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(71) Applicant: **STEELPRESS LIMITED**
46 Helen Street, Govan
Glasgow G51 3HQ(GB)

(72) Inventor: **Bell, Alan, Steelpress Limited**
46 Helen Street
Govan, Glasgow G51 3HQ(GB)

(74) Representative: **Fitzpatrick, Alan James et al**
Fitzpatricks 4 West Regent Street
Glasgow G2 1RS Scotland(GB)

(54) **Panelling for buildings.**

(57) A panel for use in the cladding of walls and roofs in buildings is formed by structurally embossing a sheet (1) of commercial quality steel or aluminium with a selected embossment pattern (E) to provide the sheet with a certain increased strength characteristic. The sheet 1 is further strengthened by profiling (Fig 2), or alternatively by applying an additional strengthening component, such as a further strengthening sheet (2,6) to the base sheet (1). In particular, the panel can comprise a pair of spaced metal sheets (4,5), with one or both structurally embossed (E) and at least one possibly profiled, and with insulating material 3 provided between the spaced sheets (4,5).

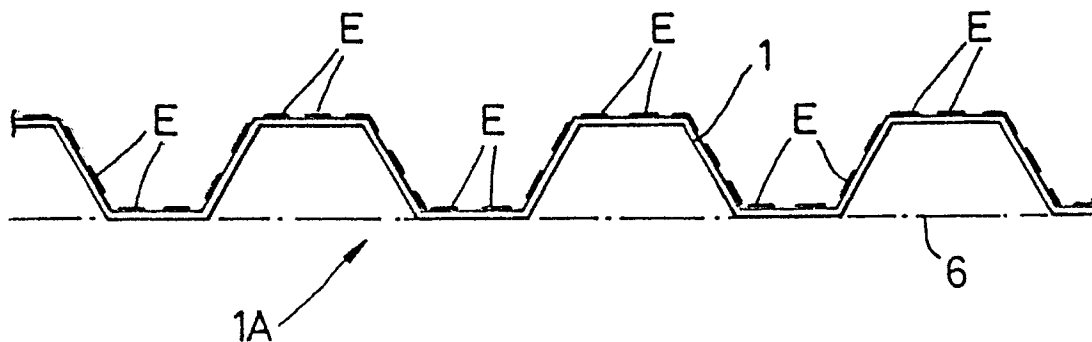


Fig. 2

PANELLING FOR BUILDINGS

The present invention relates to panels for building and especially to panels for use in the cladding of walls and roofs in buildings.

It is an object of the present invention to provide building panelling having improved strength and aesthetic characteristics.

5 According to one aspect of the present invention a method of forming a panel for use in the cladding of walls and roofs in buildings comprises the steps of providing a sheet of commercial quality steel or aluminium, embossing the sheet with a selected embossment pattern such that the sheet has strength properties between five and fifty per cent greater than those of the equivalent unembossed sheet, and applying further strengthening by profiling the embossed sheet and/or by incorporating one or more
10 additional strengthening members.

According to another aspect of the present invention a cladding panel for use in building construction comprises a metal sheet formation strengthened by profiling and/or by the provision of one or more additional strengthening members, the sheet formation carrying structural embossment defining an array of deformations which have the faculty of strengthening the sheet.

15 Preferably the metal sheet is of substantially uniform thickness.

The present invention is also a panel made by the aforesaid inventive method.

The precise embossment pattern created by the structural embossing can take a variety of forms. For example, the embossing could create an array of separate individual deformations on the sheet or alternatively a series of elongate continuous deformations or corrugations could be provided extending
20 parallel or at right angles to a deformation axis. Preferably the array or said deformation axis is set at an angle to the longitudinal axis of the panel. In particular, the deformation axis of the corrugations can be set parallel to the components longitudinal axis but alternatively it may be set transversely. The individual deformations of the array pattern can have a variety of shapes in plan view. Thus these deformations could be of rectangular, circular, square or oblong shape in plan with other shapes possible. Further, deformations
25 of different planar shape could be present in a particular array.

Thus the structural embossment of the sheet improves the structural strength property of the metal sheet and hence of the complete panel enabling a thinner sheet to be used with a consequent saving in material and hence in cost, or alternatively, for a given wall thickness, increased structural strength is imparted to the panel.

30 Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings wherein:

Fig. 1 shows an end view of sheet material usable in the present invention;

Fig. 2 shows the sheet material of Fig. 1 formed into a profiled sheet in accordance with one inventive embodiment;

35 Fig. 3 shows the sheet material of Fig. 1 used in a composite panel according to another embodiment of the present invention;

Fig. 4 shows an end view of a composite panel according to yet a further embodiment of the present invention;

Fig. 5 illustrates one embossment pattern suitable for application to the sheet material;

40 Fig. 6 shows a sectional view of a deformation of Fig. 5 through section X-X in Fig. 5.

Fig. 7 shows an embossment pattern similar to Fig. 5 but including a modification;

Fig. 8 shows a further possible embossment pattern; and

Fig. 9 shows a test arrangement for profile panels.

45 Figs. 2 to 4 show different forms of sheet panel constructions 1A-1C which are especially usable as wall cladding for buildings or as roof sheeting. The basic material for these constructions 1A-1C is metal sheeting 1 as shown in Fig. 1. The sheeting 1 initially plain is firstly embossed with a suitable embossment pattern E (particular forms of these patterns are discussed later) so as to strengthen the sheet material. In particular the embossing is such as to improve strength characteristics of the sheeting by 5% to 50%, in comparison with the plain sheeting: it has been found that the range, particularly the latter, can be achieved
50 without the need for the size (depth) of the individual deformations of the embossment E to be excessive and since the embossed sheeting 1 is further strengthened in manners to be described the strength provision of the particular embossment E will be found to be perfectly satisfactory.

The panel 1A of Fig. 2 is formed by profiling the embossed sheeting 1 of Fig. 1 using for example suitable profiling rollers, this profiling further strengthening the sheeting 1 and as will be appreciated the precise form of the profile can take a variety of shapes.

Fig. 3 shows a different strengthening arrangement: in this case the embossed sheeting 1 of Fig. 1 serves as an outer layer of a composite panel 1B which further includes a lower metal sheet layer 2 (embossed per Fig.1) with a core of insulating material 3 between the layers 1, 2.

Fig. 4 also shows a composite panel including an insulating core layer 3, and in this embodiment at least one of the outer metal sheet layers 4,5 is profiled, for example in the manner of Fig. 2. Again, structural embossment E is applied to at least one of the metal sheets 4, 5 so that the sheet in the non-profiled condition has equivalent structural strength to the embossed sheet 1 of Fig. 1. In the composite panel of Fig. 3, just as in Fig. 4, only one of the metal sheets 1, 2 could be embossed.

A further possibility is to secure a strengthening sheet (embossed or non-embossed) directly to the profiled sheet 1A in Fig. 2, as shown by the dashed line 6 in Fig. 2. Where the sheet 6 is embossed the profiled sheet 1A could be non-embossed.

The various panels of Figs. 2 to 4 can serve as cladding for building walls or as roof sheeting, and the manner of fitting can be by well established techniques which need not be explained in detail here. The panels could also be used as partitioning in building work.

In each of the above embodiments, the sheet material of the panel comprises commercial or profiling quality steel or aluminium. Commercial or profiling quality steel would be satisfied by designations Z1 and Z2 of British Standards 2989 (1982) i.e. defined as low grade commercial or profiling quality steel. The steel will be suitably coated and/or galvanised.

The embossing E has the function of strengthening the sheet material and also strain hardening the material. The embossing may be applied substantially over the full area of the sheet, but it would be possible for the embossing to be applied at only selected areas. Also, as an alternative, the embossing could be such that different areas of the panel have different embossment patterns.

The actual embossment pattern can be chosen from a wide variety of different forms, and Figs. 5, 7 and 8 merely show examples. Thus in Fig. 5, the embossment applies an array of separate individual deformations 11, 12. As can be seen in Fig. 5 the deformations 11 are of oblong form in plan view while the deformations 12 are of smaller circular shape, the pattern arrangement being defined by an orthogonal series of lines K-K, L-L with each circular deformation 12 surrounded by four oblong deformations 11. The spacing of the lines K-K, L-L specify the pitch of the deformation array, and pitch of 5 mm may be used for example. The structural embossing is achieved by a cold deformation using for example suitable embossment tool e.g. rollers, and it is a feature of the embossment that the orthogonal lines K-K, L-L are oblique to the rolling direction R.

Where the embossing of Fig. 5 is applied to the sheet material of the panel, the longitudinal axis of the sheet (extending vertically out of the plane of the paper in Figs. 1-4) will correspond with the rolling axis R so that the deformation array 11, 12 will be oblique to this longitudinal axis i.e. the orthogonal lines K-K, L-L will be oblique to this axis. It is also arranged that the thickness t (Fig. 6) of the sheet material remains substantially uniform over the area of the material even after the embossing process. It will be understood that deformations of other planar shape could be presented in the array of Fig. 5 for example deformations of rectangular or square form could be used. Further, different patterns are possible such as for example a uniform array of similar deformations, and an irregular (non-uniform) deformation array is also possible. Fig. 7 shows an embossment pattern similar to that of Fig. 5 but in this case two circular deformations 12 are surrounded by four oblong deformations 11.

Fig. 8 shows embossing E of corrugated form with nodes 13, 14 and the ratio of pitch P to valley depth H can be suitably chosen the corrugations shown in Fig. 8 being of micro profile form. Where the panel sheet is provided with the corrugated embossment of Fig. 8, the axis of deformation (i.e. out of the plane of the paper in Fig. 8) of the profile can be arranged appropriately relative to the longitudinal axis of the panel. For example, the profile deformation axis may be arranged longitudinally to the panels longitudinal axis.

In all cases it is preferred that the embossment has the effect of increasing a structural strength property e.g. bending resistance of the sheet material by a value in the range 5 per cent to 50 per cent in comparison with the non-embossed sheet material. Where a plastics and/or galvanised coating is to be applied to the material the embossment may be carried out before or after the coating is applied.

The thickness of sheet may be within the range 25 mm to 5 mm for example and the panel can have any suitable dimensions.

The application of the embossment to the panel sheet in accordance with the present invention provides two distinct advantages concerning structural and aesthetic enhancement. Thus, the embossment increases the strength of the panel and this will enable thinner sheet material to be used thereby lightening the panel and consequently giving rise to a possible saving in cost since less metal is required. Also varying quality of metal material may be utilised as the strain hardening and cold deformation of the material due by the embossment process mitigates against adverse effects created by the use of varying

quality material. Further, the embossing deformations will increase the corrosion resistance of the sheet material.

Comparison tests were carried out on panelling based on Fig. 2 and a corresponding profiled panel without the embossment (ie a plain panel). The embossed panel of the test utilised the embossment of Fig. 8 extending in the longitudinal direction of the panel. The testing was carried out by supporting a section of panelling as shown in Fig. 9 ie on three edge supports S spaced by a distance 1.9 m apart, and loading the panels substantially uniformly by increasing amounts. The following results were obtained:

TOTAL LOAD APPLIED OVER SPAN (kg)	MAXIMUM DEFLECTION IN SPAN (mm)		
	NON-EMBOSSSED 0.5	EMBOSSSED 0.5	% IMPROVED
8	2.33	1.57	33.61
54	4.19	3.07	26.73
100	4.78	3.67	23.22
146	5.48	4.34	20.80
192	6.57	5.37	18.26
238	7.93	6.69	15.63
330	8.41	7.17	14.74
376	8.97	7.72	13.93
388	9.24	8.00	13.42
408	9.94	8.68	12.67
448	11.16	9.77	12.45
468	11.72	10.12	13.65
488	13.12	10.87	17.15
508	15.44	12.02	22.15
528	16.91	12.75	24.60
548	FAIL	13.38	
568		14.72	
588		16.81	
608		18.19	
628		19.07	
648		FAIL	

As can be seen reduced deflection of up to about 30% has been achieved by the embossed panelling and as stress is proportional to the deflection amount a reduction in stress in the embossed panel of the same degree can be achieved. By adjusting the geometry of the embossment it will be possible to achieve an even greater improvement but a strength improvement of about 50% is the maximum desired.

The deformations 11, 12 can be arranged to project so as to be visible externally and this improves the aesthetic qualities of the component. In the case of the corrugated embossment of Fig. 8, the weather face of the profile, for example the surface with nodes 13, can be suitably coated with synthetic material. The stronger structurally embossed roof and wall panel sheets as described above will enable the use of a lighter and cheaper structural steel work supporting frame for these components.

Claims

1. A method for forming a panel for use in the cladding of walls and roofs in buildings comprising the steps of providing a sheet of commercial quality steel or aluminium, embossing the sheet with a selected embossed pattern such that the sheet has strength properties between five and fifty per cent greater than those of the equivalent unembossed sheet, and applying further strengthening by profiling the embossed sheet and/or by incorporating one or more additional strengthening members.

2. The method according to claim 1, wherein a profiled sheet is provided and an additional strengthening sheet is applied to the profiled sheet.

3. The method according to claim 1, wherein spaced metal sheets are provided, and insulating material

is located in the space between the sheets, at least one of the spaced metal sheets being structurally embossed.

4. A cladding panel for use in building construction comprising a metal sheet formation strengthened by profiling and/or by the provision of one or more additional strengthening members, the sheet formation
5 carrying structural embossment defining an array of deformations which have the faculty of strengthening the sheet.

5. A panel as claimed in claim 4, wherein the metal sheet is of substantially uniform thickness.

6. A panel as claimed in claims 4 or 5, including a strengthening metal sheet attached to a profiled sheet.

7. A panel as claimed in claims 4 or 5, comprising spaced metal sheets, the space between the sheets
10 being filled with insulating material.

8. A panel as claimed in any one of claims 4 to 7, wherein the sheet material comprises commercial quality steel or aluminium.

9. The invention as claimed in any one of the preceding claims, wherein the embossment provides an
15 array of separate individual deformations on the sheet.

10. The invention as claimed in any one of claims 1 to 8, wherein the embossment comprises a series of elongate continuous deformations or corrugations.

11. The invention as claimed in claim 9, wherein the array of separate deformations is arranged as a pattern having orthogonal axes and one of said axes is set at an angle of the longitudinal axis of the panel.

12. The invention as claimed in claim 10, wherein the continuous deformations or corrugations extend
20 parallel to the longitudinal axis of the panel.

13. The invention as claimed in claim 10, wherein the continuous deformations or corrugations extend at an angle to the longitudinal axis of the panel.

14. The invention as claimed in claim 13, wherein the deformations or corrugations are set transversely
25 to the longitudinal axis of the panel.

15. The invention as claimed in claim 9, wherein the deformations are of rectangular, circular, square or oblong shape in plan view.

16. The invention as claimed in claims 9 or 15, wherein the array includes deformations of different planar shape.

17. The invention as claimed in claims 9, 15 or 16 wherein at least some of the deformations are flat
30 topped.

18. The invention as claimed in claim 9 or any one of the claims 15 to 17, wherein at least one deformation of the shape is surrounded by deformations or another shape.

19. The invention as claimed in any one of the preceding claims wherein the sheet metal material has a
35 thickness on the range 0.25 mm to 5 mm.

20. The invention as claimed on any one of the preceding claims, wherein a coating is applied to the metal sheet.

21. The invention as claimed in any one of the preceding claims, wherein the deformations of the embossment essentially project solely in an external direction.

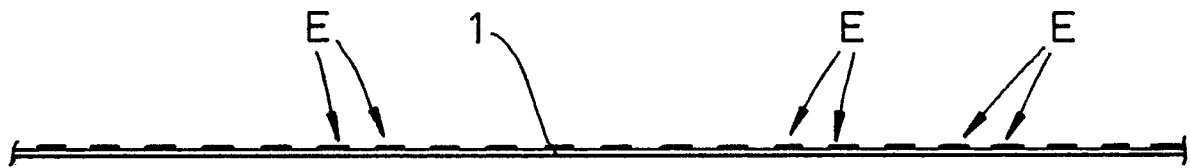


Fig. 1

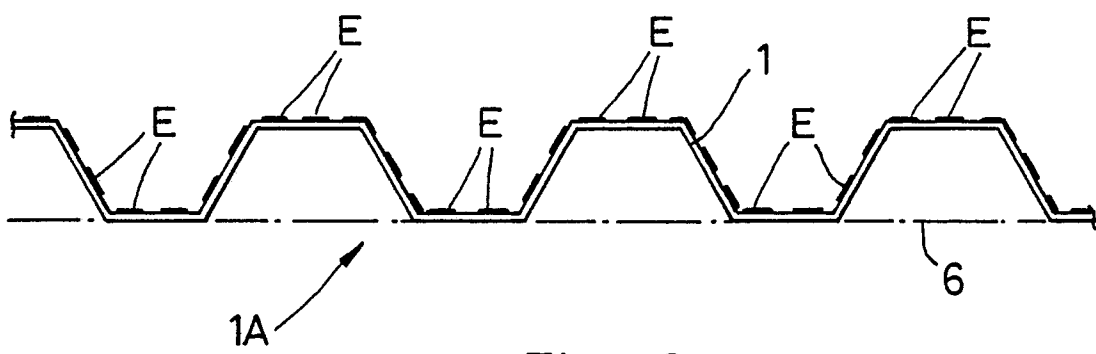


Fig. 2

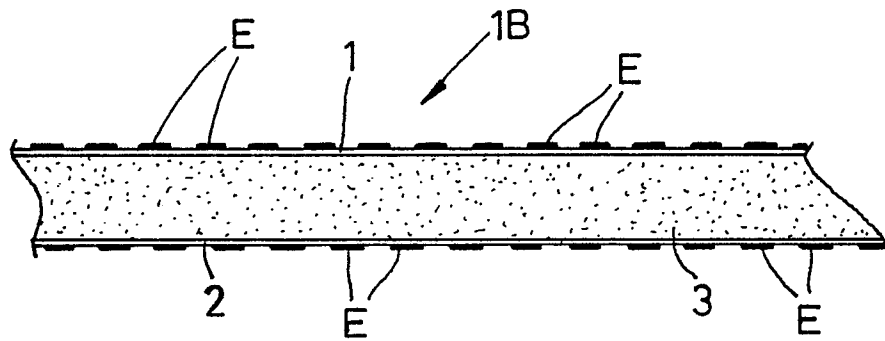


Fig. 3

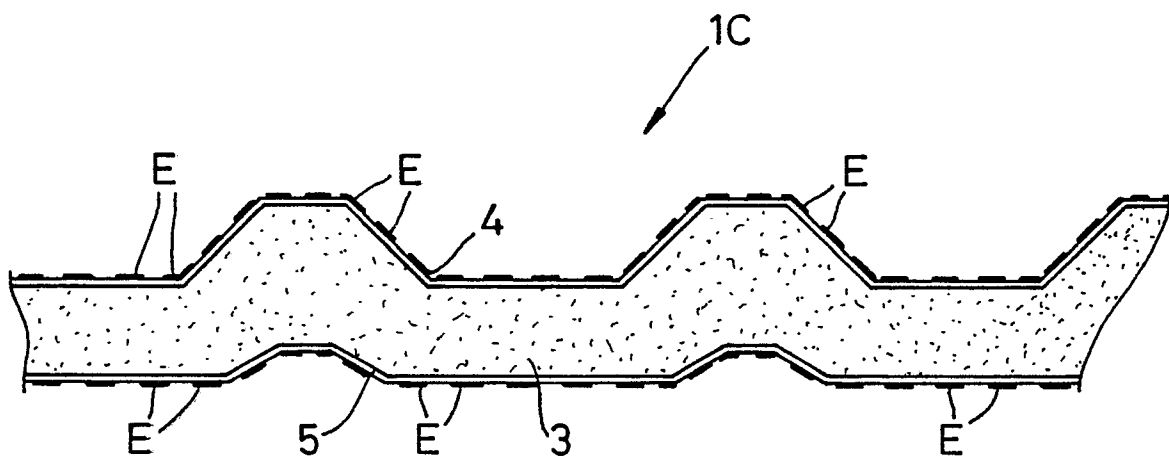


Fig. 4

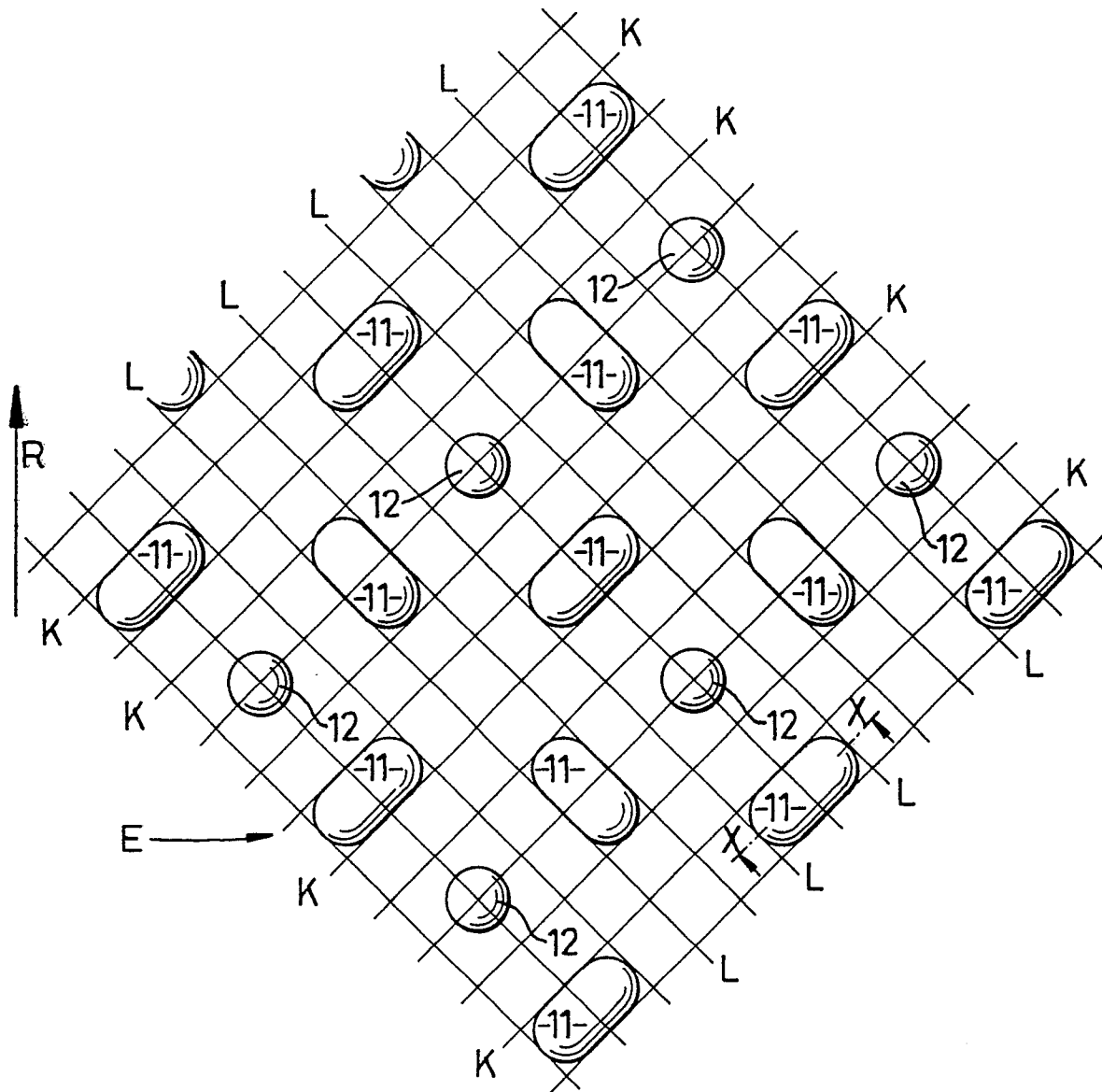


Fig. 5

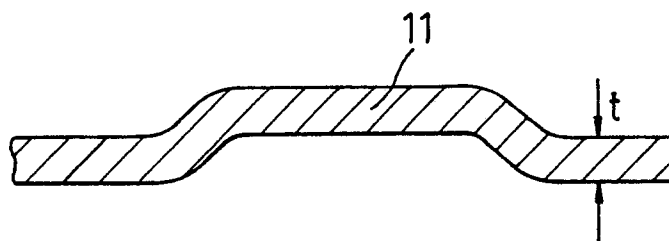
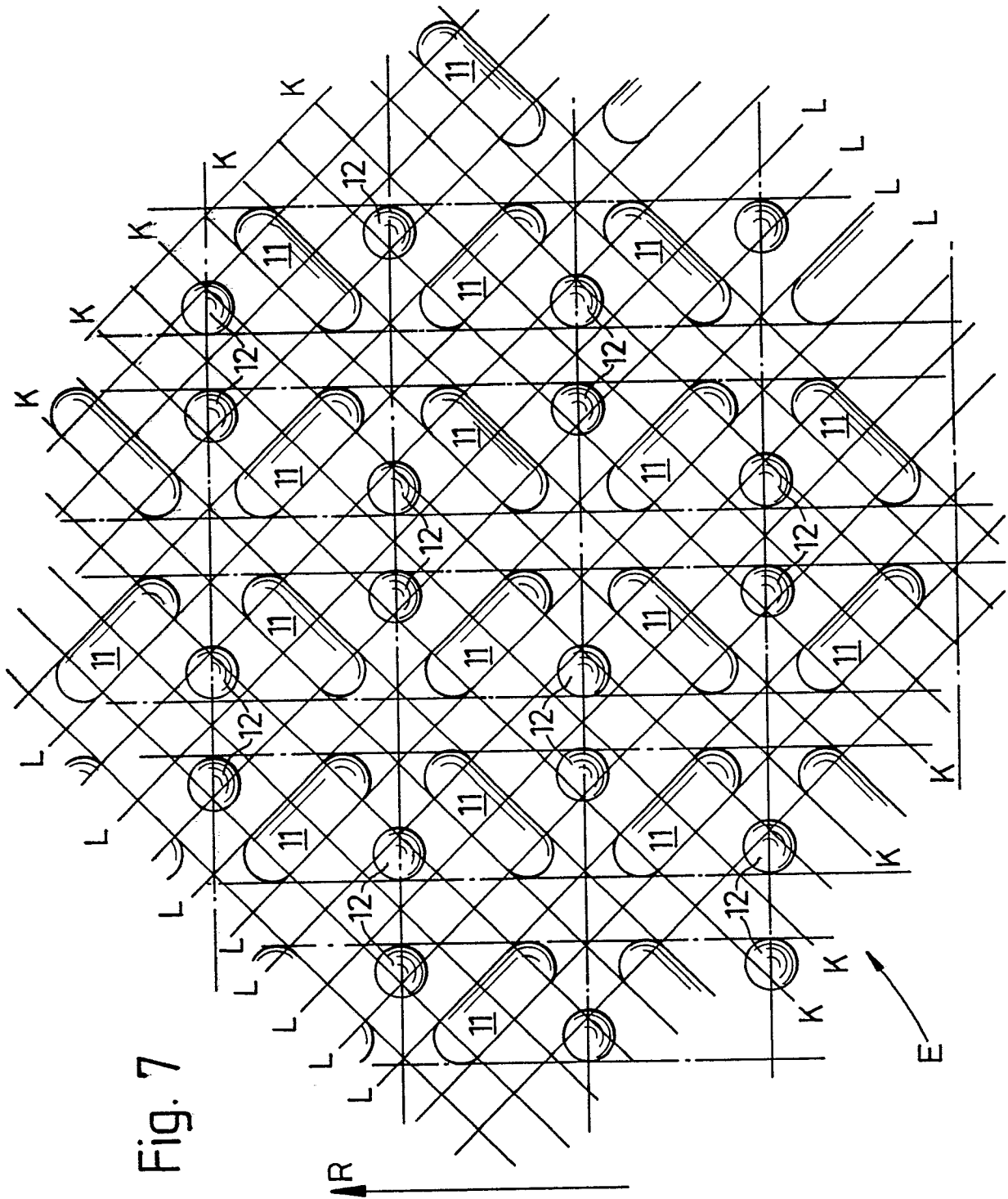


Fig. 6



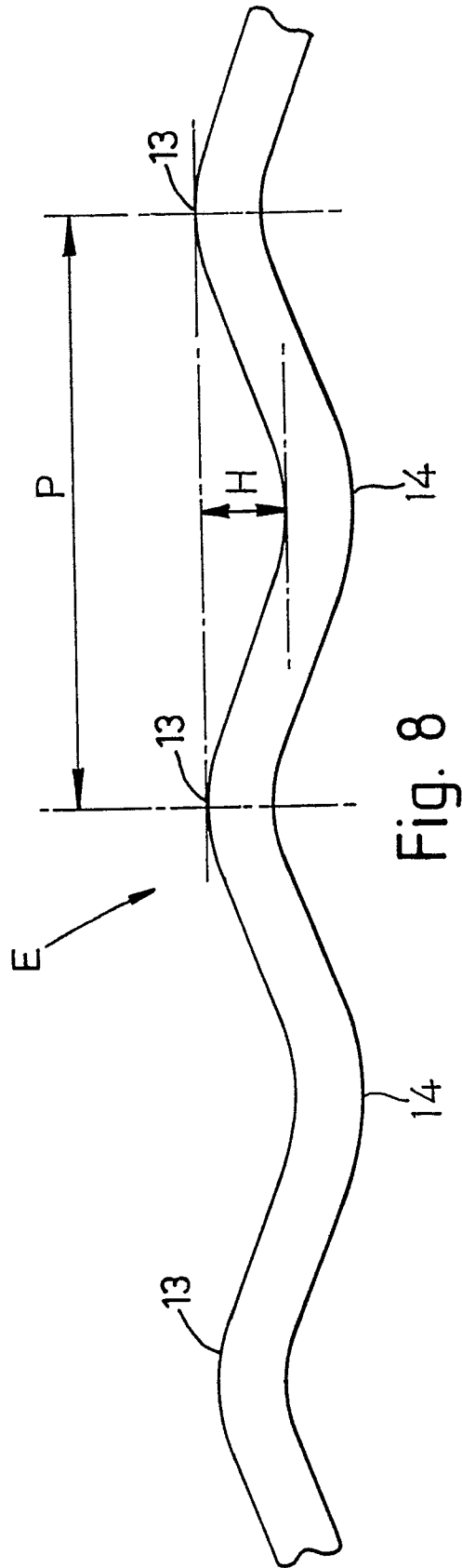


Fig. 8

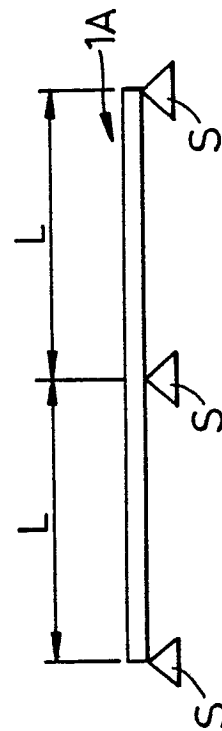


Fig. 9



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.5)
X	EP-A-0 143 290 (THYSSEN INDUSTRIE AG) * Whole document *	1,4,10, 12-14	E 04 C 2/32
Y		2,3,6,7, 20	
X	--- GB-A-1 216 990 (BRONZAVIA SA) * Page 2, lines 16-65; figures 1-3 *	1,4,9, 11,15, 21	
Y		2,6,8, 16,18, 19	
Y	--- GB-A-2 200 670 (STRAMIT INDUSTRIES LTD) * Page 4, paragraph 2; figure 1; abstract *	3,7,20	
A		1,4,8	
Y	--- FR-A-1 323 237 (CONCH INTERNATIONAL METHANE LTD) * Page 2, column 2, paragraphs 3-4; line 4 from the bottom - line 2 from the bottom; page 3, column 1, paragraph 2; figures 1-6 *	8,16,18, 19	
A			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			E 04 C
X	--- US-A-3 300 923 (BEHLEN) * Column 2, line 71 - column 3, lines 12,64-67,72 - column 4, lines 15,39-45; column 6, lines 12-44; figures 3,7,8,10,11 *	1,4,9, 11,15, 21	
	--- -/-	1,4,5,8, 9,15, 19,21	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23-03-1990	Examiner DE COENE P.J.S.
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			



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.5)
X	EP-A-0 057 537 (TATE ARCHITECTURAL PRODUCTS, INC.) * Page 12, lines 7-12; page 19, lines 3-21; page 20, line 2 from the bottom - page 21, line 1; page 24, lines 5-25; figures 2,3,6,7 *	1,4,5,8 ,9,15, 17,19	
X	GB-A- 340 655 (SOURDIS) * Page 1, lines 100-105; page 2, lines 10-23,65-79,85-90; figures 1,3,5,6 *	1,4,9, 11,15, 17	
A	-----	3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	23-03-1990	DE COENE P.J.S.	
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			