(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 December 2007 (06.12.2007)

PCT

(10) International Publication Number
WO 2007/137331 A1

(51) International Patent Classification:
A47B 96/02 (2006.01) *A47B 47/00* (2006.01)

(21) International Application Number:
PCT/AU2007/000720

(22) International Filing Date: 24 May 2007 (24.05.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

2006902856	26 May 2006 (26.05.2006)	AU
2006902885	29 May 2006 (29.05.2006)	AU

(71) Applicant *(for all designated States except US)*: **DEMATIC PTY LTD** [AU/AU]; 24 Narabang Way, Belrose, New South Wales 2085 (AU).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BERRY, Paul, Armstrong** [AU/AU]; 15 Berkeley Close, Berowra Heights, New South Wales 2082 (AU). **CLARKE, Murray, James** [AU/AU]; 56 College Street, Drummoyne, New South Wales 2047 (AU). **CELATI, Stephen, John** [AU/AU]; 17 Moala Street, Concord West, New South Wales 2138 (AU). **XIE, Jonathan, Han** [AU/AU]; 144 Metella Road, Toongabbie, New South Wales 2146 (AU).

(74) Agent: **GRIFFITH HACK**; Level 29, Northpoint, 100 Miller Street, North Sydney, New South Wales 2060 (AU).

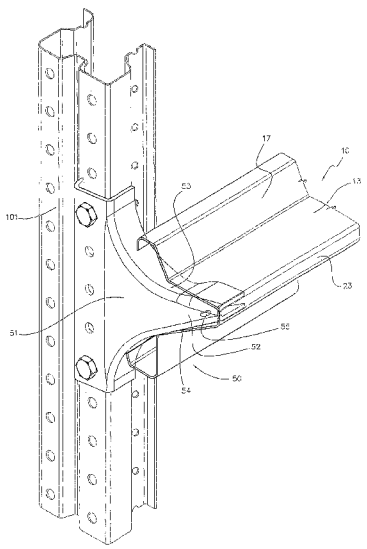
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: RACKING BEAM FOR OPEN FACED RACKING



(57) Abstract: A racking beam (10) for an open faced racking system, comprising a bearing portion (12) that incorporates a bearing surface (13), a guiding portion (16) that is disposed along a first longitudinal edge (14) of the bearing portion, and a stiffening portion (18) disposed along a second longitudinal edge (15) of the bearing portion (12). The guiding portion (16) extends upwardly from the bearing surface (13) whereas the stiffening portion (18) extends downwardly and inwardly from the bearing portion by an amount sufficient to cause a principal axis X of bending of the beam (10) to be oriented within (20) relative to a nominal plane of the bearing surface and the shear centre S of the beam to be positioned so as to be laterally displaced from the second longitudinal edge (15) within the range of +30% to -10% of the width b of the bearing surface extending between the first and second longitudinal edges.

WO 2007/137331 A1

RACKING BEAM FOR OPEN FACED RACKING

Field of the Invention

The present invention relates generally to storage racking systems and more particularly to a racking beam used in open faced racking systems, such as drive-in and drive-through racking. The invention is described with reference to that context, however it is to be appreciated that the invention has broader application and is not limited to that particular use.

Background of the Invention

In the following description, except where specifically differentiated, the term "drive-in racking" encompasses both drive-in and drive-through racking.

Drive-in style racking systems are widely used in warehousing, manufacturing and other industrial facilities. Drive-in racking has advantages of providing very dense storage compared to selective pallet racking and a relatively low capital cost compared to alternative high density solutions. In addition, pallets can be accessed with standard forklift trucks.

In drive-in style racking, the racks are arranged in blocks. Aisles are formed between the rack blocks allowing access to stock via mechanical handling equipment such as forklifts. Each drive-in rack block comprises a number of lanes of pallet storage extending multiple pallets deep into the rack.

Drive-in racks are constructed principally from vertical rack frames which are orientated perpendicular to the main access aisle. Individual lanes of pallet storage are created from adjacent planes of vertical rack frames. Each

lane comprises multiple levels of support beams, commonly referred to as pallet runners or pallet rails. The pallet runners are offset from the vertical rack frames and span in a direction parallel to the rack frames. The pallet runners generally span across multiple frames and are supported at each frame upright by a connecting bracket. The front face of the rack is thus open allowing handling equipment to drive into each lane to store and retrieve pallets in a multiple deep configuration. Pallets are supported along their left- and right-hand edges which bear on the pallet runners.

The vertical rack frames comprise vertical load bearing members commonly referred to as uprights, and metal bracing which extends between adjacent uprights to form the frame. Uprights are typically roll formed channel shaped profiles with extended rear flanges to facilitate bracing connections. The pallet runners extend between these vertical rack frames parallel with the lane.

Drive-in rack, as distinct from drive-through rack, gains its global down-aisle stability through the use of vertical spine bracing located behind the rearmost plane of pallets, and plan bracing located in the horizontal plane at the top of the rack. Due to the obstruction created by the vertical spine bracing, drive-in rack therefore functions as a "last in first out" (LIFO) system. A pallet is retrieved from the rack by the forklift truck driving into the lane to the pallet location, lifting the pallet, and then reversing out of the lane into the main access aisle.

On the other hand, access in a drive-through rack is not restricted by vertical spine bracing located behind a plane of pallets. In an empty lane of a drive-through system, forklift trucks can drive through the lane from the entry to the exit pallet locations. Such a storage

system can therefore function in a "first in first out" (FIFO) fashion which might be preferable to a LIFO system for certain types of products.

In drive-through racking, global down-aisle stability is achieved through the flexural stiffness of the connecting beams at the top of the frames, spine bracing towers located through the depth of the rack within one lane, or a combination of these mechanisms.

Summary of the Invention

According to a first aspect the present invention provides a racking beam for an open faced racking system, the beam comprising:

a bearing portion that incorporates a bearing surface;

a guiding portion that is disposed along a first longitudinal edge of the bearing portion and extends upwardly from the bearing surface; and

a stiffening portion disposed along a second longitudinal edge of the bearing portion and extending downwardly and inwardly therefrom by an amount sufficient to cause a principal axis of bending of the beam to be oriented within 20° relative to a nominal plane of the bearing surface and the shear centre of the beam is positioned so as to be laterally displaced from the second longitudinal edge within the range of +30% to -10% of the width of the bearing surface extending between the first and second longitudinal edges.

In the context of the specification the direction of lateral displacement of the shear centre from the second longitudinal edge is taken as being positive when it is towards the first longitudinal edge.

In a particular form, the racking beam is formed from sheet metal and more preferably is made from sheet steel that typically incorporates a corrosion resistant metal coating and may also incorporate a decorate paint finish. Typically the thickness of the sheet steel is between 1.5mm and 3mm. The racking beam may be profiled using a cold roll forming process although it may also be formed by other processes such as a pressing, folding or forging operation or any combination thereof.

Prior art racking beams for open faced racking (otherwise known as pallet runners) have been designed to meet the functional requirements by incorporating a guiding portion and bearing portion. However, such beams have been unsuited to spans that significantly exceed the conventional span of 1.2 m between uprights. In contrast, the racking beam according to this aspect of the present invention has significantly improved structural performance characteristics (i.e. bending strength, lateral deflection, twist) which enable significantly greater spans without increase in the gauge of the metal used in the racking beam. In particular, utilising a beam profile where the principal bending axes are aligned more with the horizontal enables loading on the bearing surface to produce primarily vertical deflection of the beam without significant concomitant lateral deflection. In addition by locating the shear centre so that it is laterally displaced from the second longitudinal edge within the above mentioned range (i.e.+30% to -10% of the width of the bearing surface) reduces the extent of twist in the cross section. A racking beam with improved structural performance may have a significant impact on

the economy of the resulting racking system as it can lead to fewer uprights, cantilever brackets, base plates and other components.

In a particular embodiment, a nominal plane of the bearing surface is disposed generally in the horizontal plane when the beam is in its installed position.

In a particular form, the shear centre is aligned close to the resultant of the load acting on the bearing flange. This resultant is typically located adjacent the second longitudinal edge.

In a particular embodiment, the stiffening portion extending downwards from the bearing surface comprises an upper web, a lower web and an inclined web disposed between the upper and lower webs, the inclined web extending downwardly and inwardly so that the lower web is offset inwardly from the upper web.

The incorporation of an inclined web in the racking beam and the dimensions of that web have been found to have a significant influence on the orientation of the principal bending axes of the beam. Further, the inclined web provides additional depth to the section and also a convenient location for receiving fasteners to secure the beam to the supporting bracket.

In a particular form the inclined web is inclined from the plane of the bearing surface at an angle greater than 15°. In one form, this angle is in the range of 15° to 45°.

In a particular embodiment, the inclined web is dimensioned such that the offset of the lower web from the upper web is in the range of 60-120% of the width of the bearing surface extending between the first and second longitudinal edges. In a particular form, the offset is in the range of 70-100% of the bearing surface.

In a further aspect, the invention is directed to a racking beam for an open faced racking system, the beam comprising: a bearing portion that incorporates a bearing surface; a guiding portion that is disposed along a first longitudinal edge of the bearing portion and extends upwardly from the bearing surface; and a stiffening portion disposed along a second longitudinal edge of the bearing portion, the stiffening portion incorporating an upper web and a lower web and an inclined web disposed between the upper and lower webs, the inclined web extending downwardly and inwardly so that the lower web is offset inwardly from the upper web by an amount in the range of 60-120% of the width of the bearing surface extending between the first and second longitudinal edges.

In yet a third aspect, the invention relates to a racking beam for an open faced racking system comprising: a bearing portion that comprises a bearing surface; a guiding portion that is disposed along a first longitudinal edge of the bearing portion and extending upwardly from the bearing surface; and a stiffening portion disposed along a second longitudinal edge of the bearing portion, the stiffening portion comprising an upper web that extends downwardly from the bearing surface, and an inclined web that extends downwardly and inwardly so that a lower portion of the inclined web is

offset inwardly from the upper web, the inclined web further comprising fastener receiving formations arranged to receive fasteners to secure the beam to supporting brackets.

The incorporation of the fastener receiving formations on the inclined web allows easy access for an installer to fix the fasteners yet still enabling the fasteners to be in a position where they are unlikely to form catch points in the racking system.

In a particular embodiment, the fastener receiving formations are in the form of apertures operative to receive respective fasteners to secure the beam to supporting brackets. In other form, these formations may be recesses or even flats that are arranged to receive self tapping screws or the like.

In yet a further aspect, the invention relates to a racking beam assembly comprising a racking beam of the third aspect and a support bracket, the beam being of generally channel shape and the bracket being locatable within the beam channel, the support bracket incorporating a fastening surface locatable behind the inclined web and wherein in use the beam is securable to the support bracket by one or more fasteners that extend through the inclined web and the fastening surface.

In a particular embodiment, the stiffening portion of the racking beam in any form described above, further comprises a lower stiffening formation disposed along a lower distal margin of the beam. In one form, this lower stiffening formation comprises a flange that projects

inwardly from the lower web and a lip return that extends from the flange to a lower terminal edge of the beam.

In a particular embodiment, the guiding portion includes an upper stiffening formation disposed along a distal margin of the guiding portion and a web disposed between the stiffening formation and the bearing portion. In a particular embodiment, the upper stiffening formation is similar to the lower stiffening formation and incorporates a flange that extends from the guiding portion web and a lip return that extends from the flange to an upper terminal end of the beam.

In a particular embodiment, the guiding portion web is inclined to the nominal plane of the bearing surface. Typically the open angle between the guiding portion web and the plane of the bearing surface is in the range of 90-120°.

In yet a further aspect, the invention relates to a racking system incorporating racking beams and/or racking assemblies according to any of the forms described above.

In one form, the racking beams are supported along their length by uprights spaced apart, possibly unequally, such that substantial bending is induced in the beams under normal design loadings.

Brief Description of the Drawings

Notwithstanding any other forms that may fall within the scope of the racking beam assemblies and systems as defined in the summary, specific embodiments will now be described by way of example only, with reference to the

accompanying drawings, in which:

FIG. 1 is a front elevation of an open faced racking system;

FIG. 2 is a side elevation of the racking system of FIG.1;

FIG. 3 is a perspective view of a racking beam used in the racking system of FIG. 1;

FIG. 4 is an underside perspective view of the racking beam of FIG. 3;

FIG. 5 is an end view of the racking beam of FIG. 3;

FIG. 6 is a detailed view of a racking beam assembly comprising a racking beam and bracket when mounted to an upright of the racking system of FIG. 1;

FIG. 7 is a schematic view of five racking beam profiles (A-E);

FIG. 8 is a graph of the orientation of the principal axes against the offset (e) for the profiles of FIG. 7;

FIG. 9 is a graph of the position of the shear centre against the offset (e) for the profiles of FIG. 7; and

FIG. 10 illustrates the orientation of the principal axes through the centroid C and the shear centre position S of profiles of the racking beams of FIG. 7.

Detailed Description of Specific Embodiments

FIG. 1 depicts an open faced racking system 100 comprising a series of vertical load bearing uprights 101 and multiple levels of racking beam assemblies 50 supported by the uprights 101. These assemblies comprise brackets 51 which are mounted to the uprights and racking beams 10, commonly referred to as pallet runners, which are affixed to the brackets. The open faced racking system 100 is designed such that lanes 102 are formed between the uprights 101 and sized to allow stock handling equipment such as fork lifts or other vehicles to drive into the lanes so as to load pallets 500 onto the racking beams. In this regard, the racking beams 10 extend along the

respective lanes and incorporate a longitudinal edge which opens out into those lanes. In this way, the lanes include pairs of racking beams which oppose one another and the pallets 500 or other stock units are placed between and supported by, those opposing racking beams.

As most clearly shown in FIG. 2, a feature of the racking system 100 is that the uprights 101 in each lane are spaced apart a distance which is significantly greater than the depth of a single pallet 500. In the present case, the spans between upright are approximately 2.4 m which equates to two pallet depths. The racking beams 10 are designed to accommodate these spans as will be discussed in more detail below. Such spans are significantly greater than conventional open style racking where the spacing between uprights 101 is arranged to be largely the same as the depth of a single pallet.

Turning to FIGS. 3 to 5, the racking beam 10 incorporates a bearing portion 12 having a bearing surface 13, which in its installed position, is generally horizontal. The bearing surface 13 has an inner or first longitudinal edge 14 that locates proximal the uprights and an outer or second longitudinal edge 15 that extends along the system lanes 102.

A guiding portion 16 is disposed along the inner longitudinal edge 14 of the bearing surface 13 and extends upwardly and outwardly from the bearing surface 13. This guiding portion comprises an inclined web 17 which functions to assist in guiding the pallet to locate properly on the bearing surface 13. The open angle of inclination of the guiding portion is generally no greater than 120° from a nominal plane of the bearing surface 13. More preferably the angle of inclination is no greater than 110° from the bearing surface plane. An inclination of 110° is generally sufficient to ensure that a pallet

accidentally placed on the guiding portion will, under its own weight, slide down to the bearing surface 13.

The guiding portion 16 further comprises an upper stiffening formation 18 that extends from the inclined web 17 to a terminal end 19 of the beam 10. The stiffening formation comprises a flange 20 and a lip 21 turned downwardly out of the plane of flange 20.

The racking beam 10 further comprises a stiffening portion 22 disposed along the outer longitudinal edge 15 of the bearing surface 13 and extending downwardly and inwardly therefrom. The stiffening portion 22 comprises an upper web 23 extending downwardly from the outer longitudinal edge 15 of the bearing surface 13, an inclined web 24 that extends inwardly and downwardly from the upper web 23, and a lower web 25 that extends downwardly from the inclined web 24. In this way, the lower web 25 is offset inwardly from the upper web by a distance (e).

The stiffening portion further comprises a lower stiffening formation 26 that extends from the lower web 25 to a terminal end 27 of the beam 10. The stiffening formation 26 comprises a flange 28 and a lip 29 turned upwardly out of the plane of the flange 28.

With this configuration, the racking beam 10 is channel-shaped with the terminal ends 19, 27 spaced apart. As best illustrated in FIG. 6 the racking beam is arranged to be disposed over brackets 51 which are secured to the uprights 101. These brackets which are of a cantilever-type are tapered towards their distal end 52 so as to locate snugly within the racking beam profile. In particular the distal end 52 of the bracket 51 locates adjacent the upper web 23, an upper surface 53 of the bracket locates under the bearing portion 12, whereas a lower surface 54 locates against the inner side of the

inclined web 24. Both the inclined web 24 and the lower surface 54 of the bracket include fastener receiving formations, which in the illustrated form comprise apertures (30 and 55 respectively). These apertures are arranged to receive fasteners (not shown) to secure the racking beam 10 to the respective brackets. The location of the fasteners is convenient, in that it provides easy access for an installer yet locates the fastener in a position where they are unlikely to cause a catch point. Further, the apertures 30 are spaced along the inclined web 24 so as to facilitate the aligning of the beam apertures 30 with the bracket apertures 55, when those brackets are fixed to the uprights 101.

By manipulating the length of the inclined web 24, significant changes can occur to both the centre of shear S as well as to the orientation (θ) of the principal axes. These findings are reflected in the graphs shown in FIGS. 8 and 9 which are derived from an analysis of five profiles (A-E) schematically illustrated in FIG. 7. These profiles differ in the length of the inclined web 24 with the graphs in FIGS. 8 and 9 representing this as a normalised offset (being the offset e, which is the lateral displacement of the upper web 23 to the lower web 25, compared to the width of the bearing surface b from the inner 14 to the outer longitudinal edge 15). In FIG. 8 the orientation (θ) of the principal bending axes is graphed against the normalised offset (e/b). In FIG. 9, the position of the shear centre S is graphed against this normalised offset. Fig. 10 illustrates the resulting profiles A to E, showing the calculated position of the shear centre S and the orientation Θ of the principal bending axes for each profile.

In general, the inventors have realised that there are advantages in orientating the principal bending axis x of the racking beam so that it is within 20° of the

horizontal. The advantage of this alignment is that vertical loading from a pallet 500 or other stock unit upon the racking beam 10 will induce vertical deflections of the racking beam 10 without resulting in any significant concomitant lateral deflections. The closer the principal axis x is to the horizontal, the less lateral deflection would occur. Reducing the lateral deflection allows the racking beam 10 to be capable of greater span than is available when vertical loading induces lateral deflection. In the illustrated form, a nominal plane of the bearing surface 13 is arranged to extend horizontally when it is installed. As such the plane of the bearing surface can be used as the reference plane for the axes.

In addition, to limit twist in the racking beam, the shear centre S also needs to be taken into account. The inventors have found that to ensure good structural performance, the shear centre S should be located close to the resultant of the load acting on the bearing surface 13. This resultant is typically near the longitudinal edge 15 and as such it is beneficial if the shear centre is positioned so as to be laterally displaced from the longitudinal edge 15 within the range of +30% to -10% of the width of the bearing surface.

From the graphs of FIGS. 8 to 10, it can be seen only profiles C, D and E fall within 20° of the bearing surface whereas profile A (where there is no offset) is over 40° and profile B (where there is only minimal offset) is over 30°. Further, it is clear that the offset produces a significant change in the shear centre with profiles A and B having a shear centre that is displaced outwardly of the longitudinal edge 15 (by an amount of 15mm and 4mm respectively), and profiles C, D and E having a shear centre that is displaced inwardly of the longitudinal edge (by 4mm, 9mm and 13mm respectively).

The width b of the bearing surface is typically in the range of 70mm - 100mm. Therefore, the lateral displacement of the shear centre S from the longitudinal edge 15 for the profiles A to E is such that profile A falls outside the above-mentioned range of +30% to -10% for all bearing surface widths between 70mm - 100mm, whereas the profiles B to E fall within this range.

As far as structural performance is concerned, the most optimal design of the five profiles is profile D. As can be seen from calculations conducted by the inventors, the principal axes are aligned so that the axis x is parallel to the bearing surface 13 whereas the shear centre S is located just inward from the upper web 23. Nevertheless, profiles C and E may also perform adequately under load. In addition to the structural performance, the incorporation of the inclined web 24 provides a convenient location to fix the beam to its support brackets. In this regard, the longer webs of profiles D and E are better suited for this role.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

It is to be appreciated that various alterations and/or additions may be made to the racking beam previously described without departing from the spirit or ambit of the present invention.

CLAIMS:

1. A racking beam for an open faced racking system, the beam comprising:

a bearing portion that incorporates a bearing surface;

a guiding portion that is disposed along a first longitudinal edge of the bearing portion and extends upwardly from the bearing surface; and

a stiffening portion disposed along a second longitudinal edge of the bearing portion and extending downwardly and inwardly therefrom by an amount sufficient to cause a principal axis of bending of the beam to be oriented within 20° relative to a nominal plane of the bearing surface and the shear centre of the beam is positioned so as to be laterally displaced from the second longitudinal edge within the range of +30% to -10% of the width of the bearing surface extending between the first and second longitudinal edges.

2. A racking beam according to claim 1, wherein the beam is formed from sheet metal.

3. A racking beam according to claim 2, wherein the sheet metal is sheet steel having a thickness of between 1.5 and 3 mm.

4. A racking beam according to any preceding claim, wherein a nominal plane of the bearing surface is disposed generally in the horizontal plane when the beam is in its installed position.

5. A racking beam according to any preceding claim wherein the stiffening portion comprises an upper web, a lower web, and an inclined web disposed between the upper and lower webs, the inclined web extending downwardly and inwardly so that said lower web is offset inwardly from the upper web.

6. A racking beam according to claim 5, wherein the offset of the lower web from the upper web is in the range of 60-120% of the width of the bearing surfaces extending between the first and second longitudinal edges.

7. A racking beam according to claim 6, wherein the offset of the lower web from the upper web is in the range of 75-100% of the width of the bearing surface.

8. A racking beam for an open faced racking system, the beam comprising: a bearing portion that incorporates a bearing surface; a guiding portion that is disposed along a first longitudinal edge of the bearing portion and extends upwardly from the bearing surface; and a stiffening portion disposed along a second longitudinal edge of the bearing portion, the stiffening portion incorporating an upper web and a lower web and an inclined web disposed between the upper and lower webs, the inclined web extending downwardly and inwardly so that said lower web is offset inwardly from the upper web by an amount in the range of 60-120% of the width of the bearing surface extending between the first and second longitudinal edges.

9. A racking beam according to any one of claims 5-8, wherein the inclined web is inclined from a nominal plane of the bearing surface by an amount greater than 15°.

10. A racking beam according to any one of claims 6 to 9, wherein the inclined web further comprises fastener receiving formations arranged to receive fasteners to secure the beam to one or more supporting brackets.

11. A racking beam for an open faced racking system comprising: a bearing portion that comprises a bearing surface; a guiding portion that is disposed along a first longitudinal edge of the bearing portion and extending upwardly from the bearing surface; and a stiffening portion disposed along a second longitudinal edge of the bearing portion, the stiffening portion comprising an upper web that extends downwardly from the bearing surface, and an inclined web that extends downwardly and inwardly so that a lower portion of the inclined web is offset inwardly from the upper web, the inclined web further comprising fastener receiving formations arranged to receive fasteners to secure the beam to supporting brackets.

12. A racking beam according to either claim 10 or 11, wherein the fastener receiving formations are in the form of apertures operative to receive respective fasteners to secure the beam to supporting brackets.

13. A racking beam according to claim 11, wherein the beam further comprises a lower web which extends downwardly from a lower portion of the inclined web.

14. A racking beam according to any one of the claims 6 to 10, wherein the stiffening portion further comprises a lower stiffening formation disposed along a lower distal margin of the beam.

15. A racking beam according to claim 14, wherein the lower stiffening formation comprises a flange that projects inwardly from the lower web and a lip return that extends from the flange to a lower terminal end of the beam.

16. A racking beam according to any preceding claim wherein the guiding portion includes an upper stiffening formation disposed along a distal margin of the guiding portion and a web disposed between the stiffening formation and the bearing portion.

17. A racking beam according to claim 16, wherein the upper stiffening formation incorporates a flange that extends from the guiding portion web and a lip return that extends from the flange to an upper terminal end of the beam.

18. A racking beam according to either claim 16 or 17, wherein the guiding portion web is inclined to a nominal plane of the bearing surface by an angle of between 90-120°.

19. A racking beam assembly comprising a racking beam according to any one of claims 10 to 12, and a support bracket, the beam being of generally channel shape and the bracket being locatable within the beam channel, the support bracket incorporating a fastening surface

locatable behind the inclined web and wherein in use the beam is securable to the support bracket by one or more fasteners that extend through the inclined web and the fastening surface.

20. An open faced racking system incorporating one or more racking beams according to any one of claims 1 to 18.

21. A racking system according to claim 20, wherein the racking beams are supported along their length by uprights spaced apart possibly unequally, such that substantial bending is induced in the beams under normal design loadings.

22. An open faced racking system incorporating one or more racking beam assemblies according to claim 19.

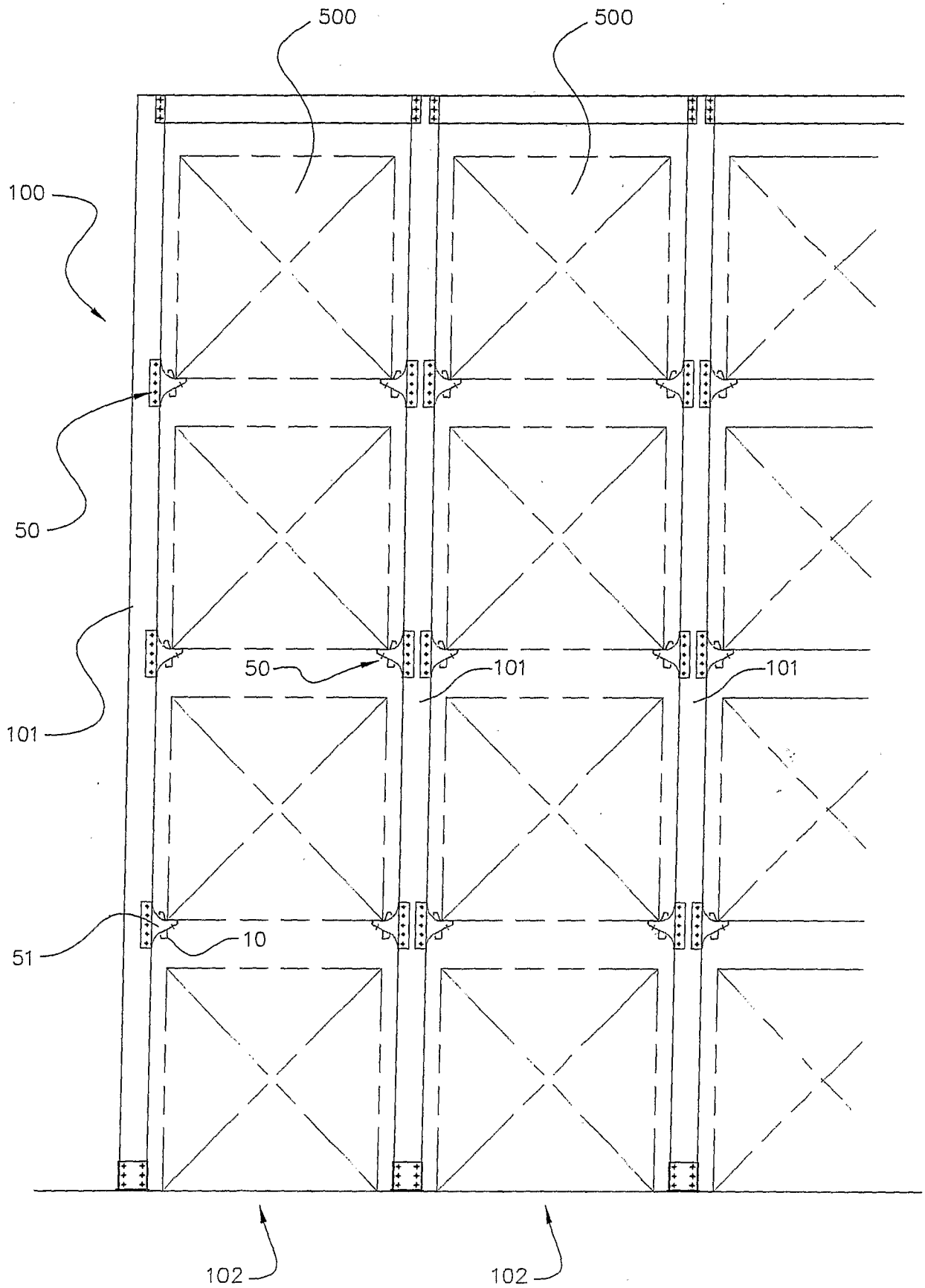


FIG 1

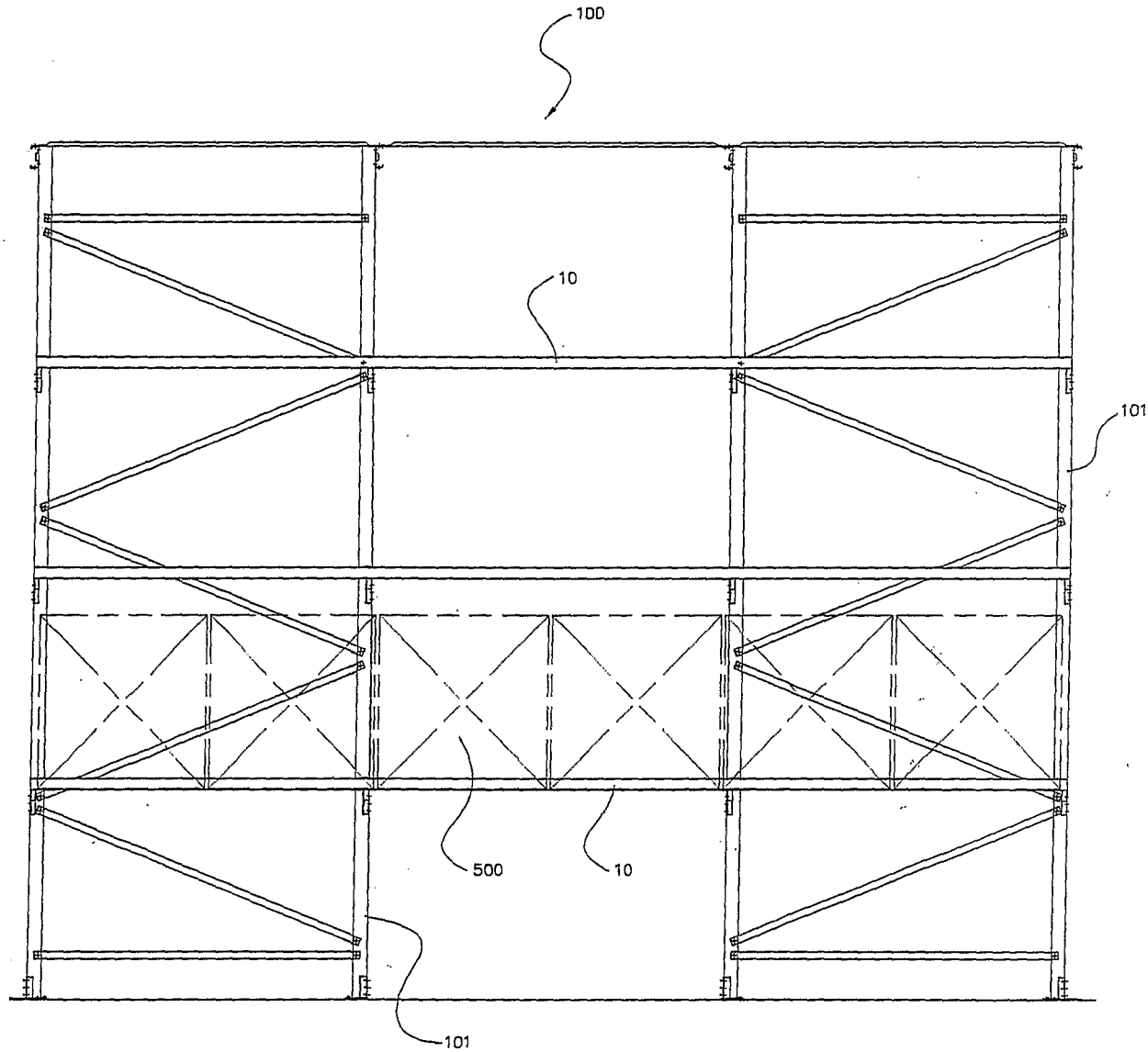


FIG 2

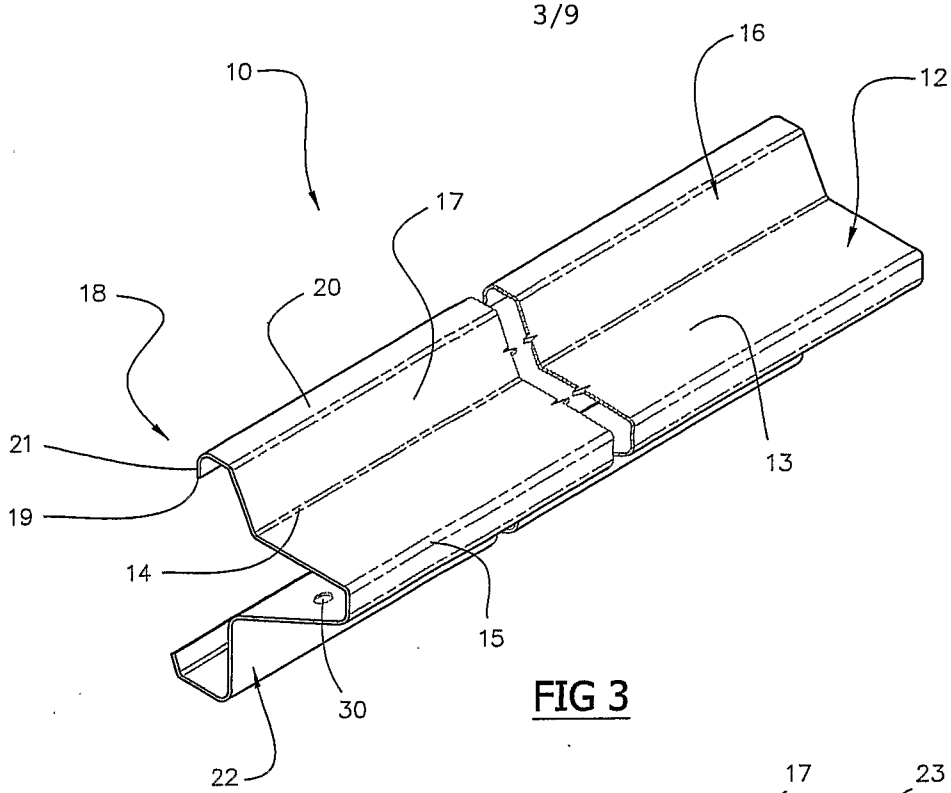

10
16
12
17
18
20
21
19
13
14
15
30
22

FIG 3

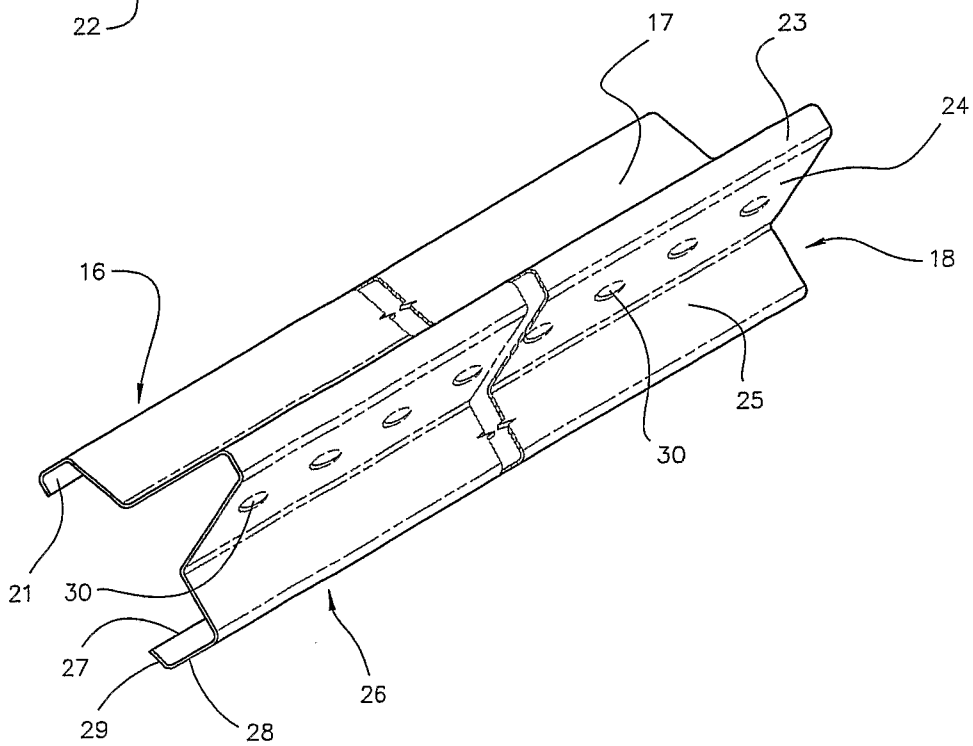

17
23
24
18
16
25
30
21
30
27
29
28
26

FIG 4

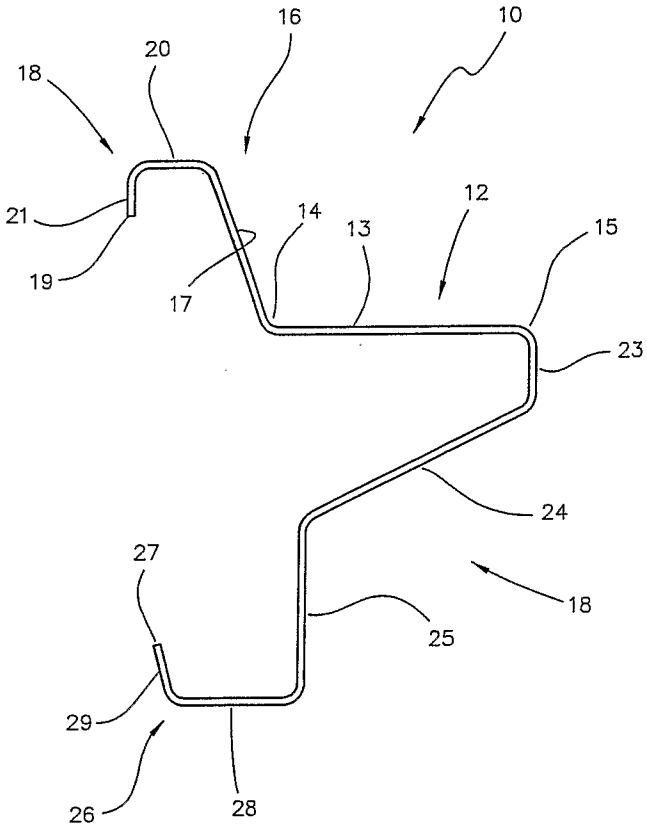


FIG 5

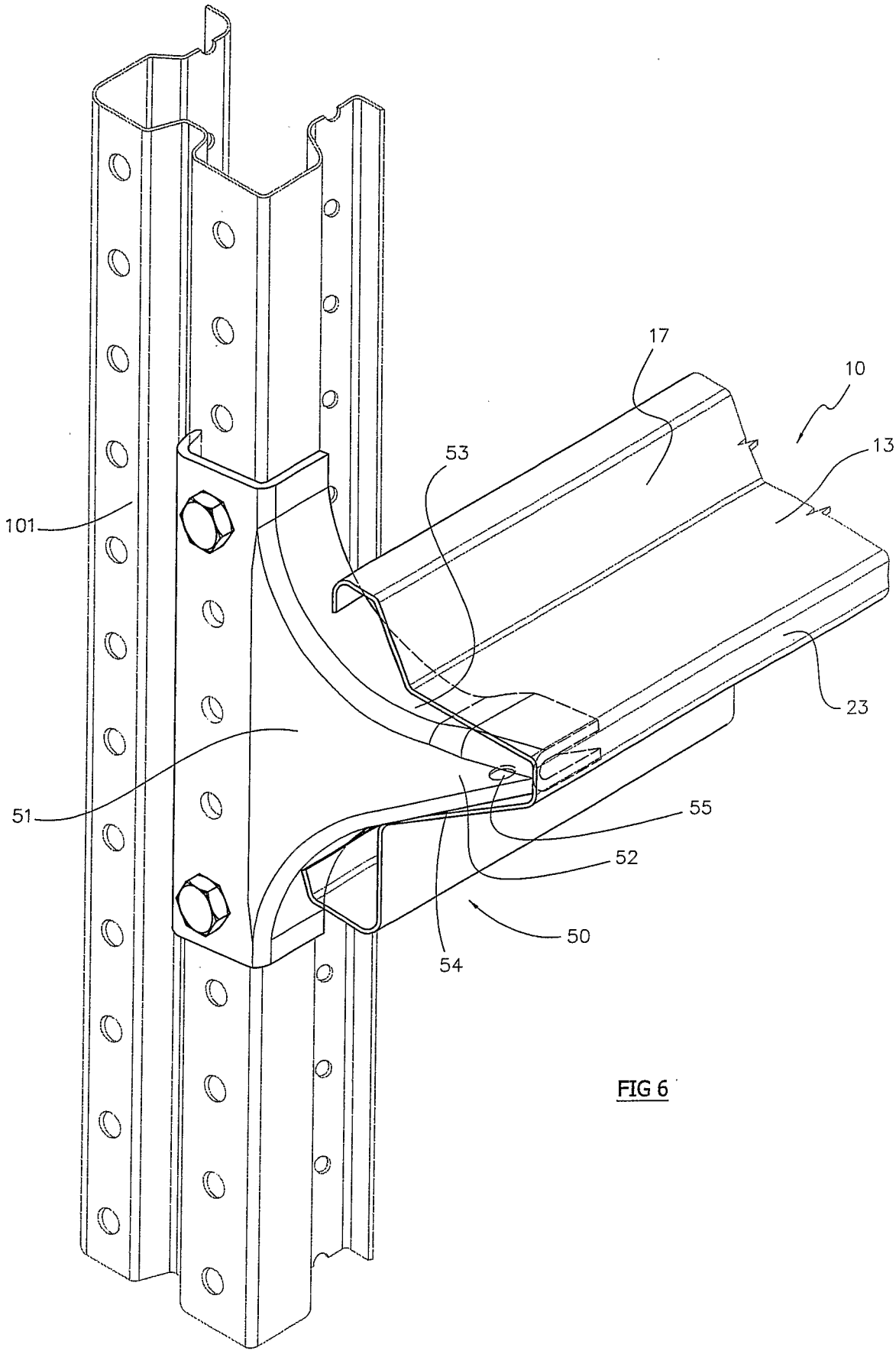


FIG 6

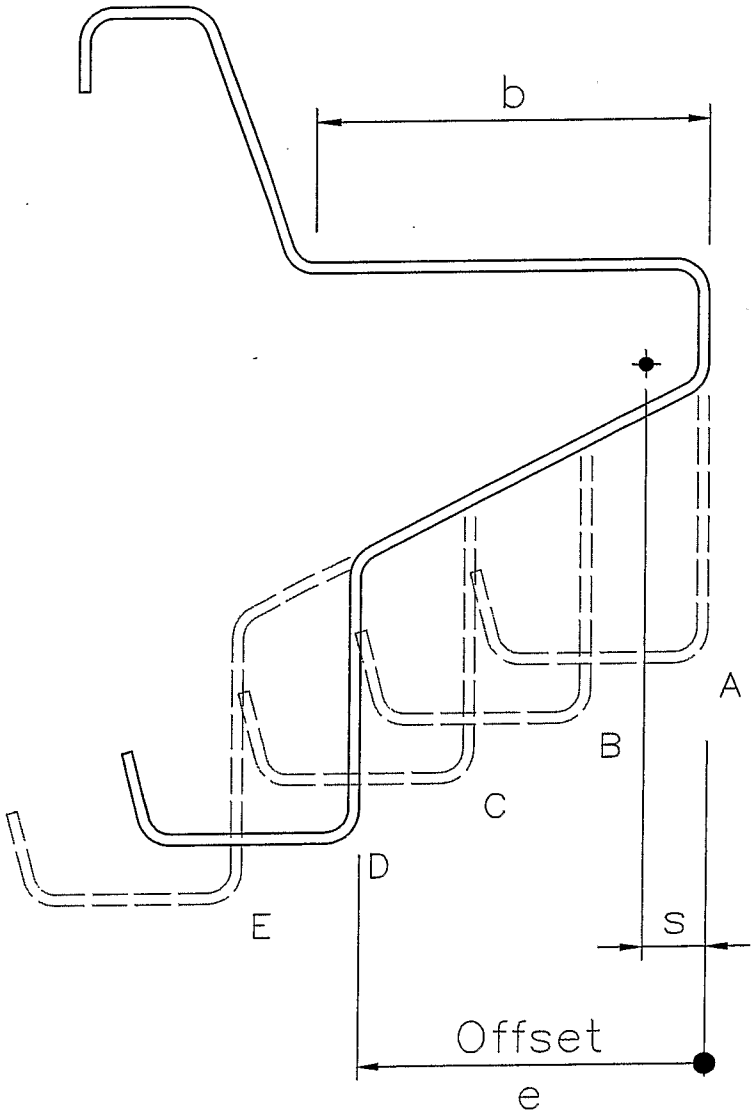


FIG 7

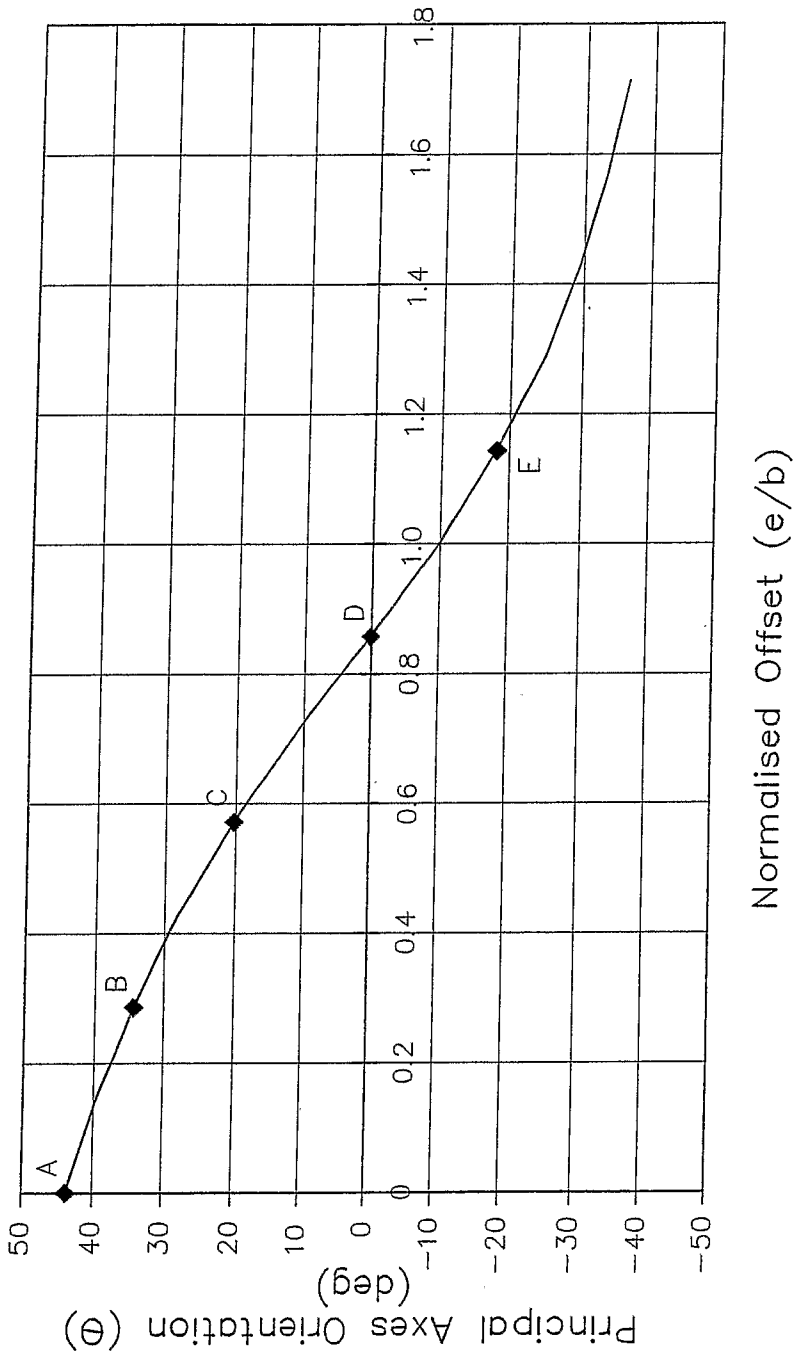

Principal Axes Orientation (Θ)
(deg)
50
40
30
20
10
0
-10
-20
-30
-40
-50
A
B
C
D
E
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Normalised Offset (e/b)

FIG 8

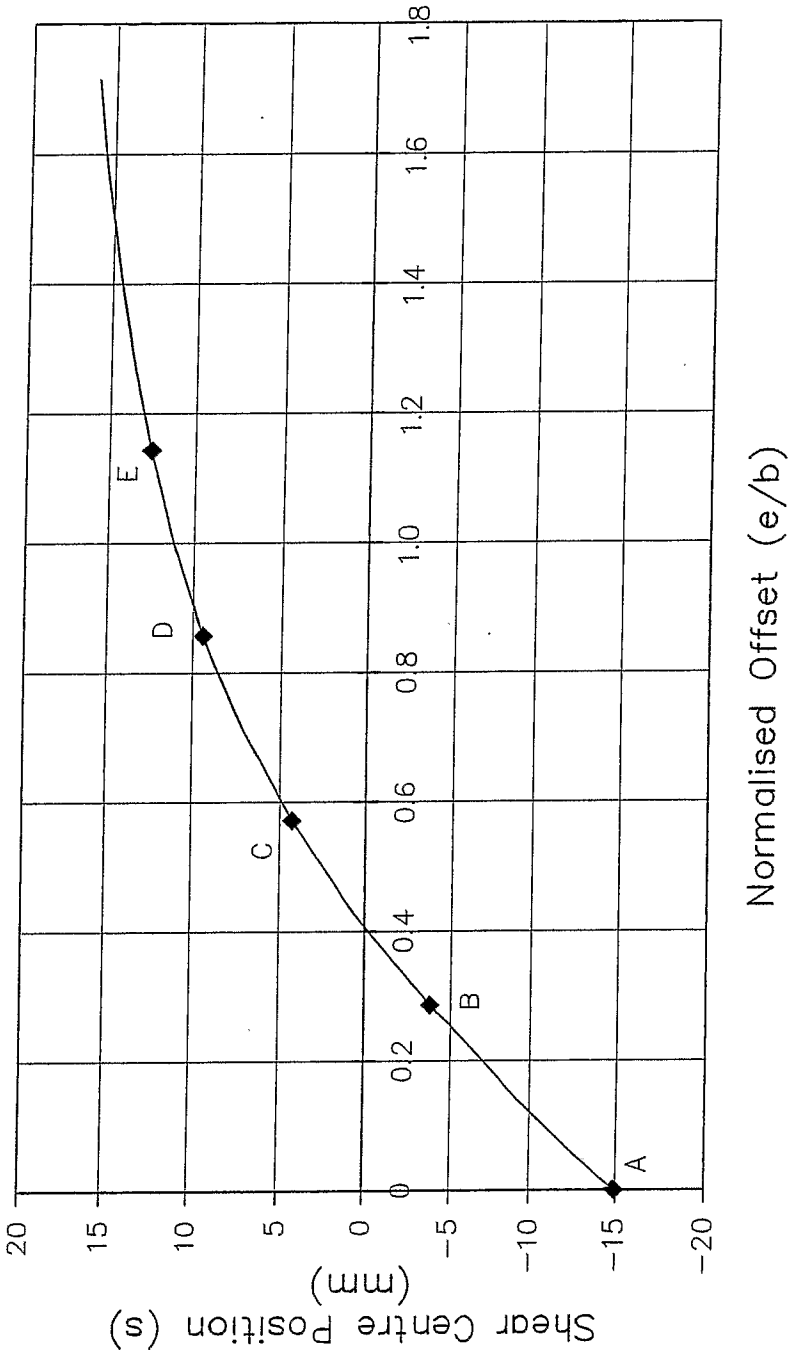
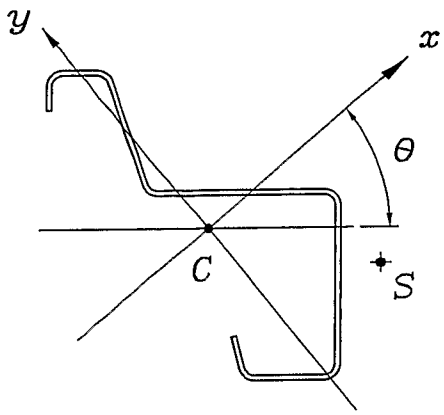
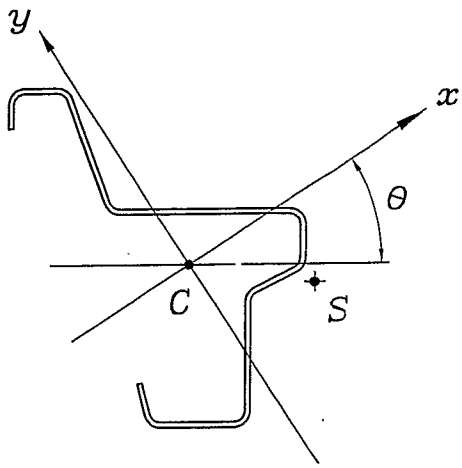

Shear Centre Position (s)
(mm)
20
15
10
5
0
−5
−10
−15
−20
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Normalised Offset (e/b)
A
B
C
D
E

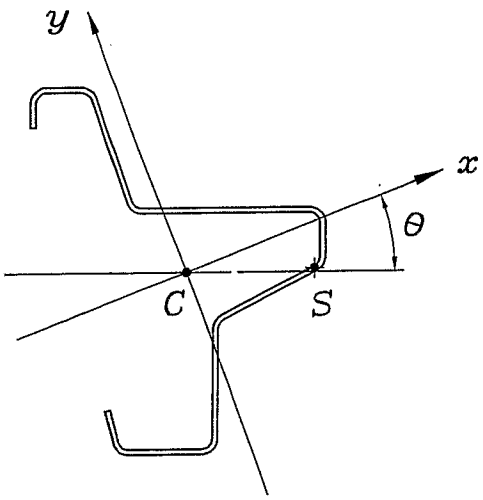
FIG 9



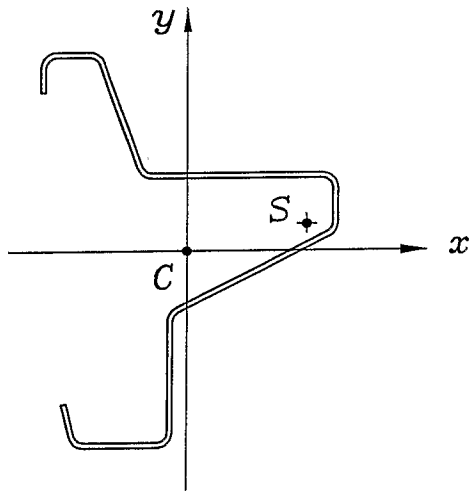
PROFILE A



PROFILE B

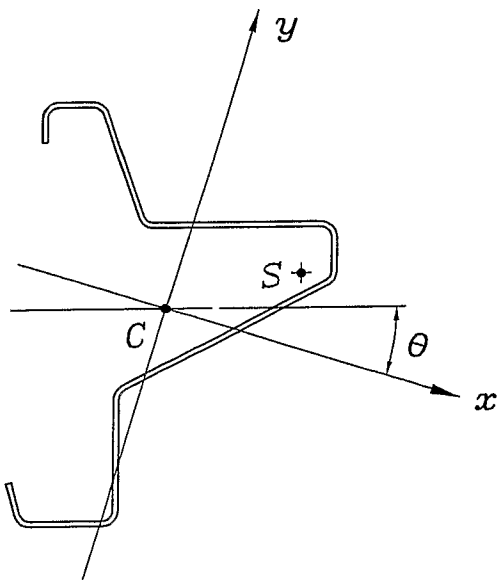


PROFILE C



PROFILE D

(OPTIMUM DESIGN)



PROFILE E

FIG 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/000720

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

A47B 96/02 (2006.01) *A47B 47/00* (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI, B65G 1/02, 1/04 A47B 96/02, 96/00, 47/00, 55/00, 57/00 key words BEAM+, BAR+, STIFF+, RIGID+, FLEX+, BEND+, DEFLECT+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5316157 A (KONSTANT) 31 May 1994 Whole document	1-22
A	US 5350074 A (ROSENBAND) 27 September 1994 Whole document	1-22
A	EP 1222880 B (RUBBERMAID INC) 25 August 2004 Whole document	1-22

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 June 2007	29 JUN 2007
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **SARAVANAMUTHU PONNAMPALAM** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6283 2070

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2007/000720

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5316157	NONE					
US	5350074	NONE					
EP	1222880	BR	0200043	CA	2367176	JP	2002209643
		MX	PA02000292	US	6820757	US	2002092818

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX