



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 0 859 118 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
19.08.1998 Bulletin 1998/34

(51) Int. Cl.<sup>6</sup>: **E06C 1/393**, E06C 1/20

(21) Application number: **97202561.3**

(22) Date of filing: **21.08.1997**

(84) Designated Contracting States:  
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC  
NL PT SE**  
Designated Extension States:  
**AL LT LV RO SI**

(72) Inventors:  
• **Van Berne, Joost**  
**4817 XH Breda (NL)**  
• **Mangini, Vitaliano**  
**60038 S. Paolo Digesi (IT)**

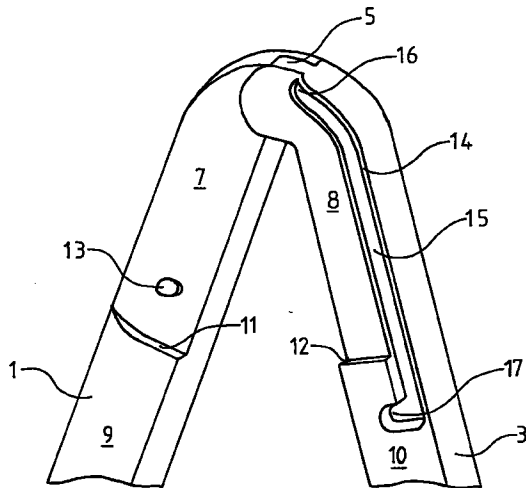
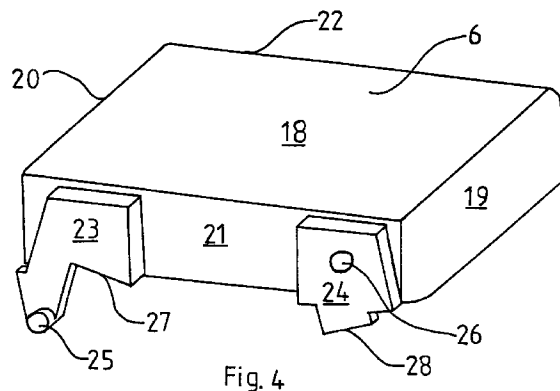
(30) Priority: **13.02.1997 EP 97200450**

(74) Representative:  
**Westphal, Klaus, Dipl.-Ing. et al**  
**Patentanwälte**  
**Westphal, Mussgnug & Partner,**  
**Waldstrasse 33**  
**78048 Villingen-Schwenningen (DE)**

(71) Applicant: **DSM N.V.**  
**6411 TE Heerlen (NL)**

(54) **Folding structure**

(57) Folding structure comprising at least two supporting elements that are connected to one another by means of a hinge joint allowing movement between a folded position and a folded-out position, which supporting elements each comprise two parallel lateral supports (1,3) that are connected to one another by at least one transverse support (2,4) and also a plateau (6), which is rotably connected to each pair of lateral supports with the aid of means of rotation (13,15,25,26) and which, in the folded-out position, constitutes a horizontal bearing surface between the lateral supports, wherein in the folded-out position, the plateau rests directly on the lateral supports.



EP 0 859 118 A1

## Description

The invention relates to a folding structure comprising at least two supporting elements that are connected to one another by means of a hinge joint allowing movement between a folded position and a folded-out position, which supporting elements each comprise two parallel lateral supports that are connected to one another by at least one transverse support and also a plateau, which is rotably connected to each pair of lateral supports and which, in the folded-out position, constitutes a horizontal bearing surface between the lateral supports.

Such a structure, in the form of folding steps, is known from EP-A-457,703. In these steps, in the folded-out position, the plateau rests on the hinge pins with which the plateau is rotably connected between the lateral supports. In order to ensure good support of the plateau, the attachments of the hinge pins are reinforced with square bushes.

This known structure involves the drawback that when the steps are used, the full load caused by the weight of a person standing on the plateau must be borne by the hinge structure. The hinge pins are then inevitably exposed to considerable transverse forces and moments of force. As a result, the pins may bend, which will have a negative influence on the actual hinge function, and they may even snap, causing the structure to collapse, unless the hinge is designed to be considerably heavier than is required for the actual hinge function.

The aim of the invention is to provide a folding structure that does not possess this drawback, or that possesses it to a lesser extent.

This aim is achieved according to the invention because, in the folded-out position, the plateau rests directly on the lateral supports.

This ensures that the hinges or other points of rotation via which the plateau is connected to the supporting elements are not loaded by the user's weight. The hinge structure is then hence loaded exclusively by the folding and folding-out themselves, for which it is indeed primarily intended. An additional advantage is that the design of the hinge structure can be considerably lighter now that it no longer has to be resistant to weights of the order of 70-80 kg and the associated transverse forces. In the structure according to the invention the load is borne entirely via pressure forces, exerted on the lateral supports, as a result of which a lighter hinge structure suffices. When hereinafter reference is made to a 'hinge' this is understood to mean any means with which two parts can be rotably connected to one another.

The structure according to the invention may be for example steps or a step-stool, but also a piece of furniture, for example a folding table or chair, with the tabletop or the seat, respectively, constituting the plateau and the legs two by two serving as the lateral supports of the supporting elements. The structure according to

the invention may furthermore also be embodied in for example a folding washing rack and in a general sense in any folding structure which in folded-out condition has a horizontal part that is subjected to a vertical load.

The structure according to the invention can be folded and has a folded and a folded-out position. In the folded-out position the structure is in the form suitable for the function of use. In the folded position the structure is generally a flat package that takes up the smallest possible volume. In the folded position the supporting elements are practically parallel to one another, with the other elements incorporated between them, projecting as little as possible beyond the supporting elements.

Each supporting element comprises two lateral supports that run parallel to one another. 'Parallel' is here also understood to mean 'at a small angle relative to one another in the plane defined by the lateral supports', for example up to 10 -15°. Setting the lateral supports at a certain angle, so that the ends of the lateral supports which rest on the ground when the structure is used are further removed from one another than the other ends, enlarges the supporting area on the ground delimited by the lateral supports, which has a favourable effect on the structure's stability. The lateral supports may to this end also include a bend or curvature. The lateral supports are connected to one another by at least one transverse support. This transverse support contributes to the structure's sturdiness and prevents the lateral supports being forced apart on the ground when they are loaded, which could cause the structure to collapse. In the case of steps, the individual steps will usually serve as the transverse supports. In the case of a table, the transverse support may be of a relatively light design because the vertical load to which it is exposed will generally be lower than with steps, a stool or a chair.

The supporting elements are connected to one another, usually via the lateral supports, by means of hinges so that they can move relative to one another. These hinges may be in the vicinity of the ends of the lateral supports, as a result of which the structure will in folded-out condition have the shape of a V with its opening facing downwards, or more in the direction of the middle of one or both of the lateral supports, as a result of which the folded-out structure will have the shape of an X or the shape of the Greek letter λ. The hinges may be attached to a shaft connecting the lateral supports of each of the supporting elements, which shaft then runs parallel to the direction of the transverse support. The hinges may also be incorporated in the lateral supports without being connected to one another. If, in the structure's folded-out position, the hinge points are at a short distance above the position of the plateau, the latter embodiment is preferable.

The plateau in a folding structure is usually fitted between the lateral supports, parallel to the transverse support. In the folded-out condition the plateau

assumes a horizontal position, hence constituting a sitting, standing or bearing surface. 'Horizontal' is here also understood to mean 'at a small angle relative to horizontal'. 'At a small angle' is here understood to be an angle of at most 10 - 15°. In the case of steps or a step-stool, a plateau that is as horizontal as possible is desirable so as to prevent the user slipping from the plateau. For similar reasons the tabletop of a folding table is preferably horizontal. If the folding structure is a chair, a slightly backwards-sloping position of the plateau, in this case the sitting element, will have a considerable favourable effect on the sitting comfort.

The plateau is rotably connected to the two lateral supports of each of the supporting elements. Often the plateau is only rotably connected to the two lateral supports of one of the supporting elements, hereinafter to be referred to as the first supporting element, and is connected to the lateral supports of the other supporting element, hereinafter to be referred to as the second supporting element, in a fashion that allows both rotation and vertical movement. The connections with the lateral supports of the first supporting element are then for example formed by round pins which are, optionally with bearings, rotably incorporated in holes or cavities made in the sides facing one another of that supporting element's two lateral supports. The connection between the plateau and the second supporting element may be designed in several manners known per se. An example of a suitable embodiment is known from EP-A-457,703. Here there is a bar on both sides of the plateau, one end of which is rotably connected to one of the lateral supports of the second supporting element, the other end being rotably connected to one side of the plateau. In folded-out condition the plateau is then on one side, parallel to the transverse support, supported by the connections with the lateral support of one supporting element, in particular by the hinge pins, and on the opposite side the plateau rests on parts of the hinge structure projecting beyond the lateral supports at the bars' connections. When the structure is folded, the plateau is pressed upwards by the bars, which are connected to the lateral supports of the second supporting element, and rotates around the axis through the plateau's connections with the lateral supports of the first supporting element until the plateau is ultimately, in the folded position, practically vertical between the lateral supports.

Another known embodiment for the connection of the plateau with the lateral supports of the second supporting element is the one with a groove in the sides facing one another of the lateral supports of the second supporting element, in which groove a pin present on each of the sides of the plateau is incorporated in a manner allowing a sliding movement and rotation. In the folded-out position the pins rest on the lowest part of the grooves' wall. When the structure is folded, the pins slide through the grooves in the direction of the top end of those grooves, the plateau again rotating around the

axis through the connections with the lateral supports of the first supporting element. When the structure is being folded, the plateau rises from the horizontal position until it is ultimately, in the folded condition, practically vertical between the lateral supports.

Something that the two embodiments have in common is that, in folded-out condition, the plateau rests directly or indirectly, which is understood to mean via parts that are connected to the hinge pins so that forces exerted on these parts are transmitted to the hinge pins, on the hinge pins, which must bear the load. In the structure according to the invention these hinge pins are unloaded in the folded-out position because the load is directly borne by the lateral supports and is not transmitted to the hinge structure. The plateau hence rests directly on the lateral supports and not on hinge pins or on parts that are connected to them so that the plateau's load is transmitted via the hinge pins after all. The plateau in the structure according to the invention may for example rest on projections of the lateral supports, which are then dimensioned so that when the structure is folded out the plateau comes into contact with the projections and comes to rest on them before the hinge pins can be loaded. It is then advantageous if the pins fit into the holes or cavities in which they rotate with a certain amount of spare room. A suitable difference in diameter between the pin and the hole or cavity will depend on the structure's overall size and will lie between 0.05 and 1 mm.

Preferably the plateau rests on provisions that are integrated in the lateral supports. A suitable example of this are lateral supports of which one part, hereinafter to be referred to as the bottom part, is thicker than a part lying higher up, hereinafter to be referred to as the top part. With more preference the bottom part projects relative to the top part, preferably on the inside, the projecting part then constituting a supporting surface. Integrated supporting surfaces present the advantage of greater strength over projections and hence the risk of the projections snapping is avoided. Preferably the plateau therefore rests on supporting surfaces integrated in the lateral supports. More preferably, the projecting part is bordered by a raised edge such that a groove is formed in which a downwardly projecting part of a side surface of the plateau can engage. Thus the plateau is supported by the supporting surface forming the bottom of the groove as well as secured against lateral movements by the upper part of lateral support and the raised edge.

Suitable materials for a structure according to the invention are the metals and plastics known for folding steps and step-stools, one skilled in the art being able to choose the dimensions in relation to the material properties and the expected load to which the structure will be subjected.

The invention will be further elucidated with reference to the following figures.

Herein Fig. 1 is the left part of a structure, in this

case a step-stool, according to the invention, represented in perspective;

Fig. 2 is a side view of the step-stool according to Fig. 1;

Fig. 3 is a side view of a first embodiment of the inward-facing sides of two lateral supports of Fig. 2, each belonging to a different supporting element, which are connected to one another; and

Fig. 4 is a perspective view of a plateau working together with the lateral supports according to Fig. 3 which is suitable for use in the step-stool of Figs. 1 and 2.

Fig. 5 is a side view of a second embodiment of the inward-facing sides of two lateral supports of Fig. 2, each belonging to a different supporting element, which are connected to one another; and

Fig. 6 is a perspective view of a plateau working together with the lateral supports according to Fig. 5 which is suitable for use in the step-stool of Figs. 1 and 2.

In Fig. 1, 1 is one of the lateral supports of the supporting element referred to as 'first' above, which furthermore consists of transverse support 2 and a complementary, second lateral support, not represented in this figure and designed in mirror image relative to lateral support 1, parallel to lateral support 1, to which it is connected by transverse support 2. The other supporting element, referred to as 'second' above, consists of lateral support 3 and a second lateral support, designed in mirror image relative to lateral support 3, not represented in the figure, which is connected to the first lateral support 3 by transverse support 4. Lateral supports 1 and 3 are connected to one another via a hinge structure at the top 5. The hinge structure at the top 5 does not form part of the invention and can be for example a simple tenon and mortise structure. 6 stands for the step-stool's plateau. This is horizontal and is connected to the lateral supports 1 and 3 and the not represented complementary lateral supports as further elucidated in the following figures.

In Fig. 2 the same numbers as in Fig. 1 have been used to refer to the corresponding parts. Transverse support 2 is of a different shape than transverse support 4. Transverse support 4 is solely intended to serve as a connection between the lateral supports of the supporting element in question to thus grant the structure sturdiness, while transverse support 2 has a flat top side and serves as an intermediate step in stepping onto the stool.

In Fig. 3, 7 and 8 are the top parts of the insides, by which are meant the sides facing the other supporting element, of lateral supports 1 and 3, respectively. They adjoin one another, lying in a single plane, at the top 5. The bottom parts of these insides are referred to by 9 and 10, respectively. There are stepped transitions, 11 and 12, between the top parts 7 and 8 and the bottom parts 9 and 10, respectively, because the bottom parts 9 and 10 are thicker than the top parts and this differ-

ence in thickness is realised on the inside. At each lateral support the stepped transition or projection constitutes a supporting surface at right angles to the insides of lateral supports 1 and 3. On the top part 7 there is a round pin 13, which can be rotably incorporated in an opening in the side of the plateau, as will be elucidated with reference to Fig. 4. On the top part 8 of lateral support 3 is an uninterrupted raised wall 14 that borders a groove 15 with a top and bottom end 16 and 17, respectively. A pin, present on the side of plateau 6, as will become evident from the explanation of Fig. 4, can be incorporated in this groove in a manner allowing movement.

In Fig. 4, 6 is a plateau that can be incorporated in a manner allowing rotation and movement in the assembly of which half is represented in Fig. 1. The plateau consists of a top surface 18, a front surface 19 and a rear surface 20, not visible in the figure, and two side surfaces 21 and 22 (the latter not visible in the figure). There are two elevations 23 and 24 on side surface 21. There is a pin 25 on elevation 23, while elevation 24 contains a cavity 26. In assembled condition, pin 25 is incorporated in groove 15 of lateral support 3, while pin 13 of lateral support 1 is incorporated in cavity 26. The difference in diameter between pin 13 and cavity 26 is 0.2 mm, the difference in diameter between pin 25 and groove 15 is 0.5 mm. Elevation 23 has a flat part 27 at the bottom side and elevation 24 has a flat part 28. The distance between pin 13 and supporting surface 11, measured in the longitudinal direction of lateral support 1 and in the stool's folded-out position, has been chosen to be such that in this folded-out position flat part 28 rests on supporting surface 11 while the bottom side of pin 13 is free from the wall of cavity 26, use having been made of the aforementioned play of 0.2 mm. In the same manner, as a result of a suitable choice of the distance between bottom end 17 and supporting surface 12, flat part 27 rests on supporting surface 12 of lateral support 3, while pin 25 is, as a result of the aforementioned 0.5 mm difference in diameter, not in contact with the base of the groove at the groove's bottom end 17. The directions of the flat parts 27 and 28 relative to the plane of the top side of the plateau have been chosen to be such that, in the stool's folded-out position, these directions coincide with the directions of supporting surfaces 12 and 11, respectively, and the top side of the plateau assumes the desired position, generally the horizontal one. The connection between side 22 of the plateau and the other pair of lateral supports connected to one another is analogous but designed in mirror image.

In Fig. 5, 207 and 208 are the top parts of the insides, by which are meant the sides facing the other supporting element, of lateral supports 201 and 203, respectively. They adjoin one another, lying in a single plane, at the top 205. The bottom parts of these insides are referred to by 209 and 210, respectively. There is a stepped transition 211 between the top part of inside

207 and the thicker bottom part 209. In the stepped transition 211 there is a groove 240 with bottom part 242, the rear wall of which is formed by an extension of part 207. The width of the groove is about half the thickness of the stepped transition. The groove 240 extends across approximately 60-70% of the width of lateral support 201. From the end of the groove, part 209 slopes to the outside of lateral support 201. On the top part 207 there is a round pin 213, which can be rotably incorporated in an opening in the side of the plateau, as will be elucidated with reference to Fig. 6.

From the side facing lateral support 201 the top part of inside 208 across approximately 40% of the width of lateral support 203 changes into the thicker bottom part 210 with a stepped transition 212. In the stepped transition 212 there is a groove 250 with bottom 252, the rear wall of which is formed by an extension of part 208. The width of the groove is approximately half the thickness of the stepped transition and is, depending on the size of the step-stools, for instance between 2 and 10 mm.

In the half of flat part 208 that is closest to outside 230 there is a groove 215, which is bordered by a side wall 214, the remainder of part 208 and a top end 216 and bottom end 217. The outside of side wall 214 is in plane 230 and its top side is in a plane with top part 208. The bottom of bottom end 217 forms a stepped transition which ends in the plane of bottom part 210. The part that is closest to outside 230 gradually changes into the transition to that outside 230, so that 210 slopes on that side.

A pin, present on the side of the plateau working together with the lateral supports, as will become evident from the explanation of Fig. 6, can be incorporated in groove 215 in a manner allowing movement.

In Fig. 6, 206 is a plateau that can be incorporated in a manner allowing rotation and movement in the assembly of which half is represented in Fig. 1. The plateau consists of a top surface 218, a front surface 219 and a rear surface 220, not visible in the figure, and two side surfaces 221 and 222 (the latter not visible in the figure). At the location of front and back surface 219 and 220, respectively, side surface 221 is extended with elevations 223 and 224. There is a pin 225 on elevation 223, while at the level of elevation 224 side surface 221 contains a cavity 226. In assembled condition, pin 225 is incorporated in groove 215 of lateral support 203, while pin 213 of lateral support 201 is incorporated in cavity 226. The difference in diameter between pin 213 and cavity 226 is 0.2 -0.7 mm, just like the difference in diameter between pin 225 and groove 215. Elevation 223 has a flat part 227 at the bottom side and elevation 224 has a flat part 228. The distance between pin 213 and bottom 242, measured in the longitudinal direction of lateral support 201, has been chosen to be such, in relation to the distance between cavity 226 and flat part 228, that in the folded-out position of the stool flat part 228 rests on the bottom 242 of groove 240, while the bottom side of pin 213 is free from the bottom part of the

wall of cavity 226, use having been made of the aforementioned difference in diameter. In the same manner, as a result of a suitable choice of the distance between bottom end 217 and bottom 252 in relation to the distance between pin 225 and flat part 227, this flat part 227 rests on the bottom 252 of groove 250 in lateral support 203, while pin 225 is not in contact with the base of the groove at the bottom end 217 of groove 215. The directions of the flat parts 227 and 228 relative to the plane of the top side of the plateau have been chosen to be such that, in the stool's folded-out position, these directions coincide with the directions of bottoms 252 and 242, respectively, and the top side of the plateau assumes the desired position, generally the horizontal one. The connection between side 222 of the plateau and the other pair of lateral supports connected to one another is analogous but designed in mirror image.

This ensures that over the entire area of the flat parts 27 and 28 and 227 and 228, respectively, the plateau rests on supporting surfaces 11 and 12 and bottoms 252 and 242, respectively. Every loading of the plateau, for example by the weight of a person standing on it, is thus transmitted to the lateral supports via the supporting surfaces integrated in the lateral supports or via the bottoms of the grooves therein. The hinges remain unloaded.

#### Claims

1. Folding structure comprising at least two supporting elements that are connected to one another by means of a hinge joint allowing movement between a folded position and a folded-out position, which supporting elements each comprise two parallel lateral supports that are connected to one another by at least one transverse support and also a plateau, which is rotably connected to each pair of lateral supports with the aid of means of rotation and which, in the folded-out position, constitutes a horizontal bearing surface between the lateral supports, characterised in that, in the folded-out position, the plateau rests directly on the lateral supports.
2. Structure according to Claim 1, in which the plateau rests on supporting surfaces integrated in the lateral supports.
3. Structure according to Claim 2, in which the supporting surfaces constitute a stepped transition between two parts of the lateral supports, differing in thickness from one another.
4. Structure according to any one of Claims 1-3, the plateau having elevations projecting in the direction of the lateral supports, a flat part of each of which is, in the structure's folded-out position, in contact

with the supporting surfaces, so that no forces are exerted on the means of rotation.

5. Structure according to Claim 4, part of the means of rotation being present on the projecting elevations. 5
6. Structure according to claim 3, in which the supporting faces are formed by a groove that is present in each of the projecting elevations and that is bordered on one side by a bottom. 10
7. Structure according to claim 6, the side walls of the plateau being extended with elevations of each of which a flat part is, in the structure's folded-out position, in contact with the bottom of one of the grooves, so that no forces are exerted on the means of rotation. 15

20

25

30

35

40

45

50

55

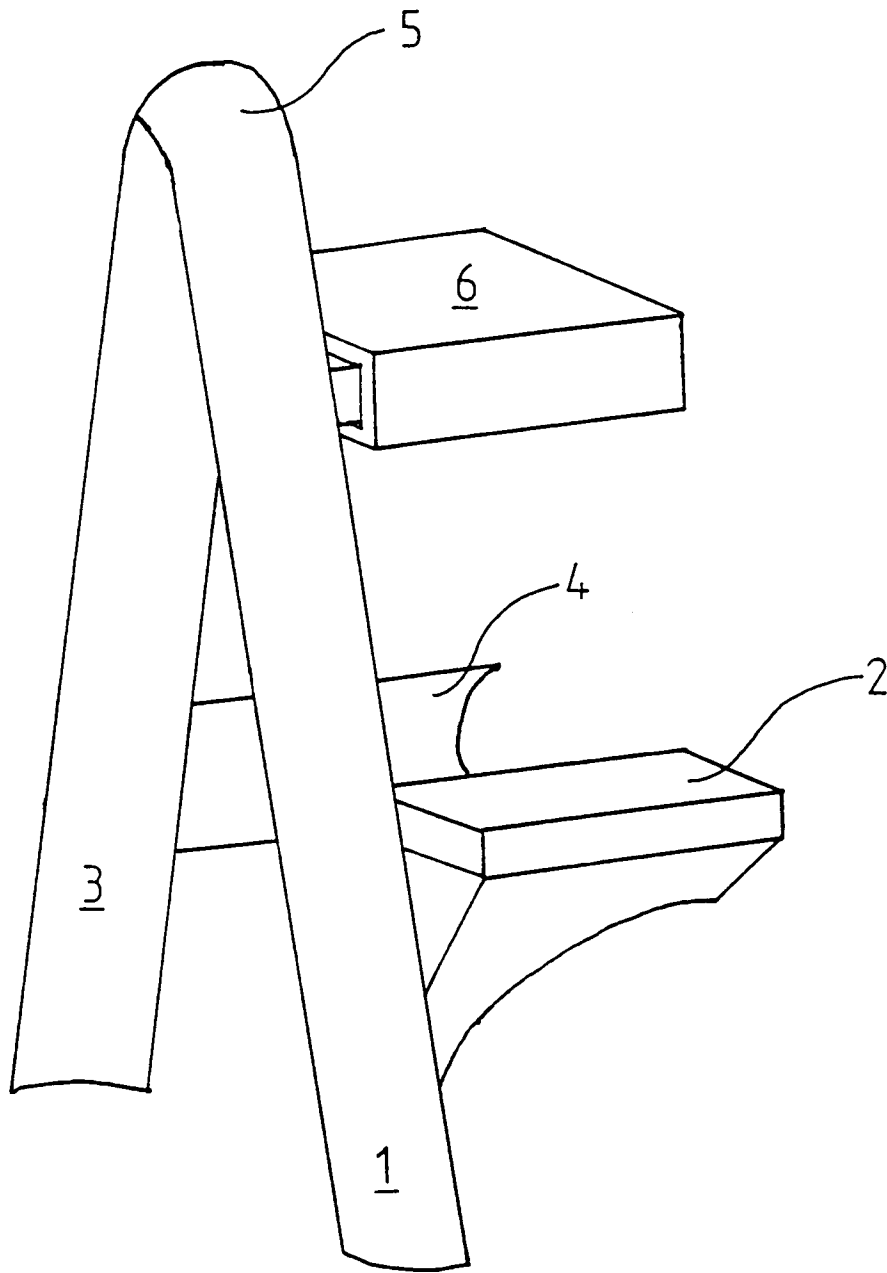


Fig. 1

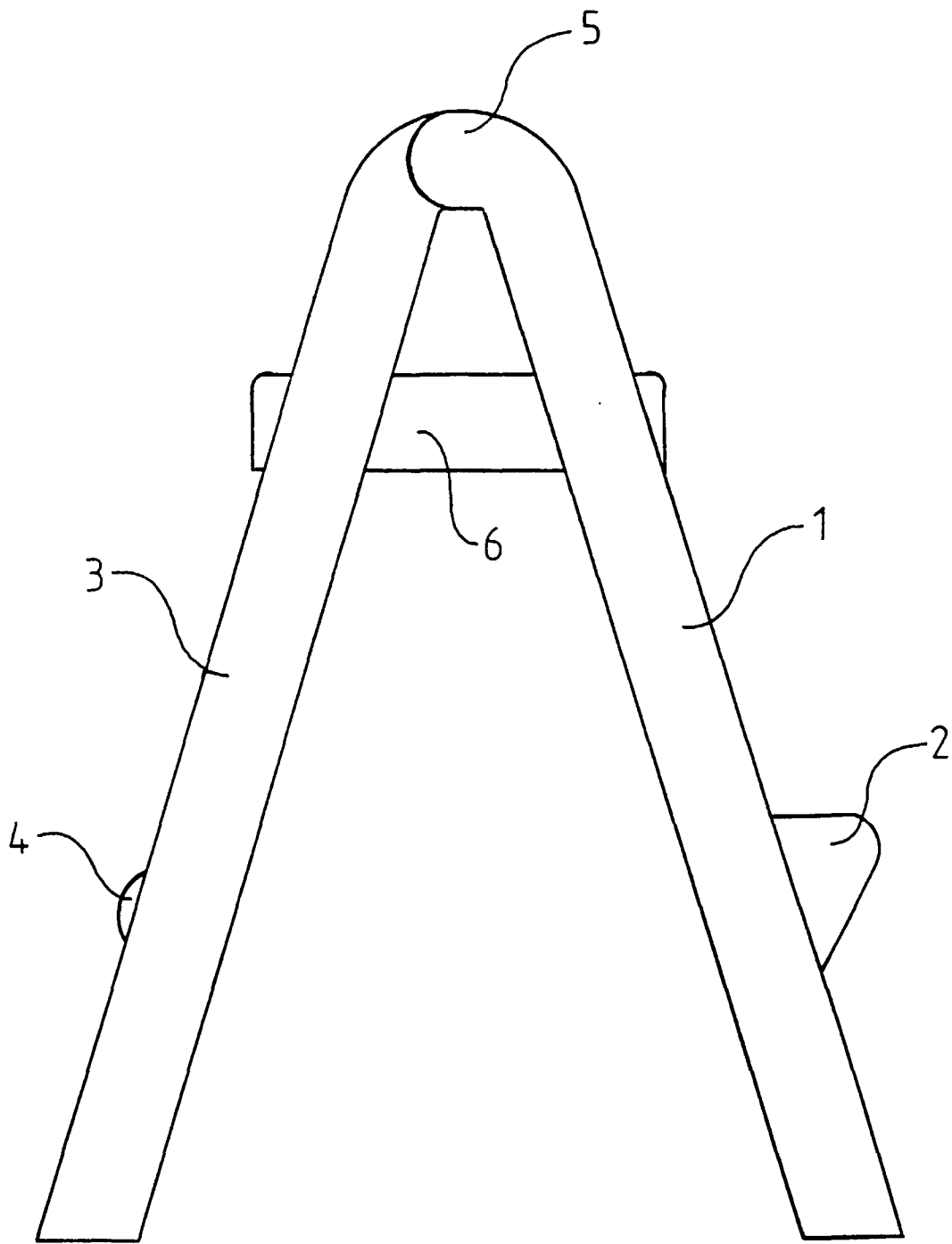


Fig. 2

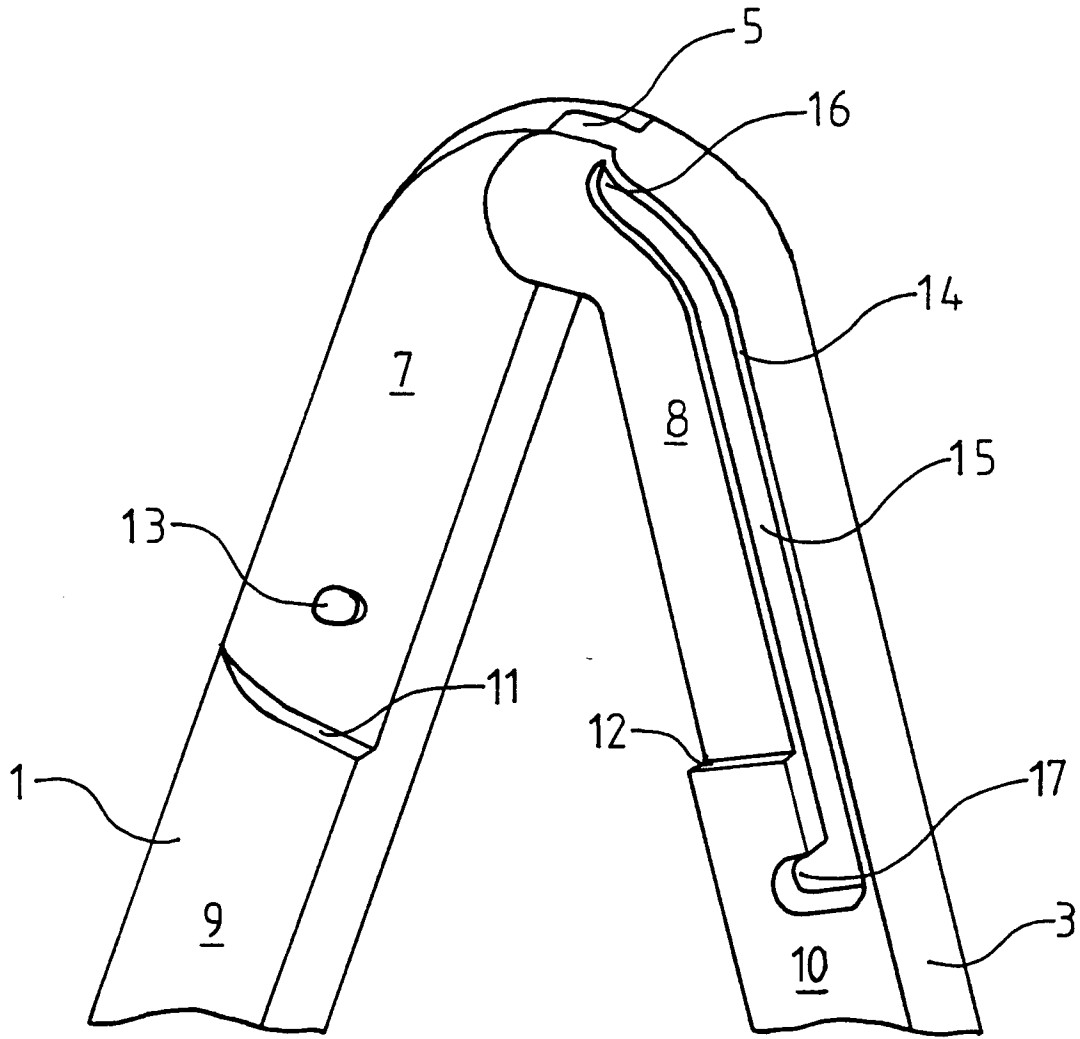


Fig. 3

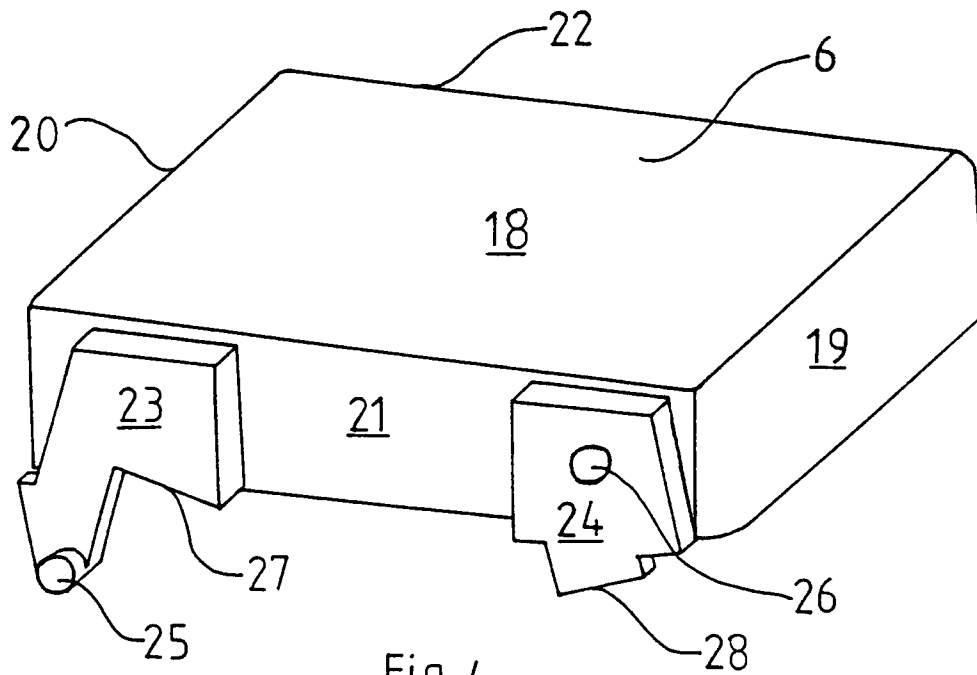


Fig. 4

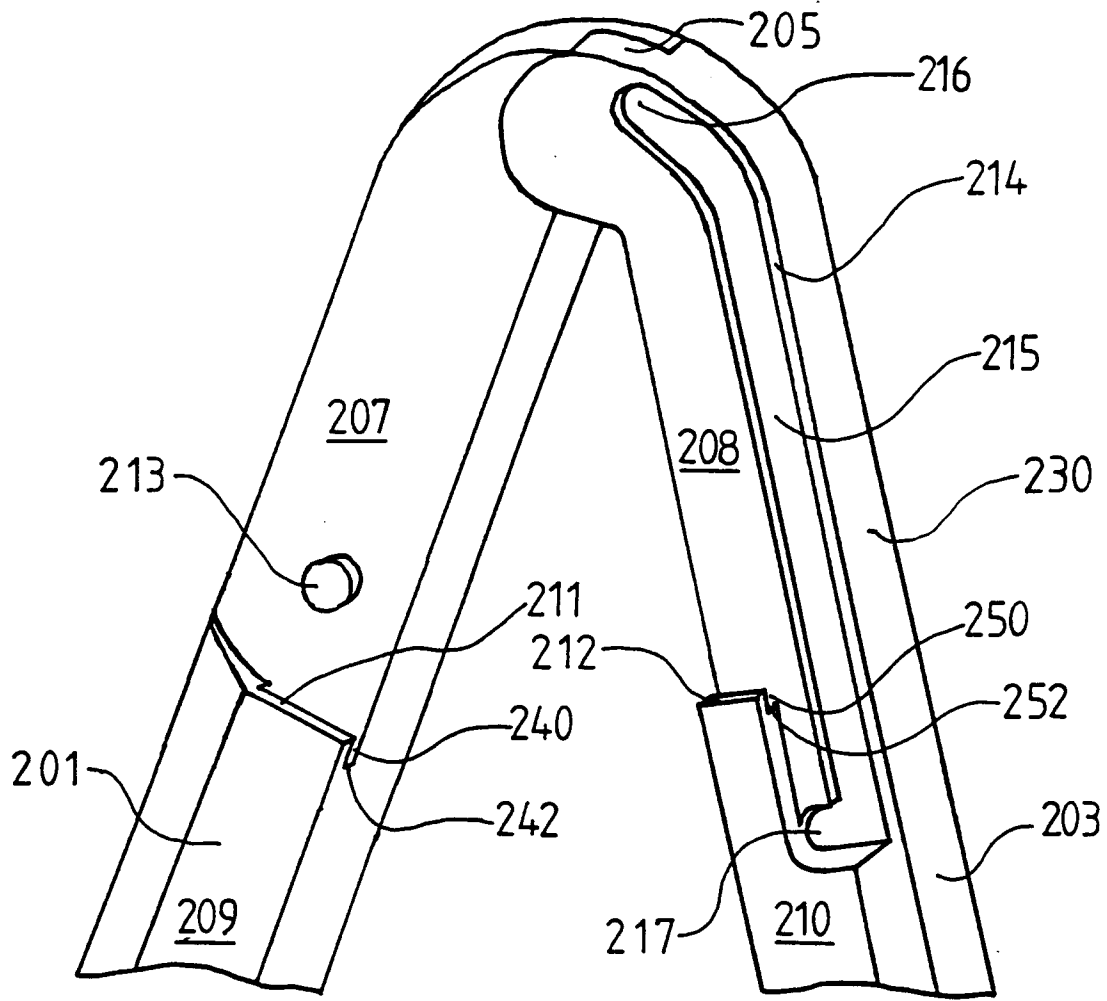


Fig. 5

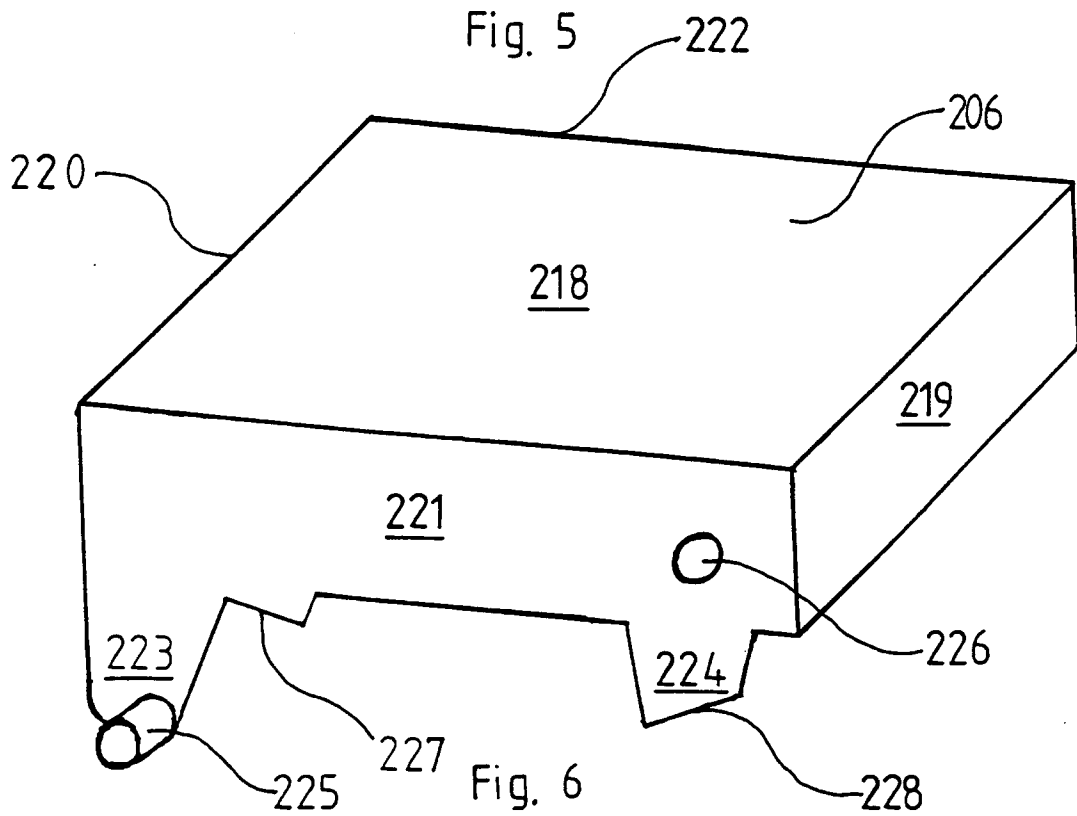


Fig. 6



European Patent  
Office

EUROPEAN SEARCH REPORT

Application Number  
EP 97 20 2561

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 1 517 676 A (HAUGH) * page 1, line 26 - page 1, line 37 * * page 1, line 56 - page 1, line 82 * * figures 1,2 * ---	1,2	E06C1/393 E06C1/20
X	US 1 537 221 A (BUGENHAGEN) * page 1, line 38 - page 1, line 57 * * figures 1,2 * -----	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			E06C
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		15 September 1997	Righetti, R
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (F04C01)