(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 438 911 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.07.2004 Bulletin 2004/30

(51) Int Cl.[7]: **A47C 21/02**, A47C 20/04

(21) Application number: **04000603.3**

(22) Date of filing: **14.01.2004**

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

(30) Priority: **15.01.2003 SE 0300067**

(71) Applicant: **Stjernfjädrar AB**
524 21 Herrljunga (SE)

(72) Inventor: **Edling, Kenneth**
52431 Herrljunga (SE)

(74) Representative: **Lind, Urban**
Awapatent AB,
P.O. Box 11394
404 28 Göteborg (SE)

(54) Adjustable bed with improved mattress connection

(57) An adjustable bed is described, comprising at least one fixed supporting part (1), a bed bottom device (2) supported by the supporting part and having at least one part (21, 23) which is movable relative to the fixed supporting part, and a mattress (3) arranged on the bed bottom device. The underside of the mattress comprises at least one pocket (31) adapted to hold at least part of the bed bottom device for fastening the mattress to the bed bottom device. Also a simple and cost-effective basic construction of an adjustable bed is described.

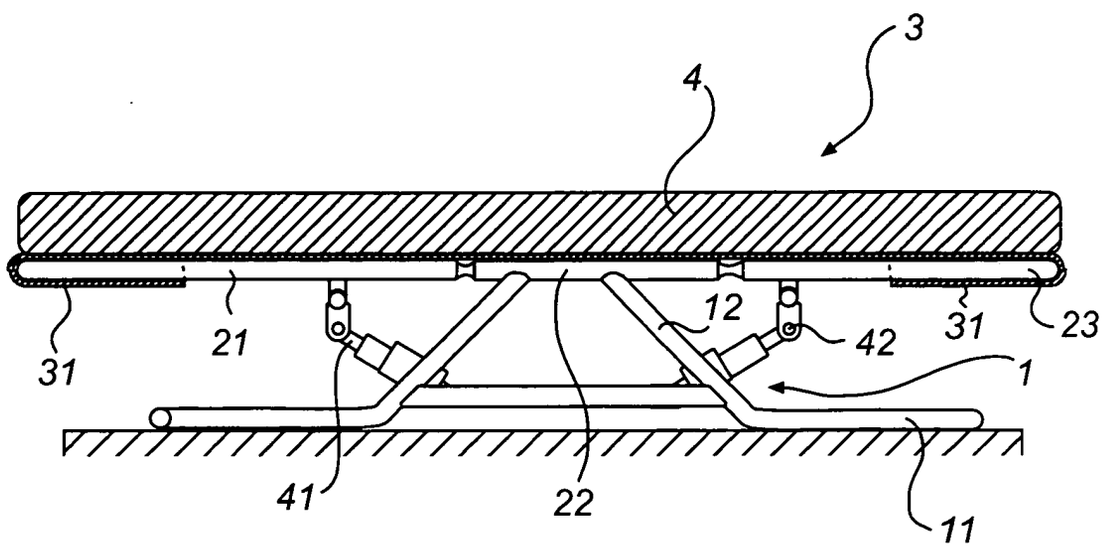

Fig. 1A

EP 1 438 911 A2

Description

Technical Field

[0001] The present invention relates to an adjustable bed and a mattress to be used with such a bed. More specifically, the invention relates to an adjustable bed of the type where the bed bottom in the longitudinal direction of the bed is divided into at least two segments articulated to each other, and adjusting means for adjusting the angle between the segments.

Background Art

[0002] Increasing efforts are devoted to making beds more comfortable. For instance, it is becoming more and more common to have adjustable beds of the type where the bed bottom in the longitudinal direction of the bed is divided into two or more segments articulated to each other, where the angle between the segments can be adjusted to the user's requirements. As a result, the bed can easily be adjusted to suit various purposes, for instance to allow sitting on the bed when reading, working, eating etc, lying on the bed when sleeping or resting, keeping the legs or head in a raised position in case of special troubles and diseases etc.

[0003] Beds of the type mentioned by way of introduction are previously known, for instance from WO 97/30614 and EP 0604240. These prior-art beds comprise four segments which can be set at different angles relative to each other by setting means.

[0004] In such adjustable beds, i.e. beds where one or more parts of the bed bottom may vary in height or in angle, it is a problem to arrange a mattress on the bed bottom. Such a mattress can be for instance, a spring mattress with coil springs, a foam-rubber mattress or the like, and ensures a soft and comfortable bed surface for the user. However, there is a problem that the mattress, if attached to the bed bottom, prevents movements of the bed and, thus, reduces the desired adjustability. This may require expensive specially designed mattresses. Furthermore, such attachment of the mattress makes it more difficult for the bed to be made, cleaned etc, and the replaceability of the mattress will also be deteriorated.

[0005] An alternative is to arrange protruding plates or the like on the periphery of the bed bottom or the bedstead. A drawback of this type of attachment, however, is that it makes the bed more expensive and more complicated to manufacture. Furthermore, it makes the bed less aesthetically pleasing. The hard edges may also cause discomfort to the user and may even constitute a risk of injuries.

[0006] Therefore there is a need for an improved method of fastening mattresses to adjustable beds.

[0007] Another drawback of adjustable beds is that they are complicated to manufacture, with a large number of components. Complicated solutions lead to, for instance, more defects. The adjustable beds are usually also very large and heavy, which makes them difficult to handle and requires a great space in the indoor environment where they are to be used etc. The above drawbacks also result in adjustable beds being very expensive to manufacture, which limits the market thereof. A further drawback of the large and complicated prior-art constructions is that there is a great risk of injuries, such as squeezing.

[0008] There is thus a need for a construction which results in simpler adjustable beds.

Object of the Invention

[0009] It is therefore an object of the present invention to provide an adjustable bed, a mattress and a method which wholly or at least partly eliminate the above-discussed drawbacks of prior-art technique.

[0010] This object is achieved by an adjustable bed, a mattress and a method according to the appended claims.

Summary of the Invention

[0011] According to a first aspect, the invention provides an adjustable bed comprising at least one fixed supporting part, a bed bottom device supported by the supporting part and having at least one part which is movable relative to the fixed supporting part, and a mattress arranged on the bed bottom device. The underside of the mattress comprises at least one pocket adapted to hold at least part of the bed bottom device for fastening the mattress to the bed bottom device.

[0012] With this adjustable bed, the mattress is thus fastened by part of the bed bottom being inserted into a pocket of the mattress. This yields flexible and yet reliable fastening of the mattress. Moreover, this construction offers great cost-effectiveness, and the mattress can very easily be mounted and dismounted, for instance, by placing the bed in a raised position.

[0013] The pocket is preferably adapted to hold a projecting part of the movable part, and it is advantageously arranged at an end of the mattress. In this manner, the pocket can be adapted, for instance, to grasp the end parts of the movable parts of the bed bottom.

[0014] In particular, it is preferred for the mattress to comprise two pockets, which are arranged at opposite ends of the mattress and have pocket openings which open towards one another. In this way, the mattress is at the same time fastened firmly in essentially all directions, which results in highly efficient attachment.

[0015] According to one embodiment, the at least one pocket is formed as a separate part, which is attached to the underside of the mattress. For instance, the separate part may consist of a sheet with pockets sewed on the underside. The separate part can then be glued, stapled, sewn or fixedly connected in some other manner to the rest of the mattress. Alternatively, the at least

one pocket can instead be integrally formed of a covering material surrounding the mattress.

[0016] The pocket is preferably made of a flexible material, preferably a textile fabric.

[0017] The pocket advantageously further comprises an expandable opening. For instance, the expandable opening may comprise a slot which is closable, for instance by means of a zip, and extends at least partly transversely of the direction of the pocket opening. Such an expandable opening facilitates mounting and dismounting of the mattress from the bed bottom device.

[0018] According to a second aspect, the invention provides a mattress for use in an adjustable bed comprising a bed bottom device and having at least one movable part. The underside of the mattress comprises at least one pocket adapted to hold at least part of the bed bottom device for fastening the mattress to the bed bottom device. Advantages are here achieved, corresponding to those of the adjustable bed discussed above.

[0019] According to another aspect, the invention provides a method for manufacturing an adjustable bed comprising the steps of providing a fixed supporting part; arranging a bed bottom device comprising at least one part which is movable relative to the fixed supporting part so as to be supported by the fixed part; and arranging and fastening a mattress to the bed bottom device by inserting at least one projecting part of the bed bottom device in a corresponding pocket on the underside of the mattress. This gives advantages corresponding to those of the adjustable bed discussed above.

[0020] According to another aspect, the invention provides an adjustable bed comprising at least one fixed supporting part and a bed bottom device supported by the supporting part and having at least one part which is movable relative to the fixed supporting part. The fixed supporting part is adapted to be arranged on a floor level and comprises a supporting part extending essentially parallel to the floor level and adapted to rest on the floor surface, and spacer elements which fixedly connect the bed bottom device to the supporting part. The spacer elements, seen in projection towards the floor level, extend over a significantly much smaller delimited surface than the supporting part. The bed bottom device and the supporting part are interconnected in such a manner that the bed bottom device with a foot end and a head end projects from the connection with the spacer elements, a free space being provided under the foot end and the head end of the bed bottom device.

[0021] This adjustable bed can be manufactured in a highly cost-effective way since it does not require a surrounding frame or the like. Instead, the bed bottom can be supported by a relatively simple base. Moreover this construction can be made very compact and light, thus making the bed easy to handle and put away. Moreover, the free space under the movable parts greatly reduces the risk of, for instance, squeezing, or even completely eliminates this risk.

[0022] Preferably, the spacer elements occupy an upwards decreasing surface, i.e. they have larger a surface towards the supporting part than towards the bed bottom device. This results in a very stable construction.

[0023] Moreover, the bed bottom device preferably comprises a frame and, attached thereto, resilient elements. The resilient elements can be zigzag spring elements. This enables a very light and cost-effective bed bottom device while at the same time it will be stable and steady. The resilient elements also make it possible to use a simpler and lighter mattress than in the case where the bed bottom device is rigid.

[0024] Moreover, it is preferred for the parts of the bed bottom device, which are movable relative to each other, to be interconnected by means of hinge elements of a rubber material. This results in a simple, light and inexpensive, but at the same reliable, hinge.

[0025] The supporting part is advantageously made of joined tubular elements, which results in a light and simple, and yet steady, bed construction.

[0026] Additional features and advantages of the present invention will be evident from the following description of preferred embodiments and the claims.

Brief Description of the Drawings

[0027] The invention will now be described in more detail by way of embodiments and with reference to the accompanying drawings, in which

Fig. 1A is a schematic side view, partly in cross-section, of an adjustable bed according to a first embodiment of the invention in an unfolded position;

Fig. 1B is a schematic side view, partly in cross-section, of the adjustable bed in Fig. 1A in a raised position;

Fig. 2A is a schematic side view, partly in cross-section, of an adjustable bed according to a second embodiment of the invention in an unfolded position;

Fig. 2B is a schematic side view, partly in cross-section, of the adjustable bed in Fig. 2A in a raised position;

Fig. 3A is a schematic perspective view, seen obliquely from above, of the adjustable bed in Figs 1 and 2, with no mattress, in an unfolded position;

Fig. 3B is a schematic perspective view, seen obliquely from above, of the adjustable bed in Fig. 3A in a raised position;

Fig. 3C is a schematic perspective view, seen obliquely from below, of the adjustable bed in Fig. 3A in a raised position;

Fig. 3D is a schematic perspective view, seen obliquely from below, of the adjustable bed in Fig. 3A, in an unfolded position;

Fig. 3E is a schematic side view of the adjustable bed in Fig. 3A in an unfolded position, and

Fig. 3F is a schematic side view of the adjustable bed in Fig. 3A in a raised position.

Description of Preferred Embodiments

[0028] A bed according to a preferred embodiment of the invention, as shown in Figs 1 and 2, comprises a supporting part 1 which supports a bed bottom device 2.

[0029] The supporting part can advantageously comprise a supporting part 11 which is adapted to rest on a floor surface and spacer elements 12 which are adapted to be connected to the bed bottom device 2 as well as the supporting part 11. Alternatively, the supporting part may, however, comprise a more traditional bedstead with a bed frame and bed legs mounted thereon. Other variants of bedsteads are also conceivable.

[0030] A mattress 3 is arranged on the bed bottom device 2. The mattress preferably comprises a resilient layer 4. The resilient layer preferably is an elastic spring layer, but other resilient layers, such as of foam-rubber material, are also conceivable. A preferred embodiment of such a mattress will be described in the following.

[0031] As is evident from Figs 1-2, the bed bottom is divided into segments in the longitudinal direction of the bed, preferably three segments: a head end segment 21, a base segment 22 and a foot end segment 23. At least some, and preferably all but one, of these segments are movable relative to the fixed bedstead 1. These segments can be, for example, adjustable so that the head end can be raised relative to the base segment as a backrest, and so that the lower foot end segment can be raised or angled down, as shown in Figs 1B and 2B. The base segment is preferably fixedly connected, for instance by welding, to the supporting part, and is preferably arranged so as to present a substantially horizontal upper face.

[0032] Adjusting means 41, 42 are arranged to adjust the inclination between the head segment and the base segment. These means may comprise, for example, one or more link arms which are operated by a piston assembly. However, several variants of the adjusting means are possible, as is known in the field. For example, other drive means instead of piston assemblies can be used, and other transmission means instead of link arms and the like can be used. Several such devices for providing the adjusting functionality of an adjustable bed are per se previously known.

[0033] A preferred variant of an adjustable bed will be described in more detail in the following.

Mattress

[0034] An embodiment of a mattress according to the invention will now be described in more detail. This type of mattress, with all, or parts of, the features that will be described below, can advantageously be used together with the adjustable bed that will be described in detail below. However, it will be appreciated that this type of mattress can also advantageously be used in many other types of adjustable beds, such as in conventional adjustable beds with a bed frame etc.

[0035] The mattress is intended for use in an adjustable bed comprising a bed bottom device 2 and having at least one movable part 21, 23.

[0036] The underside of the mattress comprises at least one pocket 31 adapted to hold at least part of the bed bottom device for attaching the mattress to the bed bottom device. The pocket/pockets is/are preferably arranged at an end of the mattress and facing the centre of the mattress. In the embodiment illustrated, the mattress comprises two pockets which are arranged at opposite ends of the mattress and have pocket openings which open towards one another. The pockets are adapted to hold and grasp a projecting part of the bed bottom device, for instance, the ends, facing away from the centre, of the foot and head end segments.

[0037] The pocket can be formed as a separate part which is attached to the underside of the mattress, as shown in Fig. 1. This part can then be attached to the rest of the mattress by keeping the surfaces together along the entire, or parts of, the surfaces engaging each other. This can be achieved by gluing, welding, stapling, seams and the like.

[0038] Alternatively, the pocket can be integrally formed of a covering material surrounding the mattress, such as a mattress case or mattress cover. Such an example is illustrated in Fig. 2.

[0039] One or more pockets may further comprise an expandable opening. This can be provided, for example, by arranging an openable slot 32 in the pocket, which preferably is arranged in a direction transversely of the pocket opening. The slot may comprise, for example, a zip for easy opening and closing. However, other means for providing closing of the slot are also possible, such as solutions involving hooks and eyes, straps, Velcro fasteners etc. The expandable opening of the pocket can also be provided by using an elastic material for the pocket or the like.

[0040] The pocket is preferably made of a flexible material, preferably a textile fabric. Other materials, such as various plastic and synthetic materials can also be used, or netting of, for example, soft metal wire.

[0041] The rest of the mattress can advantageously be a spring mattress, comprising interconnected coil springs. However, other alternatives, such as foam-rubber mattresses, are also conceivable.

[0042] An adjustable bed can thus be manufactured and mounted by carrying out the following steps. First, the bedstead for the bed is assembled as follows:

- providing a fixed supporting part and arranging a bed bottom device comprising at least one part which is movable relative to the fixed supporting part so as to be supported by the fixed part.
- arranging a bed bottom device comprising at least one part which is movable relative to the fixed supporting part so as to be supported by the fixed part.

[0043] Subsequently, a mattress is provided as de-

scribed above, and mounted on the bedstead:

- arranging and attaching a mattress to the bed bottom device by inserting at least one projecting part of the bed bottom device in a corresponding pocket on the underside of the mattress.

[0044] A mattress according to a preferred embodiment has now been described. However, many alternatives of this embodiment are possible. For example, it is possible to adjust the mattress to be connected to a plurality of variants of adjustable beds. It is also possible to adjust the pockets so as to grasp instead other parts than the ends, such as associated fingers or plates that protrude from the bed bottom device. It would also be conceivable to arrange a pocket with an expandable opening for grasping essentially the entire periphery of the bed bottom. Such a pocket could, for example, be made of an elastic material and have a circular opening edge arranged slightly inside the edge of the mattress. It is also possible to make the pockets and the rest of the mattress of many different materials. Such and other variants of mattresses must be considered to be comprised by the present invention as defined by the appended claims.

Adjustable Bed

[0045] An embodiment of an adjustable bed according to the invention will now be described in more detail. This type of adjustable bed, with all, or parts of, the features that will be described below, can advantageously be used together with the mattress described in detail above. However, it will be appreciated that this type of adjustable bed can also advantageously be used together with many other types of mattresses which are attached to the bed bottom with the aid of other means.

[0046] The adjustable bed comprises, as is especially evident from Fig. 3, at least one fixed supporting part 1 and a bed bottom device 2 supported by the supporting part and having at least one part 21, 23 which is movable relative to the fixed supporting part. Moreover, the bed preferably comprises a mattress 3 arranged on the bed bottom device, most preferred a mattress as described above.

[0047] The supporting part is adapted to be arranged on a floor level and comprises a supporting part 11 extending essentially parallel to the floor level and intended to rest on the floor surface, and spacer elements 12 which fixedly connect the bed bottom device to the supporting part. In the shown construction, the supporting part comprises two U-shaped tubular elements 111, 112 arranged so as to be positioned at the head and foot end respectively of the bed, the legs of the U directed towards each other. Other designs of the supporting part, for instance provided with projecting arms, plates or the like, are however also possible.

[0048] The spacer elements have, in projection towards the floor level, preferably a smaller extent over a significantly much smaller delimited surface than the supporting part. The spacer elements can be formed, for instance, as tubular elements 121-124, which are integrated extensions of the tubular legs of the supporting parts, and which at the other ends are joined to the bed bottom device. The attachment to the bed bottom device can be made by welding for instance. Furthermore, stabilising transverse bars 125-128 can advantageously be arranged between the tubular elements 121-124. Preferably, the spacer elements occupy an upwards decreasing surface. This can be achieved, for example, by the tubular elements 121-124 being upwardly inclined towards each other.

[0049] Other variants of spacer elements, however, are also feasible for providing a stable and separated connection of the bed bottom device to the supporting part. For instance, the entire spacer element may comprise a whole circumferential surface. Moreover, the entire spacer element can be made of one or more solid parts, instead of tubular parts.

[0050] In the shown embodiment, the bed bottom device comprises three parts:

- a fixed part 22, which preferable has a side arranged horizontally, i.e. parallel to the floor level, and turned upwards. The fixed part is also fixedly connected to the supporting part.
- A movable head end part 21, which is articulated to the fixed part.
- A movable foot end part 23, which is also articulated to the fixed part, but at the end opposite to the head end part. In this way, the bed bottom device and the supporting part will be interconnected so that the bed bottom device with a foot and head end extends from the connection with the spacer elements.

[0051] It goes without saying, however, that the bed bottom device may comprise a larger or smaller number of parts. For example, an adjustable bed of this construction may comprise only one movable head end part or foot end part. It would also be possible, for instance, for the foot end part to be divided into two or more separately movable parts. The constructions involving one or two movable parts, however, have the advantage that they present particularly cost-effective and stable solutions.

[0052] The bed bottom device can advantageously comprise at least one frame and, attached thereto, resilient elements. The frame can be made of tubular elements. For instance, the foot end part and the head end part may both comprise U-shaped tubular elements 211, 231 arranged so as to be positioned at the head and foot end respectively of the bed, the legs of the U directed towards each other. The legs can then be connected by way of straight tubular elements 221, 222 of the fixed part. The resilient element can advantageously comprise zigzag spring elements 201. However, other

spring elements are of course possible, such as attached strips or mats of an elastic material, such as rubber.

[0053] However, other designs of the parts of the bed bottom device, are possible, having for instance solid frame parts. Moreover, the parts could consist of more or less whole plates or the like.

[0054] The parts of the bed bottom device, which are movable relative to each other, are interconnected by means of hinge elements 202. The hinge elements can be made, for instance, of an elastic rubber material.

[0055] Adjusting means 41, 42 are arranged to adjust the inclination between the movable parts 21, 23 and the fixed base segment 22. In the described embodiment, the adjusting means comprise an electrically driven piston 411, 421. The pistons are at their one ends preferably movably connected to the spacer element 12, and at their other ends movably connected to the movable parts 21, 23 of the bed bottom device. The connection to the movable parts can advantageously be provided by way of a yoke 412, 422 which is fixed to the frame parts across the movable parts.

[0056] Several parts of the adjusting means, however, are possible, as is known in the field. For instance, other drive means than piston assemblies can be used, other transmission means instead of link arms etc. can be used. Several such devices for providing the adjusting functionality can be used in the adjustable bed described above.

[0057] The above-described bedstead of the adjustable bed is very robust and steady while at the same time the bed can be made very light and compact. Furthermore, this construction affords a highly cost-effective solution. The construction also provides a free space under the foot and head end respectively of the bed bottom device, which on the one hand makes the bed construction simpler and, on the other hand, reduces the risk of squeezing etc.

[0058] The bedstead of the adjustable bed that has been described above can, of course, be varied in many ways. For instance, the supporting part, the spacer element and the bed bottom device can be designed in other ways, as indicated above. Such variants of the bedstead for the bed must be considered to be comprised by the present invention as defined in the appended claims.

Summary

[0059] An adjustable bed has now been described, comprising at least one fixed supporting part, a bed bottom device supported by the supporting part and having at least one part which is movable relative to the fixed supporting part, and a mattress arranged on the bed bottom device. The underside of the mattress comprises at least one pocket adapted to hold at least part of the bed bottom device for fastening the mattress to the bed bottom device. Moreover a simple and cost-effective basic construction of an adjustable bed has been described. It will be appreciated by a person skilled in the art that the described bedstead can also be used together with other mattress constructions, and that the mattress described above can also be used together with other bed constructions, although the combination, of course, is the most preferred.

Claims

1. An adjustable bed comprising at least one fixed supporting part (1), a bed bottom device (2) supported by the supporting part and having at least one part (21, 23) which is movable relative to the fixed supporting part, and a mattress (3) arranged on the bed bottom device, the underside of the mattress comprising two pockets (31), which are arranged at opposite ends of the mattress and have pocket openings which open towards one another, said pockets (31) being adapted to hold at least part of the bed bottom device for fastening the mattress to the bed bottom device.

2. An adjustable bed as claimed in claim 1, wherein at least one of the pockets is adapted to hold a projecting part of the movable part.

3. An adjustable bed as claimed in claim 1 or 2, wherein at least one of the pockets is arranged at an end of the mattress.

4. An adjustable bed as claimed in any one of the preceding claims, wherein at least one of the pockets is arranged at a short side of the mattress for holding a foot end and/or head end of the bed bottom device.

5. An adjustable bed as claimed in any one of the preceding claims, wherein at least one of the pockets is formed as a separate part which is attached to the underside of the mattress.

6. An adjustable bed as claimed in any one of claims 1-5, wherein at least one of the pockets is integrally formed of a covering material surrounding the mattress.

7. An adjustable bed as claimed in any one of preceding claims, wherein at least one of the pockets is made of a flexible material, preferably a textile fabric.

8. An adjustable bed as claimed in any one of the preceding claims, wherein at least one of the pockets further has an expandable opening.

9. An adjustable bed as claimed in claim 8, wherein

the expandable opening has a slot which is closable, for example by means of a zip, and extends at least partly transversely of the direction of the pocket opening.

10. A mattress for use with an adjustable bed comprising a bed bottom device (2) and having at least one movable part (21, 23), the underside of the mattress comprising two pockets (31), which are arranged at opposite ends of the mattress and have pocket openings which open towards one another, said pockets being adapted to hold at least part of the bed bottom device for fastening the mattress to the bed bottom device.

11. A mattress as claimed in claim 10, wherein at least one of the pockets is arranged at an end of the mattress.

12. A mattress as claimed in claim 10 or 11, wherein at least one of the pockets is formed as a separate part which is attached to the underside of the mattress.

13. A mattress as claimed in any one of claims 10-12, wherein at least one of the pockets is integrally formed of a covering material surrounding the mattress.

14. A mattress as claimed in any one of claims 10-13, wherein at least one of the pockets further comprises an expandable opening.

15. A method for manufacturing an adjustable bed comprising the steps of

providing a fixed supporting part;

arranging a bed bottom device comprising at least one part which is movable relative to the fixed supporting part so as to be supported by the fixed part; and

arranging and fastening a mattress to the bed bottom device by inserting at least two projecting parts of the bed bottom device in corresponding pockets (31) on the underside of the mattress which open towards one another.

16. An adjustable bed comprising at least one fixed supporting part (1) and a bed bottom device (2) supported by the supporting part and having at least one part (21, 23) which is movable relative to the fixed supporting part, wherein

the fixed supporting part (1) is adapted to be arranged on a floor level and comprises a supporting part extending essentially parallel to the floor level and adapted to rest on the floor surface, and spacer elements which fixedly connect the bed bottom device to the supporting part, the spacer elements, seen in projection towards the floor level, extending over a significantly much smaller delimited surface than the supporting part; and

the bed bottom device and the supporting part being interconnected in such a manner that the bed bottom device with a foot and head end respectively projects from the connection with the spacer elements,

a free space being provided under the foot and head end respectively of the bed bottom device.

17. An adjustable bed as claimed in claim 16, wherein the spacer elements occupy an upwards decreasing surface.

18. An adjustable bed as claimed in claim 16 or 17, wherein the bed bottom device comprises at least one frame and, attached thereto, resilient elements.

19. An adjustable bed as claimed in claim 18, wherein the resilient elements comprise zigzag spring elements.

20. An adjustable bed as claimed in any one of claims 16-19, wherein the parts of the bed bottom device, which are movable relative to each other, are interconnected by means of hinge elements of a rubber material.

21. An adjustable bed as claimed in any one of claims 16-20, wherein the supporting part is made of joined tubular elements.

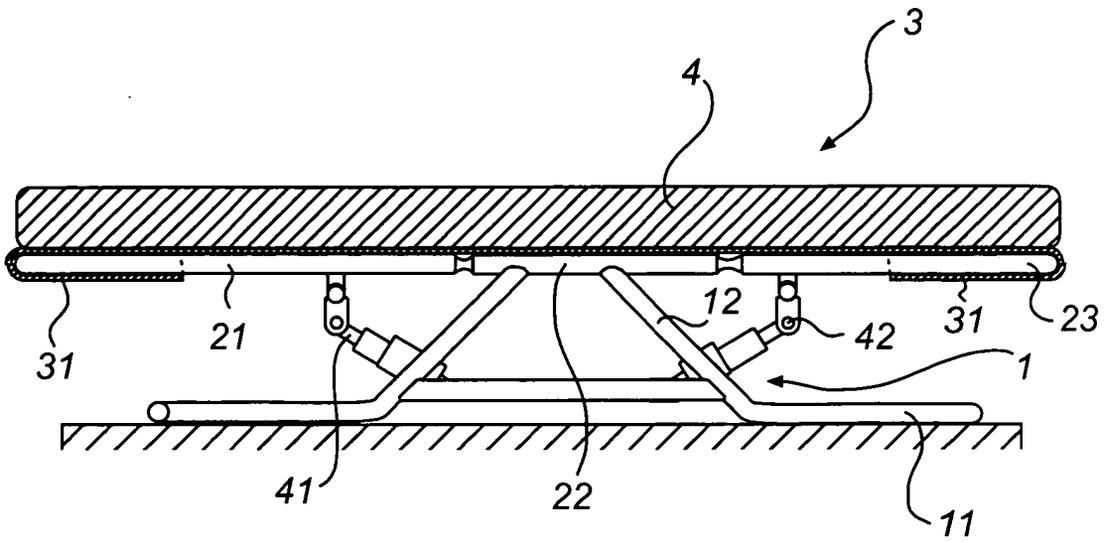

Fig. 1A

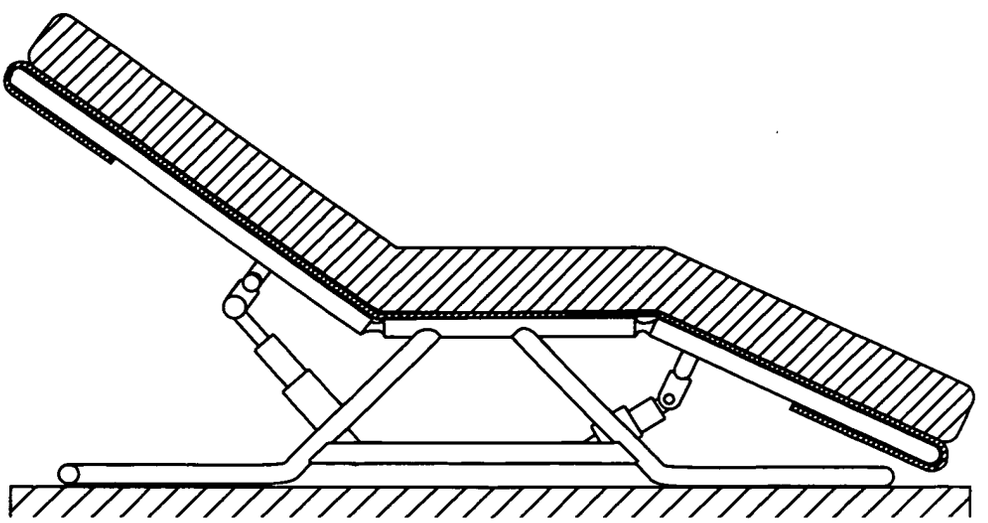

Fig. 1B

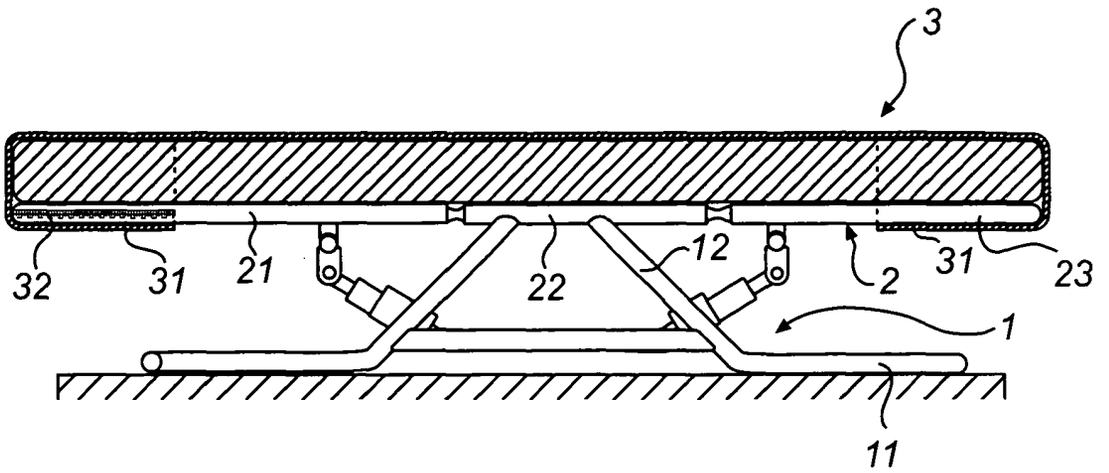

Fig. 2A

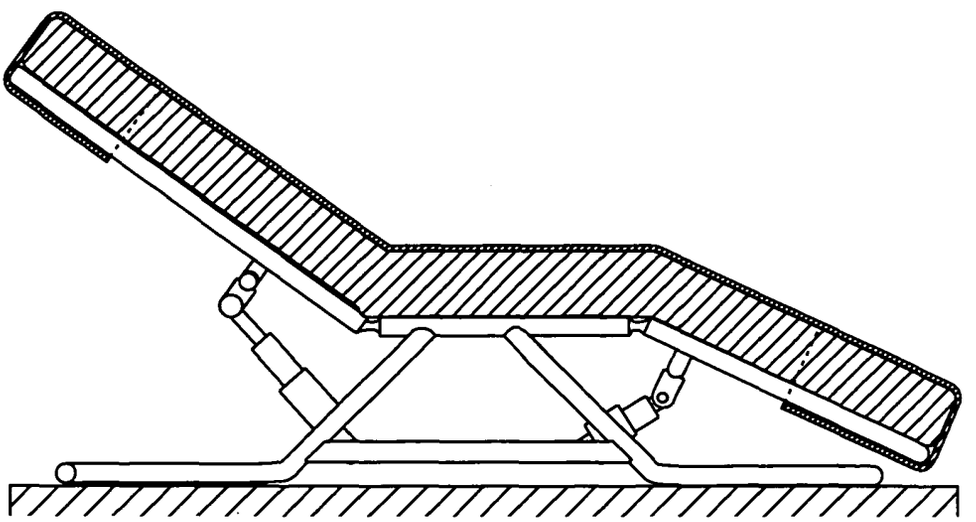

Fig. 2B

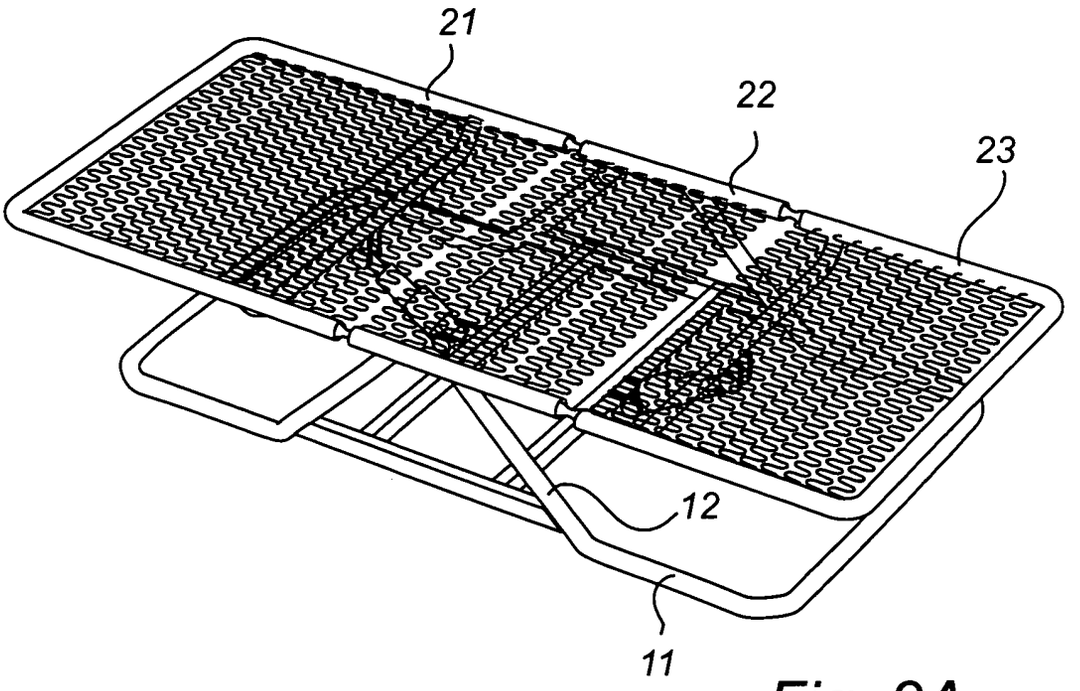

Fig. 3A

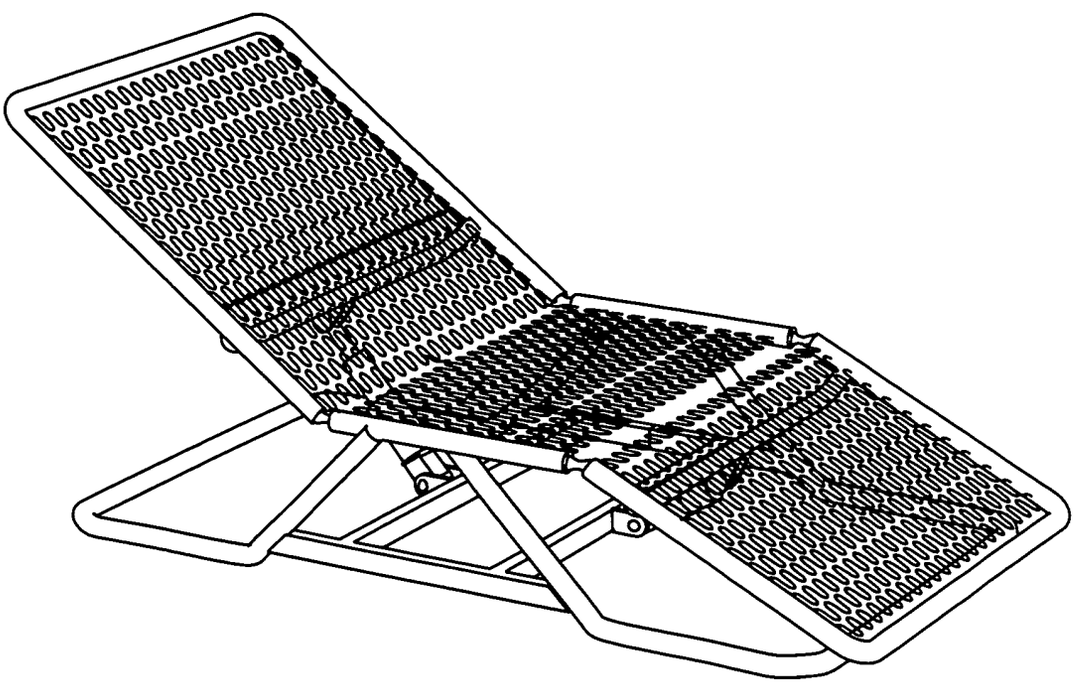

Fig. 3B

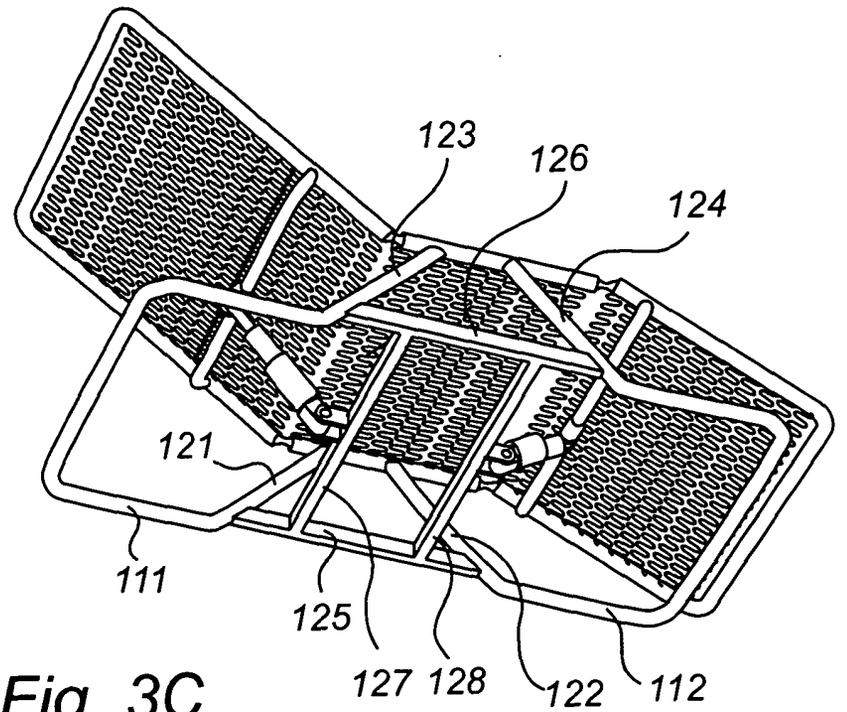
123
126
124
121
111
125
127
128
122
112

Fig. 3C

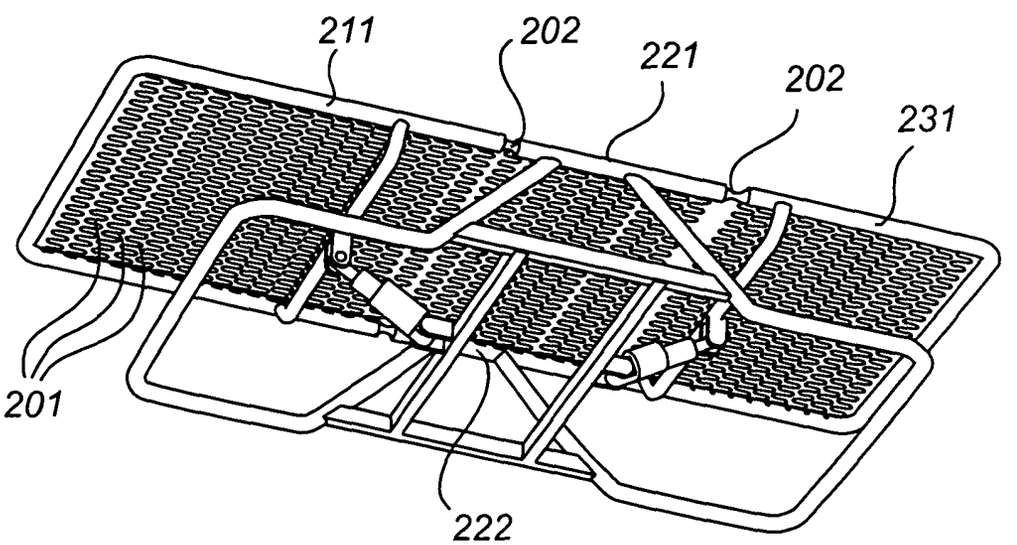
211
202
221
202
231
201
222

Fig. 3D

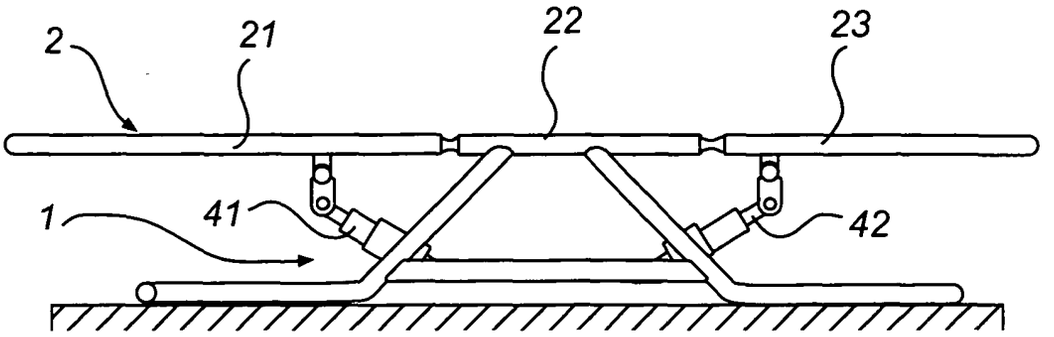

Fig. 3E

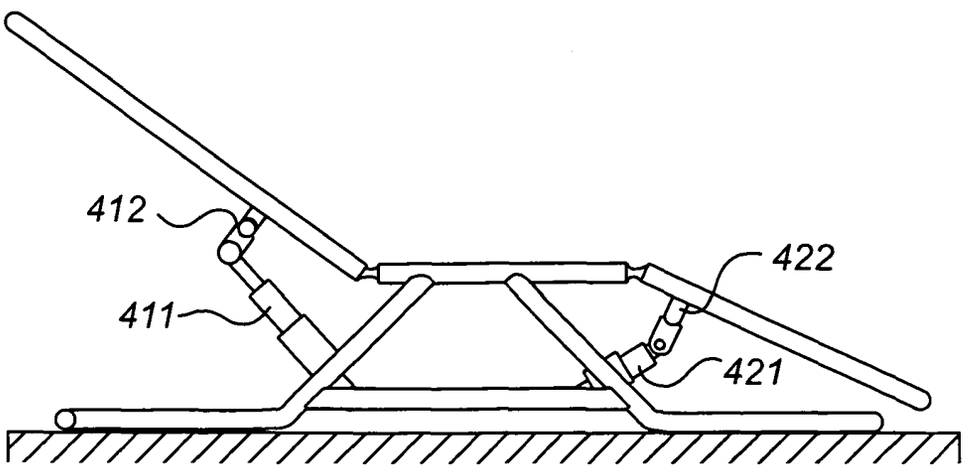

Fig. 3F