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(54) Structural beam.

(57) The structural beam for building constructions comprises a pair of web members (122) each having a cross section having a center section (124), said center section (124) having a height of approximately thirty-three percent (33 %) of the total height of said elongate structural member cross section, a pair of leg members (126) each angled in the same direction at an acute angle from the center section (124) and a pair of flange mounts (128) each angled from the leg members (126) so as to be parallel to each other; said web members (122) being joined only to each other along their length in facing abutment so that said joined web members (122) form an approximate "X" shape with one of the flange mounts (128) of each of the web members (122) being coplanar with a corresponding flange mount (128) of the other web member (122); a top plate member (30) spanning the respective coplanar flange mounts (128) of the web members (122) and joined thereto along the length of the structural beam; and, a bottom plate member (130) spanning the other respective coplanar flange mounts (128) of the web members (122) and joined thereto along the length of the structural beam.

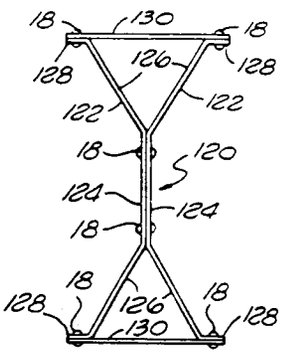

FIG. 12a

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FIELD OF THE INVENTION

This invention relates to the field of structural building materials, and more particularly to a fabricated structural beam.

BACKGROUND OF THE INVENTION

A variety of types of structural beams are used in non-residential construction. Some examples include fabricated wooden girders, laminated wood beams and reinforced concrete beams. By far, the most commonly used material is structural steel of various cross sections, such as "I"-section, "H"-section, "C"-section, "Z"-section and channel section. These structural steel shapes are most commonly manufactured by hot or cold rolling processes and generally provide a relatively heavy beam for a given load carrying capacity.

Structural sections fabricated from sheet steel are used in some construction applications. For example, it is now a common practice to utilize fabricated steel studs, particularly in non-residential construction. These are generally made from galvanized steel sheet, cold-rolled into a "C"-section or channel section. Furthermore, corrugated or fluted steel sheets are widely used in flooring and roofing applications.

Certain other fabricated structural shapes are known in the prior art. For example, Figure 1 illustrates a prior art structural shape fabricated from sheet steel. Beam 1 comprises a web portion 2 and opposing head portions 3 and 4. As can he clearly seen in the illustration, beam 1 can be easily fabricated from a single flat sheet of steel by rolling or otherwise folding the sheet longitudinally. It should be noted that edges 5 and 6 of the sheet are folded back towards web portion 2, but are not fastened or otherwise secured thereto. A prior art beam such as beam 1 has a very limited load bearing capability.

It is one of the objects of the present invention to provide a fabricated structural beam that has a load carrying capability comparable to that of conventional hot or cold rolled structural steel sections, but which is light in weight compared to a conventional section of equal load carrying capability.

SUMMARY OF THE INVENTION

According to the invention there is provided an elongate structural member for building construction consisting of four members comprising: a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel to each other; said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member; a top plate member, having down-turned terminal edge portions, spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and, a bottom plate member, having up-turned terminal edge portions, spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member, said top and bottom plates being planar in the area between and contiguous to said web members.

According to another aspect of the invention there is provided an elongate structural member for building construction consisting of four members comprising: a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel to each other; said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member; a top plate member, having up-turned terminal edge portions forming an extending channel, spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and, a bottom plate member, having up-turned terminal edge portions, spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member, said top and bottom plates being planar in the area between and contiguous to said members. The extending channel of the top plate may receive a vertical stud member or a wood beam.

According to a further aspect of the invention there is provided an elongate structural member for building construction consisting of four members comprising: a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel

to each other; said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member; a top plate member spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and, a bottom plate member spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member, said top and bottom plates being planar in the area between and contiguous to said web members, one of said top and bottom plate members having a longitudinal depression extending the length thereof. The longitudinal depression in one of said top and bottom plate members may have a plurality of spaced apertures.

The invention also provides an elongate structural member for building construction consisting of four members comprising a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel to each other; said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member; a top plate member spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and, a bottom plate member spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member, said top and bottom plates being planar in the area between and contiguous to said web members, one of said top and bottom plate members having a longitudinal depression extending the length thereof. The top plate member and bottom plate member may be joined to the web members by spot welding or by continuous welds. The top and bottom plate members may be thicker than the web members. The outer edge regions of the top and bottom plate members may be bent in the same direction or in opposite directions and a closure members may be fastened thereto to define a longitudinal chamber therein.

In yet another form of the invention there is provided in a metal beam construction, an elongate structural beam for building construction consisting of four members comprising: a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel to each other; said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member; a top plate member spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and, a bottom plate member spanning the other respective coplanar flange mounts or the web members and joined thereto along the length of the structural member; said beam being supported in said construction by a web mount.

In one embodiment the center section of said pair of web members has a height of at least approximately two thirds of the height of said structural member cross section. In another embodiment the center section has a height of approximately thirty-three percent (33 %) of the total height of said elongate structural member cross section.

Still further, the invention also provides in an elongate structural member for building construction comprising: a single longitudinally folded member configured to have mating web portion in side-by-side mating and abutting relationship, one end portion configured to form an enclosed triangle in cross section, and the other opposed end portions each comprising ends of said single longitudinally folded member extending outwardly from said mating web portions.

The other opposed end portions may extend in a plane normal to the web portions and the terminus of each of said other opposed end portions may be upturned and normal to the extending portions thereof. A wood beam can be received between the other opposed end portions. The terminus of each of the other opposed ends may also be down-turned and normal to the extending portions thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross sectional view of a prior art fabricated structural beam.

Figure 2 is perspective view of a preferred embodiment of a fabricated structural beam according to the present invention.

Figure 3 is a cross sectional view of the beam shown in Figure 2.

Figures 4a, b illustrate the individual folded members used to construct the beam illustrated in Figures 2 and 3.

Figure 5 illustrates another embodiment of the present invention.

Figure 6 illustrates a modification of the embodiment shown in Figure 5.

Figure 7 illustrates yet another embodiment of the present invention.

Figure 8 illustrates a modification of the embodiment shown in Figure 7.

Figure 9 illustrates still another embodiment of the present invention.

Figure 10 illustrates yet a further embodiment of the present invention.

Figure 11 illustrates an additional embodiment of the present invention.

Figures 12a-12e illustrate variations on an embodiment of the present invention having fabricated head structures.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, for purposes of explanation and not limitation, specific numbers, dimensions, materials, etc. are set forth in order to provide a thorough understanding of the present invention. However, it will he apparent to one skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details.

Referring first to Figures 2 and 3, a preferred embodiment of the present invention will be described. Beam 10 comprises a pair of triangularly shaped head portions 12 and 14 joined together by web portion 16. In overall configuration, beam 10 is thus similar to a conventional "I" beam. However, unlike a conventional structural beam, beam 10 is fabricated from relatively thin gauge sheet material. In most applications, beam 10 will be built up from cold rolled sheet steel. However, it is to be understood that the present invention is not limited to such a choice of material, but may be constructed from any suitable malleable sheet material. In particular, certain applications may recommend the use of aluminum or even a plastic.

The construction of beam 10 can best be understood with reference to Figures 4a and 4b which illustrate the individual members 20 and 30 that are interleaved to form beam 10. Member 20 is folded longitudinally and comprises a web portion 22, triangular head portion 14, web flange 24 and tail flange 26. In the illustrated embodiment, member 30 is identical to member 20, but need not be so. Members 20 and 30 are interleaved such that web portion 22 of member 20 extends between web portion 32 and web flange 34 of member 30. Likewise, web portion 32 of member 30 extends between web portion 22 and web flange 24 of member 20. Tail flange 26 of member 20 abuts wall 13 of triangular head portion 12. Likewise, tail flange 36 of member 30 abuts wall 15 of triangular head portion 14.

It is preferable that the cross-section of head portions 12 and 14 be substantially equilateral triangles. However, the invention is not limited in this regard.

Members 20 and 30 are secured to one another by fastening means 18. Fastening means 18 may comprise conventional mechanical fasteners, such as rivets or screws. Fastening means 18 may also comprise other conventional fastening means, such as spot welding or adhesives. The preferred embodiment utilizes a fastening technique sold under the trademark TOX by Pressotechnik, GMBH and its licensees. This technique employs a stamp and die to join together two or more thicknesses of material in a cold extrusion forming process. The TOX process is particularly advantageous for use with the present invention since it is fast, does not employ consumable fasteners and does not rupture anticorrosion coatings.

Web portion 16 of fabricated beam 10 comprises two thicknesses of material. For applications requiring a greater web thickness, either or both of web flanges 24 and 34 may be extended such that web portion 16 comprises three or four thicknesses of material.

Beams of the present invention, such as beam 10, may be conveniently fabricated by a continuous process wherein coils of sheet steel are fed through a suitable arrangement of rollers to impart the desired longitudinal folds and simultaneously interleave the members. The fabricated beam then passes through an array of mating stamp and die sets to fasten the members together at suitable intervals. The length of the completed beam is not inherently limited by such a process, and thus beams of any practical length can be readily manufactured. Moreover, the arrangement of rollers can be relatively easily altered to produce beams of differing transverse dimensions. The manufacturing process also easily accommodates sheet materials of different thicknesses so that the load capacity of the manufactured beam may be selected for each lot produced. For relatively large construction projects, suitable equipment may be located at the job site to produce beams according to the present invention in a manner somewhat analogous to that used for on-site fabrication of residential gutters.

Referring next to Figure 5, another embodiment of the present invention is illustrated. Here, beam 40 comprises members 42 and 44. These members may be fastened together at locations 45, 46 and 47 as

shown in Figure 5; however, it is preferable to insert a third member 50 between members 42 and 44 as shown in Figure 6. Insert 50 includes tail flanges 52 and 54 that abut against the respective triangular head portions of members 42 and 44. Members 42, 44 and 50 are fastened together by fastening means 18 as described above. The resulting structure of beam 40 is quite similar to that of beam 10 as illustrated in Figure 3, except that the web portion comprises three thicknesses of material. This embodiment has the particular advantage that member 50 may be made of a heavier gauge material than members 42 and 44, thereby imparting additional strength to beam 40 without necessarily increasing the thickness of material in the head portions of the beam. It should be noted that member 50 may comprise a conventional "I" beam or other conventional steel section where substantial reinforcement is desired. Member 50 need not be inserted over the entire span of beam 40, but may be inserted only in certain longitudinal regions requiring additional reinforcement.

Still another embodiment of the present invention is illustrated in Figure 7. Beam 60 comprises a single longitudinally folded member having parallel web portions 62 and 64, head portion 66 and opposing tail flanges 68 and 70. This embodiment can he utilized as illustrated in Figure 7 by fastening web portion 62 and 64 together at locations 72 and 74. However, it is preferable to add a second longitudinal member 76 as shown in Figure 8. Member 76 includes tail flange 78 that abuts head portion 66. As with the other embodiments thus far described, web portion 62 and 64 and member 76 are secured by fastening means 18. As with the embodiment illustrated in Figure 6, member 76 may be of the same or a heavier gauge than the remainder of the beam.

Referring now to Figure 9, a modification of the embodiment illustrated in Figures 2 and 3 is shown. In this embodiment, members 20' and 30' are essentially identical to members 20 and 30 previously described except for corrugations 80 and 82. These corrugations are added to provide additional stiffness in beam 10'.

In a similar manner, Figure 10 illustrates a further modification of beam 10 as shown in Figures 2 and 3. Beam 10'' includes embossed ribs or corrugations 86 on the sloping walls of head portions 12'' and 14''. It will be understood that other patterns of corrugations and other means of reinforcement may be incorporated with any of the embodiments described herein.

With reference now to Figure 11, yet another embodiment of the present invention is shown. Beam 100 is constructed in a manner essentially similar to the embodiments described above. However, this design offers significant advantages as will be described below.

Beam 100 comprises web member 102, which includes tail flanges 104 at each end. Beam 100 also comprises a pair of identical head members 106. Each of head members 106 is folded approximately in the shape of an equilateral triangle having sides 107, 108 and 109. Side 109 terminates with web flange 110 and side 107 terminates with web flange 111 in like manner. Flanges 104 of web member 102 are secured to sides 108 of head members 106 by means of fasteners 18. Likewise, tail flanges 104 of web member 102 are secured to sides 108 of head members 106 by means of fasteners 18. As discussed in connection with the previously described embodiments, fasteners 18 may be any suitable form of fastener. However, in this embodiment, the TOX fastening system is not preferred because of the difficulty of positioning a dye within the triangular head members. More suitable fastening means for this embodiment are rivets or spot welding.

In beam 100, shear and bearing loads are carried by sides 107 and 109 of head members 106 and also by web member 102. By fastening the web member flanges 104 to head member sides 108, greater flexural strength is achieved in comparison to the beams described above. Moreover, web member 102 of this embodiment increases the buckling strength of the head members. The thickness of web clement 102 may be selected to achieve any desired beam strength. It is to be noted that this selection may be independent of the selected thickness of head members 106, thereby allowing the structural characteristics of beam 100 to be optimized for particular applications.

Figures 12a-12e illustrate further variations of structural beams within the scope of this invention. Referring first to Figure 12a, the basic characteristics of this design will be described with equal applicability to the variations shown in Figures 12b-12e. Beam 120 comprises a pair of identical web members 122. Each of web members 122 has a center portion 124, outwardly angled intermediate portions 126, and flange portions 128. Web members 122 are attached to one another at their respective center portions 124 by means of fasteners 18.

Beam 120 further comprises head members 130 secured to respective flange portions 128 of the web members, also by means of fasteners 18. Beam 120 differs from all of the previously described beams in that the triangular head structures are not folded from a single sheet of material, but rather are fabricated from individual elements, namely, intermediate portions 126 of web members 122 and head members 130. These elements define a tubular structure with a generally triangular cross-section as in all other

embodiments described thus far.

Beam 140 illustrated in Figure 12b is essentially identical to beam 120, but employs extended head members 142. Beam 150 shown in Figure 12c is again essentially identical to beam 120 but employs channel shaped head members 152. Figure 12d illustrates a beam 160 wherein head members 162 have a "C"-section. Figure 12e shows beam 170 in which head member 172 includes a longitudinal depression 173 that serves as a stiffening element. Head member 174 is shown as a simple plate identical to head members 130 of beam 120. However, it is to be understood that head member 174 could be identical to head member 172. In fact, any combination of head members can be utilized with the basic structure comprising web members 122 to accommodate special applications.

By virtue of flange elements 128 of the various embodiments illustrated in Figures 12a-12e, these beams are particularly well suited for fastening horizontal collateral elements, such as floors or ceilings, from either the top or bottom of each flange. By virtue of vertical flange elements 155, beams 150 and 160 are further adapted for fastening vertical collateral elements, such as partitions, wallboard, or window wall directly to the beam. Moreover, vertical flange elements 155 facilitate fastening beams 150 and 160 from the side to conventional strap hangers and the like. As in all of the previously described embodiments, the thickness of the individual members of these beams may be selected to achieve virtually any desired structural characteristics. The beams illustrated in Figures 12a-12e offer the particular advantage of being more economical to manufacture, partly due to the fact that obtuse folds of material are not required.

It will be recognized that the above described invention may be embodied in other specific forms without departing from the spirit or essential characteristics of the disclosure. Numerous variations will be apparent to persons skilled in the art of structural design. For example, while the embodiments discussed above are most advantageously constructed of cold rolled sheet steel, a hot rolling process may be employed in certain applications. In particular, it should be noted that cold rolled and hot rolled sections may be combined as discussed above in connection with Figure 6. Furthermore, because of the open nature of the beams of the present invention, a plurality of such beams may be "nested" within one another to provide a greater load bearing capability than a single such beam without increasing the gauge of sheet material used.

To illustrate the advantages of the present invention, the following tables compare the calculated performance of a test section comprising the embodiment illustrated in Figures 2 and 3 with various standard structural shapes. In each of the following tables, the beam of the present invention has a height of 200 millimeters and a width of 60 millimeters. Results for three material thickness are presented, namely 1.0 millimeter, 1.2 millimeter, and 1.6 millimeter. All results are for standard sections of hot rolled British grade 43C steel, which is generally equivalent to ASTM A36.

In the following tables, Columns (a), (b), and (c) give the mass per meter, cross sectional area and moment of inertia for the sections respectively. Column (d) gives the load considered for deflection purposes, W_D, based on the design criterion that the maximum deflection should be less than 1/360th of a beam length of 3 meters. Column (e) gives the load ratio with respect to the test section. Column (f) gives the maximum span for each section when the point load equal to W_D for the lest section is applied to the simply-supported beams. Column (g) gives the maximum span ratio with respect to the test section.

When a section of the present invention is compared with standard sections of similar mass per meter, its moment of inertia is significantly larger than that of the other sections. Thus, it supports more loading compared with the standard sections. Similarly, it spans longer than the standard sections for the same maximum deflection.

Table 1

Section	(a) Mass/Length (kg/m)	(b) Cross-Sectional Area x 10^{-3} (m^2)	(c) Moment of Inertia x 10^{-6} (m^4)	(d) W_D (kN)	(e) Maximum Load Ratio	(f) Maximum Span (m)	(g) Maximum Span Ratio
Test section 200 mm x 60 mm thickness = 1.0 mm	5.64	0.718	3.4670	10.790	1.0	3.000	1.0
Channel section 76 mm x 38 mm web thickness=5.1mm flange thickness=6.8mm	6.70	0.853	0.7414	2.310	0.21	1.387	0.46
Square hollow section 60 mm x 60 mm wall thickness = 3.2 mm	5.67	0.722	0.3870	1.204	0.11	1.002	0.33
Rectangular hollow section 80 mm x 40 mm wall thickness = 3.2mm	5.67	0.722	0.5810	1.810	0.17	1.228	0.41

Table 2

Section	(a) Mass/Length (kg/m)	(b) Cross-Sectional Area x 10^{-3} (m^2)	(c) Moment of Inertia x 10^{-6} (m^4)	(d) W_D (kN)	(e) Maximum Load Ratio	(f) Maximum Span (m)	(g) Maximum Span Ratio
Test section 200 mm x 60 mm thickness = 1.2 mm	6.764	0.8616	4.194	13.05	1.0	3.000	1.0
Channel section 76 mm x 38 mm web thickness=5.1mm flange thickness=6.8mm	6.700	0.853	0.7414	2.31	0.18	1.261	0.42
Square hollow section 60 mm x 60 mm wall thickness = 4.0 mm	6.97	0.888	0.4610	1.43	0.11	0.995	0.33
Rectangular hollow section 80 mm x 40 mm wall thickness = 4.0 mm	6.97	0.888	0.6960	2.17	0.17	1.222	0 41

Table 3

Section	(a) Mass/Length (kg/m)	(b) Cross-Sectional Area x 10^{-3} (m^2)	(c) Moment of Inertia x 10^{-6} (m^4)	(d) W_D (kN)	(e) Maximum Load Ratio	(f) Maximum Span (m)	(g) Maximum Span Ratio
Test section 200 mm x 60 mm thickness = 1.6 mm	9.02	1.1480	5.714	17.78	1.0	3.000	1.0
Channel section 102 mm x 51 mm web thickness= 6.1 mm flange thickness = 7.6 mm	10.42	1.3280	2.0770	6.46	0.36	1.809	0.60
Square hollow section 80 mm x 80 mm wall thickness = 3.6 mm	8.59	1.0900	1.0600	3.30	0.19	1.292	0.43
Rectangular hollow section 100 mm x 50 mm wall thickness = 4.0 mm	8.86	1.1300	1.4200	4.42	0.25	1.495	0.50
"I" section 254 mm x 102 mm web thickness = 5.8 mm flange thickness = 6.8 mm	22.0	2.8400	28.670	89.19	5.02	6.72	2.24
"Z" section 76.2 mm x 69.85 mm thickness = 6.35 mm	9.99	1.2710	1.195	3.72	0.21	1.37	0.46

Claims

1. An elongate structural member for building construction consisting of four members comprising:
a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange

mounts each angled from the leg members so as to be parallel to each other;

said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member;

a top plate member, having down-turned terminal edge portions, spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and,

a bottom plate member, having up-turned terminal edge portions, spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member, said top and bottom plates being planar in the area between and contiguous to said web members.

2. An elongate structural member for building construction consisting of four members comprising:

a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel to each other;

said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member;

a top plate member, having up-turned terminal edge portions forming an extending channel, spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and,

a bottom plate member, having up-turned terminal edge portions, spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member, said top and bottom plates being planar in the area between and contiguous to said web members.

3. The structural member in accordance with Claim 2 wherein said extending channel of said top plate member is adapted to receive a vertical stud member.

4. The structural member in accordance with Claim 2 wherein said extending channel of said top plate member is adapted to receive a wood beam.

5. An elongate structural member for building construction consisting of four members comprising:

a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel to each other;

said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member;

a top plate member spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and,

a bottom plate member spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member, said top and bottom plates being planar in the area between and contiguous to said web members, one of said top and bottom plate members having a longitudinal depression extending the length thereof.

6. The structural member in accordance with Claim 5 wherein said longitudinal depression in one of said top and bottom plate members have a plurality of spaced apertures.

7. An elongate structural member for building construction consisting of four members comprising:

a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel to each other;

said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member;

a top plate member spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and,

a bottom plate member spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member, said top and bottom plates being planar in the area between and contiguous to said web members, one of said top and bottom plate members having a longitudinal depression extending the length thereof.

8. The structural member of Claim 7 wherein said top plate member and said bottom plate member are joined to said web members by spot welding.

9. The structural member of Claim 7 wherein said top plate member and said bottom plate member are joined to said web members by continuous welds.

10. The structural member of Claim 7 wherein said top plate member and said bottom plate member are thicker than said web members.

11. The structural member of Claim 7 wherein said top plate member and said bottom plate member have a cross section having the outer edges thereof bent through an angle of approximately ninety degrees so as to define a pair of outer edge regions thereon, one of said outer edge regions of said top plate member and a respective outer edge region of said bottom plate member being substantially parallel, whereby a closure member may be fastened thereover to define a longitudinal chamber therein.

12. The structural member of Claim 7 wherein said top plate member and said bottom plate member have a cross section having the outer edges thereof bent through an angle of approximately ninety degrees so as to define a pair of outer edge regions thereon, one of said outer edge regions of said top plate member and a respective outer edge region of said bottom plate member being substantially parallel, the outer edge regions of said top plate member and said bottom plate member being bent in the same direction.

13. The structural member of Claim 7 wherein said top plate member and said bottom plate member have a cross section having the outer edges thereof bent through an angle of approximately ninety degrees so as to define a pair of outer edge regions thereon, one of said outer edge regions of said top plate member and a respective outer edge region of said bottom plate member being substantially parallel, the outer edge regions of said cop plate member and said bottom plate member being bent in opposite directions.

14. The structural member of Claim 7 wherein each of said web members have a cross section having the outer edges thereon bent toward each other so as to be substantially parallel, whereby a closure member may be fastened thereover to define a longitudinal chamber herein.

15. The structural member of Claim 7 wherein said center section of said pair of web members has a height of at least approximately two thirds of the height of said structural member cross section.

16. The structural member of Claim 7 wherein said center web members are roll formed sheet metal.

17. The structural member of Claim 7 wherein said center web members and said top and bottom plate members are roll formed sheet metal.

18. The structural member of Claim 7 wherein said center web members and said top plate member are roll formed sheet metal, said top plate member having a shallow downward projecting channel rolled formed therein.

19. In a metal beam construction, an elongate structural beam for building construction consisting of four members comprising:

a pair of web members each having a cross section having a center section, a pair of leg members each angled in the same direction at an acute angle from the center section and a pair of flange mounts each angled from the leg members so as to be parallel to each other;

said web members being joined only to each other along their length in facing abutment so that said joined web members form an approximate "X" shape with one of the flange mounts of each of the web members being coplanar with a corresponding flange mount of the other web member;

a top plate member spanning the respective coplanar flange mounts of the web members and joined thereto along the length of the structural member; and,

a bottom plate member spanning the other respective coplanar flange mounts of the web members and joined thereto along the length of the structural member;

said beam being supported in said construction by a web mount.

20. The structural member of Claim 19 wherein said top plate member and said bottom plate member are joined to said web members by spot welding.

21. The structural member of Claim 19 wherein said top plate member and said bottom plate member are joined to said web members by continuous welds.

22. The structural member of Claim 19 wherein said top plate member and said bottom plate member are thicker than said web members.

23. The structural member of Claim 19 wherein said top plate member and said bottom plate member have a cross section having the outer edges thereof bent through an angle of approximately ninety degrees so as to define a pair of outer edge regions thereon one of said outer edge regions of said top plate member and a respective outer edge region of said bottom plate member being substantially parallel, whereby a closure member may be fastened thereover to define a longitudinal chamber therein.

24. The structural member of Claim 19 wherein each of said web members have a cross section having the outer edges thereof bent toward each other so as to be substantially parallel, whereby a closure member may be fastened thereover to define a longitudinal chamber therein.

25. The structural member of Claim 19 wherein said center section of said pair of web members has a height of at least approximately two thirds of the height of said structural member cross section.

26. The structural member of Claim 19 wherein said center web members are roll formed sheet metal.

27. The structural member of Claim 19 wherein said center web members and said top and bottom plate members are roll formed sheet metal.

28. The elongated structural member in accordance with claims 1, 2, 5, 7 and 19 wherein said center section has a height of approximately thirty-three percent (33 %) of the total height of said elongate structural member cross section.

29. An elongate structural member for building construction comprising:

a single longitudinally folded member configured to have mating web portions in side-by-side mating and abutting relationship, one end portion configured to form an enclosed triangle in cross-section, and the other opposed end portions each comprising ends of said single longitudinally folded member extending outwardly from said mating web portions.

30. The structural member in accordance with Claim 29 wherein said other opposed end portions extend in a plane normal to said web portions.

31. The structural member in accordance with Claim 29 wherein the terminus of each of said other opposed end portions are upturned and normal to the extending portions thereof.

32. The structural member in accordance with Claim 31 wherein said other opposed end portions are adapted to receive a wood beam therebetween.

33. The structural member in accordance with Claim 30 wherein the terminus of each of said other opposed ends are down-turned and normal to the extending portions thereof.

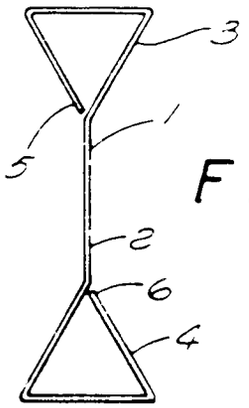

FIG. 1 PRIOR ART

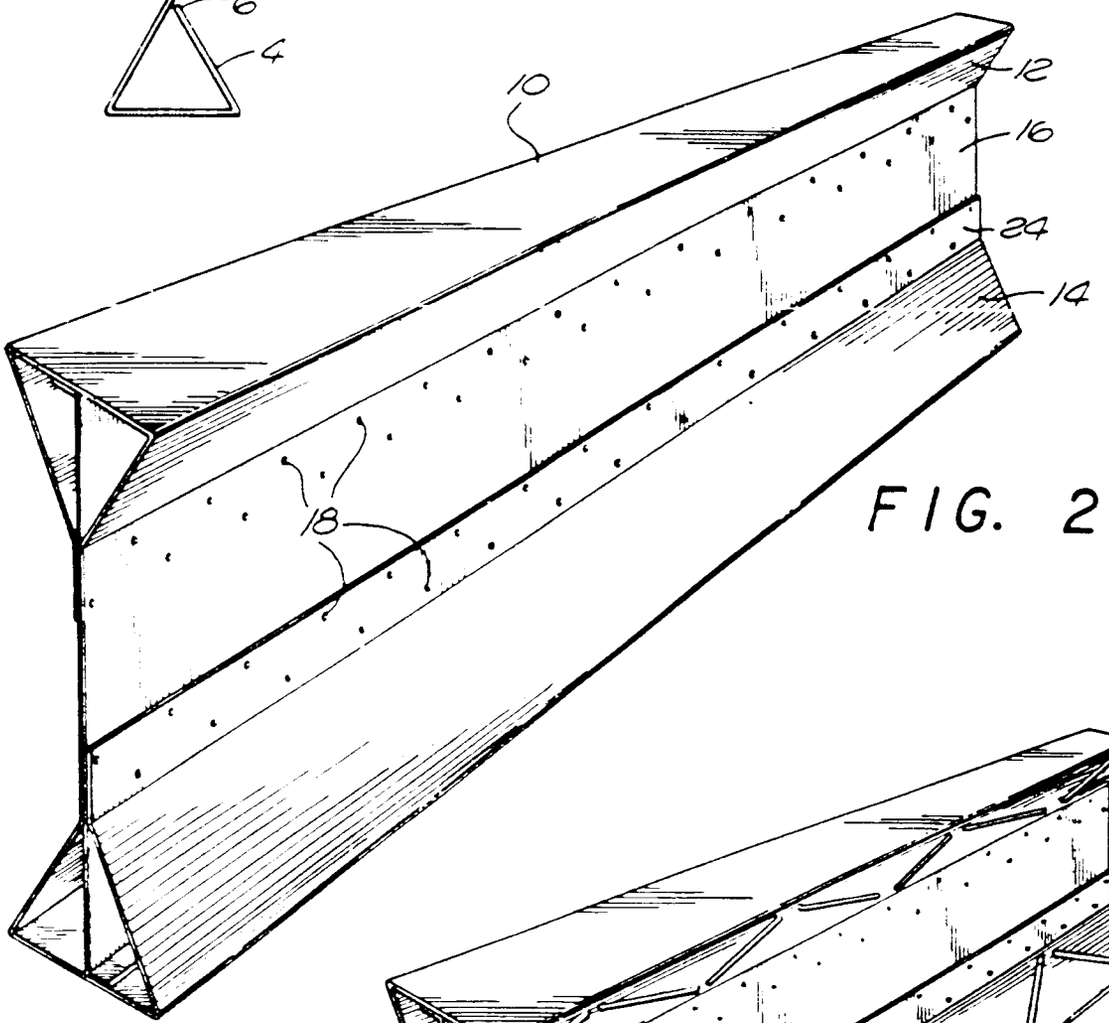

FIG. 2

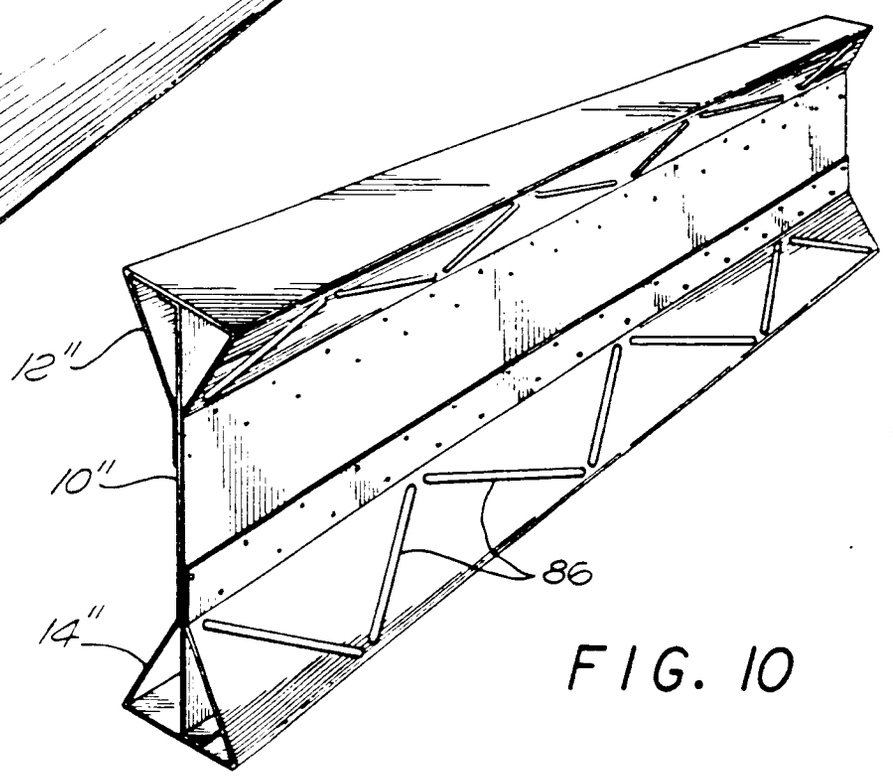

FIG. 10

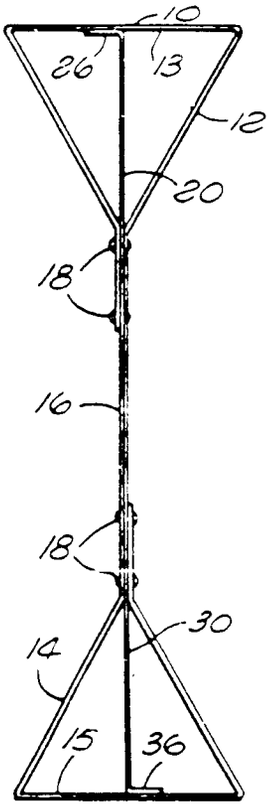

FIG. 3

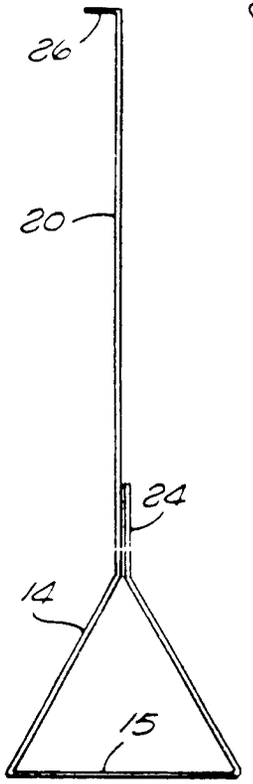

FIG.4a

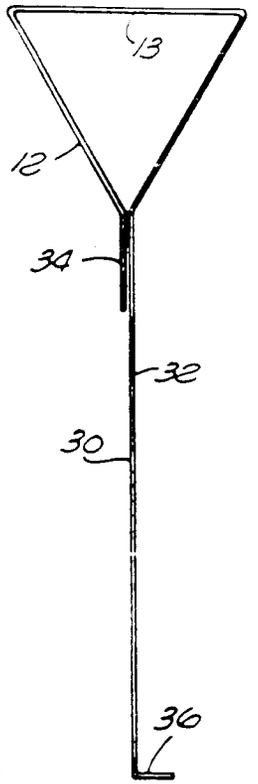

FIG. 4b

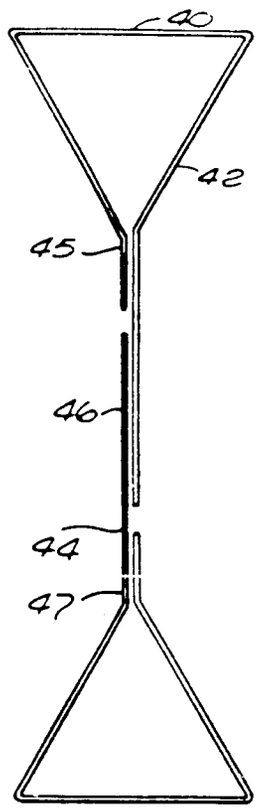

FIG. 5

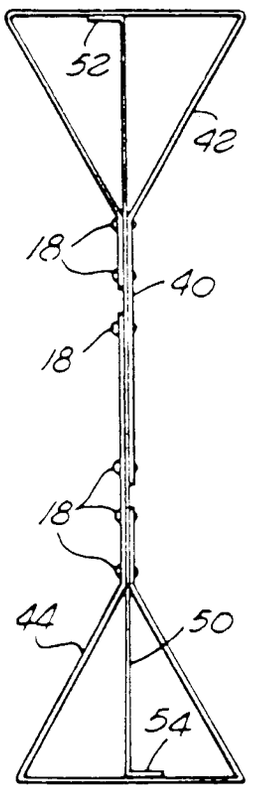

FIG. 6

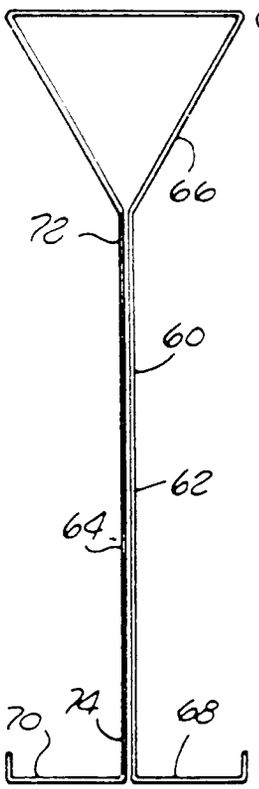

FIG. 7

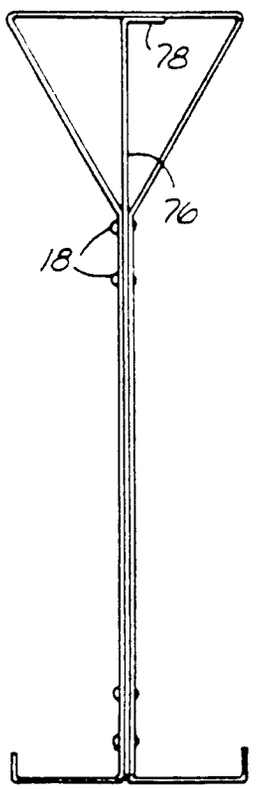

FIG. 8

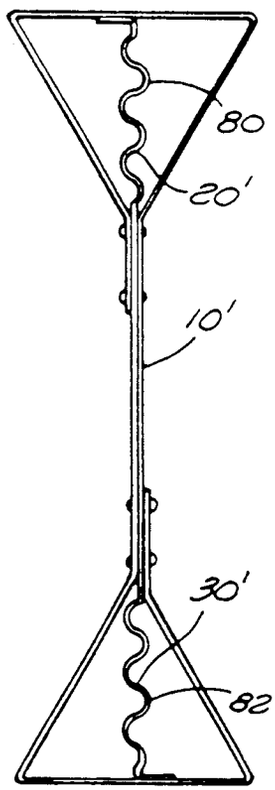

FIG. 9

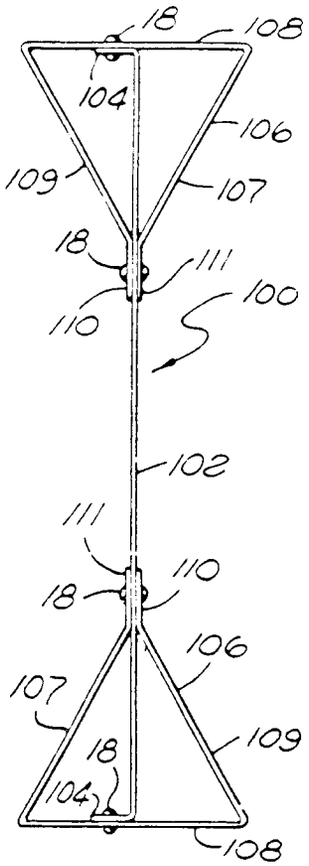

FIG. 11

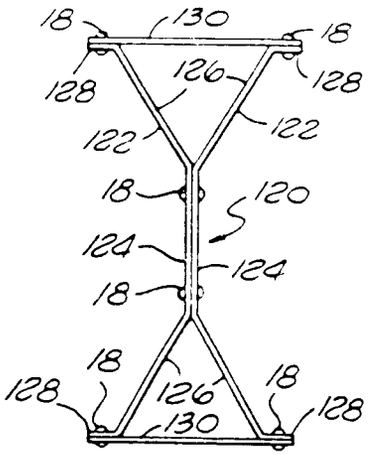

FIG. 12a

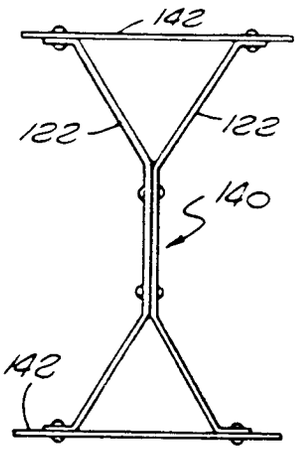

FIG. 12b

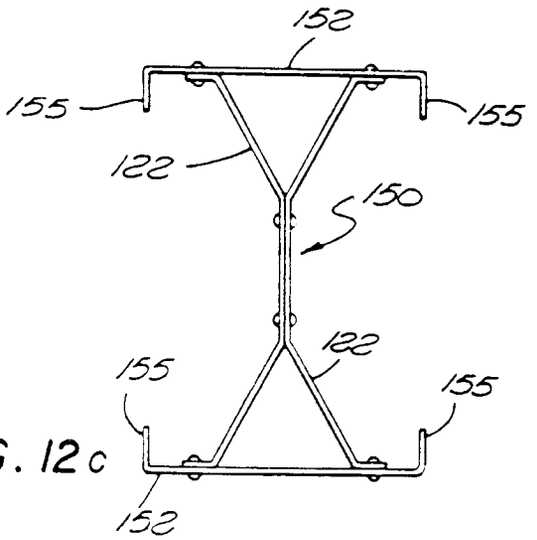

FIG. 12c

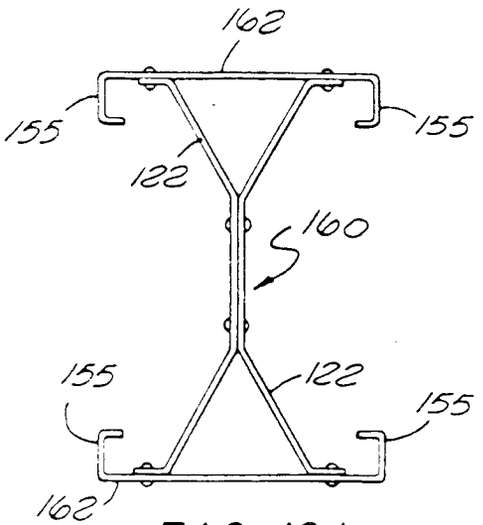

FIG. 12d

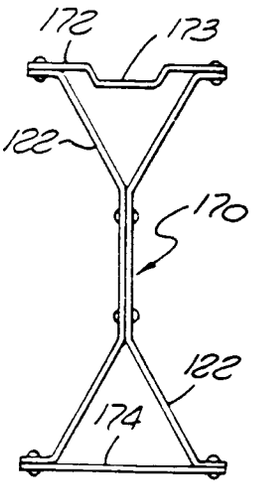

FIG. 12e

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 20 3383

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 Y 	US-A-1 360 720 (E. BROWN ET AL.) * the whole document * ---	1,5, 7-11,13, 14, 19-24,28 2-4,6, 12, 15-18, 25-27	E04C3/07
X Y A 	GB-A-640 341 (W. HOLT) * page 2, line 10 - line 82; figures * ---	1,28 15,25 2-14, 16-24, 26,27, 30,31,33	
Y 	OA-A-4 816 (SOCOMECAM) * figures 2,3 * ---	2-4,12, 31-33	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
Y A 	US-A-3 224 154 (A. J. TOTI ET AL.) * figures 1,9,10 * ---	6 5,7-18	E04C B64C
Y 	US-A-3 698 224 (SAYTES) * abstract; figures * ---	16-18, 26,27	
X Y 	FR-A-2 533 607 (DONN INC.) * abstract; figures * ---	29,30 31-33	
A 	GB-A-1 372 095 (P. BOONEN) * the whole document * ---	1,2,5,7, 9,21	
	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 February 1995	Righetti, R

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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 3383

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)
A	FR-A-1 256 094 (LACOUR) * the whole document *	1,2,5,7, 9,10,21, 22	
A	GB-A-591 110 (F. WEAKLEY) * figure 5 *	4,5,7,32	
A	GB-A-698 461 (J. T. B. WINDOWS LTD ET AL.) * figures *	4,19,29	
A	AU-B-556 374 (D. TRAMBAS) * claim 1; figures *	1,13	
A	FR-A-2 269 618 (SAIP) * page 7, line 9-16; figure 8 *	1,7,8, 10,19, 20,22	
A	CH-A-435 183 (T. WUPPERMANN GMBH) * figures 12,15,17,20 *	1,2,4, 11,14, 24,32	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A	FR-A-2 549 933 (DONN FRANCE) * abstract; figures *	19	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 February 1995	Righetti, R

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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