



(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 726 102 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
14.08.1996 Bulletin 1996/33

(51) Int. Cl.⁶: **B21D 5/00**, B21D 11/08

(21) Application number: **96200297.8**

(22) Date of filing: **09.02.1996**

(84) Designated Contracting States:
**AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL
PT SE**

(30) Priority: **13.02.1995 NL 9500263**
26.06.1995 NL 1000668

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(54) Method for deforming a plate and plate suitable therefor

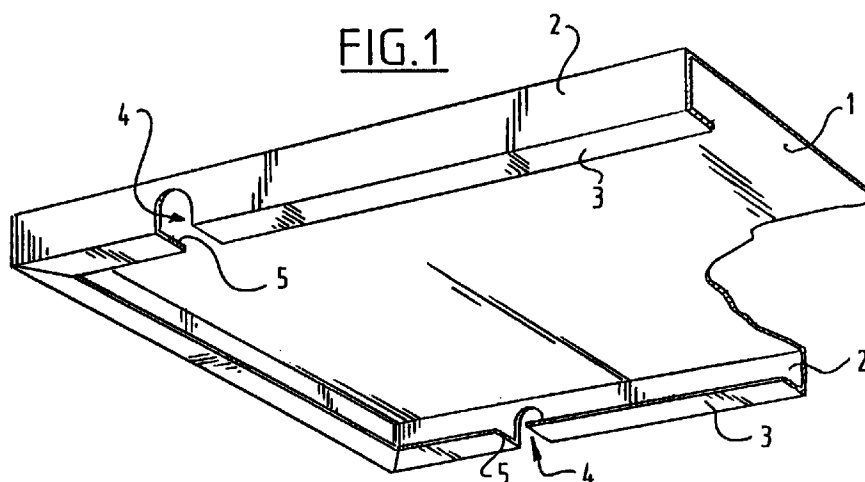
(57) The present invention relates to a method for deforming a plate, wherein the plate is bent along at least one bend line, and a plate suitable for this purpose. The invention also relates to a device for manufacturing such a plate in accordance with this method, wherein the method is distinguished by weakening the plate along the bend line prior to bending.

According to another aspect of the invention the method is distinguished by weakening the plate, prior to bending, along at least one bend line containing at least a curve.

With the method according to the present invention it is possible to transport in flat situation the plates suit-

able for manufacturing products or semi-manufactured products with a three-dimensional form, whereby less space is required for transport. Forming of the products or semi-manufactured products can herein take place by bending parts of the plate along bend lines manually or using a simple tool at the place of destination.

A final advantage is that by bending the flat plates with bend lines arranged according to the present invention products or semi-manufactured products with curving surfaces can be manufactured.



EP 0 726 102 A1

Description

The present invention relates to a method for deforming a plate, wherein the plate is bent along at least one bend line, and a plate suitable for this purpose. The invention also relates to a device for manufacturing such a plate in accordance with this method.

Such a method is known, wherein a plate is deformed along bend lines using a folding press such that a product or semi-manufactured product with a three-dimensional form is obtained. The folding press is necessary since in many cases the flat plate is manufactured from metal with a thickness such that manual bending along a bend line or bending using a simple tool is impossible. The plate can however also be manufactured from another material, such as plastic.

The product or semi-manufactured product is therefore fully finished using the folding press, wherein the resulting forms do not generally lend themselves for nesting of products or semi-manufactured products during transport. A large volume is therefore required for transport, which entails high costs.

A further drawback is that a folding press is generally very voluminous and costly. Such a device is moreover only suitable for bending the said plates wherein professional skill and experience are required in operating the folding press, such as for setting of the folding press.

The invention has for its object to obviate the above stated drawbacks and provides to this end a method which is distinguished by weakening the plate along the bend line prior to bending.

According to another aspect of the invention the method is distinguished by weakening the plate, prior to bending, along at least one bend line containing at least a curve.

With such a method according to the present invention it is possible to transport the plates in a flat state suitable for manufacturing products or semi-manufactured products with a three-dimensional form, whereby less space is required for transport. Forming of the products or semi-manufactured products can herein take place by bending parts of the plate along bend lines manually or using a simple tool at the place of destination. The lower costs of transporting plates in flat position make possible a greater area of distribution.

A further advantage of the method according to the present invention is that use can herein be made of machines which are also suitable for other purposes. Such machines are at least generally less bulky.

Operation of the machines required in the method according to the present invention, such as a cutter, stamp or a pressure roller, is also easily automated since less professional skill and experience are required therefor, thus resulting in simpler operation involving short or no setting times. As a consequence hereof it is possible to operate with very short delivery times and production of small series is cost-effective.

In addition, flat plates manufactured according to the present invention can, after bending, enclose a volume or an object. Manufacture of a duct, a block or other closed form is for instance possible.

A final advantage is that by bending the flat plates with bend lines arranged according to the present invention products or semi-manufactured products with curving surfaces can be manufactured since the plate can be weakened along at least one bend line containing at least a curve.

The invention is further elucidated with reference to the figure description hereinbelow of a number of embodiments of the invention. In the drawing:

fig. 1 shows a perspective view of a metal shelf for a shelving system as embodiment of a semi-manufactured product produced according to the method of the present invention;

fig. 2 shows a top view of a metal plate with bend lines for manufacturing the shelf shown in fig. 1;

fig. 3 shows a sectional view of a metal plate in which weakenings are arranged by means of an embodiment of the method according to the present invention;

fig. 4 shows a sectional view of a metal plate in which a weakening is arranged by means of another embodiment of the method according to the present invention;

fig. 5 is a cross sectional view of a metal plate having weakenings in both sides;

fig. 6 is a top view of an embodiment of a plate with bend lines containing curves;

fig. 7 shows a perspective view of the form of the object obtained by bending the plate shown in fig. 6;

fig. 8 is a top view of another embodiment of a plate with bend lines containing curves;

fig. 9 is a perspective view of the form of the object obtained by bending the plate shown in fig. 7; and

fig. 10 is a cross sectional view of a metal plate having weakening in both sides.

Corresponding components are referred to in the figures with corresponding reference numerals.

The metal shelf for a shelving system shown in fig. 1 comprises: a plateau 1, edges 2 and strips 3. The edges 2 are folded relative to plateau 1 and the strips 3 relative to edges 2 so that the shelf has a greater sturdiness than in the case where only the plateau is placed on supports (not shown) of shelving systems bearing shelves. The shelf shown here contains passages 4 formed by incisions in edges 2 and in strips 3 for receiving therein the supports of shelving systems.

The metal plate 14 shown in fig. 2 contains bend lines 10, 11, wherein the part of the metal plate 14 corresponding with the plateau 1 of the shelf is defined by bending along the bend lines 10 and wherein the parts of the metal plate 14 corresponding with edges 2 and strips 3 are defined by bending along the bend lines 11.

The parts of plate 14 corresponding with edges 2 and strips 3 are provided in mutually opposing edges of plate 14 with incisions 5 which form the passages 4 shown in fig. 1 after bending of plate 14 along the bend lines 10, 11.

It will be apparent that transport of a large number of the shelves shown in fig. 1 takes up a considerably larger volume than transport of an equally large number of the plates 14 shown in fig. 2.

Plates such as those shown in fig. 2 are generally thicker than 0.5 mm so that the product for manufacturing, in fig. 1 and 2 a shelf, will possess a required strength. In accordance with the method according to the present invention metal plates of such a thickness are provided with weakenings along bend lines 10, 11, which will be further described hereinafter. As a consequence of these weakenings the plate 14 becomes bendable along bend lines 10, 11 manually or using a simple tool, so that after processing in accordance with the method according to the present invention the plate 14 can be transported in flat state and can be formed by bending at the place of destination.

A flexible coating formed by a lacquer layer 15 is applied to both sides of the metal plate 14 shown in section in fig. 3. Prior to applying this lacquer layer 15 the recesses 16, 17 forming the weakenings are arranged in the plate 14. In the plate 14 shown in this figure both recesses 16 and 17 are formed by a milling operation on plate 14, wherein use is made of different milling heads to form recesses 16 and 17. The recesses 16, 17 are formed in the plate to a depth such that bending of the plate 14 is possible manually or using a simple tool, wherein sufficient strength of the edges formed by bending remains ensured.

In addition, the recesses are preferably formed such that the angle through which parts of the plate adjoining the bend line are bendable relative to each other is defined by this form. The side walls of the for instance U-shaped recesses 17 fit together at a number of points after bending through the predetermined angle so that further bending is not possible. In the case of V-shaped recesses 16 the whole of the side walls of these recesses 16 fit together in the bent situation of the plate so that once again no further bending is possible.

In addition to the above mentioned milling operation, other material-removing operations such as spark erosion can also be performed on the plate to arrange the recesses.

In the plate 1 shown in fig. 4 a recess 18 forming a weakening is formed by exerting a pressure on the surface of plate 14 using a pressure roller or a stamp. Recess 18 is therefore arranged by deforming.

When it is required that the recesses forming the weakenings be arranged very precisely, the plate can be etched. It is further possible to make incisions in the plate using lasers, wherein in most cases is required that in order to control the depth of the incision cooling of the plate takes place.

In another embodiment of the invention more than one recess is arranged along a bend line. Recesses can herein be arranged in the immediate vicinity of or on a bend line in mutually opposite sides of the plate, which preferably takes place simultaneously.

In the embodiment shown in fig. 5 two recesses 19 are formed in mutually opposite surfaces of the plate. When plate 14 with coating 15 thereon is bent in the direction designated with arrow A, the form shown in broken lines results. This embodiment of the invention has the advantage that deformation of the outward facing surface at the thus formed edge in the plate is much less than in the case of recesses in one side of the plate 14, thus achieving a greater strength. The plate 14 with recesses 19 in mutually opposite surfaces can also be bent in the direction indicated with arrow A as well as in the opposite direction.

Two or more than two parallel recesses formed along a bend line can also be arranged in one surface of the plate. By bending along each recess through a small angle it is herein possible to form the plate such that after bending it is folded into a gradual bend with a certain radius.

The plate 20 shown in fig. 6 is an embodiment of a plate processed by means of the method according to the present invention wherein bend lines 21 contain curves. In the embodiment shown here the form of the bend lines 21 corresponds with that of a full period of a sinusoidal function, which is shown in this figure by the dashed lines, each corresponding with a bend line 21.

The object 22 shown in fig. 7 is obtained by bending plate 20 along bend lines 21, wherein after bending of plate 20 the bend lines 21 form edges 23 of the object 22. The form of the object 22 shown in this figure is a random one used to clarify the principle of the present invention wherein bend lines contain curves.

A limitation in respect of the form of the bend lines 21 in plate 20 forming the edges 23 after bending is the requirement that the edges have a two-dimensional form, i.e. that in the form depicted the object 22 has four separate contact planes, each wholly containing an edge 23. Another requirement is that the bend lines 21 must bend gradually such that the bent surfaces of the object 22 adjoining the edges 23 can be formed without excessive tension in these surfaces. However, in order to manufacture an object with a form where the bend lines required therefor do not comply with the above stated requirement, incisions can be arranged in these surfaces of the object to relieve the tension. The forms of neighbouring bend lines must also be accurately related to each other in order to prevent such excessive tension.

The plate 29 shown in fig. 8 is provided with bend lines 26, which are arranged in the plate by means of the method according to the present invention, and incisions 27. The plate 29 is divided into separate part surfaces 24, 25 and 28 by bend lines 26 and incisions 27. The object 30 shown in fig. 9 is manufactured by bending plate 29 along the bend lines 26. The form of the

object 30 shown in this figure is a random one used to clarify the principle of the present invention wherein bend lines contain curves. By bending plate 29 along bend lines 26 these latter form the edges 31 of object 30. After bending of plate 29 the separate part surfaces 24, 25 and 28 of plate 29 serve respectively as upper surface 24, side surfaces 25 and fastening strips 28, wherein each fastening strip 28 is fixed with one of the many methods known in the art to the rear side of a corresponding side surface 25. Mainly as a result of the curved bend line, which in fig. 8 runs over the plate 29 in a curve from top right to bottom left, the upper surface 24 and the right-hand side surface 25 are curved in fig. 9.

In the embodiment shown in fig. 10 two recesses 32, 33 are formed along a bendline in mutually opposite surfaces of the plate 14. When plate 14 with coating 15 thereon is bent in the direction designated with arrow A, the form shown in broken lines results. This embodiment of the invention has the advantage, that stress along the outward facing surface at the thus formed edge is minimised.

The shape of the plate 14 in the embodiment of the invention shown here can for example be achieved by making an incision to form recess 33, for example with a laser (not shown), and subsequently exerting pressure on the surface of the plate 14 opposite to the recess 33, form recess 32 and to open recess 33.

Within the scope of the present invention it is also possible to bend a metal plate along a plurality of straight bend lines using a folding press so that a nestable semi-product is formed, which enhances the sturdiness of the product or semi-manufactured product finally to be formed. Weakenings such as recesses are herein arranged as according to the present invention along the remaining bend lines so that the product or semi-manufactured product can be formed by bending along these bend lines manually or using a simple tool at the place of destination.

In the foregoing only recesses are described as embodiment of the weakenings according to the present invention. It is however also possible within the scope of the invention to arrange weakenings in other ways. It is for instance possible to arrange an additive in the material of the plate along bend lines such that a flexible or resilient strip is formed in the plate. Use can also be made of heat-cold treatments of the plate to bring about manual flexibility.

Claims

1. Method for deforming a substantially flat metal plate to another spatial form by bending the plate along at least one bend line, **characterized by** weakening the plate along the bend line prior to bending.
2. Method as claimed in claim 1, **characterized by** weakening the plate along at least one bend line containing at least a curve, prior to bending.

3. Method as claimed in claim 2, **characterized in that** after bending of the plate the bend line containing at least a curve is located wholly in a separate plane.
4. Method as claimed in claim 2 or 3, **characterized in that** each separate part surface of the plate adjoining the bend line containing at least a curve has in itself a three-dimensional form after bending of the plate.
5. Method as claimed in any of the foregoing claims, **characterized by** forming in a surface of the plate at least one elongate recess along the bend line.
6. Method as claimed in claim 5, **characterized by** forming recesses along the bend line simultaneously and in mutually opposite surfaces of the plate.
7. Method as claimed in claim 5 or 6, **characterized by** forming at least one recess by material removal, such as by means of a milling operation or a spark erosion process.
8. Method as claimed in claims 5, 6 or 7, **characterized by** forming at least one recess by deforming, such as by exerting a pressure using a stamp or a pressure roller.
9. Method as claimed in claims 5-8, **characterized by** forming at least one recess by etching.
10. Method as claimed in claims 5-9, **characterized by** forming at least one recess by making an incision, such as by using a laser beam.
11. Method as claimed in any of the foregoing claims, wherein a coating such as paint or lacquer is applied to the object formed from the plate, **characterized by** applying a flexible coating on at least one surface of the plate prior to bending.
12. Device for manufacturing a plate in order to enable bending of the plate along at least one bend line, wherein the device comprises support means for supporting the plate and processing means for processing the plate, **characterized by** weakening means for weakening the plate along at least one bend line prior to bending.
13. Device as claimed in claim 12, **characterized in that** the weakening means are formed by means for arranging at least one recess in the surface of the plate.
14. Device as claimed in claim 12 or 13, **characterized in that** the weakening means are formed by means for simultaneously arranging recesses in mutually opposite surfaces of the plate.

15. Plate which is substantially flat and manufactured from metal and contains at least one bend line and is bendable therealong to deform the plate to another spatial form, **characterized by** at least one weakening along at least one bend line. 5
16. Plate as claimed in claim 15, **characterized in that** at least one bend line contains curves.
17. Plate as claimed in claim 15 or 16, **characterized by** at least one recess forming a weakening in the surface of the plate. 10
18. Plate as claimed in claim 15, 16 or 17, **characterized by** recesses forming a weakening in mutually opposite surfaces of the plate. 15
19. Plate as claimed in any of the claims 15-18, **characterized by** a flexible coating on at least one surface of the plate. 20

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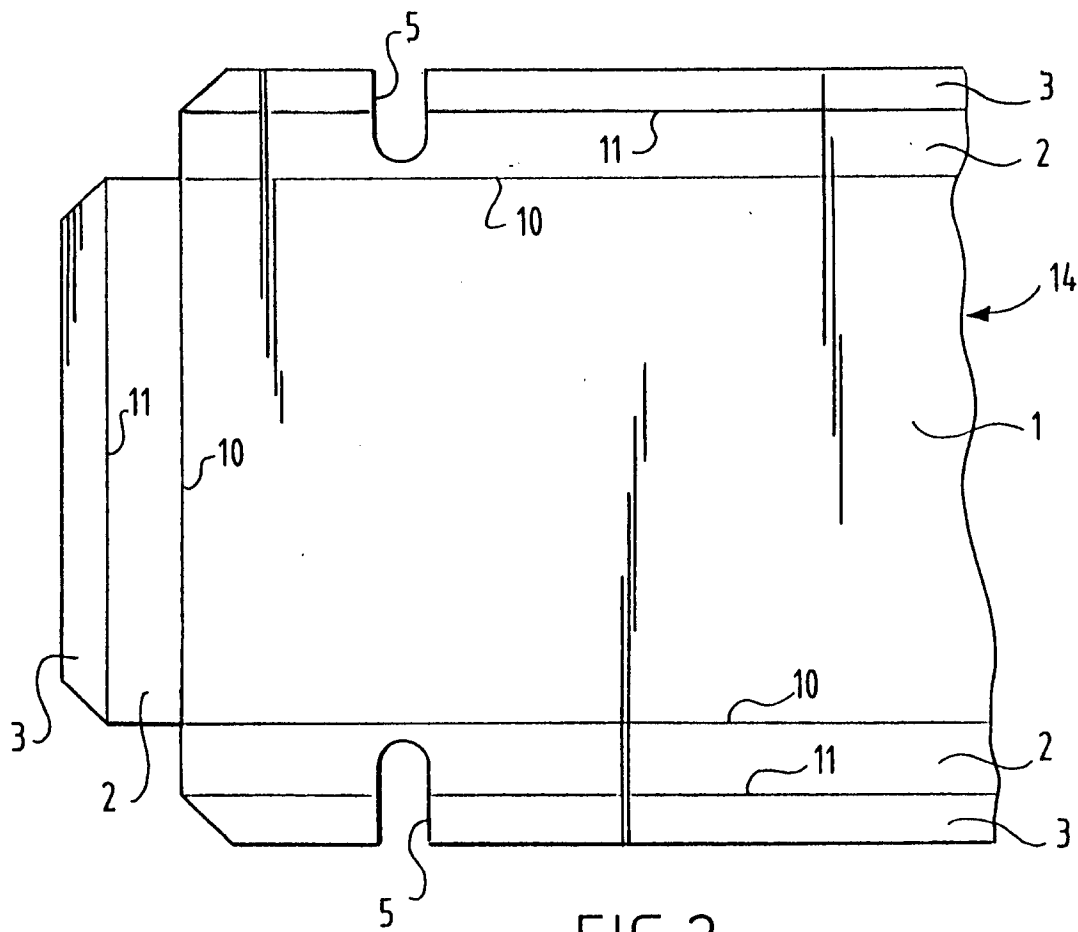
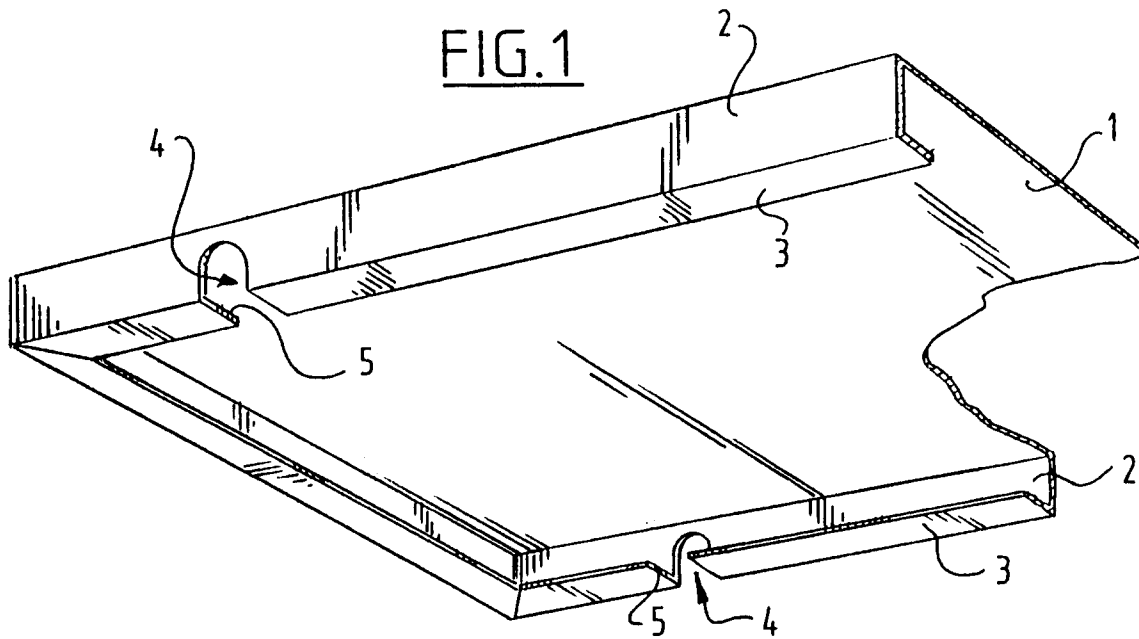
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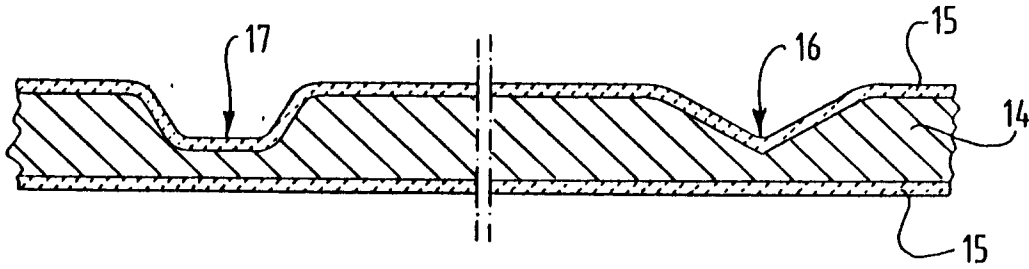


FIG.3

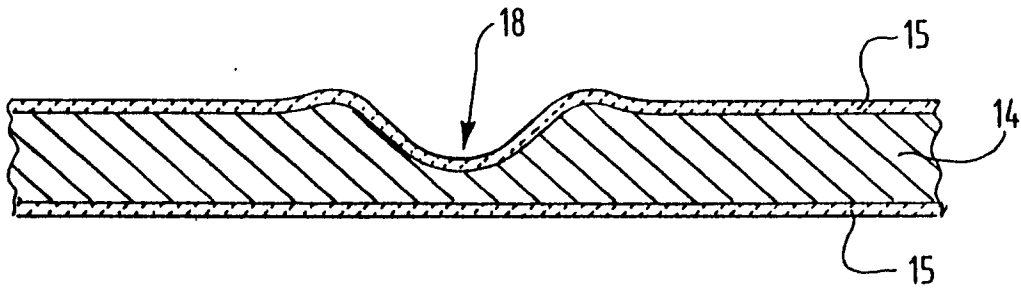


FIG.4

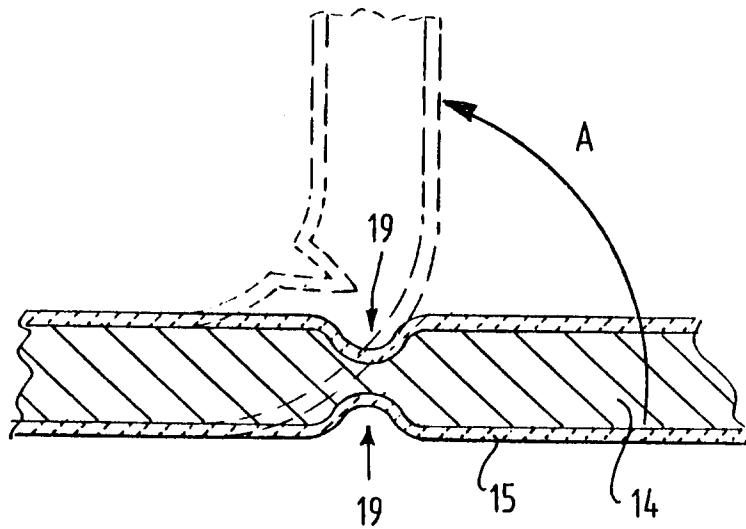


FIG.5

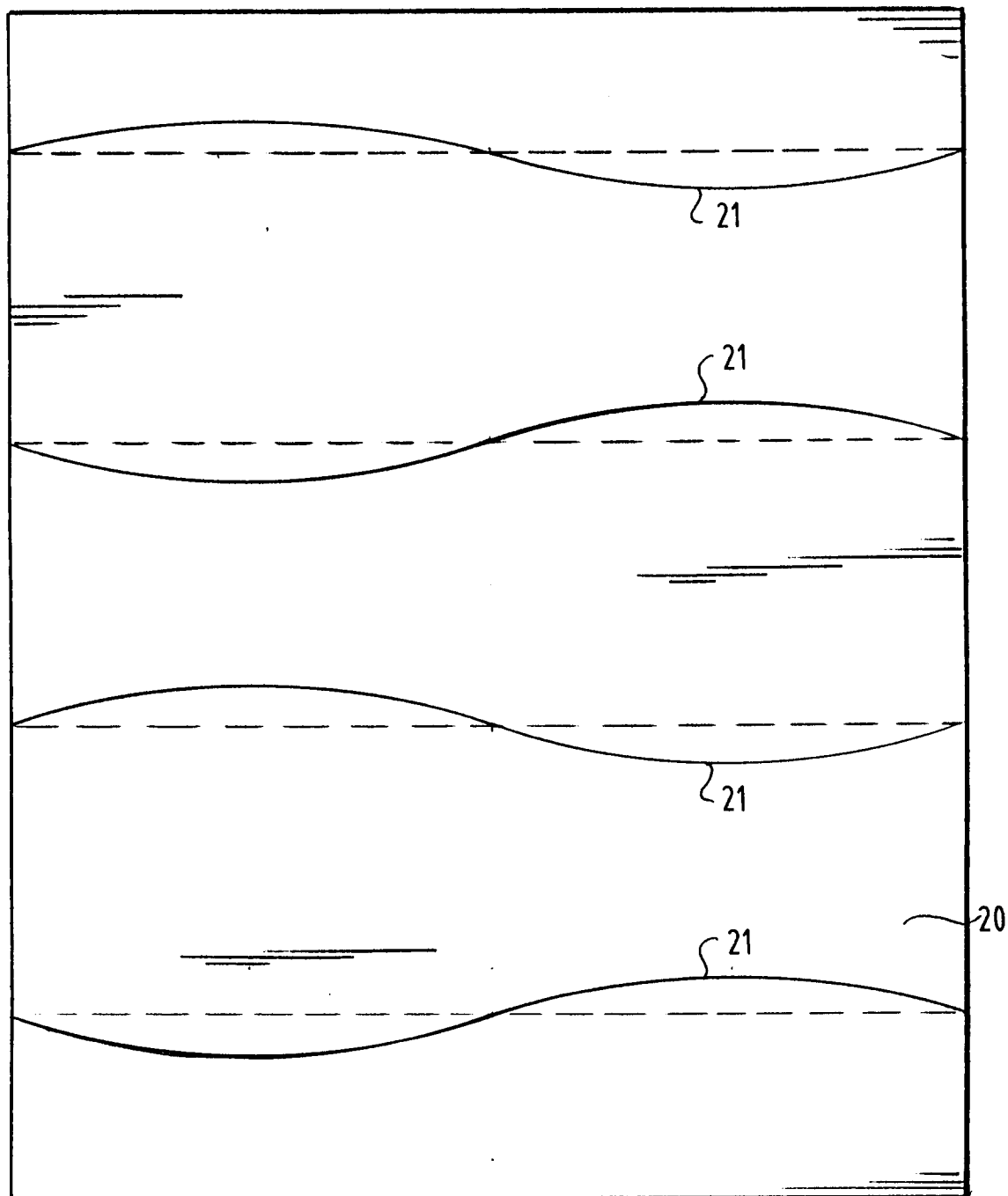


FIG. 6

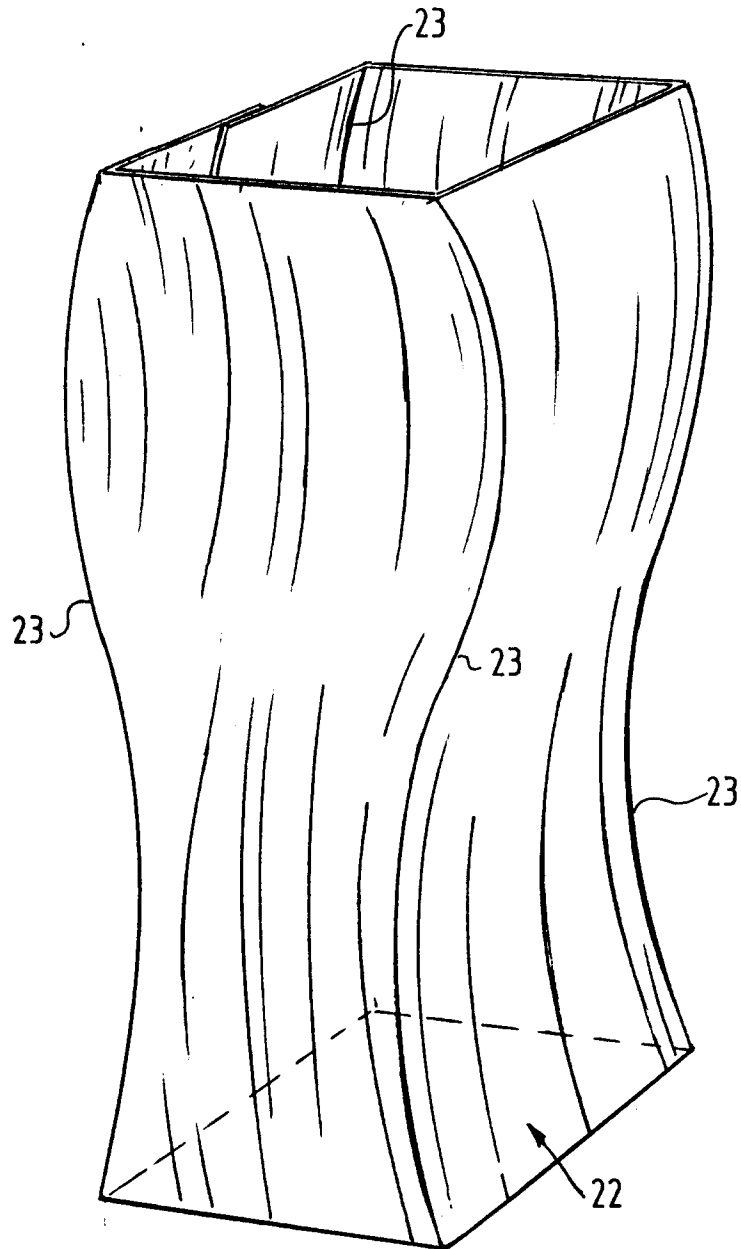
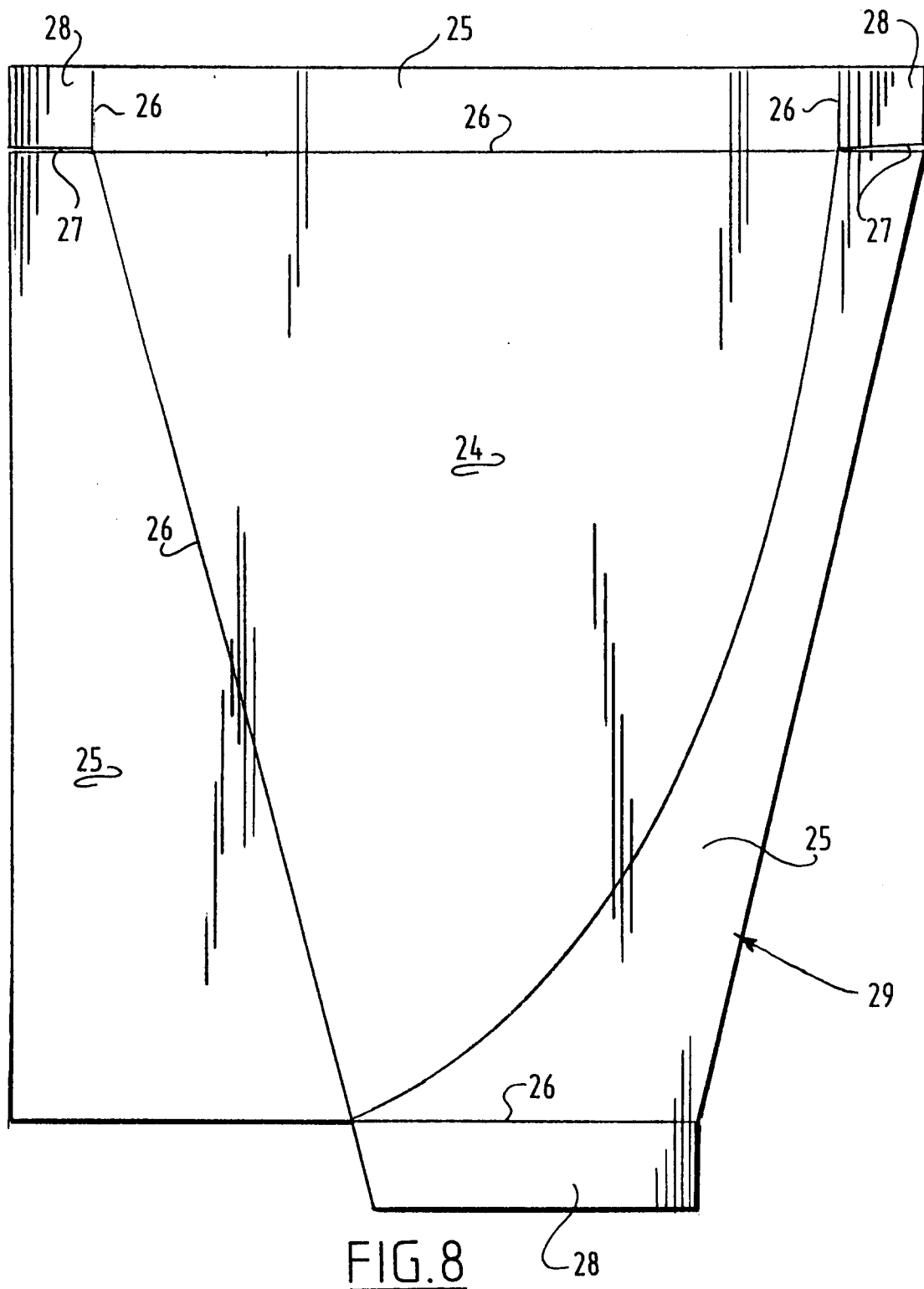
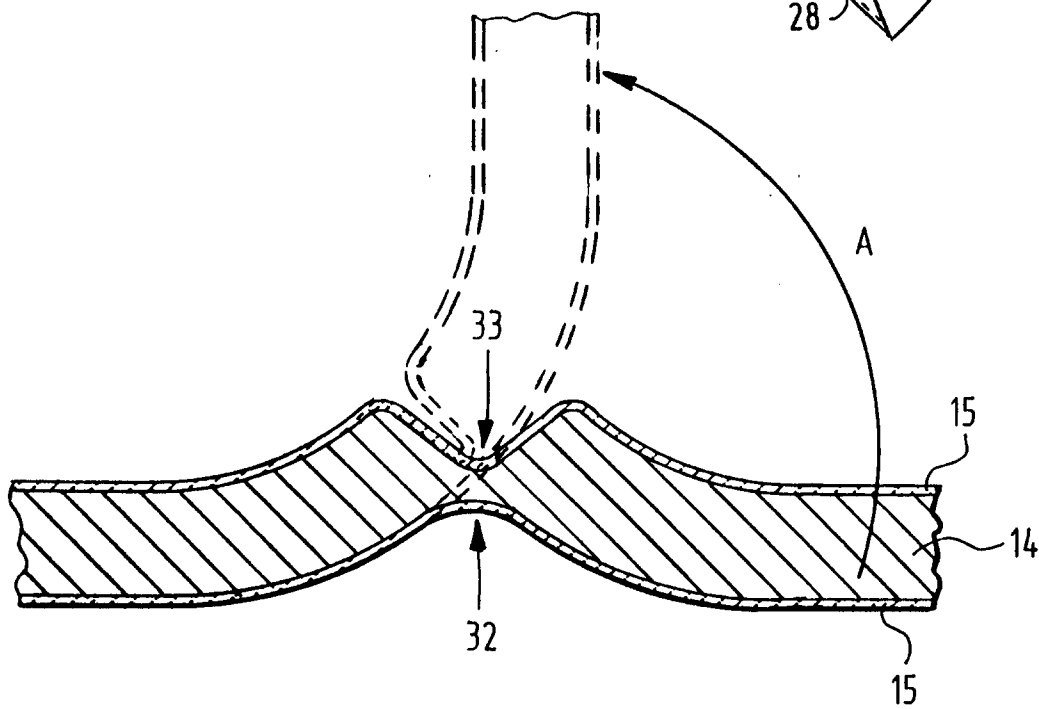
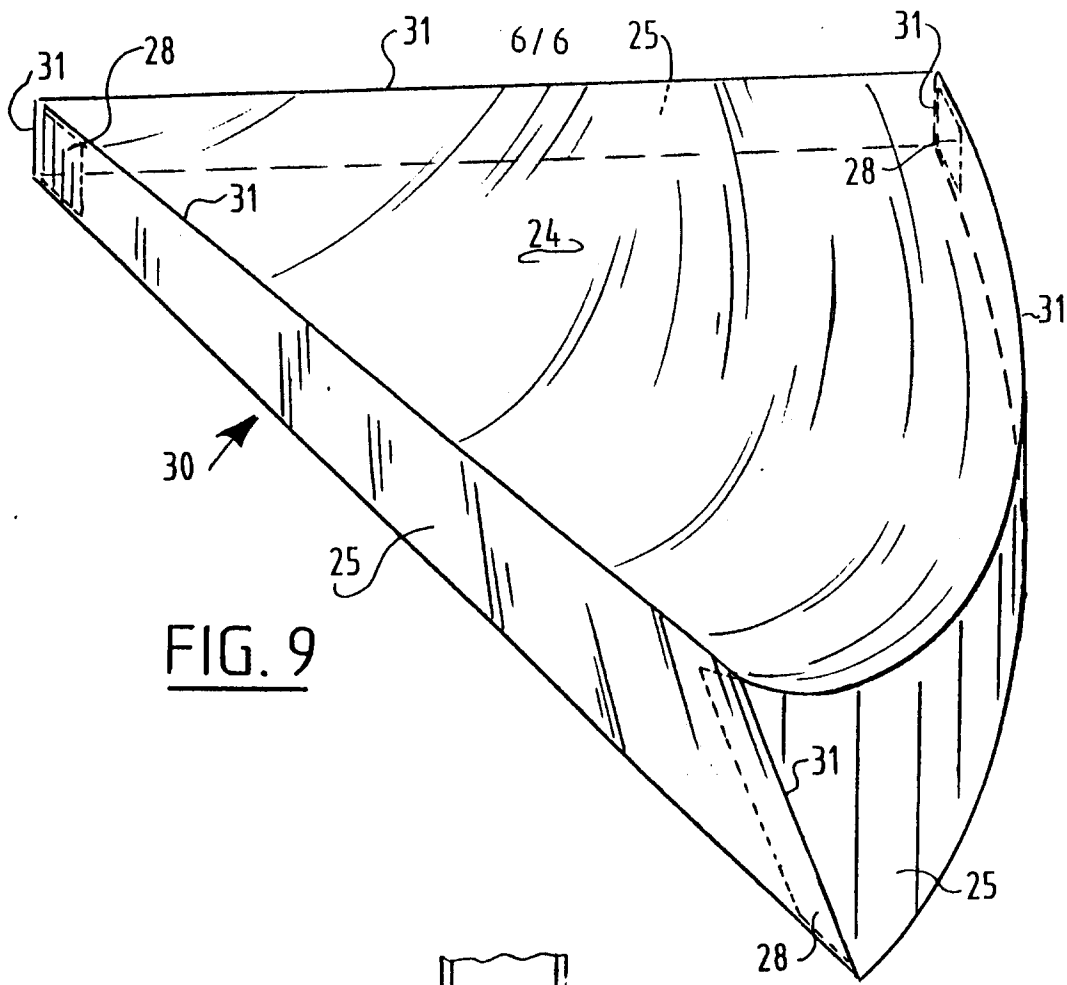


FIG. 7







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EUROPEAN SEARCH REPORT

Application Number
EP 96 20 0297

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	WO-A-82 03574 (STROEMBERG) 28 October 1982 * the whole document *	1-10, 12-19	B21D5/00 B21D11/08
X	DE-A-22 26 776 (ROBERTSON) 14 December 1972 * page 6, line 20 - page 7, line 6; claims; figure 4 *	1,11,19	
X	PATENT ABSTRACTS OF JAPAN vol. 7, no. 68 (M-201), 19 March 1983 & JP-A-57 209720 (TOUYOU MEIHAN SEIZOU KK), 23 December 1982, * abstract *	1-5, 7-10, 12-17	
X	PATENT ABSTRACTS OF JAPAN vol. 8, no. 234 (M-334), 26 October 1984 & JP-A-59 113929 (KIYOSHIN NEEMU PUREETO), 30 June 1984, * abstract *	1-5, 7-10, 12-17	
A	PATENT ABSTRACTS OF JAPAN vol. 6, no. 1171 (M-139), 30 June 1982 & JP-A-57 044420 (KONDO HIDENORI), 12 March 1982, * abstract *		TECHNICAL FIELDS SEARCHED (Int.Cl.6) B21D
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 176 (M-398), 20 July 1985 & JP-A-60 046819 (KUWABARA BUNKICHI), 13 March 1985, * abstract *		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22 April 1996	Examiner Peeters, L
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	

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