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

(11) EP 1 001 104 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.05.2000 Bulletin 2000/20

(51) Int. Cl.[7]: **E04B 2/12**

(21) Application number: **98610043.6**

(22) Date of filing: **13.11.1998**

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

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(54) A coherent spatial structure of prismatic form bodies and connecting bodies

(57) A coherent spatial structure is formed of at least two generally prismatic columns (101 - 106) of form bodies (107 stacked on top of each other. Each form body (107) is composed of a main section (A) of rhombic cross-sectional shape and first and second end sections (B, C) each comprising two pyramid configurations (27, 28) forming a depression into or an extension of said main section (A). The structure further includes at least one connecting body (109 - 113) of a generally triangular prismatic form for connecting form bodies (107) from each of said columns (101 - 106) into said spatial structure, said prismatic form having end faces in the form of identical isosceles triangles (109b,c - 113b,c). The end faces (109b,c - 113b,c) are provided with connecting means (114) for connecting said connecting body (109 - 113) with said form bodies, said end faces having an apex angle selected from a limited number of angle values.

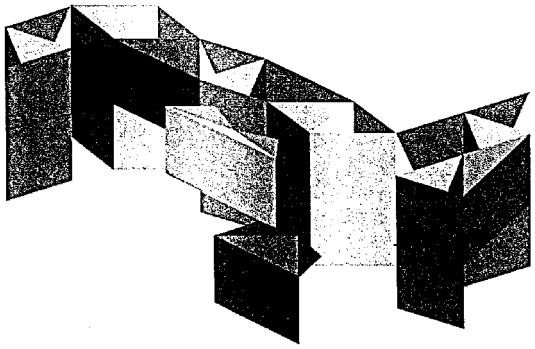

Fig 1

EP 1 001 104 A1

Description

[0001] The invention relates to coherent spatial structures composed of generally prismatic form bodies.

[0002] Such structures may be utilized e.g. for the erection of attractive room-dividing walls for exhibition purposes, as sculptural building components or play bricks providing a challenge to fantasy.

[0003] In published International Patent Application WO 91/13863 a system of such form bodies is disclosed, which comprises three main groups of form bodies that can be used together or separately. A first main group comprises bodies having a cubic base structure with extensions or depressions in the form of pyramid structures, whereas a second and a third main group comprise generally prismatic bodies with cross-sectional profiles in the form of an equilateral triangle or an isosceles orthogonal triangle with end sections in the form of pyramidal extensions or depressions adapted to the profile of the prismatic body.

[0004] The form bodies of this prior art concept may be solid bodies or frame structures, or they can be made as foldable bodies.

[0005] Departing from this prior art it is the object of the invention to provide a coherent spatial structure of interconnected form bodies.

[0006] According to the invention, this and other objects are accomplished by the provision of a coherent spatial structure comprising at least two generally prismatic form bodies each composed of a main section of rhombic cross-sectional shape, which is identical for said at least two form bodies, and first and second end sections, each comprising two pyramid configurations, each having a base in the shape of an equilateral triangle and forming a depression into or an extension of said main section, said structure further comprising a connecting body of a generally prismatic form for connecting said two form bodies into said spatial structure, said prismatic form having a triangular cross-section defining a rectangular surface and two end faces in the form of identical isosceles triangles projecting from opposite sides of said rectangular surface at right angles thereto and having legs of the same length as the side length of the base of each end section of said form bodies, at least one of said end faces being connected with connecting means for connecting said connecting body with two of said form bodies, said end faces having an apex angle selected from a limited number of angle values.

[0007] By selection of appropriate connecting bodies large variety of different coherent spatial structures of an attractive design may be built from a number of prismatic form bodies of the same rhombic cross-sectional form.

[0008] In a preferred embodiment the limited number of angle values comprises the values 30°, 60°, 90°, 120° and 150°.

[0009] In a further preferred embodiment said form bodies as well as said connecting body are foldable bodies made of board material, said bodies been erectable from a flat collapsed condition into an erected condition defining the geometrical shape of said form bodies and connecting body, respectively, folding lines being provided in said board material to define edges between adjoining surfaces thereof.

[0010] Thereby, advantages are obtained with respect to handling, storage and shipment of form bodies and connecting bodies for building of large spatial structure.

[0011] In a particularly preferred embodiment the coherent spatial structure of the invention is characterized in that in said collapsed condition two adjoining side walls of the main section of each form body are disposed in a first plane and the two other adjoining side walls in a second plan overlying said first plane, each of said first and second end sections being composed of interconnected pairs of first, second and third wall parts in the form of orthogonal isosceles triangles of equal size, the hypotenuses of said pairs of first and second wall parts adjoining the side walls of the main section disposed in said first and second plane, respectively, whereas the hypotenuses of said third wall parts coincides and one leg of each of said third wall parts coincides with one leg of one of said first wall parts, corresponding wall parts of said first and second end section, respectively, being disposed in different one of said first and second planes.

[0012] As will appear in further detail from the following the possibility is offered thereby of forming sixteen different geometrical form bodies by erection of a single member having the same configuration in the flat collapsed condition and the form bodies thus provided may be built together to obtain an endless number of different spatial structures.

[0013] In a further preferred embodiment, each form body is made of two pieces of board material each comprising two adjoining side walls of the main section, the pairs of first and third wall parts of one end section and the pair of second wall parts of the other end section, said pieces being adhesively connected by means of flange parts adjoining edges of the side walls of the main section and legs of the first and second wall parts of each end section defining external edges of each of said pieces.

[0014] In connection therewith it is preferred that the connecting body comprises a rectangular wall part and two adjoining triangular wall parts defining said rectangular surface and said end faces respectively, said connecting means comprising identical flange parts adjoining the legs of each of said end sections and each having the form of an orthogonal isosceles triangle of the same size as the first and second triangular wall parts of the end sections of said form bodies.

[0015] In the following, the invention will be explained in more detail with reference to the accompa-

nying schematical drawings, in which

fig. 1 is a perspective view of an example of a coherent spatial structure according to the invention;

fig. 2 a) - e) show five different forms of foldable connecting bodies;

fig. 3 a) - e) are perspective views of spatial structures composed of two form bodies interconnected by the respective connecting bodies shown in fig. 2,

fig. 4 is a schematical illustration of the connection between a connecting body and a prismatic column of three form bodies stacked on top of each other;

fig. 5 is a perspective view of a preferred form of a foldable form body in an erected condition;

fig. 6 shows the form body of fig. 5 in its flat collapsed condition;

fig. 7 shows one of two identical board pieces from which the collapsed form body in figure 6 is formed; and

figs. 8 and 98 show two further examples of erected configurations of the form body, illustrated by a side view at a) and end views at b) and c), respectively;

[0016] The example shown in fig. 1 of a coherent spatial structure according to the invention is composed of six prismatic columns 101 - 106, each composed of two prismatic form bodies 107 positioned one above the other. The form bodies 107 are foldable bodies which as further explained in the following are made from board members which are identical in their flat collapsed condition, but which may be erected into 16 different spatial structures.

[0017] As further described below each of form bodies 107 is composed of a main section A of rhombic cross-sectional shape and first and second end sections B and C, each comprising two pyramid configurations having a base in the shape of an equilateral triangle and forming a depression into or an extension of the main section. In fig. 1 only the upper end sections of the upper form body in each of columns 101 - 106 is shown and in this example the pyramid configurations of all these end sections form depressions into the main sections of the respective form bodies. In prismatic columns 102 and 104 one of two pyramid configurations of the illustrated upper end section is covered by a single plate triangular plate member 108.

[0018] The prismatic columns 101 - 106 are interconnected by connecting bodies 109 to 113 of a generally prismatic form having a triangular cross-section defining a rectangular surface and two end faces in the form of identical isosceles triangles projecting from opposite sides of said rectangular surface at right angles thereto and having legs of the same length as the side length of the base of each end section of form bodies 101 to 106.

[0019] In the embodiment shown all connecting bodies 109 to 113 are foldable bodies made from board material. According to the invention the connecting bodies 109 to 113 amy take different forms with respect to the value of the apex angle of the isosceles triangle forming their end faces. The apex angle may thus be selected from a limited number of angle values.

[0020] In the illustrated example five different connecting bodies 109 - 113 are used, for which as shown in fig. 2 a) - 2 e) the apex angle values are 30°, 90°, 150°, 60° and 120°, respectively.the connecting bodies 109 - 113 may be selected in any arbitrary combination, whereby a multitude of different spatial structures may be formed. In fig. 3 a) - 3 e) the configurations formed by interconnection of two prismatic columns of form bodies by means of each of the connecting bodies 109 to 113 shown in fig. 2 in its flat collapsed form.

[0021] At least one end face of each connecting body, but preferable both end faces, is connected with connecting means for connecting the connecting body with a form body 107. In the illustrated foldable design of the form bodies 107 and connecting bodies 108 each of connecting bodies 109 - 113 comprises a rectangular wall part 109a - 113a and two adjoining triangular wall parts 1o9b,c - 113b,c defining said rectangular surface and said end faces, respectively, and the connecting means comprising identical flange parts 114 adjoining the legs of each of said end sections. In all connecting bodies 109 - 113 the flange parts 114 are identical and take the form of an orthogonal isosceles triangle of the same size as the first and second triangular wall parts of the end sections of the form bodies.

[0022] The connection of a connecting body to two form bodies 107 which are to be interconnected in the spatial structure is provided by bending one flange part 114 of the connecting body into a depression in an end section of the relevant form body 107 formed by one of the two pyramid configurations of the end section and the connection may be locked by positioning another form body on the top, said other for body having at its lower end section a downwards extension formed by one of the two pyramid configurations and matching the pyramid depression in the first form body.

[0023] Thus, as schematically shown in figure 4 a connecting body 109 is ideally connected between two prismatic columns each composed of three form bodies 107 stacked on top of each other by inserting each flange part 114 of the connecting body between mating triangular side faces 115 and 116 of a pyramidal depression in the top end section of a lower form body and a downwards pyramidal extension of the lower end section of an upper form body, respectively.

[0024] The form body in fig. 5 comprises a main section A composed of a first pair of rectangular side walls 1 and 2 and a second pair of rectangular side walls 3 and 4 which are all identical and are pivotally interconnected along parallel first side edges 5, whereby in the erected condition the main section A will have the shape of a prism with a rhombic cross-sectional form.

[0025] Along the other parallel side edges 6 and 7 the side walls of the main section A are connected with a first end section B and a second end section C, respectively. In the erected condition, each of these end sections B and C is formed to provide two identical pyramid structures each having a base in the form of an equilateral triangle with a side length equal to the side length of side edges 6 and 7 of the side walls of the main section A.

[0026] As more clearly apparent from figures 6 and 7, each of end sections B and C is composed of a first pair of wall parts 8 - 9 and 8' - 9-,respectively, a second pair of wall parts 10 - 11 and 10' - 11'. respectively, a third pair of wall parts 12 - 13 and 12' - 13' respectively and a fourth pair of wall parts 14 - 15 and 14' - 15', respectively.

[0027] The wall parts 8 to 13 and 8' to 13' of the first, second and third pairs are formed as identical isosceles orthogonal triangles.

[0028] In wall parts 8 and 9 of the first pair of wall parts in the end section B the hypotenuses are pivotally connected, i.e. form folding lines with the upper side edges 6 of the first pair of side walls 1 and 2 of the main section A, whereas the hypotenuses of the second pair of wall parts 10 and 11 are pivotally connected, i.e. form folding lines with the upper side edges 6 of the other pair of side walls 3 and 4 of the main section A.

[0029] Conversely, the hypotenuses of the first pair of wall parts 8' and 9' in the end section C are pivotally connected, i.e. form folding lines with the lower side edges 7 of the second pair of side walls 3 and 4 of the main section A, whereas the hypotenuses of the second pair of wall parts 10' and 11' are pivotally connected with the lower side edges 7 of the first pair of side walls 1 and 2 of the main section A.

[0030] In each of wall parts 8 - 9 and 8' - 9' of the first pair of wall parts in each of end sections B and C one leg 16 form a pivotal folding connection with one leg in one of wall parts 12 -13 and 12' - 13' of the third pair of wall parts, the hypotenuses 17 of said wall parts coinciding to form a pivotal connection.

[0031] Correspondingly, in each of wall parts 10 - 11 and 10' - 11', respectively, of the second pair of wall parts in end sections B and C, one leg 18 forms a pivotal or folding connection with one side of one of wall parts 14 - 15 and 14' - 15' of the fourth pair of wall parts, said wall parts being pivotally connected with each other along a common side edge 19 and 19', respectively.

[0032] As shown in figures 2 and 3 the foldable form body is formed, in the preferred embodiment from two identical board pieces, one of said pieces 20 being shown in solid lines and accommodating the first pair of side walls 1 and 2 of the main section A together with the first and third pairs of wall parts 8 - 9 and 12 - 13 of one end section B and the second and fourth pairs of wall parts 10' - 11' and 14' - 15' of the other end section C.

[0033] Conversely, the other board piece 21 accommodates the second pair of side walls 3 and 4 of the main section A together with the first and third pairs of wall parts 8' - 9' and 12' - 13', respectively, of the end section C and the second and fourth pairs of wall parts 10 - 11 and 14 - 15 of the end section B.

[0034] In the flat collapsed condition shown in fig. 2 the two pairs of side walls 1 - 2 and 3 - 4 of the main section A overlap each other entirely and the same is the case for the first and second pairs of wall parts 8 - 9, 8' - 9' and 10 - 11, 10' - 11', respectively, of each end section, whereas the fourth pair of wall parts 14 - 15 and 14' - 15', respectively, of each end section is overlapped by the third pair of wall parts 12 - 13 and 12' - 13', respectively, of the other section.

[0035] As appears from fig. 7 which shows one of the two board pieces 20, 21 edge flanges 24 and 25 are provided along those of the first side edges 5 of the side walls 1 - 2 and 3- 4 of the main section A and those legs 22 and 23 of the first and second pairs of wall parts 8 - 9, 8' - 9' and 10 - 11, 10' - 11' of end sections B and C which define external edges of the board piece for joining the two board pieces by adhesive connections.

[0036] Since the folding lines between the wall parts 8 to 15 and 8' to 15' of the two end sections B and C will allow folding in both directions, each of end sections B and C may in the erected condition be folded to form identical first and second pyramid structures each having a base in the form of an equilateral triangle with a side length corresponding to the length of side edges 6 and 7 of the side walls of the main section and the corresponding length of the hypotenuse of wall parts 8 to 11 and 8' - 11' in the first and second pairs of wall parts in the two end sections. As shown in fig. 5 this side length is equal to the length of the shorter diagonal 26 in the rhombic structure formed by main section A.

[0037] In the example shown in figure 5 the two pyramid structures 27 and 28 formed by end section B form a depression into and an extension from the main section A, respectively.

[0038] However as shown in figure 8 both pyramid structures 27 - 28 and 27' - 28', respectively, at the same end section may form either extensions or depressions and, as shown in figure 9 at each end section one of the pyramid structures may form an extension and the other a depression.

[0039] Altogether the folding concept will allow folding of one and the same structure in the collapsed condition into $2^4 = 16$ different configurations in the erected condition.

[0040] In the case of a depression formed by one or more of the pyramid structures at the end sections the cavity formed by such a depression or two depressions next to each other may be covered by a simple plate member 29 having the form of an equilateral triangle corresponding to the base of the pyramid structure or a rhombic form corresponding to the form of the main section in the erected condition.

[0041] Obviously, the length of side edges 5 forming

the corners between the side walls of the main section which will normally define the height dimension of any erected configuration of the form body may be varied as desired and form bodies having different height dimensions may be combined to form a multitude of different spatial structures.

Claims

1. A coherent spatial structure comprising at least two generally prismatic columns (101 - 106) of form bodies (107 stacked on top of each other, each form body (107) being composed of a main section (A) of rhombic cross-sectional shape, which is identical for said form bodies, and first and second end sections (B, C) each comprising two pyramid configurations (27, 28), each having a base in the shape of an equilateral triangle and forming a depression into or an extension of said main section (A), said structure further comprising at least one connecting body (109 - 113) of a generally prismatic form for connecting form bodies (107) from each of said at least two columns (101 - 106) into said spatial structure, said prismatic form having a triangular cross-section defining a rectangular surface (109a - 113a)and two end faces in the form of identical isosceles triangles (109b,c - 113b,c) projecting from opposite sides of said rectangular surface at right angles thereto and having legs of the same length as the side length of the base of each end section of said form bodies, at least one of said end faces (109b,c - 113b,c) being connected with connecting means (114) for connecting said connecting body (109 - 113) with said form bodies, said end faces having an apex angle selected from a limited number of angle values.

2. A spatial structure as claimed in claim 1, **characterized** in that said limited number of angle values comprises the values 30°, 60°, 90°, 120° and 150°.

3. A spatial structure as claimed in claim 1 or 2, **characterized** in that the rectangular surface (109a - 113a) of said connecting body (109 - 113) has a height between said opposite sides equal to the height of the main section (A) of each of said form bodies between said end sections (B, C).

4. A spatial structure as claimed in any of the preceding claims, **characterized** in that said form bodies (107) as well as said connecting body (109 - 113) are foldable bodies made of board material, said bodies been erectable from a flat collapsed condition into an erected condition defining the geometrical shape of said form bodies and connecting body, respectively, folding lines being provided in said board material to define edges between adjoining surfaces thereof.

5. A spatial structure as claimed in claim 4, **characterized** in that in said collapsed condition two adjoining side walls (1, 2) of the main section (A) of each form body (107) are disposed in a first plane and the two other adjoining side walls (3, 4) in a second plane overlying said first plane, each of said first and second end sections (B, C) being composed of interconnected pairs of first, second and third wall parts (8,9; 10',11'; 12,13) in the form of orthogonal isosceles triangles of equal size, the hypotenuses of said pairs of first and second wall parts adjoining the side walls (1, 2; 3, 4) of the main section (A) disposed in said first and second plane, respectively, whereas the hypotenuses (17) of said third wall parts coincides and one leg (16) of each of said third wall parts (12, 13) coincides with one leg of one of said first wall parts (8, 9), corresponding wall parts of said first and second end section (B, C), respectively, being disposed in different one of said first and second planes.

6. A spatial structure as claimed in claim 5, **characterized** in that each end section (B, C) comprises a pair of fourth triangular wall parts (14', 15'), which in the flat collapsed condition are disposed between and adjoin said second wall parts (10', 11') and in said erected condition underlie and support said third wall parts (12, 13).

7. A spatial structure as claimed in 5 or 6, **characterized** in that each form body is made of two pieces of board material (20) each comprising two adjoining side walls of the main section, the pairs of first and third wall parts of one end section and the pair of second wall parts of the other end section, said pieces being adhesively connected by means of flange parts (24, 25) adjoining edges of the side walls of the main section (A) and legs of the first and second wall parts of each end section (B, C) defining external edges of each of said pieces.

8. A spatial structure as claimed in any of claims 5 to 7, **characterized** in that said connecting body (109 - 113) comprises a rectangular wall part and two adjoining triangular wall parts defining said rectangular surface (109a - 113a) and said end faces (109b,c - 113b,c), respectively, said connecting means comprising identical flange parts (114) adjoining the legs of each of said end faces (109b,c - 113b,c) and each having the form of an orthogonal isosceles triangle of the same size as the first and second triangular wall parts (8, 9, 10', 11') of the end sections (B, C) of said form bodies.

9. A spatial structure as claimed in claim 8, **characterized** in that connection of said connecting body (109 - 113) and said prismatic columns (101 - 106) of stacked form bodies is provided by interposing a

flange part (114) of said connecting body between mating side faces a pyramidal depression in the upper end section (B) of a lower form body and a downwards pyramidal extension of the lower end section (C) of an upper form body in each of said columns (101 - 106).

10. A spatial structure as claimed in any of the preceding claims, **characterized** in that it comprises at least one additional element in the form of a simple cover plate member (108) of a form corresponding to that of any of said triangular base of said pyramid structure or the combination of two such bases of the end section of a form body.

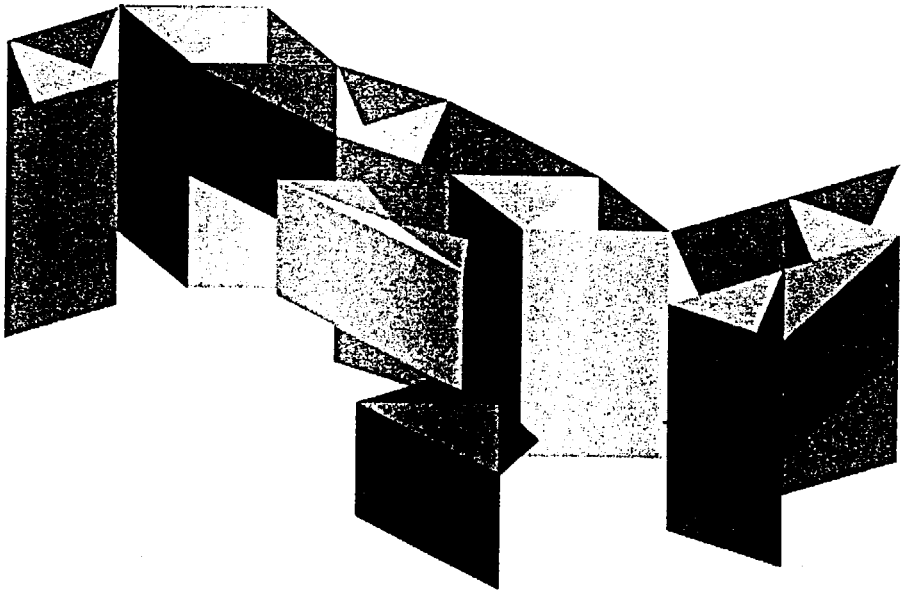

Fig 1

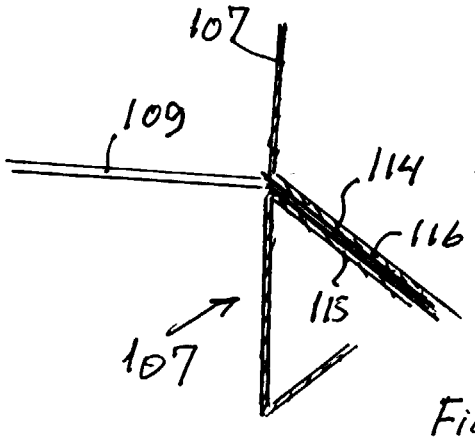

Fig 4

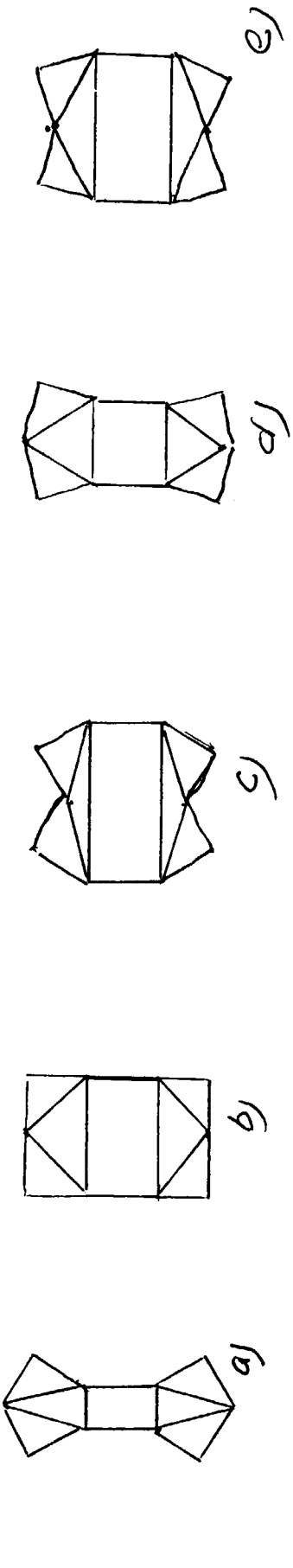

Fig2

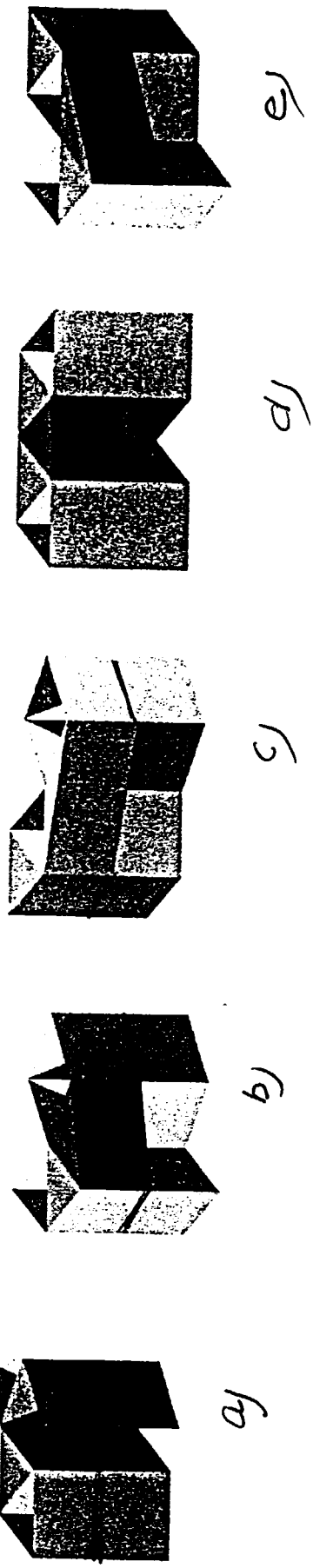

Fig3

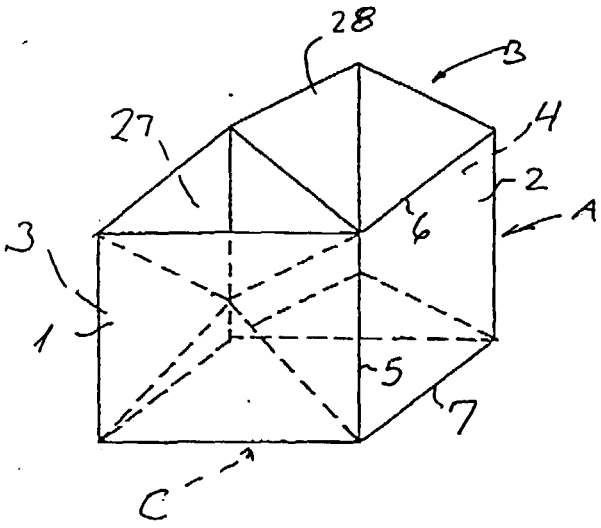

Fig 5

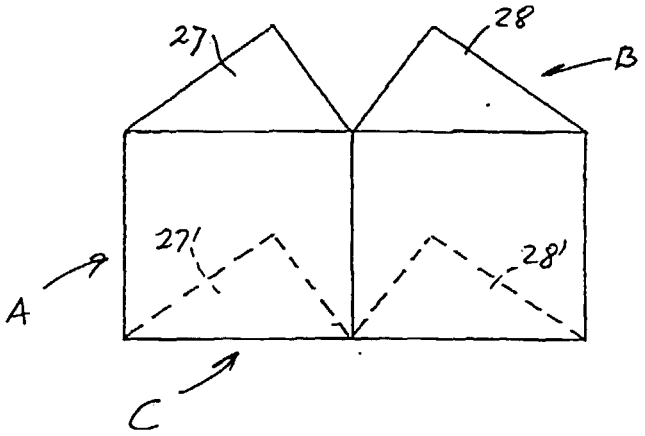

Fig 8a)

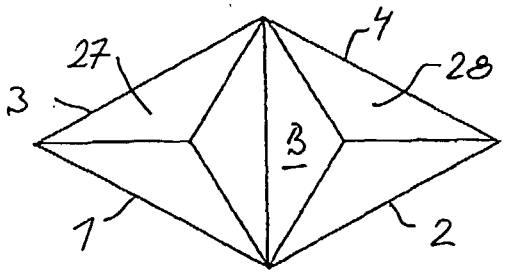

Fig 8b

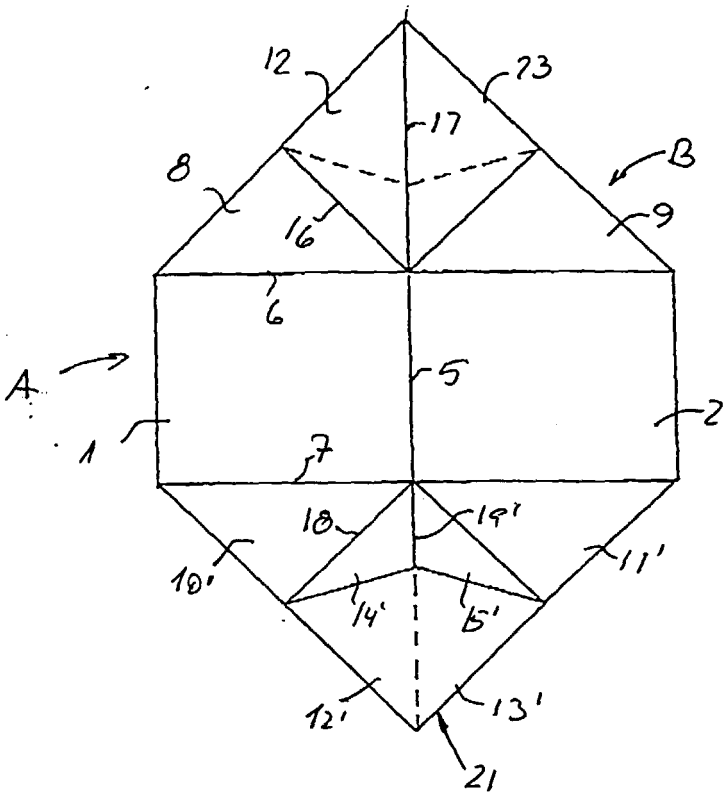

Fig 6

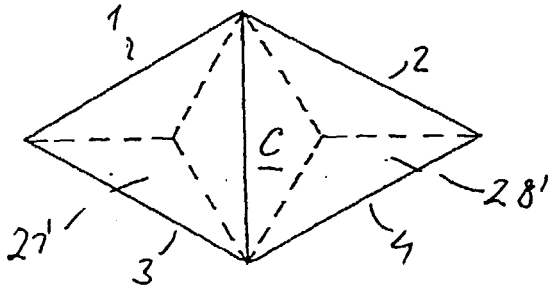

Fig 8 c)

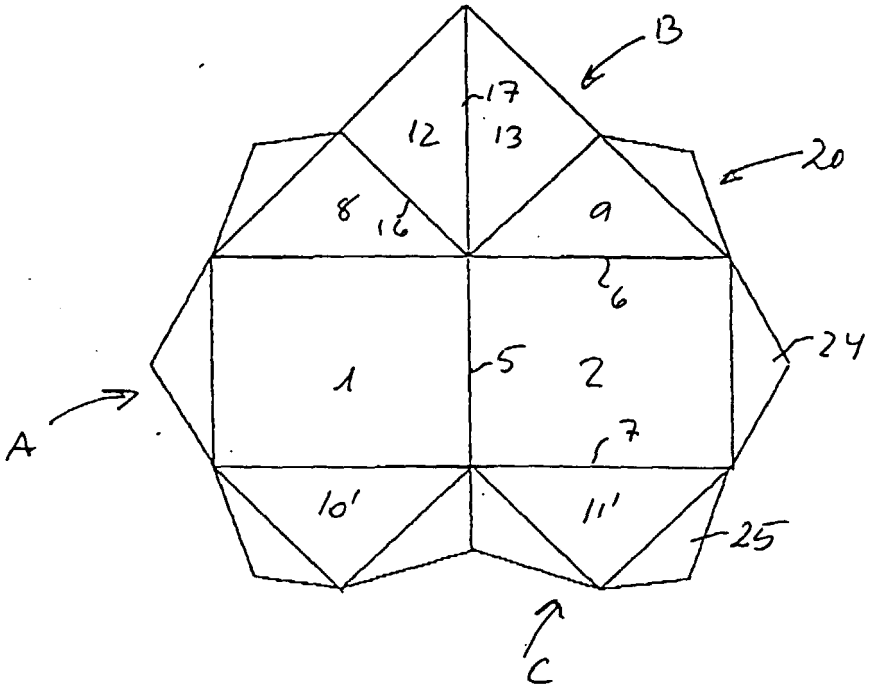

Fig 7

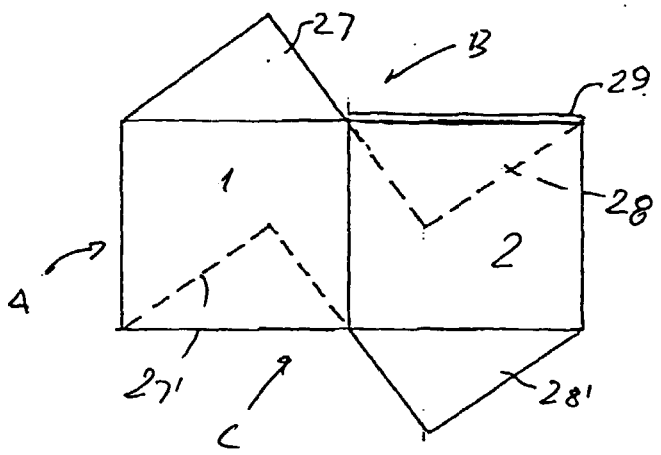

Fig 9a

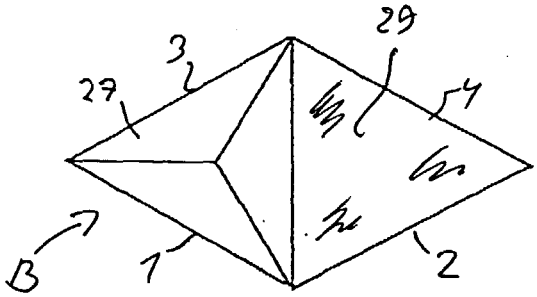

Fig 9b

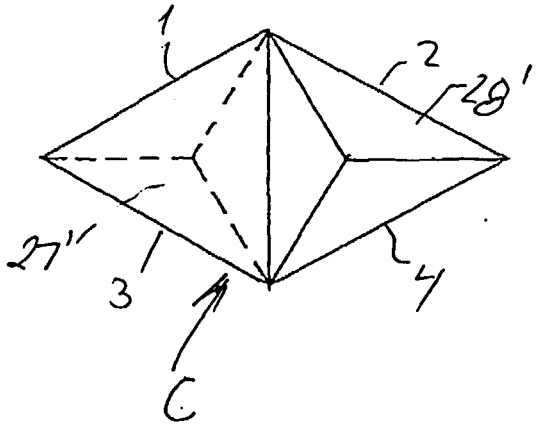

Fig 9c

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 61 0043

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)
A,D	WO 91 13663 A (PETERSEN) 19 September 1991 * page 7, line 15 - page 8, line 32; figures 16-19 *	1	E04B2/12
A	FR 2 408 688 A (SOCIETE ORAMECO) 8 June 1979 * figure 8 *	1	
A	DE 21 23 900 A (STÜBEN) 23 November 1972 * figures 7-13 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E04B
A63H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 April 1999	Mysliwetz, W

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82