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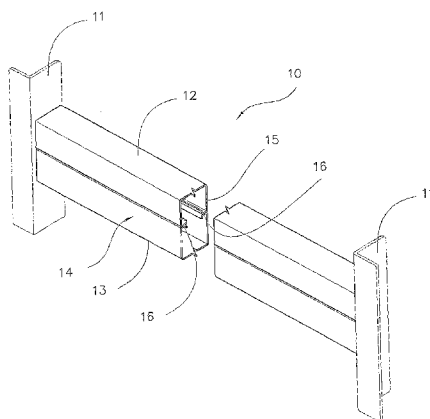
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(54) Title: A STORAGE RACK BEAM



(57) Abstract: A storage rack beam (10) includes top (12) and bottom (13) flanges and at least one web (14) that interconnects the flanges (12, 13). The web (14) includes at least one stiffening formation (16) arranged to stiffen an intermediate region of the web (14) along at least a substantial portion of its length so as to resist lateral loading applied to the beam (10). The beam (10) may taken various forms, including first and second U-shaped sections in opposed abutting relationship, or formed as a closed S-shaped profile. The application also discloses a storage rack beam that has a vertical loading capacity and a horizontal loading capacity, wherein at least part of the horizontal loading capacity is independent of the vertical loading capacity applied to the beam.

WO 2007/016735 A1

A STORAGE RACK BEAM

FIELD OF THE INVENTION

5 The present invention relates generally to storage racking systems and more particularly to racking beams used in such systems.

BACKGROUND OF THE INVENTION

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Storage racking systems are widely used in warehousing and other industrial facilities. These systems typically include multiple levels of metal racking beams arranged to support cartons or pallets and which are supported by vertical load bearing members commonly referred to as uprights. These uprights are typically made from a profiled steel section and metal bracing is provided which extends between adjacent uprights.

20

The racks are usually arranged in straight rows with aisles formed between those rows that allow access to the stock. To make the most efficient use of the available space, these aisles are made as narrow as possible. As such, there is an ongoing risk of damage to the racking system from handling equipment such as forklifts or the like in view of the confined spaces in which the handling equipment operate.

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SUMMARY OF THE INVENTION

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In a first aspect, the present invention provides a racking beam comprising top and bottom flanges, at least one web interconnecting the flanges, and at least one

- 2 -

stiffening formation arranged to stiffen an intermediate region of the at least one web along at least a substantial portion of its length so as to resist lateral loading applied to the racking beam.

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In accordance with this aspect of the invention, a racking beam is provided which has enhanced lateral loading capacity. This capacity is ideally suited to resist frontal impact on the racking beams which would otherwise cause beam damage. Whilst such frontal impact may not compromise the safety of a beam, a damaged appearance to the beam looks both unsightly and often causes concern amongst operators and managers.

15 Racking beams are susceptible to lateral impact typically by damage from forklifts or the like operating in the confined spaces provided in the aisles or by stocking procedures where operators use the racking beam to assist in locating the stock in place, typically by
20 lowering a pallet onto the beam prematurely and then pushing the load until the bottom front board of the pallet hits the beam.

The at least one stiffening formation is located in
25 an intermediate region of the web. This has particular advantages as it not only stiffens a region of the racking beam which is most susceptible to failure under lateral load, but moreover it provides a condition where part of the capacity of the beam to resist lateral loading is
30 independent of the vertical loading applied to the beam.

In a further aspect, the invention relates to a racking beam that has a vertical loading capacity and a

- 3 -

horizontal loading capacity, wherein at least part of the horizontal loading capacity is independent of the vertical loading capacity applied to the beam.

- 5 In one form, at least 20% of the horizontal loading capacity is independent of the vertical loading capacity.

 In one form, the racking beam is formed as a hollow section, having two spaced apart webs interconnecting the
10 flanges. In this form, the at least one stiffening formation is arranged to stiffen at least one of the webs. In use, these webs typically form the front and back faces of the racking beam. In an arrangement where only one of the webs include a stiffening formation, typically the
15 stiffening formation is formed on the front web.

 In a particular form, one or more stiffening formations is arranged to stiffen both the webs.

- 20 In one form, the racking beam is formed from first and second members that are disposed one on top of the other and are joined together. In a particular form, the at least one web of the racking beam comprises a first part formed from the first member and a second part formed
25 from the second member and wherein the at least one stiffening formation is formed at the joint between the first and second members.

 In a particular form, the two members are joined by
30 one or more conventional stitch welds or a continuous laser weld.

- 4 -

In one form, the racking beam is formed from first and second U shaped sections, each section having a flange, first and second webs projecting from the flange, inwardly extending lips at the distal end of the
5 respective webs, and a lip return disposed at a distal end of the lips. With this configuration, the two U shaped sections are in opposed abutting relationship with the flanges of the sections forming respectively the top and bottom flanges of the racking beam and respective ones of
10 the webs of the sections being aligned so as to form the first and second webs of the beam.

With this arrangement, the lips of the webs of the respective sections form respective stiffening formations
15 of the racking beam which are disposed intermediate the top and bottom flanges.

In another form, the at least one stiffening formation is in the form of a diaphragm which connects the
20 spaced apart webs.

In one form, the racking beam is formed from a rectangular or square hollow section and a U section as described above. In this form the respective lips of the
25 U section are disposed in abutment with one side of the hollow section, which side forms the diaphragm of the racking beam.

In another form, the racking beam is formed from
30 sheet material which is configured generally as a closed S shape which thereby forms two generally square or rectangular hollow sections that share a common wall that in turn forms the diaphragm of the racking beam.

- 5 -

In yet a further form, the at least one stiffening formation is in the form of a dimple or rib of sufficient depth in the web to provide adequate stiffening.

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In general, the at least one stiffening formation may be continuous along at least a substantial portion of the length of the beam, or may be formed from a plurality of shorter lengths that function in a similar manner as a continuous stiffening formation.

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In general, the racking beam according to embodiments of the invention allows for stiffening of one or more webs in the beam. Typically this stiffening may be positioned anywhere in an intermediate region of the web, from 20% of the depth down to 80% to the depth, but is preferably located just above the neutral axis at approximately 40-45% of the depth.

15

In a particular form, the stiffness is sufficient so that the web does not suffer from local buckling, but instead is able to realise the full yield capacity of the material. At a particular level of stiffness depending on the dimensions of the web, the web will change from behaving as a single plate element supported by the top and bottom flanges, to behaving as two separate plate elements both supported by the stiffening formation and one of the flanges. In this latter case, since the buckling half wave length decreases in direct proportion to the reduced width of each plate element, namely by a factor of two, the buckling strength of the total plate assembly will increase by a factor of approximately four, and generally yielding rather than buckling will become

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- 6 -

the determining factor. Rather than an abrupt change in behaviour, this transition may occur more gradually, as the effectiveness of the stiffening formation increases, and produce an intermediate partially stiffened buckling response.

A further advantage of adding the stiffening formation near the neutral axis of the beam, is that the stiffener is relatively unstressed due to vertical load and is thus able to fully contribute to the horizontal resistance of the beam, irrespective of the level of vertical loading.

The beam is typically made from metal such as aluminium, titanium, stainless steel or normal steel. Stainless steel may find niche applications in clean room or pharmaceutical environments but the most common commercial use is typically normal steel. Whilst titanium could be used it is anticipated to have limited application because of the expense of the metal. The beam is ideally suited for thinner materials and typically the gauge of the metal is from between 1.2 mm to 2.5 mm. In addition to using metals, the beam could be applied to a range of other materials such as plastics or composites.

In one form the beam is formed from sheet metal which may be roll formed into its final shape. If the beam is formed from metal such as aluminium or plastic, the beam may be formed using an extrusion process instead of a roll forming process.

As will be appreciated, frontal impact as indicated above, often occurs when the beams are already heavily

- 7 -

loaded with pallets and that the applied horizontal loading may have a dynamic opponent. The racking beam according to embodiments of the invention is able to cater for the combined vertical and horizontal load conditions as well as the potential for localised damage from dynamic point loading.

BRIEF DESCRIPTION OF THE DRAWINGS

It is convenient to hereinafter describe embodiments of the present invention with reference to the accompanying drawings. It is to be appreciated however that the particularity of the drawings and the related description is to be understood as not limiting the preceding broad description of the invention.

In the drawings:

Fig. 1 is a front schematic view of a storage racking system;

Fig. 2 is an isometric view of a first embodiment of a racking beam for use in the racking system of Fig. 1;

Fig. 3 is an elevation view of the racking beam of Fig. 2;

Fig. 4 is a plan view of the racking beam of Fig. 2;

Fig. 5 is a sectional view of along the section line A of Fig. 3;

Fig. 6 is an isometric view of a second embodiment of racking beam for the racking system of Fig. 1;

Fig. 7 is a cross sectional view of the racking beam of Fig. 6;

Fig. 8 is an isometric view of the third embodiment of a racking beam for the racking system of Fig. 1;

- 8 -

Fig. 9 is a cross sectional view of the racking beam of Fig. 8.

Fig. 10 is an interaction graph illustrating horizontal and vertical loading capacity for 1.6mm thickness beams;

Fig. 11 is an interaction graph illustrating horizontal and vertical loading for 2.0mm thickness beams; and

Fig. 12 is a graph of horizontal deformation and the reciprocal of available moment capacity for various beams.

DETAILED DESCRIPTION OF EMBODIMENTS

Fig. 1 illustrates a storage racking system 100 that includes multiple levels 101, 102 of metal racking beams 10 which support cartons or pallets 103 that are supported by vertical members 104 that are commonly referred to as uprights. These uprights are typically made from a profiled steel section and metal bracing (not shown) is provided which extends between adjacent uprights 104. The metal racking beams 10 include connectors 11 at opposite ends which connect the beams to the adjacent uprights 104.

A first embodiment of the racking beam 10 is disclosed with reference to Figs. 2 to 5. The beam comprises top and bottom flanges (12 and 13) which are interconnected by webs 14, 15. The racking beam is generally rectangular in cross section and further incorporates stiffening formations 16 which are disposed in an intermediate region of respective ones of the webs 14, 15. These stiffening formations are designed to stiffen the intermediate region of the webs 14, 15 along its length so as to improve the beam's resistance to

- 9 -

lateral loading applied to the racking beam 10. Such lateral loading may be caused by frontal impact of the racking beams from forklifts or the like operating in the confined spaces provided in the aisles of the storage racks 100.

In the illustrated form, the beam is made from steel strip having a gauge of between 1.2 mm to 2.5 mm. However, it is to be appreciated that beam 10 may be made from other metal such as aluminium, titanium or stainless steel which may be formed from strip which is roll formed or could be formed using an extrusion process. The beam also could be made from other non-metallic materials such as plastic or composite structures.

15

As best illustrated in Fig. 5, the racking beam 10 is formed from first and second U shaped members 20, 21. These members 20, 21 are disposed one on top of the other in opposing relationship with the bottom member 21 being equal to or slightly larger than the top member 20.

20

Each member 20, 21 includes a flange 22, 23 and webs 24, 25, 26 and 27 which project from the respective flanges 22, 23. The members 20, 21 also include inwardly directed lips 28, 29, 30 and 31 disposed at the distal end of the respective webs and lip returns 32, 33, 34 and 35 which extend from the respective lips.

25

The members 20, 21 are joined so that respective ones of the lips 28, 29, 30 and 31 are in abutting relationship. The members are typically welded together along this joint by either conventional stitch welding or a continuous laser welding process.

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- 10 -

Through this construction, the stiffening formations 16 are formed by the interconnecting lips and lip returns. Furthermore, in the embodiment shown the respective webs 14 and 15 of the racking beam are formed by the respective webs 24, 25, 26 and 27 of the members 20, 21.

Figs. 6 and 7 illustrate a second embodiment 40 of the racking beam. The racking beam 40 includes many of the features of the first racking beam and like features have been given like reference numerals.

In a construction which is similar to the earlier embodiment the racking beam 40 is formed from first and second members 41 and 42 which are disposed one on top of the other. Further, the bottom member is a U shaped member as in the racking beam 10. However, in contrast to the earlier embodiment, the top member is in the form of a square or rectangular hollow section and the stiffening formation 16 is in the form of a diaphragm 43 which extends across an intermediate region of the racking beam 40 thereby interconnecting the opposite beam webs 14, 15.

Figs. 8 and 9 illustrate yet a further form of racking beam 50. The racking beam 50 incorporates many of the features of the earlier embodiments and like reference numerals have been given to like features.

In the embodiment shown in Figs. 8 and 9 the configuration of the racking beam 50 is similar to that shown in Figs. 6 and 7 with the stiffening formation 16 incorporating a diaphragm 51 that extends between the opposite webs 14 and 15 at an intermediate portion of

- 11 -

those webs. However in the racking beam 50, the beam is not constructed from two sections but rather is formed from a single metal sheet which is folded into a closed S shape. As best illustrated in Fig. 9, the sheet from which the racking beam 50 is formed incorporates opposite longitudinal edge margins 52 and 53 which are folded over so as to abut an intermediate region of the sheet which forms the diaphragm 51. Typically these edge margins 52 and 53 are joined to the intermediate region 51 by means of a continuous laser or a conventional stitch welding process.

An advantage of the racking beams 10, 40 or 50 is that they have improved capacity to resist the lateral impact which may occur from forklifts or the like operating in the confined spaces. Further, the stiffening formations 16, in their various forms, are located in an intermediate region in the web. This has particular advantage as it not only stiffens a region of the racking beam which is most susceptible to failure under lateral load, but moreover it provides a condition where a significant part of the capacity of the beam to resist lateral loading is largely independent of the vertical loading applied to the beam.

25

Typically under static loading behaviour, the bending due to vertical load on the racking beam causes a linear stress gradient from compression in the top flange 12 through zero stress at the neutral axis to tension in the bottom flange 13. If the beam is heavily loaded, both the top and bottom flanges may be fully stressed due to the vertical load and may not have any excess capacity to contribute to the beam's resistance of horizontal loads.

- 12 -

Under horizontal loading, such as by lateral impact, the bending due to horizontal load causes a linear stress gradient from compression in say the front face i.e. web 14 through zero stress at the neutral axis to tension in the rear face 15. If the beam is already carrying heavy vertical loads, the horizontal resistance may need to derive primarily from the webs 14 and 15. In prior art arrangements, these webs were not stiffened and as such these webs behave as a long plate element under axial compression supported by its edges, for which the typical failure mode is local buckling with a half wave length similar to the width of the plate element.

By incorporating the stiffening formations 16 in the webs, the webs may change from behaving as a single plate element supported by the top and bottom flanges of the beam, to behaving as two separate plate elements, both supported by the central stiffener and one of the flanges. In this latter case, since the buckling half wave length decreases in direct proportion to the reduced width of each plate element, namely by a factor of two, the buckling strength of the total plate assembly will increase by a factor of approximately four, and yielding rather than buckling will become the determining factor. A further benefit of adding the stiffener near the neutral axis of the beam is that the material is relatively unstressed due to vertical load and is thus able to fully contribute to the horizontal resistance of the beam, irrespective of the level of vertical loading.

Figs. 10 and 11 are interaction graphs illustrating the relationship between the vertical loading capacity and

- 13 -

horizontal loading capacity of beams according to the above embodiment (the "S" and "UU" type beams as compared to a RHS).

5 Fig. 10 illustrates loading capacity for beams having 1.6mm thickness whereas the graph in Fig. 11 is for a 2mm case.

10 In these graphs the vertical axis represents the vertical loading whereas the horizontal axis illustrates lateral or horizontal loading. In the case of the vertical axis, 100% of the vertical loading capacity is represented by 1.0. As will be appreciated from these graphs the incorporation of the stiffening formations
15 effectively increases the total horizontal loading capacity by 50% for the 1.6mm case, and 30% for the 2.0mm case. This is represented by a horizontal shift of the graph line along the horizontal axis.

20 As a result of this shift, for the case where the vertical beam is under 90% of loading, the "RHS" has only approximately 10% horizontal capacity whereas the "S" and "UU" beams have approximately 40% capacity in the 2.0mm case, and 60% capacity in the 1.6mm case. Furthermore, as
25 can be appreciated from these graphs there is a minimum horizontal loading capacity created in the "S" and "UU" beams which is independent of the vertical loading capacity.

30 Example

Background

In order to validate the biaxial bending behaviour presented in the interaction diagrams of Figs. 10 and 11,

- 14 -

frontal impact tests were conducted for two RHS beams and one UU beam.

Each beam of standard length 2590mm was loaded with the equivalent of 1000kg pallets, which equates to an applied vertical moment M_x at mid-span of 3.29kN.m. A pendulum weight was used to simulate the impact of a 3000kg forklift at 2km/h and the permanent horizontal deformation δ_y was measured.

10 Results

The horizontal and vertical bending capacities, M_{sx} and M_{sy} , of each beam were calculated using recognised methods of cold-formed steel design. These values, together with the applied vertical moment, were then applied to the appropriate interaction line from the biaxial bending diagram shown in Fig. 11, in order to determine the horizontal bending moment capacity M_y available to resist frontal impact. The results are summarised in the following table.

20

Beam type	M_{sx} (kN.m)	M_{sy} (kN.m)	M_x (kN.m)	M_y (kN.m)	δ_y (mm)
100x50x2.0 RHS	5.24	3.00	3.29	1.12	18
100x50x3.0 RHS	7.31	4.98	3.29	2.74	8
110x50x2.0 UU	6.73	4.87	3.29	3.04	6

It is to be expected that there would be an inverse relationship between the available horizontal bending moment capacity M_y and the permanent horizontal deformation δ_y , namely that the greater the moment resistance the lower the expected permanent deformation. Fig. 12 shows a graph of the permanent deformation plotted against the

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- 15 -

reciprocal of the available moment capacity, which indicates that there is an inverse relationship and therefore provides supporting evidence for the general concepts and theory presented.

5

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
10 "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.

15 Finally, it is to be appreciated that various alterations or additions may be made to the parts previously described without departing from the spirit or ambit of the present invention.

- 16 -

CLAIMS:

1. A racking beam comprising top and bottom flanges, at least one web interconnecting the flanges, and at least one stiffening formation arranged to stiffen an intermediate region of the at least one web along at least a substantial portion of its length so as to resist lateral loading applied to the racking beam.
2. A racking beam that has a vertical loading capacity and a horizontal loading capacity, wherein at least part of the horizontal loading capacity is independent of the vertical loading capacity applied to the beam.
3. A racking beam according to claim 2, wherein at least 20% of the horizontal loading capacity is independent of the vertical loading capacity loading applied to the beam.
4. A racking beam according to either claim 2 or 3, wherein the racking beam comprises top and bottom flanges, at least one web interconnecting the flanges, and at least one stiffening formation operative to stiffen an intermediate region of the at least one web along at least a substantial portion of its length.
5. A racking beam according to either claim 1 or 4, wherein the racking beam is formed as a hollow section having two spaced apart webs interconnecting the flanges, the at least one stiffening formation being arranged to stiffen at least one of the webs.

- 17 -

6. A racking beam according to claim 4, wherein the one or more stiffening formations is arranged to stiffen both the webs.

5 7. A racking beam according to claims 4 to 6, wherein the racking beam is formed from first and second members that are disposed one on top of the other and are joined together, the at least one web of the racking beam comprising a first part formed from the first member and a
10 second part formed from the second member, and wherein the at least one stiffening formation is formed at the joint between the first and second members.

8. A racking beam according to claim 7, wherein the two
15 members are joined by one or more conventional stitch welds or a continuous laser weld.

9. A racking beam according to either claim 7 or 8, wherein the first and second members are U sections, each
20 section having a flange, first and second webs projecting from the flange, inwardly extending lips at the distal end of the respective webs, and a lip return disposed at a distal end of the lips, and wherein the two U sections are in opposed abutting relationship with the flanges of the
25 sections forming respectively the top and bottom flanges of the racking beam, and respective ones of the webs of the sections being aligned so as to form the first and second webs of the beam.

30 10. A racking beam according to claim 9, wherein the lips of the webs of the respective sections form respective stiffening formations of the racking beam which are disposed intermediate the top and bottom flanges.

- 18 -

11. A racking beam according to any one of claims 5 to 8,
wherein the at least one stiffening formation is in the
form of a diaphragm which interconnects the spaced apart
5 webs.

12. A racking beam according to claim 11, when dependent
on claim 7, the first member is in the form of a
rectangular or square hollow section, and the second
10 member is in the form of a U section having a flange,
first and second webs projecting from the flange, inwardly
extending lips at the distal ends of the respective webs,
and a lip return disposed at a distal end of the lips,
wherein the respective lips of the U section are disposed
15 in abutment with one side of the hollow section, which
side forms the diaphragm of the racking beam.

13. A racking beam according to claim 11, wherein the
racking beam is configured generally as a closed S shape
20 having two generally square or rectangular hollow sections
that share a common wall, that common wall in turn forms
the diaphragm of the racking beam.

14. A racking beam according to any preceding claim, when
25 dependent on either claim 1 or 4, wherein the at least one
stiffening formation is in the form of a dimple or rib of
sufficient depth in the web to provide adequate
stiffening.

30 15. A racking beam according to any preceding claim, when
dependent on claim 1 or 4, wherein the at least one
stiffening formation is continuous along at least a
substantial portion of the length of the beam.

- 19 -

16. A racking beam according to any one of claims 1 to 14, when dependent on claim 1 or 4, wherein the stiffening formation is formed from a plurality of sections that
5 function in a similar manner as a continuous stiffening formation.

17. A racking beam according to any preceding claim, when dependent on claim 1 or 4, wherein the at least one
10 stiffening formation is positioned from 20% of the beam depth down to 80% of the depth of the web.

18. A racking beam according to claim 17, wherein the at least one stiffening formation is positioned approximately
15 40% to 45% of the beam depth.

19. A racking beam according to any preceding claim, when made from metal.

20. A racking beam according to claim 19, wherein the metal is steel.

21. A racking beam according to claim 20 wherein the gauge of the steel is between 1.2 mm to 2.5 mm.

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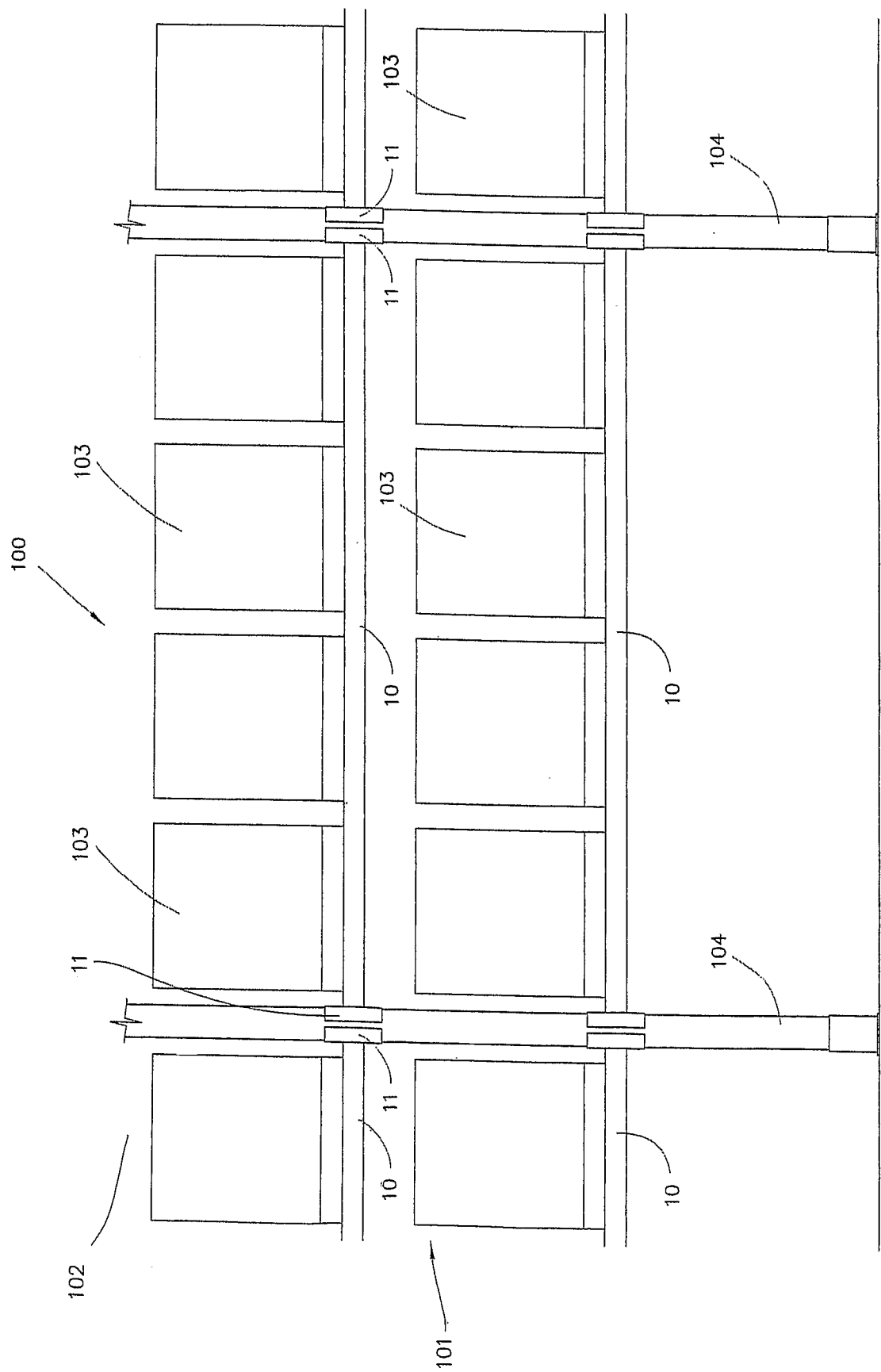


FIG. 1

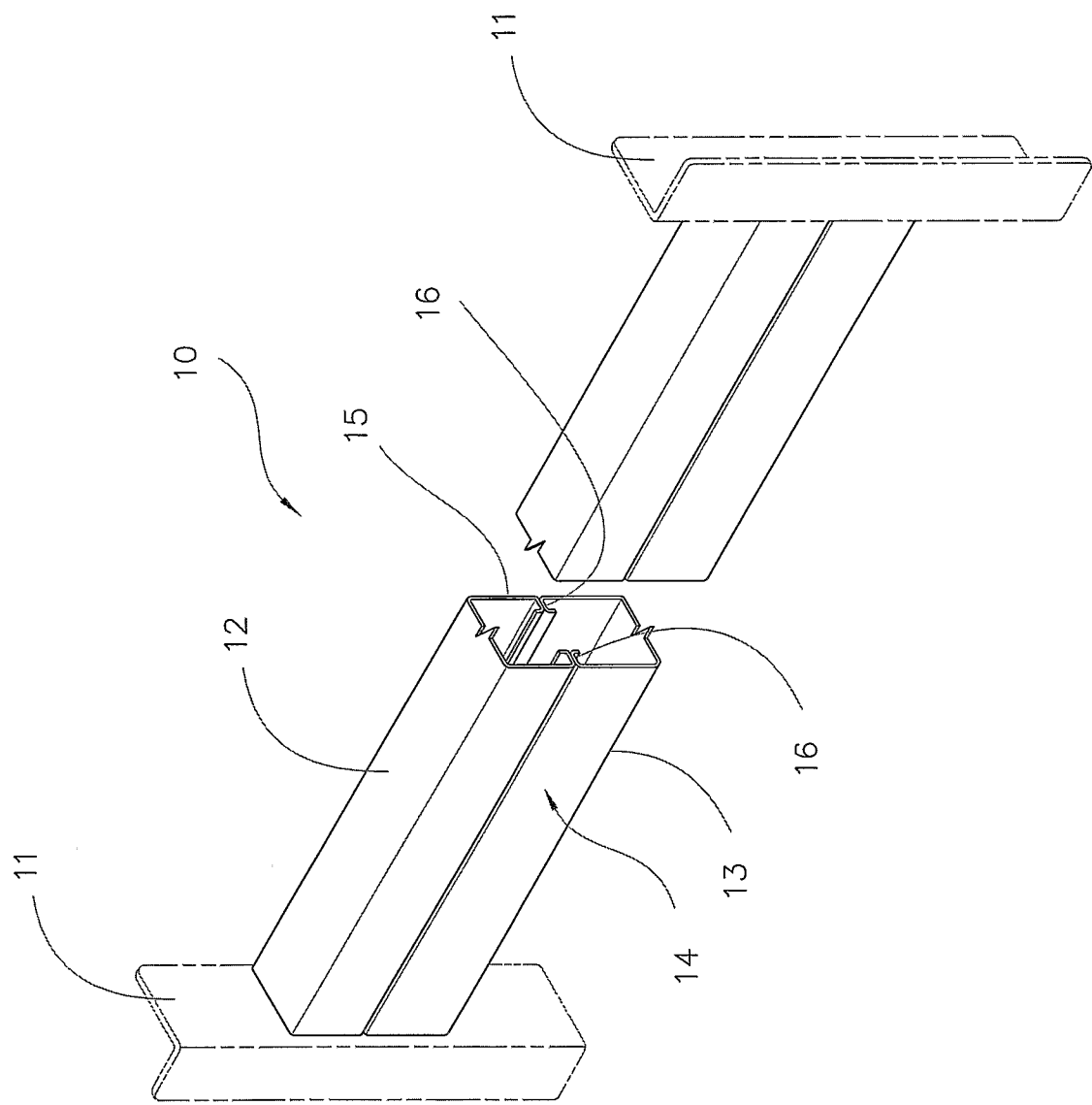


FIG. 2

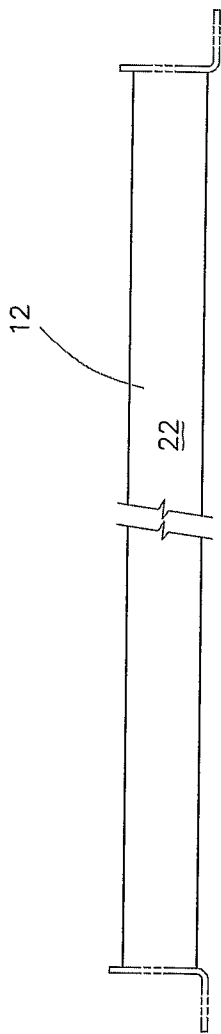


FIG. 4

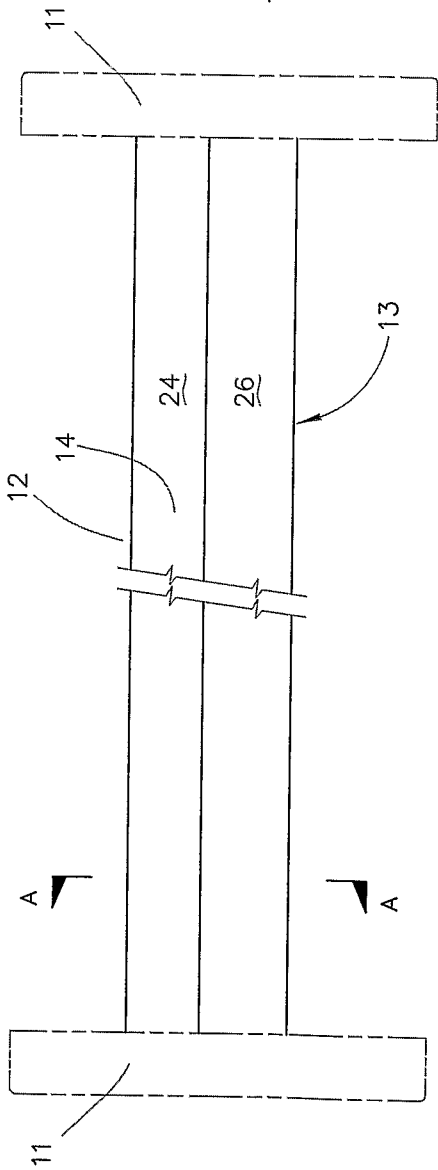


FIG. 3

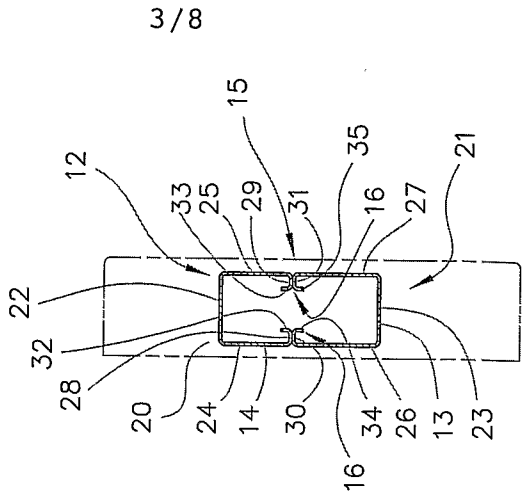


FIG. 5

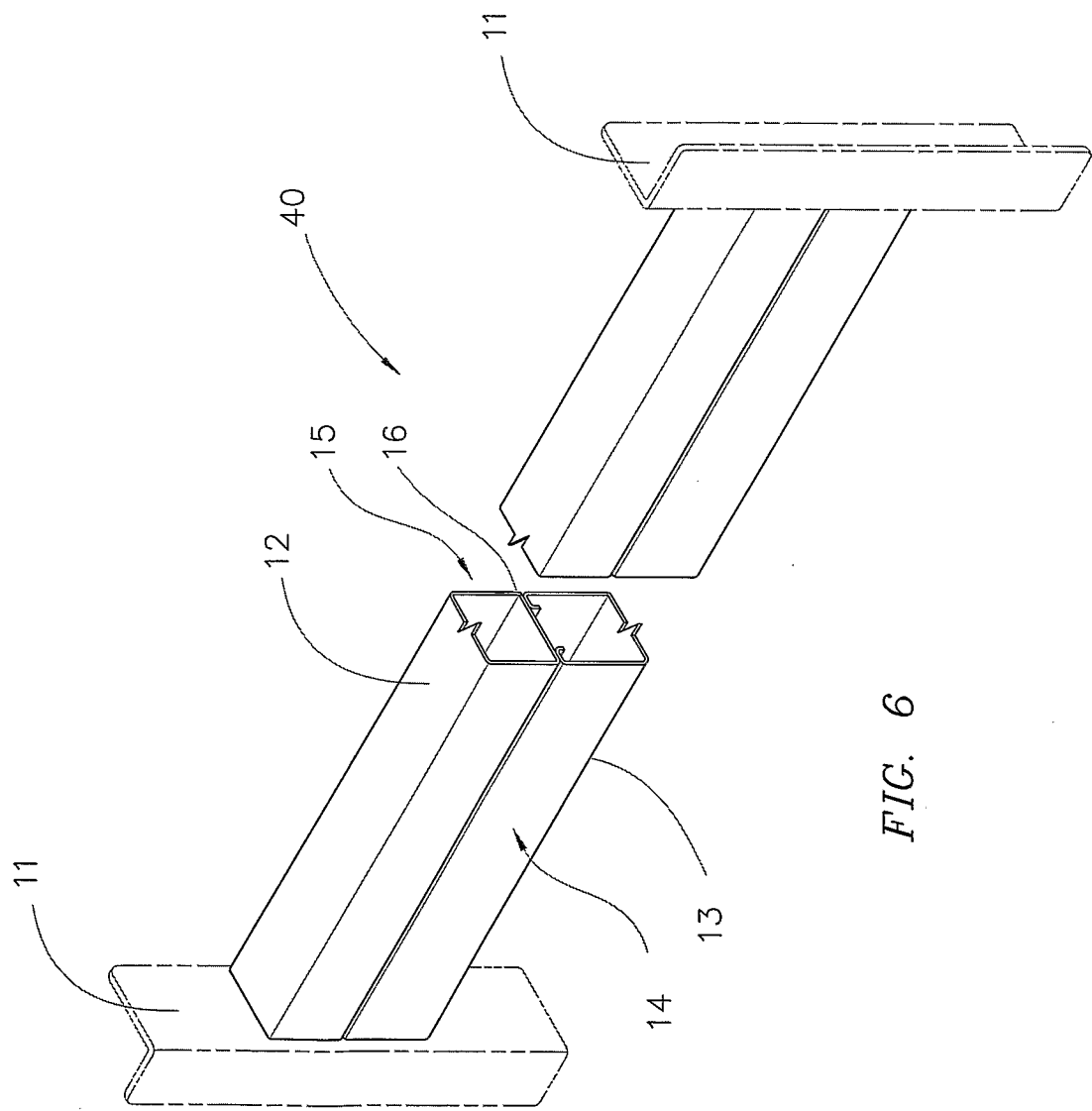


FIG. 6

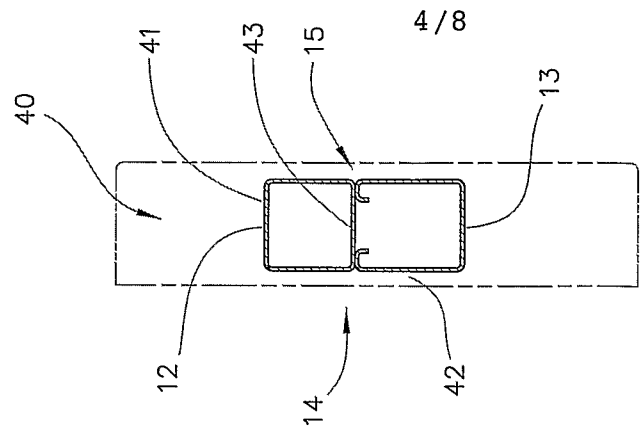


FIG. 7

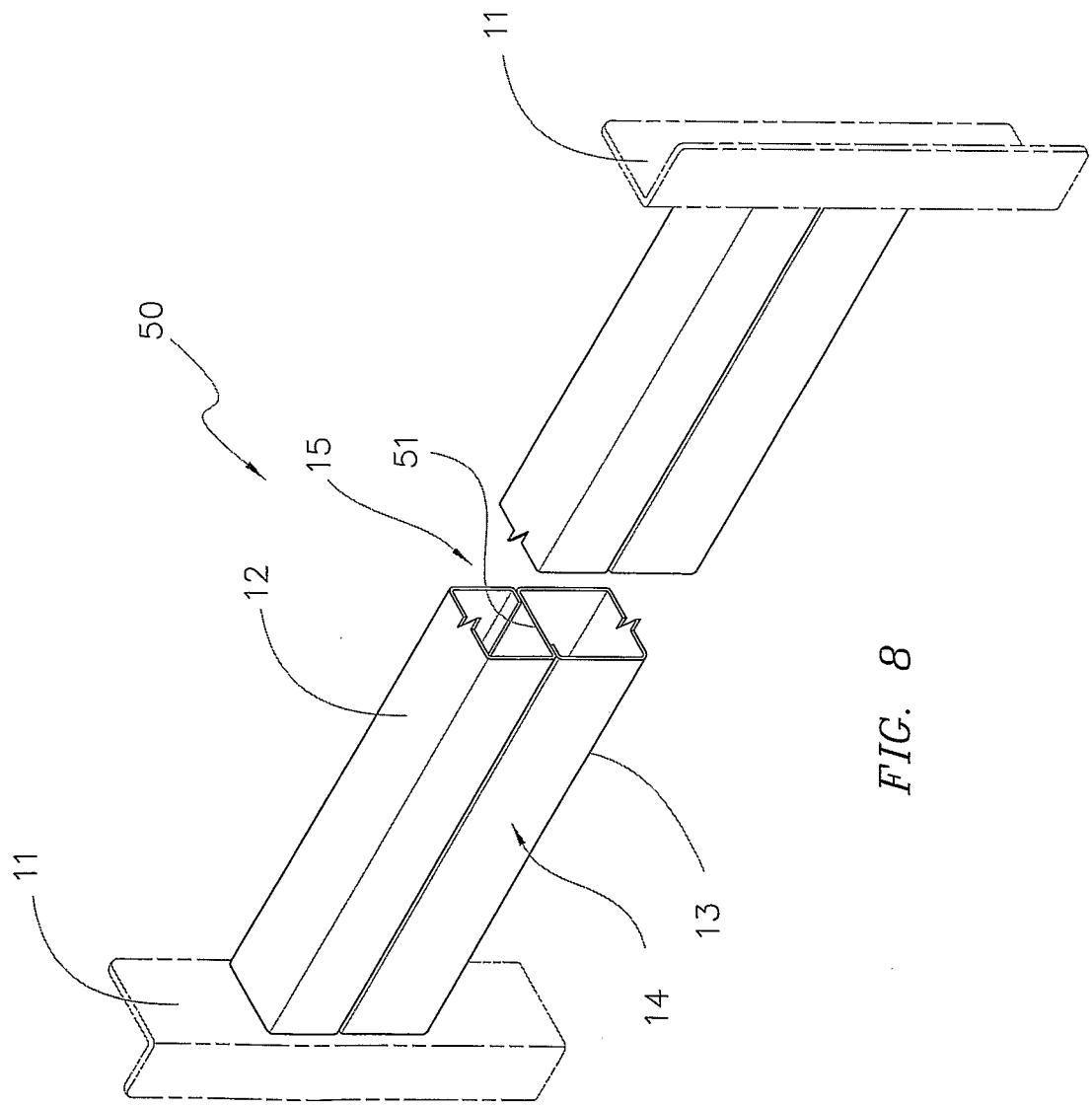


FIG. 8

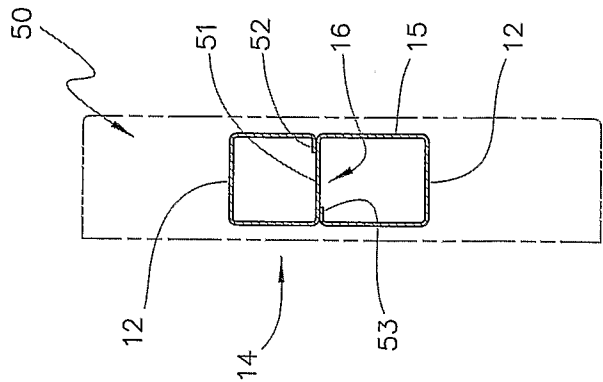
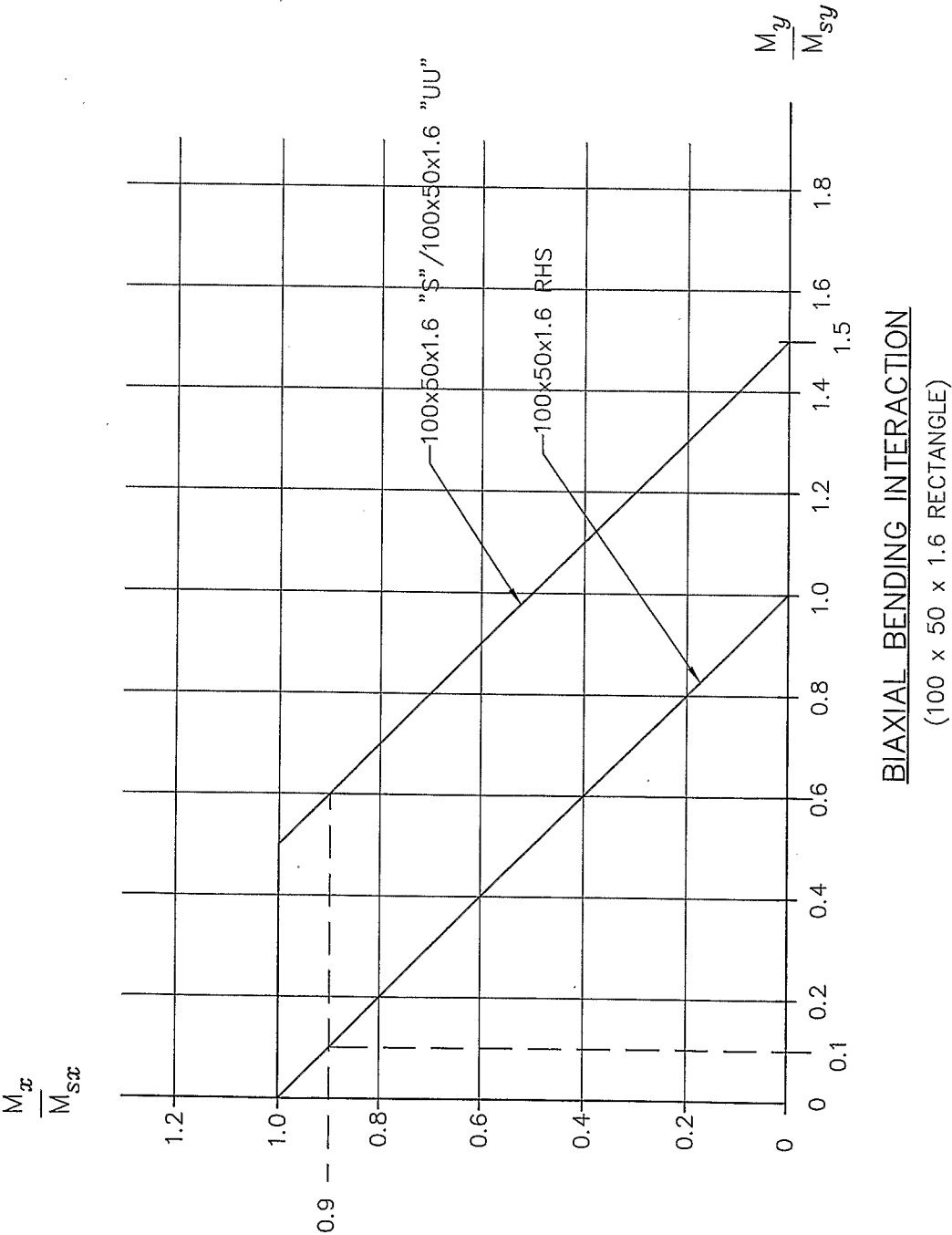
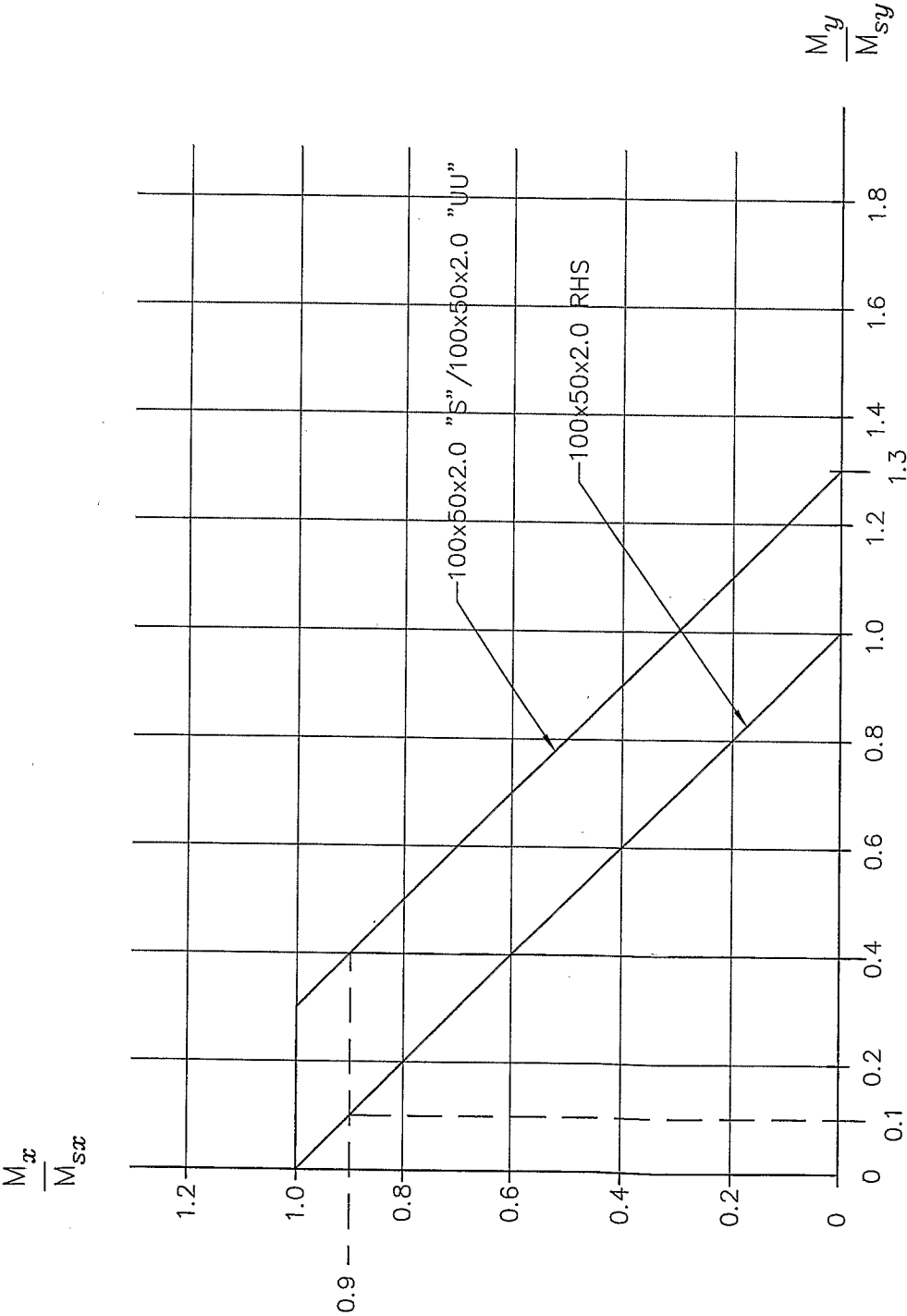


FIG. 9



BIAXIAL BENDING INTERACTION
(100 x 50 x 1.6 RECTANGLE)

FIG. 10



BIAXIAL BENDING INTERACTION
(100 x 50 x 2.0 RECTANGLE)

FIG. 11

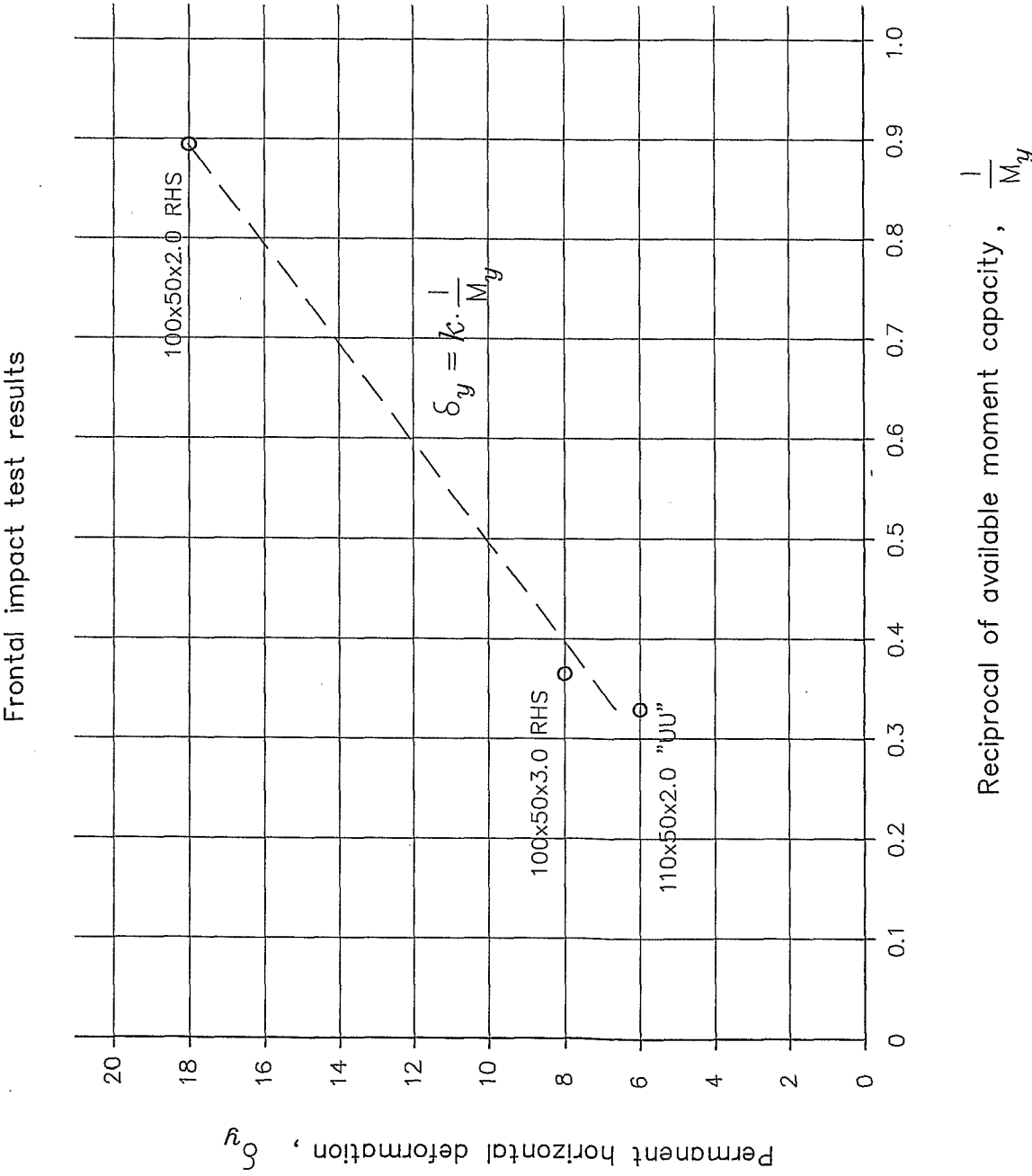


FIG. 12

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/AU2006/001126

A. CLASSIFICATION OF SUBJECT MATTER Int. Cl. <i>E04C 3/07</i> (2006.01) <i>F16S 3/02</i> (2006.01) <i>F16S 3/06</i> (2006.01) <i>A47B 55/00</i> (2006.01) <i>E04G 5/00</i> (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 IPC F16S 3/- and KEYWORDS rack, shelf, shelve, beam, rod, bar, reinforce, stiff, strength, brace, rigid, resist, proof, guard, prevent, load, impact, bend, deform, blow, force, front, lateral, horizon, side, rib, ridge, dimple, lip, diaphragm, protrusion, mid, centre, center		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU21278/02 A1 (NEWMAN) 22 August 2002 Whole document	1, 5, 14, 15, 17, 19 to 21
X	WO 1999/067478 A1 (RBS TECHNOLOGIES HOLDING COMPANY PTY LTD) 29 December 1999 Whole document	1, 5, 15, 19 to 21
X	DE 195 25 347 C1 (YMOS INDUSTIEPRODUKTE AG) 11 July 1996 Whole document	1, 5, 14, 15, 19 to 21
☒ 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 23 October 2006	Date of mailing of the international search report 3 NOV 2006	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized officer COLIN FITZGIBBON Telephone No : (02) 6283 2226	

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 1993/015353 A1 (RMT PTY LTD) 5 August 1993 Whole document	1, 5, 15 to 17, 19 to 21
X	WO 1991/009252 A1 (PELL-MELL PTY LTD) 27 June 1991 Whole document	1, 5, 14, 15, 17, 19 to 21
X	FR 2568668 A3 (PROFILAFROID) 7 February 1986 Whole document	1, 5, 14, 15, 17, 20 to 21
X	AU 18342/76 B (507984)(BILL) 6 April 1978 Whole document	1, 14, 15, 17, 19 to 21
X Y	DE 298 23 522 U1 (SCHULTE) 26 August 1999 Figure 1	2, 3 4 to 6, 11
X Y	DE 197 26 720 C1 (DAIMLER-BENZ AKTIENGESELLSCHAFT) 8 October 1998 Figure 1	2, 3 4 to 6, 11
X Y	DE 297 11 232 U1 (HERZ) 6 November 1997 Figure 3	2, 3 4 to 6, 11
X Y	DE 30 35 526 A1 (NAHR) 8 April 1982 Figure 1	2, 3 4 to 6, 11
X Y	CH 593448 (SONOBAT S A) 30 November 1997 Figure 1	2, 3 4 to 6, 11

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See separate sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Supplemental Box

(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: III Lack of Unity of Invention

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claim 1 and 5 to 21 are directed to a racking beam comprising top and bottom flanges, at least one web interconnecting the flanges, and at least one stiffening formation arranged to stiffen an intermediate region of the at least one web along at least a substantial portion of its length so as to resist lateral loading applied to the racking beam. It is considered that the at least one stiffening formation arranged to stiffen an intermediate region of the at least one web along at least a substantial portion of its length so as to resist lateral loading applied to the racking beam comprises a first distinguishing feature.
- Claims 2, 3 and 4 are directed to a racking beam that has a vertical loading capacity and a horizontal loading capacity, wherein at least part of the horizontal loading capacity is independent of the vertical loading capacity applied to the beam. It is considered that at least part of the horizontal loading capacity being independent of the vertical loading capacity applied to the beam comprises a second distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a priori*.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2006/001126

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			
AU	21278/02	AU	21278/02		
WO	1999/067478	AU	44924/99		
DE	19525347	NONE			
WO	1993/015353	AU	34440/93	AU	64241/96
WO	1991/009252	AU	69549/91	CA	2047224
		EP	0457877	ZA	9009681
FR	2568668	NONE			
AU	18342/76	AU	18342/76		
DE	29823522	NONE			
DE	19726720	EP	0887235	JP	11-129045
				US	6141935
DE	29711232	NONE			
DE	3035526	NONE			
CH	593448	NONE			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.					
END OF ANNEX					