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(54) **ADJUSTABLE-FIRMNESS DEVICE AND REST FURNITURE COMPRISING THE DEVICE**

(57) An adjustable force device for relaxation furniture that comprises a multitude of resilient elements and at least one rigid base element on which the resilient elements rest, in such a way that the resilient elements are intended to compress when receiving pressure and return to their original shape when this pressure is removed, in which at least some of the resilient elements comprise:
- a head component on the upper part of the resilient

element;
- a means for transmitting tension applied to the head component,
the means for transmitting tension to an actuating device of the means for transmitting tension being connected in such a way that the action of the actuating device causes the connected resilient element or elements to compress via the respective means for transmitting tension.

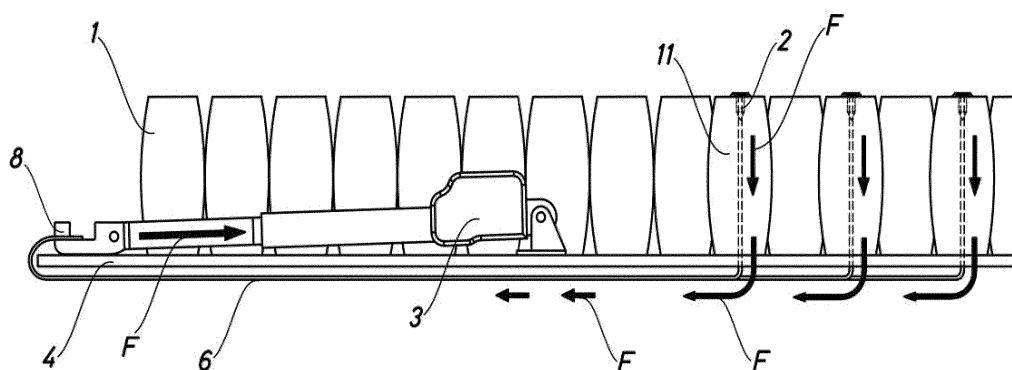


Fig.1

Description

[0001] The present invention relates to an adjustable firmness device that can regulate its firmness by means of an external actuating control device for example, and to a piece of relaxation furniture that comprises said device.

[0002] Relaxation furniture refers to those items of furniture whose functions include that of relaxation. Examples of relaxation furniture are mattresses, settees, chairs, armchairs, sofas, pillows and cushions, etc. While the present invention applies especially to mattresses, chairs, armchairs and sofas, this invention is not necessarily limited to said applications.

[0003] Adjustable firmness devices are known that enable the user to set the firmness of the relaxation element by means of a mechanism that enables the firmness to be adapted to each user and at any time.

[0004] The adjustable firmness devices that currently exist on the market function via various systems, such as: the use of air chambers as an intermediate layer in the mattress or as an insert in one of the foam layers; the use of strings in the upper part of the spring block; or the use of systems that vary the working height of the resilient elements from the bottom of these systems to change the initial length of the resilient elements.

[0005] More specifically, the European Patent ES2414656 document discloses a furniture device that comprises a system for adjusting firmness by separating two plates adjacent to a group of resilient elements. It has a deformation element that moves one of the plates vertically to increase or decrease the deformation of the resilient elements from the part under them. One problem presented by the invention ES2414656 lies in the actuation zone, since the plate acts on the whole resilient group, while another problem of ES2414656 is the inability to be able to maintain the height of the resilient element throughout the entire trajectory of the plate.

[0006] The Patent PCT WO2014117995 document discloses a mattress with adjustable firmness and height. The firmness is adjusted by increasing or decreasing the tension created on some non-resilient strings located in the upper part of the spring block, which are parallel to the relaxation surface, while the height is adjusted by cams that push the resilient element along the lower part. One problem presented by said invention is the low comfort level provided since the firmness is adjusted by the tensioning of some strings transverse to the mattress, resulting in the body of the person sleeping resting on strings rather than on the springs.

[0007] The Patent PCT WO2005053466 document discloses a sprung mattress with adjustable firmness that uses one or several air chambers positioned under the springs. By inflating or deflating these airtight chambers the initial length of the spring can be modified by compressing it from its lower surface. One main problem presented by this invention is the difficulty in keeping the height of the upper layer of the springs constant when

the air chamber is inflated or deflated.

[0008] One objective of the present invention is to disclose an adjustable firmness device for relaxation furniture that does not present the aforementioned disadvantages.

[0009] The present invention therefore discloses an adjustable firmness device that uses head components to compress one or several resilient elements along the upper part that absorb the right amount of energy of each element so that the actuation zone of this device has the required force.

[0010] More specifically, the present invention discloses a device capable of adjusting the firmness by varying or absorbing the resilient force exerted by one or several of the resilient members on one or several layers of the relaxation furniture. According to the present invention, the firmness is adjusted by decreasing/increasing the density of the active resilient elements per area of relaxation surface, thus reducing/increasing the pressure exerted by the resilient members against the user. To reduce the density of resilient elements per unit of surface - or working area if only a single resilient element is involved-, it reduces the total resilient constant of the set of resilient elements and, therefore, that of the relaxation furniture. This is done by using, on each resilient element the user wishes to activate/deactivate, a head component located on the upper part of each resilient element and a means for transmitting a tensile force to the head component to compress the resilient element, thus absorbing part of the resilient energy by reducing the summation of the resilient constant of the set.

[0011] The present invention discloses variable firmness devices and relaxation furniture that comprises such devices.

[0012] More specifically, the present invention discloses an adjustable firmness device that comprises a relaxation surface, a multitude of resilient elements situated under the relaxation surface, and at least one rigid base element on which the resilient elements rest, in such a way that the resilient elements are intended to compress when receiving pressure from the relaxation surface, and return to their original shape when this pressure is removed, in which at least some of the resilient elements comprise:

- a head component on the upper part of the resilient element;
- a means for transmitting tension applied to the head component,

the means for transmitting tension to an actuating device of the means for transmitting tension being connected in such a way that the action of the actuating device causes the connected resilient element or elements to compress via the respective means for transmitting tension.

[0013] The resilient element or elements are compressed via a head component on the upper part and a rigid element in the base, in such a way that a string is

preferably passed along the rigid element, whose end is attached to the head component so that it can exert a tensile force on the string and thus compress the resilient element or elements. Since they are resilient, the elements return to their original shape once the compressive force exerted on them has stopped.

[0014] The means used to transmit the tension from the actuator to the resilient element can preferably be any flexible element that only transmits a tensile force and never a compressive force. More preferably, the means for transmitting tension is a string, a thread or a cable.

[0015] The means used to drive the strings could be an electrical linear or rotational actuator, or it could be done manually using a hand crank system. The actuating device preferably has means for regulating its action so that compressions of varying magnitude can be produced. Even more preferably, the actuating device is an electrical, mechanical or hydraulic linear actuator, or an electrical, mechanical or hydraulic rotational actuator. In the present invention, a hydraulic actuator is considered to be an actuator that uses a pressurised fluid or gas to transmit a force or torque, a definition normally used in the technical field in which the invention falls.

[0016] The actuating device can be operated preferably using a control device attached by cable, by a radio-frequency device, by an RFID device, via a Bluetooth receiver and computer application; a mobile network or Wi-Fi device; by an electronic or computerised artificial intelligence system, or manually using a system of hand cranks and/or cams actuated by human force.

[0017] The actuating device is preferably fixed to the rigid base element. It can be located, for example, on the rigid base, in the lower part or even inside the rigid base element.

[0018] The aforementioned resilient elements are preferably springs or a set of springs, or a foam block or set of foam blocks.

[0019] The rigid base element could preferably comprise a board or combination of boards, a support structure or combination of support structures. It could preferably be composed of one or several materials such as wood, metal, polymers or resin-bonded fibres, for example.

[0020] The adjustable firmness device that is the subject of the present invention is intended to be incorporated in any furniture designed for relaxation/comfort, with one or several devices potentially being included in the same piece of furniture. The device applies especially for use in mattresses, chairs, armchairs, sofas and easy chairs, although the invention is not necessarily limited to said application. The adjustable firmness device that is the subject of the present invention can be inserted into one of the layers of the relaxation furniture.

[0021] Lastly, the furniture that is the subject of the present invention has an adjustable firmness device which, by means of a flexible media for transmitting tension that is attached to a head component, can absorb

part of the resilient potential energy of the resilient element or elements on which a force is to be exerted to compress said elements, in order to adjust the pressure exerted by the resilient element or elements on the product's user.

[0022] More specifically, the present invention discloses a piece of relaxation furniture that comprises an adjustable force device to compress some resilient elements, in such a way that they compress when receiving a pressure force from the relaxation surface, and return to their original shape when this pressure is removed.

[0023] To provide a better understanding, some drawings are attached of various embodiments of the adjustable firmness device that is the subject of the present invention, which serve as explanatory but non-limiting examples.

Figure 1 shows an illustration of a front elevation view of a first embodiment of an adjustable firmness device in a neutral position, in the maximum mattress firmness configuration.

Figure 2 shows a front elevation view of the adjustable firmness device of the previous figure in a contracted position, the minimum mattress firmness configuration.

Figure 3 shows a cross section of a second embodiment of an adjustable firmness device controlled by a linear actuator, in which some of its internal components can be seen.

Figure 4 shows a cross section of a third embodiment of an adjustable firmness device controlled by a rotational actuator.

Figure 5 shows a perspective view of the adjustable firmness device of the previous figure, in the neutral position.

Figure 6 shows a perspective view of the adjustable firmness device of the previous figure, in a contracted position.

Figure 7 is a perspective view of a fifth embodiment of an adjustable firmness device with a foam block as a resilient element.

Figure 8 is a perspective view of a sixth embodiment of an adjustable firmness device with a profiled foam block as a resilient element.

Figure 9 is a perspective view of a seventh embodiment of an adjustable firmness device with a set of foam blocks as resilient elements.

[0024] Figure 1 shows a set of resilient elements 1, 11 positioned on a rigid board 4. A linear actuator 3 is posi-

tioned on the board 4. Some resilient elements 11 have head components 2. As seen in the figure, the forces F are transmitted from the actuator, passing along the rigid base 4. The means for transmitting the forces F (threads or cords 6, for example) are connected to a coupling part 8 of the means of transmission to the actuator in order to drive said transmission means. When it passes along the rigid board 4, the force F vector changes direction in accordance with a component perpendicular to the resilient elements. The force F ends up being applied on the head components located on the upper surface of the affected resilient elements 11 to exert pressure that causes these resilient elements 11 to compress. Although the action of the force F has been represented, Figure 1 shows an example of the neutral position of the resilient elements, where no forces F are generated. In the neutral position, the device presents maximum firmness, which is transmitted to the relaxation surface of the relaxation furniture on which the device is installed (neither the relaxation surface nor the furniture are represented in the figures).

[0025] Figure 2 shows a side view of the same device in Figure 1, with the resilient elements 11 compressed, thus producing the device's minimum firmness.

[0026] In Figures 1 and 2, the resilient elements are pockets made of materials with resilient properties.

[0027] Figure 3 shows a second embodiment of an adjustable firmness device which has a rigid base in the form of structure 5, with a linear actuator 3 inside said structure 5 and threads 6 tasked with compressing the resilient elements 11 via the head components 2 situated on the upper part of the resilient elements 11. In the example shown, the resilient elements 11 comprise pocketed springs 12.

[0028] Figure 4 shows a third embodiment of an adjustable firmness device which is similar to the previous figure, the difference being in the actuation method, since the threads 6 are tightened using a rotational actuator 7, which converts its driving torque into a tensile force on the thread or threads. The remaining elements are similar to the previous embodiments and identified using the same numbering.

[0029] Figures 5 and 6 show a fourth embodiment of an adjustable firmness device similar to the previous ones, with a rigid base in the form of structure 5 and with some resilient elements 1, 11 in the form of pocketed springs. In this embodiment, some resilient elements 11 can be compressed as required, while other resilient elements 1 cannot. Figure 5 shows the neutral position where all of the resilient elements 1, 11 are at the same height since there is no tension in the cords or threads. This situation represents the device's maximum firmness. Figure 6 shows the state of maximum tension in the cords or threads, where the selected resilient elements 11 are contracted due to the force exerted by the actuating device. This situation causes the density of resilient elements per surface area to be reduced. This situation therefore represents the device's minimum firm-

ness. Between the neutral position (Figure 5) and that of maximum tension (Figure 6), there are an infinite number of compression points for the resilient elements, which implies an infinite range of different levels of firmness. For this, the force exerted by the actuating device must be adjustable.

[0030] Figures 7, 8 and 9 respectively show three adjustable firmness devices with a rigid base in the form of structure 5 and some resilient elements 1, 11 made of foam. Figure 7 shows a single foam block 11. However, the single foam block has a multitude of head components 2 that can be actuated via an actuating device (not shown in the figure). Figure 8 shows various elongated profiled foam blocks, in which some blocks are resilient elements 1 that cannot be actuated, while other resilient elements 11 are foam block elements that can be actuated. The foam blocks that can be actuated have a multitude of head components 2 for receiving the compression force. Lastly, Figure 9 shows a set of individual foam blocks in which each foam block is a resilient element. Likewise, the device has resilient elements 11 that may or may not be actuated.

[0031] The devices shown in Figures 1 to 9 can be situated inside a piece of relaxation furniture (not shown) as part of the device that provides firmness to a resting surface. For example, the devices shown may be situated immediately under the resting surface (with the upper part of the resilient elements in contact with the resting surface), or they may comprise one of various comfort layers in the piece of furniture. The resilient elements of the device that is the subject of the present invention may generally be available as resilient elements of relaxation furniture of the type already known.

[0032] The characteristics shown in each of the different embodiments can be applied to other embodiments, and combined with one another. The base used in the embodiment shown in Figures 1 and 2 may therefore be applied to the other embodiments by fixing, for example, the actuating devices to the lower part of the board 4. The base will generally be fixed, for example, by fastening it to the rest of the piece of relaxation furniture. The type of resilient elements can likewise be interchanged. As an example, resilient elements can be used in the form of different-sized foam blocks, single foam blocks, springs, pocketed springs, hollow elements made of resilient material, chambers and sections made of synthetic material, etc.

[0033] While the invention has been presented and described with reference to embodiments thereof, it is understood that these are non-limiting examples of the invention, for which there might be many variable details, constructive or otherwise, that might become evident to experts in the field once they have interpreted the subject matter disclosed in the present description, claims and drawings. All variations and equivalents shall thus be included within the scope of the present invention if they can be considered to fall within the broadest scope of the following claims.

Claims

1. Adjustable force device for relaxation furniture that comprises a multitude of resilient elements and at least one rigid base element on which the resilient elements rest, in such a way that the resilient elements are intended to compress when receiving pressure, and return to their original shape when this pressure is removed, in which at least some of the resilient elements comprise:
 - a head component on the upper part of the resilient element;
 - a means for transmitting tension applied to the head component,

characterised in that the means for transmitting tension is or are connected to an actuating device of the means for transmitting tension in such a way that the action of the actuating device causes the connected resilient element or elements to compress via the respective means for transmitting tension, in such a way that a neutral position represents the maximum firmness of the device, whereas when selected resilient elements are compressed by the actuator, the firmness of the device is reduced by means of the reduction in the density of the active resilient elements per surface area.
2. Adjustable force device for relaxation furniture according to the previous claim, **characterised in that** the means for transmitting tension is a string, a thread or a cable.
3. Adjustable force device for relaxation furniture according to either one of the previous claims, **characterised in that** the aforementioned resilient elements are springs or a set of springs, or a foam block or set of foam blocks.
4. Adjustable force device for relaxation furniture according to any one of the previous claims, **characterised in that** the actuating device has means for regulating its action so that compressions of varying magnitude can be produced.
5. Adjustable force device for relaxation furniture according to any one of the previous claims, **characterised in that** the rigid base element comprises a board or combination of boards, a support structure or combination of support structures.
6. Adjustable force device for relaxation furniture according to any one of the previous claims, **characterised in that** the actuating device is an electrical, mechanical or hydraulic linear actuator, or an electrical, mechanical or hydraulic rotational actuator.
7. Adjustable force device for relaxation furniture according to any one of the previous claims, **characterised in that** the actuating device can be operated using a control device attached by cable, by a radio-frequency device, by an RFID device, via a Bluetooth receiver and computer application; a mobile network or Wi-Fi device; by an electronic or computerised artificial intelligence system, or manually using a system of hand cranks and/or cams actuated by human force.
8. Adjustable force device for relaxation furniture according to any one of the previous claims, **characterised in that** the actuating device is fixed to the rigid base element.
9. Relaxation furniture, **characterised in that** it comprises an adjustable force device according to any one of Claims 1 to 8.
10. Relaxation furniture according to Claim 9, **characterised in that** it comprises a relaxation surface, the resilient elements being positioned in such a way that they compress when receiving the pressure from said surface, and return to their original shape when this pressure is removed.
11. Furniture according to any one of the previous claims, **characterised in that** it is a mattress, chair, armchair or sofa.

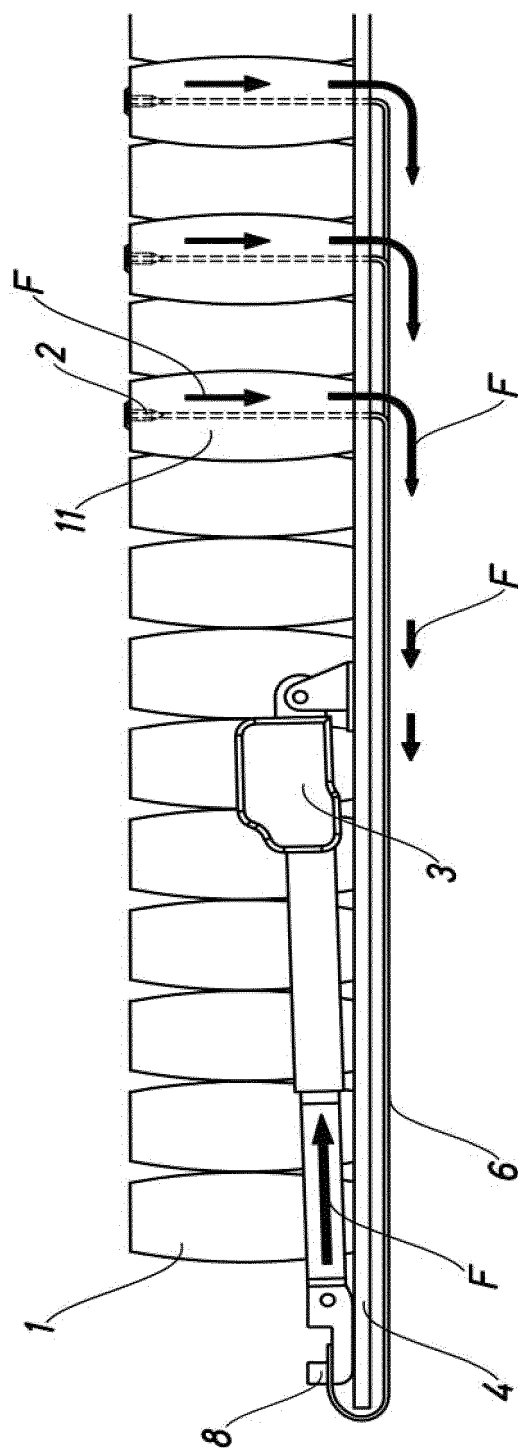


Fig.1

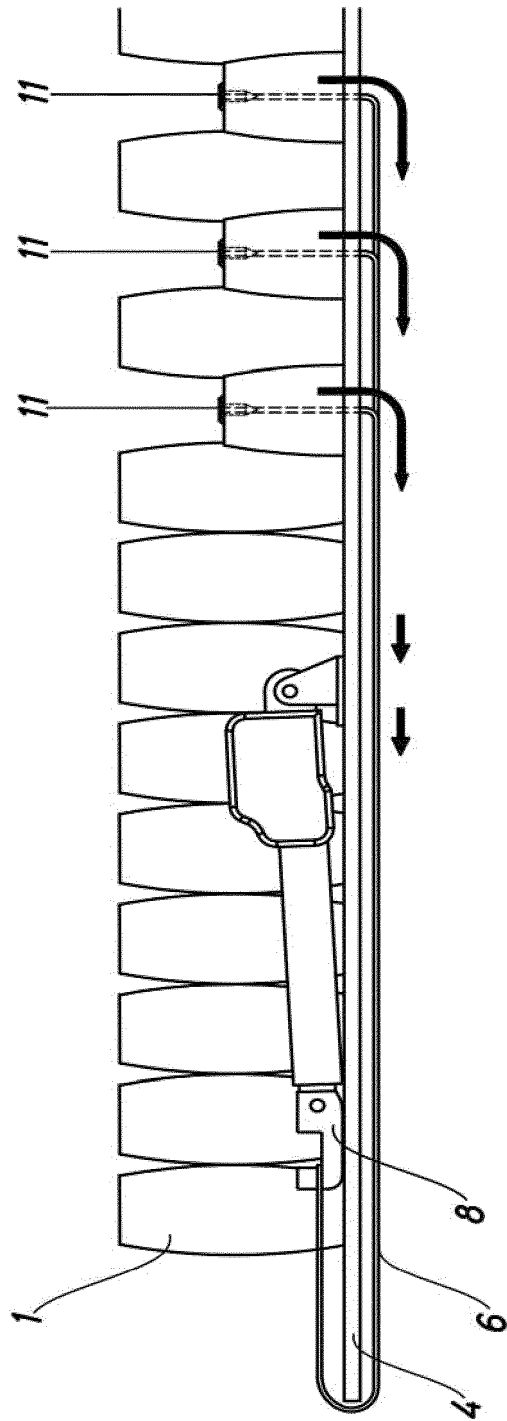


Fig.2

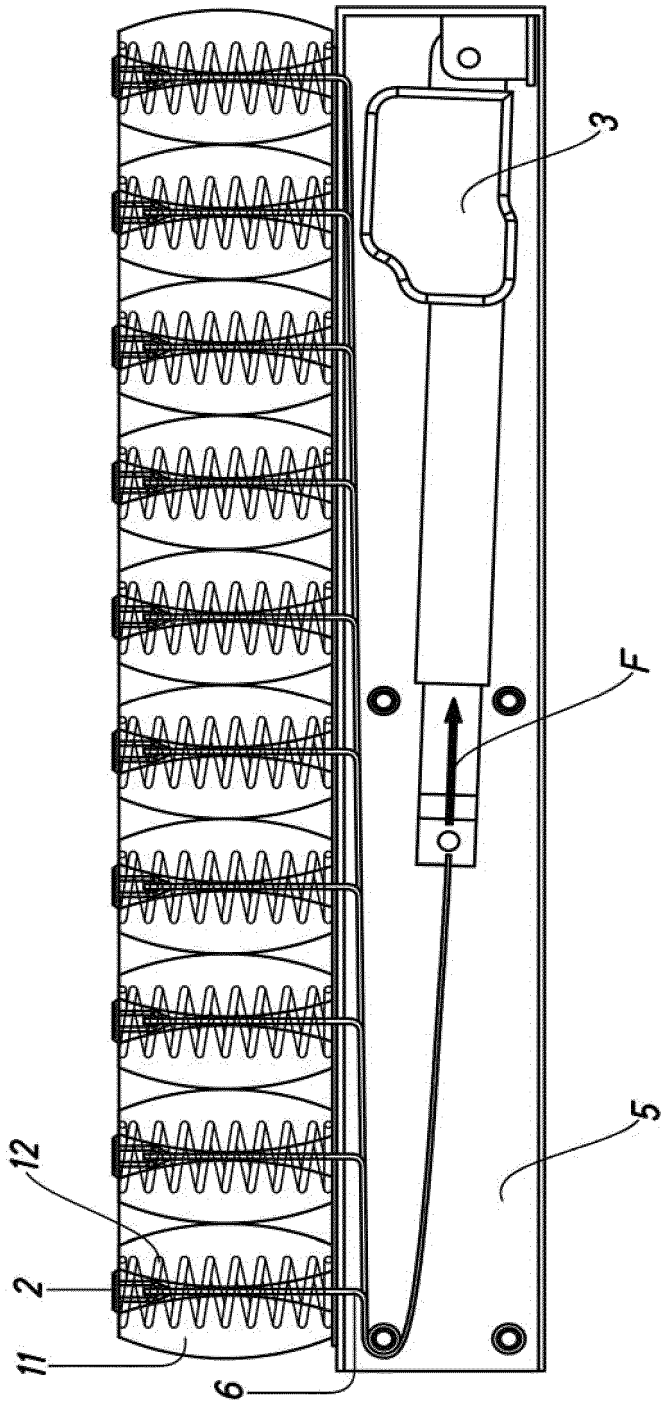


Fig.3

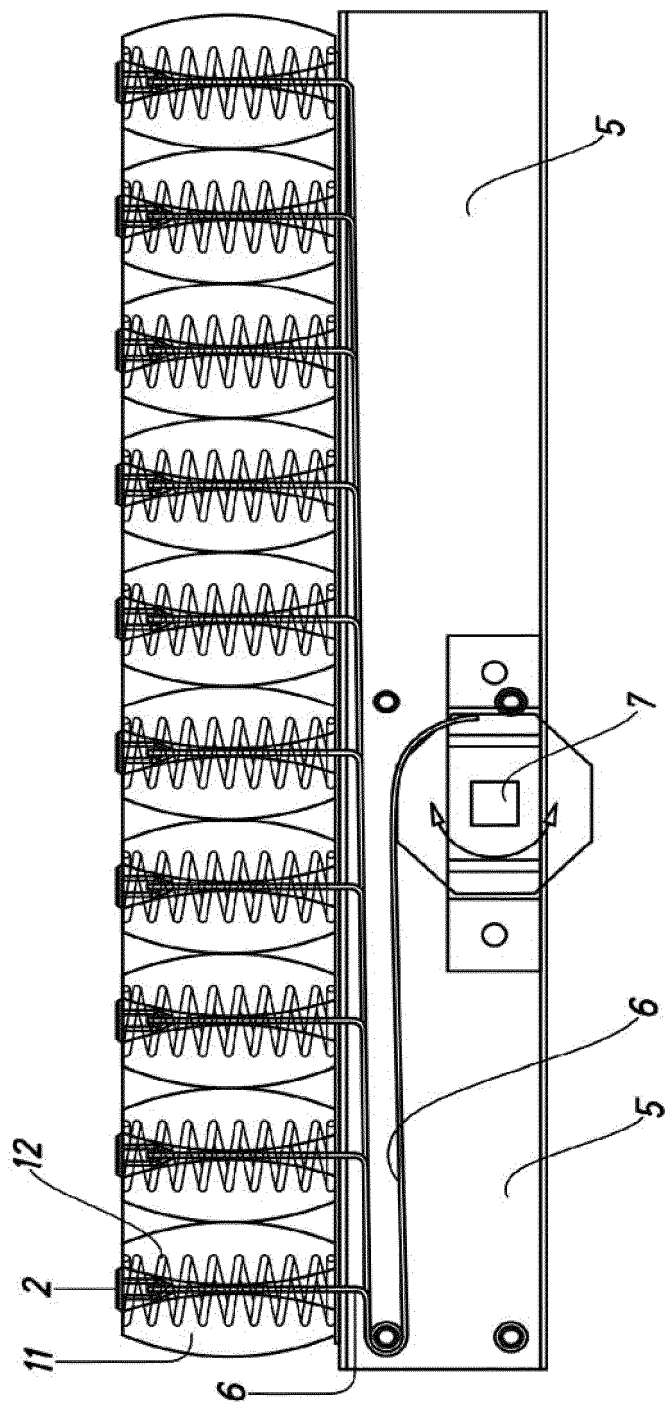


Fig.4

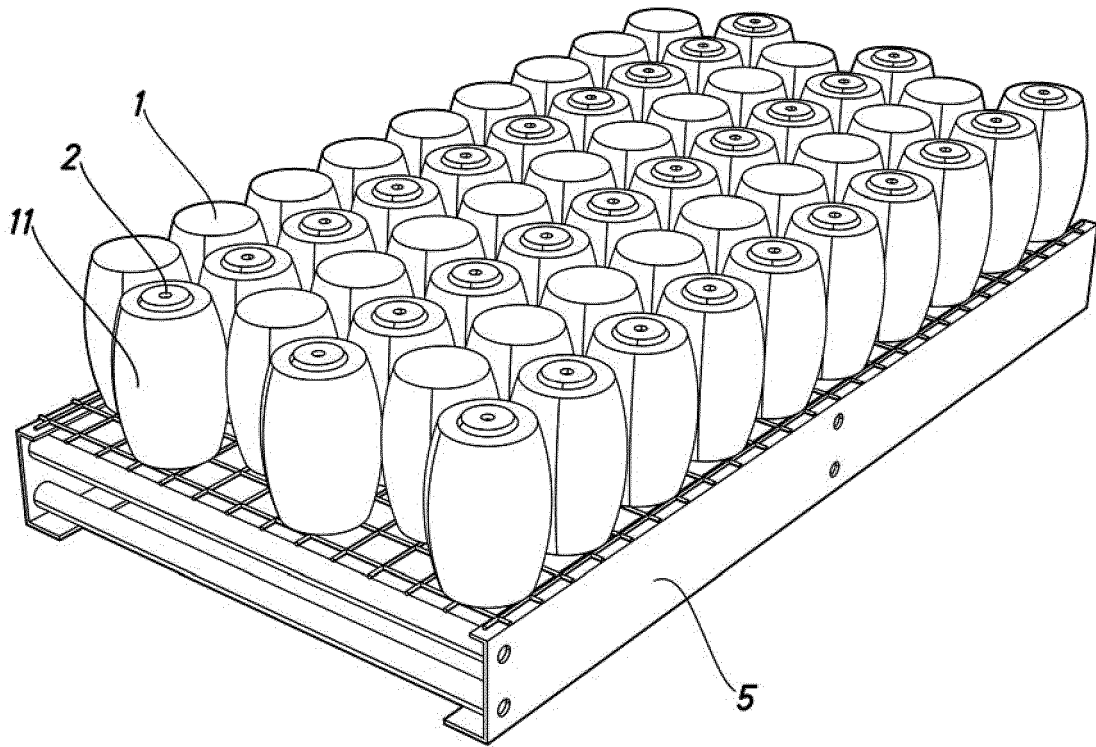


Fig.5

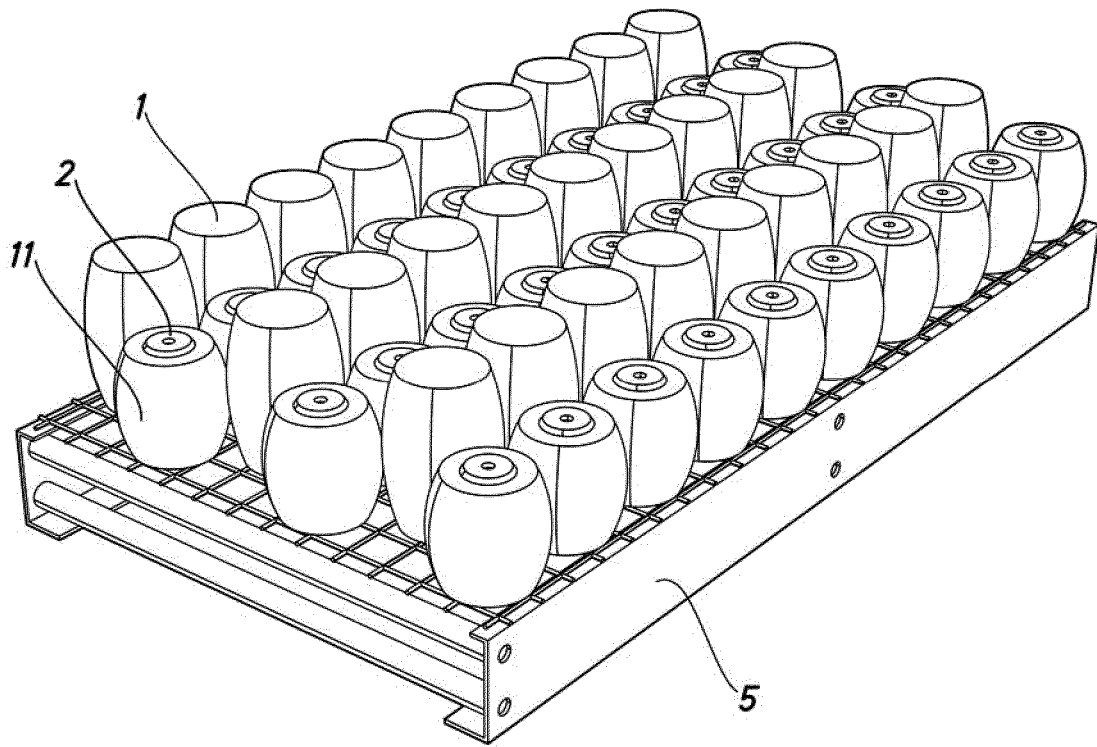


Fig.6

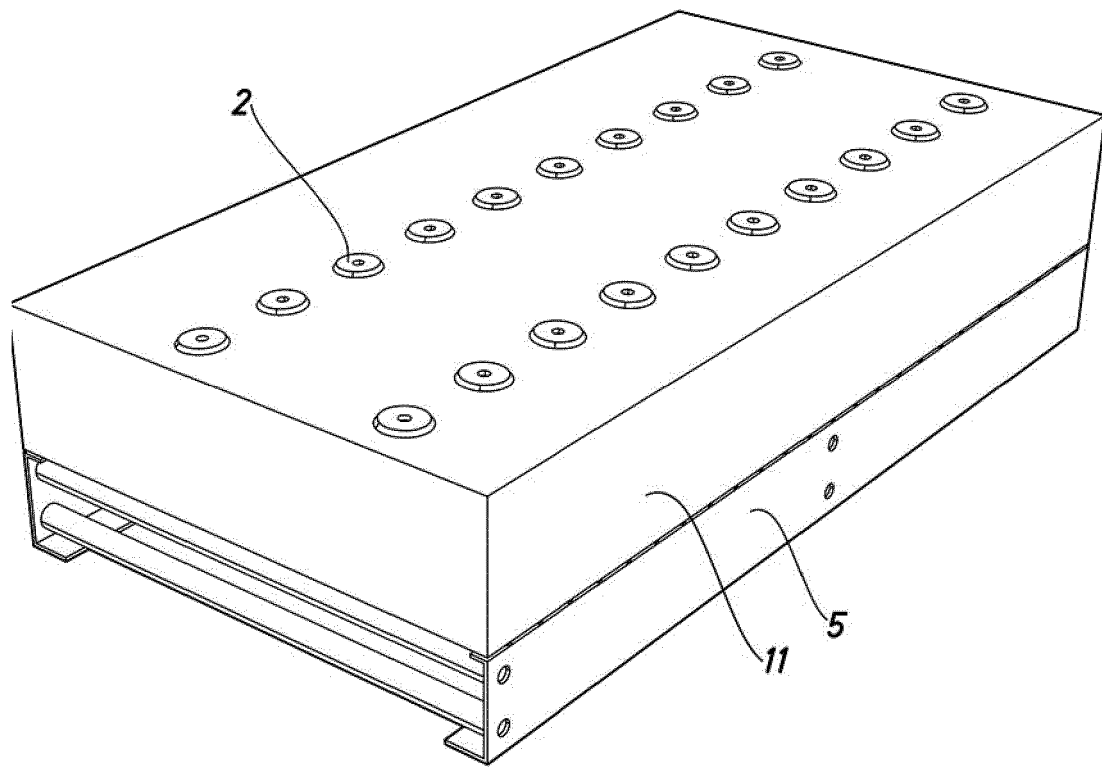


Fig.7

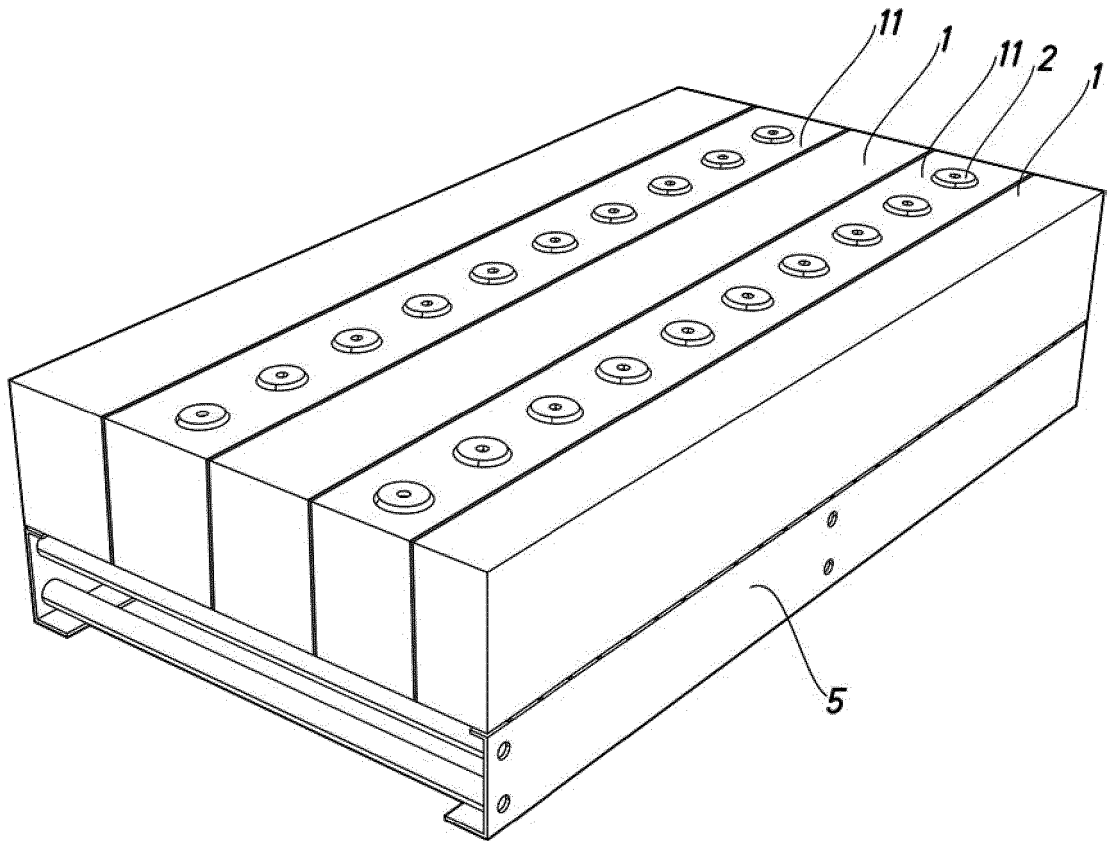


Fig.8

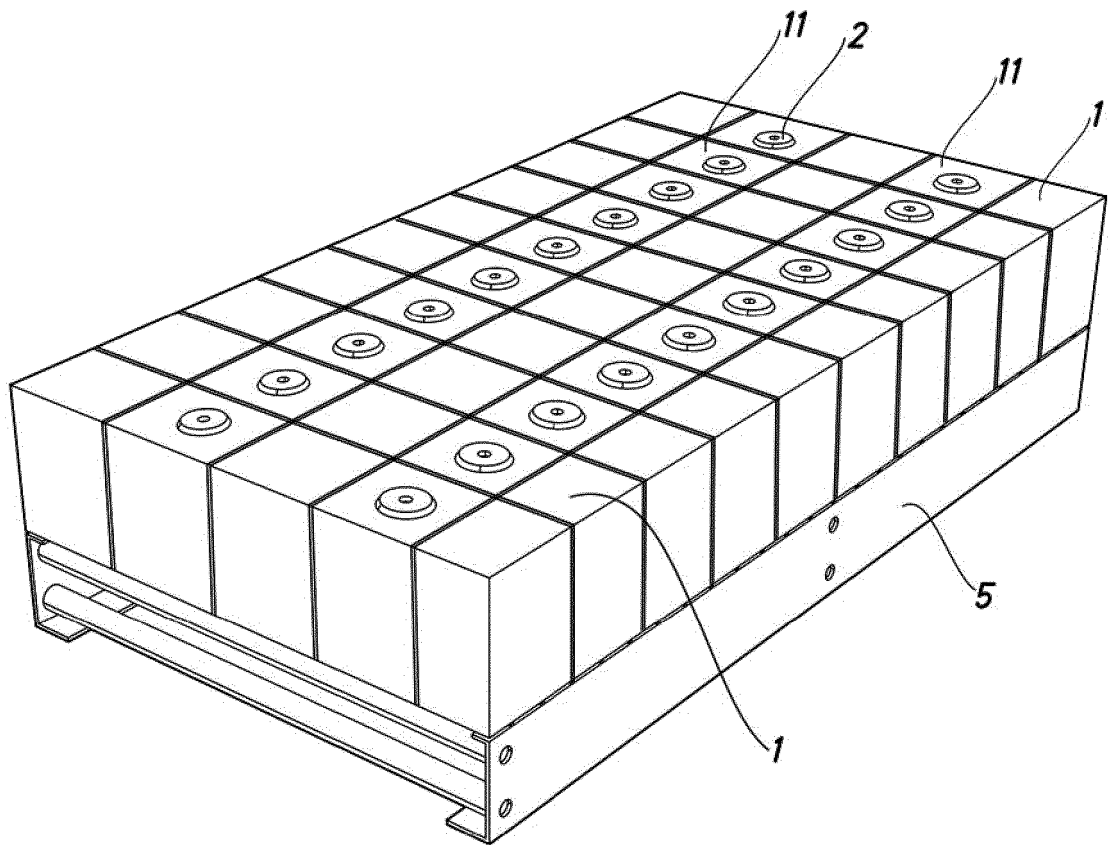


Fig.9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2020/070478

5	A. CLASSIFICATION OF SUBJECT MATTER		
	A47C23/04 (2006.01) A47C27/06 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC		
	B. FIELDS SEARCHED		
10	Minimum documentation searched (classification system followed by classification symbols) A47C		
	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPODOC, INVENES, WPI, INTERNET		
	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
20	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	A	CN 109588906 A (DONGGUAN JINZHONGXIU BEDDING ARTICLE CO LTD) 09/04/2019, Description. Figures: 1-4	1-11
25	A	SE 1550345 A1 (BED FACTORY SWEDEN AB) 13/08/2016, Description: pag. 2, lin.17 - pag. 6, lin. 3 Figures: 2a-6, 8	1-11
30	A	EP 2801297 A1 (YOU BED AB) 12/11/2014, Description: parag. 0048 - parag. 0075. Figures: 1a-5b	1-11
	A	EP 2245967 A1 (PASS OF SWEDEN AB) 03/11/2010, Description: parag. 0038 - parag. 0056. Figures: 1a-5b	1-11
35	A	US 4667357 A (FORTUNE RICHARD L) 26/05/1987, Description: col. 2, lín. 14 - col. 4, lín. 20. Figures: 1-8	1-11
40	☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance. "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure use, exhibition, or other means. "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
50	Date of the actual completion of the international search 01/09/2020		Date of mailing of the international search report (02/09/2020)
55	Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04		Authorized officer R. Bozal Callejo Telephone No. 91 3498581

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2020/070478

C (continuation).		DOCUMENTS CONSIDERED TO BE RELEVANT
Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2874390 A (STONE MORTON D) 24/02/1959, Description: col. 2, lin 72 - col. 3, lin. 56. Figures: 1-2	1-11

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2020/070478

Information on patent family members

Patent document cited in the search report	Publication date	Patent family member(s)	Publication date
CN109588906 A	09.04.2019	NONE	
SE1550345 A1	13.08.2016	SE540814 C2	20.11.2018
EP2801297 A1	12.11.2014	NO2994022T T3	26.05.2018
		NZ714858 A	28.09.2018
		US2019110605 A1	18.04.2019
		US10694861 B2	30.06.2020
		PL2994022T T3	29.06.2018
		BR112015028051	25.07.2017
		A2	31.12.2019
		BR112015028051	06.04.2018
		A8	12.03.2018
		ES2662329T T3	14.06.2017
		DK2994022T T3	01.03.2018
		RU2015152181 A	17.03.2016
		RU2015152181 A3	29.01.2019
		US2016073789 A1	19.02.2016
		US10188218 B2	08.01.2020
		KR20160019430 A	24.02.2016
		KR102050210B B1	31.07.2018
		CN105358012 A	24.12.2015
		CN105358012B B	09.08.2018
		AU2014264588 A1	13.11.2014
		AU2014264588B B2	30.06.2015
		CA2911678 A1	16.03.2016
		SE1550921 A1	27.12.2017
		EP2994022 A1	13.11.2014
		EP2994022 B1	
EP2245967 A1	03.11.2010	WO2014180924 A1	30.08.2013
			26.03.2019
		PL2245967T T3	27.06.2014
		BRPI1006761 A2	22.07.2013
		RU2521306 C1	18.10.2012
		ES2414656T T3	11.04.2012
		JP2012524567 A	25.06.2014
		CN102413736 A	15.02.2012
		CN102413736B B	18.11.2011
		KR20120014008 A	23.02.2012
		MX2011011337 A	14.05.2013
		US2012042454 A1	28.11.2011
		US8438681 B2	04.11.2010
		SG175033 A1	16.03.2011
		CA2759594 A1	04.11.2010
		CN201759166U U	06.01.2011
		WO2010124964 A2	
		WO2010124964 A3	
US4667357 A	26.05.1987		
US2874390 A	24.02.1959	NONE	
		NONE	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- ES 2414656 [0005]
- WO 2014117995 A [0006]
- WO 2005053466 A [0007]