>paragraphs[0037 - 0064]; figures.            | 1-7                   |
| A         | WO 2019041996 A1 (SHENZHEN LONG HIT ROBOTICS<br>TECH CO LTD) 07/03/2019,<br>abstract; figures. | 1-7                   |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2024/070783

Information on patent family members

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