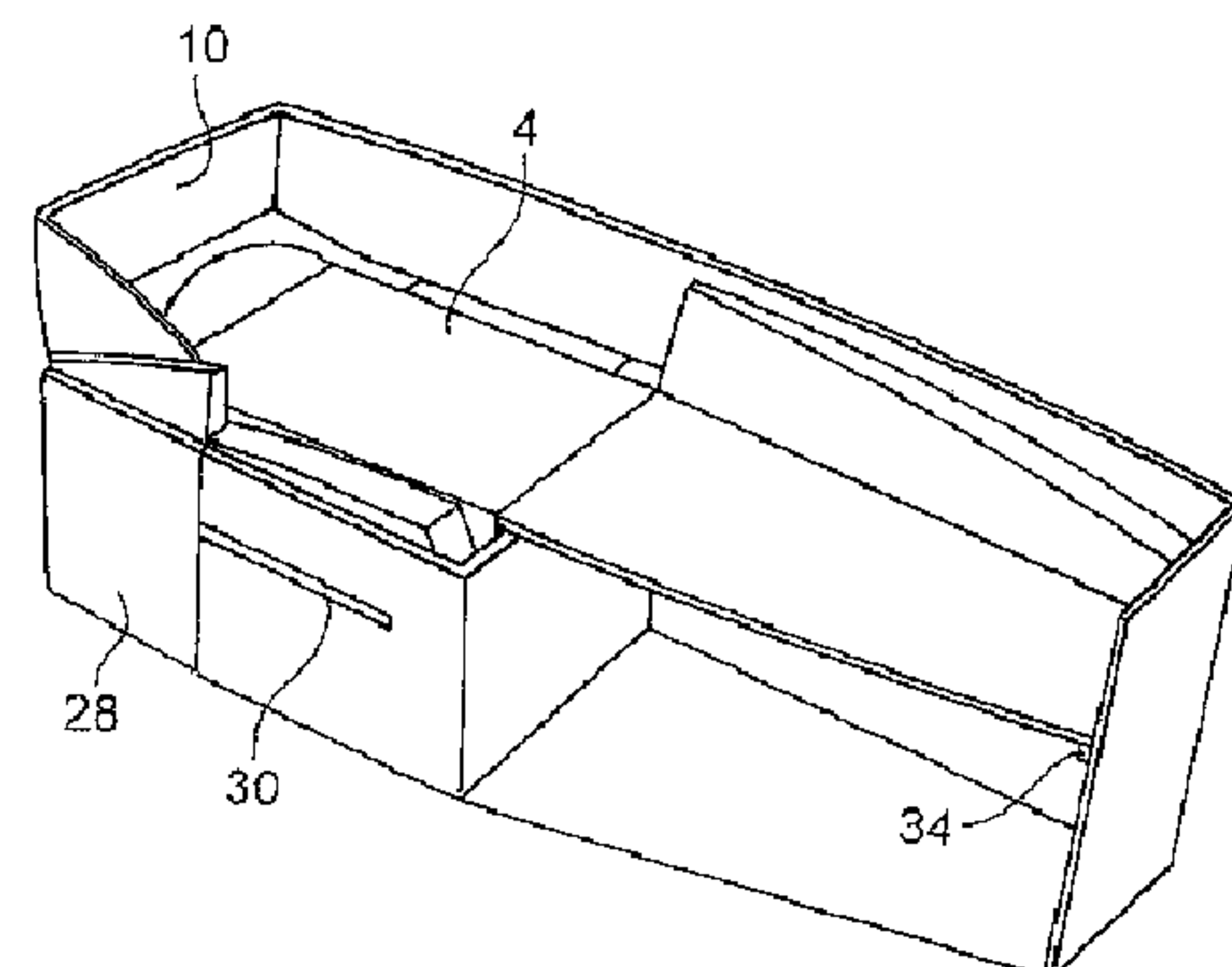
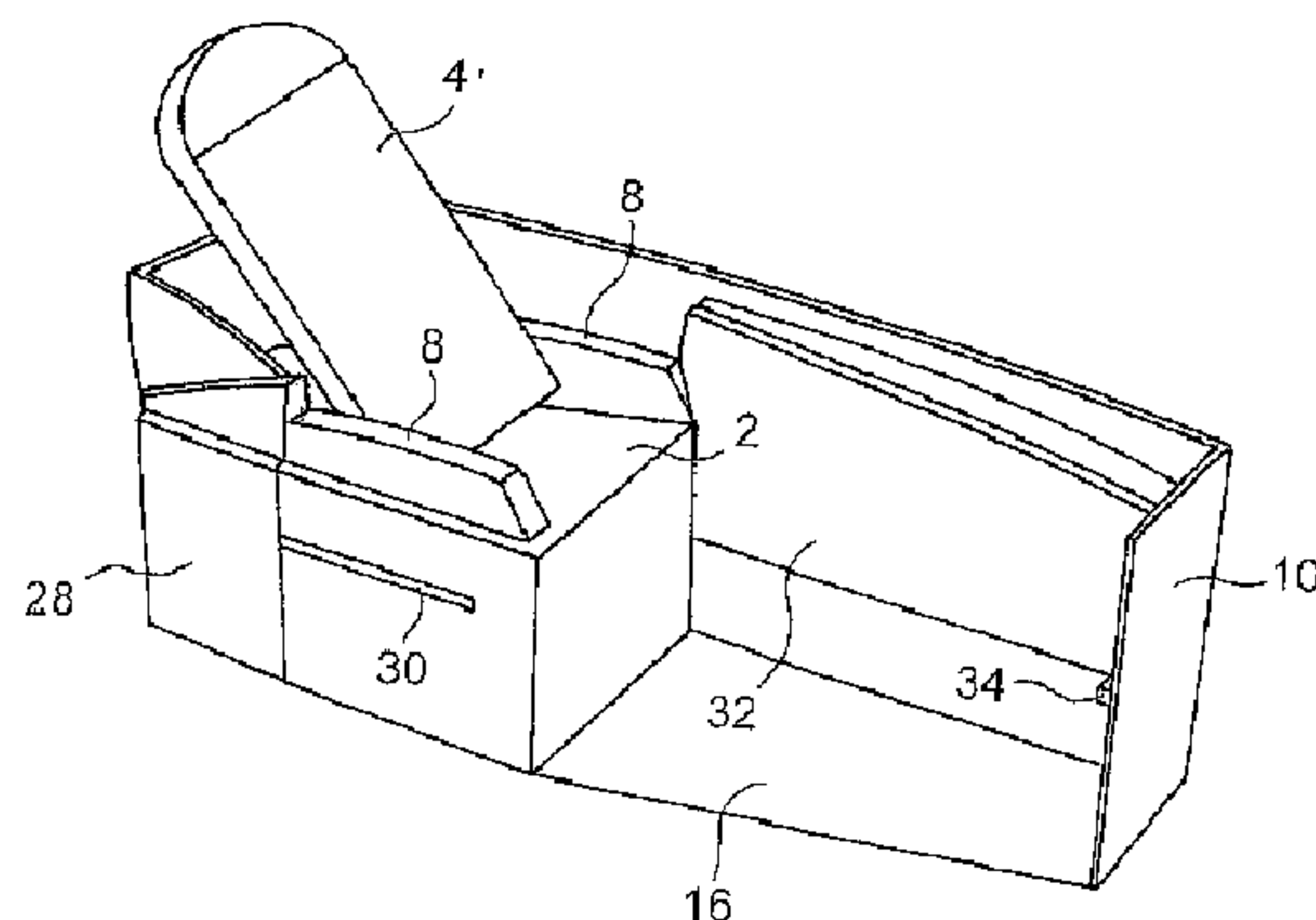
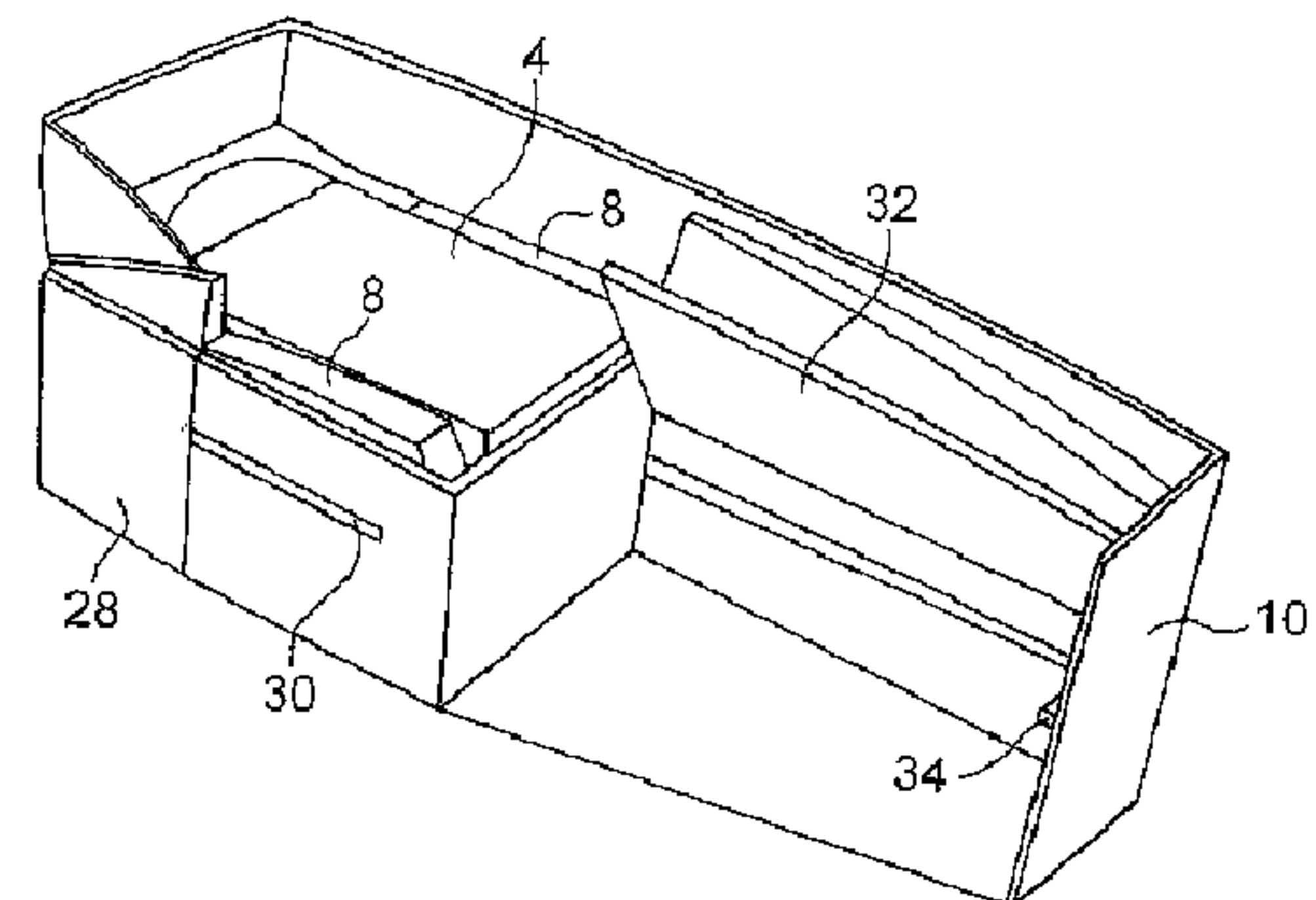
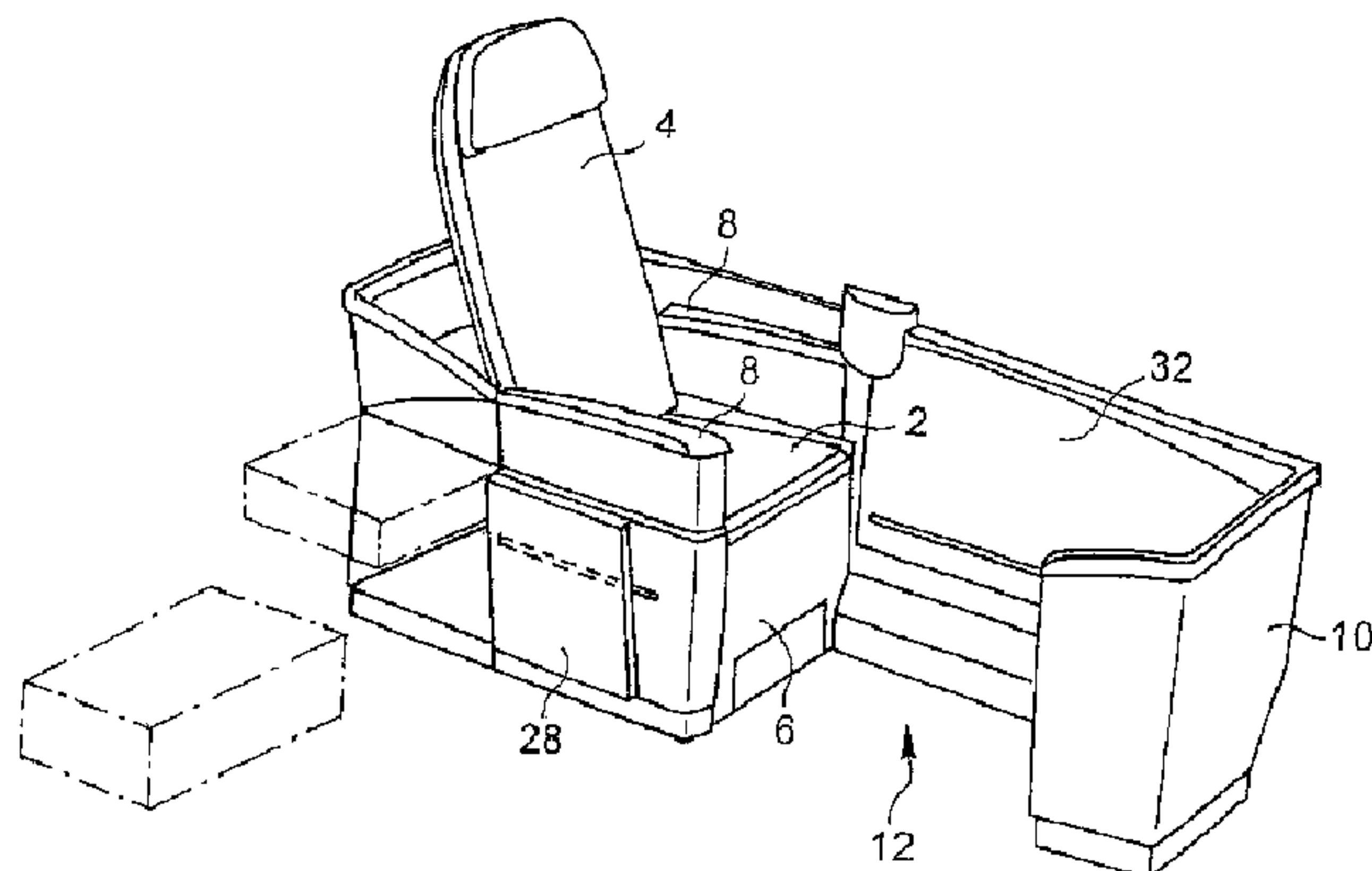




(86) Date de dépôt PCT/PCT Filing Date: 2003/11/27
(87) Date publication PCT/PCT Publication Date: 2005/04/21
(45) Date de délivrance/Issue Date: 2012/01/10
(85) Entrée phase nationale/National Entry: 2006/03/22
(86) N° demande PCT/PCT Application No.: FR 2003/003501
(87) N° publication PCT/PCT Publication No.: 2005/035360
(30) Priorité/Priority: 2003/09/26 (FR03/11330)

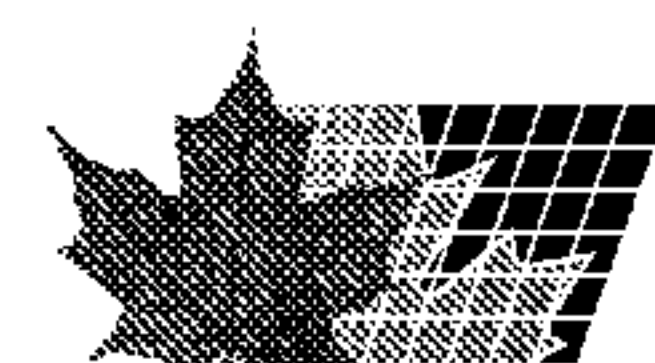
(51) Cl.Int./Int.Cl. *B64D 11/06* (2006.01),
B60N 2/34 (2006.01)
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(54) Titre : SIEGE CONVERTIBLE DESTINE A RECEVOIR UN PASSAGER D'AERONEF
(54) Title: CONVERTIBLE SEAT INTENDED TO ACCOMMODATE AN AIRCRAFT PASSENGER



(57) Abrégé/Abstract:

This seat comprises a frame (14), a seat-rest (2) borne by the frame (14), a back-rest (4) and a foot-rest (6) hinged along a transverse edge of the seat-rest (2). This seat can change from a so-called seated position in which the back-rest (4) forms an



(57) **Abrégé(suite)/Abstract(continued):**

angle with the seat-rest (2) and its base (24) is close to the rear transverse edge of the seat-rest (2) to a so-called lying-down position in which it has a substantially planar surface intended to accommodate the passenger in lying down position. The frame (14) is a fixed frame. At most two of the members of the group constituted by the seat-rest (2), the back-rest (4) and the foot-rest (6) form the substantially planar surface of the seat in lying-down position. At least one additional berth portion is provided to cooperate with the seat-rest (2) and/or the back-rest (4) and/or the foot-rest (6) to form the substantially planar surface intended to accommodate the passenger in lying-down position.

A B S T R A C T

Convertible seat intended to accommodate an aircraft passenger

This seat comprises a frame (14), a seat-rest (2) borne by the frame (14), a back-rest (4) and a foot-rest (6) hinged along a transverse edge of the seat-rest (2).

This seat can change from a so-called seated position in which the back-rest (4) forms an angle with the seat-rest (2) and its base (24) is close to the rear transverse edge of the seat-rest (2) to a so-called lying-down position in which it has a substantially planar surface intended to accommodate the passenger in lying down position.

The frame (14) is a fixed frame.

At most two of the members of the group constituted by the seat-rest (2), the back-rest (4) and the foot-rest (6) form the substantially planar surface of the seat in lying-down position.

At least one additional berth portion is provided to cooperate with the seat-rest (2) and/or the back-rest (4) and/or the foot-rest (6) to form the substantially planar surface intended to accommodate the passenger in lying-down position.

Figure 1

Convertible seat intended to accommodate an aircraft passenger

The present invention relates to a convertible seat intended to accommodate an aircraft passenger and more particularly, but not exclusively, such a seat intended to be surrounded by a wall delimiting the space around the seat intended for the person traveling in that seat.

In aircraft intended to travel long distances, several comfort classes generally are offered to the passengers. One type of seat generally corresponds to each comfort class. Accordingly, for the highest comfort class there generally are seats convertible into a bed and thus allowing the passengers to sleep in a lying-down position. There also are seats having a tilting back-rest and foot-rest. Finally, there also are seats, in general without a foot-rest, in which only the back-rest can be slightly tilted.

The space set aside for a passenger varies according to the comfort class. For reasons of comfort and safety, the seat for one passenger must not encroach excessively upon the space set aside for a neighboring passenger, in particular the passenger occupying the seat positioned behind said seat. Thus, when the seats are relatively close to each other, the tilting of the back-rest can be only a few degrees. When the seats are spaced farther apart, the tilting of the back-rest can be greater. In the latter case, the tilting is limited according to the distance separating the free end of the seat in relation to the rear of the seat-rest. Thus, by way of numerical example, it can be provided according to the distance separating two rows of seats, that one seat must not, for example, encroach more than 60 cm upon the space left in front of the seat located behind it, and this then corresponds, for example, to a 130° tilt of the back-rest.

In the compartments of an aircraft offering a seat convertible into a bed, it is known, in order to enhance the comfort of the passengers in that compartment, to surround the seat with a wall isolating the individual traveling in the seat from the rest of the compartment. A seat which is converted into a bed by simply pivoting the back-rest and the foot-rest to bring them into the plane of the seat-rest is not suited to such a compartment layout, because a considerable space is lost at the rear of each seat.

To solve this problem, document WO-96/18537 proposes a seat convertible into a bed which is found on the aircraft of some airline companies.

This seat is implemented on a frame which is mounted in sliding relationship to the floor of the cabin of the aircraft in which it is located. Then, in order to change from the easy chair configuration able to accommodate a passenger in seated position to the bed configuration to accommodate a passenger in lying-down position, a motor causes the movable frame to slide while other motors act in particular on the back-rest and the foot-rest to bring them substantially into the plane of the seat-rest of the seat.

Such a seat allows the passengers to travel under optimal comfort conditions. The seats described in this document, however, are very heavy, which puts the airline company at a disadvantage in terms of the number of passengers and pieces of luggage which can be loaded on board the aircraft.

The present invention thus has the purpose of supplying a seat convertible into a bed the mass of which is reduced. When this seat changes from its configuration provided for accommodating a seated passenger to its configuration provided for accommodating that passenger in lying-down position, or conversely, the seat should preferably remain within the space limits defined by a wall positioned around the seat and defining the space allotted to the passenger during the flight.

To this end, it provides a convertible seat intended to accommodate an aircraft passenger, comprising a frame, a seat-rest borne by the frame and a back-rest, the seat being able to change from a so-called seated position in which the back-rest forms an angle with the seat-rest which is assumed horizontal to a so-called lying-down position in which it has a substantially planar surface intended to accommodate the passenger in lying-down position.

According to the invention, the frame is a fixed frame and the seat comprises on the one hand guiding means to make the back-rest change from its seated position to a substantially horizontal position and, on the other hand, at least one additional berth portion cooperating with the back-rest to form the substantially planar surface intended to accommodate the passenger in lying-down position.

The frame here is the structure, most often of metal, which bears the various components of the seat and which must withstand the stresses to which those components and the passenger are subjected in the event of being acted on mechanically. By keeping this frame fixed, the saving in weight can be

appreciable. As a matter of fact, considering the magnitude of the stresses which the seat structure must be able to withstand, the mechanism making it possible to move that structure must be able to take up those stresses and therefore must be reinforced, which entails a considerable additional mass.

5 The guiding means are, for example, guiding means which make it possible for the back-rest to have a rotational and possibly also translational movement. The back-rest then is used to form the surface for lying down with an additional berth portion which does not necessarily include the seat-rest and/or a possible foot-rest.

10 When the back-rest has a base and a free end, the guiding means for the seat advantageously comprise translational guiding means for the base of the back-rest. Such a translation makes it possible to make the most of the space available for a passenger and thus to convert the seat into a bed without having to encroach upon the space intended for another passenger.

15 More generally, the present invention provides a convertible seat intended to accommodate an aircraft passenger, comprising:

- a frame,
- a seat-rest borne by the frame,
- a back-rest having a base and a free end, and
- 20 - possibly a foot-rest hinged along a transverse edge of the seat-rest between a position substantially perpendicular to the seat-rest and a position in which the plane of the seat-rest and the plane of the foot-rest form an obtuse angle, or are even flat,

25 said seat being able to change from a so-called seated position, in which the back-rest forms an angle with the seat-rest and its base is close to the rear transverse edge of the seat-rest, to a so-called lying-down position in which it has a substantially planar surface intended to accommodate the passenger in lying-down position.

30 According to the invention, the frame is a fixed frame, at most two of the members of the group constituted by the seat-rest, the back-rest and the foot-rest form the substantially planar surface of the seat in lying-down position, and at least one additional berth portion is provided to cooperate with the seat-rest and/or the back-rest and/or the foot-rest to form the substantially planar surface intended to accommodate the passenger in lying-down position.

The fact of keeping a frame fixed in relation to the aircraft cabin in which it is mounted makes possible a very appreciable saving in weight in relation to the convertible seats of the prior art which have a movable frame as indicated above. Furthermore, the seats of the prior art which are convertible use their back-rest, 5 their seat-rest and their foot-rest to form the planar surface intended to accommodate the passenger in lying-down position. The present invention by contrast proposes using at most only two of these three members and an additional berth portion to obtain that planar surface. Despite the use of a complementary member, the overall mass of the convertible seat according to the 10 invention can remain very appreciably smaller than the mass of the convertible seats of the prior art.

The members of the group constituted by the seat-rest, the back-rest and the foot-rest and which form the substantially planar surface if the seat in lying-down position can change from their position corresponding to the seated 15 position of the seat to their position corresponding to the lying-down position of the seat by virtue of guiding means such as, rotational guiding means (hinge, pivot, shaft, etc.) and/or translational guiding means (rails, jacks, etc.).

In a preferred embodiment, the back-rest is a component member of the planar surface intended to accommodate the passenger in lying-down position.

20 In this embodiment, the seat advantageously comprises guiding means making it possible, on passage of the seat from the seated position to the lying-down position, to guide the back-rest in such manner that the back-rest in lying-down position comes to cover most of the position of the seat-rest in its seated position. The back-rest in lying-down position then covers for example the seat- 25 rest, and an edge of the back-rest in lying-down position selected from the group comprising the base of the back-rest and its free end preferably is substantially superposed with respect to one edge of the seat-rest.

Said guiding means make it possible, on passage of the seat from the seated position to the lying-down position, to guide the back-rest in a movement 30 which advantageously is a combination of a longitudinal translation and a rotation about an axis that is substantially transverse and horizontal.

These guiding means comprise, for example, on both sides of the frame, at least one guiding rail so as to guide the base of the back-rest, on passage from the seated position to the lying-down position, from the position corresponding to the rear of the seat-rest in seated position to a position
5 corresponding to the front of the seat-rest in seated position.

In a variant embodiment, these guiding means comprise on both sides of the frame at least one guiding rail so as to guide the base of the back-rest on passage from the seated position to the lying-down position from the position corresponding to the rear of the seat-rest in seated position to a drawn-back
10 back position such that when the base of the back-rest is in this drawn-back position, the free end of the back-rest is in a position corresponding to the front of the seat-rest in seated position.

A preferred embodiment provides that the back-rest of the seat according to the invention is joined to a fixed portion of the seat by means of
15 two levers located respectively on each of the two sides of the seat-rest, that each lever is pivotally mounted about an axis substantially horizontal and transverse in relation to said fixed portion, and that the back-rest is pivotally mounted about an axis that is substantially horizontal and transverse between the two levers. This embodiment makes possible easy manipulation of the
20 back-rest to change it from its substantially vertical position to its substantially horizontal position or conversely. In addition, this technical solution is simple and low in production cost. The seat-rest is, for example, fixed to the frame, thus constituting a fixed portion of the seat, and the levers then can be mounted on the lateral sides of the seat-rest. In order to follow the shape of the
25 seat and not to form a protruding part, in particular when the seat is in seated position, the levers advantageously have an L shape. In order to facilitate pivoting of the back-rest, the two levers advantageously are joined by a plate. The latter makes it possible to rigidify the movable group comprising the back-rest. For each lever, the distance between the axis of pivoting of the lever in
30 relation to said fixed portion and the axis of pivoting of the back-rest is for example between half and three-quarters of the length of the seat-rest, in the longitudinal direction.

5a

Accordingly, in one preferred embodiment, the present invention provides a convertible seat intended to accommodate an aircraft passenger, comprising a frame, a seat-rest borne by the frame and a back-rest, the seat being able to change from a so-called seated position in which the back-rest
5 forms an angle with the seat-rest which is assumed horizontal to a so-called lying-down position in which it has a substantially planar surface intended to accommodate the passenger in lying-down position, characterized in that the seat-rest is a fixed seat-rest, and in that the seat comprises on the one hand guiding means to make the back-rest change from its seated position to a
10 substantially horizontal position and, on the other hand, at least one additional berth portion cooperating with the back-rest to form the substantially planar surface intended to accommodate the passenger in lying-down position.

In a further preferred embodiment, the present invention provides a convertible seat intended to accommodate an aircraft passenger, comprising:
15 - a frame, - a seat-rest borne by the frame, - a back-rest having a base and a free end, and - possibly a foot-rest hinged along a transverse edge of the seat-rest between a position substantially perpendicular to the seat-rest and a position in which the plane of the seat-rest and the plane of the foot-rest form an obtuse angle, or are even flat, said seat being able to change from a so-called seated position, in which the back-rest forms an angle with the seat-rest
20 and its base is close to the rear transverse edge of the seat-rest, to a so-called lying-down position in which it has a substantially planar surface intended to accommodate the passenger in lying-down position, characterized in that the seat-rest is a fixed seat-rest, and in that at most two of the members of the
25 group constituted by the seat-rest, the back-rest and the foot-rest form the substantially planar surface of the seat in lying-down position, and in that at least one additional berth portion is provided to cooperate with the seat-rest and/or the back-rest and/or the foot-rest to form the substantially planar surface intended to accommodate the passenger in lying-down position.

30 In these different embodiments described above, there are preferably provided clamping and/or locking means which hold the back-rest in its raised position when the seat is in its so-called seated position.

In the case in which the back-rest is used to form the planar surface intended to accommodate the lying-down passenger, the additional berth portion cooperating with the back-rest to form a planar surface comprises, for example, a shelf moveable between a substantially horizontal position extending forwardly in line with the back-rest when the seat is in lying-down position and a substantially lateral vertical position in the seated position. The substantially planar surface for lying down then can be made up of the back-rest in substantially horizontal position and said movable shelf. On the other hand, in a variant, in lying-down position, said movable shelf cooperates, for example, with the back-rest and a unit arranged facing and at a distance from the frame and of which the height corresponds substantially to that of the seat-rest of the seat.

An embodiment of a seat according to the invention provides that the seat-rest is pivotally mounted about a transverse axis located close to its front edge so as to be able to pivot approximately 180° and then be substantially in line with the back-rest in lying-down position. In this embodiment, the means cooperating with the back-rest to form a planar surface comprise, for example, the pivoted seat-rest as well as a unit arranged facing and at a distance from the frame and of which the height corresponds substantially to that of the seat-rest of the seat.

Another embodiment provides that it comprises a foot-rest pivotally mounted about a transverse axis located close to its front edge so as to be able to pivot approximately 90° and then be substantially in line with the back-rest in lying-down position. The means cooperating with the back-rest to form a planar surface then comprise, for example, the pivoted foot-rest as well as a unit arranged facing and at a distance from the frame and of which the height corresponds substantially to that of the seat-rest of the seat.

Said unit also can comprise a movable flap capable of pivoting approximately 180° about an axis that is substantially transverse and horizontal so as to form an additional berth portion.

An advantageous variant provides that the back-rest incorporates an additional berth portion. The latter is for example pivotally or slidingly mounted in relation to the back-rest.

There also may be provided configurations in which the back-rest is folded down but does not cover the seat-rest. Such a case is, for example, the

case in which the convertible seat comprises guiding means making it possible, on passage of the seat from the seated position to the lying-down position, to guide the back-rest in a movement which is the combination of a longitudinal translation and a rotation about an axis that is substantially transverse and horizontal, such that the back-rest and the seat-rest are in line with each other, the base of the back-rest being situated facing the front transverse edge of the seat-rest. The additional berth portion then, for example, is a fixed part mounted on the frame at the rear of the seat-rest and in line therewith.

The invention also relates to the embodiments in which the planar surface intended to accommodate a lying-down passenger does not comprise the back-rest. Such a seat according to the invention comprises, for example, guiding means making it possible, on passage of the seat from the seated position to the lying-down position, to guide the back-rest in a movement which is the combination of a longitudinal translation toward the rear and a rotation about an axis that is substantially transverse and horizontal such that the back-rest in the lying-down position of the seat is substantially perpendicular to the plane of the seat-rest of the seat. The back-rest then is put "out of the way" and stored vertically, leaving the space available for forming the surface for lying down with other members. The planar surface intended to accommodate a passenger in lying-down position then comprises, for example, the seat-rest of the seat, a fixed portion mounted on the frame at the rear of the seat-rest and in line with the latter, as well as a shelf capable of moving between a substantially horizontal position extending forwardly in line with the seat-rest in the lying-down position and a substantially lateral vertical position in the seated position.

The present invention relates very particularly to a convertible seat such as described above and characterized in that it further comprises a lateral wall surrounding in particular the rear of the seat.

In such a seat, a luggage compartment advantageously is provided between the lateral wall and the seat frame. This luggage compartment preferably comprises a lateral door which can be a door sliding in a substantially vertical plane with the aid of a substantially horizontal guiding rail borne by the lateral wall.

The present invention also relates to a module comprising a seat as well as a wall surrounding the seat at least partially, characterized in that the seat is a seat as described above.

Finally, it relates to an aircraft intended for the transport of passengers comprising at least one convertible seat as described above.

Details and advantages of the present invention will appear more clearly from the following description, made with reference to the attached
5 schematic drawing in which:

Figure 1 represents a seat according to the invention in its configuration to accommodate a passenger in seated position,

Figures 2 and 3 schematically show the seat of Figure 1 when it is in intermediate positions between its so-called seated position and its so-called lying-
10 down position,

Figure 4 schematically shows the seat of Figure 1 converted into a bed,

Figures 5a to 5e are schematic side views showing the movement of the back-rest of the seat of Figures 1 to 4 during passage from the position of Figure 1 to that of Figure 3,

15 Figures 6a to 6d, 7a to 7d, 8a to 8d, 9a to 9d, 10a to 10d, 11a to 11d and 12a to 12d schematically show seven distinct embodiments of a convertible seat according to the invention, respectively in seated position, in a first intermediate position, in a second intermediate position and in the lying-down position, and

20 Figures 13a to 13c schematically show in side view a preferential embodiment of an easy chair intended for a seat according to the invention in a first seated position, in a second seated position with the back-rest inclined toward the rear and in a lying-down position.

Figure 1 shows a first embodiment of a seat according to the invention.
25 This seat comprises a seat-rest 2, a back-rest 4 and a foot-rest 6. On each side of the seat-rest 2 there also is an armrest 8, in each case.

This seat is intended to accommodate an aircraft passenger and to be fixed to the floor of an aircraft cabin. This seat is more particularly intended for a first-class compartment of an aircraft or else possibly for a business-class
30 compartment. Then to clearly delimit the space given to the passenger traveling in the seat, a wall 10 surrounds that space. It is understood that the seat is located within that space and an opening 12 formed in the wall 10 allows access to the interior of that space and to the seat. The wall 10 has, for example, a height of approximately 80 cm, which substantially corresponds to the height of the

armrests 8. Thus a person seated in the seat can converse with a neighboring person and be relatively well isolated from the other travelers when the seat is converted into a bed. It is understood, however, that a different height can be chosen.

5 Figure 1 shows the seat in a so-called seated position in which it is intended to accommodate a passenger traveling in seated position. Figures 2 and 3 show intermediate positions of the seat of Figure 1 prior to reaching the so-called lying-down position illustrated in Figure 4. In the latter position, the seat has a substantially planar surface for lying down intended to accommodate a
10 passenger in lying-down position.

 Figures 5a to 5e illustrate the passage of the back-rest 4 from its substantially vertical raised position corresponding to the seated position of the seat (Figure 1) to its substantially horizontal lengthwise position corresponding to the lying-down position of the seat (Figures 3 and 4). These Figures 5 illustrate
15 only the easy chair accommodating the passenger in seated position and not all the components of the seat also allowing it to be converted into a bed.

 Figures 5a to 5e make it possible to better perceive the structure of the seat itself. The latter comprises a frame 14 having four legs for it to be fixed to the floor. This fixing is performed, for example, in a manner conventional in the field of
20 aeronautics. In aircraft cabins, provision usually is made to incorporate into the floor 16 longitudinal rails (not illustrated) distributed over the entire width of the cabin and extending over substantially the entire length thereof. These rails have regularly spaced anchoring points, generally with a pitch of 2.54 cm, or one inch. Each leg of the frame 14 then comes to be fixed in known manner to an anchoring
25 point of such a rail.

 In the following description, it is considered that the space is oriented as perceived by a passenger seated (or lying down) in the seat. The floor 16 of the cabin therefore is at the bottom and is horizontal, while the seat is above the floor. The back-rest 4, in the seated position of the seat, is at the rear of the seat. The
30 armrests 8 are arranged longitudinally and are to the right and left of the seat-rest 2.

 The frame 14 has a framework connecting the legs at a distance from the floor. The seat-rest 2 of the seat is integrally fixed to this framework. The rear legs of the frame 14 extend upward above the framework to serve as a support for

the armrests 8.

As for the back-rest 4, it has pins 18 mounted at the end of legs 20. The pins 18 are guided in grooves 22 formed on the frame 14, on the longitudinal edges of the framework. The back-rest 4, in the seated position of the seat, has a base 24 located at the bottom at the level of the seat-rest 2 and a free end situated remote from the base 24 and bearing a headrest 26. The legs 20 are each attached to the base 24 of the back-rest 4 and furthermore bear a pin 18 at their free end. Each pin 18 extends substantially horizontally crosswise in relation to the seat. Two legs 20 are located on each side of the back-rest 4 and substantially form a V the free ends of which each bear a pin 18. The grooves 22 are formed on a substantially vertical plate, one plate being arranged to the left of the seat-rest 2 and another to the right thereof. Clamping and/or locking means are provided to hold the pins 18 in a given position in the corresponding groove 22. These clamping and/or locking means possibly are remote controlled, for example by a lever arranged at the front end of an armrest 8.

Figure 5a shows the back-rest 4 in its raised, substantially vertical position corresponding to the seated position of the seat. The pins 18 then abut on the rear of the corresponding grooves 22.

Figure 5b shows the back-rest 4 when the latter is starting to tilt to approach the horizontal position. In this first movement, the back-rest pivots around the axis defined by the two upper pins 18. These latter remain in abutment on the bottom of the groove 22 and the lower pins 18 move toward the front in the lower grooves 22.

After this first pivoting movement, the back-rest 4 advances toward the front of the seat in an essentially translational movement (Figure 5c). The base 24 of the back-rest 4 then approaches the front of the seat-rest 2.

When the base 24 of the back-rest 4 comes close to the front of the seat-rest 2 (Figure 5d), the translational movement of the back-rest toward the front is combined with a rotation so as to bring the back-rest 4 into a substantially horizontal position as illustrated in Figure 5e.

It is noted in these Figures 5 that the movement of the back-rest 4 takes place without being hindered by the wall 10. The frame 14 and the wall 10 are arranged in relation to one another such that in the substantially horizontal lengthwise position of the back-rest 4, on the one hand the headrest 26 is close -

at most a few centimeters away - to the wall 10, and on the other hand, the base 24 of the back-rest is substantially above the front transverse edge of the seat-rest 2.

Given that the height of the back-rest 4 is greater than the length of the seat-rest 2, when the conditions of the preceding paragraph are satisfied, a space then remains between the frame 14 which is beneath the seat-rest 2 and the wall 10. This space advantageously can be used for the storage of luggage. Thus there is noted in Figures 1 to 4 the presence of a sliding door 28 on the wall 10, arranged at the level of the floor 16 of the cabin and at the rear of the seat, to allow access to and closing of that storage space. A horizontal guiding rail 30 is, for example, provided in the wall 10 to allow sliding of that door 28.

The presence of such a storage space behind the seat is very advantageous. As a matter of fact, the storage volume made available in this way is greater than the volume usually provided per passenger in an aircraft cabin. Furthermore, this layout of a luggage compartment behind the seat and on the floor 16 entails practically no additional weight, as is the case when luggage compartments are set up overhead in an aircraft cabin.

The passage of the back-rest 4 to the horizontal position does not make it possible to accommodate a passenger in lying-down position. Complementary means then are provided to cooperate with the back-rest 4 in horizontal position in order to create a surface for lying down capable of comfortably accommodating a man in lengthwise position. Figures 3 and 4 show these additional means and illustrate their implementation.

An additional berth portion 32 is provided inside the wall 10. When a passenger is traveling seated in the seat, this additional berth portion 32 is stored vertically along the wall 10, inside the latter, in front of the frame 14. This additional berth portion 32 has a planar surface complementary to the surface of the back-rest 4 to form a full berth capable of accommodating a passenger.

This additional berth portion 32 could be simply a member independent from the rest of the seat and from the wall 10 which would be held, for example, with the aid of straps when it is stored vertically along the wall 10 and which would be detached in order to place it in horizontal position to cooperate with the back-rest in horizontal position to form a berth.

It is preferable, however, to provide guiding means to facilitate the

passage of the additional berth portion 32 from its vertical stored position to its horizontal "service" position. Thus, for example, a substantially horizontal shaft can be provided at the bottom of the additional berth portion 32 when the latter is in vertical stored position along the wall. This shaft then is engaged in a substantially vertical guiding groove on the one hand on the seat side, for example the groove can be formed on a front leg of the frame 14, and on the other hand on the wall 10 side facing the seat. Then when the shaft of the additional berth portion 32 abuts in the high position, or else even during movement of that shaft in the corresponding grooves, the additional berth portion 32 is pivoted (cf. Figure 3) to assume a horizontal position (cf. Figure 4). This additional berth portion 32 is held in this horizontal position by resting on the front transverse edge of the seat-rest 2 as well as on a ledge 34 formed on the inner surface of the wall 10 opposite the seat.

In conventional manner, the seat according to the invention also can comprise a foot-rest 6 as in the embodiment illustrated in Figure 1. This foot-rest 6 can for example be tilted to support the legs of a passenger traveling in seated position and to enhance his comfort. Such a foot-rest is not described in further detail here because, on the one hand, it is known to the person skilled in the art, and on the other hand, in this described embodiment it is not involved in the conversion of the illustrated easy chair into a berth.

It may be noted in Figures 3 and 4 that the armrests 8 are in a lowered position in relation to the position of Figure 1. In this way, the passenger traveling lying down is not made uncomfortable by these armrests 8 which also can be used to increase the surface for lying down.

The convertible seat so formed can have a mass appreciably smaller than the mass of the convertible seats which are found in current aircraft. This is achieved in particular by virtue of the fact that the frame 14 is a fixed frame which does not move. This seat therefore is of a completely innovative design. As a matter of fact, in the prior art, an easy chair is converted into a berth by placing the back-rest of the easy chair, its seat-rest and its foot-rest beside each other, in substantially the same plane. In order then to be able to be converted into a bed, while remaining in a given rather restricted delimited space, it then is preferable in the state of the art prior to the invention to move the seat-rest of the easy chair. The solution provided described hereinabove does not require any movement of

the seat-rest. In comparison with the convertible seats of the prior art, it involves an additional member, the additional berth portion 32, and although it has this additional member, the total mass can be considerably smaller than the mass of a conventional convertible aircraft seat.

5 In addition to the very significant advantage as regards the seat mass, the solution provided above has another significant advantage as regards the storage of luggage traveling in the cabin. This solution makes it possible to eliminate the luggage compartments which usually are found overhead in aircraft cabins, which provides a further advantage in terms of mass. Another advantage
10 is to make it possible to have a considerably greater feeling of space in the aircraft cabin. In addition, the luggage is easier to store, since it becomes unnecessary to pick it up to lift it into a compartment: it suffices to slide it on the floor, which is considerably more ergonomic. Finally, as the luggage is stored at floor level, there is no risk of its falling down when the luggage compartment is opened.

15 Figures 6 to 12 show the variant embodiments of a convertible aircraft seat according to the invention, which also offers numerous advantages in relation to the convertible seats of the prior art.

 The seats and other members illustrated in Figures 6 to 12 also can be surrounded by a wall 10 such as that shown in Figures 1 to 5. This wall preferably
20 is provided for all these embodiments in order to delimit the space given to a passenger. Nonetheless, to prevent this wall from concealing portions of the seat, it is not illustrated in these Figures in order to better show the conversion of the seat into a berth.

 In the embodiment of Figure 6, the back-rest 4 also cooperates with an
25 additional berth portion 32, which can be identical to the one of the preceding Figures and which therefore bears the same reference, to form a berth. The difference here is the direction of pivoting of the back-rest 4 to change from its substantially vertical position to its horizontal position. Whereas in the first embodiment described previously, the back-rest 4 was pivoted such that its front
30 surface in the seated position becomes the upper surface in lying-down position, in this second embodiment, it is the rear surface of the back-rest 4 in seated position which becomes the upper surface in lying-down position.

 In order to accomplish this new pivoting and translational movement symbolized by black arrows in Figure 6b, grooves 42 are provided. Like the

grooves 22, they are formed laterally on the frame 14. Instead of being substantially at the height of the seat-rest 2, however, they are behind the latter. The grooves 42 thus make it possible to guide the base of the back-rest 4 in translation toward the rear at the same time that the back-rest 4 pivots to fold
5 down on the seat-rest 2.

Once the back-rest 4 is folded down, there is seen again the same additional berth portion 32 as in the first embodiment, which is translated upward and pivots - black arrows in Figure 6c - to form a substantially planar surface for lying down. The additional berth portion 32 here also rests, for example, on a
10 ledge such as the ledge 34 of the preceding Figures, but which has not been illustrated here.

In the variant embodiment of Figure 7, the back-rest 4 adopts the same movement as in the embodiment of Figure 6 and is guided by grooves 42 to pass from the substantially vertical raised position to the substantially horizontal
15 position.

In this embodiment, the passenger has facing him a unit 36 which can have several functions. It can serve simply as a seat in the event that this passenger wishes to welcome another passenger and converse with him. This unit 36 also can serve as storage, for example, for a comforter and a pillow which are
20 used when the seat forms a berth. It also can serve to house a television or computer screen. All these functions are given by way of nonrestrictive example.

This unit 36 has an upper portion which is substantially at the same height as the back-rest 4 when the latter is in horizontal position. To then form a berth when the back-rest 4 is folded down horizontally, provision is made to use an
25 additional berth portion 32', similar to the additional berth portion 32 of the preceding Figures. Nonetheless, considering the presence here of the unit 36 and the upper portion thereof, the additional berth portion 32' is of reduced size in relation to the additional berth portion 32 described previously. This additional
30 berth portion 32' of reduced size also is stored vertically between the easy chair and the unit 36 and passes from its vertical stored position to its horizontal "active" position by translation and pivoting, as illustrated by the two black arrows of Figure 7b. Here also a shaft can be provided for pivoting. There also can be provided merely two grooves, one on the side of the frame 14 of the seat and the other on the side of the unit 36 for storage of the additional berth portion 32'. In horizontal

position, the additional berth portion 32' thus comes to rest on the seat-rest 2 and the unit and forms a substantially planar berth with the folded down back-rest 4 and the upper portion of the unit 36.

5 In the embodiment of Figure 8, the back-rest 4 passes from its substantially vertical raised position to its horizontal position in the same manner as for the embodiment of Figures 1 to 5.

10 In this fourth embodiment of a seat according to the invention, there is again to be found an additional berth portion 40. In original manner, this additional berth portion 40 is stored in the back-rest 4. It has substantially the same length as the back-rest 4 and a slightly lesser width.

The back-rest 4 can be hollow, for example, and thus have a tubular form of rectangular section, possibly closed at the end opposite the base of the back-rest 4. The additional berth portion 40 is then housed in the cavity of the back-rest.

15 The back-rest 4 also can have a U-shaped section. The base of the U forms the front surface of the back-rest 4 when the latter is in raised position, that is, the surface against which the passenger leans when he is sitting in the seat. The two branches of the U then form a runner in which the additional berth portion 40 slides.

20 Once the additional berth portion 40 has been brought outside the back-rest 4, it should be positioned at the same level as the back-rest 4 by a translation of a few millimeters, or centimeters, upward. For this purpose, there can be provided a mechanism similar, for example, to that used to extend a table. Extensions are accordingly stored under the table top and are made to slide in
25 order to bring them out, and at end of travel the extension is positioned in the same plane as the table top. Here furthermore, considering the significant overhang, provision also is made to support the free edge of the additional berth portion 40. A support 38 thus is positioned facing the easy chair. It is in the form of a vertical wall facing the easy chair. Holding lugs (not illustrated) are for example
30 provided on the surface of the support 38 located on the easy chair side to accommodate and hold the free end of the additional berth portion 40.

The fifth embodiment illustrated in Figure 9 is a variant embodiment of the fourth embodiment. There is again found the same movement of the back-rest 4 to pass from the substantially vertical raised position to the substantially

horizontal position, and an additional berth portion 40' is incorporated into the back-rest 4.

Here the additional berth portion 40' is pivotally mounted with respect to the back-rest 4. It thus suffices to provide a hinge at the base of the back-rest 4
5 between the latter and the additional berth portion 40' to bring the latter into horizontal position. To convert the seat into a bed, the back-rest 4 therefore is brought into its substantially horizontal position as shown in Figures 9a and 9b, then the additional berth portion 40' is pivoted in order to double the surface area for lying down obtained with the back-rest 4 placed in horizontal position. Here
10 also, considering the significant overhang, the additional berth portion 40' is held with the aid of a support 38 advantageously equipped with holding lugs.

In the embodiment of Figure 10, the back-rest 4 passes from its substantially vertical raised position to its horizontal position in the same manner as for the first embodiment shown in detail in Figures 1 to 5. As for the
15 embodiments of Figure 7, a unit 36 facing the easy chair is seen again here.

This embodiment is a variant of the embodiment of Figure 8. To be precise, there is seen again here an additional berth portion 40" incorporated into the back-rest 4 and sliding in relation thereto. By virtue of the presence of the unit 36, the additional berth portion 40" is of reduced size in relation to the additional
20 berth portion 40 of Figure 8. The passage of the seat from the seated position to its lying-down position takes place as for the embodiment of Figure 8. At the end of conversion, the berth then is formed here from the back-rest 4, the additional berth portion 40" and the upper portion of the unit 36, whereas for the embodiment of Figure 8, the berth comprises only two parts: the back-rest 4 and the additional
25 berth portion 40.

The seventh embodiment of a seat according to the invention provided here is developed, for example, from the preceding embodiment. Indeed, there again is seen a similar back-rest 4 guided by grooves 22 for the passage into its substantially horizontal position and the presence of a unit 36 facing the easy
30 chair.

The surface for lying down comprises the back-rest 4 brought into horizontal position and the upper portion of the unit 36. This does not suffice to accommodate a passenger in lying-down position and the space between the back-rest 4 in horizontal position and the unit 36 should be filled in. In this

embodiment, the invention provides for using the foot-rest 6 as is done conventionally in the convertible seats of the prior art by bringing this member of the easy chair into a substantially horizontal position, in line with the back-rest 4. It also provides for doubling up the upper portion of the unit into a fixed part and a
5 flap 44 joined to the fixed part by means of a hinge, arranged on a transverse edge of the fixed part, on the easy chair side.

The berth thus formed is made up of four members: the back-rest 4, the foot-rest 6, the flap 44 and the fixed upper portion of the unit 36.

In the eighth embodiment of a seat according to the invention provided
10 by the present description (Figure 12), the back-rest 4 of the seat first of all changes from its substantially vertical raised position into a substantially horizontal position in the same manner as for the embodiments of Figures 1-5 and 8-11. Once it is in this position, the entire back-rest 4 pivots 180° around a transverse axis substantially corresponding to the front transverse edge of the seat-rest 2. A
15 support 38 with holding lugs for accommodating and supporting the back-rest 4 again is seen facing the easy chair.

This seat also comprises a fixed additional berth portion 46 which is substantially in the same plane as the seat-rest 2 and which extends the latter toward the rear. When the seat is surrounded by a wall such as the wall 10 of
20 Figures 1 to 5, this fixed additional berth portion 46 preferably extends until it reaches that wall 10. In this manner, the surface area for lying down provided for the passenger is as large as possible, taking into consideration the dimensions of the wall 10.

Like Figures 5a to 5e, Figures 13a to 13c show an easy chair of a
25 convertible seat according to the invention. For the sake of simplicity and clarity, for the easy chair only the seat-rest, the back-rest and the guiding means for the latter have been illustrated in these Figures.

In this embodiment, the seat-rest 2 of the easy chair remains fixed. The back-rest 4 is joined to the seat-rest 2 by means of two levers 48. In Figures 13a
30 to 13c, only the right lever is visible, the other lever 48 being concealed. This left lever 48 is similar to the lever visible in the drawing. As can be seen, each lever is of generally L-shape.

Each lever 48 is pivotally mounted on the one hand in relation to the seat-rest 2 and on the other hand in relation to the back-rest 4. Each lever 48 is

pivotally mounted about a transverse horizontal shaft 50, arranged laterally at the rear of the seat-rest 2. In pivoting around this shaft 50, each lever 48 remains in a substantially vertical plane. The shaft 50 traverses the lever 48 at its free end corresponding to the small branch (horizontal) of the L.

5 The back-rest 4 is mounted between the two levers 48. The joint between each lever 48 and the back-rest 4 is formed by a transverse horizontal shaft 52. The two levers 48 are joined, for example, by a plate (not illustrated) which extends to the rear of the back-rest 4 in seated position. This plate extends, for example, over all or part of the height of the large branch (vertical) of the levers
10 48. It makes it possible, by rigidifying the movable group comprising the seat, to facilitate the movement of that group in relation to the seat-rest 2.

 In the position illustrated in Figure 13a, the easy chair is in a normal seated position. In Figure 13b, the back-rest 4 is tilted toward the rear in relation to the position of Figure 13a. In order to pass from the position illustrated in the latter
15 Figure to the position of Figure 13b, the two levers 48 each pivot around their shaft 50. The two positions of the levers 48 illustrated in these two Figures 13a and 13b are, for example, indexed.

 In the positions illustrated in Figures 13a and 13b, the levers 48 are locked on their shafts 50 and the back-rest 4 is locked in relation to the shafts 52.
20 The locking means used here are not illustrated in the drawing. Such locking means are known to the person skilled in the art.

 In order to pass from the position illustrated in Figure 13a or that of Figure 13b to the position illustrated in Figure 13c, it is the levers 48 should be pivoted in the direction of the arrow shown next to shaft 50 and the back-rest 4
25 should be swung in the direction of the arrow shown near the shaft 52. In this movement, the bottom of the back-rest 4, that is, the portion of the back-rest in seated position near the seat-rest 2, moves substantially along the upper surface of the seat-rest 2. This movement is illustrated by a third arrow above the seat-rest 2.

30 There have been illustrated In Figures 13a and 13c, on the one hand a wall 10 surrounding the seat corresponding to the seat-rest 2 and to the back-rest 4 illustrated and as visible in Figures 1 to 5, and on the other hand a luggage compartment 54. This luggage compartment 54 occupies space at the rear of the illustrated easy chair, between the frame (not illustrated) thereof and the wall 10.

Such a luggage compartment 54 then can accommodate two bags of the size usually allowed in the cabin of an airplane.

As illustrated in Figures 13b and 13c, this luggage compartment 54 also can serve as a support for the back-rest 4 of the illustrated easy chair. In the embodiment represented, the luggage compartment 54 has a cut-off corner in its upper portion on the easy chair side. The slant of this cut-off corner corresponds to the slant of the back-rest in its seated position tilted toward the rear (Fig. 13b). The bottom of the back-rest 4 thus can come to rest against this slanted cut-off corner which also serves as a stop for the levers 48. In Figure 13c, the back-rest 4 is in substantially horizontal position and it comes to rest on the upper portion of the luggage compartment 54.

In this preferred embodiment, the distance separating the shafts 50 and 52 on the same side is slightly greater than half the length of the seat-rest 2. In this manner, it is possible to move the bottom of the back-rest, on passage from a seated position to the lying-down position, through a distance corresponding substantially to the length of the seat-rest 2. This distance separating the shafts is dependent, of course, on the position of these shafts. It also possibly depends on the thickness of the seat-rest and of the back-rest. In a variant embodiment, arranging the shafts 50 not on the seat-rest 2 but on the frame (not illustrated on Figures 13a to 13c) of the easy chair, or on another fixed portion of the easy chair, could be considered.

The back-rest 4, in the horizontal position illustrated in Figure 13c, thus forms a portion of the surface for lying down of the seat according to the invention in lying-down position. To complete the surface for lying down obtained with the back-rest 4 so as to be able to accommodate a passenger in lying-down position, additional means such as those illustrated in Figures 1 to 4 or 6 to 12 can be considered.

All these embodiments make it possible to have a seat convertible into a bed in simple manner. They can be formed making very appreciable savings in weight in comparison with known aircraft seats which can be converted into beds. These seats are provided to be surrounded by a vertical wall separating the passenger traveling in that seat from the rest of the cabin space, thus creating an individual space for the passenger in order to enhance his comfort.

In comparison with the convertible seats of the prior art, the surface for

lying down is not made up of the back-rest, the seat-rest and the foot-rest, but comprises at most two of these three members. It may also be noted that the frame of the seat, that is, the structure, generally metal, which is intended to hold the aircraft seat in its position while withstanding the mechanical stresses to which the seat can be subjected, is fixed and does not move in relation to the cabin in which it is located.

The present invention is not limited to the embodiments described hereinabove by way of nonrestrictive examples. It also concerns all the variant embodiments within the capability of the person skilled in the art in the context of the claims given below.

Thus, for example, other embodiments can be considered. It can thus for example be considered to have an additional berth portion incorporated into the seat-rest. The seat also can be made movable in relation to the frame which bears it.

In all the embodiments presented, the back-rest is used to serve as a surface for lying down. A variant in which the back-rest would be left vertical and pushed completely toward the rear, can also be considered. The surface for lying down then could comprise the fixed seat-rest completed at the rear by a fixed cushion extending the seat-rest and at the front by an additional berth portion stored for example vertically, cooperating or not cooperating with a unit.

The guiding means for the back-rest can be different from those shown for moving the back-rest. In a variant embodiment, the back-rest can be mounted on a carriage capable of moving in relation to the frame of the seat.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A convertible seat intended to accommodate an aircraft passenger, comprising a frame, a seat-rest borne by the frame and a back-rest, the seat being able to change from a so-called seated position in which the back-rest forms an angle with the seat-rest which is assumed horizontal to a so-called lying-down position in which it has a substantially planar surface intended to accommodate the passenger in lying-down position,

characterized in that the seat-rest is a fixed seat-rest, and in that the seat comprises on the one hand guiding means to make the back-rest change from its seated position to a substantially horizontal position and, on the other hand, at least one additional berth portion cooperating with the back-rest to form the substantially planar surface intended to accommodate the passenger in lying-down position.

2. A convertible seat according to claim 1, characterized in that the back-rest has a base and a free end, and in that the guiding means for the seat comprise translational guiding means for the base of the back-rest.

3. A convertible seat intended to accommodate an aircraft passenger, comprising:

- a frame,
- a seat-rest borne by the frame,
- a back-rest having a base and a free end, and
- possibly a foot-rest hinged along a transverse edge of the seat-rest

between a position substantially perpendicular to the seat-rest and a position in which the plane of the seat-rest and the plane of the foot-rest form an obtuse angle, or are even flat,

said seat being able to change from a so-called seated position, in which the back-rest forms an angle with the seat-rest and its base is close to the rear transverse edge of the seat-rest, to a so-called lying-down position in

which it has a substantially planar surface intended to accommodate the passenger in lying-down position,

characterized in that the seat-rest is a fixed seat-rest, and in that at most two of the members of the group constituted by the seat-rest, the back-rest and the foot-rest form the substantially planar surface of the seat in lying-down position, and in that at least one additional berth portion is provided to cooperate with the seat-rest and/or the back-rest and/or the foot-rest to form the substantially planar surface intended to accommodate the passenger in lying-down position.

4. A convertible seat according to claim 3, characterized in that the back-rest is a component member of the planar surface intended to accommodate the passenger in lying-down position.

5. A convertible seat according to claim 4, characterized in that it comprises guiding means making it possible, on passage of the seat from the seated position to the lying-down position, to guide the back-rest in such manner that the back-rest in lying-down position comes to cover most of the position of the seat-rest in its seated position.

6. A convertible seat according to claim 5, characterized in that the back-rest in lying-down position covers the seat-rest, and in that an edge of the back-rest in lying-down position selected from the group comprising the base of the back-rest and its free end is substantially superposed with respect to one edge of the seat-rest.

7. A convertible seat according to claim 5 or 6, characterized in that the guiding means make it possible, on passage of the seat from the seated position to the lying-down position, to guide the back-rest in a movement which is a combination of a longitudinal translation and a rotation about an axis that is substantially transverse and horizontal.

8. A convertible seat according to any one of claims 2, 5 to 7, characterized in that the guiding means comprise on both sides of the frame at least one guiding rail so as to guide the base of the back-rest, on passage from the seated position to the lying-down position, from the position corresponding to the rear of the seat-rest in seated position to a position corresponding to the front of the seat-rest in seated position.

9. A convertible seat according to any one of claims 2, 5 to 7, characterized in that the guiding means comprise on both sides of the frame at least one guiding rail so as to guide the base of the back-rest on passage from the seated position to the lying-down position from the position corresponding to the rear of the seat-rest in seated position to a drawn-back position such that when the base of the back-rest is in this drawn-back position the free end of the back-rest is in a position corresponding to the front of the seat-rest in seated position.

10. A convertible seat according to any one of claims 1, 3 to 6, characterized in that the back-rest of the seat is joined to a fixed portion of the seat by means of two levers located respectively on each of the two sides of the seat-rest, in that each lever is pivotally mounted about an axis substantially horizontal and transverse in relation to said fixed portion, and in that the back-rest is pivotally mounted about an axis that is substantially horizontal and transverse between the two levers.

11. A convertible seat according to claim 10, characterized in that the seat-rest is fixed to the frame, and in that the levers are mounted on the lateral sides of the seat-rest.

12. A convertible seat according to any one of claims 10 or 11, characterized in that the levers are joined by a plate.

13. A convertible seat according to any one of claims 10 to 12, characterized in that for each lever the distance between the axis of pivoting of the lever in relation to said fixed portion and the axis of pivoting of the back-rest is between half and three-quarters of the length of the seat-rest, in the longitudinal direction.

14. A convertible seat according to any one of claims 1, 2, 4 to 13, characterized in that clamping and/or locking means hold the back-rest in its raised position when the seat is in its so-called seated position.

15. A convertible seat according to any one of claims 1, 2, 4 to 14, characterized in that the additional berth portion cooperating with the back-rest to form a planar surface comprises a shelf moveable between a substantially horizontal position extending forwardly in line with the back-rest when the seat is in lying-down position and a substantially lateral vertical position in the seated position.

16. A convertible seat according to claim 15, characterized in that the substantially planar surface for lying down is made up of the back-rest in substantially horizontal position and said movable shelf.

17. A convertible seat according to claim 15, characterized in that in lying-down position, said movable shelf cooperates with the back-rest and a unit arranged facing and at a distance from the frame and of which the height corresponds substantially to that of the seat-rest of the seat.

18. A convertible seat according to any one of claims 1, 2, 4 to 14, characterized in that it comprises a foot-rest (6) pivotally mounted about a transverse axis located close to its front edge so as to be able to pivot approximately 90° and then be substantially in line with the back-rest (4) in lying-down position.

19. A convertible seat according to claim 18, characterized in that the means cooperating with the back-rest (4) to form a planar surface comprise the pivoted foot-rest (6) as well as a unit (36) arranged facing and at a distance from the frame (14) and of which the height corresponds substantially to that of the seat-rest (2) of the seat.

20. A convertible seat according to claim 19, characterized in that the unit also can comprise a movable flap capable of pivoting approximately 180° about an axis that is substantially transverse and horizontal so as to form an additional berth portion.

21. A convertible seat according to any one of claims 1, 2, 4 to 14, characterized in that the back-rest incorporates an additional berth portion.

22. A convertible seat according to claim 21, characterized in that the additional berth portion incorporated into the back-rest is slidingly mounted in relation thereto.

23. A convertible seat according to claim 21, characterized in that the additional berth portion incorporated into the back-rest is pivotally mounted in relation thereto.

24. A convertible seat according to any one of claims 2 or 4, characterized in that comprises guiding means making it possible on passage of the seat from the seated position to the lying-down position to guide the back-rest in a movement which is the combination of a longitudinal translation and a rotation about an axis that is substantially transverse and horizontal such that the back-rest and the seat-rest are in line with each other, the base of the back-rest being situated facing the front transverse edge of the seat-rest.

25. A convertible seat according to claim 24, characterized in that the additional berth portion is a fixed part mounted on the frame at the rear of the seat-rest and in line therewith.

26. A convertible seat according to claim 3, characterized in that it comprises guiding means making it possible on passage of the seat from the seated position to the lying-down position to guide the back-rest in a movement which is the combination of a longitudinal translation toward the rear and a rotation about an axis that is substantially transverse and horizontal such that the back-rest in the lying-down position of the seat is substantially perpendicular to the plane of the seat-rest of the seat.

27. A convertible seat according to claim 26, characterized in that the planar surface intended to accommodate a passenger in lying-down position comprises the seat-rest of the seat, a fixed portion mounted on the frame at the rear of the seat-rest and in line with the latter as well as a shelf capable of moving between a substantially horizontal position extending forwardly in line with the seat-rest in the lying-down position and a substantially lateral vertical position in the seated position.

28. A convertible seat according to any one of claims 1 to 27, characterized in that it further comprises a lateral wall surrounding in particular the rear of the seat.

29. A convertible seat according to claim 28, characterized in that a luggage compartment is provided between the lateral wall and the frame of the seat.

30. A convertible seat according to claim 29, characterized in that the luggage compartment comprises a lateral door.

31. A convertible seat according to claim 30, characterized in that the lateral door is a door sliding in a substantially vertical plane with the aid of a

substantially horizontal guiding rail borne by the lateral wall.

32. A module comprising a seat as well as a wall surrounding the seat at least partially, characterized in that the seat is a seat according to one of claims 1 to 31.

33. An aircraft intended for the transport of passengers, characterized in that it comprises at least one convertible seat according to any one of claims 1 to 31.

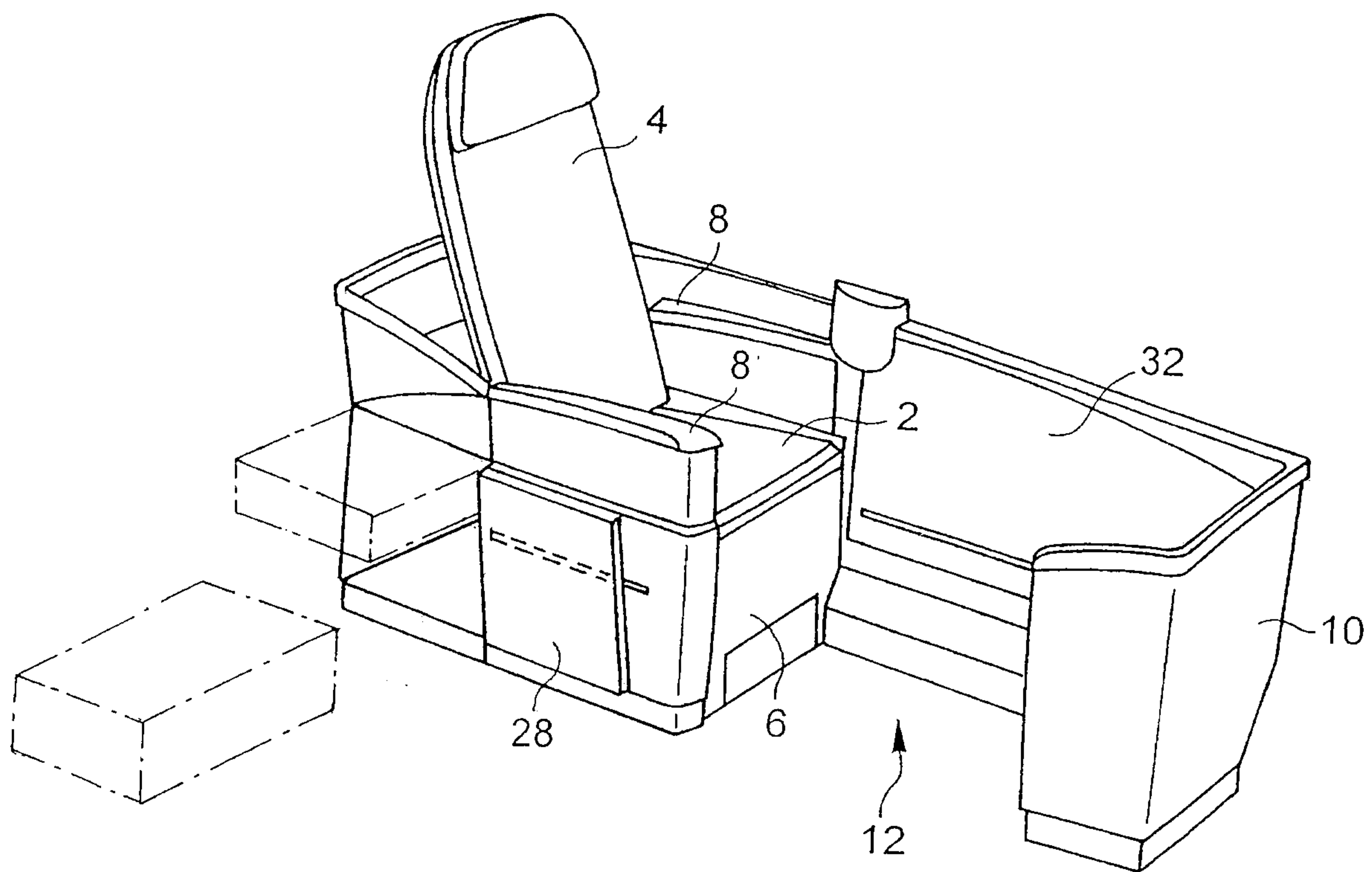


Fig.1

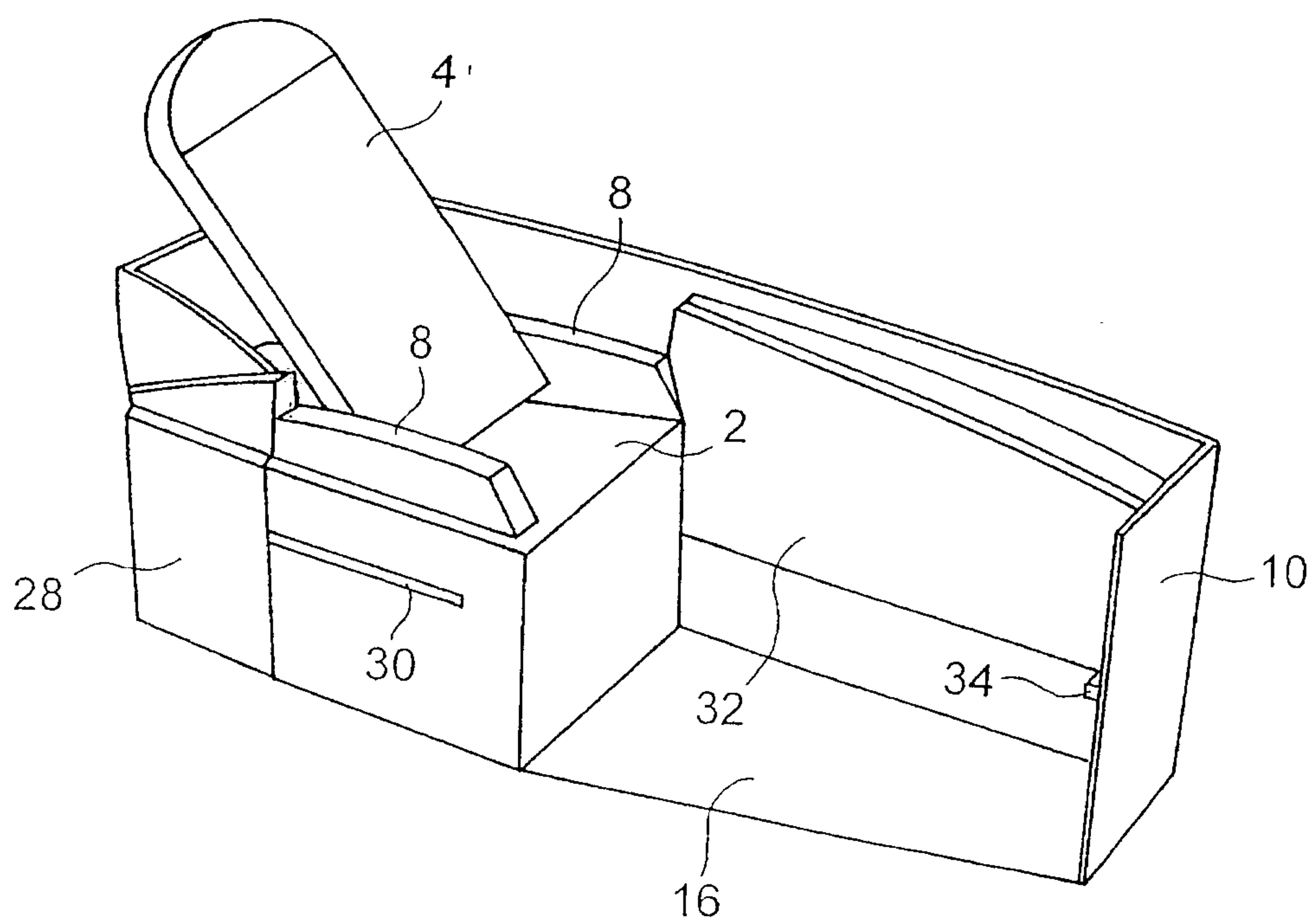


Fig.2

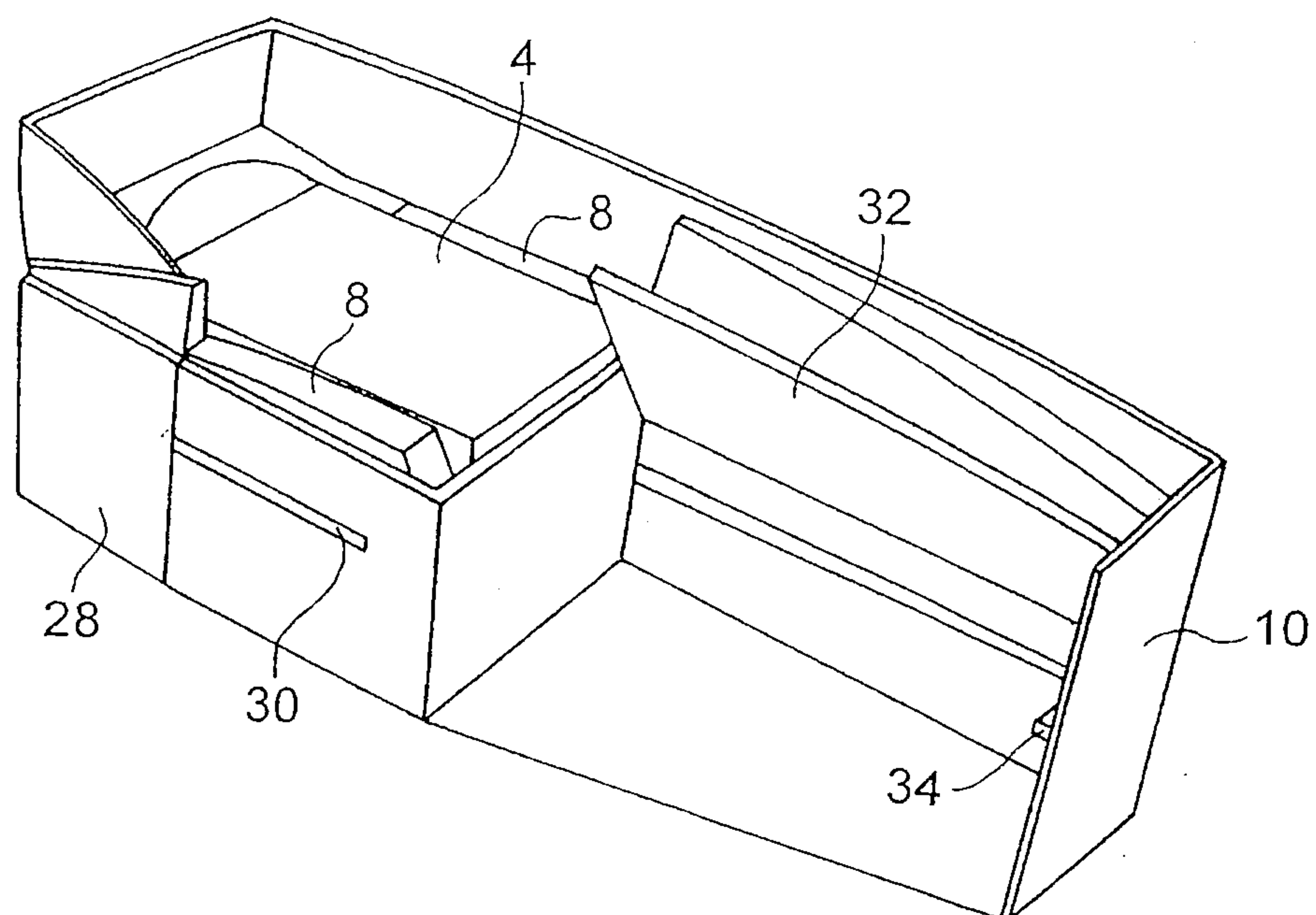


Fig.3

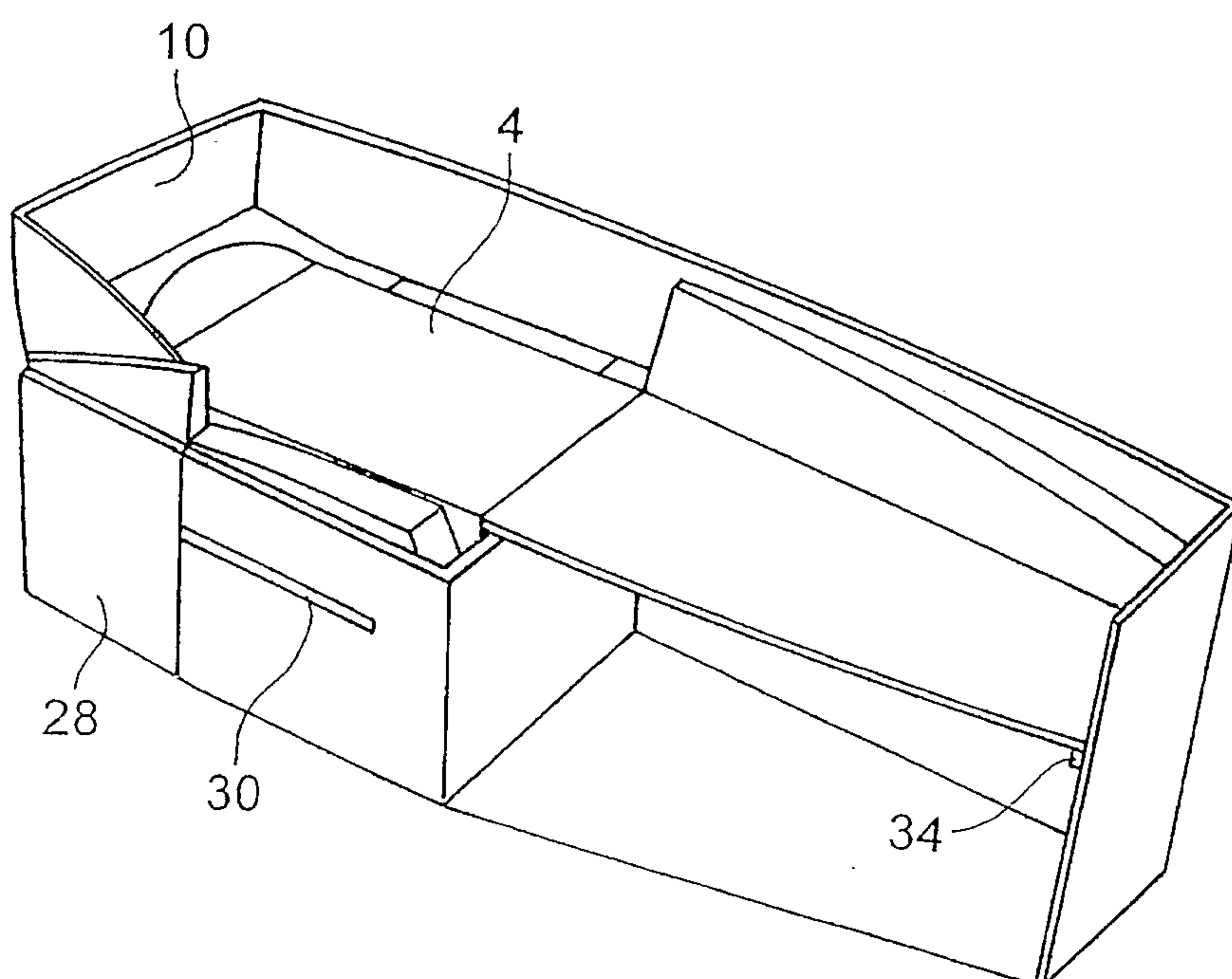


Fig.4

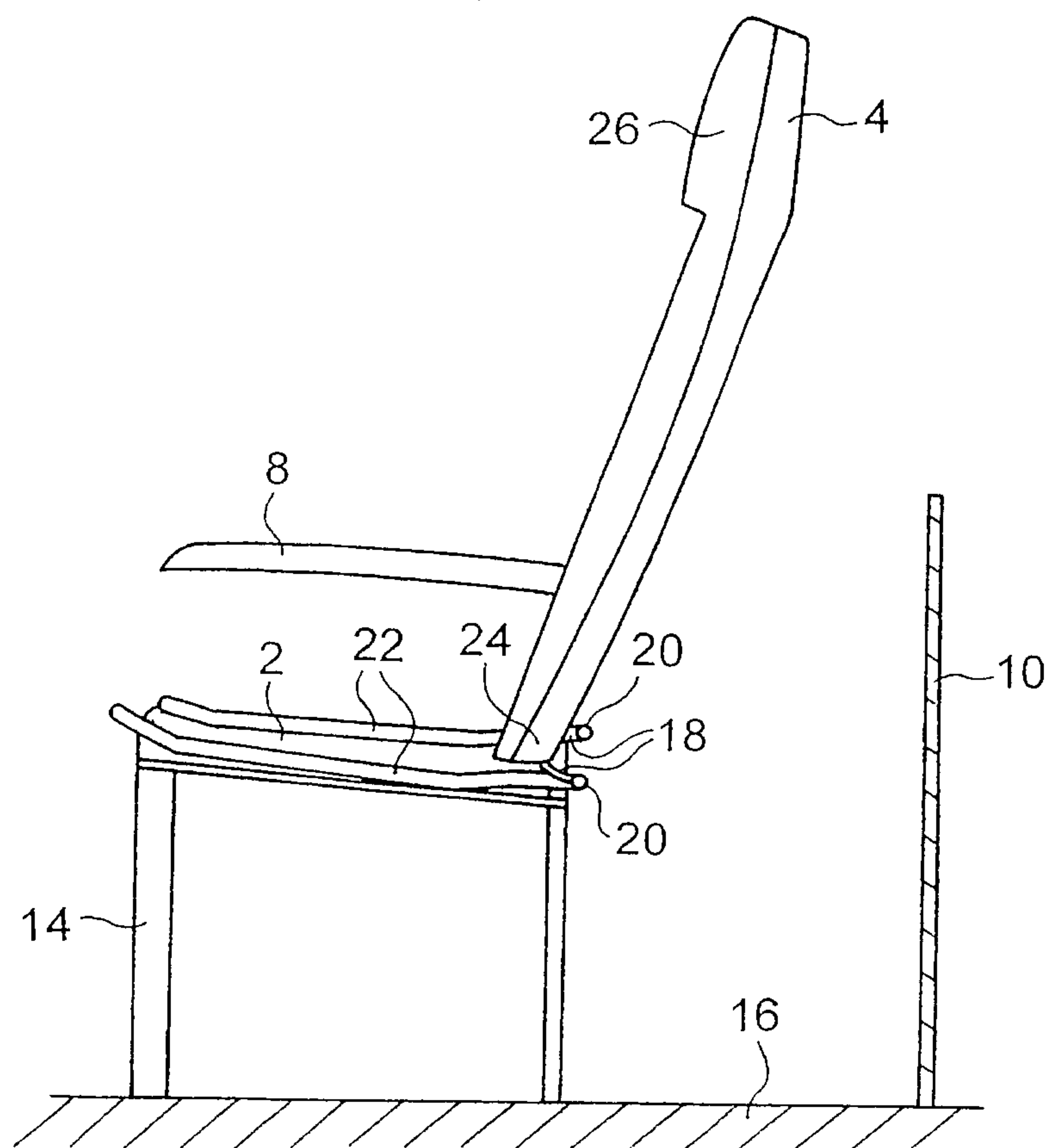


Fig.5a

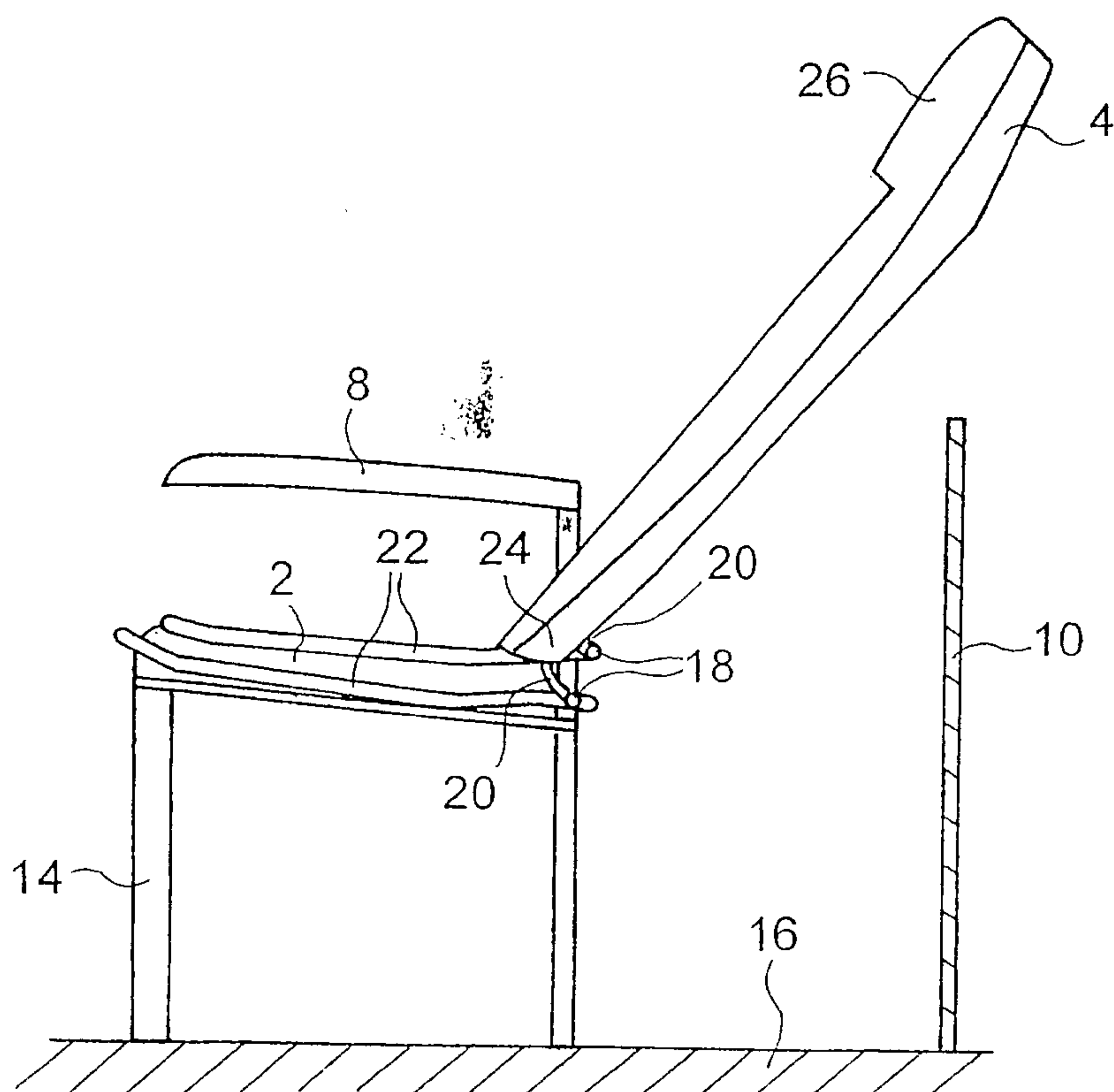


Fig.5b

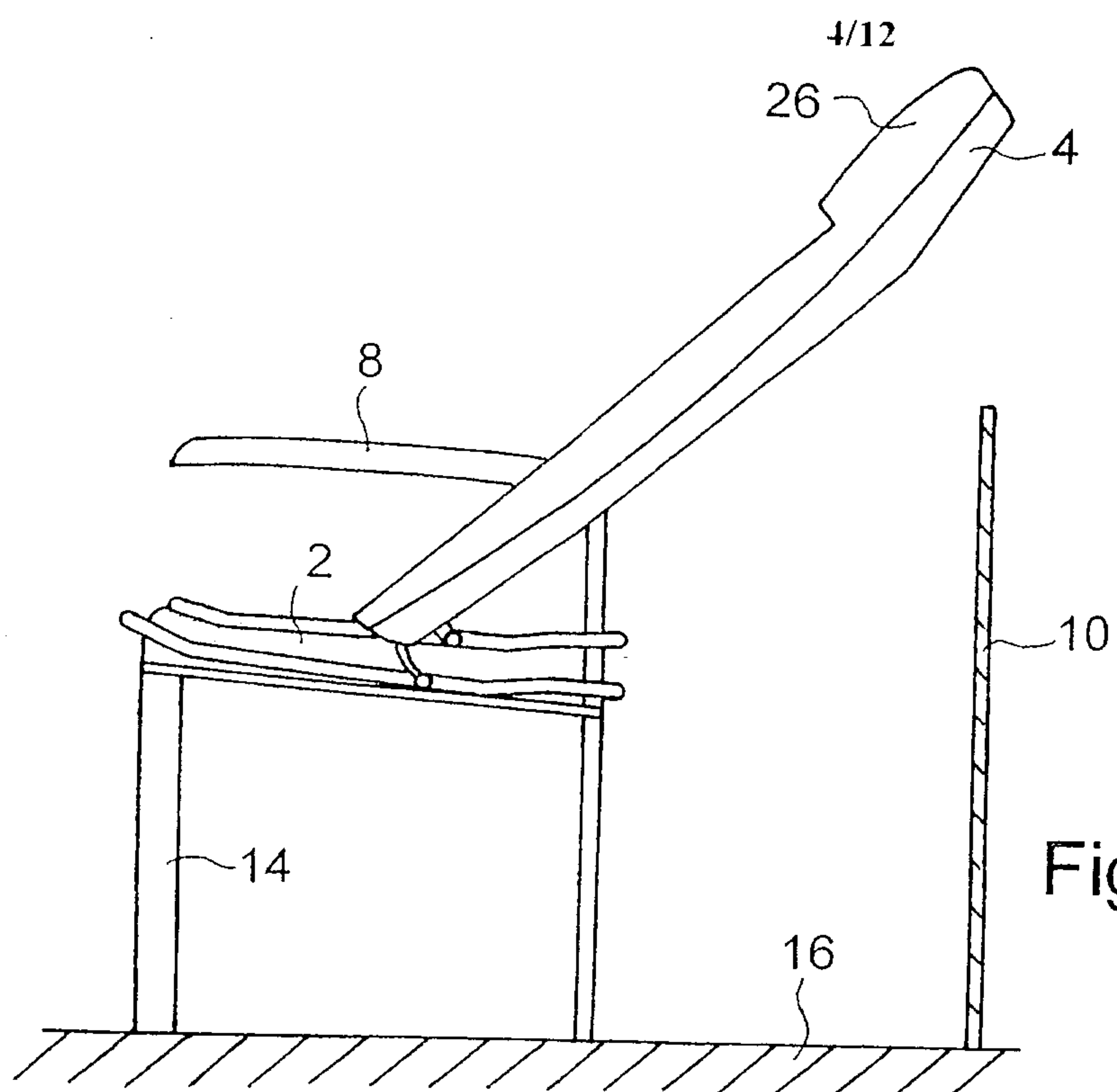


Fig.5c

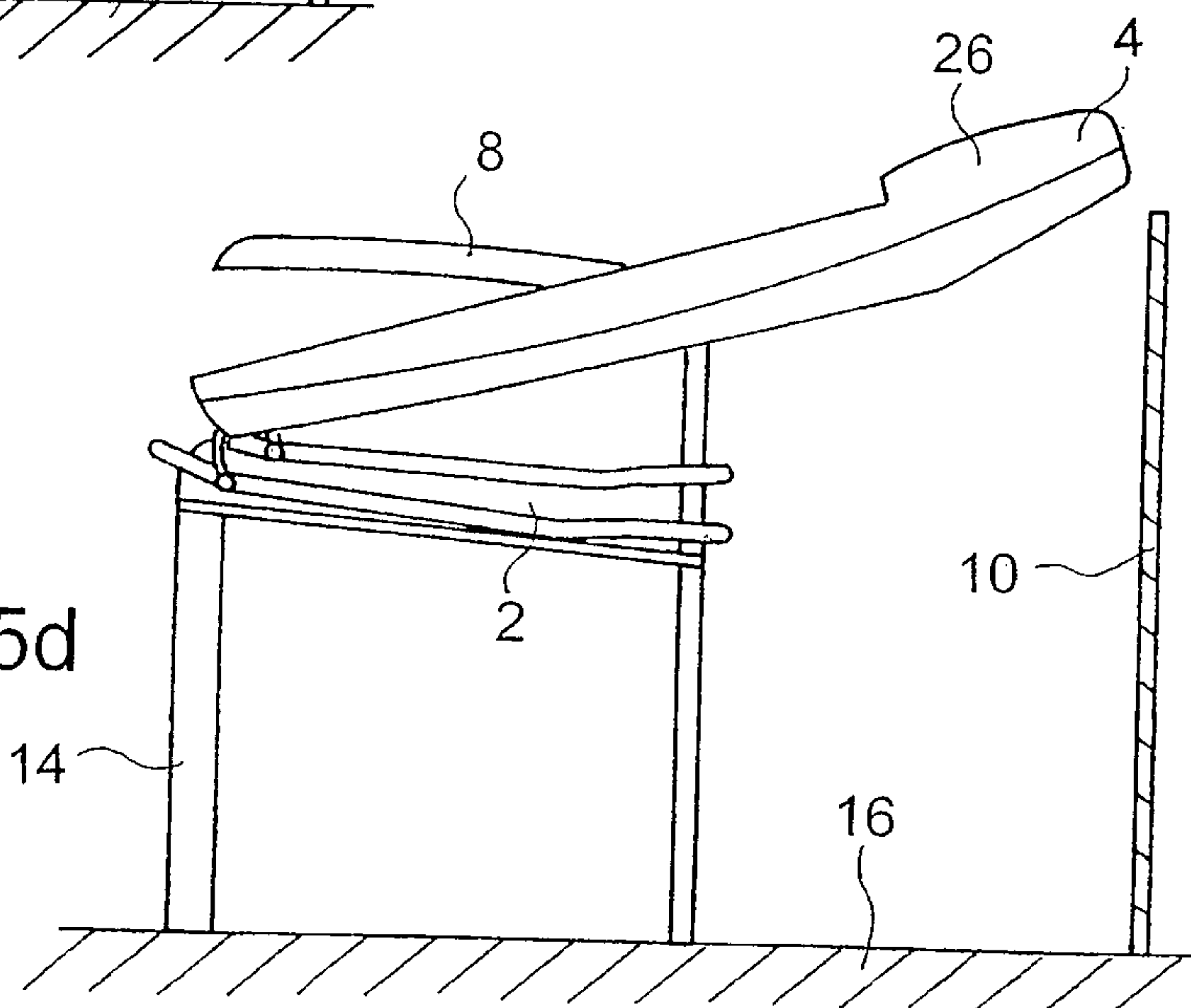


Fig.5d

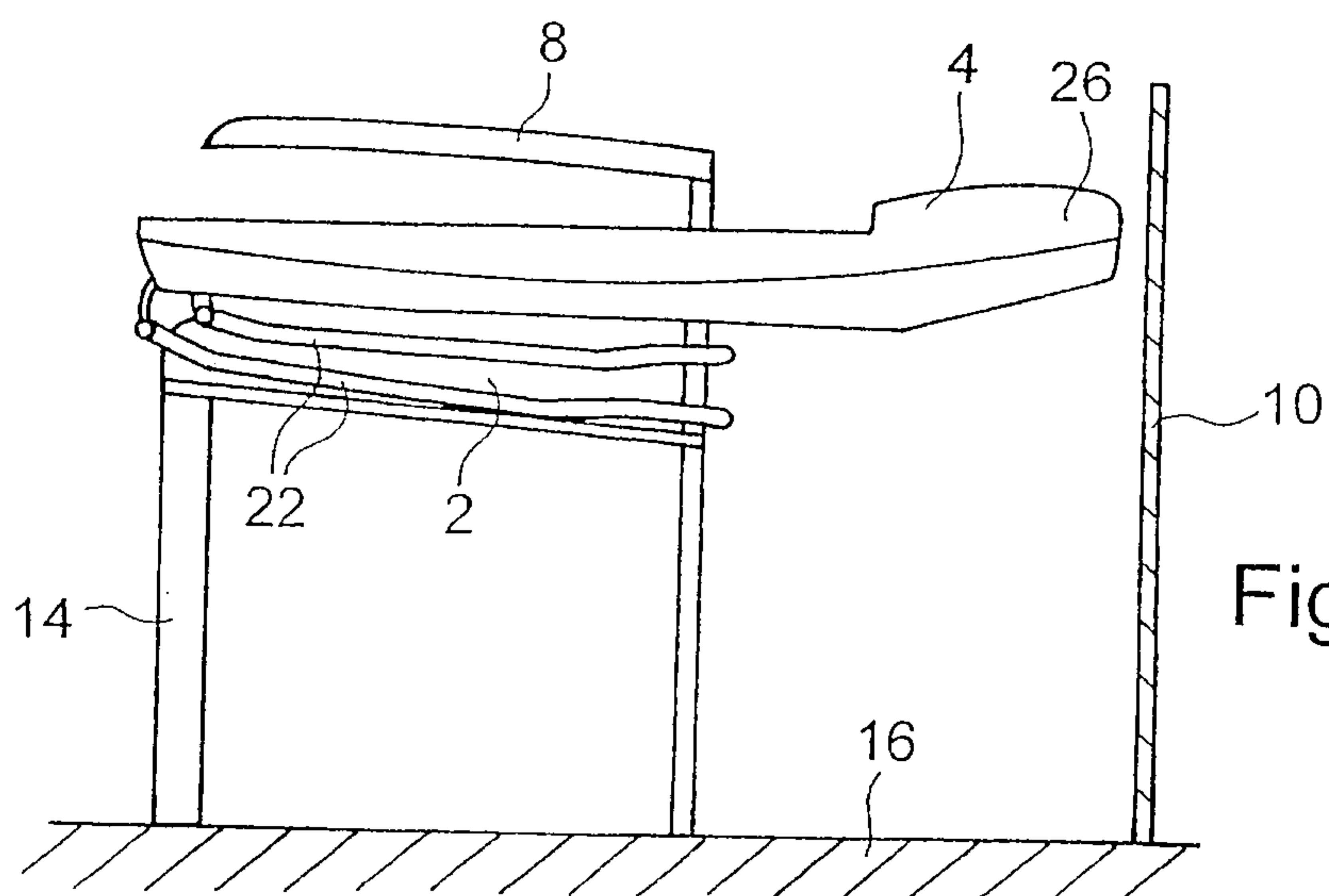


Fig.5e

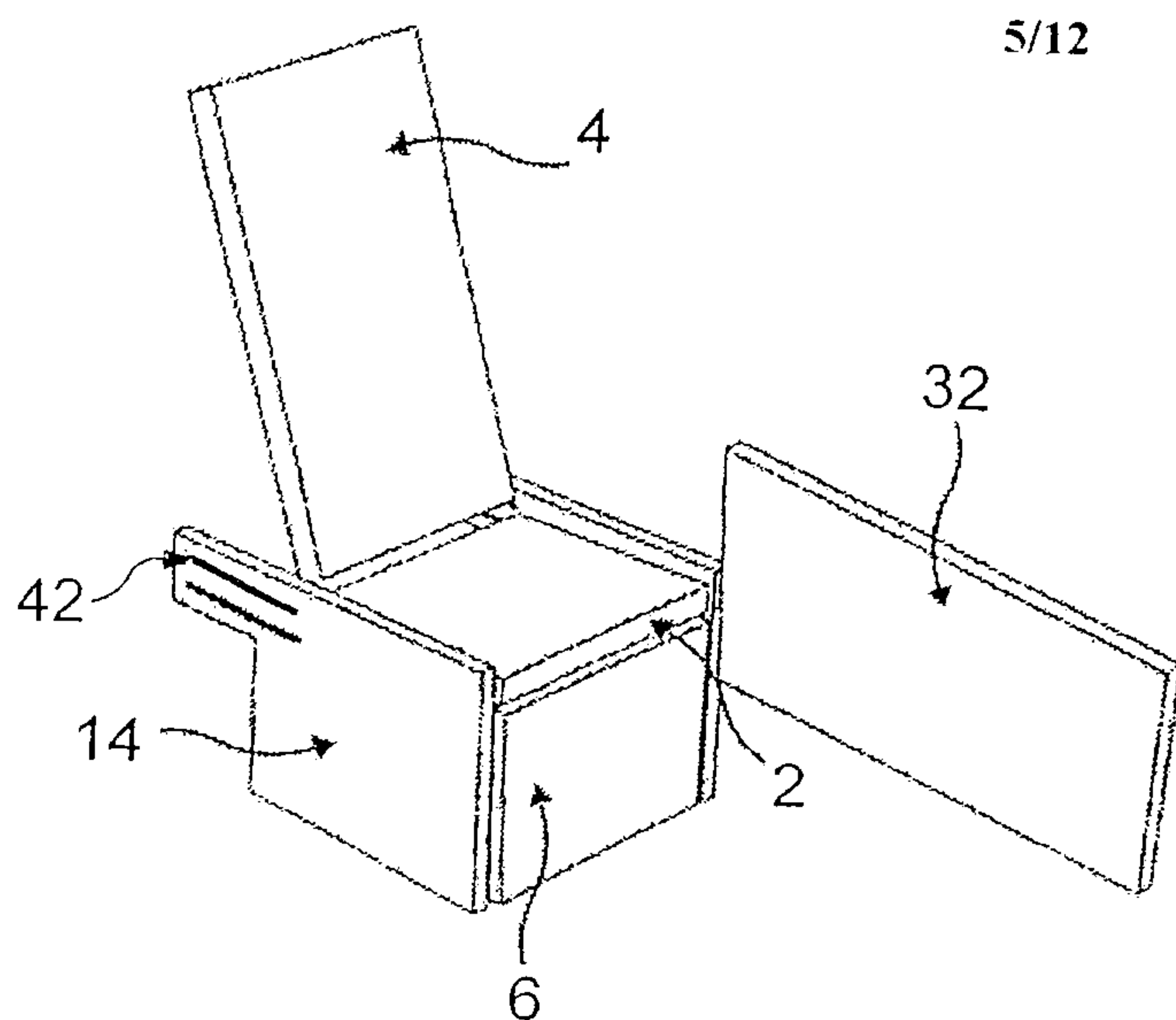


Fig. 6a

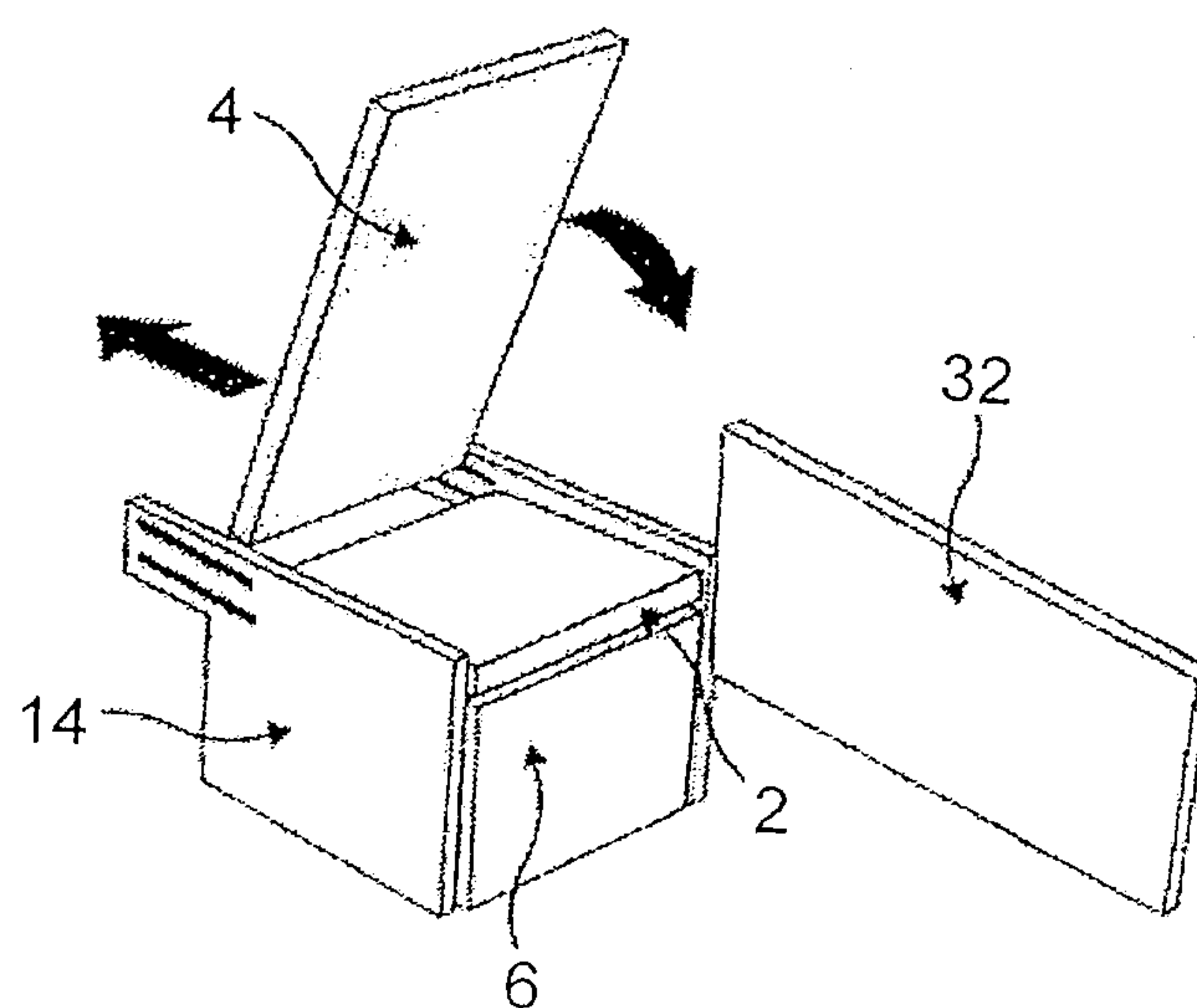


Fig. 6b

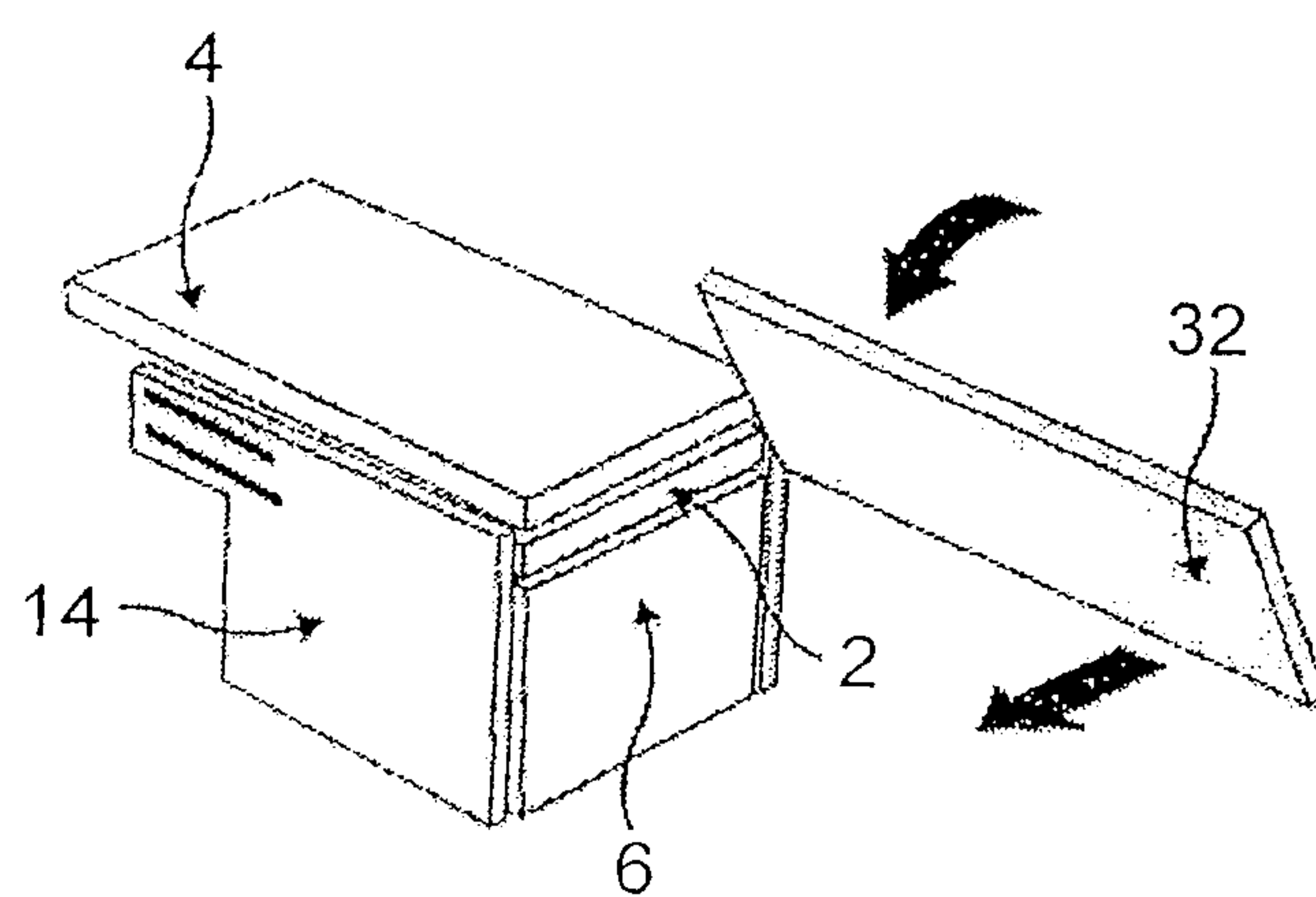


Fig. 6c

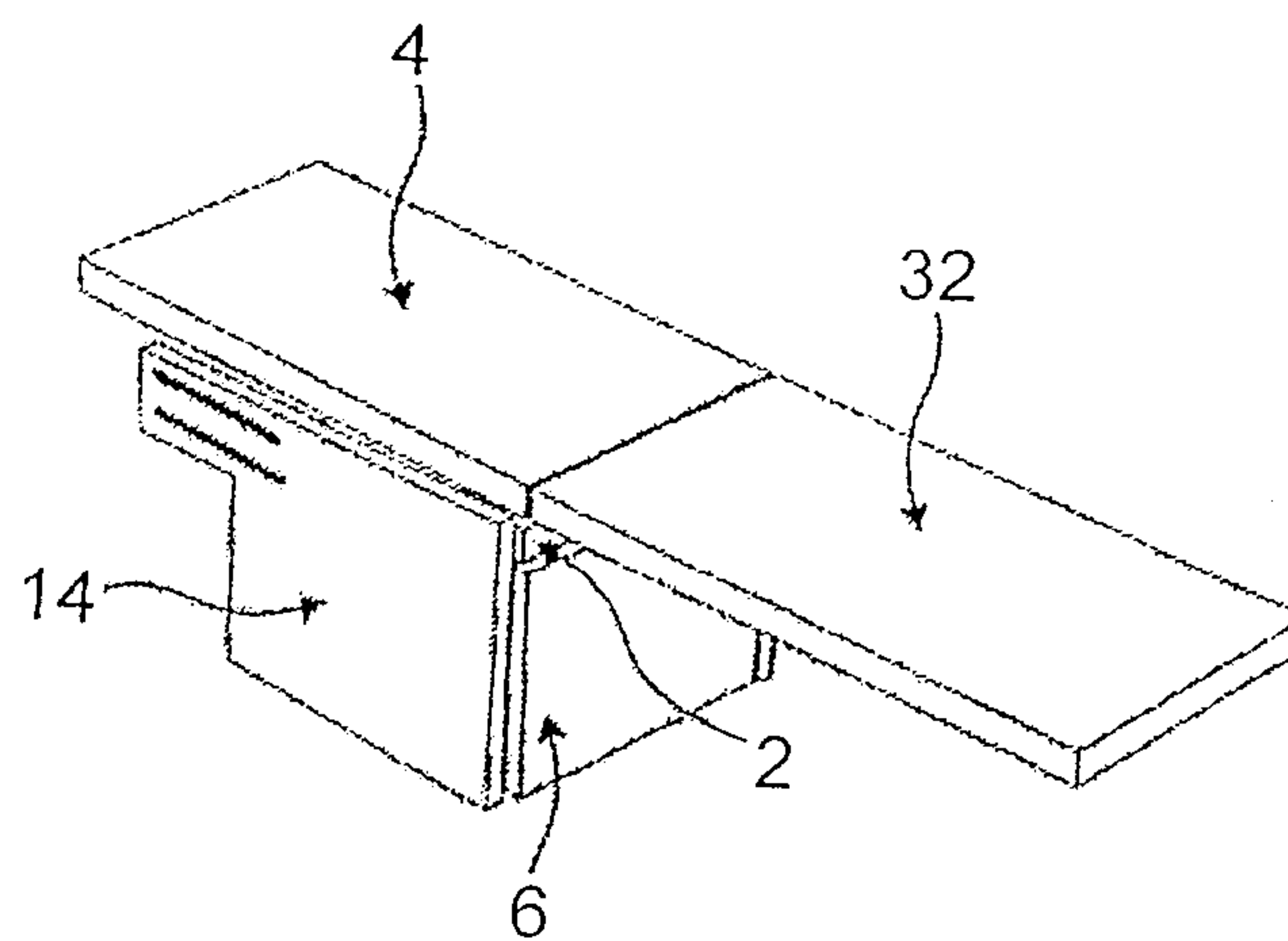


Fig. 6d

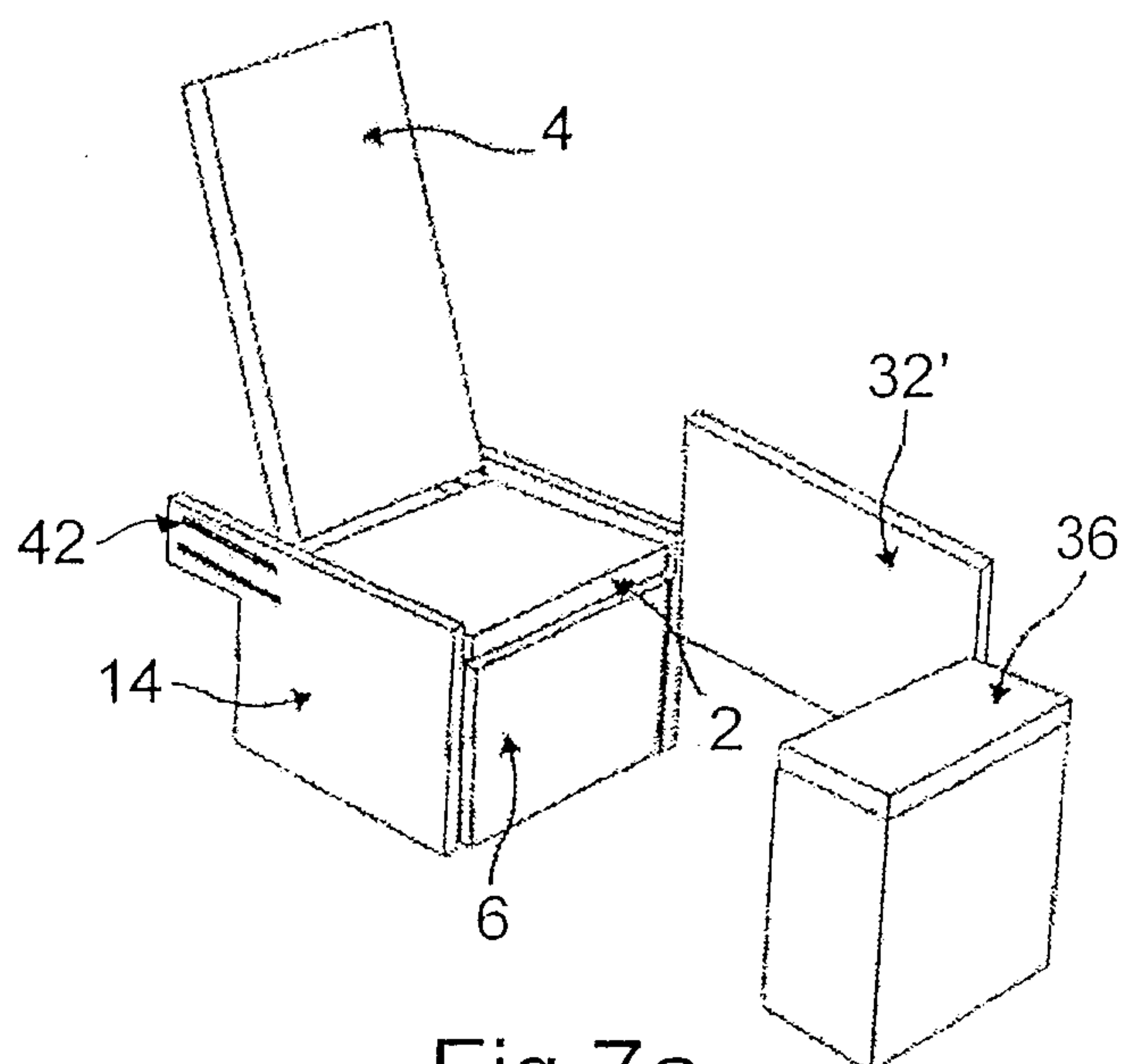


Fig.7a

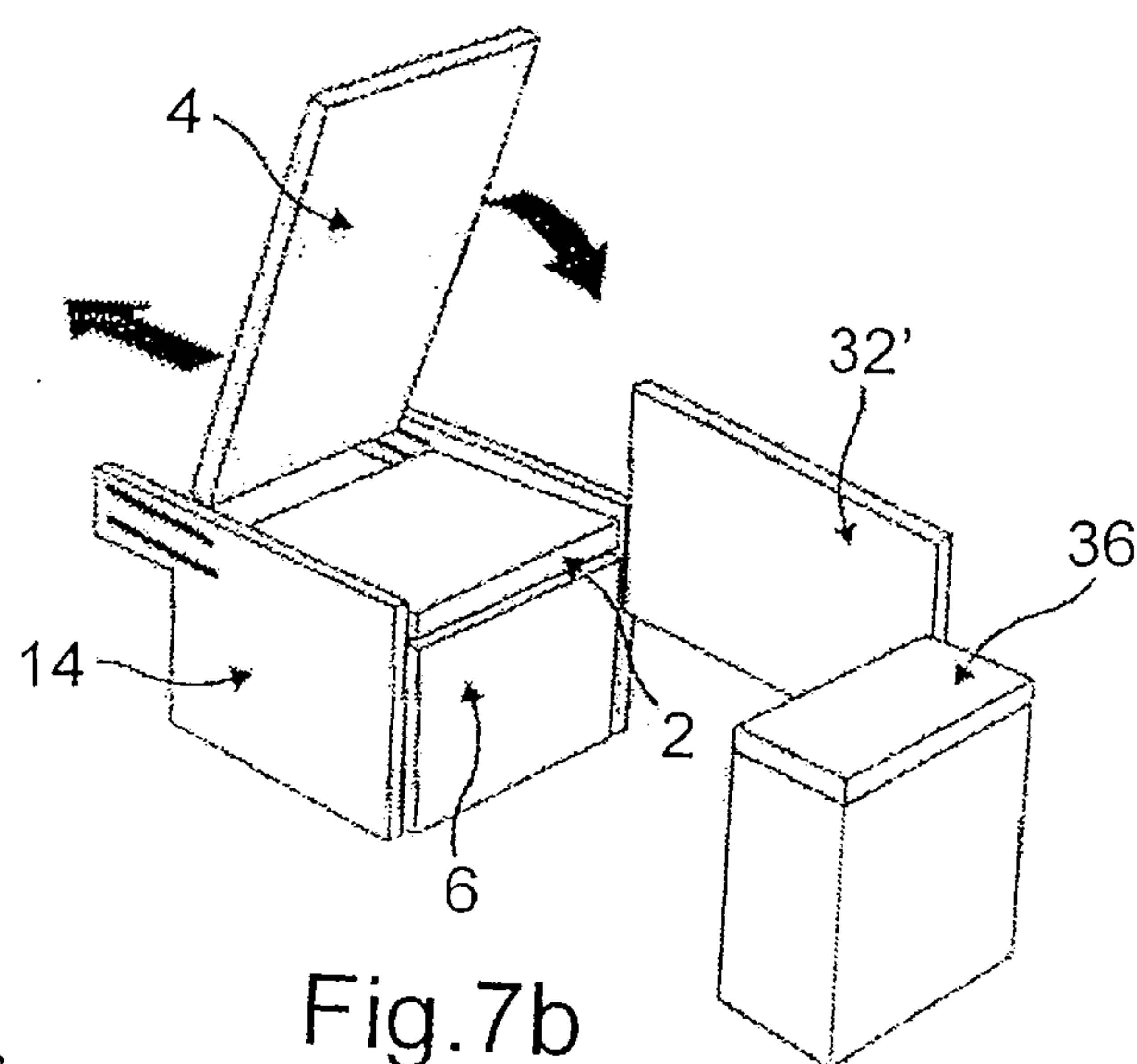


Fig.7b

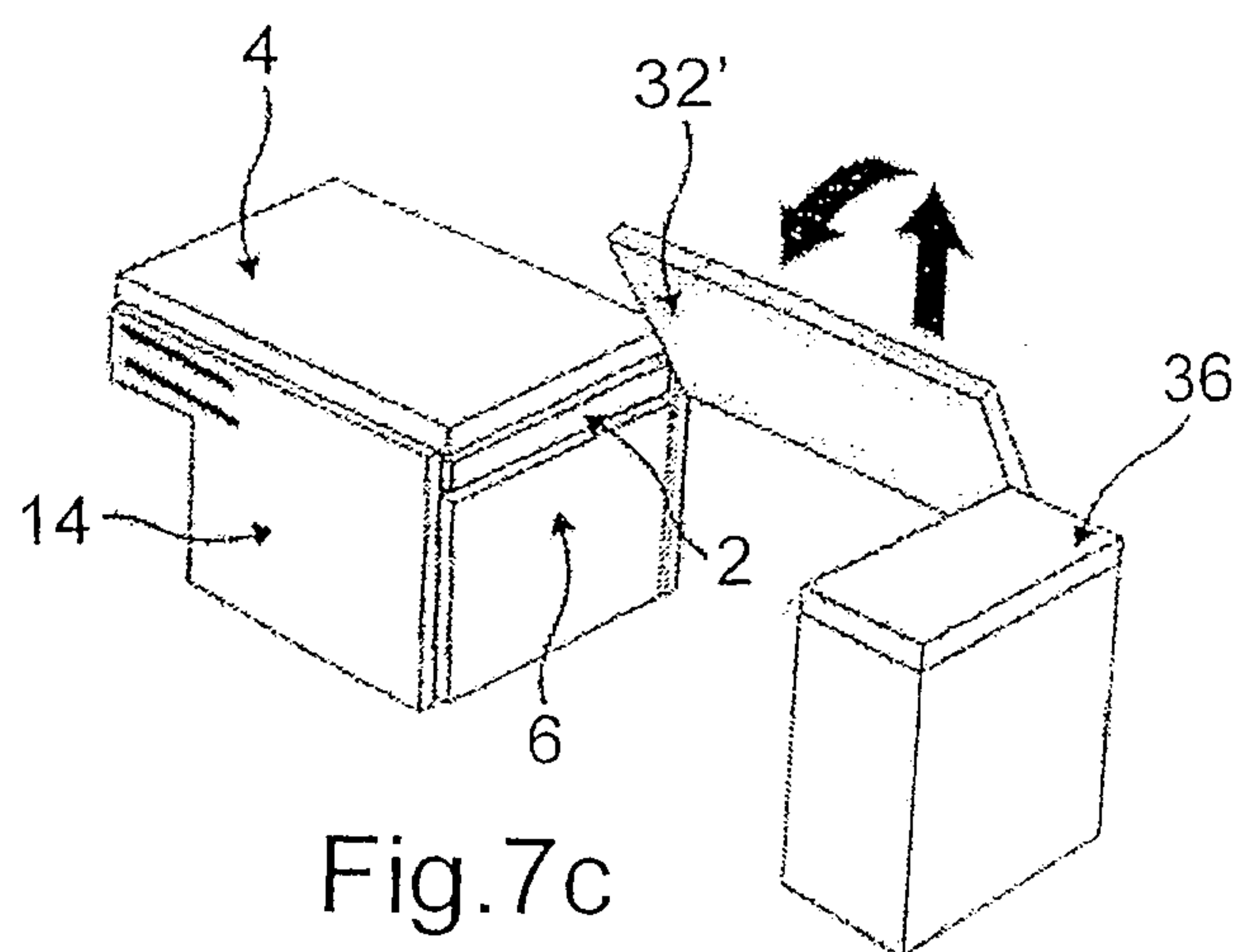


Fig.7c

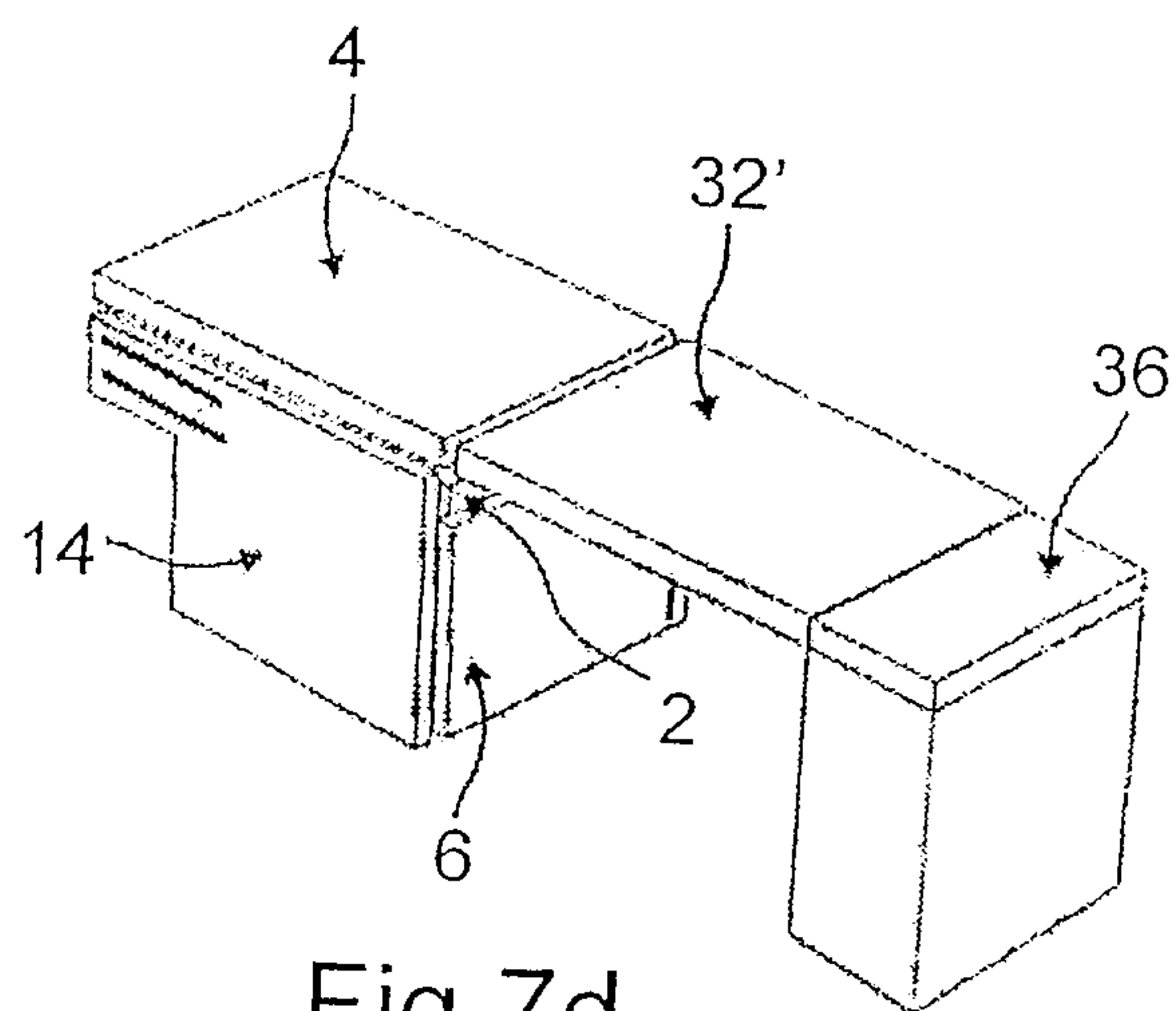


Fig.7d

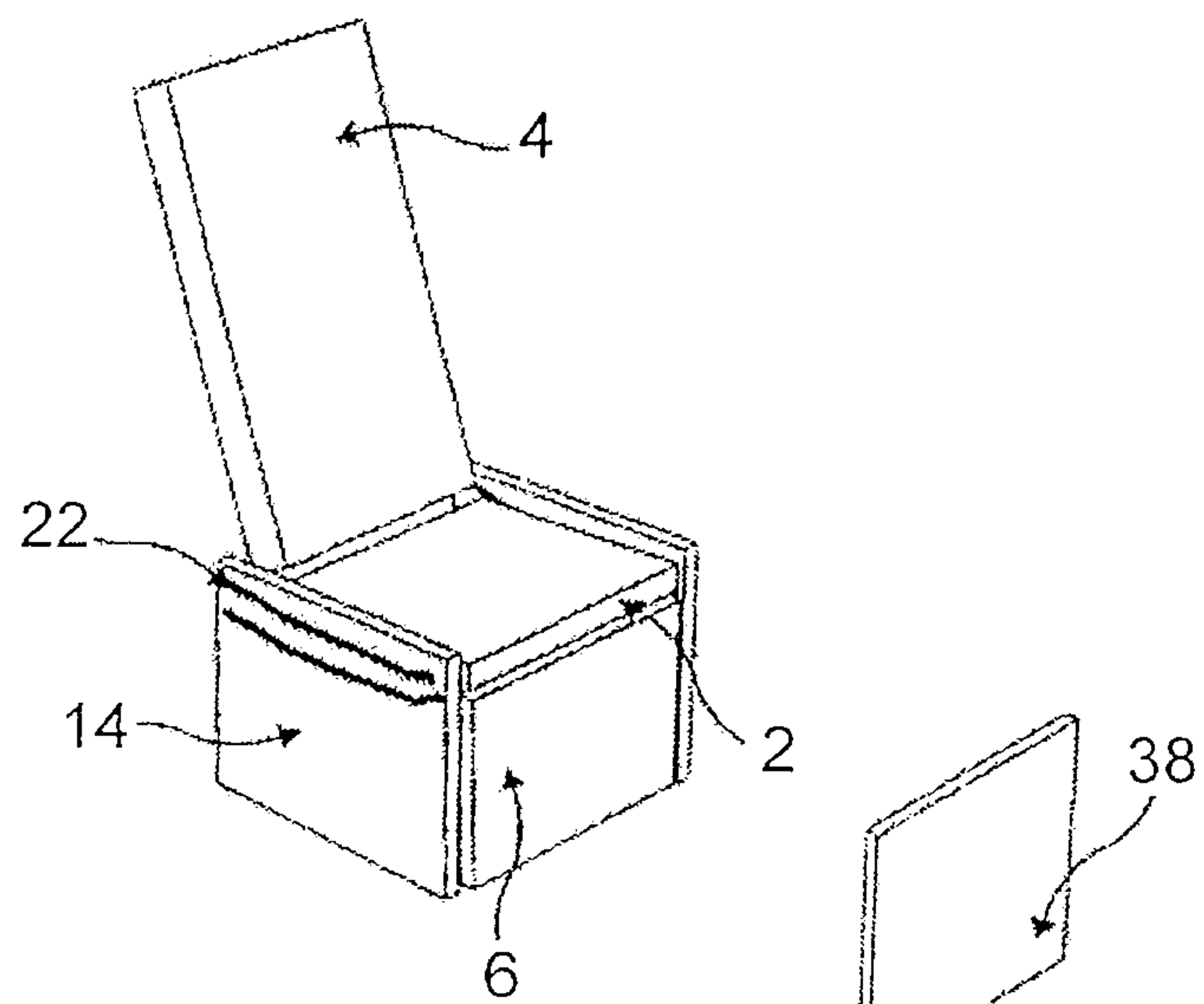


Fig. 8a

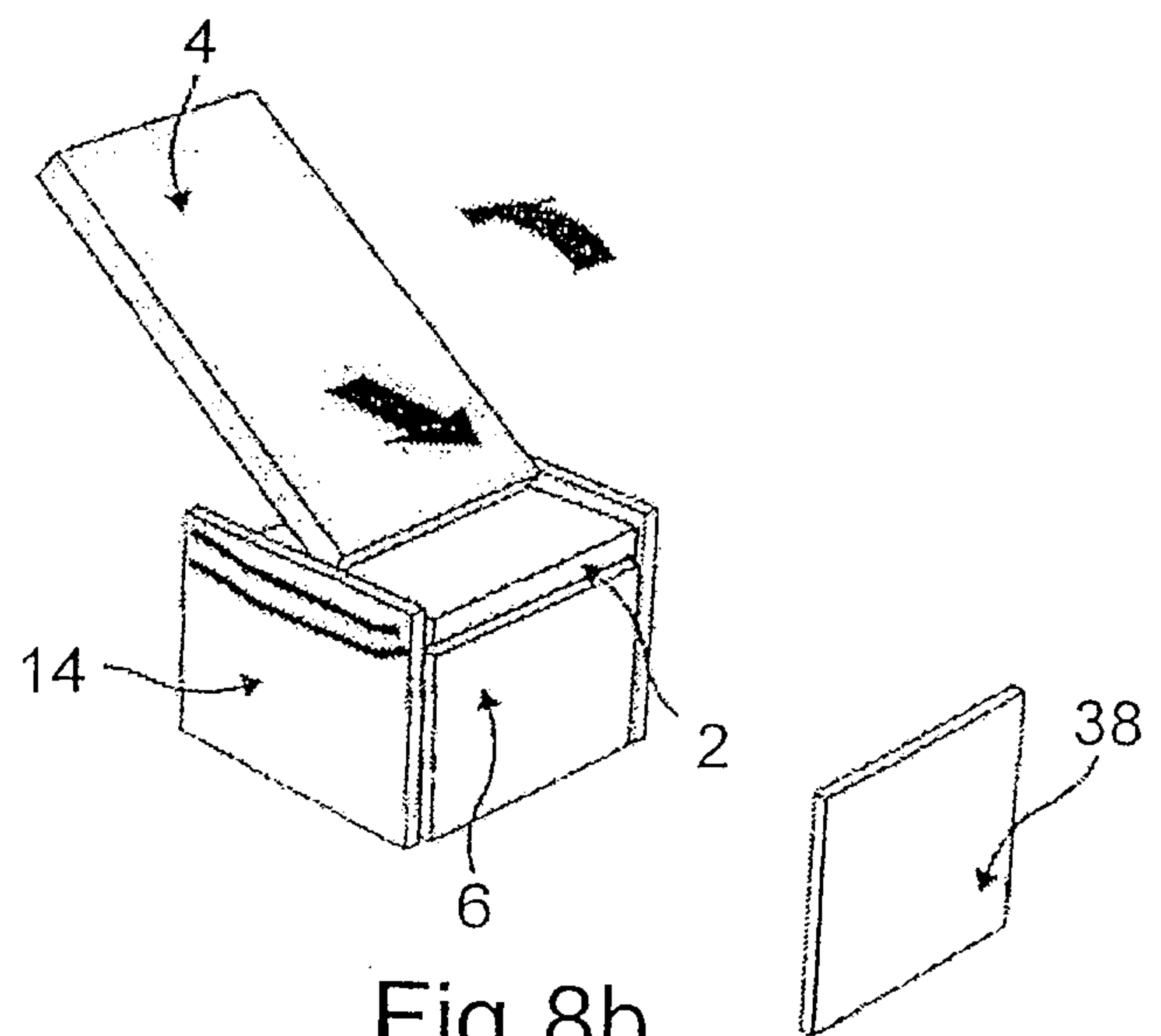


Fig. 8b

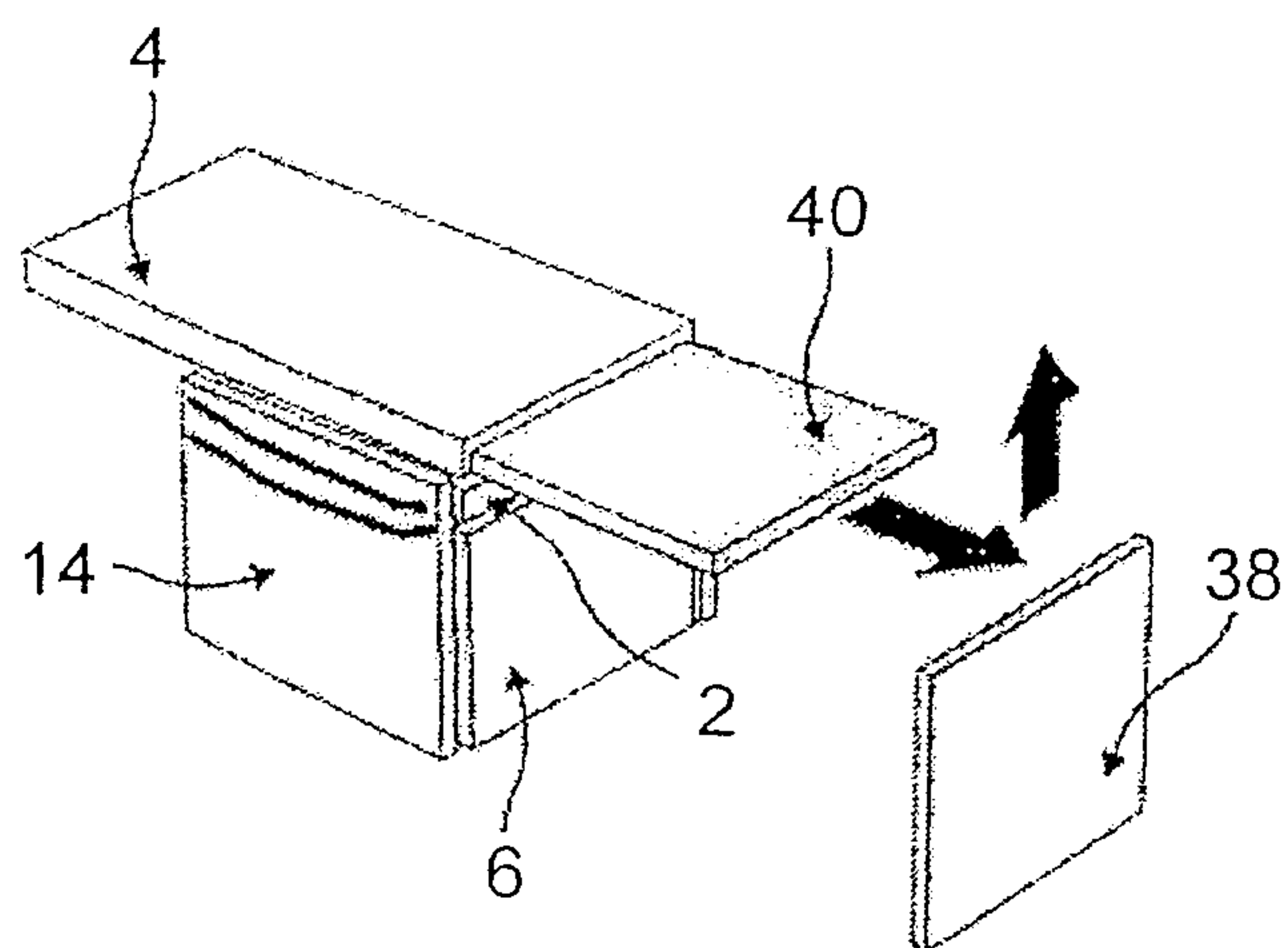


Fig. 8c

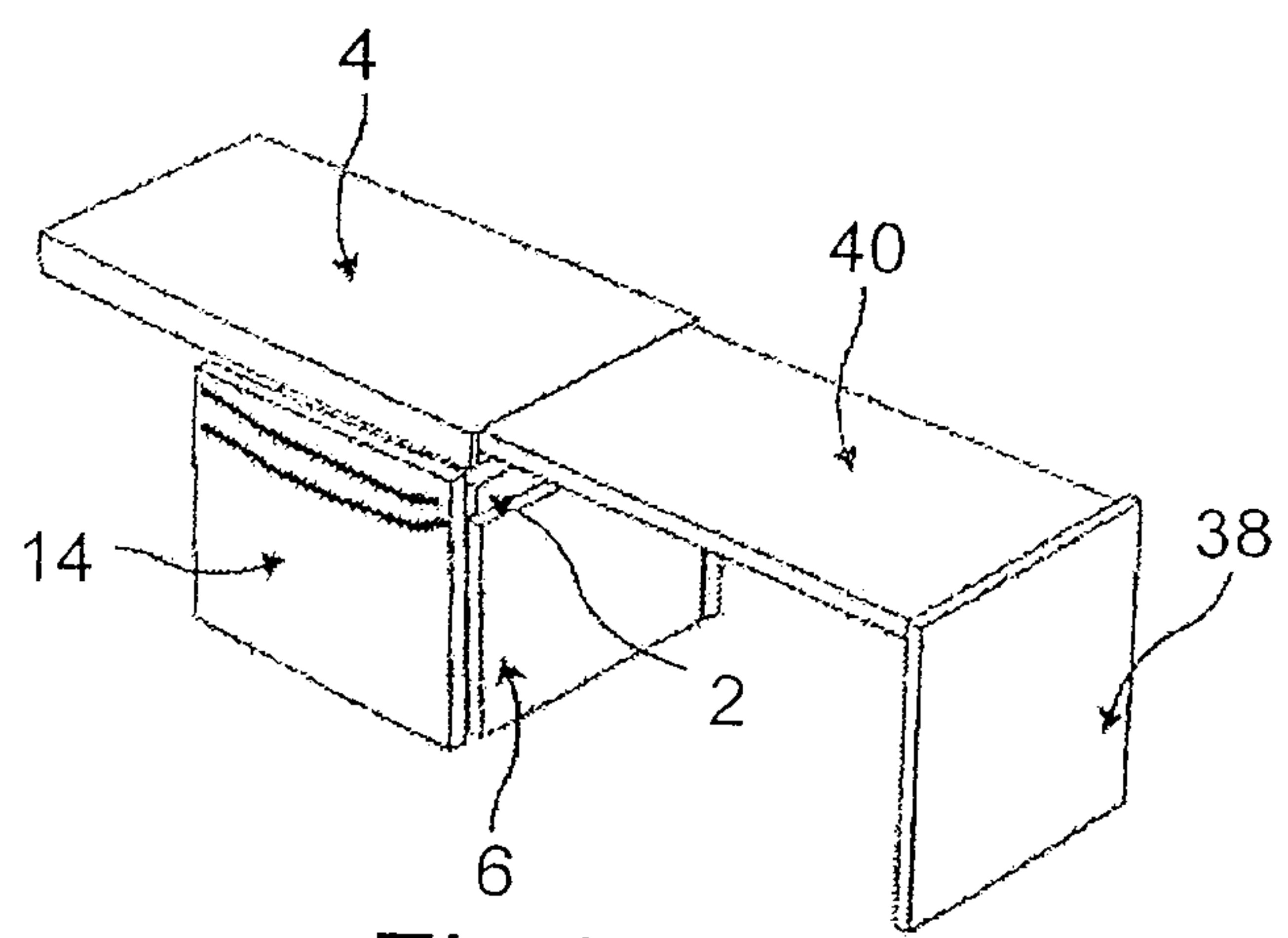
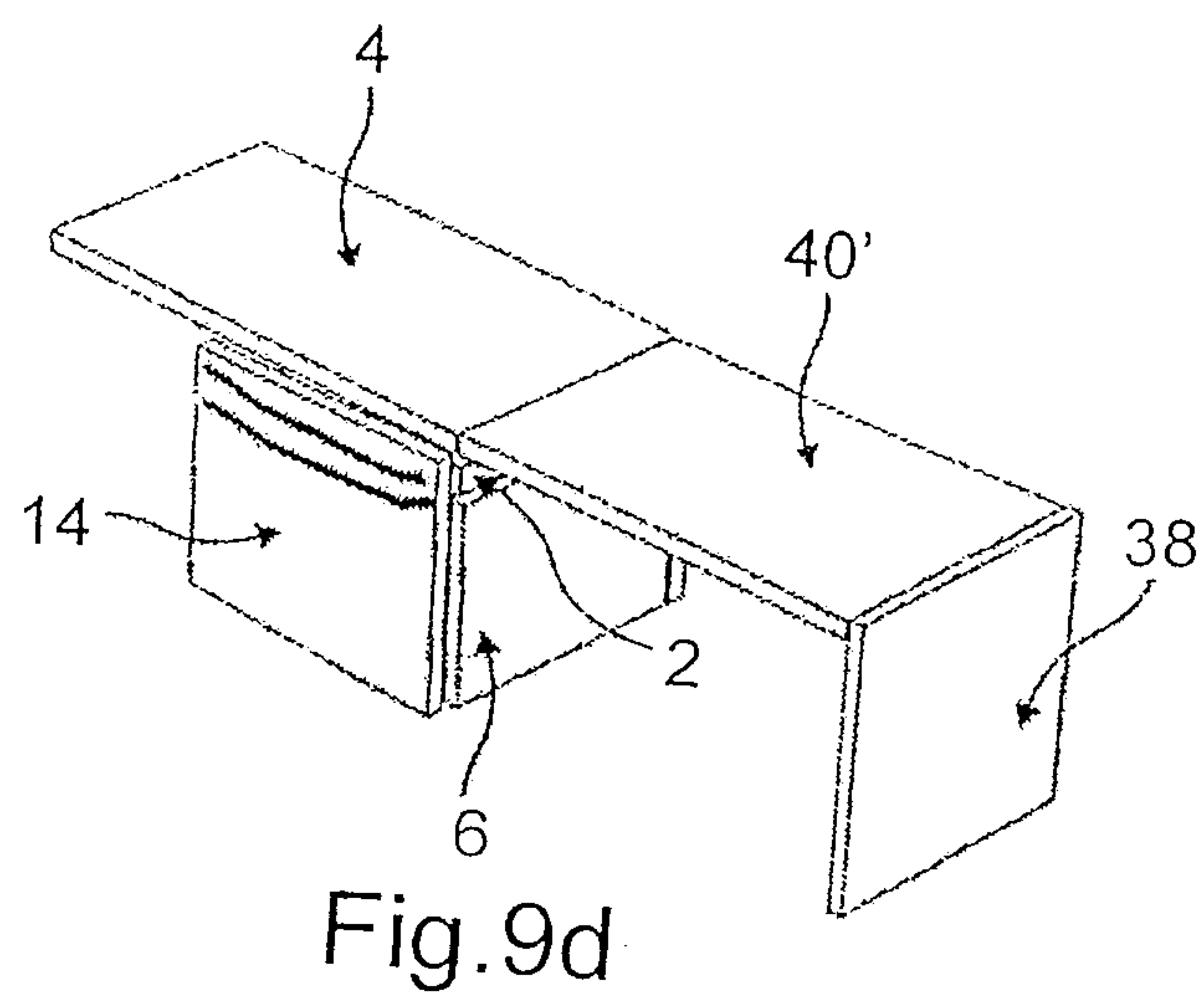
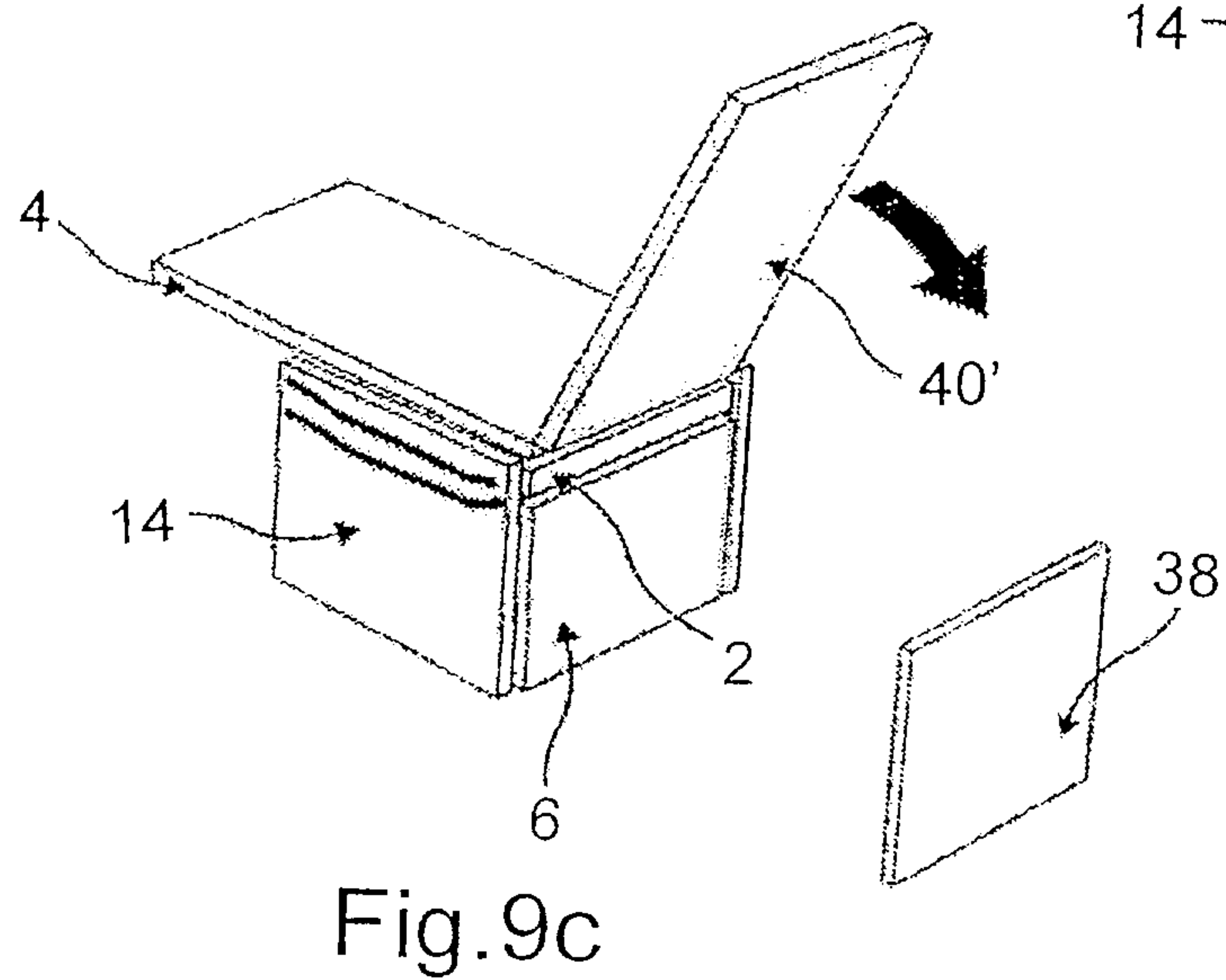
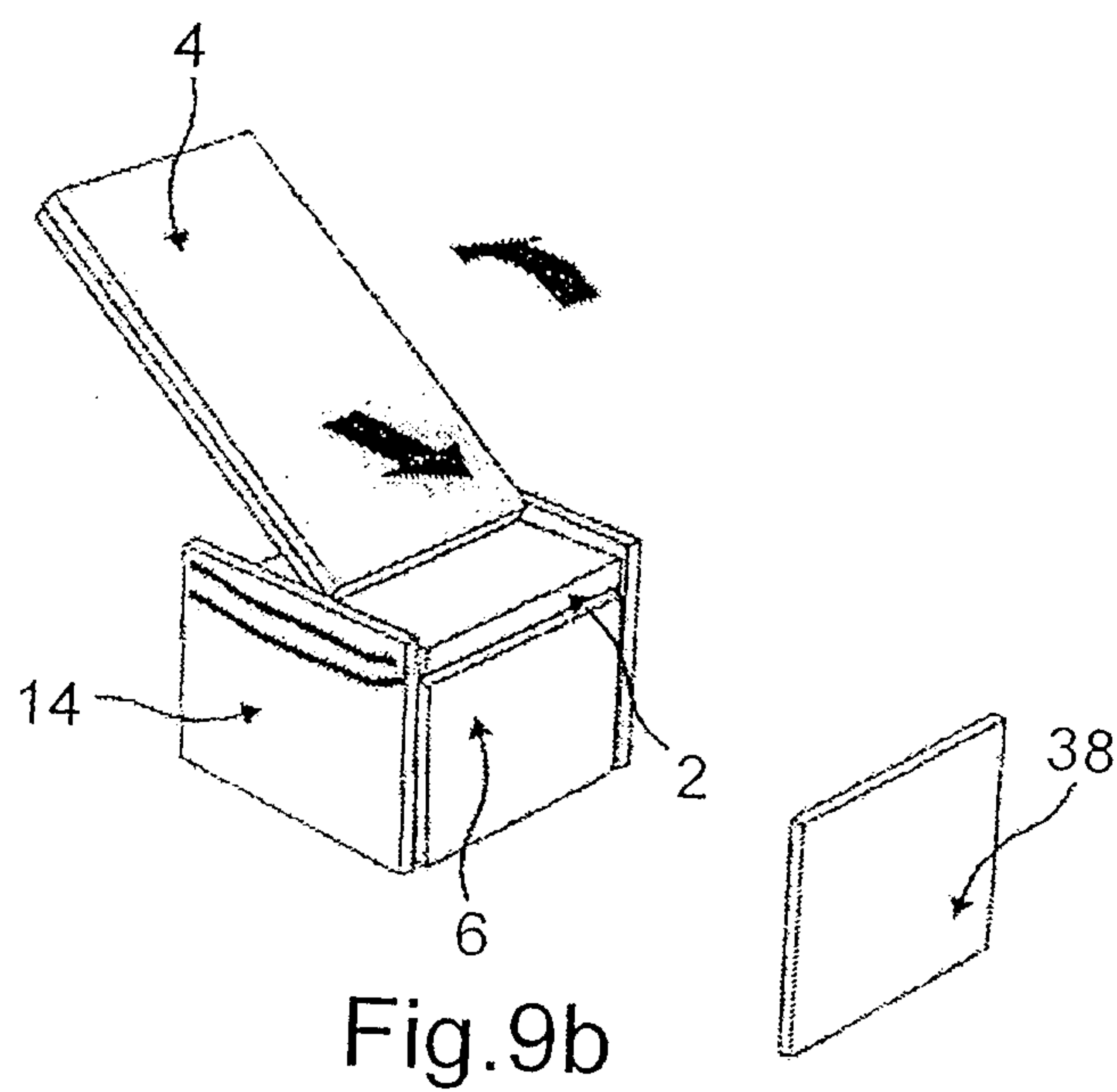
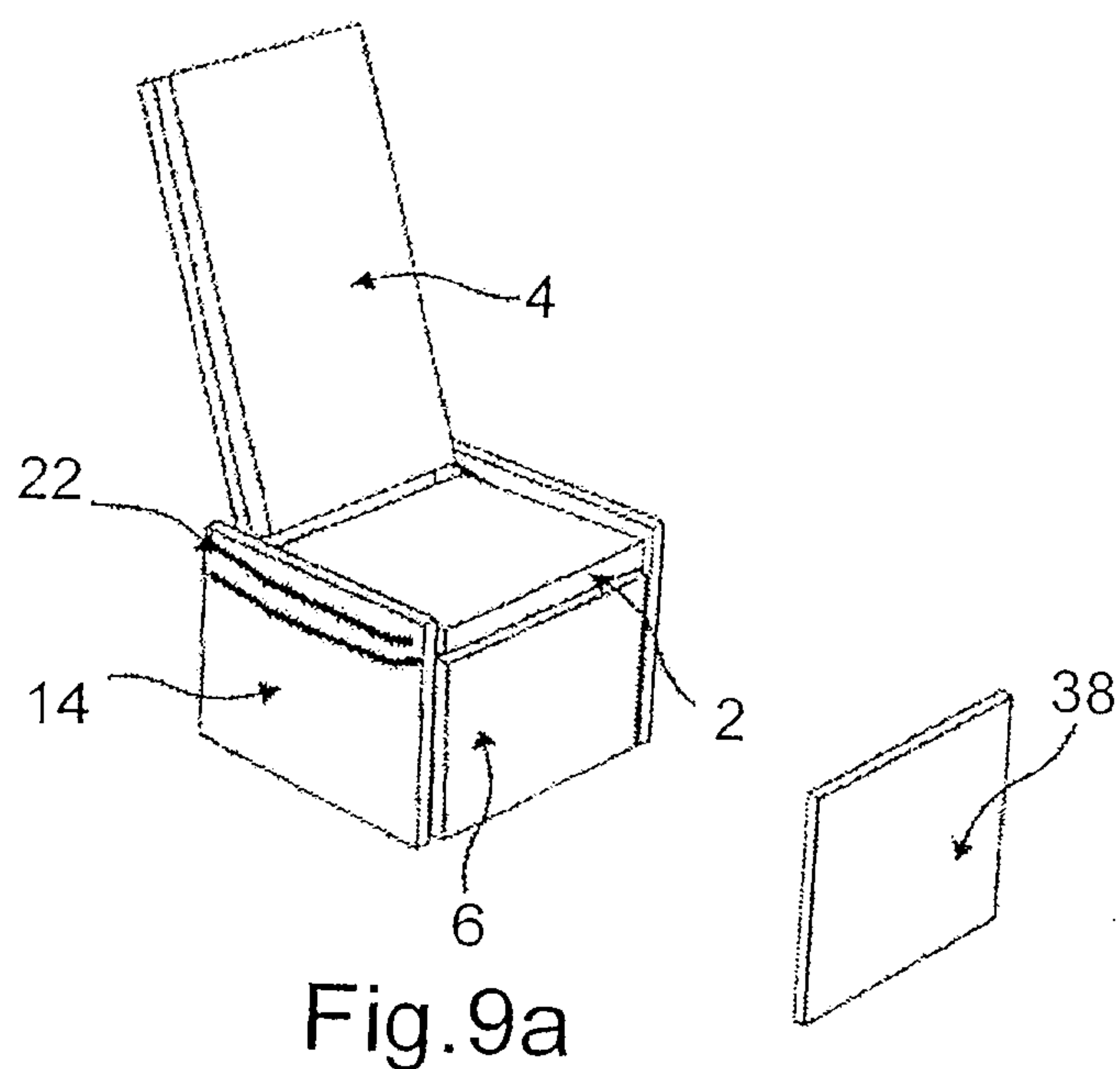
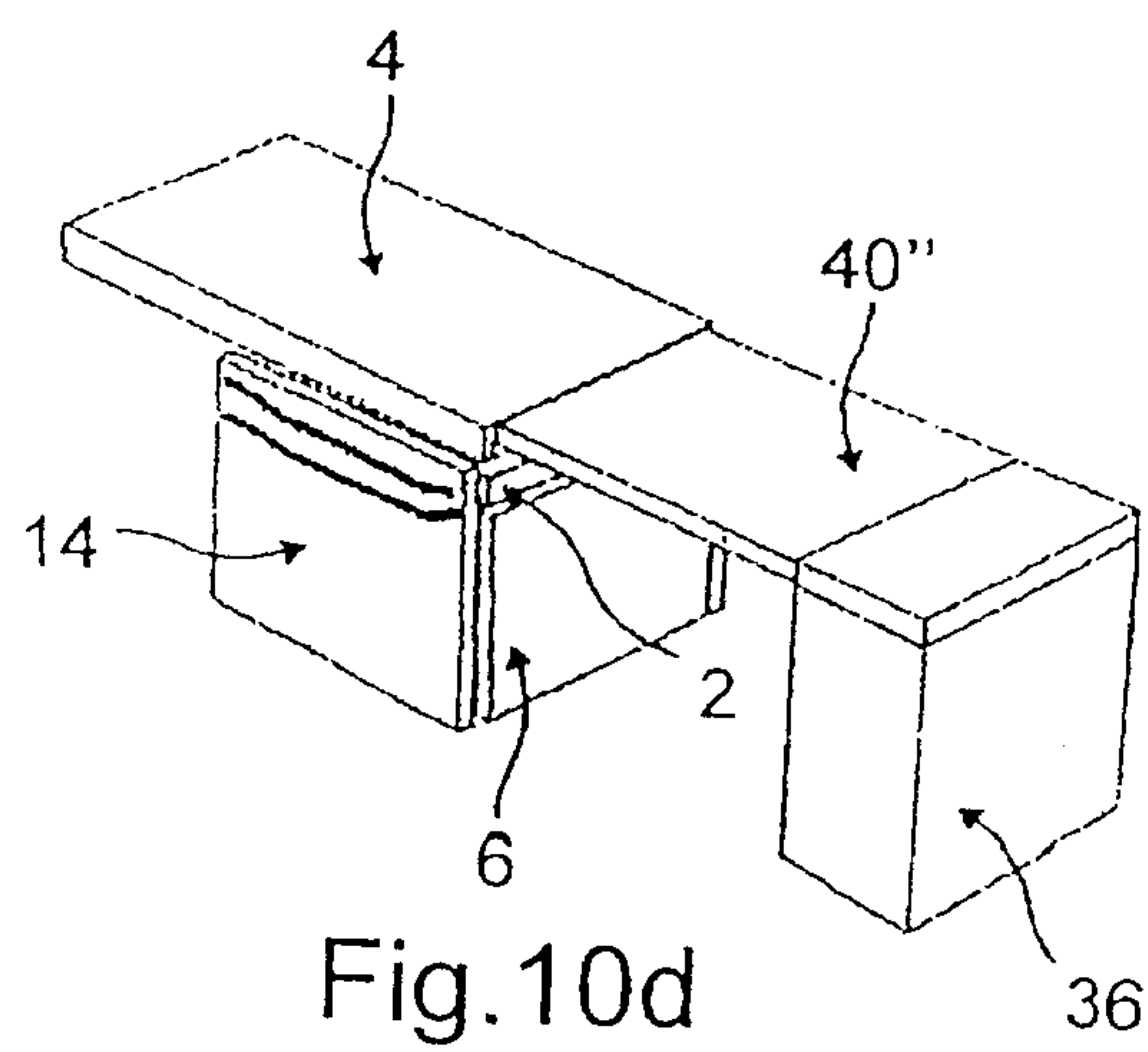
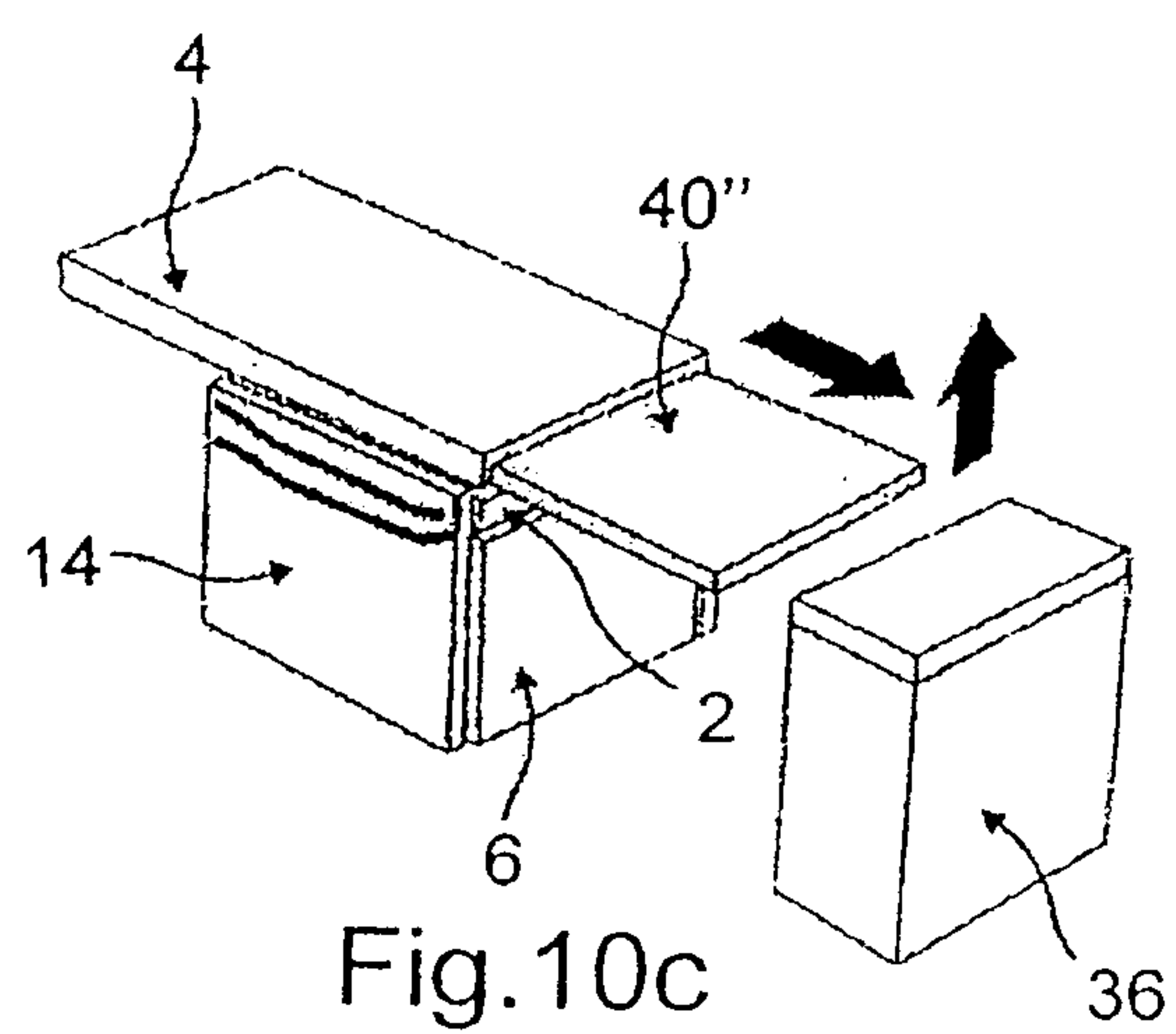
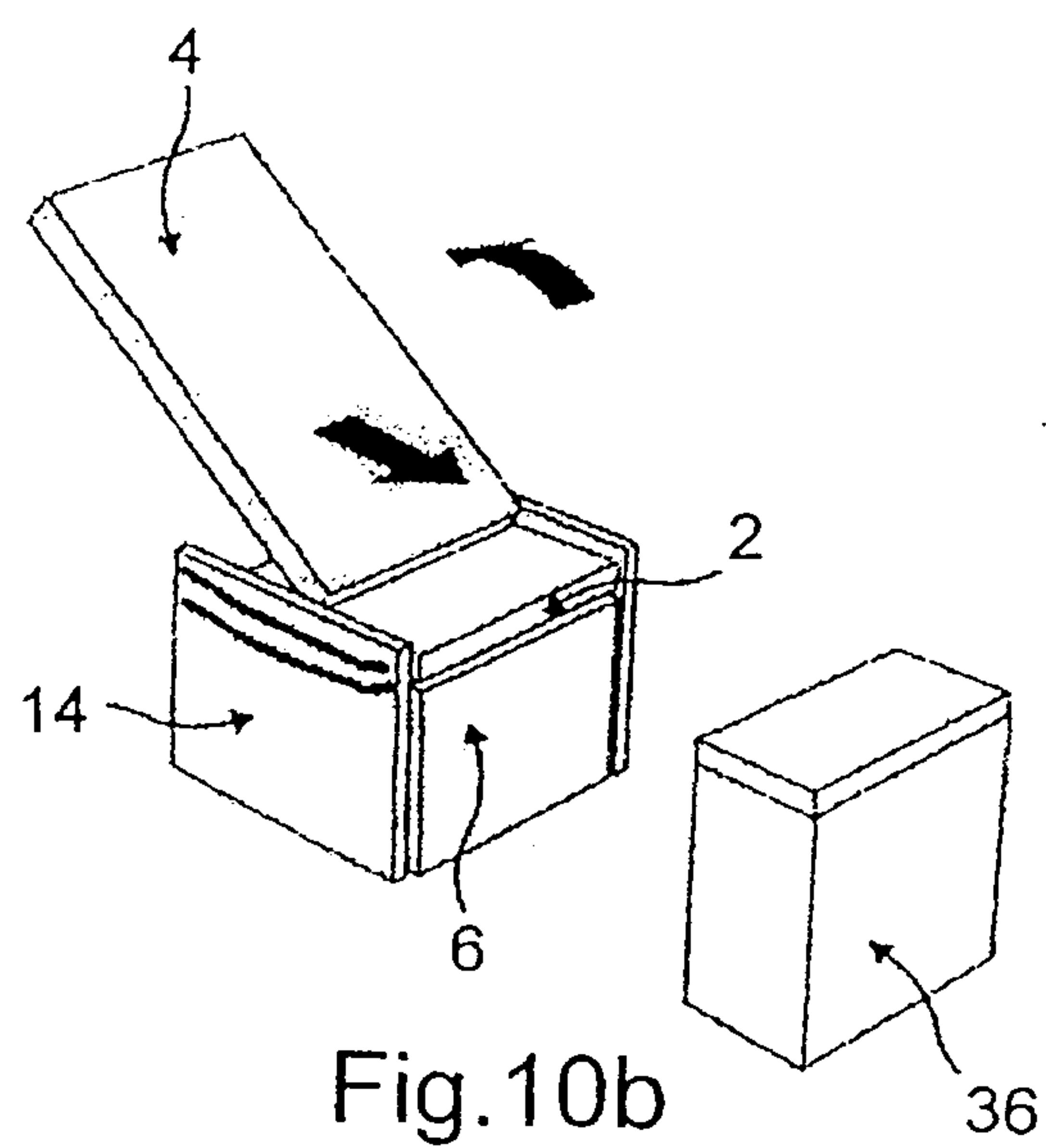
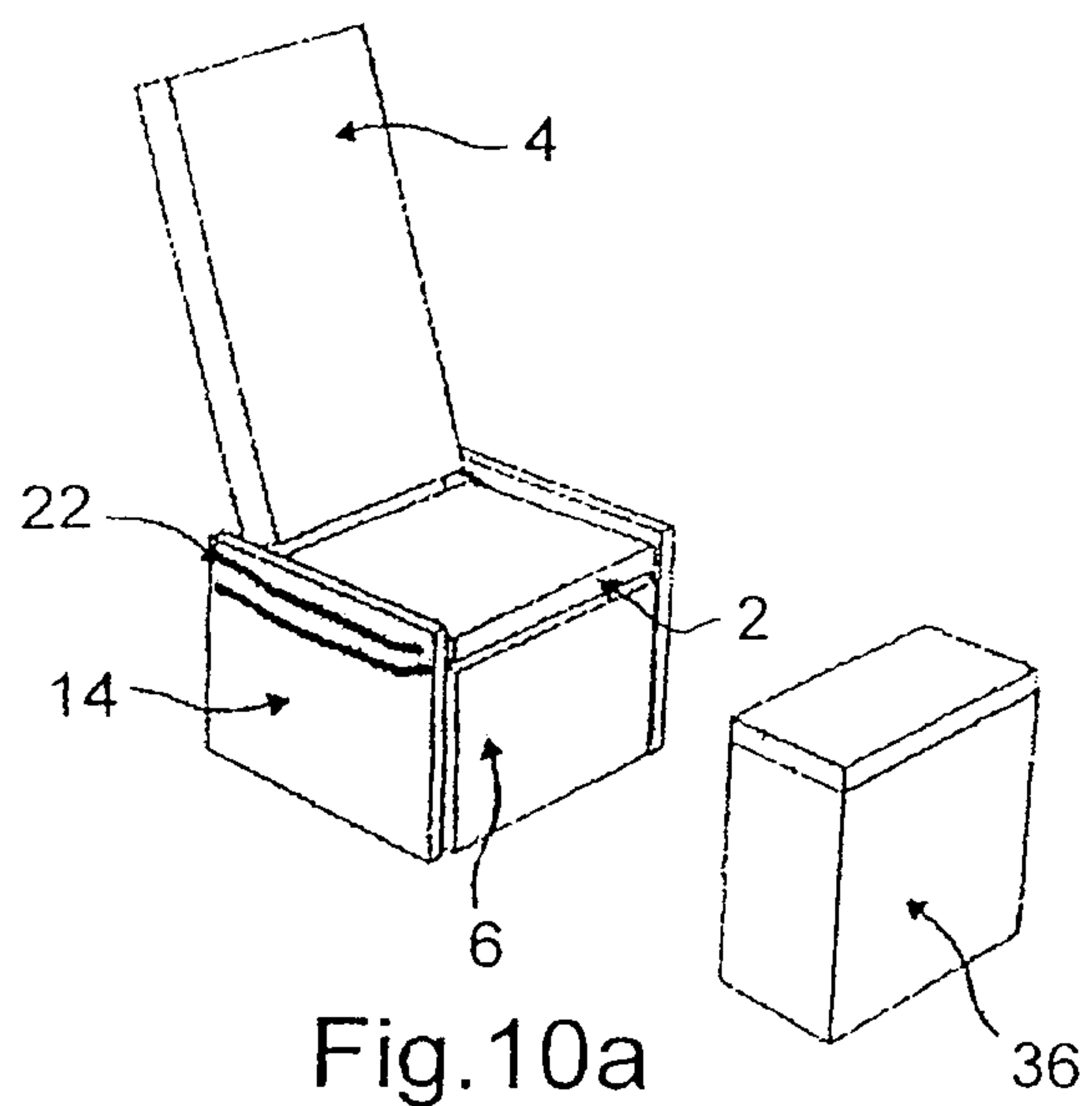


Fig. 8d





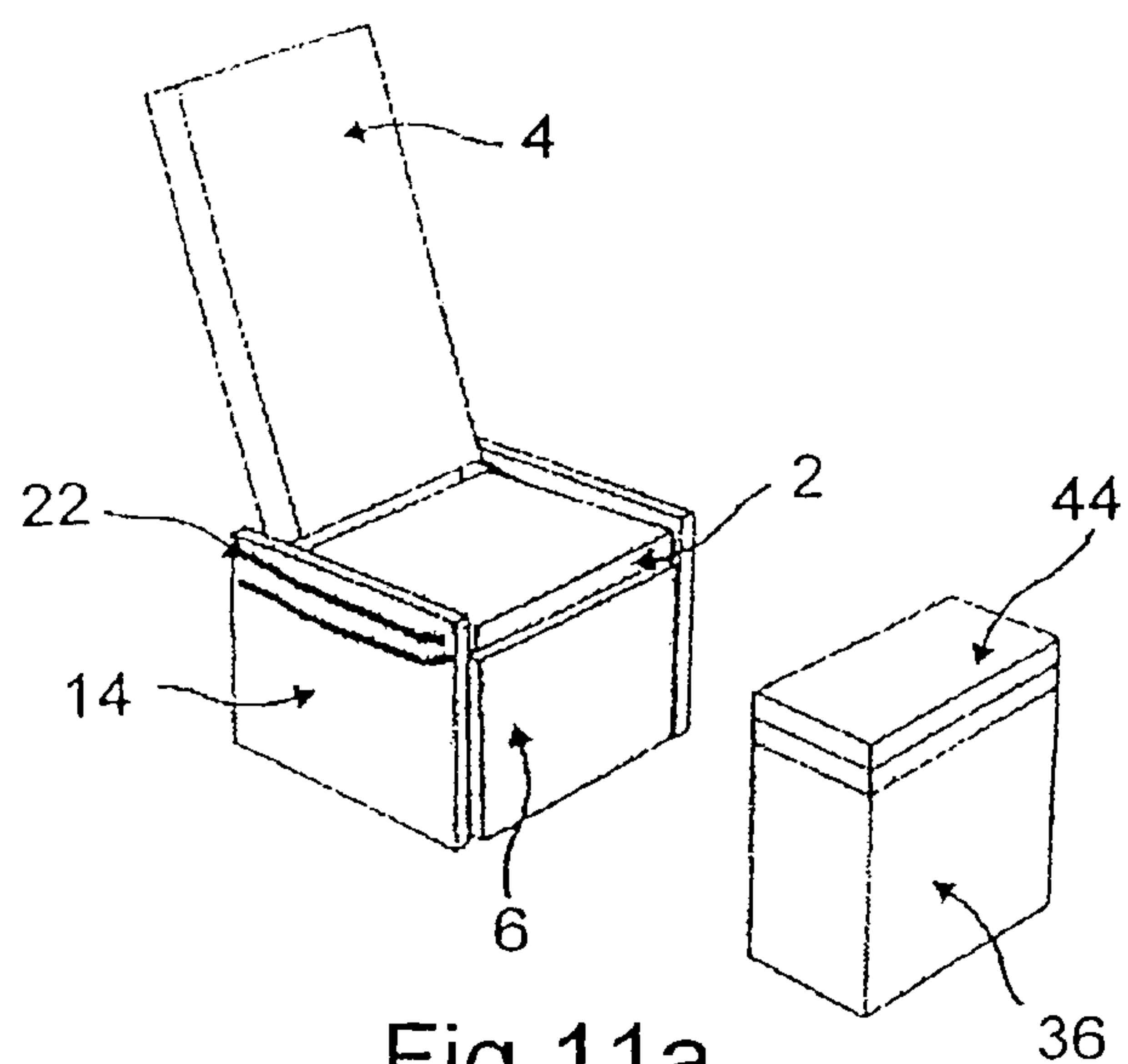


Fig.11a

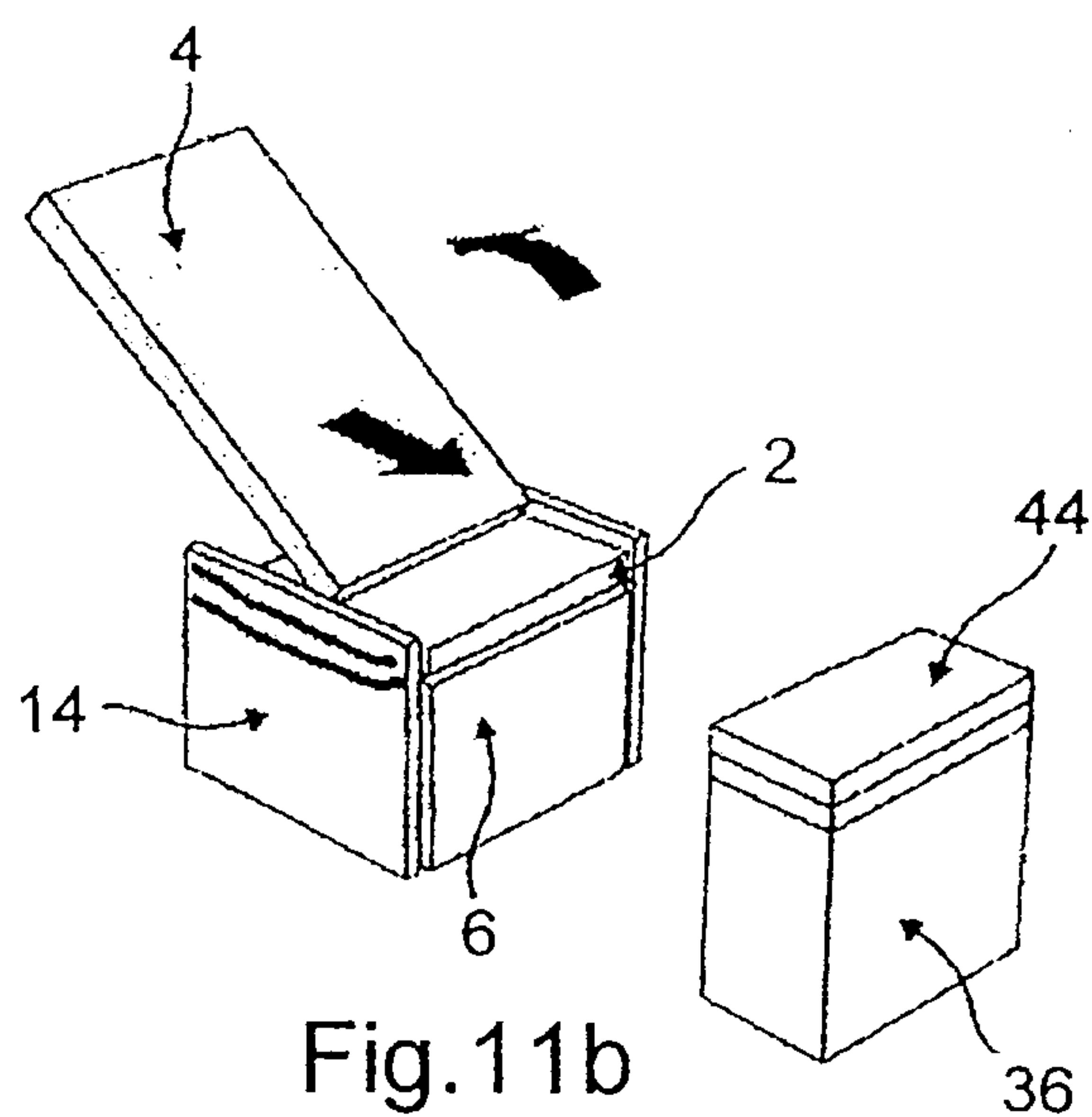


Fig.11b

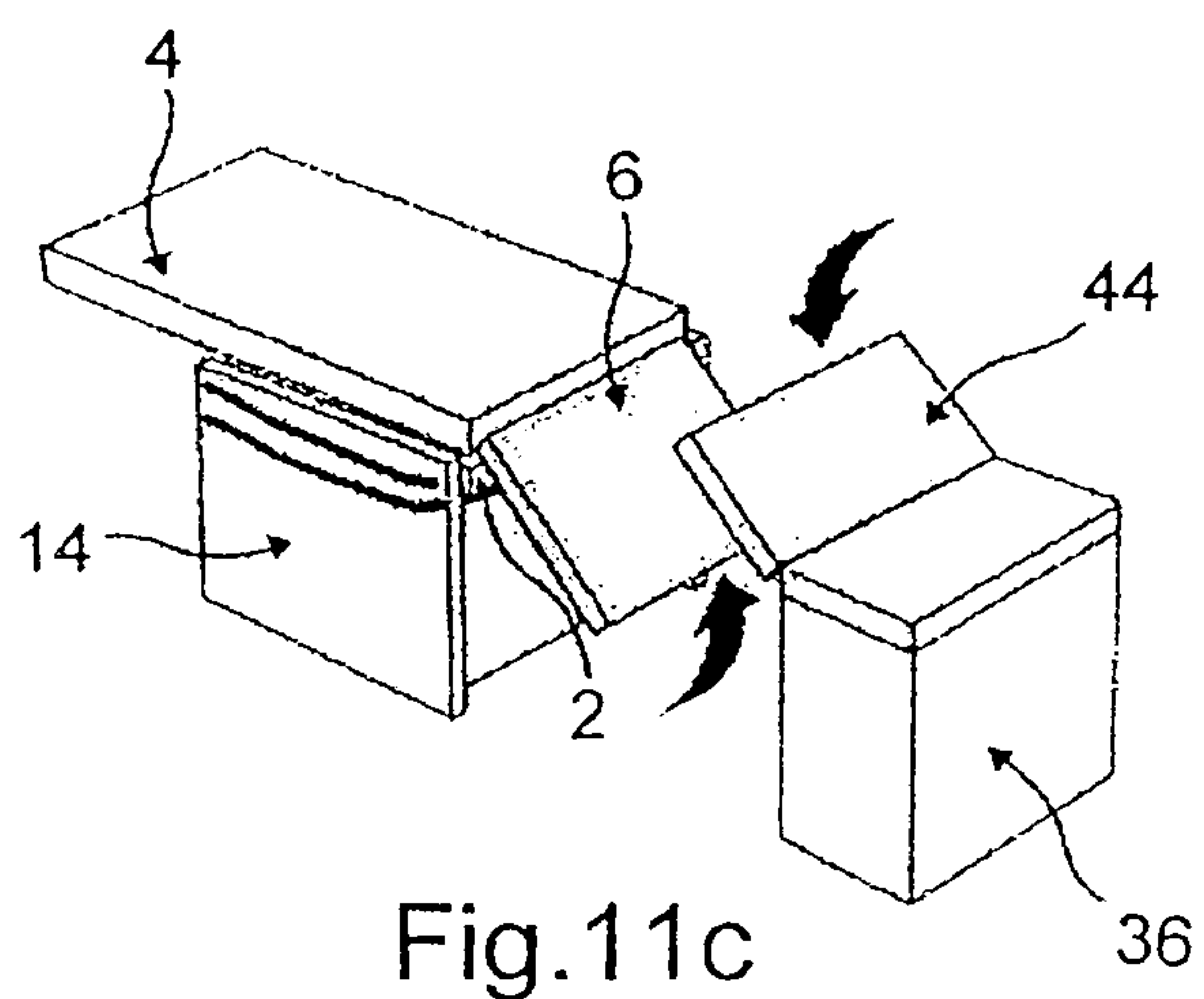


Fig.11c

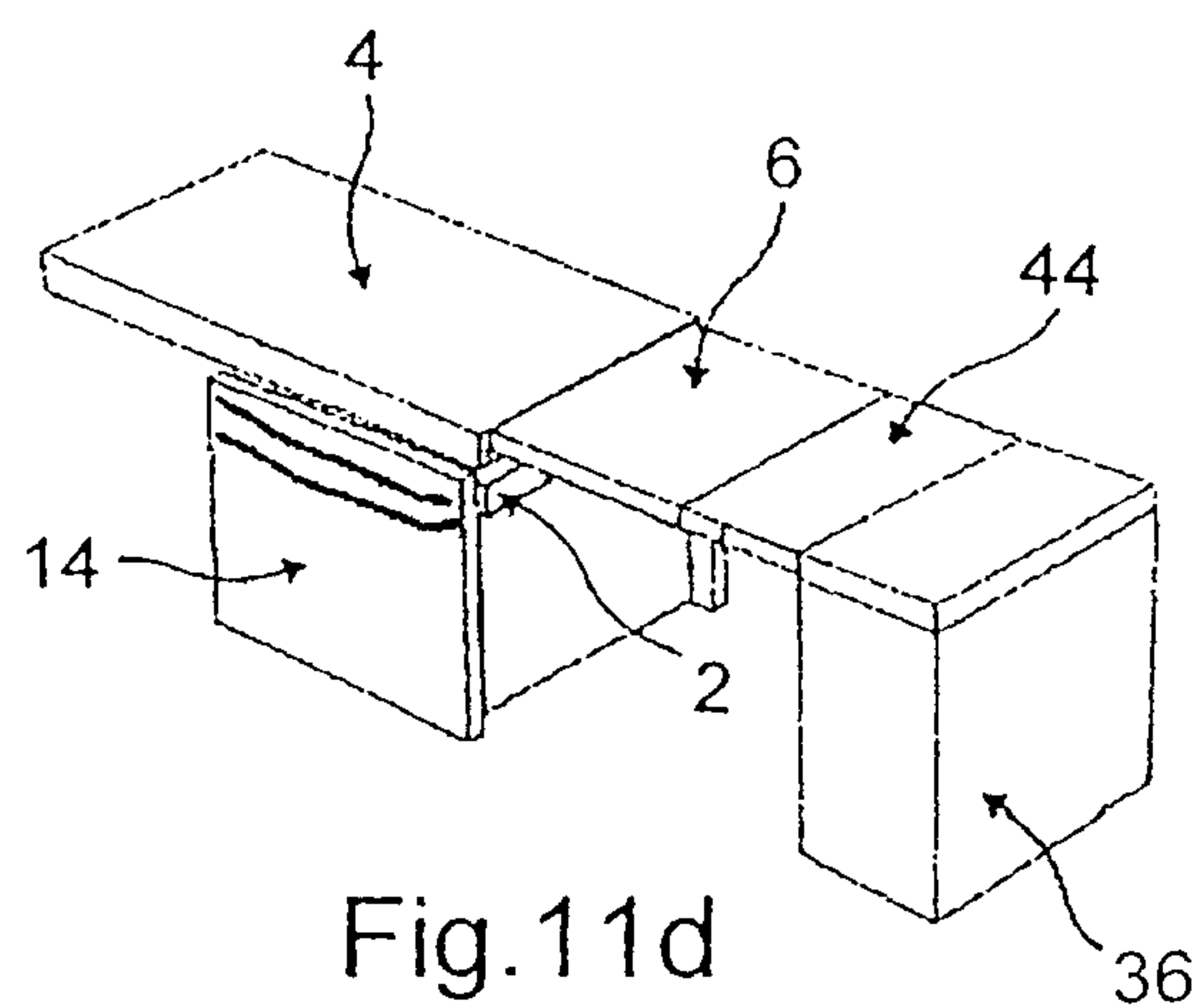
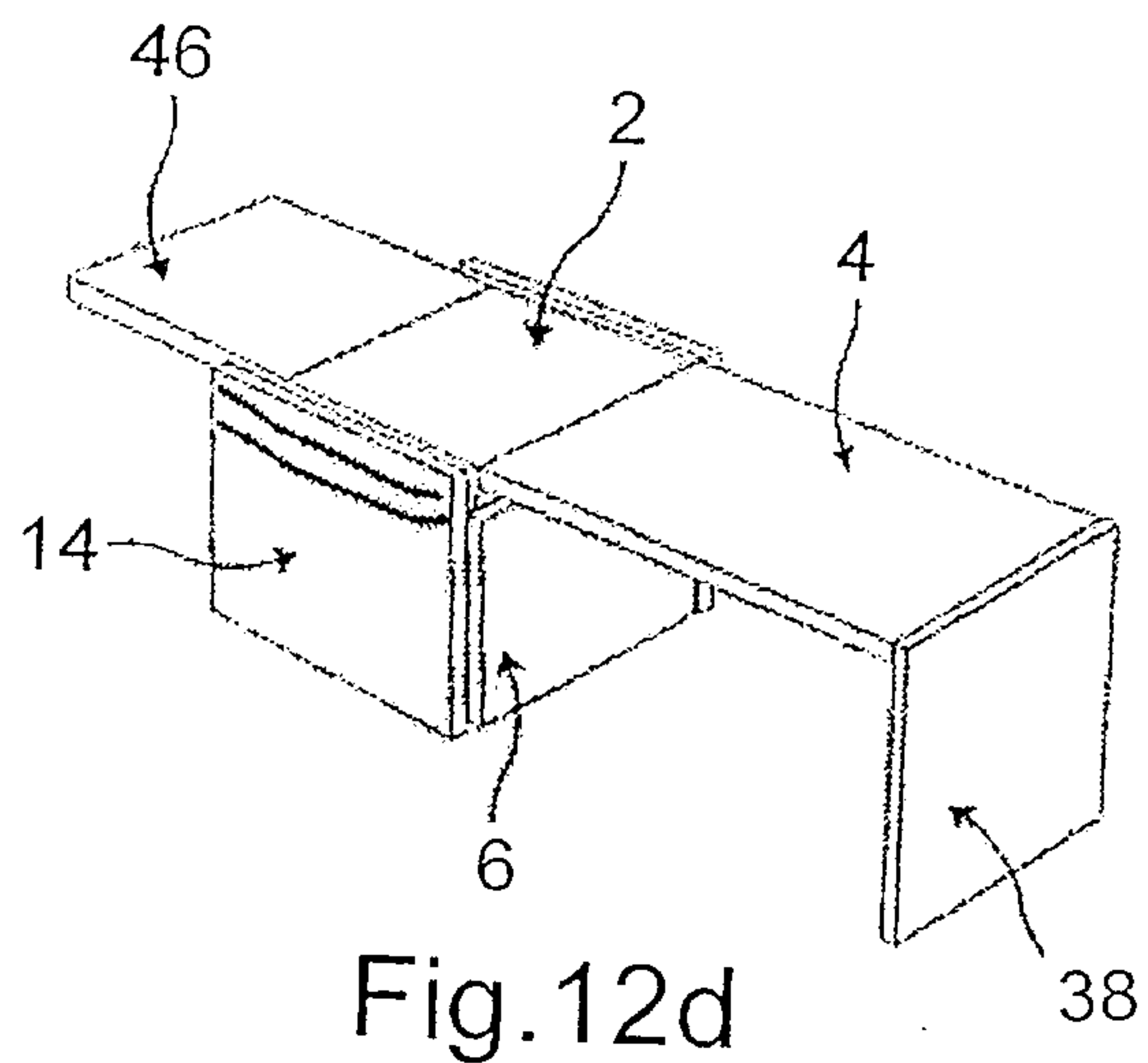
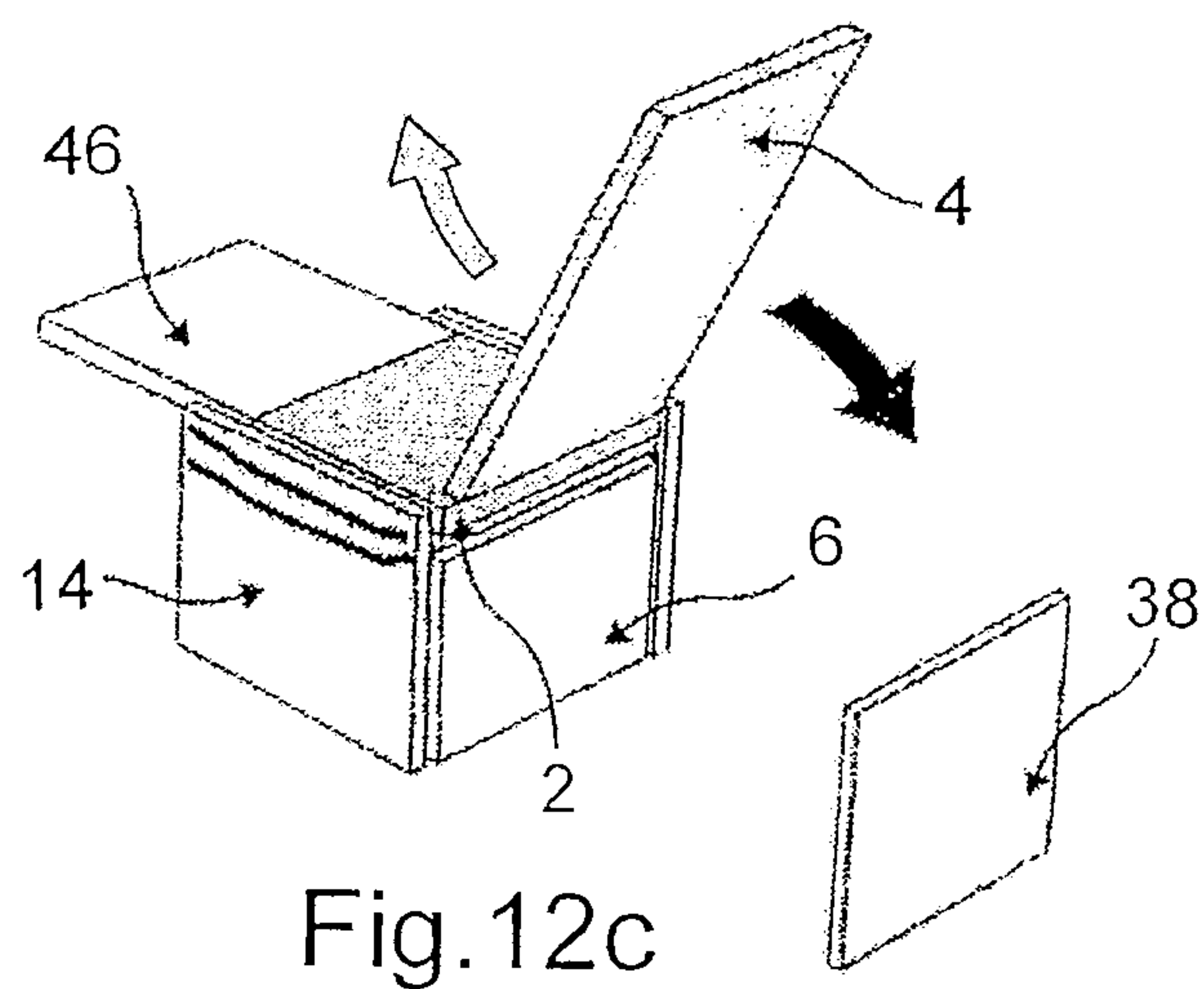
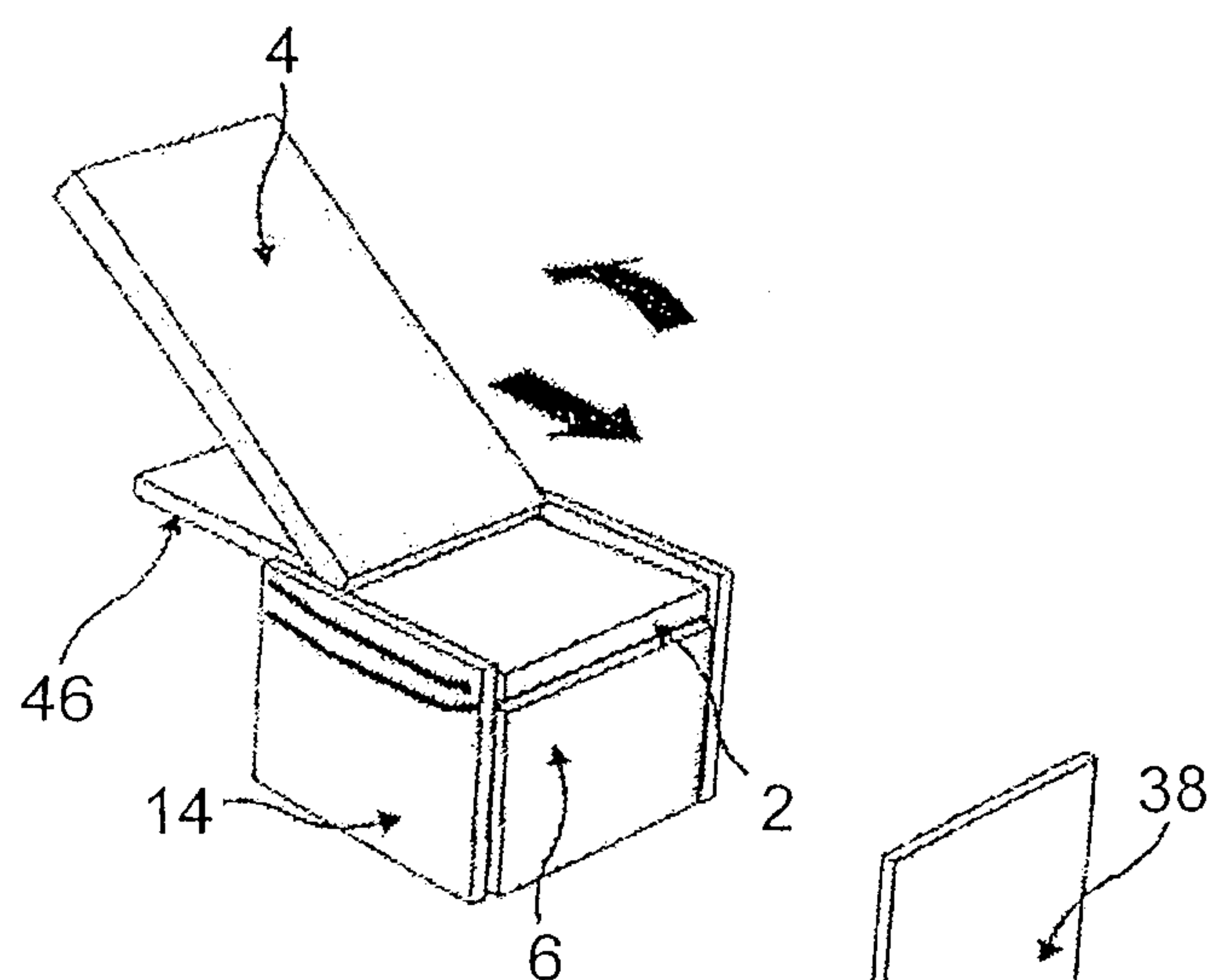
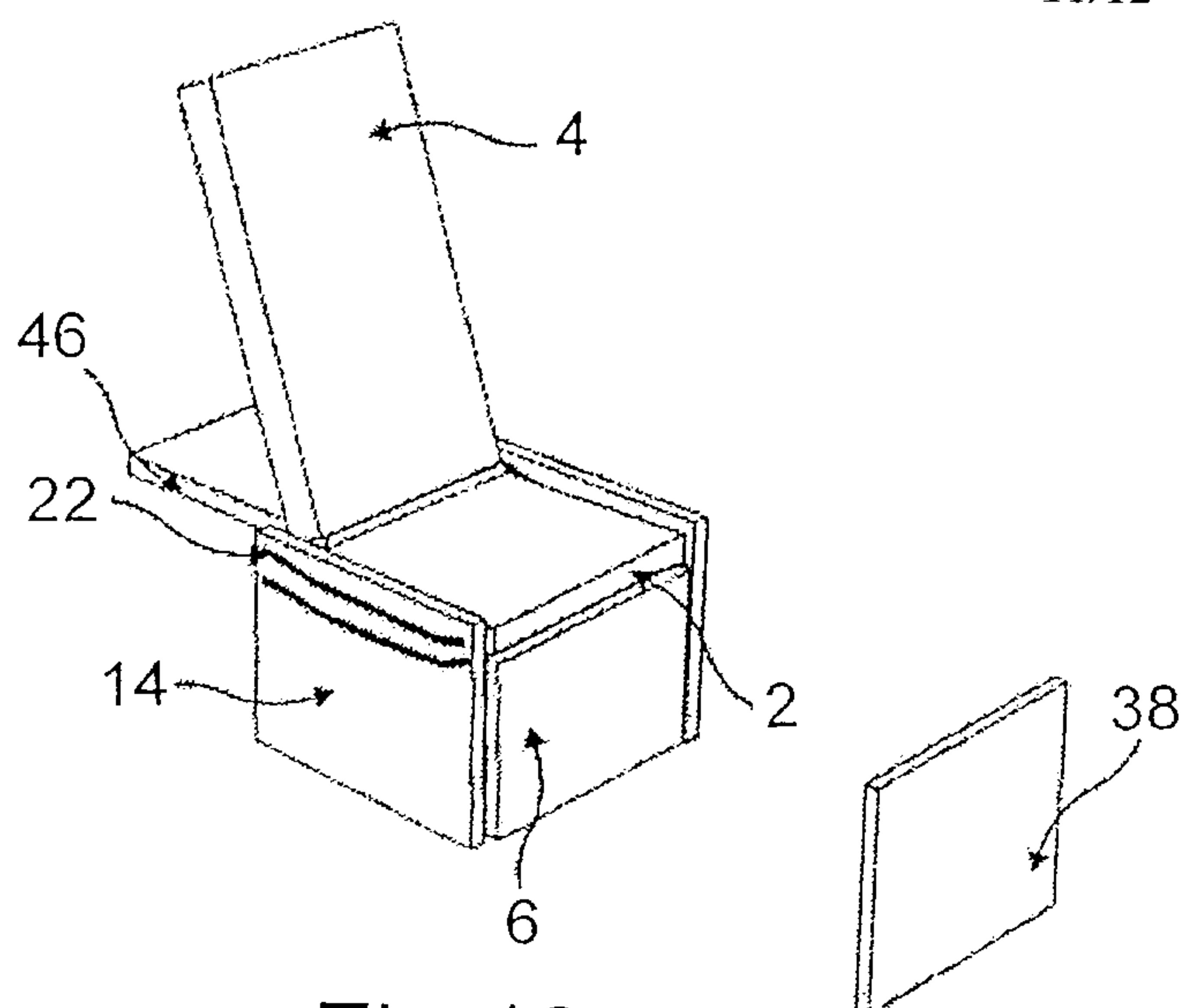


Fig.11d



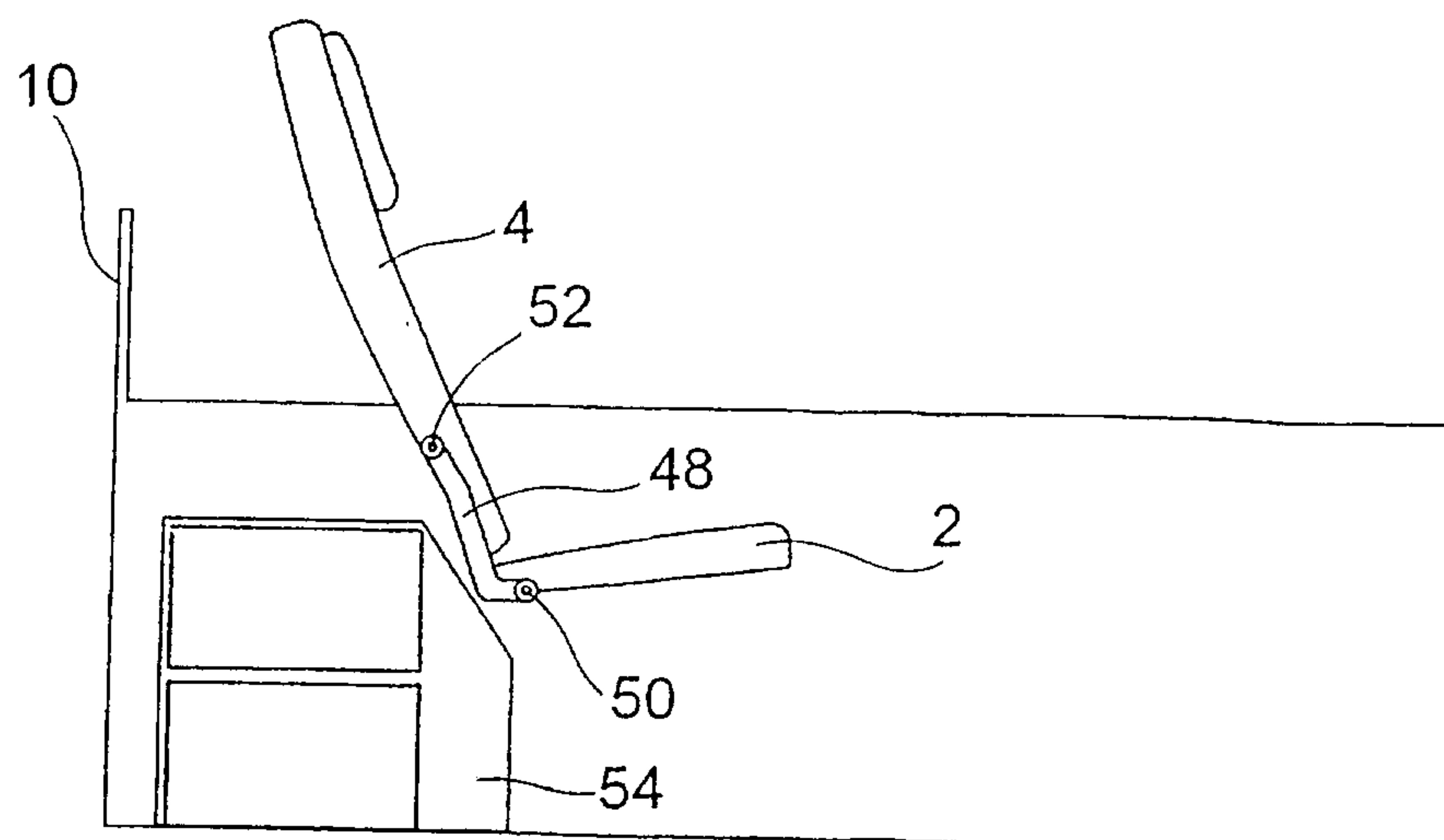


Fig. 13a

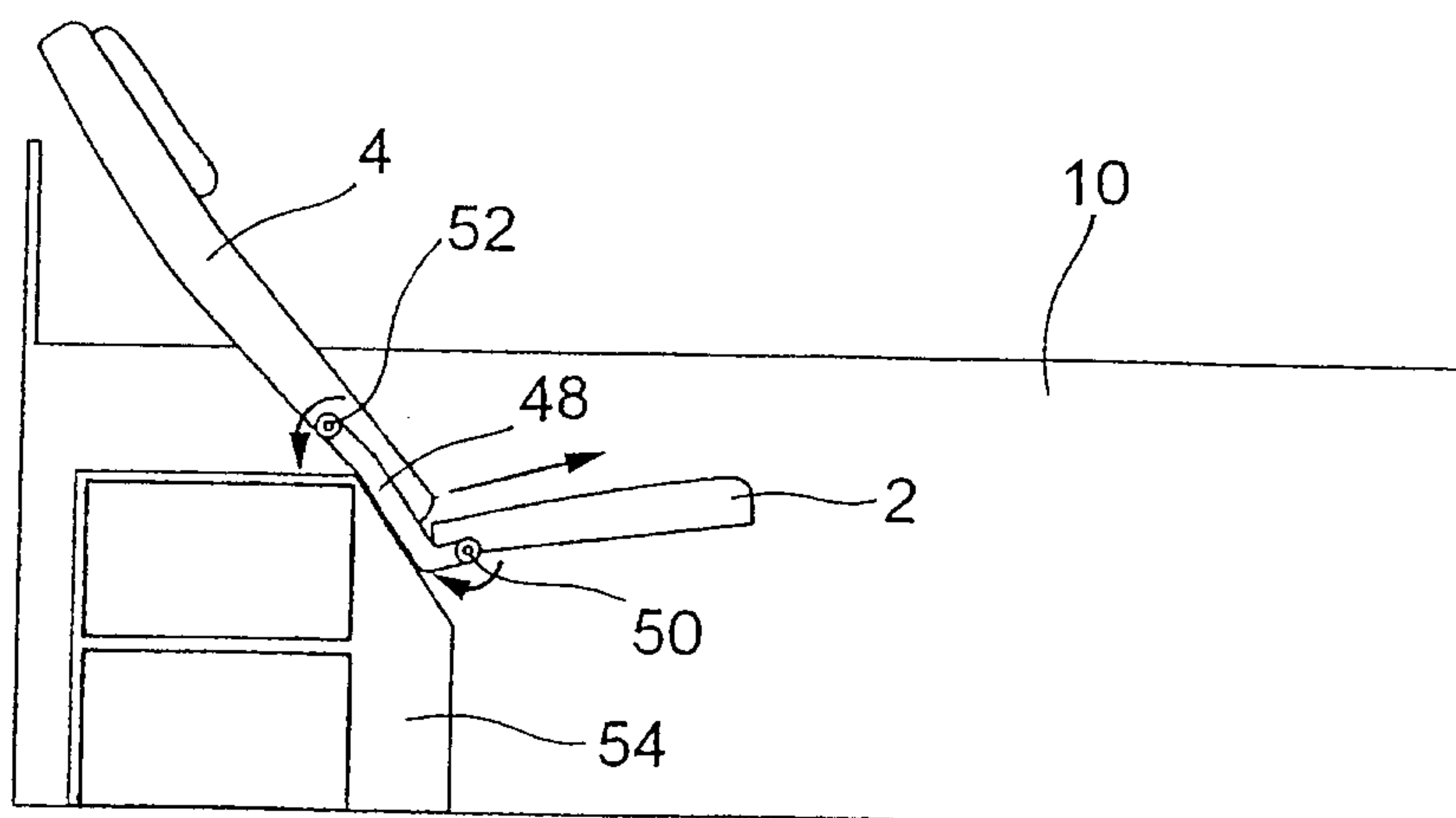


Fig. 13b

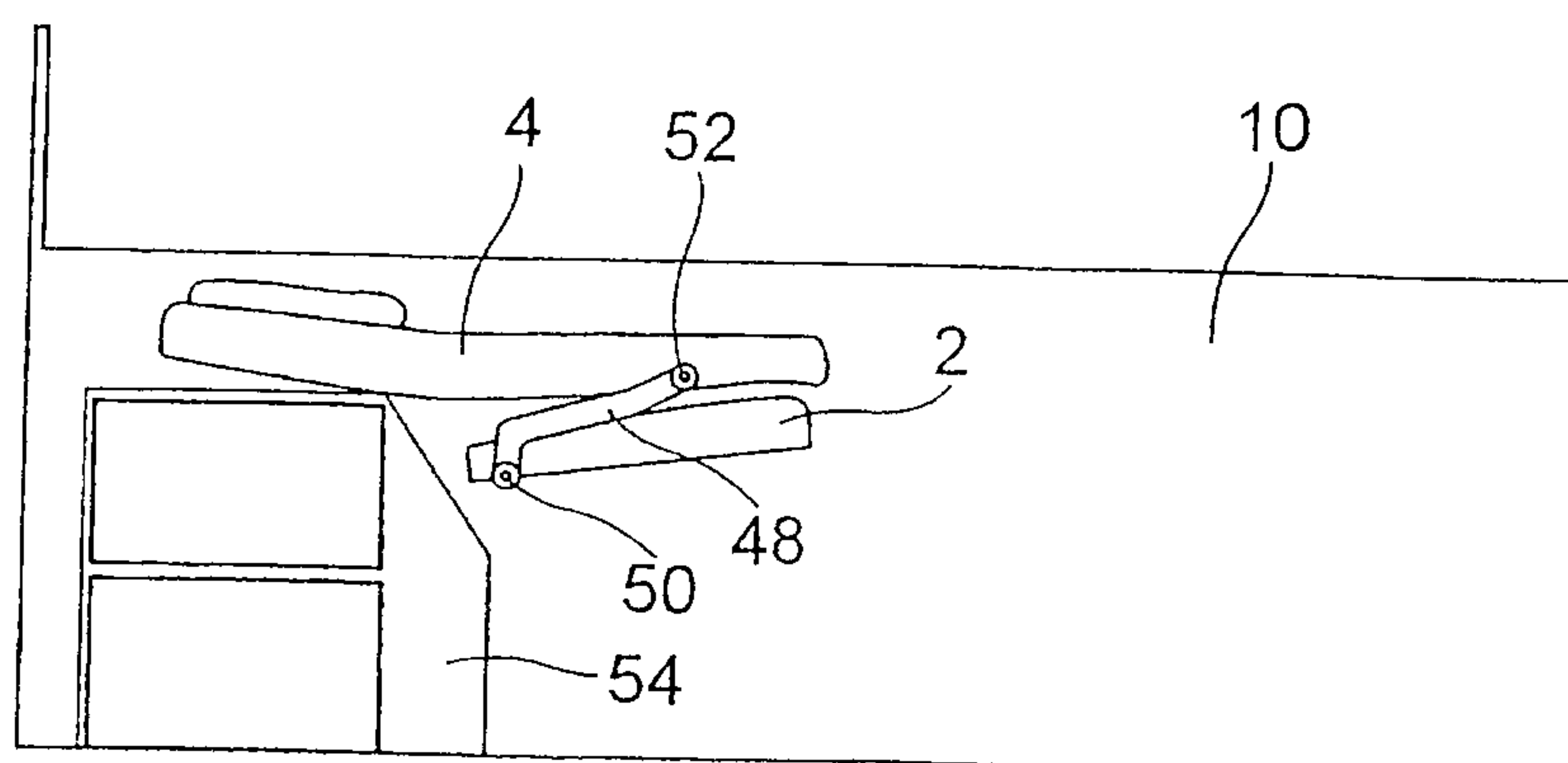


Fig. 13c

