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

(11) EP 1 855 513 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
14.11.2007 Bulletin 2007/46

(51) Int Cl.:
H05K 1/18 *(2006.01)* ***H02B 1/34*** *(2006.01)*
A47B 43/04 *(2006.01)*

(21) Application number: **07008290.4**

(22) Date of filing: **24.04.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **08.05.2006 US 429892**

(71) Applicant: **Northrop Grumman Corporation**
Los Angeles, CA 90067 (US)

(72) Inventors:
- **Tenreiro, Antonio**
  Palm Bay, Florida 32907 (US)
- **Johnson, David R.**
  Satellite Beach, Florida 32937 (US)
- **Duerr, Robert A.**
  Merritt Island, Florida 32952 (US)
- **Rooks, Ashley**
  Orlando, Florida 32828 (US)

(74) Representative: **Thacker, Darran Ainsley**
Serjeants,
25 The Crescent,
King Street
Leicester LE1 6RX (GB)

(54) Expandable modular rack design

(57) An expandable rack (20) for supporting and/or storing articles and/or article housing structured and arranged to transition from a collapsed position to an extended position is disclosed. The rack (20) is suitable for use in a confined space such as the interior of a vehicle. The rack comprises a plurality of substantially vertical support posts (22,24,26,28) and a plurality of foldable substantially horizontal frame members (56A,56B;58A, 58B;60A,60B) that are pivotally connected between adjacent substantially vertical support posts. The horizontal frame members are moveable from a collapsed folded position, that is adjacent to and substantially vertical along a vertical support post, to an extended unfolded position, that is substantially perpendicular to the support post. The expandable rack (20) can comprise integral fasteners. A pallet mounted expandable rack system and a method for deploying an expandable rack within a vehicle are also disclosed.

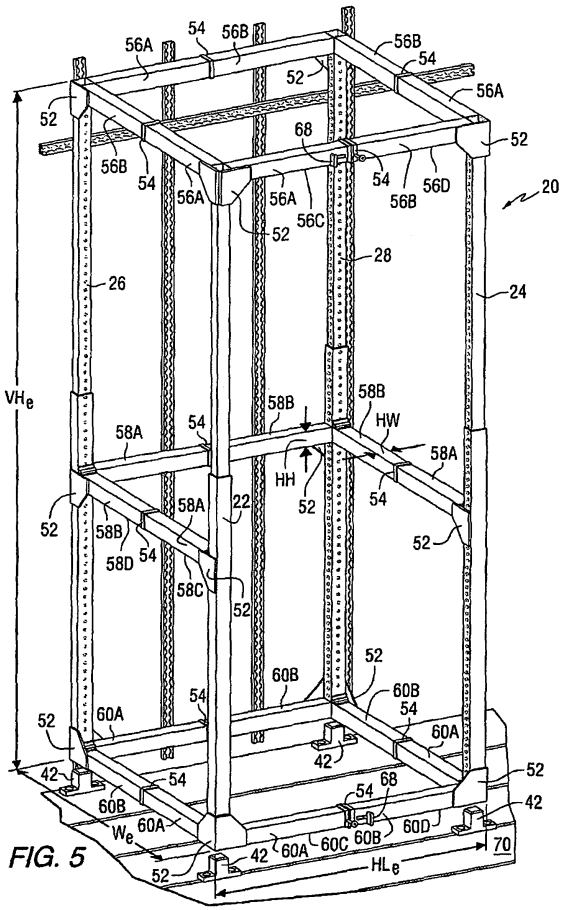

FIG. 5

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to racks for supporting and/or storing articles, and more particularly, relates to expandable racks structured and arranged to transition from a collapsed folded position to an extended unfolded position.

BACKGROUND INFORMATION

[0002] Article supporting/storing racks are conventionally known. Such articles can include computers, computer components, electrical components, electrical, chemical, magnetic and biological sensors, radar equipment, and the like. A conventional rack for supporting and/or storing such articles typically comprises stationary vertical posts and fixed horizontal bracings that support the articles. Such conventional racks typically take up a significant amount of space, are not easily portable and may require substantial assembly time.

[0003] It is often desired to use articles such as computers, computer components, electrical components, electrical, chemical, magnetic and biological sensors and radar equipment within a confined space such as a vehicle. It is also often desired to organize such components by supporting and storing them in racks to optimize space. Conventional assembled racks can be difficult to maneuver into confined spaces, especially through doorways, manholes or around sharp corners. Rack systems that comprise disassembled parts, although easy to carry into a confined space, often require considerable time to reassemble within a desired location. Accordingly, there is identified a need for an improved rack capable of supporting and/or storing articles that is easily transportable into a confined space such as a vehicle and is quickly assembled within the confined space.

SUMMARY OF THE INVENTION

[0004] An aspect of the present invention is to provide an expandable rack structured and arranged to transition from a collapsed folded position to an extended unfolded position.

[0005] The expandable rack can comprise a plurality of substantially vertical support posts, and a plurality of foldable substantially horizontal frame members pivotally connected between adjacent substantially vertical support posts, wherein at least one of the foldable substantially horizontal frame members is moveable from a collapsed folded position adjacent to and substantially aligned with the vertical support posts to an extended unfolded position substantially perpendicular to the vertical support posts. The expandable rack can include at least one shelf structured and arranged to support an article and/or an article housing.

[0006] Another aspect of the present invention is to provide a transportable pallet mounted expandable rack system for deployment in a vehicle. The pallet mounted rack system can comprise a pallet, and an expandable rack removeably mounted on the pallet. The rack can comprise a plurality of substantially vertical support posts, and a plurality of foldable substantially horizontal frame members pivotally connected between adjacent substantially vertical support posts wherein at least one of the foldable substantially horizontal frame members is moveable from a collapsed folded position adjacent to and substantially aligned with the vertical support posts to an extended unfolded position substantially perpendicular to the vertical support posts.

[0007] A further aspect of the present invention is to provide a method of deploying an expandable rack within a vehicle. The method can comprise the steps of providing an expandable rack in a collapsed position within a vehicle interior, transitioning the expandable rack from the collapsed folded position to an extended unfolded position, and securing the rack to the interior of the vehicle. The expandable rack can comprise a plurality of substantially vertical support posts, and a plurality of foldable substantially horizontal frame members pivotally connected between adjacent substantially vertical support posts wherein at least one of the foldable substantially horizontal frame members is moveable from a collapsed folded position adjacent to and substantially aligned with the vertical support posts to an extended unfolded position substantially perpendicular to the vertical support posts.

[0008] These and other aspects of the present invention will be more fully understood following a review of this specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 is a perspective view of an expandable rack in the vertically collapsed and horizontally collapsed position in accordance with the present invention.

[0010] Figure 2 is a perspective view of an expandable rack in the vertically extended and horizontally collapsed position in accordance with the present invention.

[0011] Figure 3 is a perspective view of an expandable rack in the vertically extended and partially horizontally extended position in accordance with the present invention.

[0012] Figure 4 is a perspective view of an expandable rack in the vertically extended and partially horizontally extended position in accordance with the present invention.

[0013] Figure 5 is a perspective view of an expandable rack in the vertically extended and horizontally extended position in accordance with the present invention.

[0014] Figure 6 is an enlarged portion of the perspective view of Figure 5.

[0015] Figure 7 is a perspective view of an expandable rack in the vertically extended and horizontally extended position and a shelf partially engaged therein in accord-

ance with the present invention.

[0016] Figure 8 is a perspective view of an expandable rack in the vertically extended and horizontally extended position and a shelf fully engaged therein in accordance with the present invention.

[0017] Figure 9 is a perspective view of an expandable rack in the vertically extended and horizontally extended position and a shelf slideably positioned partially outside the rack in accordance with the present invention.

[0018] Figure 10 is a perspective view of an expandable rack in the vertically extended and horizontally extended position and a shelf supporting an article housing that is slideably positioned partially outside the rack in accordance with the present invention.

[0019] Figure 11 is a perspective view of an expandable rack in the vertically extended and horizontally extended position and a shelf rotatably supporting an article housing that is slideably positioned partially outside the rack in accordance with the present invention.

[0020] Figure 12 is a perspective view of an interior of a vehicle including an expandable rack in the vertically extended and horizontally extended position and a pallet comprising a second expandable rack, shelves and article housing in accordance with the present invention.

[0021] Figure 13 is a perspective view of an interior of a vehicle including an expandable rack in the vertically extended and horizontally extended position with multiple shelves supporting article housings and a pallet in accordance with the present invention.

DETAILED DESCRIPTION

[0022] Referring to Figures 1-13, an expandable rack 20, in accordance with the present invention, is shown. The rack 20 is structured and arranged to transition from a collapsed folded position to an extended unfolded position within a confined area such as within the interior of a vehicle. As used herein, the term "vehicle" includes aircraft, such as planes, helicopters, and the like, watercraft, such as submarines, ships, boats, and the like, and land vehicles such as cars, trucks, buses and vans, and the like. The rack 20 is structured to support and/or store articles and/or article housings. As used herein, the term "article" includes any item that could be housed within a storage rack, such as computers, computer components, electrical components, electrical, chemical, magnetic and biological sensors and radar equipment.

[0023] As shown in Figure 1, the rack 20 comprises a plurality of substantially vertical support posts. The rack 20 can comprise a left front vertical support post 22, a right front vertical support post 24, a left rear vertical support post 26 and a right rear vertical support post 28. The vertical support posts 22, 24, 26 and 28 can be made of any suitable material such as metal and/or a polymeric composition. Each vertical support post 22, 24, 26 and 28 comprises an upper end 34, a lower end 36 and a middle section 38 located along the vertical support post 22, 24, 26 and 28 between the upper end 34 and the lower end 36. Although the upper end 34, the lower end 36 and the middle section 38 are shown in Figure 1 with reference to one vertical support post, it is appreciated herein that each vertical support post 22, 24, 26 and 28 can comprise corresponding upper and lower ends and middle sections. In one embodiment, the lower end 36 of each vertical support post 22, 24, 26 and 28 is configured to receive a floor fastener 42 within its interior, the floor fastener 42 being optionally slideable within a groove 41 in the floor, as will be discussed herein. The vertical support posts 22, 24, 26 and 28 can comprise any cross-sectional shape such as square, rectangular, circular, triangular, hexagonal and the like. The vertical support posts 22, 24, 26 and 28 can comprise a hollow interior or can be solid throughout, depending on the configuration of the rack 20. The vertical support posts 22, 24, 26 and 28 can comprise a plurality of holes 40 suitable for receiving pegs or shelving fasteners as will also be discussed herein.

[0024] Still referring to Figure 1, in one embodiment the vertical support posts 22, 24, 26 and 28 are telescopic and are capable of transitioning from a vertically collapsed position, as shown in Figure 1, to a vertically extended position, as shown in Figure 2 along the axis extending between the upper end 34 of the vertical support posts 22, 24, 26 and 28 and the lower end 36 of the vertical support posts 22, 24, 26 and 28. The telescopic vertical support posts 22, 24, 26 and 28 can comprise any number of concentrically nesting sections, such as a first section 30 that extends into an interior of a second section 32 in the vertically collapsed position. Each vertical support post 22, 24, 26 and 28 can comprise a first telescopic section 30 having an outer diameter that is sized to fit within an interior diameter of a second telescopic section 32.

[0025] The height of the vertical support posts 22, 24, 26 and 28 can be any suitable height, such as a height that is taller than the height of several articles and/or article housings stacked on top of each other. For example, the vertical support posts 22, 24, 26 and 28 can have a vertically collapsed height VH_c, shown in Figure 1, of from about 36 to about 60 inches (about 90 to about 150 cm), such as from about 48 to about 52 inches (about 120 to about 130 cm).

[0026] Still referring to Figure 1, the vertical support posts 22, 24, 26 and 28 can have any desired width and length such that the rack 20 is easily portable but strong enough to support a plurality of articles housed within the rack 20. In one embodiment, the vertical support posts 22, 24, 26 and 28 have a width VW and a length is the horizontal direction VL both as shown in Figure 1, of from about 1 to about 4 inches (about 2 to about 10 cm), such as from about 2 to about 2 ½ inches (about 5 to about 6 cm). In another embodiment, the vertical support posts 22, 24, 26 and 28 can have a vertically collapsed height VH_c, shown in Figure 1, of from about 30 to about 54 inches (about 76 to about 137 cm), such as from about 46 to about 47 inches (about 116 to about 119 cm).

[0027] In one embodiment, a user can manually pull the vertical support posts 22, 24, 26 and 28 from a vertically collapsed position, as shown in Figure 1, to a vertically extended position, as shown in Figure 2. When the rack 20 is extended vertically, as shown in Figure 2, the vertical support posts 22, 24, 26 and 28 can have a vertically extended height VH_e, shown in Figure 2, of from about 60 to about 108 inches (about 152 to about 274 cm), such as from about 72 to about 87 inches (about 182 to about 221 cm). In one embodiment, the height of the vertical support posts 22, 24, 26 and 28 in the vertically extended position is from 2 to 5 times longer than the height of the vertical support posts 22, 24, 26 and 28 in the vertically collapsed position, such as from 3 to 4 times longer. Once a user has extended the rack 20 from the vertically collapsed position to the vertically extended position, the rack 20 can lock in position by a vertical locking mechanism 44. The vertical locking mechanism 44 can comprise any suitable fastener such as a pin(s) that extends into a hole(s) 40 within the vertical support post(s) 22, 24, 26 and 28, a sliding mechanism that engages to hold the first section 30 and the second section 32 of the vertical support posts 22, 24, 26 and 28 in place, and/or a friction resistance fit between the first section 30 and the second section 32 of the vertical support post 22, 24, 26 and 28. One or more vertical support posts 22, 24, 26 and 28 may comprise a vertical locking mechanism 44 positioned at any desired location, such as between the upper end 34 and the lower end 36 or at about the middle section 38. The vertical locking mechanism 44 can be positioned on an adjacent surface to the holes 40 suitable for receiving pegs or shelving fasteners. In another embodiment, once the rack 20 has been expanded to the vertically expanded position, it can be positioned within the orientation of the floor fasteners 42, as shown in Figure 2.

[0028] Once the rack 20 has been expanded to the vertically expanded position, as shown in Figure 2, a user can transition the rack 20 from a horizontally collapsed position, as shown in Figures 1 and 2, to a partially horizontally extended position, as shown in Figures 3 and 4, and subsequently to a fully horizontally extended position, as shown in Figures 5-13.

[0029] As shown in Figures 1 and 3, the rack 20 comprises a plurality of foldable substantially horizontal frame members 56A and 56B, 58A and 58B, and 60A and 60B. As shown in Figure 3, the horizontal frame members 56A and 56B, 58A and 58B, and 60A and 60B are each pivotally attached to adjacent vertical support posts 22, 24, 26 or 28 by an integral pivoting fastener 52. In the horizontally collapsed position, as shown in Figures 1 and 2, each horizontal frame member 56A and 56B, 58A and 58B, and 60A and 60B is positioned adjacent to and extending substantially vertical along an adjacent vertical support post 22, 24, 26 or 28. Fastener 52 allows each horizontal frame member 56A and 56B, 58A and 58B, and 60A and 60B to pivot up to 90° with respect to the vertical support posts 22, 24, 26 and 28 when the rack 20 is transitioned from the horizontally collapsed position to the horizontally extended position. As shown in Figure 5, in the fully horizontally extended position, the horizontal frame members 56A and 56B, 58A and 58B, and 60A and 60B are substantially perpendicular to the vertical frame members 22, 24, 26 and 28. Fastener 52 can comprise any suitable fastener or fastening means, such as a nut and bolt system, a grommet, a ball and socket joint, hinge and pin, or the like. In one embodiment, the fastener 52 can comprise a horizontal locking mechanism to lock the horizontal frame members 56A and 56B, 58A and 58B, and 60A and 60B perpendicular to the vertical support posts 22, 24, 26 and 28 in the fully horizontally extended position.

[0030] As shown in Figures 3-5, the rack 20 can comprise a plurality of upper horizontal frame members 56A and 56B positioned at about the upper end 34 of the vertical support posts 22, 24, 26 and 28 and extending between adjacent vertical support posts 22, 24, 26 and 28. The rack 20 can comprise a plurality of lower horizontal frame members 60A and 60B positioned at about the lower end 36 of the vertical support posts 22, 24, 26 and 28, extending between adjacent vertical support posts 22, 24, 26 or 28. The rack 20 can further comprise a plurality of middle horizontal frame members 58A and 58B positioned vertically between the upper end 34 and the lower end 36 of the vertical support posts 22, 24, 26 and 28 and extending between adjacent vertical support posts 22, 24, 26 and 28. In one embodiment, the rack 20 comprises a plurality of upper horizontal frame members 56A and 56B and a plurality of lower horizontal frame members 60A and 60B. The rack 20 can comprise an upper horizontal frame member 56A and 56B extending between each adjacent vertical support post, a middle horizontal frame member 58A and 58B extending between each adjacent vertical support post, and/or a lower horizontal frame member 60A and 60B extending between each adjacent vertical support post. In one embodiment, the rack 20 may comprise a middle horizontal frame member 58A and 58B extending between the left front vertical support post 22 and the left rear vertical support post 26, a middle horizontal frame member 58A and 58B extending between the left rear vertical support post 26 and the right rear vertical support post 28, and a middle horizontal frame member 58A and 58B extending between the right rear vertical support post 28 and the right front vertical support post 24.

[0031] Still referring to Figures 3-5, in one embodiment, the left front vertical support post 22 and the right front vertical support post 24 are not be joined by a middle horizontal frame member. In this embodiment, the left front vertical support post 22 and the right front vertical support post 24 having no middle horizontal frame member positioned therebetween can be considered the "front" of the rack 20 and can be disposed to face away from an adjacent wall when installed. This can allow large articles to pass into the interior of the rack 20 as will be described herein. It will be appreciated, however, that

the rack can be installed having any desired orientation depending on the needs of the user.

[0032] Still referring to Figures 3-5, multiple middle horizontal frame members 58A and 58B may be positioned between adjacent vertical support posts and between the upper horizontal frame members 56A and 56B and the lower frame members 60A and 60B. In one embodiment, from 1 to 10 sets of middle frame members 58A and 58B, such as from 1 to 3 middle frame members 58A and 58B, may be positioned between adjacent vertical support posts and between the upper horizontal frame members 56A and 56B and the lower frame members 60A and 60B. As used herein, the term "set of middle frame members" means a plurality of middle frame members extending between adjacent vertical support posts in substantially the same horizontal plane.

[0033] As shown in Figures 4-5, each horizontal frame member can comprise at least two portions 56A and 56B, 58A and 58B, and 60A and 60B respectively. The first portion 56A, 58A and 60A of the horizontal frame member and the second portion 56B, 58B and 60B are hinged 54 at a location along the horizontal frame member between adjacent vertical support posts 22, 24, 26 or 28. The hinging mechanism 54 can be integral to the first portion 56A, 58A and 60A of the horizontal frame members and integral to the second portion 56B, 58B and 60B of the horizontal frame members. The hinging mechanism 54 can comprise a mechanical hinge, a living hinge, a line or region of flexure, or a material having a greater degree of flexibility than the material comprising the first portion 56A, 58A and 60A and the second portion 56B, 58B and 60B. The hinging mechanism 54 and pivoting fastener 52 allows each of the horizontal frame members 56A and 56B, 58A and 58B, and 60A and 60B to transition from a horizontally collapsed position to a horizontally expanded position when a force is applied to rack 20 in the side-to-side direction. In one embodiment, the hinging mechanism 54 allows first portion 56A, 58A and 60A to rotate 90° in a first direction and second portion 56B, 58B and 60B to rotate 90° in a second direction that is opposite the first direction such that first portion 56A, 58A and 60A and the second portion 56B, 58B and 60B are aligned in substantially the same horizontal plane when rack 20 is fully horizontally extended, as shown in Figure 5.

[0034] Again referring to Figure 1, when the rack 20 is in the horizontally collapsed position, each hinged horizontal frame member is foldable such that first surface 56C, 58C and 60C of first portion 56A, 58A and 60A is positioned substantially parallel to second surface 56D, 58D and 60D of second portion 56B, 58B and 60B in the horizontally collapsed position. When the rack 20 is transitioned to a horizontally extended position, as shown in Figure 5, the first surface 56C, 58C and 60C of first portion 56A, 58A and 60A is positioned in substantially the same horizontal plane as the second surface 56D, 58D and 60D of second portion 56B, 58B and 60B in the fully horizontally expanded position.

[0035] As shown in Figures 3 and 4, the upper horizontal frame members 56A and 58B and the lower horizontal frame members 60A and 60B can be hinged in opposite directions to allow for a more compact collapsed rack position. In one embodiment, the upper horizontal frame members 56A and 56B are hinged such that hinging mechanism 54 angles first portion 56A and second portion 56B downward toward the lower end 36 of the vertical support posts 22, 24, 26, and 28. The lower horizontal frame members 60A and 60B can be hinged such that hinging mechanism 54 angles the first portion 60A and the second portion 60B upwards toward the upper end 34 of the vertical support posts 22, 24, 26, and 28. By hinging the upper horizontal frame members 56A and 56B downward and the lower horizontal frame members 60A and 60B upwards, the upper horizontal frame members 56A and 56B and the lower horizontal frame members 60A and 60B do not extend beyond the vertical support posts 22, 24, 26, and 28 in the horizontally collapsed position as shown in Figures 1 and 2. The middle horizontal frame members 58A and 58B can be hinged in the same direction as either the upper horizontal frame members 56A and 56B or the lower horizontal frame members 60A and 60B depending on the desired placement of the middle horizontal frame members 58A and 58B along the vertical support posts 22, 24, 26 and 28. In one embodiment, if multiple sets of middle horizontal frame members 58A and 58B are positioned along the vertical support posts 22, 24, 26 and 28, at least one set of middle horizontal frame members 58A and 58B can be hinged upwards and at least one other set of middle horizontal frame members 58A and 58B can be hinged downwards.

[0036] As shown in Figure 5, the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B can have any desired length, width and height such that the rack 20 is easily portable but strong enough to support a plurality of articles housed within the rack 20. The length of the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B can be any suitable length, such as a length that is longer than the length of an article and/or article housing. For example, the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B can have a horizontally collapsed length HL_c, shown in Figure 1, of from about 4 to about 16 inches (about 10 to about 40 cm), such as from about 8 to about 10 inches (about 20 to about 25 cm). The horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B can have a horizontally extended length HL_e, as shown in Figure 5, of from about 22 to about 40 inches (about 56 to about 102 cm), such as from about 35 to about 36 inches (about 89 to about 91 cm). In one embodiment, the length of the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B in the horizontally extended position is from 2 to 5 times longer than the length of the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B in the horizontally collapsed position, such as from 3 to 4 times longer.

[0037] Still referring to Figure 5, in one embodiment,

the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B have a width HW shown in Figure 5, of from about 1 to about 4 inches (about 2 to about 10 cm), such as from about 1 ½ to about 2 inches (about 3 to about 5 cm). In another embodiment, the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B have a height HH shown in Figure 5, of from about 1 to about 4 inches (about 2 to about 10 cm), such as from about 1 ½ to about 2 inches (about 3 to about 5 cm). The vertical support posts 22, 24, 26 and 28 and the horizontal fame members 56A and 56B, 58A and 58B and 60A and 60B can be made of any suitable material such as metal and/or a polymeric composition. In one embodiment, the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B can comprise the same material as the vertical support posts 22, 24, 26 and 28. The horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B can comprise a hollow interior or can be solid throughout. The horizontal frame members can comprise a plurality of holes suitable for receiving pegs or shelving fasteners as will be discussed herein. The horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B can comprise any shape such as square, rectangular, circular, triangular, hexagonal and the like.

[0038] Still referring to Figure 5, in one embodiment, a user can manually pull the rack 20 from into the fully horizontally extended position, as shown in Figure 5. Once the rack 20 is fully extended from the horizontally collapsed position to the horizontally extended position, the rack 20 can be locked in position by a horizontal locking mechanism 68. Although only shown on the upper horizontal frame members 56A and 56B and the lower horizontal frame members 60A and 60B, it will be appreciated that any of the horizontal frame members may include a horizontal locking mechanism 68. In one embodiment, every horizontal frame member 56A and 58B, 58A and 58B, and 60A and 60B comprise a horizontal locking mechanism 68. The locking mechanism 68 can comprise any suitable fastener such as a pin that extends into a hole within the horizontal frame member 56A and 56B, 58A and 58B and 60A and 60B, a sliding mechanism that engages to hold the first section 56A, 58A and 60A and the second section 56B, 58B and 60B of the horizontal frame member in place.

[0039] By transitioning the rack 20 from the collapsed position, shown in Figure 1, to the extended position, shown in Figure 5, the height, length and width of the rack 20 are each enlarged. As shown in Figure 1, the overall height of the rack 20 in the collapsed position VH_c can be from about 36 to about 60 inches (about 91 to about 152 cm), such as from about 48 to about 52 inches (about 122 to about 132 cm). As shown in Figure 5, the overall height of the rack 20 in the extended position VH_e can be from about 60 to about 108 inches (about 152 to about 274 cm), such as from about 72 to about 87 inches (about 182 to about 220 cm). In one embodiment, the overall height of the rack 20 in the extended position can be from 2 to 5 times taller than the height of the rack 20 in the collapsed position, such as from 3 to 4 times taller. Also shown in Figure 1, the overall length of the rack 20 in the collapsed position HL_c can be from about 4 to about 16 inches (about 10 to about 40 cm), such as from about 8 to about 10 inches (about 20 to about 25 cm). As shown in Figure 5, the overall length of the rack 20 in the extended position HL_e can be from about 20 to about 40 inches (about 50 to about 102 cm), such as from about 35 to about 36 inches (about 89 to about 91 cm). In one embodiment, the overall length of the rack 20 in the extended position can be from 2 to 5 times taller than the length of the rack 20 in the collapsed position, such as from 3 to 4 times taller. In one embodiment, the width W_e of the rack 20 in the extended position, as shown in Figure 5, increases from the width W_c in the collapsed position, shown in Figure 1, by the same amount as the length HL_e of the rack 20 in the extended position increases from the length HL_c in the collapsed position. In another embodiment, in each set of horizontal frame members, two horizontal frame members may have a different length from two other horizontal frame members. In this embodiment, the width W_e of the rack 20 in the extended position may be different from the length HL_e of the rack 20 in the extended position. The dimensions of the horizontal frame members 56A and 56B, 58A and 58B and 60A and 60B can be selected to accommodate various sized articles. Once the rack 20 has been fully extended in the vertical and horizontal directions, the vertical support posts 22, 24, 26 and 28 can be aligned with the floor fasteners 42, as shown in Figure 5.

[0040] As shown in Figure 6, once the rack 20 has been fully extended in the vertical direction and the horizontal direction, it can be secured to the floor 70 by aligning the interior of at least one of the vertical support posts 22, 24, 26 or 28 (only vertical support posts 24 and 28 shown in Figure 6) with at least one floor fastener 42. Floor fasteners 42 can be slid within a groove 41 that is recessed in or protruding from the floor 70. Once the floor fastener 42 is positioned at a desired location, the floor fastener 42 can be secured to the floor 70 of a vehicle or the like by any convenient means, such as pegs or screws. Each floor fastener 42 comprises a protrusion 72 that is configured to slideably engage the interior of a vertical support post 22, 24, 26 or 28. The floor fasteners 42 can engage the interior of at least one of the vertical support posts 22, 24, 26 or 28 by any suitable securing means, such as snap pins, bolts, screws, pressure fit pins, and the like. The floor fasteners 42 prevent rack 20 from sliding on the floor 70 when a vehicle accelerates, turns, or when articles are positioned within the rack as will be discussed later. In one embodiment, once the rack 20 is engaged with the floor fasteners 42, the lower horizontal frame members 60B can contact the floor 70. In another embodiment, the floor fastener 42 can be slideably engaged within a groove 41 within the floor 70. In another embodiment, the floor fastener 42 can be slid to a desired location within groove 41 on the floor 70 and

subsequently secured in place by floor fasteners 42. In another embodiment, the groove 41 can comprise a raised ridge that floor fastener 42 can slide along.

[0041] As shown in Figures 7-9, one or more shelves 74 can be positioned within the interior of the rack 20. As shown in Figures 7-8, in one embodiment, the shelf 74 can be positioned within the interior of the rack 20 after the rack 20 has been secured by the horizontal locking mechanisms 68 and secured to the floor 70 by engagement with the floor fasteners 42. In one embodiment, as shown in Figures 7-9, the shelf 74 can comprise a first surface 78 and a second surface 80 hinged together along hinge 76 to allow a greater degree of portability. The shelf 74 can comprise any suitable dimensions, such as dimensions to allow the shelf 74 to be fully contained within the vertical support posts 22, 24, 26 and 28. In one embodiment, shown in Figures 7-9, one or more saddles 75 can be positioned over one or more horizontal frame members, such as 60A or 60B to assist in stabilizing the rack 20. In one embodiment, two saddles 75 opposite each other in substantially the same plane can be positioned over opposite segments of the horizontal frame members, such as 60A and 60B as shown in Figure 7, or horizontal frame members 58A and 58B.

[0042] As shown in Figure 8, the shelf 74 can be positioned to supportably engage the vertical support posts 22, 24, 26 and 28 and/or the horizontal frame members 56A and 56B (not shown), 58A and 58B and/or 60A and 60B of rack 20. In one embodiment, the shelf 74 can comprise a series of pegs that can engage a plurality of holes 40 within the vertical support posts 22, 24, 26 and 28. A plurality of shelves 74 can be positioned at any location along the vertical support posts 22, 24, 26 and 28. In one embodiment, each shelf 74 supportably engages a set of middle horizontal frame members 58A and 58B.

[0043] In another embodiment as shown in Figure 9, the shelf 74 can comprise at least two sliding mechanisms 82 positioned on the underside 84 of the shelf 74 that are fixably attached to the horizontal frame members 56A and 56B (not shown), 58A and 58B or 60A and 60B. The sliding mechanism 82 can comprise any conventional slider arrangement having a fixed portion 86 which can be attached to the horizontal frame members 56A and 56B, 58A and 58B or 60A and 60B and a slider portion 88 which is slideably engaged with the fixed portion 86 and attached to the underside 84 of the shelf 74.

[0044] As shown in Figure 9, the shelf 74 can also comprise a circular recessed area 90 structured and arranged to at least partially receive an article and/or an article housing within the recessed area 90. Articles and article housings can be adapted to contain a protrusion structured to mate with the recessed area 90 of the shelf 74 such that the articles and/or article housings do not slide on the shelves 74 once positioned within the vertical support posts 22, 24, 26 and 28 of the rack 20.

[0045] The shelf 74 can be horizontally slideable from an extended position at least partially positioned outside the rack, as shown in Figures 9-11, to a retracted position within the rack 20, as shown in Figures 12 and 13.

[0046] As shown in Figure 10, an article housing 92, such as an equipment casing, rests on an article shelf 93 which has a disk-shaped projection (not shown) which can be positioned within the circular recessed area 90 (shown in Fig. 9) of the shelf 74 when the sliding mechanisms 82 are extended outside the rack 20.

[0047] As shown in Figure 11, once an article and/or article housing 92 and the article shelf 93 are positioned on the shelf 74 and/or within the recessed area of the shelf 74, the article 92 can be secured to the shelf 74 by straps 94 or the like and rotated within the recessed area of the shelf 74 when the sliding mechanisms 82 are extended outside the rack 20. As shown in Figure 11, the shelf 74 can be configured to allow an article 92 to easily rotate with respect to the orientation of the shelf 74.

[0048] As shown in Figure 12, one or more shelves 74, optionally housing one or more articles and/or article housings 92 can be positioned entirely within rack 20 by sliding the sliding mechanism from a position extending outside the rack, shown in Figures 9-11, to a confined position within the interior of the rack 20, shown in Figure 12. As shown in Figure 13, multiple shelves 74 and articles and/or article housings 92 can be positioned within the rack 20. In addition to being secured to the floor 70, the rack 20 can optionally be secured to a vehicle wall 100 or ceiling by additional fasteners 130 that connect portions of the rack 20 to an installed rack grid 140.

[0049] As shown in Figure 12, a fully expanded rack 20 including vertically expanded vertical support posts 22, 24, 26 and 28 and horizontally expanded horizontal frame members 56A and 56B, 58A and 58B, and 60A and 60B houses an article and/or article housing 92 on a shelf 74 having sliding mechanisms 82 positioned within the interior of the rack 20. Also shown in Figure 12, a second expandable rack 120 of the present invention can be introduced into a confined space, such as on the floor 70 on a vehicle as a transportable pallet mounted expandable rack system 110. The transportable pallet mounted expandable rack system comprises a pallet 96 and an expandable rack 120, at least one shelf 174, and at least one article and/or article housing 192 mounted on the pallet 96. The pallet 96 can be carried in to a confined space or can be delivered on a skid by mechanical means.

[0050] In the event a user desires to move the rack 20 to a second location, the articles and/or article housings 92 and shelves 74 can be removed from the rack 20, any horizontal locking mechanism(s) and/or vertical locking mechanism(s) can be disengaged, and the rack 20 can be transitioned from a horizontally and vertically expanded position to a horizontal and vertically collapsed position.

[0051] Whereas particular embodiments of this invention have been described above for purposes of illustration, it will be evident to those skilled in the art that numerous variations of the details of the present invention

may be made without departing from the invention as defined in the appended claims.

Claims

1. An expandable rack (20) structured and arranged to transition from a collapsed position to an extended position, comprising:

a plurality of substantially vertical support posts (22,24,26,28); and
a plurality of foldable substantially horizontal frame members (56A,56B;58A,58B;60A,60B) pivotally connected between adjacent substantially vertical support posts (22,24,26,28), wherein at least one of the foldable substantially horizontal frame members (56A,56B;58A,58B; 60A,60B) is moveable from a collapsed folded position adjacent to and substantially aligned with the vertical support posts (22,24,26,28) to an extended unfolded position substantially perpendicular to the vertical support posts (22,24,26,28).

2. An expandable rack (20) according to claim 1, wherein each of the foldable substantially horizontal frame members (56A,56B;58A,58B;60A,60B) includes a hinge (54).

3. An expandable rack (20) according to claim 1 or claim 2, wherein the plurality of substantially vertical support posts comprises a left front post (22), a right front post (24), a left rear post (26) and a right rear post (28), and wherein at least one of the plurality of substantially horizontal frame members (56A,56B) is pivotally connected between the left front post (22) and the right front post (24), at least one of the plurality of substantially horizontal frame members (56A,56B) is pivotally connected between the left front post (22) and the left back post (26), at least one of the plurality of substantially horizontal frame members (56A,56B) is pivotally connected between the right front post (24) and the right back post (28), and at least one of the plurality of substantially horizontal frame members (56A,56B) is pivotally connected between the left back post (26) and the right back post (28).

4. An expandable rack (20) according to claim 3, wherein the rack (20) can be transitioned between the collapsed folded position in which the front vertical posts (22,24) and the rear vertical posts (26,28) are adjacent to each other and the left vertical posts (22,26) and the right vertical posts (24,28) are adjacent to each other, and the extended unfolded position in which the front vertical posts (22,24) and the rear vertical posts (26,28) are spaced apart from each other and the left vertical posts (22,26) and the right vertical posts (24,28) are spaced apart from each other.

5. An expandable rack (20) according to any preceding claim, wherein the plurality of substantially horizontal frame members are upper horizontal frame members (56A,56B) and are pivotally connected between adjacent vertical support posts (22,24,26,28) at upper ends (34) of the vertical support posts.

7. An expandable rack (20) according to claim 6, wherein the plurality of substantially horizontal frame members are middle horizontal frame members (58A,58B) and are pivotally connected between adjacent vertical support posts (22,24,26,28) at a location along the vertical support posts between the upper horizontal frame members (56A,56B) and the lower horizontal frame members (60A,60B).

6. An expandable rack (20) according to claim 5, wherein the plurality of substantially horizontal frame members are lower horizontal frame members (60A, 60B) and are pivotally connected between adjacent vertical support posts (22,24,26,28) at lower ends (36) of the vertical support posts.

8. An expandable rack (20) according to claim 1, wherein the plurality of substantially horizontal frame members comprises:

a plurality of upper horizontal frame members (56A,56B) pivotally connected between adjacent vertical support posts (22,24,26,28) at upper ends (34) of the vertical support posts; and
a plurality of lower horizontal frame members (60A,60B) pivotally connected between adjacent vertical support posts (22,24,26,28) at lower ends (36) of the vertical support posts.

9. An expandable rack (20) according to claim 8, wherein the upper horizontal frame members (56A, 56B) pivot in a downward direction in the collapsed folded position and the lower horizontal frame members (60A,60B) pivot in an upward direction in the collapsed folded position.

10. An expandable rack (20) according to claim 8 or claim 9, further comprising a plurality of middle horizontal frame members (58A,58B) pivotally connected between adjacent vertical support posts (22,24,26,28) at locations along the vertical support posts between the upper horizontal frame members (56A,56B) and the lower horizontal frame members (60A,60B).

11. An expandable rack (20) according to claim 10, wherein the plurality of vertical support posts com-

prises a left front post (22), a right front post (24), a left rear post (26), and a right rear post (28), and wherein at least one of the middle horizontal frame members (58A,58B) is pivotally connected between the left front post (22) and the left back post (26), at least one of the middle horizontal frame members (58A,58B) is pivotally connected between the right front post (24) and the right back post (28), and at least one of the middle horizontal frame members (56A,56B) is pivotally connected between the left back post (26) and the right back post (28).

12. An expandable rack according to claim 10 or claim 11, wherein the middle horizontal frame members (58A,58B) pivot in a downward direction in the collapsed folded position.

13. An expandable rack (20) according to any preceding claim, wherein at least one of the plurality of vertical support posts (22,24,26,28) telescopes from a vertically collapsed position to a vertically extended position.

14. An expandable rack (20) according to any preceding claim, wherein the plurality of substantially vertical support posts (22,24,26,28) are pivotally connected to the plurality of foldable substantially horizontal frame members (56A,56B;58A,58B;60A, 60B) by locking fasteners (52).

15. An expandable rack (20) according to any preceding claim, wherein at least one of the substantially vertical support posts (22,24,26,28) has a lower end (36) that is engageable with a floor fastener (42).

16. An expandable rack (20) according to any preceding claim, further comprising at least one shelf (74) removeably engageable with the plurality of vertical support posts (22,24,26,28) and/or the horizontal frame members (56A,56B;58A,58B;60A,60B) .

17. An expandable rack (20) according to claim 16, wherein the shelf (74) is adjustable vertically along the plurality of vertical support posts (22,24,26,28).

18. An expandable rack (20) according to claim 16, wherein the shelf (74) is horizontally slideable from a retracted position within the rack (20) to an extended position at least partially positioned outside the rack (20).

19. An expandable rack (20) according to any of claims 16 to 18, wherein the shelf (74) is structured and arranged to support an article and/or an article housing.

20. An expandable rack (20) according to any preceding claim, wherein the rack (20) is portable.

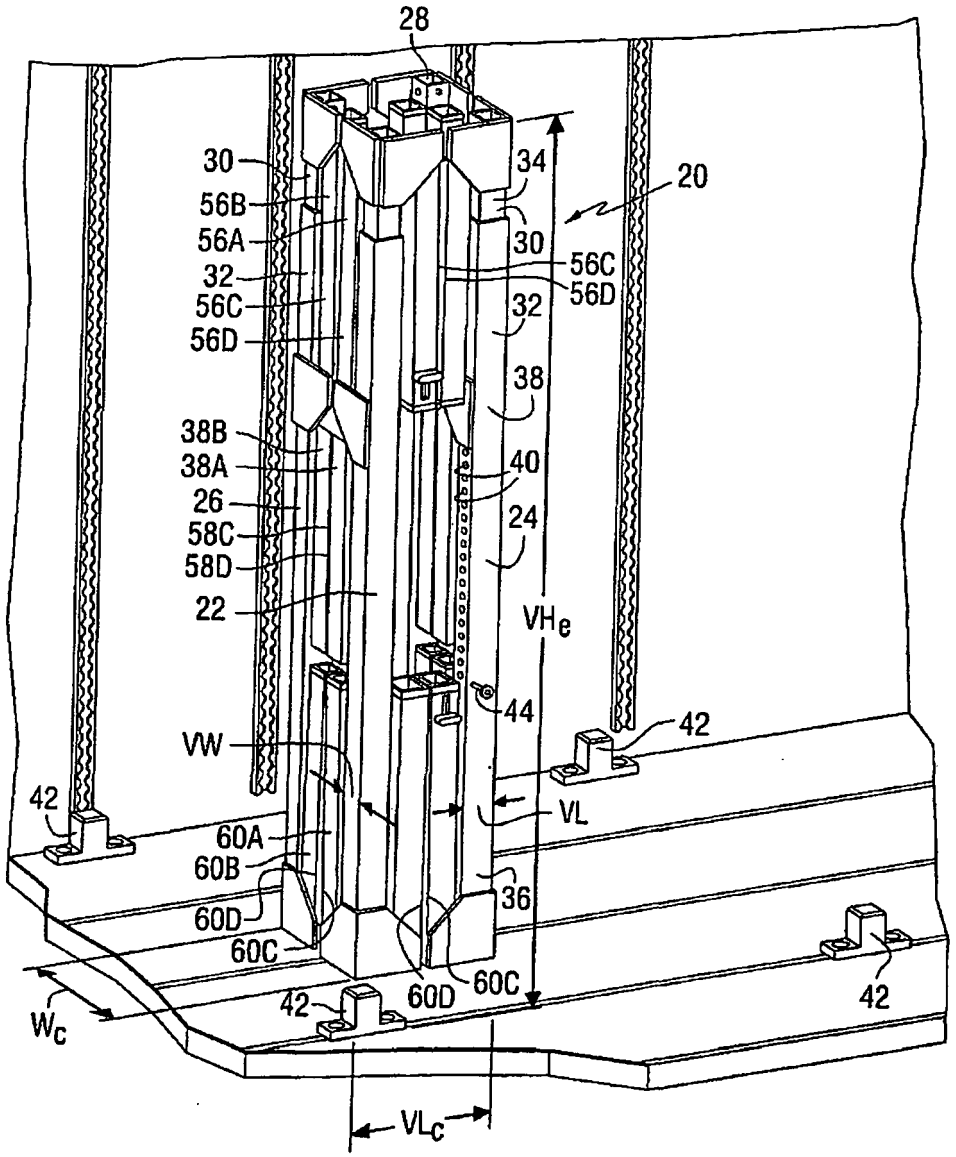
21. An expandable rack (20) according to any preceding claim, wherein the rack (20) is attached to a vehicle in use.

22. A transportable pallet mounted expandable rack system for deployment in a vehicle comprising:

a pallet; and
an expandable rack according to any of claims 1 to 21 removeably mounted on the pallet.

23. A method of deploying an expandable rack (20) according to any of claims 1 to 21 within a vehicle, the method comprising the steps of:

locating the expandable rack (20) within a vehicle interior;
transitioning the expandable rack (20) from the collapsed folded position to an extended unfolded position; and
securing the rack (20) to the interior (70) of the vehicle.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60D
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FIG. 1

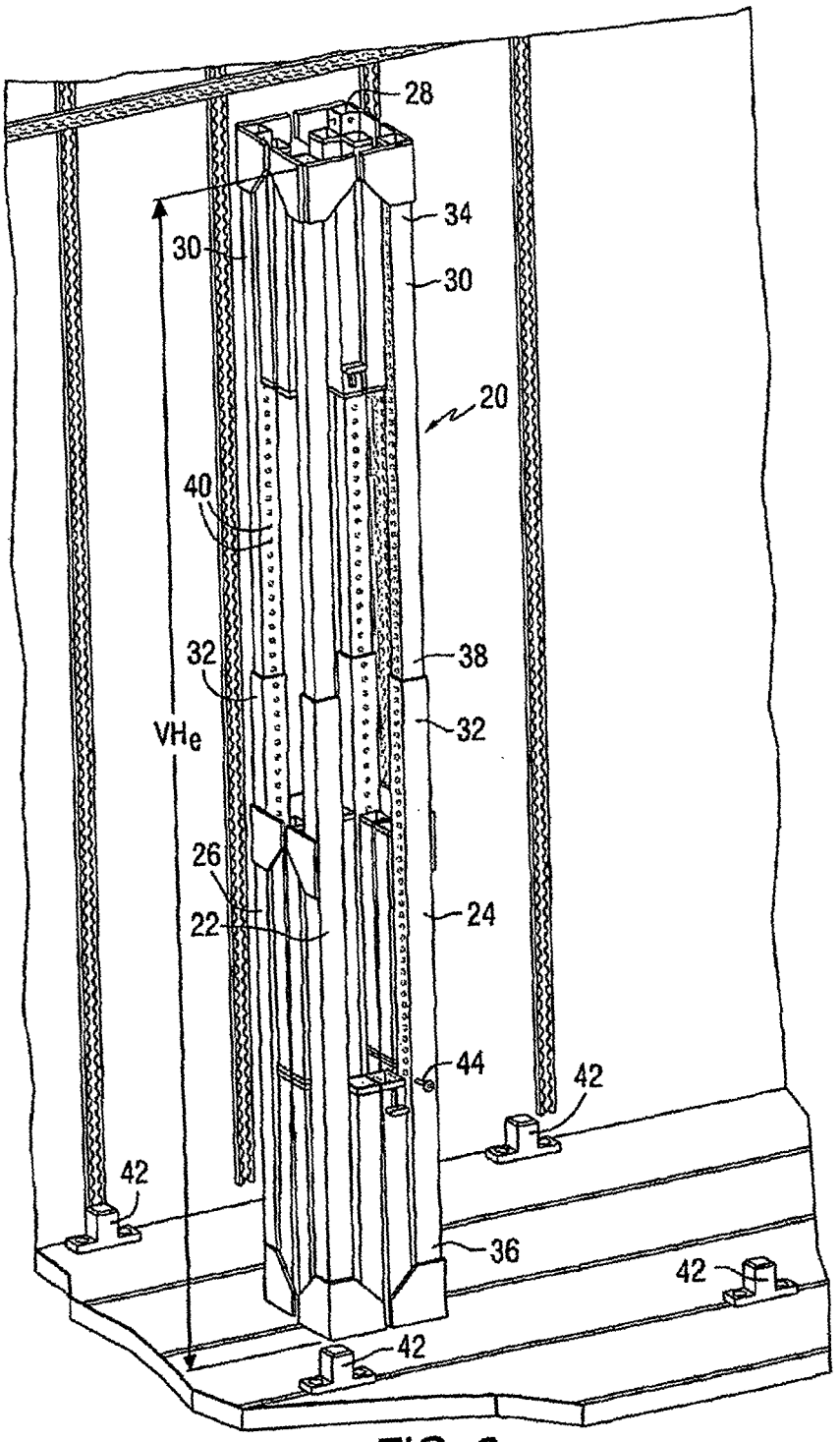
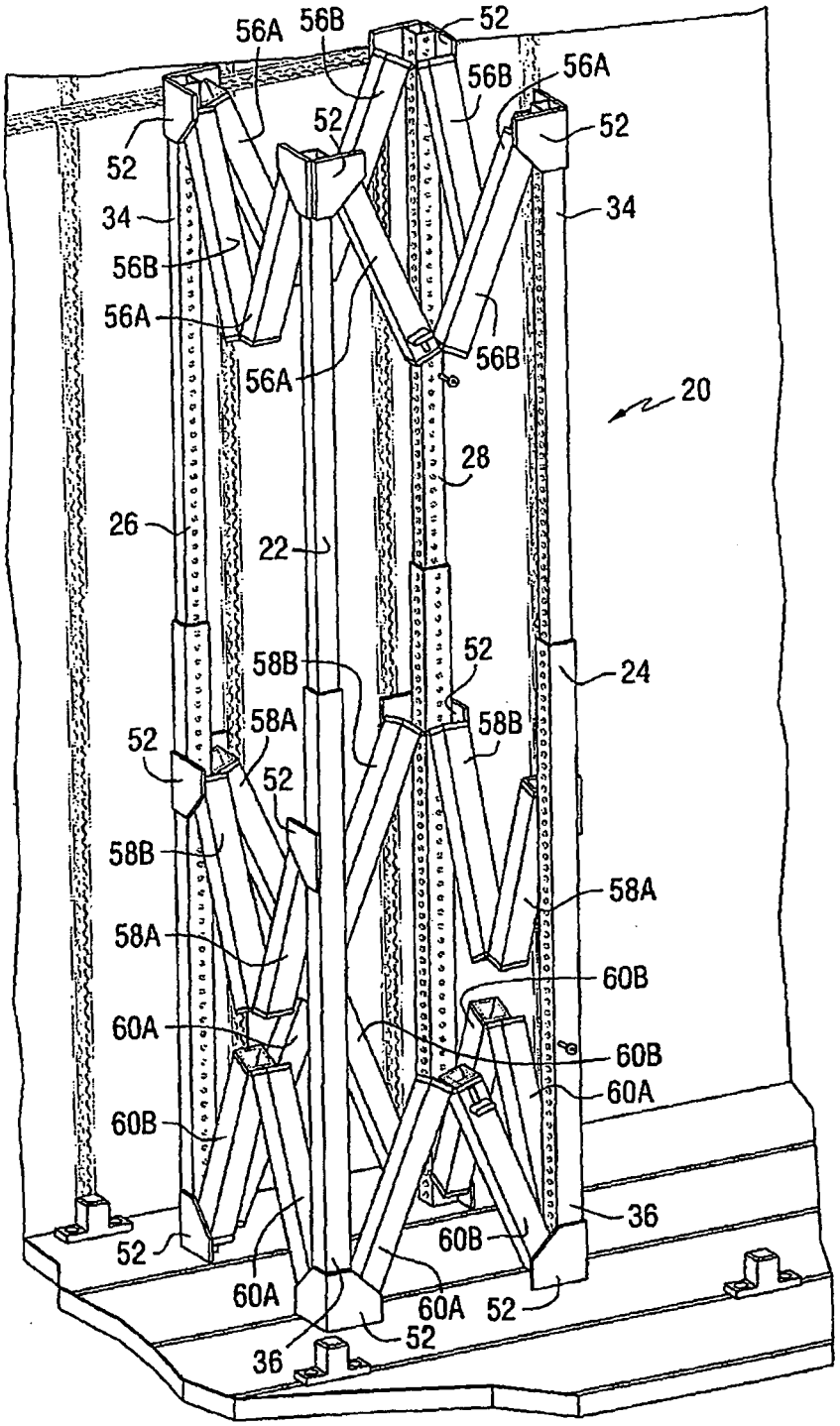


FIG. 2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52
58B
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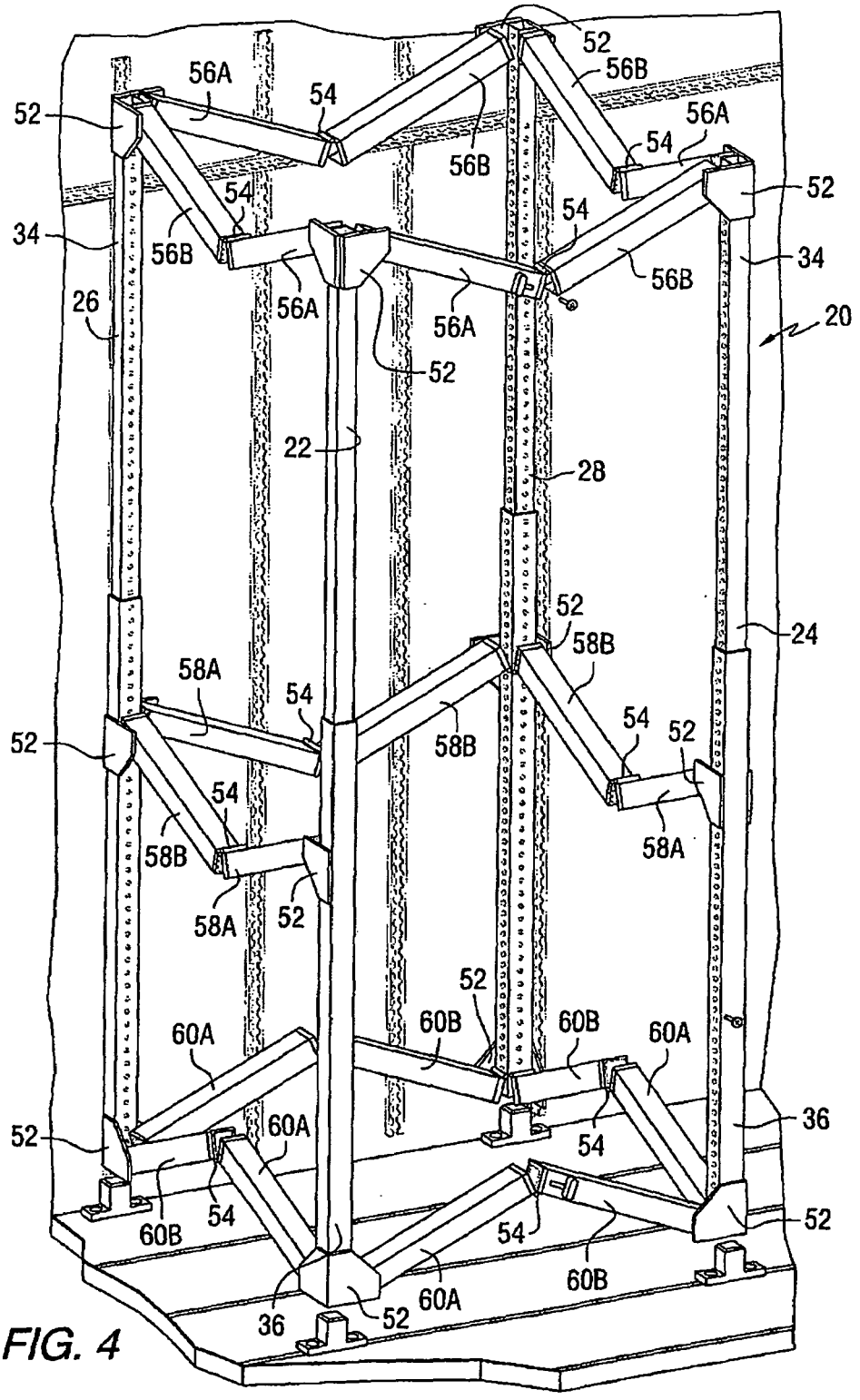
FIG. 3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52
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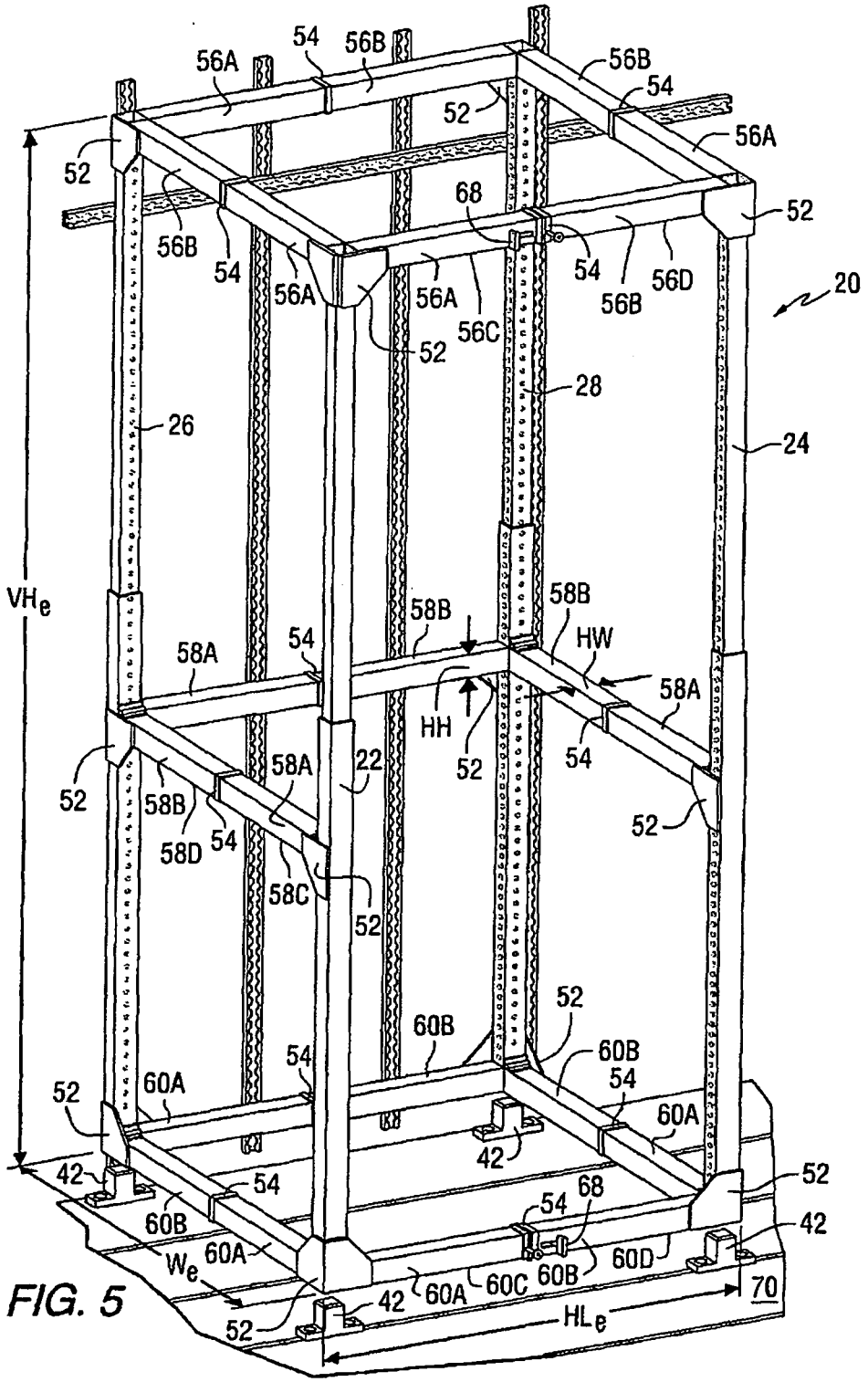
60A

FIG. 4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28
26
24
VHe
58B
58B
HW
58A
54
58A
HH
52
54
58A
22
52
58B
58D
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58C
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FIG. 5

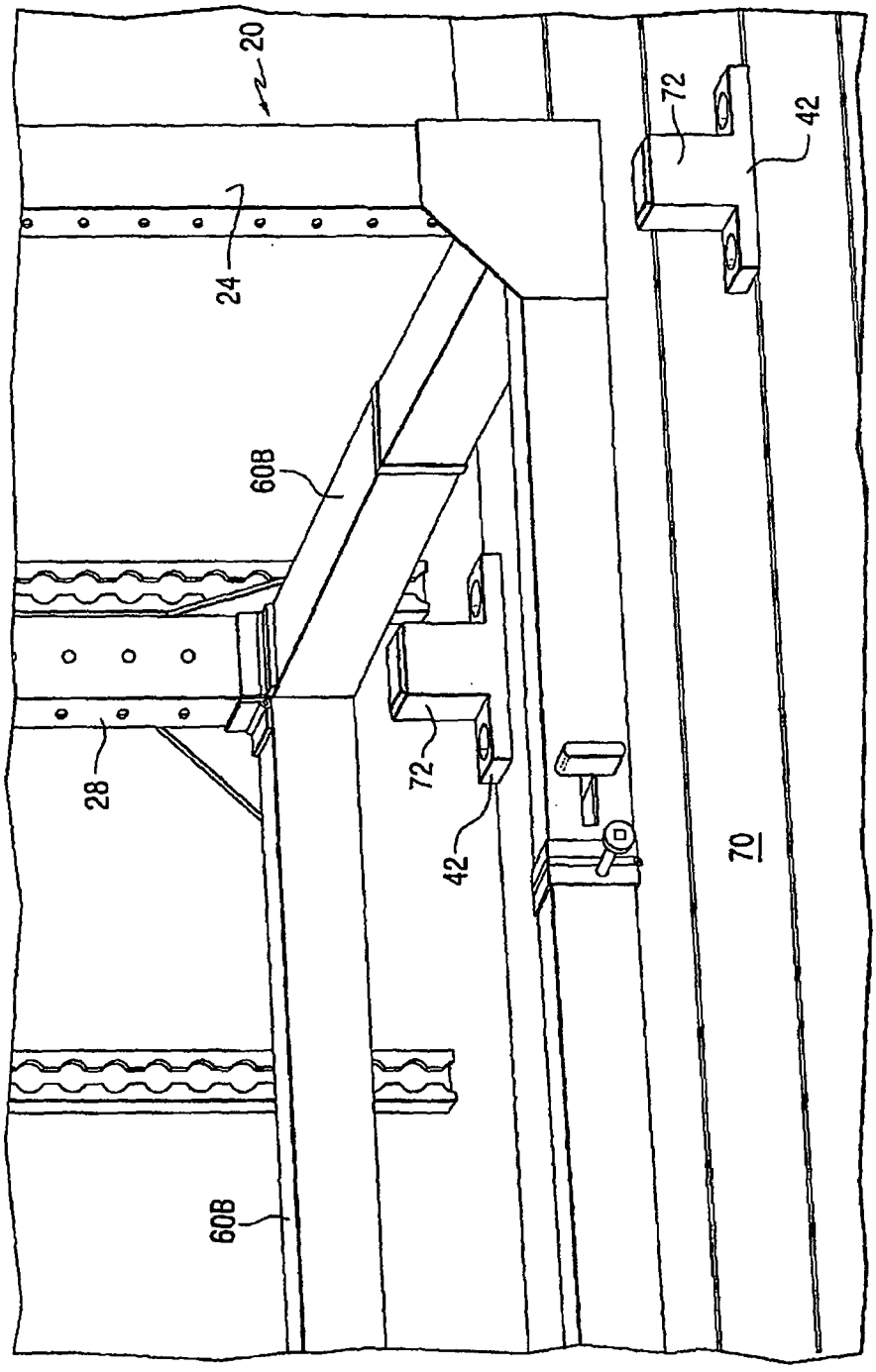
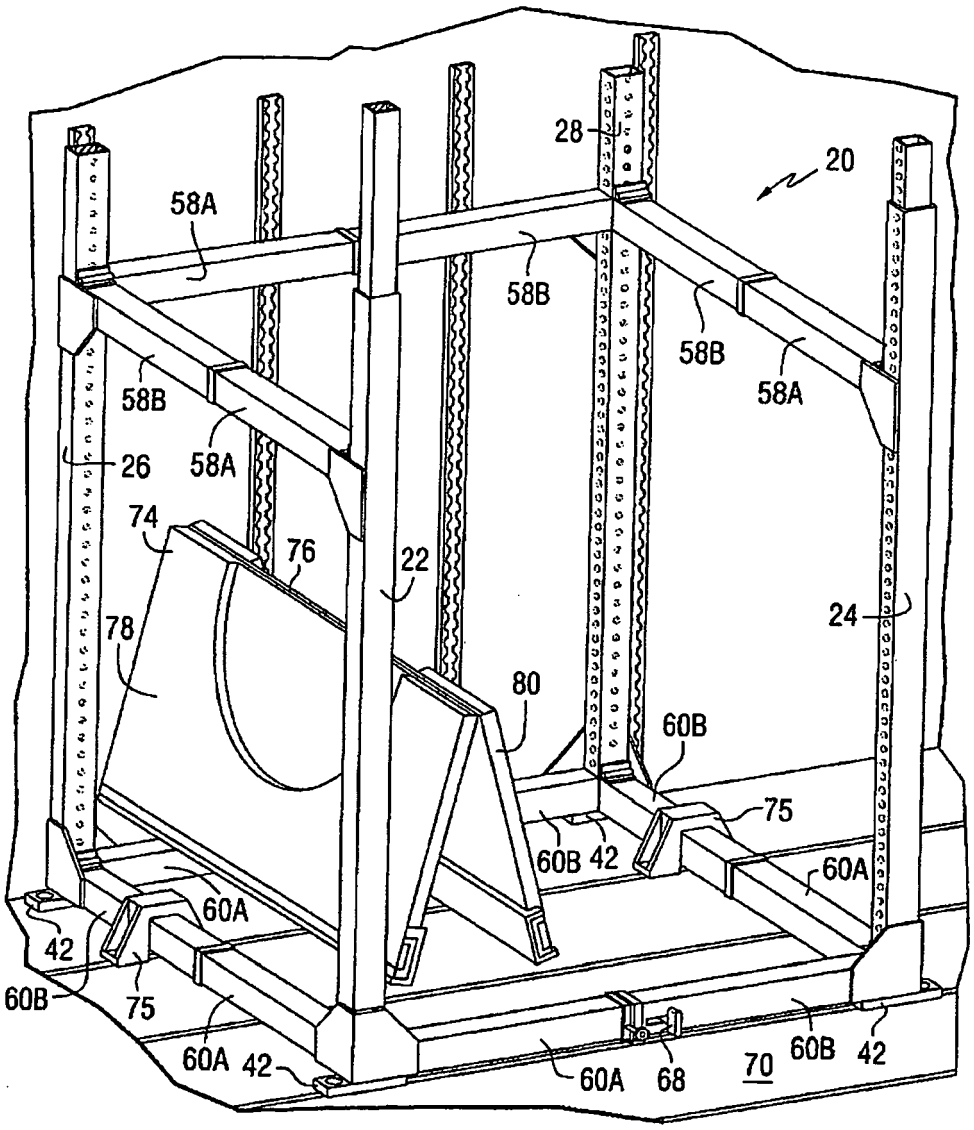


FIG. 6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60B
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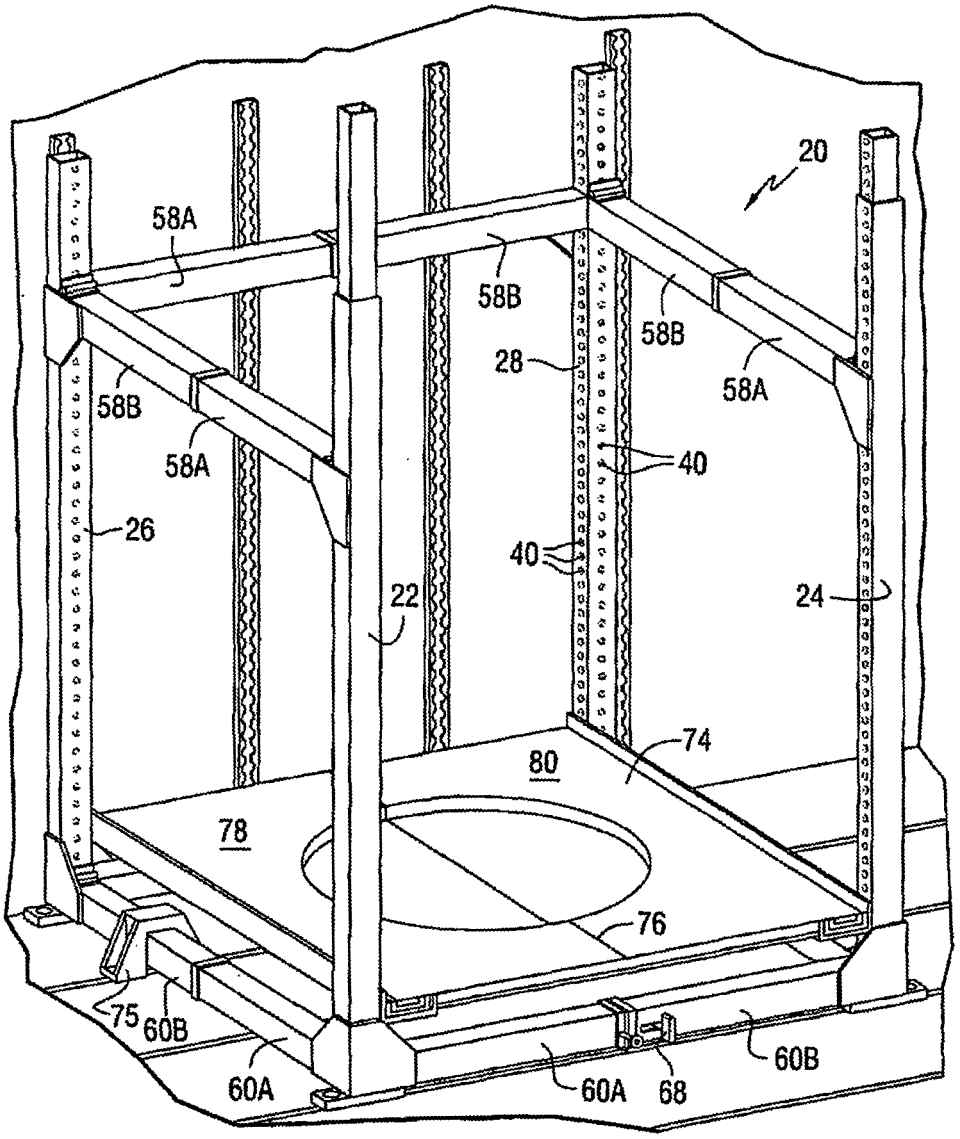
FIG. 7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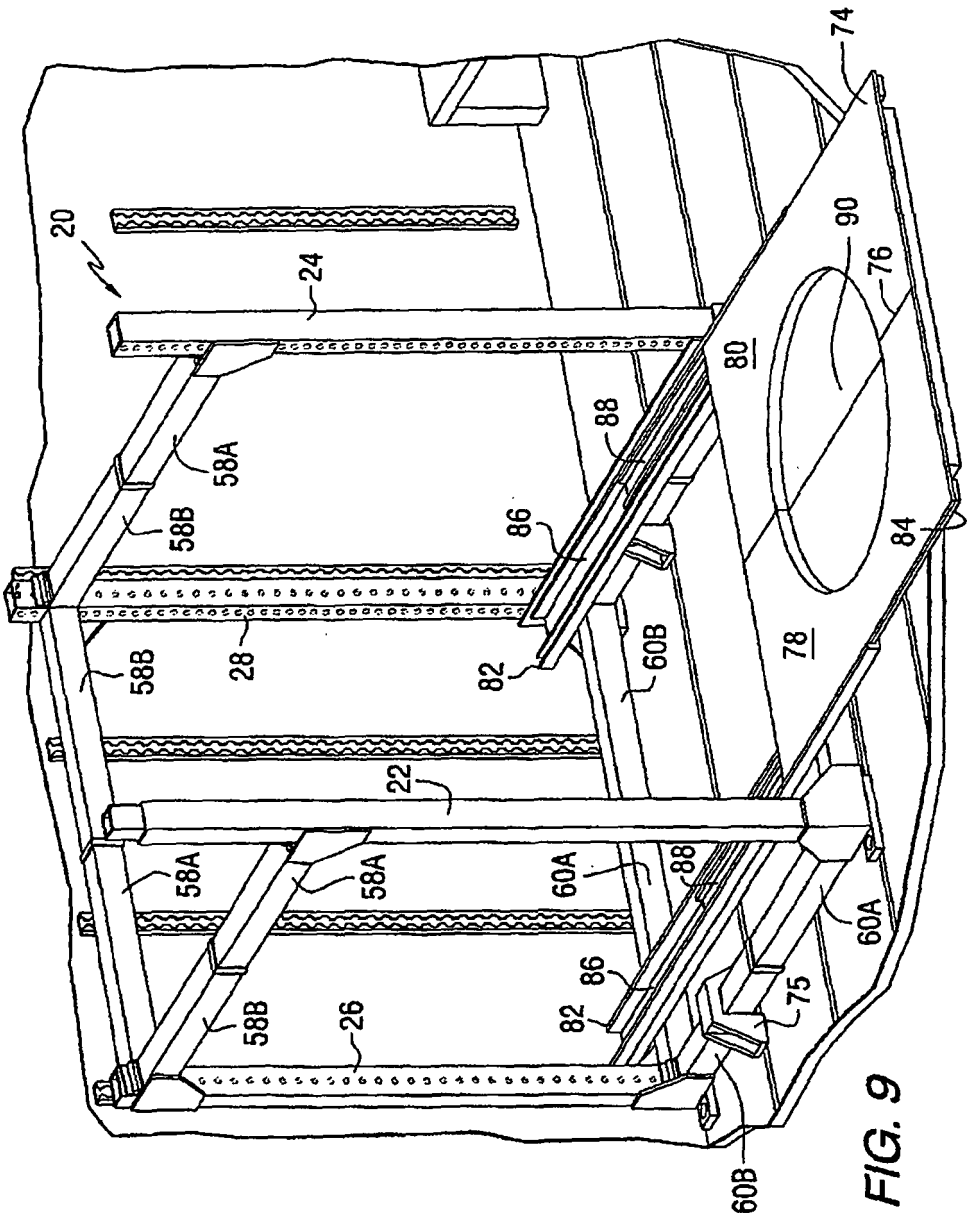
60B

FIG. 8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60A
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FIG. 9

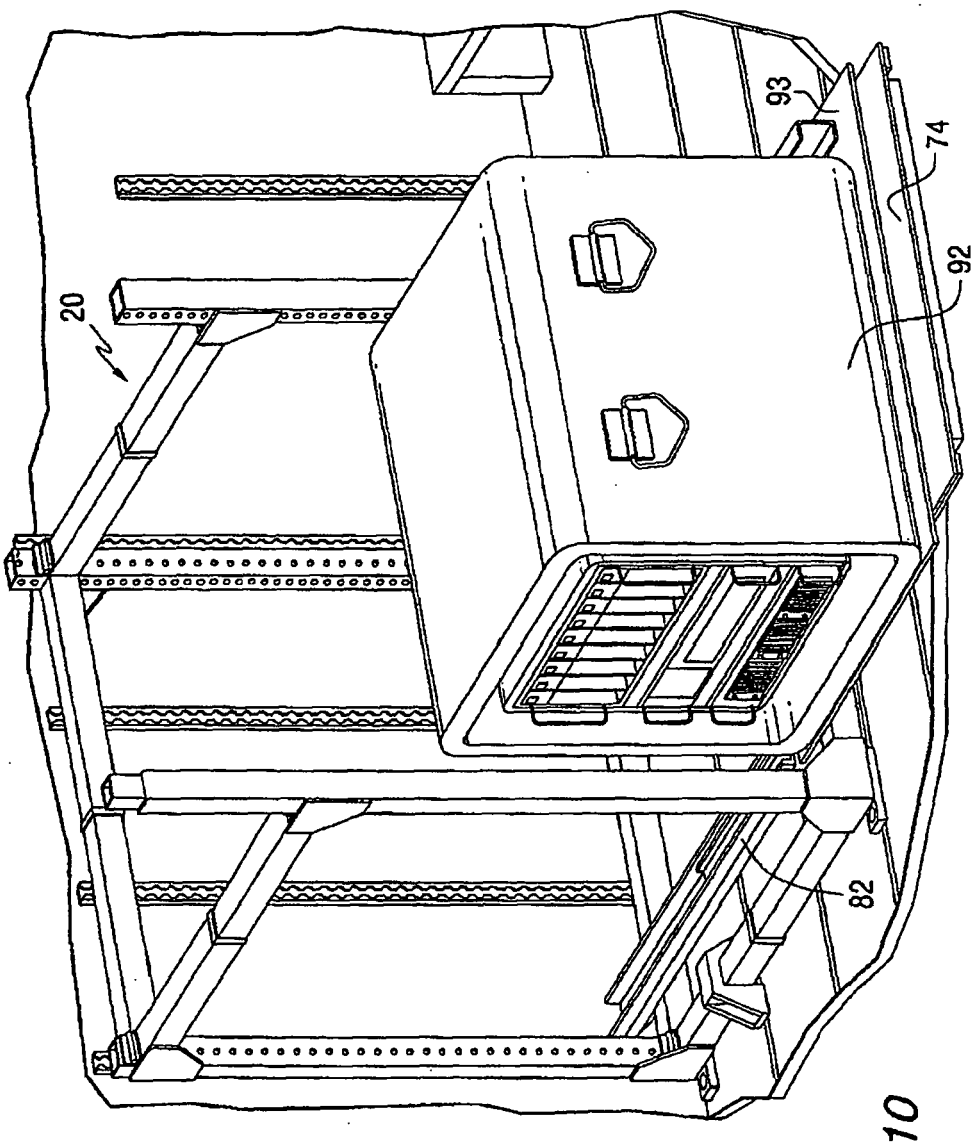


FIG. 10

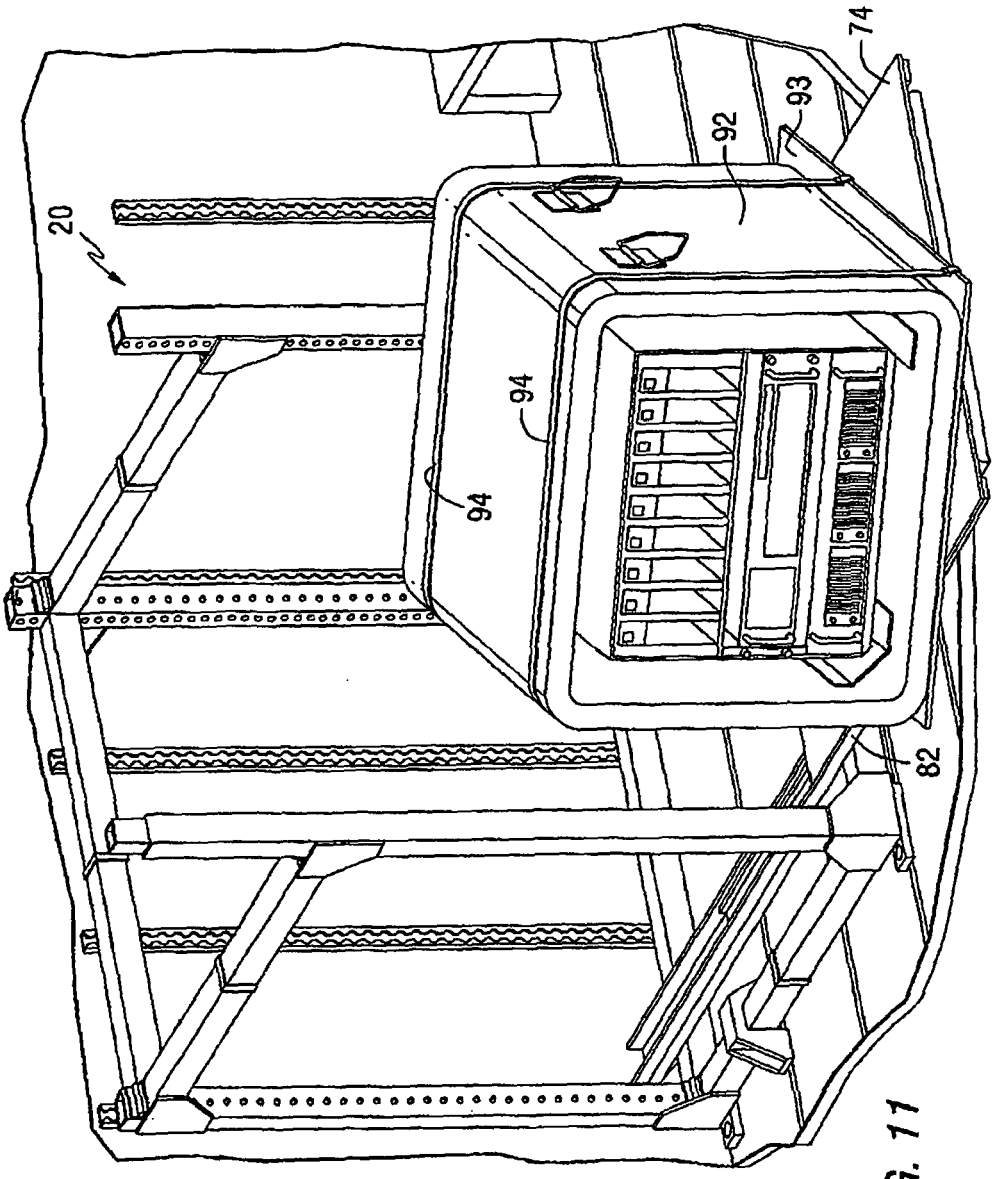
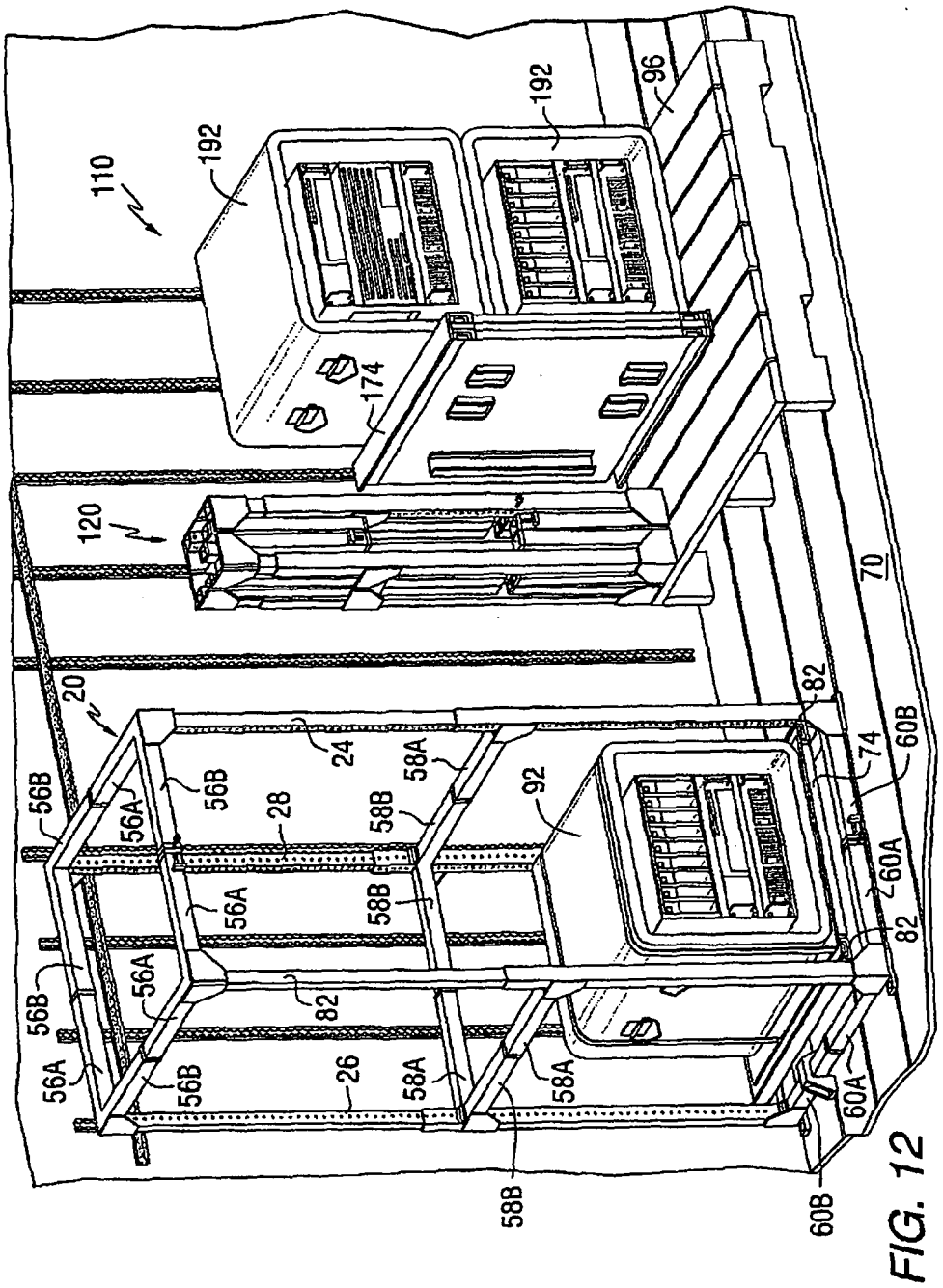


FIG. 11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60B

FIG. 12

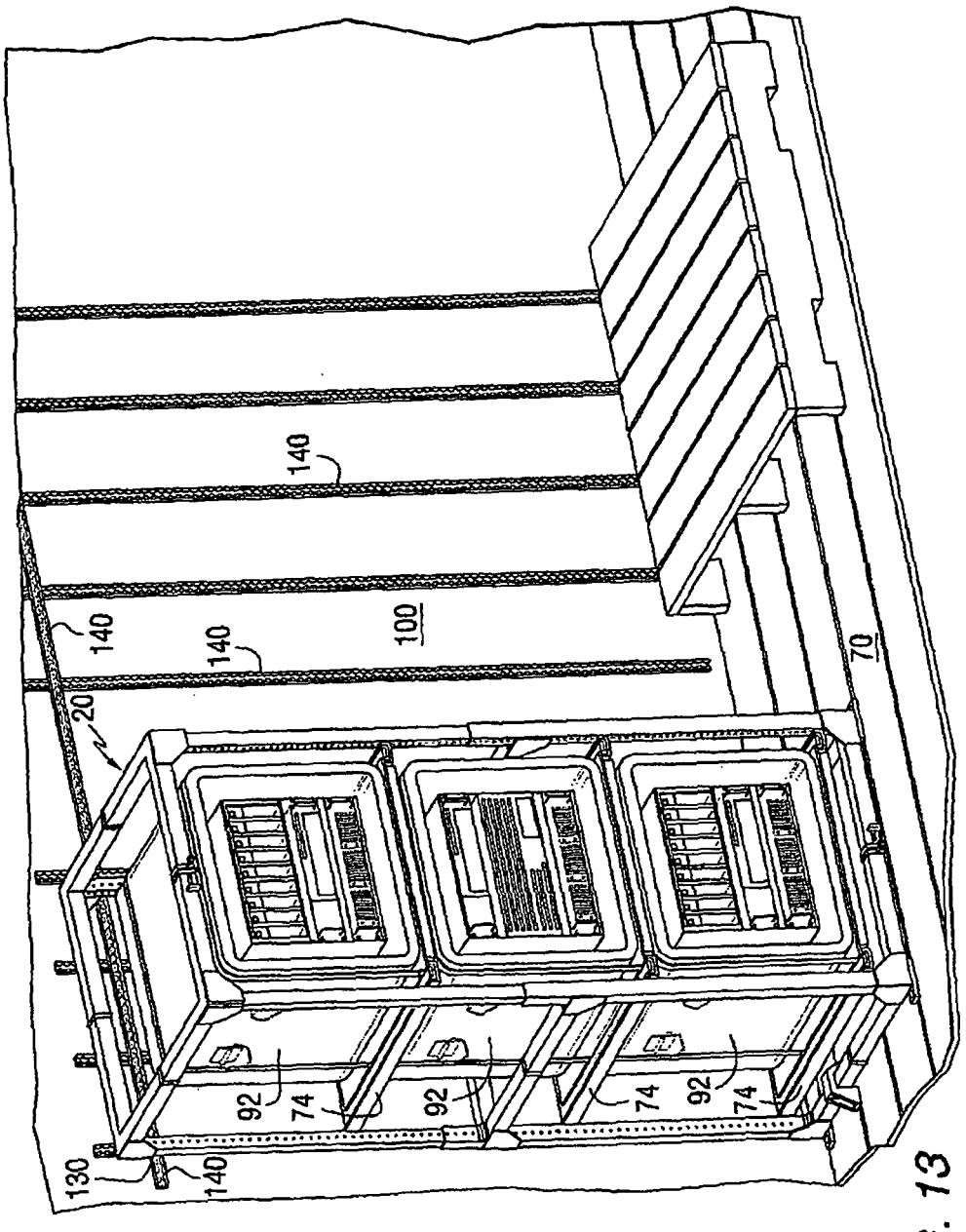

FIG. 13

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 00 8290

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X Y	US 4 482 900 A (BILEK FRANK V [US] ET AL) 13 November 1984 (1984-11-13) * column 2, line 56 - column 3, line 24; figure 2 * -----	1-6,8,9, 20,21,23 7,10-14, 22	
Y	US 2004/194419 A1 (SIMMONS ROBERT J [US]) 7 October 2004 (2004-10-07) * paragraphs [0004] - [0006], [0014] - [0016], [0024]; figures 1,2 * -----	7,10-14, 22	
Y	US 4 964 020 A (SAVAGE DALE A [US] ET AL) 16 October 1990 (1990-10-16) * column 5, lines 20-46; figures 8,10 * -----	13	

TECHNICAL FIELDS SEARCHED (IPC)

H05K
H02B
A47B
E04B
E04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	29 August 2007	Molenaar, Eelco

CATEGORY OF CITED DOCUMENTS

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