



(22) Date de dépôt/Filing Date: 2006/07/24

(41) Mise à la disp. pub./Open to Public Insp.: 2007/03/28

(45) Date de délivrance/Issue Date: 2010/07/13

(30) Priorité/Priority: 2005/09/28 (US11/237,189)

(51) Cl.Int./Int.Cl. *B60P 3/00* (2006.01),
B60R 11/06 (2006.01), *B60R 9/055* (2006.01)

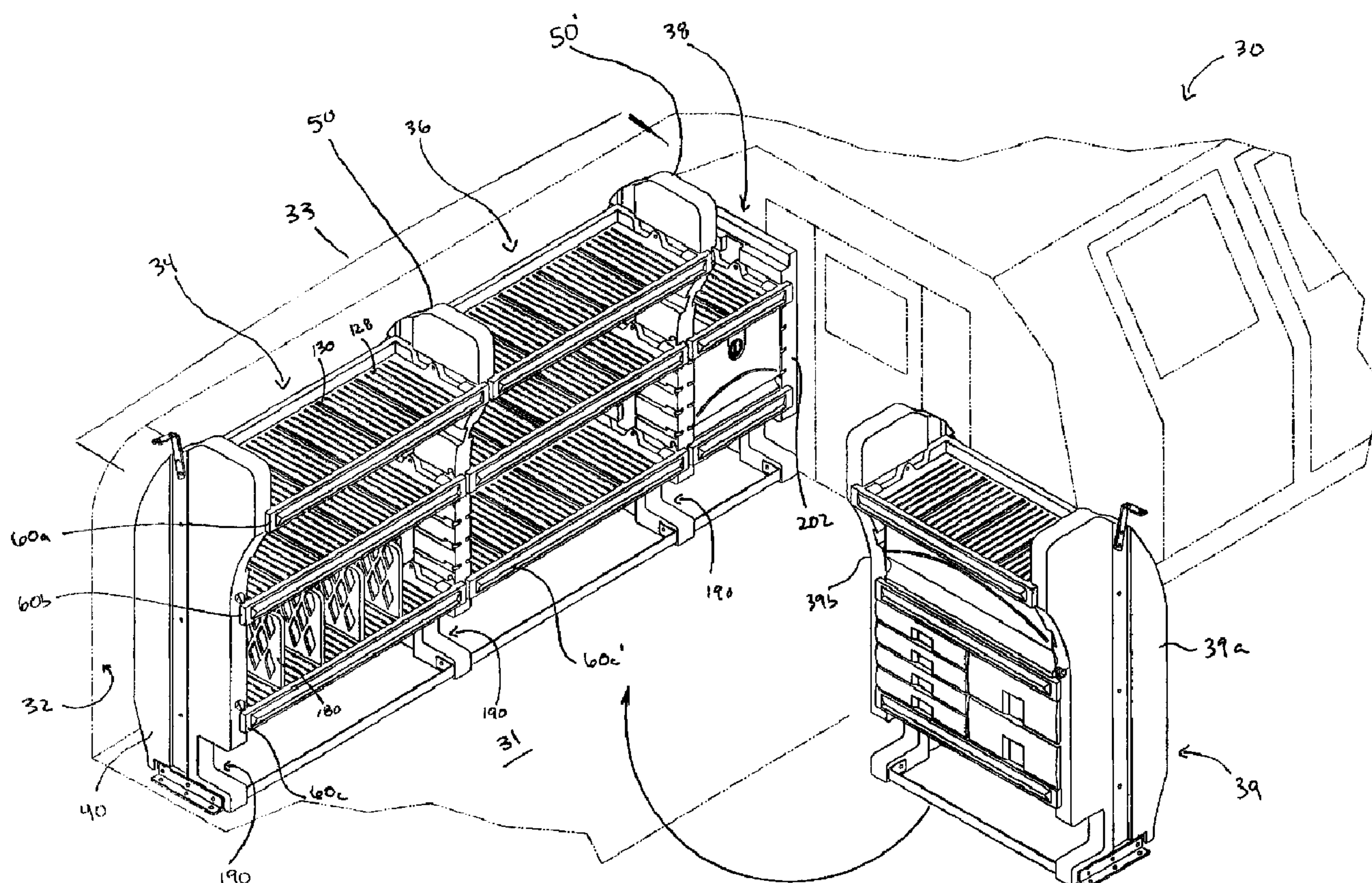
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(54) Titre : SYSTÈME REGLABLE DE RAYONNAGE ET DE RANGEMENT POUR VEHICULES

(54) Title: ADJUSTABLE SHELVING AND STORAGE SYSTEM FOR VEHICLES



(57) Abrégé/Abstract:

An adjustable storage system includes one or more adjustable storage units. The storage units generally comprise opposing panels comprising a polymer material and one or more shelf supports means that are integral with the panels. Shelves and/or drawers, also made from polymer materials, may then be disposed between the panels. Storage units may be added to the storage system by adding additional panels. In some embodiments, adjacent storage units of a storage unit may share a panel.



ADJUSTABLE SHELVING AND STORAGE SYSTEM FOR VEHICLES**ABSTRACT**

[00110] An adjustable storage system includes one or more adjustable storage units. The storage units generally comprise opposing panels comprising a polymer material and one or more shelf supports means that are integral with the panels. Shelves and/or drawers, also made from polymer materials, may then be disposed between the panels. Storage units may be added to the storage system by adding additional panels. In some embodiments, adjacent storage units of a storage unit may share a panel.

ADJUSTABLE SHELVING AND STORAGE SYSTEM FOR VEHICLES

BACKGROUND

[0001] The present disclosures relates to a storage system for vehicles. More specifically, the present disclosure relates to a modular storage system for use in vehicles. It finds particular application in conjunction with vehicles such as, for example, cargo vans and the like, and will be described with particular reference thereto. It is to be appreciated, however, that the present exemplary embodiment is also amenable to other like applications.

BRIEF DESCRIPTION

[0002] Service professionals, e.g., plumbers, contractors, cable or telephone installers, electricians, etc., are commonly required to carry in their vehicles a large number and variety of tools, parts, equipment, and the like necessary to perform their work. The tools, parts, equipment, etc., can range from large or bulky tools or large spools of cable to smaller tools, fasteners, spare parts, etc. As such, it is known to equip service vehicles with storage units to house items of various sizes.

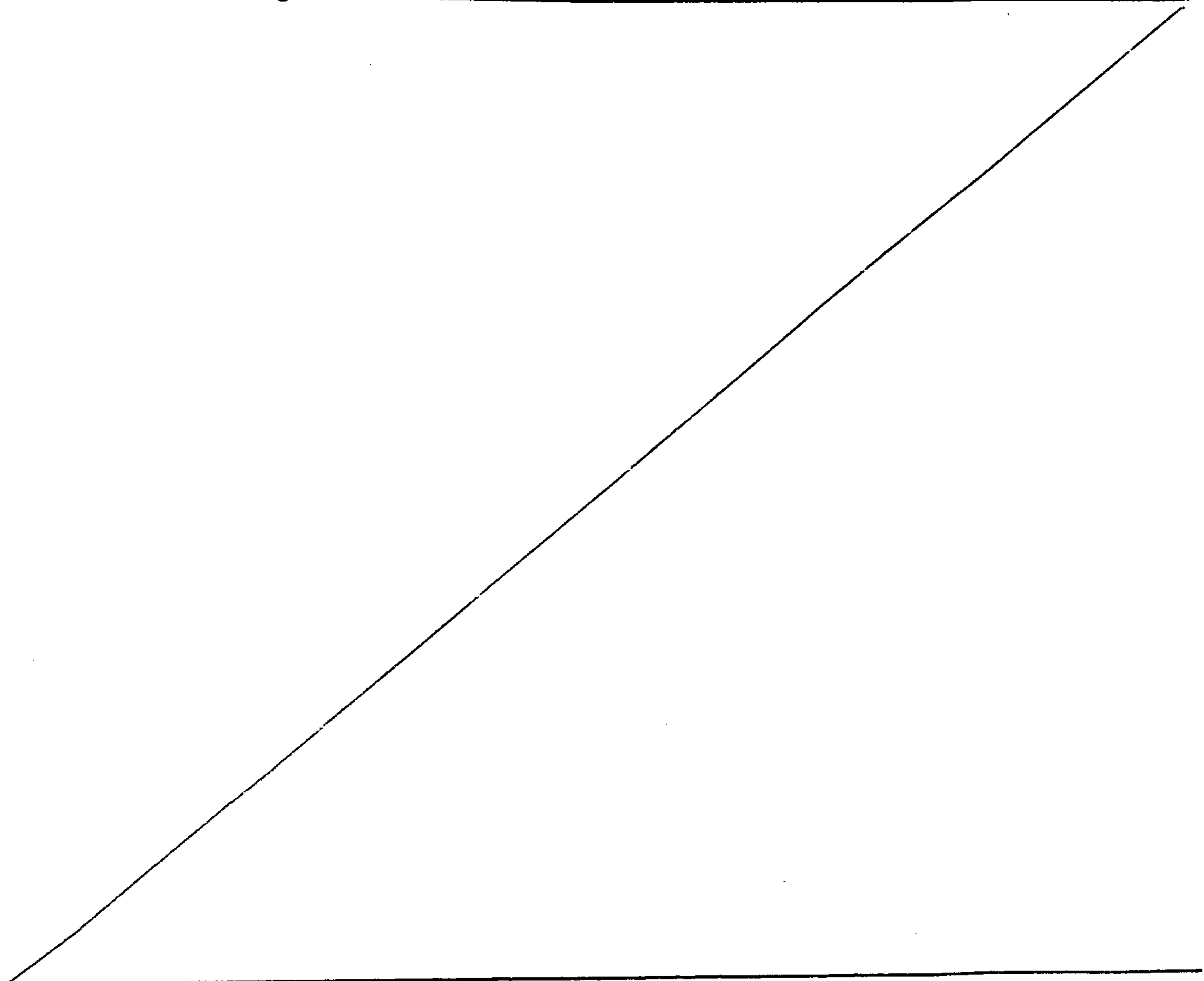
[0003] Many of the storage units known in the art are steel units that include steel end panels, a back panel and steel shelving. The shelves of these storage units are essentially tray structures having a bottom and four sides extending perpendicular from and perpendicular to the bottom. The shelves are fitted between the two end panels adjacent the back panel to provide a storage unit. The shelves are held in position by connecting the shelves directly to each of the end panels and the back panel. The shelves may be held in position by welding the sides of the shelves to the end panels and the back panel or by mechanical fasteners connecting the shelves to each of the end and back panels through the sides of the shelves.

[0004] There are several disadvantages associated with these known storage units. Storage units known in the art are essentially as-is structures that are not easily reconfigurable or adjustable. It may be advantageous or even necessary for a worker to house an item in the vehicle for which no space currently exists. Therefore, it would be beneficial for the worker to be able to reconfigure the storage system in his vehicle by moving, adding or removing shelving, drawers, etc. Shelves that are welded to the end and back panels are not removable (or, at least, not

easily removed). In the storage unit described above, shelves or drawers are connected to both back panels and the end panels and therefore cannot be adjusted or reconfigured without either completely removing the unit from the vehicle or unmounting the end panels and back panel.

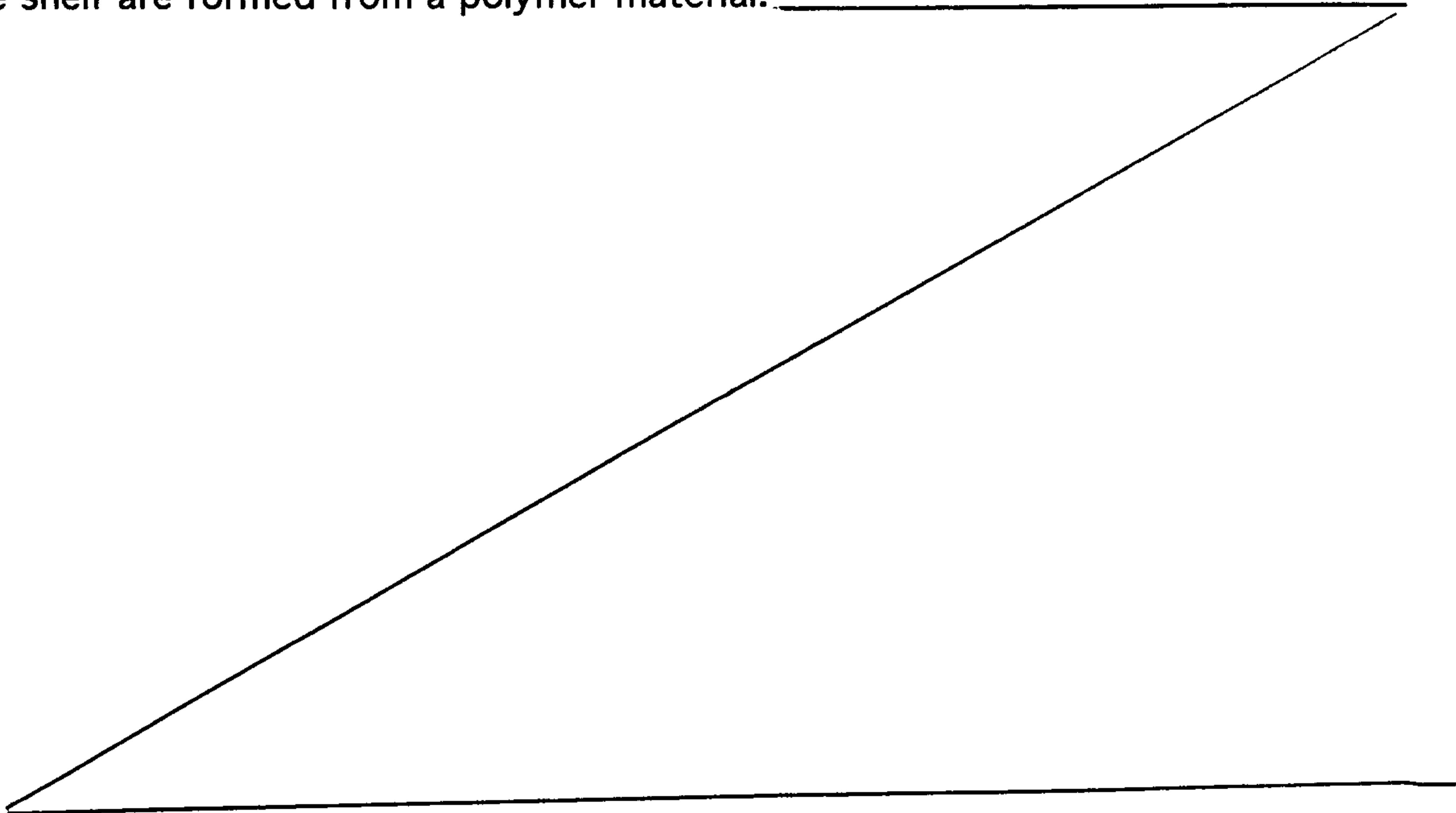
[0005] Additionally, several disadvantages are associated with the all steel construction of the storage units. First, the all steel construction may create a noisy environment. When empty, the steel units are prone to rattling during the operation of the vehicle. The noise level may be increased when the units are filled with various equipment including metal tools or parts. Second, the all steel units can be rather heavy, and added weight to a vehicle may increase fuel consumption for operation of the vehicle and increase the cost to operate the vehicle.

[0006] Therefore, there is a need for a storage system and storage units for vehicles that are modular, reconfigurable, and/or customizable by the user. Further, there is also a need for a storage unit or system for vehicles wherein the means for adjusting or reconfiguring the system is easily accessible to the user. Additionally, there is also need for a storage system that is lighter in weight compared to conventional storage units.



SUMMARY OF THE INVENTION

[0007] In one aspect, the invention provides a modular storage system for a vehicle having a front, a back, a curb-side, and a street-side, the storage system comprising a first support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the first panel; a second support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the first panel, and a second surface, the second panel disposed generally parallel to the first panel and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the second panel and opposite the shelf support means of the first panel; and a shelf dimensioned for removable receipt between the first and second panels, the shelf being supported by the shelf support means. At least the first panel further comprises a channel vertically disposed between the top and the bottom of the panel and a vertical member disposed within the vertical channel such that the shelf abuts the vertical member. The first panel, the second panel, and the shelf are formed from a polymer material.



[0008] The disclosure also provides, in various embodiments thereof, a modular storage unit for a vehicle having a front, a back, a curb-side, and a street-side, the storage unit comprising (a) a first panel having a top, a bottom, a front edge, a first surface, and a second surface opposite the first surface, the second surface comprising at least one channel recessed relative to the second surface and horizontally disposed between the front and rear edges of the first panel; and (b) a second panel generally parallel and opposite the first panel, the second panel having a top, a bottom, a front edge, a rear edge, a first surface, a second surface, the first surface of the second panel being oriented toward the second surface of the first panel, and at least one shelf support channel recessed relative to the first surface of the second panel and horizontally disposed between the front and rear edges of the second panel; wherein the first panel and the second panel comprise a polymer material.

[0009] Additionally, the disclosure provides, in various embodiments, a kit for forming a modular storage system for a vehicle comprising a plurality of panels having a top, a bottom, a first surface, a second surface, a front edge, and a rear edge, at least one of the first and second surfaces of the panels comprising one or more shelf support means horizontally disposed between the front and rear edges of the panels for receiving a shelf.

[0010] The disclosure also provides, in various embodiments thereof, a modular storage unit for a vehicle having a front, a back, a curb-side, and a street-side, the storage unit comprising (a) a first panel having a top, a bottom, a front edge, a first surface, and a second surface opposite the first surface, the second surface comprising at least one drawer slide channel recessed relative to the second surface and horizontally disposed between the front and rear edges of the first panel; and (b) a second panel generally parallel and opposite the first panel, the second panel having a top, a bottom, a front edge, a rear edge, a first surface, a second surface, the first surface of the second panel being oriented toward the second surface of the first panel, and at least one drawer slide channel recessed relative to the first surface of the second panel and horizontally disposed between the front and rear edges of the second panel, the drawer slide channels dimensioned for receiving a drawer; wherein the first panel and the second panel comprise a polymer material.

[0011] The disclosure also provides, in various embodiments thereof, a modular storage system for a vehicle having a front, a back, a curb-side wall, and a street-side wall, the storage system comprising (i) a first storage unit disposed along the curb-side wall, the first storage unit comprising (a) a first support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the first panel; and (b) a second support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the first panel, and a second surface, the second panel disposed generally parallel to the first panel and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the second panel and opposite the shelf support means of the first panel; and (ii) a second storage unit disposed along the street-side wall, the second storage unit comprising (a) a third support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the third panel; and b) a fourth support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the third panel, and a second surface, the fourth panel disposed generally parallel to the third panel and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the fourth panel and opposite the shelf support means of the third panel; and wherein the support panels are formed from a polymer material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIGURE 1 is a perspective of the cargo bay of a vehicle containing adjustable shelving systems with one swung away from its normal position for clarity;

[0013] FIGURE 2 is an exploded view of one segment of the shelving system depicted on the left hand side of the vehicle in FIGURE 1;

[0014] FIGURE 3 is an enlarged cross sectional view of a portion of a vertical panel of a storage unit and supported adjacent shelves on either side of the panel;

[0015] FIGURE 4 is a front plan view of a portion of a storage unit having a

number of drawers, the drawers being shown in phantom;

[0016] FIGURE 5A is an enlarged cross sectional view of the upper portion of the center drawer mounting system in FIGURE 4;

[0017] FIGURE 5B is an enlarged cross sectional view of the lower portion of the center drawer mounting system in FIGURE 4;

[0018] FIGURE 6 is a cross sectional view of the storage unit of FIGURE 4 taken along the lines 6-6 showing the drawers in a closed position;

[0019] FIGURE 6A shows the view of FIGURE 6 with the drawers in an open position;

[0020] FIGURE 7 is an enlarged cross sectional view of the drawer slide in FIGURES 6 and 6A taken along line 7-7;

[0021] FIGURE 8 is a cross sectional view of the storage unit in FIGURE 4 taken along the line 8-8 showing a center drawer mounting system disposed between two (2) shelves;

[0022] FIGURE 9 is a side elevational view of the center drawer mounting system in FIGURE 8;

[0023] FIGURE 10 is a front plan view of a storage unit having a door between the top and middle shelves of the unit;

[0024] FIGURE 10A is a front plan view of a storage unit with a door between the middle and bottom shelves of the storage unit;

[0025] FIGURE 10B is an enlarged cross sectional view of the storage unit in FIGURE 10A taken along the lines 10B-10B;

[0026] FIGURE 11 is an enlarged cross sectional view of the storage unit of FIGURE 10 showing details of the door hinge;

[0027] FIGURE 12 is an enlarged cross sectional view of a portion of the storage unit in FIGURE 11 taken along the lines 12-12 (with the shelf face not being shown in cross section);

[0028] FIGURE 13 is a side view of a storage unit (from the rear of the vehicle) having a door, the door being shown in a fully opened position;

[0029] FIGURE 14 is a side view (looking into the back of the vehicle) of storage units adjacent the curb-side and street-side walls of the vehicle and showing the cargo or aisle space available between portions of the units;

[0030] FIGURE 14A is a side view (looking into the back of a vehicle) comparing

the storage capabilities of storage systems employing conventional end panels to storage systems employing upright panels having curved or arcuate segments as may be employed in various embodiments of the disclosure;

[0031] FIGURE 15 is a detail showing a retainer means for positioning a back panel on an intermediate panel;

[0032] FIGURE 16 shows the positioning of a back panel and the retainer means of FIGURE 15;

[0033] FIGURE 17 is a detail showing a retainer means for positioning a back panel along an end panel;

[0034] FIGURE 18 is a cross sectional side view of a shelf;

[0035] FIGURE 19 is a cross sectional side view of two (2) shelves in a nesting configuration;

[0036] FIGURE 20 is a front plan view of a cubby unit;

[0037] FIGURE 21 is a side plan view of the cubby unit of FIGURE 20;

[0038] FIGURE 22 is a front plan view of another cubby unit; and

[0039] FIGURE 22A is a front plan view of a panel formed by flipping one of and then stacking the cubby panels of FIGURE 22.

DETAILED DESCRIPTION

[0040] The present disclosure relates, in various embodiments thereof, to a modular storage system for a vehicle and modular storage units that form or make-up the storage system. The storage system and storage units are particularly suitable for use in a vehicle such as a van, cargo van, truck, or the like.

[0041] Vehicles such as vans, commercial vans, cargo vans, trucks, and the like include a forward section, a back section, a longitudinal center line, a street-side and a curb-side. Using the American convention for driving, the area left of the longitudinal center line of the vehicle is referred to as the street-side and the area right of the longitudinal center line of the vehicle is referred to as the curb-side. The terms "street-side" and "curb-side" are merely used for purposes of convenience. It will be appreciated that items defined as a street-side item or a curb-side item can be switched along the longitudinal center line of the vehicle without departing from the scope of the disclosure.

[0042] Generally, a storage system in accordance with the present disclosure

comprises one or more individual storage units, wherein the individual storage units are formed by opposing, generally vertical or upright, panels. The general upright or vertical panels are also referred to herein as support panels. One or more shelves, or one or more drawers, may be disposed between the panels. The major components of a storage unit, i.e., the panels, the shelves, and/or the drawers, are formed from non-corrosive or polymeric materials. The panels include a means for supporting the shelves and/or the drawers. The shelf support or drawer support means may be integral with and molded as part of the upright panels.

[0043] With reference to FIGURE 1, a vehicle **30**, such as a van, includes a cargo bay **31** with storage system **33** adjacent street-side wall **32** and storage system **39** adjacent the opposite (curb-side) wall. Storage system **33** comprises individual storage units **34**, **36**, and **38**. Storage unit **34** is formed from upright panel **40** and upright panel **50**, which may include one or more shelves, such as shelves **60a**, **60b**, and **60c**, disposed between panels **40** and **50**. Storage unit **36** is formed from upright panel **50** and upright panel **50'**, which may include one or more shelves or one or more drawers disposed between panels **50** and **50'**. Storage unit **38** is a cubby unit formed from upright panel **50'** and a cubby panel **202**.

[0044] With reference to FIGURE 2, storage unit **34** of storage system **33** is shown. Generally, storage unit **34** includes a pair of opposing panels **40** and **50** having one or more shelves removably disposed between the panels. Panels **40** and **50** may be releasably connected to one another by one or more connecting members such as, front connecting member **80** and/or back panel **82**.

[0045] Panels **40** and **50** each include a first surface **41** and **51**, respectively, a second surface **42** and **52**, respectively, a top **43** and **53**, respectively, a bottom **44** and **54**, respectively, a front edge **45** and **55**, respectively, and a back edge **46** and **56**, respectively. For purposes of convenience, the first surfaces of the panels are described as being oriented toward the back of the vehicle, and the second surfaces of the panels are being described as oriented toward the front of the vehicle. The panels **40** and **50** may be positioned adjacent a side wall of the vehicle, and are oriented opposite and generally parallel to one another. As show in FIGURE 2, the second surface **42** of panel **40** faces the first surface **51** of panel **50**. The second surface **42** of panel **40** is a mirror image of the first surface **51** of panel **50**. By the previously described convention, in a storage system comprising more than two

upright panels, the second surface of one panel faces the first surface of the next successive panel.

[0046] Storage unit **34** contains shelves **60a**, **60b**, and **60c**, disposed between panels **40** and **50**. Panels **40** and **50** include one or more shelf support means, e.g., **70a**, **70b**, **70c**, and **70d** integral with faces **42** and **51** of panels **40** and **50** respectively. As shown in FIGURE 2 and FIGURE 3, the shelf support means in panels **40** and **50** are channels **70a**, **70b**, **70c**, and **70d**, each having a generally horizontal lower surface and a generally horizontal upper surface extending from the front of the panels to the back of the panels. The channels are dimensioned to receive a shelf, such as, for example, one of shelves **60a**, **60b**, or **60c**, with the bottom of a shelf being supported by the lower surfaces, such as, for example, lower surfaces **72**, **72'** (FIGURE 3), of the respective channels.

[0047] With reference to the embodiments in FIGURES 1 and 2, the shelves such as shelves **60a**, **60b**, and **60c**, are positioned between panels **40** and **50**, and supported by shelf support means such as channels **70a**, **70b**, **70c**, and/or **70d**. As shown in FIGURE 3, the bottom of a shelf, such as shelves **60b** and **60b'** is (are) supported by the lower surface of a channel, such as for example, lower surfaces **72** and **72'** of channels **70c** and **70c'**, respectively.

[0048] A panel may optionally include shelf support means on both the first and second surfaces of the panel. For example, as depicted in FIGURES 1, 2, and 3, panel **50** includes shelf support means along each of the first and second surfaces of the panel. In one embodiment, such as that shown in FIGURES 1, 2, and 3, the first and second surfaces of a panel are mirror images of each other such that the shelf support means are positioned at the same vertical height within the panel. Thus, as shown in FIGURES 1 and 3, a panel such as panel **50** may support one or more shelves on each side of the panel. Panels having shelf support means along both (upright) surfaces provides some of the modularity to a shelving unit/system. In particular, a panel that can accommodate shelves or drawers on both sides allows an additional storage or shelving unit to be added such that the storage system may be expanded.

[0049] Further, the use of such panels allows adjacent storage units, such as units **34** and **36** in FIGURE 1, to share an upright panel, which allows for reducing the number of parts used or needed to create a storage system. This may be

beneficial to reduce the cost to create a system. A system with fewer parts should also have a reduced weight.

[0050] The shelves may optionally be releasably attached to the end panel to further secure or maintain the shelf in its position between the panels. The panels may also be releasably attached to a panel by fasteners, screws bolts, and the like via apertures or bores in the panels. A panel capable of supporting a shelf at the same vertical height on each surface of the panel may include an aperture or bore extending through the first and second surfaces of the panel. The aperture or bore is adapted to receive a fastener extending through one side wall of a shelf positioned on one side of the panel, through the apertures and through the side wall of a shelf supported along the second surface of the panel. For example, with reference to FIGURE 3, panel **50** includes shelf support means **70c** recessed relative to first surface **51** and shelf support **70c'** recessed with respect to second surface **52**. Shelf **60b** is supported by lower surface **72** of channel **70c**, and shelf **60b'** is supported by lower surface **72'** of channel **70c'**. Channels **70c** and **70c'** further include vertical walls **76** and **76'**, respectively. Vertical walls **76** and **76'** include bosses **94** and **94'** having an aperture **95** extending therethrough. Fastener **96** is positioned through an aperture in side wall **63a** of shelf **60b**, through aperture **95**, through an aperture of side wall **63b'** of shelf **60b'**; and secured with a tightening nut **97**.

[0051] A shelf support means includes any aperture or channel adapted to receive a portion of a shelf. The size and shape of the shelf support means may be selected as desired for a particular purpose or intended use. The shelf support means may be channels, such as channels **70a-70d** in FIGURE 2, that extend from the front of a panel to the back of a panel. In other embodiments, the shelf support means is a channel having an opening along the front edge of the panel such that a shelf may be positioned between two panels or removed therefrom by sliding the panel along the channel from the front of the panels. A shelf support means that is an elongated channel extending from the front of a panel may extend the full distance between the front and back of a panel (as shown in the embodiment in FIGURE 2). In another embodiment, a shelf support channel may have a terminal end adjacent the back of a panel. A terminal end may act as a stop when positioning a shelf in such a shelf support means.

[0052] In still other embodiments, a shelf support means may include a channel adapted to receive a shelf wherein the channel does not fully extend to either the front or the back of a panel. In such embodiments, a shelf may be positioned, such as by snap-fitting the shelf into the channel.

[0053] In further embodiments, a shelf support means may comprise a ledge extending from a surface of a support panel. A ledge may be integrally molded as part of a support panel. In one embodiment, a shelf support means on a given panel may comprise a generally continuous ledge extending between a front surface and a back edge of a support panel. A generally continuous ledge may extend substantially the entire distance between the front and back edge or it may have a length less than the distance between the front and back edge of a support panel. In other embodiments, a shelf support means on a given panel may comprise a plurality of ledges disposed at generally the same vertical height so as to define a generally horizontal surface for supporting a shelf. The shape, size, length, and number of ledges used to form a shelf support means is not critical and may be selected as desired for a particular purpose or intended use.

[0054] In other embodiments, a shelf support means includes one or more apertures adapted to receive a corresponding projection on a shelf. Or, in the alternative, a shelf support means may comprise a projection on a surface of a support panel adapted to mate with a corresponding aperture on a shelf. In such embodiments, a shelf may be positioned by, mating the apertures and projections (such as by, for example, snap-fitting). The shape, size, and number of the apertures and projections is not critical and may be selected as desired for a particular purpose or intended use.

[0055] In an exemplary embodiment, a shelf support means is a channel having an opening along the front of a panel such that a shelf may be easily slid into or out of the shelf support channel. This allows for quicker reconfiguration of a shelving unit or system and may not require removal or movement of the support panels to reconfigure a storage unit or system.

[0056] In other embodiments, a given shelf support means in one panel is positioned at the same vertical height of a shelf support means in the opposing face of the next successive panel such that opposing shelf support means lie in the same horizontal plane. The number, location, size and shape of the shelf support means

is not limited and may be chosen to accommodate a particular vehicle or intended use. In other embodiments, the shelf support means in all panels, or within an individual unit may be identical. Additionally, opposing faces of successive panels may be mirror images of one another.

[0057] The support panels may include other apertures or channels as desired for a particular purpose or intended use. For example, and with reference to FIGURE 2, the support panels may include a vertical slot or channel, **90**, adapted to receive a vertical member **92**. Vertical member **92** may be used to provide further support to the support panels such as panels **40** and **50**. In one embodiment, the vertical member **92** is made from a metal material and includes one or more apertures such that the vertical member may be releasably connected or attached to the upright support panels such as panels **40** or **50**. As show in FIGURE 2, the apertures of the vertical member **92** may be located or positioned to correspond with apertures of connecting member **93** that serves as a means for attaching a panel to the wall or ceiling of the vehicle. In this way, a fastener that connects connecting member **93** with a panel such as panel **40** extends through apertures in panel **40** and through the corresponding apertures in vertical member **92** so as to provide a metal-to-metal contact in attaching the panel to the vehicle.

[0058] The vertical members **92** are not limited in any manner and may be shaped and sized for a particular purpose or intended use. For example, the vertical member may extend the full height of the panel, or may have a height that is less than the full height of the panel. The vertical member may be any shape as desired for a particular purpose or intended use including, but not limited to, rectangular, a cylinder, quonset-shaped, and the like.

[0059] Additionally, the panels may include means for supporting one or more drawers between successive upright support panels. The drawer slide means may be formed as part of the support panels, i.e., integral with the surface(s) of the support panels, or provided via separate pieces such as is described in US 2005-0225108. Drawer slide means that are integral with a panel may include projections or recessed grooves generally extending between the front and back of a panel. Drawer slide means formed from recessed grooves will generally define an opening at the front of the panel dimensioned for receiving a

drawer.

[0060] In the several embodiments shown in FIGURES 1, 2, and 4-9, the panels comprise drawer slide means that are integral with at least one surface of the panels. The drawer slide means generally include recessed channels. The drawer slide means may be configured (as shown in FIGURES 1, 2 and 4-9) in a manner similar to the drawer slide configuration described in U.S. Patent Application Serial No. 10/821,366. With reference to FIGURE 4, an embodiment of storage unit **34** is shown that includes large drawers **100** and small drawers **102** disposed between panels **40** and **50**. As shown in FIGURES 2 and 4, panels **40** and **50** may comprise one or more drawer slide means **110** adapted to slidably receive a drawer. Drawer slide means **110** are integral with panels **40** and **50** and recessed relative to first and second surfaces thereof, respectively. With reference to FIGURES 6 and 6A, drawer slides **110** comprise a channel **112** having a lower surface **116** and an upper surface **114**. Channel **112** is adapted to receive a portion of a shelf in sliding engagement with lower surface **116** and/or upper surface **114**. The number, location, shape, and size of the drawer slide means **110** may be selected as desired for a particular purpose or intended use. As previously described, the opposing faces of successive panels are preferably mirror images of one another and thus, in embodiments comprising one or more drawer slides, drawer slides on opposing faces of successive panels are preferably positioned at the same vertical height on the panel.

[0061] In one embodiment, the panels are adapted to receive one drawer slidably positioned between opposing drawer support means. In another embodiment, a drawer slide post, such as post **122**, may be positioned between adjacent panels, such as panels **40** and **50**. Post **122** (FIGURES 4, 5A, 5B, 8, and 9) includes drawer slide means **110'** on each vertical surface of the post to allow drawers to be positioned between panel **40** and post **122** and between panel **50** and post **122** as seen in FIGURE 4. The top and bottom of post **122** comprise protrusions **124** and **126** respectively. The protrusions may be knob-like protrusions of various shapes or elongated members of various shapes. The post may be positioned between panels **40** and **50** by inserting protrusions **124** into a slot, recess, or groove **128** in the bottom surface **68** of shelf **60b** and inserting protrusion **126** into slot, recess, or groove **130** in the upper surface **69** of shelf **60c** (FIGURES 5A and 5B). The

protrusions are shaped to correspond to the shape of the slot, recess, or grove into which the protrusions are inserted. The protrusions may be sized such that the protrusions are slightly smaller than the slot, recess, or grove so that the protrusion may be snugly fitted into the slot, recess, or grove, such as, for example, by snapping the protrusion into the slot, recess, or grove.

[0062] With reference to FIGURES 5A, 5B, and 7, drawers **100** and **102** have outer walls **101a** and **101b**, and **103a** and **103b**, respectively. Drawers **100** and **102** further include flanges **106a** and **106b**, and **107a** and **107b**, respectively, substantially perpendicular to outer surfaces of outer walls **101a/101b** and **103a/103b**, respectively. As show in FIGURES 5A, 5B, and 7, flanges **106a/106b** and **107a/107b** are integral with the outer surfaces of the respective drawer walls. Channels **112**, (FIGURES 6 and 6A) and **112'** (FIGURES 8 and 9) of drawer support means **110** and **110'**, respectively, are adapted to receive flanges **106a/106b** and **107a/107b** respectively. The flanges **106a/106b** and **107a/107b** are slidable along the lower surface **116** and **116'** of channel **112** and **112'**, respectively.

[0063] In one embodiment, the drawer slides may be configured to provide a stop so that the drawer may not be pulled out beyond a particular point. With reference to FIGURES 6, 6A, and particularly 7, a portion of panel **50** is shown depicting shelf support means **110** (FIGURE 6) having channels **112** defined by upper surface **114** and lower surface **116**. The discussion with respect to the drawer support means **110** on panels **40** and **50** is applicable to drawer support means **110'** on post **122** as depicted in FIGURES 8 and 9. For ease of discussion reference will be made to only one side of drawer **100**; it being appreciated that generally the same procedure and operation may apply to the other side for installing/using a drawer of this embodiment. As previously described, channel **112** is adapted to receive a flange, such as, for example, flanges **106a** and **107a**, of a drawer such as drawer **100**. Drawer **100** is moved into an open or closed position by sliding flange **106a** along lower surface **116**. A drawer stop **118** is provided by a stop wall **120** integral with and extending upwardly from the plane of lower surface **116**. Stop wall **118** is integral with vertical surface **117** of channel **112** and offset slightly from surface **51** of panel **50** such that flange **106a** is slidable along lower surface **116**. Generally, a drawer may include a protrusion or projection, such as, for example, flange **108a**, along the rear portion of the drawer. As shown in FIGURE 7, flange **108a** is integral

with flange **106a**, and drawer **100** may be slid along lower surface **116** until flange **108a** contacts or engages stop wall **120** of drawer stop **118**. It will be appreciated that a drawer may also include another flange (**108b** not shown) along the rear portion of the drawer and adjacent or integral with flange **106b**.

[0064] Optionally, the shelf support means may also include a rear stop. For example, drawer slides **110** include rear stop **121** (FIGURES 6 and 6A).

[0065] To position a drawer such as drawer **100** in the drawer slides depicted in FIGURES 1, 2 and 4-9, the rear portion of the drawer and flanges **108a** and **108b** (not shown) are moved into upper slots **132** (FIGURE 6) and **132'** (FIGURES 8 and 9) until flanges **108a** and **108b** can fit into an openings **133** (FIGURE 6) and **133'** (FIGURES 8 and 9), respectively, defined by the distance between the edge of upper surface **114** and the upper edge of stop wall **120** (**114'** and **120'** in FIGURES 8 and 9). Flanges **108a** and **108b** are then lowered through openings **133** and **133'**, respectively, until flanges **108a** and **106a** contact lower surface **116** and flanges **108b** and **106b** contact lower surface **116'**. At that point, the drawer, such as drawer **100**, may be slid into an open or closed position as desired along respective lower surfaces **116** and **116'** of channels **112** and **112'**.

[0066] The size and shapes of the drawers and/or drawer slides are not critical, and may be configured for a particular vehicle or intended use. Drawer stops, e.g., **118** need not have angled walls as depicted in FIGURES 6, 6A, 8, and 9, but may have any configuration that will sufficiently engage a portion of a drawer to prevent the drawer from opening or closing further. Additionally, a post comprising drawer support means need not be utilized. Rather, in other embodiments, drawers may be positioned using only opposing shelf support means, and the drawers may be substantially the entire width of a storage unit. Additionally, one or more posts comprising shelf support means may be positioned between opposing panels to provide more than two columns of drawers. There is no limit to the configuration or permutations, and the embodiment in FIGURES 4-9 is merely exemplary of one possible embodiment.

[0067] The panels may also comprise means for releasably attaching a door to successive panels and provide a locker-type environment in a unit. With reference to FIGURES 10-12, storage unit **34** is depicted as having a door positioned between either shelves **60a** and **60b** or between shelves **60b** and **60c**. The door may include

any suitable means for attaching a door to the panels. For example, in one embodiment, the doors may include pins projecting from the sides of the doors for receipt in a corresponding slot in the panels. One or both of the pins may be spring loaded such that a pin may be inserted into a slot on one panel, and the (other) spring loaded pin may be depressed such that the door may be positioned between the panels and then the pin released into a corresponding slot on the other panel.

[0068] With reference to FIGURES 10-12, another embodiment is shown wherein the door comprises pins integral with and molded to the sides of the doors. The panels each comprise slots **170** (FIGURE 12) integral with the upper surface **74** (FIGURES 11 and 12) of shelf support means **70** so as to define an opening at the bottom of slot **170**. Door **160** is positioned between panels **40** and **50** by inserting pins **166** into the opening of slots **170**. A door is held in place and a shelf, such as, for example, shelf **60c**, is positioned in the shelf support means immediately below the slots into which the door has been positioned. The upper surface of the front walls and/or a portion of the side walls of the shelf maintain the door pins in place within the slot such that the door is now rotatable between an open and closed position about a horizontal axis.

[0069] The shape and configuration of the door is not limited in any manner and may be selected as desired for a particular purpose or intended use within a particular vehicle. For example, the door may be configured to allow the door to open to a selected position. With reference to FIGURES 11 and 13, door **160** comprises a groove or indentation **168** along the front surface **161** of door **160**. When the door is moved into an open position the door is rotated downwardly until the apex of the groove **168** contacts a portion of the shelf **60** thereby defining an angle α . The angle depends on the thickness of the door panel and/or the depth of the groove **168**. The use of groove **168** allows door **160** to be opened to a position such that the angle α is at least about 90° . In the illustrated embodiment, the angle α is greater than 90° , which is advantageous because it reduces the space occupied by the door in an open position and may allow easier access to the interior portion of the shelf. Aisle space in a truck or van is valuable. The width of the truck or van is limited. This limited width must often be allocated between storage units on each side of the truck and the aisle between storage units. The aisle must be sufficiently wide to allow excess. However, if the aisle can be made one inch narrower by use

of a door or doors that open beyond 90°, the storage system can be made one inch deeper.

[0070] The support panels (e.g., panels **40**, **50**, and **50'**) may be sized, shaped, and configured as desired for a particular purpose or intended use in a particular vehicle. For example, the panels may be generally rectangular having a relatively flat front, back, top, and bottom edges. In another embodiment, the panels may have a generally vertical or flat front edge and a back edge that has a generally vertical portion adjacent or near the bottom of the panel and a curved or angled portion towards the top of the panel to more closely mimic the shape of a vehicle's walls. In still another embodiment, as shown in the embodiment in FIGURES 1 and 2, both the front edge and the back edge of the panel may be curved or angled to more closely mimic the shape of the vehicle walls. Having the front edge of the panel mimic the shape or contour of the back edge of the panel is desirable to maximize shelf space because the depth of the panel would generally not decrease towards the top of the panel. Consequently, shelves or drawers near the top of a unit would not have to be less deep than those near the bottom. Additionally, using panels that are contoured such that the depth of the panel is essentially the same at different vertical points aids a given panel's modularity in that a shelf at one position can be moved to any other selected position without the need for obtaining or locating a different sized shelf for the unit.

[0071] The support panels may also include a cut-out portion adjacent the bottom of the panels. With reference to FIGURE 2, cut-out **190** of panel **40** is recessed relative to the front edge **45** of panel **40** and includes lower surface **192**, upper surface **194**, and vertical surface **196**. The shape and size of a cut-out portion is not critical and may be selected as desired for a particular purpose or intended use. In one embodiment, a cut-out has a square or rectangular shape. Generally, the depth of a cut-out is not limited except to the extent that the depth should not compromise the structural integrity or stability of the panel(s).

[0072] The cut-out portions provide extra space in the cargo area between storage units or systems on opposite walls of the vehicle. With reference to FIGURE 14, the effect of employing a cut-out portion in the support panels is depicted. As shown in FIGURE 14, the vertical portions of front edge **45** of panel **40** and the front edge of panel **39a** are separated by a distance D1. A distance D2 is

provided between vertical surface **196** of cut-out **190** and vertical surface **196'** of cut-out **190'** that is greater than the distance **D1** between the vertical front edges of panels **40** and **39a**. The cut-out portions **190** and **190'**, which provide distance **D2**, may allow for objects such as sheets or boards to be positioned between the storage units **33** and **39** that would not fit within the distance **D1** of the support panels. The distance **D2** may be selected as desired for a particular purpose or intended use and depends on the distance between the support panels of opposing storage units/systems, and the shape and depth of the cut out portions **190** (and **190'**). For example, the panels may be provided to provide a distance **D2** to allow for items such as 4' by 6', or 4' by 8' boards or sheets to be horizontally stored between the storage systems such as storage system **33** and **39**.

[0073] A plug-member may be provided to cover or generally fill-in a cut-out area, such as, for example, cut-out **190**. A plug-member may be dimensioned for receipt in a cut-out. A plug-member may be adapted for releasable connection to a panel member. For example, as shown in FIGURE 2, plug-member **197** includes a tab **198** with apertures **199** adapted to receive a fastener. To fill the open area of cut-out **190**, plug-member **197** is positioned in cut-out **190**. Tab member **198** overlaps a portion of a panel, such as panel **40**, and the plug-member is releasably connected to the panel by a fastener inserted through apertures **199** and into a surface of a panel.

[0074] While the support panels may have any shape as desired or selected for a particular purpose or intended use, FIGURE 14A demonstrates the advantage of employing support panels having curved or arcuate portions along the front and/or back edges of the panels toward the top of the panels. As previously described, the front and back ends of the support panels may be curved to more closely mimic the shape or contour of the vehicle walls. FIGURE 14A shows how storage space may be maximized in a vehicle, such as vehicle **400**, using panels **420** and **420'**, in accordance with an embodiment of the present disclosure, as compared to using conventional panels **410** and **410'**. The designation **SS** refers to the street-side of the vehicle, and **CS** refers to the curb-side of the vehicle. For ease of discussion in describing the shape of the support panels, panels **410** and **410'** are mirror images, and panels **420** and **420'** are mirror images, and reference will be made to the panels on one side of the vehicle. Conventional panel **410** comprises a vertical front

edge **412**, a vertical back edge **414**, and an edge **416** that angles out of the vertical plane of back edge **414** and toward the top edge of panel **410**. As shown in FIGURE 14A, the storage space in a system using a conventional panel, such as panel **410**, decreases toward the top of the panel because the distance between vertical front edge **412** and edge **416** continues to decrease toward the top of the panel. Conventional panels are also generally formed from a metal material, and it may be expensive to form contoured or shaped panels by stamping.

[0075] A panel, such as panel **420**, that is formed from a polymer material, however, is more amenable to molding into desired shapes, and a shape may be provided that provides more storage space. In FIGURE 14A, panel **420** comprises a polymeric material and is shaped similar to the embodiments shown in FIGURES 1-14. Panel **420** comprises a generally vertical portion **421** along a front edge of the panel, and a generally vertical portion **422** along a back edge of the panel. The generally vertical portions **421** and **422** extend from the bottom of the panel toward the top of the panel. The back of panel **420** includes a curved or arcuate portion **424** that extends or curves inwardly toward the longitudinal center line of the vehicle and upwardly toward the top and front edge of the panel. Additionally, the front edge of the panel includes a curved or arcuate portion **426** that extends inwardly toward the longitudinal center line of the vehicle **400** and upwardly toward the ceiling **402** of the vehicle. Providing a panel with front and back edges that are curved or arcuate provides additional storage space, such as the shaded space **450**, as compared to conventional panels **410**. By providing arcuate front and back edges having similar degrees of curvature, the distance between the front and back edges does not decrease. Thus, in panel **420**, for example, there is more space near the top of the panels **420** that can be utilized for storage.

[0076] Employing panels with curved or arcuate portions allows for tighter tolerances in fitting a shelving unit in a vehicle. For example, providing panels with a curved or arcuate surface near the top of the panels allows for the creation of taller panels to better utilize the overhead space in a vehicle. While conventional panels, such as panel **410**, could be made taller, there is a limiting return in useful storage space because the depth of the panel decreases toward the top of the panel. The limited additional storage space may not outweigh the cost to provide a taller unit. With the shaped polymer panels, such as panel **420**, that have curved or arcuate

edges toward the top of the panel, however, because more useful storage space is provided and there is more incentive to employ taller panels. Thus, the panels can be made taller to extend into the overhead space of the vehicle. In one embodiment, for example, a panel having curved or arcuate portions along the edges may be provided such that there is a distance of less than two inches between the top of the panel and the ceiling of the vehicle. In another embodiment, this distance may be one inch or less. Comparatively, conventional panels typically have a distance of about five to about seven inches between the top of the panel and the vehicle ceiling. Similarly, panels having a curved or arcuate back edge allow for tighter tolerances along the vehicle walls.

[0077] The degree or severity of the curvature of an edge of a panel may be selected as desired for a particular purpose or intended use.

[0078] FIGURE 14A also demonstrates the storage space that may be available with a polymer storage panel having a cut-out portion as compared to conventional panels without such a feature. As shown in FIGURE 14A, there is a distance **430** between the front edges of conventional panels **410** and **410'**. In certain vehicles, for example, this distance may be about 37 inches. The use of polymer panels having a cut-out portion, such as cut-out portions **433** and **433** in panels **420** and **420'**, respectively, provides extra space **434** between certain areas of the opposing storage units. The space **434** may be, for example, to provide a space to store 4' x 8' sheets.

[0079] A back panel may be provided adjacent to successive support panels. A back panel may be provided as merely a backing to a storage unit and/or to connect adjacent support panels. A back panel may be held in position by any suitable means including, but not limited to, clips, fasteners, bolts, rivets, pop rivets, and the like. In some embodiments, a back panel is releasably connected to a shelving unit.

[0080] In one embodiment, a back panel may be retained or positioned adjacent the back surface of a panel by a retainer clip molded to the back edges of the support panels. With reference to FIGURES 15 and 16, a retainer clip on an intermediate panel, such as for example panel **50**, is shown. The retainer clip **140** includes a base member **142** extending from and integral with rear surface **56** of panel **50**. The retainer clip includes enlarged outer member **144** extending beyond the sides of the base member **142** such that a channel **146** is provided between

back surface **56** of panel **50** and the underside of outer member **144**. Channel **146** is sized to receive a back panel, such as back panel **82'**. As show in FIGURES 15 and 16, the retainer clip **140** provides a channel adjacent each of the first and second surfaces of the support panel. The shape of the base member, e.g., member **142**, and/or the shape of the enlarged outer member, e.g., member **144**, may be selected as desired for a particular purpose or intended use. For example, the sides of the base member may be, but are not limited to, parallel, curved, or angled, diverging sides. Similarly, the undersides of the elongated outer member may be, but not limited to, parallel, curved or angled relative to the back surface of the support panel.

[0081] Clips may optionally be provided, such as clip **150** in to FIGURE 17, that only include one channel for receiving a back panel. With reference to FIGURE 17, outer portion **156** of clip **150** is set off from back surface **46** of panel **40** by walls **152** and **154** of clip **150** so as to define a channel **158** between back edge **46** of panel **40** and the underside of outer portion **156**. As shown in FIGURE 17, clip **150** includes a bottom wall **152**. Bottom wall **152** may be suitable for supporting a bottom portion of a back panel and preventing the panel from moving downwards. It will be appreciated that intermediate panels, such as panel **50**, may include clips with bottom walls. Employing a clip having a bottom wall may eliminate the need for further means such as fasteners or bolts to retain a back panel in place. Even if clips with bottom walls are used, a back panel may be fastened or bolted to a panel.

[0082] The back panels may have a height that extends from the top of a storage unit to the bottom of a storage unit. In other embodiments, a back panel may have a height that does not extend to the bottom of the storage unit to accommodate any objects on the floor including, for example, a wheel-well of the vehicle.

[0083] A back panel may include an aperture, such as aperture **84** (FIGURE 2). Aperture **84** may be dimensioned for receiving a light or fan or any other desirable feature. A light may be particularly desirable for placement in aperture **84**. A cargo area may not be sufficiently lit, or the light may be blocked by a person moving around in the cargo area or standing between a main light source and a storage unit. Thus a light source disposed in aperture(s) **84** may provide sufficient lighting to a storage unit or a particular area of the storage unit. The extra light source in a storage unit allows a person to operate in or search through a storage unit without

having to handle an extra light source such as a flash light.

[0084] A back panel may be formed by any suitable material, including, but not limited to, pressboard, cardboard, plastic, fiber reinforced plastic, and the like.

[0085] The shelves are not limited in any manner and may be shaped and sized as desired for a particular purpose or intended use. Generally, a shelf includes a front wall, a back wall, opposing side walls, a shelf surface, and a bottom surface. One of the side walls may include an aperture for releasably receiving a fastener to secure the shelf to a respective panel.

[0086] In one embodiment, shelves may have a configuration such that two shelves may be stacked or stored in a nesting arrangement. This may be accomplished, in one embodiment, by providing a shelf configuration wherein a portion of a shelf's side panels have a height less than the height of the front and back walls of the shelf. For example, with reference to FIGURE 18, shelf **60** comprises front wall **61**, back wall **62**, and side walls **63**. As shown in FIGURE 19, side wall **63** includes hollows **64a** and **64b** recessed relative to the upper edge of side wall **63** and separated by section **65**. Section **65** includes projection **66** adapted to receive a fastener to connect a shelf to a panel. It will be appreciated that a shelf does not have to include section **65** and could include a generally continuous hollow or recessed area along a side wall. By providing a side wall having a portion or portions, such as hollows **64a** and **64b**, with a height less than the height of the front walls and back walls of the shelf, a shelf may be inverted and nested with another self such as shown in FIGURE 19. In FIGURE 19, shelf **60'** is inverted and positioned on shelf **60** such that the upper surface of back wall **62'** of shelf **60'** contacts portion **64b** of shelf **60** and portion **64b'** of shelf **60'** contacts the upper surface of back wall **62** on shelf **60**. Providing shelves of a configuration that allows for two shelves to be nested allows shelves to be stored in a manner that requires less space than if the shelves were merely stacked on top of one another. This is beneficial because space may be limited in many vehicles that are already filled with tools, parts, and the like.

[0087] A shelf surface may have any design or configuration as desired for a particular purpose or intended use. For example, a shelf surface may be generally flat or smooth. In another example, a shelf may include one or more projections or grooves or channels. Projections or channels or grooves may have any shape,

height, depth, and/or width, and may be oriented in direction as desired for a particular purpose or intended use. As an example, a shelf surface such as surface 69 may include projections 128 (FIGURE 1). A shelf surface such as upper surface 69 may also include slots or groves such as slots 130 (FIGURE 1) for receiving various add on pieces such as, for example, drawer support posts 122 (FIGURES 4, 5A, and 5B), dividers 180 (FIGURES 1, 10, 10A, and 10B) or the like.

[0088] In one embodiment, the shelves may comprise a means for adjusting the load rating of the shelf as is described in US 2005-0225108. Shelves used in storage units in accordance with the present disclosure are generally formed from polymer materials such as, for example, plastics or composite materials. Because the size of the storage units is not limited and may be any length as desired for a particular vehicle or intended use, the shelves may have widths of several feet or greater. Depending on the thickness of the shelf walls and horizontal support areas, along with the strength of the particular polymer plastic used to form the shelf, shelves several feet long may not be able to withstand a particular load. As shown in FIGURE 18, additional supports may be used to provide additional support to a shelf within a storage unit. Specifically, FIGURE 18 shows a shelf 60 having a bottom surface 68. Shelf 60 includes slots 67a, 67b, and 67c offset upwardly from bottom surface 68. Slots 67a-c extend lengthwise (between the side walls of the shelf) along the bottom of the shelf. As shown in FIGURE 18, slots 67a-c are dimensioned to mate with and surround three sides of the square tube or bar 240. Preferably, bar 240 is dimensioned to snap into slots 67a-c and fit snugly therein. Preferably, the support bars are dimensioned so that the lower (exposed) extremity of the bar is substantially coplanar with the bottom surface of the shelf such that the support bar will contact the upper surface of a shelf support. The support bars may also be dimensioned so that the lower extremities of the bar are not coplanar with the bottom surface of the shelf but slightly recessed. In that case, the bar would not contact the upper surface of the shelf support. The bars, such as bars 240, provide further support across the width of the shelf so that the shelf is able to support a greater load. Bars or beams having different cross-sectional shapes, such as, but not limited to, a u-shape, rectangle, quonset-shape cylinder, or the like can also be used.

[0089] The use of support bars positioned in widthwise slots of a shelf provides a method for adjusting the load rating of a shelf. Specifically, a shelf that is not further supported by any support bars has a first load rating. A shelf that is supported along the width of the shelf by one bar has second load rating, and so forth. Thus, a shelf may have $N+1$ load ratings where N is the number of widthwise slots in the shelf bottom surface to accommodate bars such as, for example, bar **240**. The load rating may, therefore, be adjusted by either adding or removing bars as needed for the intended use. Thus, for example, in FIGURE 19, shelf **60** would have four load ratings, i.e., one load rating without any support bars, and three additional load ratings depending on whether one, two or three bars are positioned within slots **67a**, **67b**, or **67c**. There is no limit as to the number of widthwise slots that a shelf may have (on the bottom surface). Because the supports are tightly restrained in the slots **67a-c**, they are prevented from rattling.

[0090] The support bar **240** is not limited in any manner. A support bar may be configured in any shape and made from any material to provide the desired support for a particular use. For example, a support bar may be made from steel or extruded aluminum or a fiber reinforced composite. Alternatively, a support bar may be molded inside the shelves. That is, the bars may be encapsulated within a shelf. While encapsulating support bars in the shelves may increase the load rating of a particular shelf, encapsulating the support bars within the shelf does not allow for the load rating of the shelf to be adjusted.

[0091] A storage system in accordance with the present disclosure may optionally include a cubby unit. A cubby unit may be a completely separate structure or it may be formed using a wall of another storage unit. In one embodiment, for example, a cubby unit may be formed by closely spacing two support panels.

[0092] With reference to FIGURE 1, cubby unit **38** is formed by closely spacing cubby panel **202** adjacent a support panel such as panel **50'**. The height of cubby panel **202** may be selected as desired for a particular purpose or intended use. In one embodiment, cubby panel **202** is about 50% of the height of support panel **50'**. In another embodiment, cubby panel **202** is greater than about 50% of the height of a support panel such as panel **50'**.

[0093] In another embodiment, a cubby unit may be an individual unit separate

from the other shelving units in a shelving system. With reference to FIGURES 20 and 21, a cubby unit is shown comprising an upright cubby panel **202a** and an upright cubby panel **202b** opposite and generally parallel to cubby panel **202a**. Each of the cubby panels includes a first surface, a second surface, a front edge, a rear edge, a top, and a bottom. The cubby panels **202a** and **202b** may be connected by a connecting member such as connecting member **210** along the bottom of the cubby panels. The cubby unit **200** may include shelf support means such as shelf support means **70** and one or more shelves such as shelves **220a** and **220b** supported by the shelf support means. The cubby panels may also include drawer slides such as drawer slides **110**.

[0094] Cubby panels **202a - 202d** in FIGURES 20 and 21 have a different configuration than cubby panel **202** in FIGURE 1. In FIGURE 1, cubby panel **202** comprises shelf and drawer support channels on only one face of the panel. Cubby panels **202a - 202d** are shown having shelf and drawer support channels on both the first and second surface such that another storage unit panel or other cubby panels may be added on either side of the cubby unit.

[0095] The cubby panels in FIGURES 20 and 21 have a configuration that allows a panel to be stacked on top of the other panel in a mating relationship, which allows for creating for a taller cubby unit if desired. As shown by the dashed lines in FIGURES 20 and 21, cubby unit **200** may include cubby panel **202c** stacked on top of cubby panel **202a** and cubby panel **202d** stacked on cubby panel **202b**. Cubby panel **202a** includes an upper surface **204a** and a ledge **205a**, and a bottom surface **206a** and an inverted ledge **207a**. Cubby panel **202c** is identical to cubby panel **202a** and includes an upper surface **204c** and an upper ledge **205c** as well as a lower surface **206c** and an inverted ledge **207c**. The upper surface **204a** and ledge **205a** are shaped and dimensioned to mate with the inverted ledge and lower surface of another panel, e.g., inverted ledge **207c** and lower surface **206c**, respectively, of cubby panel **202c**. Cubby panel **202d** is stacked on top of cubby panel **202b** in a manner similar to the stacking of panel **202c** on panel **202a**. The interaction of the ledges and upper surfaces prevents the top cubby from sliding sideways with respect to the bottom cubby.

[0096] Cubby panels may also include one or more apertures adjacent each of the top and bottom ledges of the panels to allow stacked cubby panels to be

releasably connected together and prevent stacked cubby panels from sliding forward and/or backward relative to each other. For example, as shown in FIGURE 21, panel **202b** includes apertures **212b** adjacent the bottom of the panel and aperture **214b** adjacent the top of the panel. When cubby panel **202d** is stacked on panel **202b**, the panels may be releasably connected via, for example, a fastener, through apertures **214b** of panel **202b** and corresponding apertures **212d** (not visible) of panel **202d**.

[0097] Similar to the support panels, the cubby panels may include apertures through which a shelf may be releasably secured to a cubby panel. For example, cubby panels **202b** and **202d** include apertures **216b** and **216d**, respectively, disposed between the shelf supports of the cubby panels.

[0098] Cubby panels may include generally vertical channels. For example, cubby panels **202b** and **202d** include vertical channels **218b** and **218d**, respectively. When a cubby unit is formed by stacking cubby panels, a channel may be formed by channels **218b** and **218d** that is substantially similar to channel **90** previously described herein and dimensioned for receiving a vertical member. That is, in one embodiment, when stacked, channels **218b** and **218d** may be taken as a single channel similar to channel **90** of the support panels. A vertical member may be disposed within the channels **218b** and **218d** and, similar to that of a vertical member disposed within a vertical channel of a support member, provide a metal-to-metal contact point between a cubby unit and a connecting member that connects a cubby unit to a portion of a vehicle. In another embodiment, a vertical member disposed within the vertical channels of stacked cubby units may be releasably connected to the cubby panels to prevent the stacked panels from sliding forward or backward relative to one another.

[0099] As previously mentioned, using stackable cubby panels to create a cubby unit wall or a cubby unit allows for creating taller units. This feature may be beneficial to create cubby units in different sized vehicles. For example, a system or kit may include a cubby panel or panels that have a height of about 50% of the upright panels used for the other storage units. In another embodiment, a cubby panel may have a height greater than about 50% of the height of a support panel. In one embodiment, a cubby panel may have a height that is about 75% the height of the support panels. The height of a cubby panel is not critical and may be

selected as desired for a particular purpose or intended use. A first vehicle, however, may have a height in the cargo area that could not accommodate a cubby unit formed from stacking the cubby panels. A second vehicle may have a cargo area height that could accommodate a cubby unit formed from the stacked cubby panels. Thus the same panels in one vehicle may be used to create a different (sized) unit in another vehicle.

[00100] In another embodiment, cubby panels may be configured such that opposing panels may be stacked to form a single, taller cubby panel (or storage panel). With reference to FIGURE 22, a cubby unit **300** is shown comprising cubby panels **302** and **304**. Cubby panels **302** and **304** comprise first and second surfaces, the first (outer) surface of each panel being generally planar, and the second (inner) surface of each panel comprising shelf support channels **306** and drawer slide channels **308**. Panels **302** and **304** are essentially mirror images of each other, with the second (inner) surfaces of the opposing panels facing each other. The cubby panels **302** and **304** are connected along a bottom, front edge of the panels by connector member **310**. The cubby unit **300** could comprise one or more shelves or drawers, but is shown in FIGURE 22 without such storage features.

A taller cubby panel **320** (FIGURE 22A) may be formed by disconnecting connector member **310** and flipping or inverting panel **302** and placing top edge **303** of panel **302** on top edge **305** of panel **304**. Panels **302** and **304** may be connected in any suitable manner to prevent the panels from slipping in either a front-to-back or side-to-side manner. For example, a connector member could be releasably fastened to any of the inner surface, outer surface, front edge, and/or back edge of the panels. The new panel **320** may then be positioned adjacent another cubby panel or support panel as desired to provide a new storage space for a vehicle. It will be appreciated that a new panel could also be created by inverting or flipping panel **304** onto panel **302**.

[00101] The ability to invert a panel may be desirable in the field where a vehicle may not have additional pieces necessary to form a different panel structure. For example, a vehicle may not have the capacity to store extra cubby panels to form a taller section. Or, cubby panels, such as, for example, **302** and **304**, could be removed from one vehicle in which they are used to form a cubby unit, such as **300**, and then inserted into a separate vehicle as a taller panel simply by inverting the

cubby panels to form the taller structure.

[00102] The shape, size, and general configuration of a cubby panel may be selected as desired for a particular purpose or intended use. The cubby panels may include features similar to those of the upright vertical panels of the storage units, including, for example, shelf support means, drawer support means, cut-out portions, vertical channels for receiving a vertical member, and the like. Similar to the upright or support panels of a storage unit, a cubby panel may include such features only on one side of the cubby panel or may include such features on both sides, such that a storage system may be expanded by adding additional upright/support panels or cubby panels. It will also be appreciated that a cubby panel may have a generally planar upper surface and does not have to have a ledge configuration as shown in FIGURES 1, 20, and 21.

[00103] The primary components of an individual storage unit, e.g., support panels, cubby panels, shelves, drawers, doors, dividers, of a shelving unit/system in accordance with the present disclosure are formed from a material other than metal.

The components are formed from a polymer material such as plastic materials. Suitable plastic polymers include, but are not limited to, polyethylenes, polypropylenes, polystyrene, acrylonitrile-butadiene-styrene resins, phenolic resins, polyurethanes, polyolefins, polyisocyanurates, and the like. The polymer materials may also be composite materials, i.e., a polymer matrix reinforced with a fiber or other reinforcing material having a sufficient length to thickness ratio to provide a desirable reinforcing function in one or more directions. In one embodiment, the polymer material is a foamed polymer. Foamed polymers are also known as cellular polymers, polymeric foams, and expanded polymers. Examples of suitable foamed polymers include, but are not limited to, cellular polystyrene, polyurethane foams, polyisocyanurate foams, phenolic foams, cellulose acetate, and polyolefin foams.

[00104] The components of a storage unit/system in accordance with the present disclosure may be formed by any suitable molding method including, but not limited to, injection molding, blow molding, vacuum forming, and the like. Foamed polymers may be formed by injection molding, blow molding, extrusion, casting, vacuum forming, and the like.

[00105] A storage system in accordance with the disclosure is modular in a number of different aspects. In one aspect, an individual storage unit is modular in

that shelves, drawers, doors, dividers, and the like may be removed and/or repositioned to provide different size spaces to meet a particular storage need. Additionally, the length of an individual storage unit is changeable by changing the distance between support panels.

[00106] In another aspect, a storage system comprising at least two storage units may be reconfigured by adding or removing storage units. In some embodiments, the storage units of a storage system may be separate storage units positioned adjacent one another. In other embodiments, such as, for example, storage system **33** in FIGURE 1, adjacent storage units share a support panel (e.g., panel **50** is shared by storage units **34** and **36**). Additional storage units could be added by simply adding support panels. Additionally, the size of one storage unit may be changed without the need to change the size of another unit in the system.

[00107] A storage unit or storage system may be reconfigured in any way desired for a particular purpose or intended use. The above combinations, embodiments, and examples of how a storage unit or system may be reconfigured are merely exemplary embodiments and examples of a few of the numerous combinations or configurations.

[00108] A kit may also be provided that includes one or more of at least one of the components to form a storage unit or system in accordance with the disclosure. For example, a kit may include two or more support panels, one or more shelves, one or more drawers, doors, dividers, etc. A kit that includes shelves may include shelves of different lengths to form storage units, including cubby units, of different sizes.

[00109] The exemplary embodiment has been described with reference to the specific embodiments disclosed herein. Modifications and alterations may occur to others upon reading and understanding the preceding detailed description. It is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS

1. A modular storage system for a vehicle having a front, a back, a curb-side, and a street-side, the storage system comprising:

a first support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the first panel;

a second support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the first panel, and a second surface, the second panel disposed generally parallel to the first panel and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the second panel and opposite the shelf support means of the first panel; and

a shelf dimensioned for removable receipt between the first and second panels, the shelf being supported by the shelf support means,

wherein at least the first panel further comprises a channel vertically disposed between the top and the bottom of the panel and a vertical member disposed within the vertical channel such that the shelf abuts the vertical member, and

wherein the first panel, the second panel, and the shelf are formed from a polymer material.

2. The modular storage system according to claim 1, wherein the shelf support means of the first and second panels is a channel horizontally disposed between the front edges of the panels and the back edges of the panels.

3. The modular storage system according to claim 2, wherein the channel extends to the front edges of the panels and defines a channel opening along the front edge of the panels.

4. The modular storage system according to claim 1, wherein the first panel is attached to the second panel by a connecting member attached to each of the first and second panels adjacent the front edge of each panel.

5. The modular storage system according to claim 1, wherein the first panel comprises one or more drawer slides integral with the first panel and recessed relative to the forward facing surface of the panel; and

the second panel comprises one or more drawer slides integral with the second panel and recessed relative to the rearward facing surface of the second panel, the one or more drawer slides of the second panel being positioned opposite and generally parallel to the one or more drawer slides of the second panel.

6. The modular storage system according to claim 1, wherein at least the first panel defines a cut-out portion relative to the front edge of the panel and adjacent the bottom of the panel.

7. The modular storage system according to claim 6, further comprising a plug member dimensioned for receipt in the cut-out of the at least first panel.

8. The modular storage system according to claim 1, further comprising a back panel adjacent the rear edges of the first and second panels.

9. The modular storage system according to claim 8, wherein the back panel is positioned by one or more retainer clips located on the rear edge of the first and second panels.

10. The modular storage system according to claim 1, wherein the back panel comprises opposite ends and includes one or more apertures disposed between the ends of the panel.

11. The modular storage system according to claim 1, further comprising a third panel positioned opposite and generally parallel to the second panel;

the second panel further comprising one or more shelf support means disposed between the front and rear edges of the second surface of the second panel; and

the third panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the first surface of the third panel being oriented toward the second surface of the second panel, the first surface of the third panel comprising one or more shelf support means disposed between the front and rear edges of the first surface of the third panel and opposing the one or more shelf support means along the second surface of the second panel.

12. The modular storage system according to claim 11, further comprising a cubby unit, the cubby unit comprising a fourth panel opposite and generally parallel to the third panel.

13. The modular storage system according to claim 12, wherein the third panel has a height and the fourth panel has a height less than the height of the third panel.

14. The modular storage system according to claim 1, further comprising a cubby unit, the cubby comprising a separate unit adjacent one of the support panels, the cubby comprising a first cubby panel having a top, a bottom, a front edge, a rear edge, a first surface, a second surface, and one or more shelf support means disposed between the front and rear edges of the first cubby panel; and

a second cubby panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the first cubby panel, and a second surface opposite the first surface of the second cubby panel, and comprising one or

more shelf support means opposite the one or more shelf support means of the first cubby panel.

15. The modular storage system according to claim 14, wherein the cubby panels have a height less than a height of the first or second support panels.

16. The modular storage system according to claim 14, wherein the height of the cubby panels is 75% of the height of the first or second support panels.

17. The modular storage system according to claim 14, wherein the height of the cubby panels is 50% of the height of the first or second support panels.

18. The modular storage system according to claim 14, wherein the cubby unit further comprises a third cubby panel stacked on top of the first cubby panel and a fourth cubby panel stacked on top of the second cubby panel and opposing the third cubby panel.

19. The modular storage system according to claim 1, further comprising a door rotatably mounted to the first and second panels, the door being rotatable about a horizontal axis.

20. The modular storage system according to claim 19, wherein the door comprises an outer face, the outer face contacting a shelf immediately below the door when the door is rotated into a fully open position, the door in a fully opened position defining an angle of at least 90° relative to a closed position.

21. The modular storage system according to claim 20, wherein the door comprises a horizontal groove adjacent a bottom of the door and recessed relative to the outer face of the door, the groove being positioned such that when the door is

rotated to a fully opened position, the groove communicates with a shelf immediately below the door such that the door in a fully opened position to defines an angle relative to the closed position of greater than 90°.

22. The modular storage system according to claim 1, comprising a shelf removably disposed within at least one pair of opposing shelf support means in the first and second panels.

23. The modular storage system according to claim 1, wherein each support panel comprises a generally vertical portion along each of the front and rear edges of the panel, an arcuate portion along the back edge of the panel extending inwardly toward a longitudinal center line of the vehicle and upwardly toward the top of the panel, and an arcuate portion along the front edge of the panel extending inwardly toward the longitudinal center line of the vehicle and upwardly toward the top of the panel.

24. A modular storage unit for a vehicle having a front, a back, a curb-side, and a street-side, the storage unit comprising:

(a) a first panel having a top, a bottom, a front edge, a first surface, and a second surface opposite the first surface, the second surface comprising at least one channel recessed relative to the second surface and horizontally disposed between the front and rear edges of the first panel, and the first panel including a support member extending substantially between the top and the bottom of the first panel, wherein at least one of the first and second surfaces of the first panel includes a support member channel formed therein, open to the at least one of the first and second surface, and extending substantially between the top and the bottom, the support member channel receiving the support member such that the support member is at least partially exposed along the at least one of the first and second surfaces of the first panel; and

(b) a second panel generally parallel and opposite the first panel, the second panel having a top, a bottom, a front edge, a rear edge, a first surface, a second surface, the first surface of the second panel being oriented toward the second surface of the first panel, and at least one ~~shelf-support~~ channel recessed relative to the first surface of the second panel and horizontally disposed between the front and rear edges of the second panel;

wherein the first panel and the second panel comprise a polymer material.

25. The modular storage unit according to claim 24, wherein the horizontal channels are shelf support channels.

26. The modular storage unit of claim 25, wherein the at least one horizontal channel in the first and second panels extends to the front of each of the panels and defines an opening along a portion of the front edge of each of the panels.

27. The modular storage unit according to claim 26, wherein the horizontal channels defining an opening along the front edge of the first and second panels are drawer support channels.

28. The modular storage unit according to claim 26, wherein the horizontal channels defining an opening along the front edge of the first and second panels are shelf support channels.

29. The modular storage unit according to claim 27, wherein the first panel comprises a slot recessed relative to the second surface of the first panel, the second panel comprises a slot recessed relative to the first surface of the second panel and positioned opposite the slot on the first panel, the slots being positioned immediately above an upper edge of at least one of the horizontal channels of the first and second

panels and defining an opening adjacent the upper edge of the shelf support channels, and

the storage unit further comprising a door having a left edge, a right edge, a top, and a bottom, the door comprising a first pin integral with left edge of the door and a second pin integral with the right edge of the door, the pins disposed adjacent the bottom of the door and dimensional for receipt in the slots;

the door being rotatably mounted to the first and second panels by positioning the first pin into the slot on the first panel, positioning the second pin into the slot on the second panel, and positioning a shelf into the shelf support channels immediately beneath the slots into which the pins of the door have been positioned.

30. The modular storage unit according to claim 24, wherein a shelf is removably disposed between opposite horizontal channels.

31. The modular storage unit according to claim 30, wherein the shelf comprises a polymer material.

32. The modular storage unit according to claim 24, wherein the horizontal channels are shelf supports and (i) the second surface of the first panel further comprises at least one drawer slide recessed relative to the second surface of the first panel, and (ii) the first surface of the second panel further comprises at least one drawer slide recessed relative to the first surface of the second panel, a drawer slide of the first panel having an opposing drawer slide at the same general vertical height on the second panel.

33. The modular storage unit according to claim 32, further comprising a shelf removably disposed between a pair of opposing shelf supports.

34. The modular storage unit according to claim 32, further comprising a drawer removably disposed between a pair of opposing drawer slides.

35. The modular storage unit according to claim 32, further comprising a shelf removably disposed between opposing shelf supports and a drawer removably disposed between opposing drawer slides.

36. A kit for forming a modular storage system for a vehicle comprising:
a plurality of panels having a top, a bottom, a first surface, a second surface, a front edge, and a rear edge, at least one of the first and second surfaces of the panels comprising one or more shelf support means horizontally disposed between the front and rear edges of the panels for receiving a shelf; and
one or more shelves dimensioned for receipt in the shelf support means, the one or more shelves having a bottom surface, a front wall, a back wall, a pair of opposing side walls, and comprising a polymeric material;
wherein the front and back walls of the one or more shelves have a height, and the sidewalls of the one or more shelves have a height less than the height of the front and back walls.

37. The kit according to claim 36, wherein the kit comprises at least two shelves, the two shelves being nestable by inverting a first shelf and positioning the inverted shelf on top of a second shelf such that one of the front or back walls of the first shelf is in engaging contact with the side walls of the second shelf and one of the front or back walls of the second shelf is in engaging contact with the side walls of the inverted first shelf.

38. The kit according to claim 36, wherein the first and second surface of at least one of the panels comprises a shelf support means.

39. The kit according to claim 36, wherein the panels further comprise a plurality of horizontal drawer slide channels, disposed between the front and rear edges of the panel.

40. The kit according to claim 36, wherein at least one of the panels comprises a generally vertical channel disposed between the top and bottom of the panel.

41. The kit according to claim 36, wherein at least one panel comprises a cut-out portion adjacent the bottom of the panel and recessed relative to the front edge of the panel.

42. The kit according to claim 41, further comprising a plug member dimensioned for receipt in the cut-out.

43. The kit according to claim 36, wherein the panels comprise a polymeric material.

44. A modular storage system for a vehicle having a front, a back, a curb-side wall, and a street-side wall, the storage system comprising:

(i) a first storage unit disposed along the curb-side wall, the first storage unit comprising:

a) a first support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the first panel; and

b) a second support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the first panel, and a second surface, the second panel disposed generally parallel to the first panel

and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the second panel and opposite the shelf support means of the first panel; and

(ii) a second storage unit disposed along the street-side wall, the second storage unit comprising:

a) a third support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the third panel; and

b) a fourth support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the third panel, and a second surface, the fourth panel disposed generally parallel to the third panel and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the fourth panel and opposite the shelf support means of the third panel; and

wherein the support panels are formed from a polymer material.

45. The modular storage system according to claim 44, wherein each support panel comprises a generally vertical portion along each of the front and rear edges of the panel, an arcuate portion along the back edge of the panel extending inwardly toward a longitudinal center line of the vehicle and upwardly toward the top of the panel, and an arcuate portion along the front edge of the panel extending inwardly toward the longitudinal center line of the vehicle and upwardly toward the top edge of the panel.

46. The modular storage system accordingly to claim 44, wherein each support panel defines a cut-out portion located relative to the front edge of the panel and adjacent the bottom of the panel, the cut-out portions comprising (i) an opening along the front edges of the panels, and (ii) a back surface.

47. The modular storage system accordingly to claim 46, wherein a distance, D, is defined between the back surface of the cut-out portions of the panels of the first storage unit and the back surface of the cut-out portions of the panels of the second storage unit.

48. The modular storage system accordingly to claim 47, wherein the distance D is at least 48 inches.

49. The modular storage unit according to claim 24, further comprising a connecting member configured for coupling at least one of the first and second panels to the vehicle.

50. The modular storage unit according to claim 24, wherein the second panel includes a support member extending substantially between the top and the bottom of the second panel, and the support member spaced apart from the first panel.

51. The modular storage unit according to claim 50, wherein the first surface of the second panel includes a support member channel formed therein, open to the first surface of the second panel, and extending substantially between the top and the bottom, the support member channel receiving the support member such that the support member is at least partially exposed along the first surface of the second panel.

52. The modular storage unit according to claim 1, wherein the shelf is directly fastened to the vertical member with a fastener.

53. A modular storage system for a vehicle having a front, a back, a curb-side, and a street-side, the storage system comprising:

a first support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the first panel;

a second support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the first panel, and a second surface, the second panel disposed generally parallel to the first panel and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the second panel and opposite the shelf support means of the first panel; and

a shelf dimensioned for removable receipt between the first and second panels, the shelf being supported by the shelf support means,

wherein at least the first panel defines a cut-out portion relative to the front edge of the panel and adjacent the bottom of the panel, and

wherein the first panel, the second panel, and the shelf are formed from a polymer material.

54. The modular storage system according to claim 53, further comprising a plug member dimensioned for receipt in the cut-out of the at least first panel.

55. A modular storage system for a vehicle having a front, a back, a curb-side, and a street-side, the storage system comprising:

a first support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the first panel;

a second support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the first panel, and a second surface, the second panel disposed generally parallel to the first panel and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the second panel and opposite the shelf support means of the first panel;

a door rotatably mounted to the first and second panels, the door being rotatable about a horizontal axis; and

a shelf dimensioned for removable receipt between the first and second panels, the shelf being supported by the shelf support means,

wherein the door comprises an outer face, the outer face contacting a shelf immediately below the door when the door is rotated into a fully open position, the door in a fully opened position defining an angle of at least 90° relative to a closed position, and

wherein the first panel, the second panel, and the shelf are formed from a polymer material.

56. The modular storage system according to claim 55, wherein the door comprises a horizontal groove adjacent a bottom of the door and recessed relative to the outer face of the door, the groove being positioned such that when the door is rotated to a fully opened position, the groove communicates with a shelf immediately below the door such that the door in a fully opened position to defines an angle relative to the closed position of greater than 90°.

57. A modular storage system for a vehicle having a front, a back, a curb-side, and a street-side, the storage system comprising:

a first support panel having a top, a bottom, a front edge, a rear edge, a first surface, and a second surface, the second surface comprising one or more shelf support means disposed between the front and rear edges of the second surface of the first panel;

a second support panel having a top, a bottom, a front edge, a rear edge, a first surface oriented toward the second surface of the first panel, and a second surface, the second panel disposed generally parallel to the first panel and comprising one or more shelf support means disposed between the front and rear edges of the first surface of the second panel and opposite the shelf support means of the first panel; and

a shelf dimensioned for removable receipt between the first and second panels, the shelf being supported by the shelf support means,

wherein each support panel comprises a generally vertical portion along each of the front and rear edges of the panel, an arcuate portion along the back edge of the panel extending inwardly toward a longitudinal center line of the vehicle and upwardly toward the top of the panel, and an arcuate portion along the front edge of the panel extending inwardly toward the longitudinal center line of the vehicle and upwardly toward the top of the panel, and

wherein the first panel, the second panel, and the shelf are formed from a polymer material.

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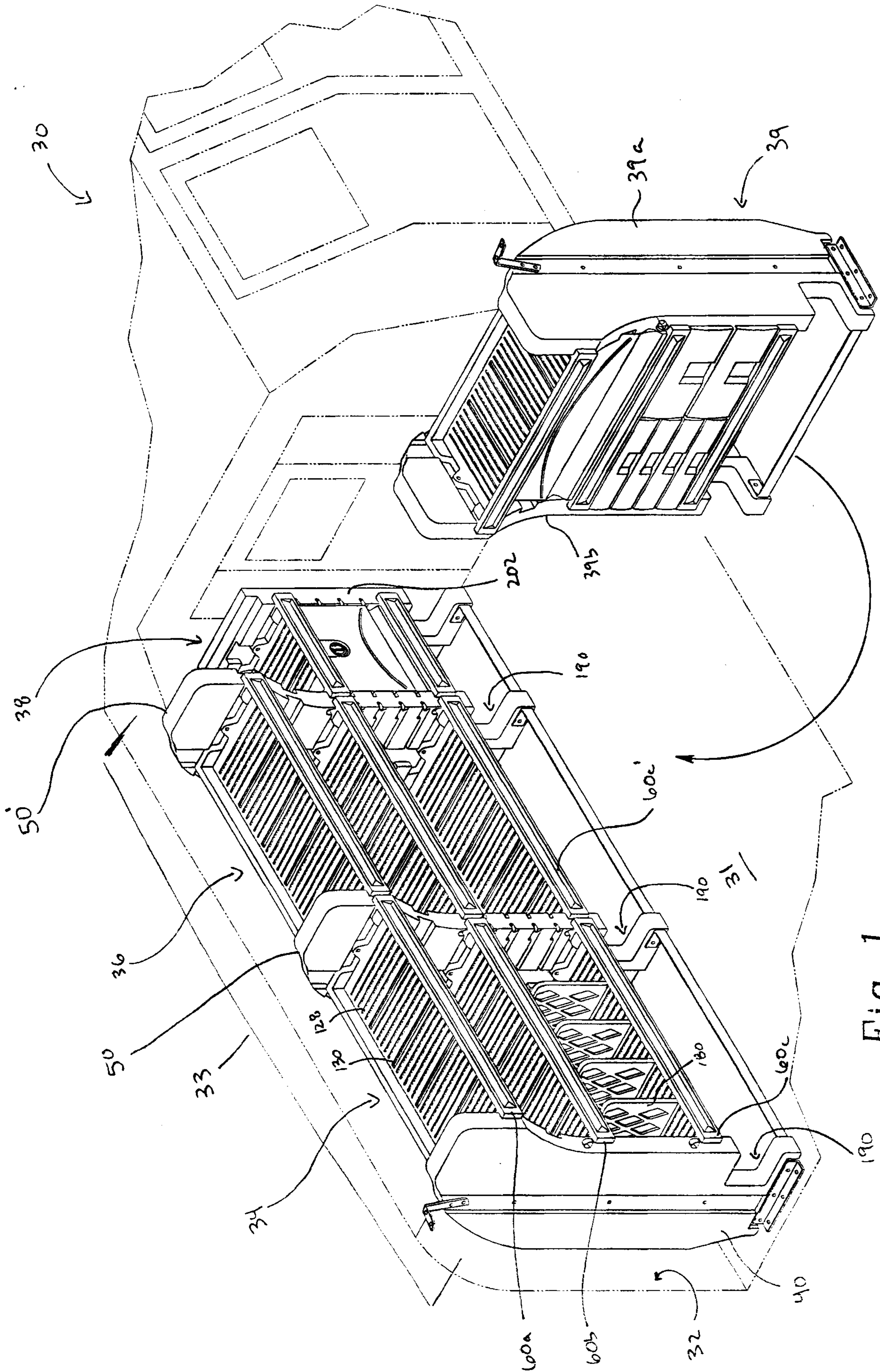


Fig. 1

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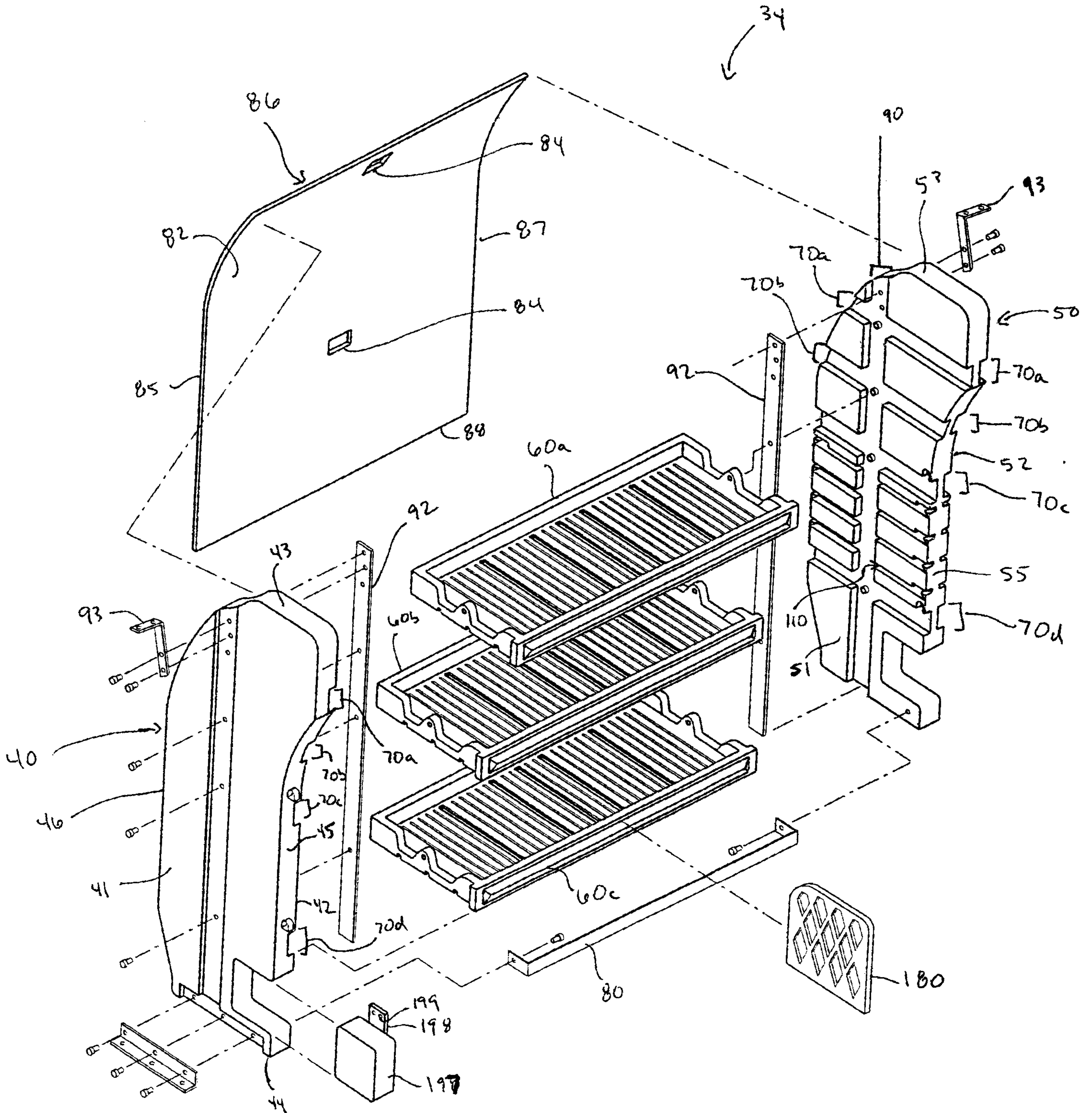


Fig. 2

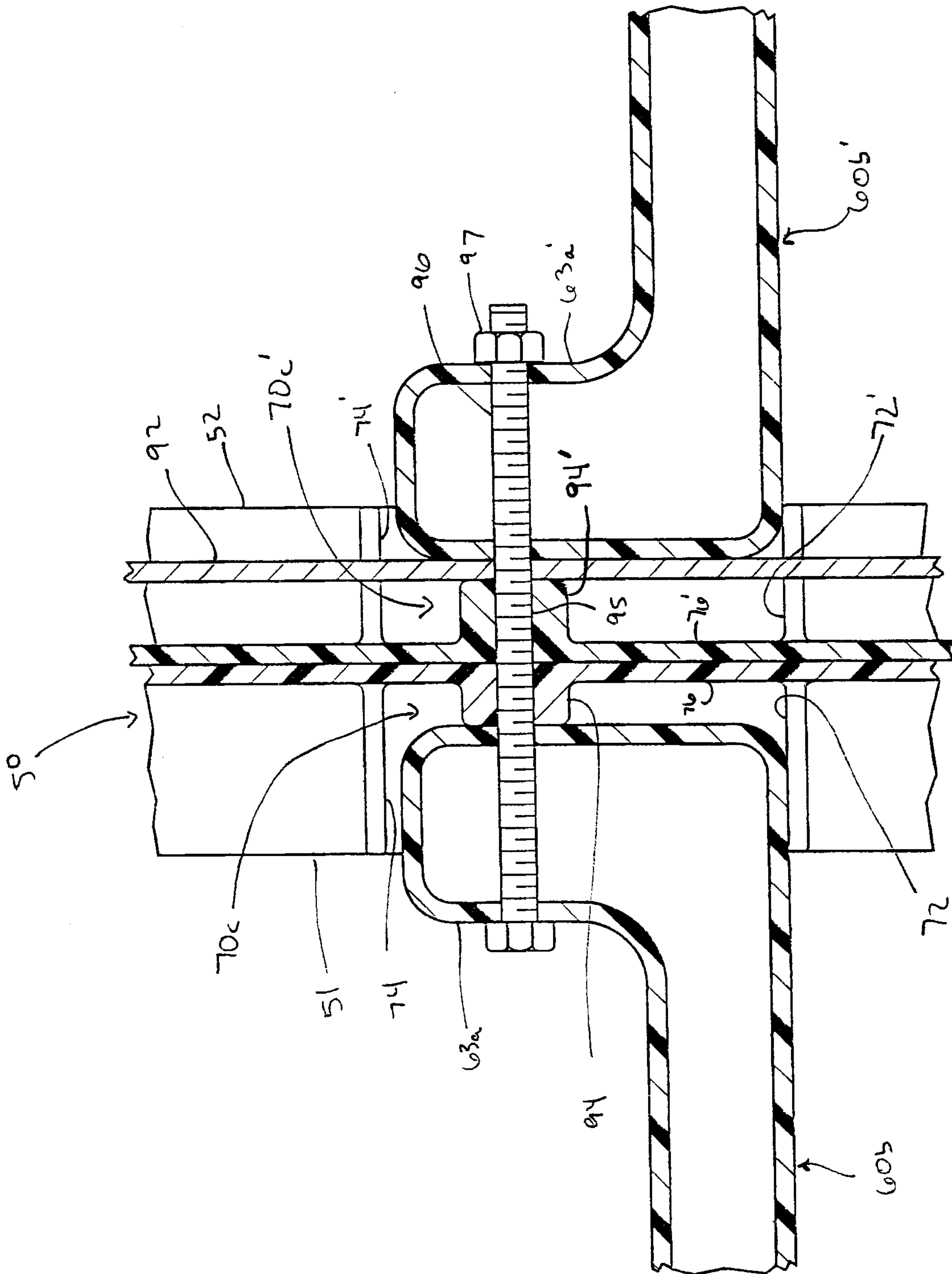
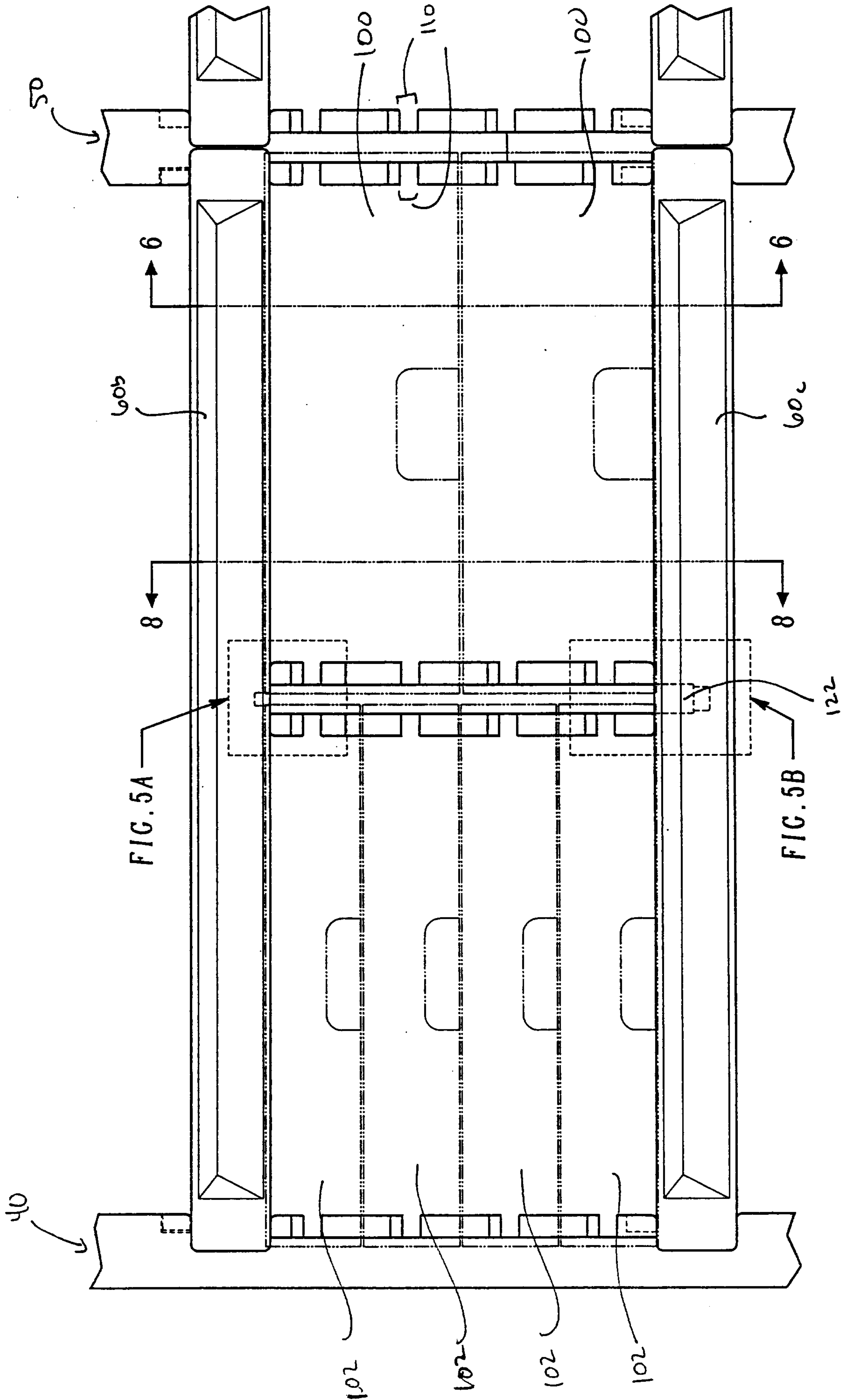


Fig. 3



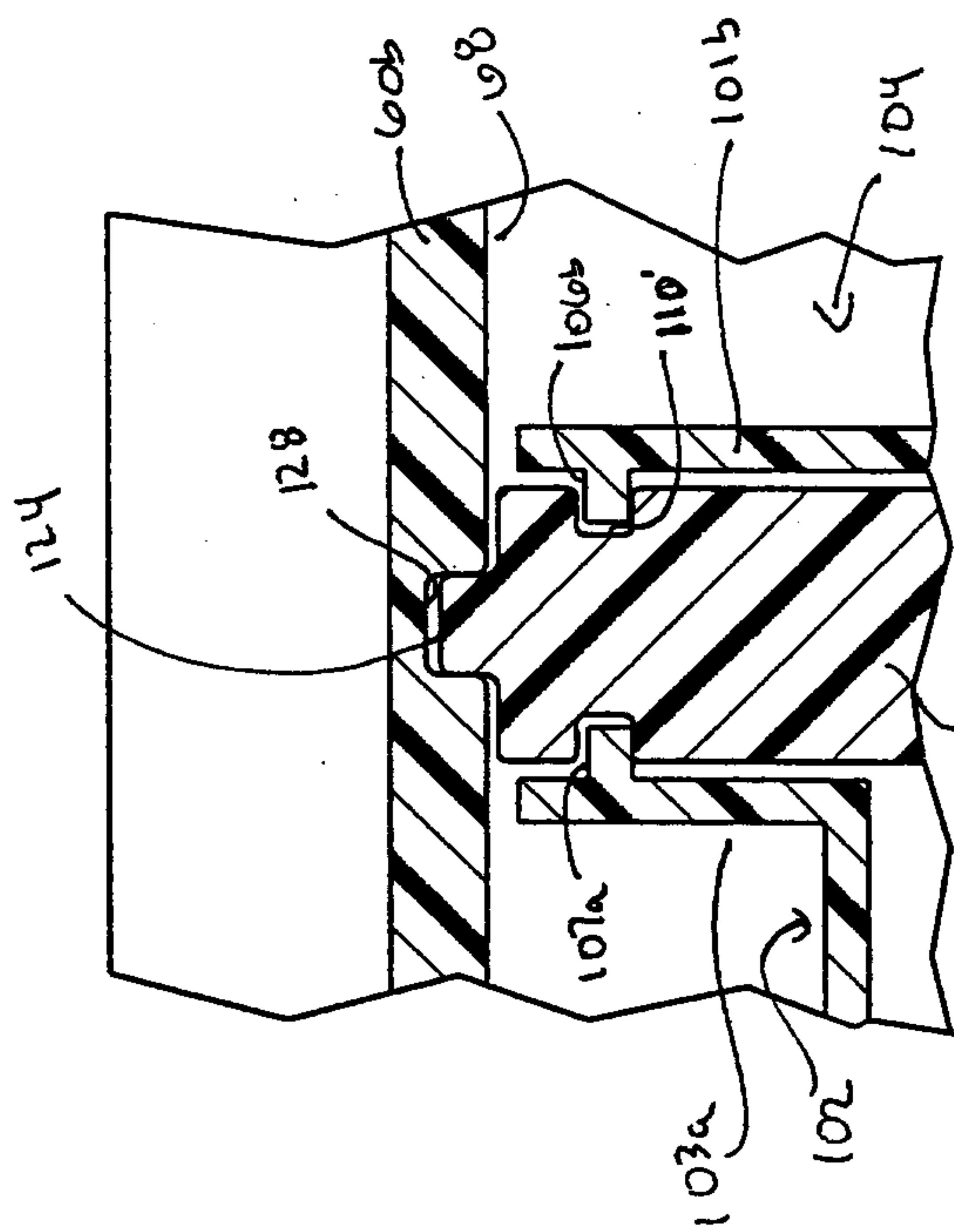


Fig. 5A

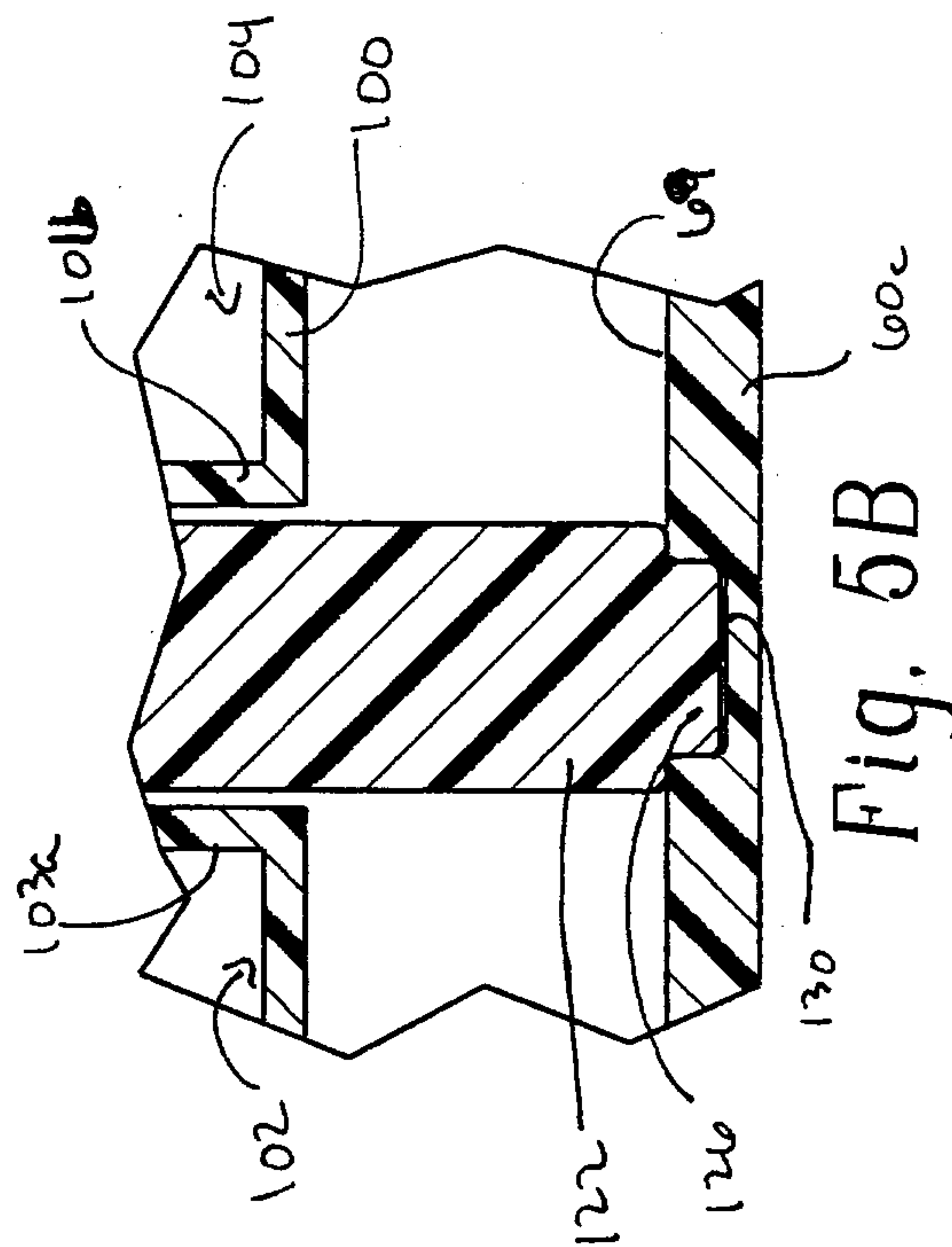


Fig. 5B

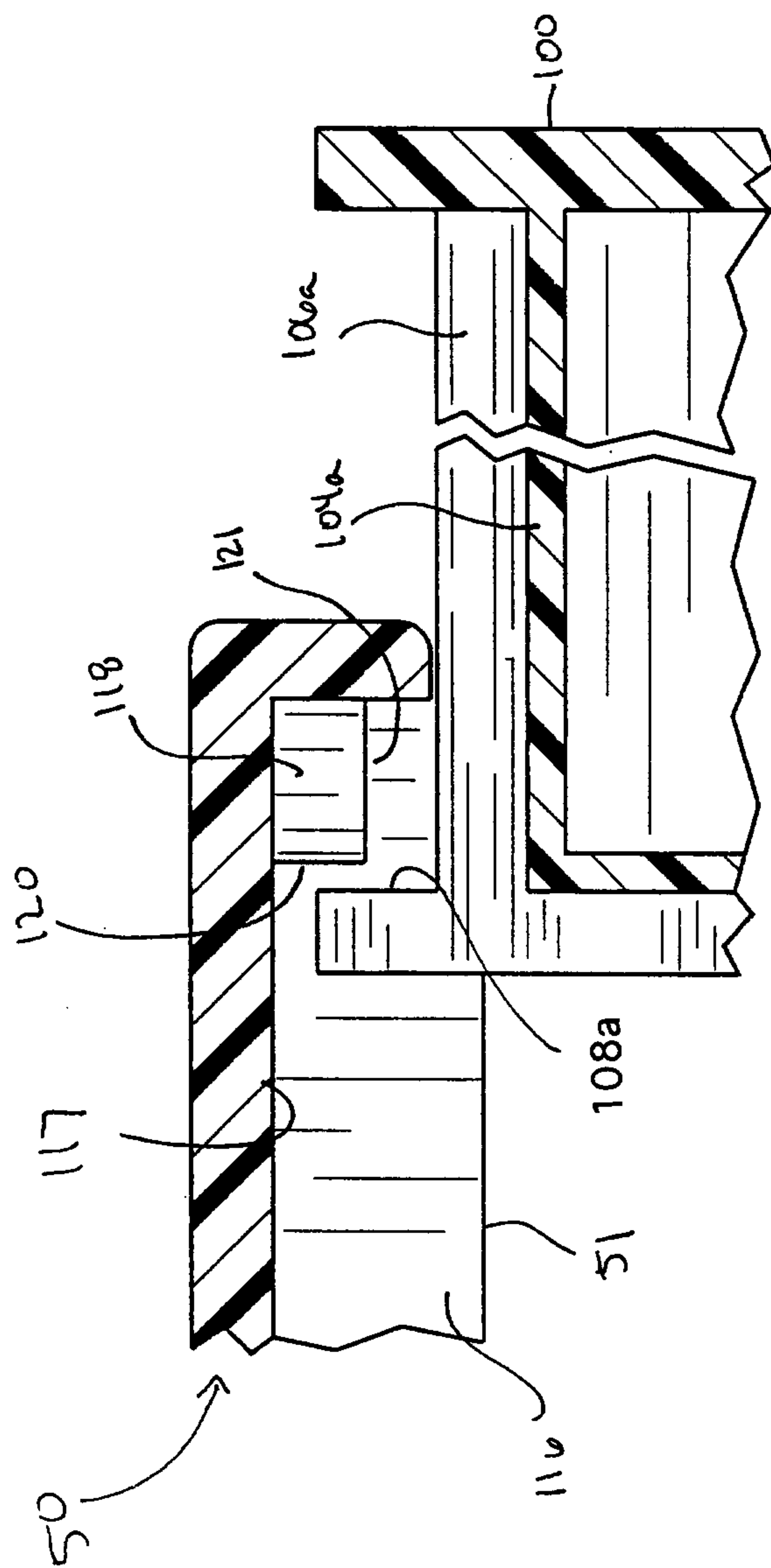


Fig. 7

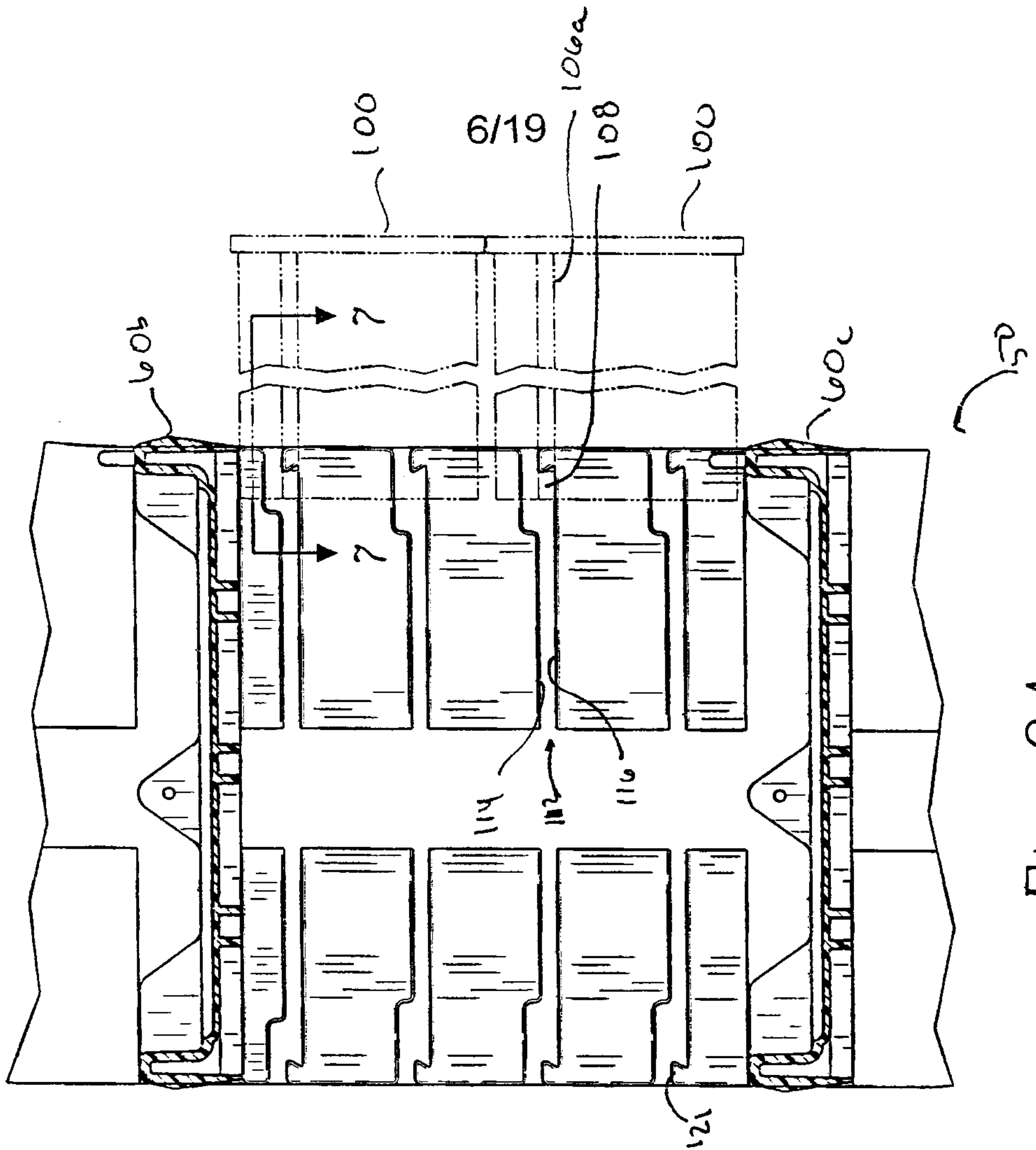


Fig. 6A

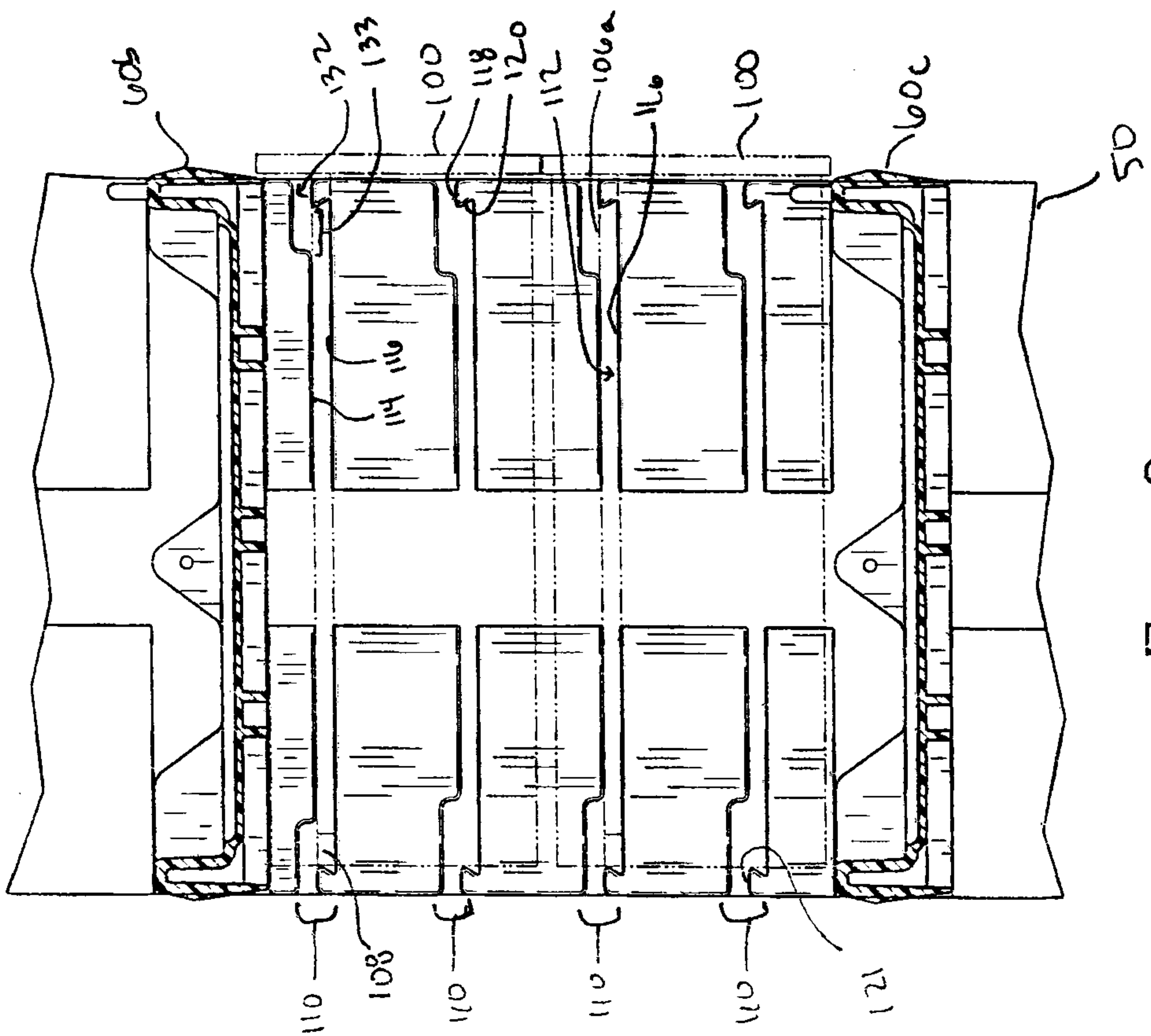


Fig. 6

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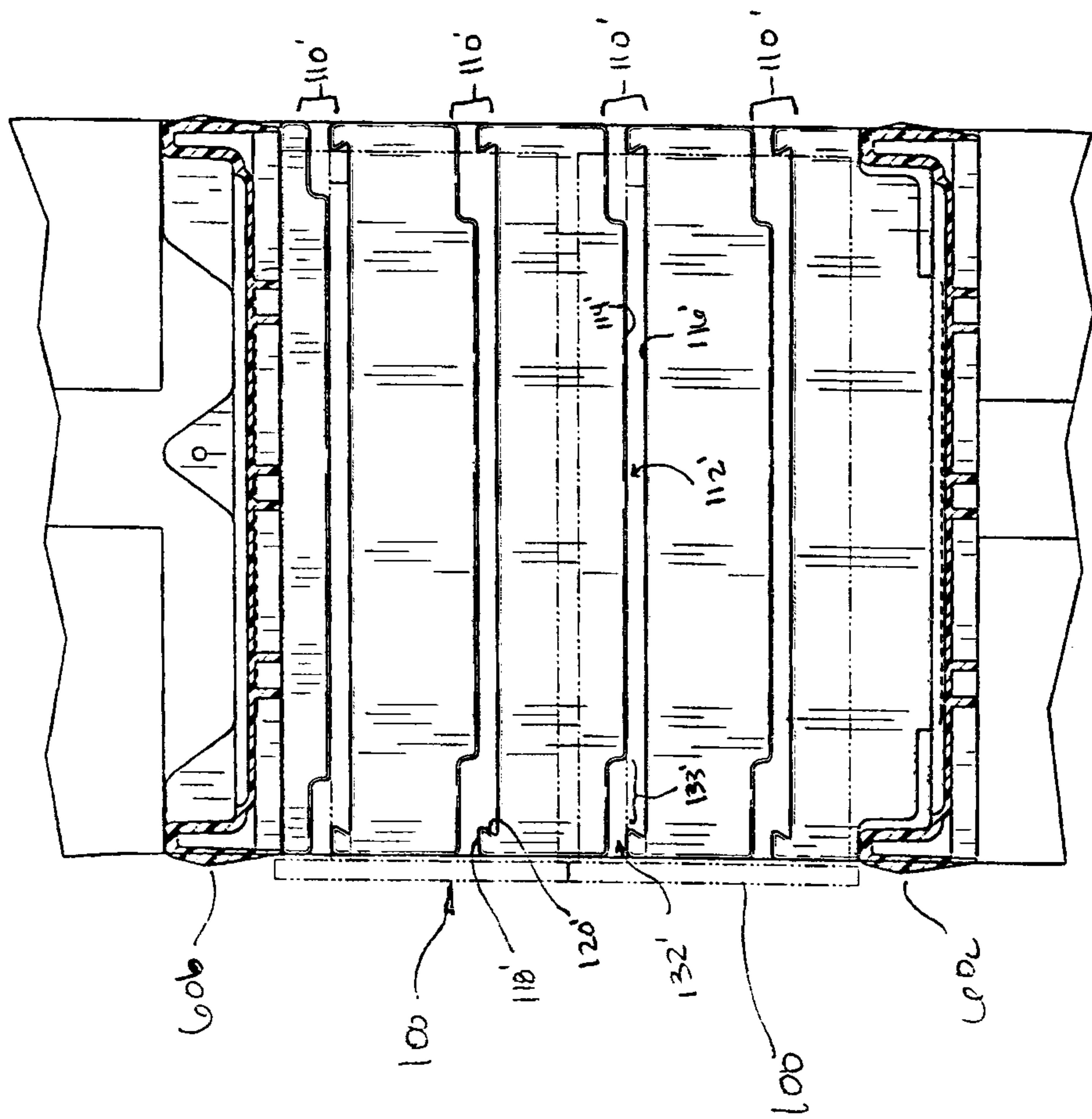


Fig. 8

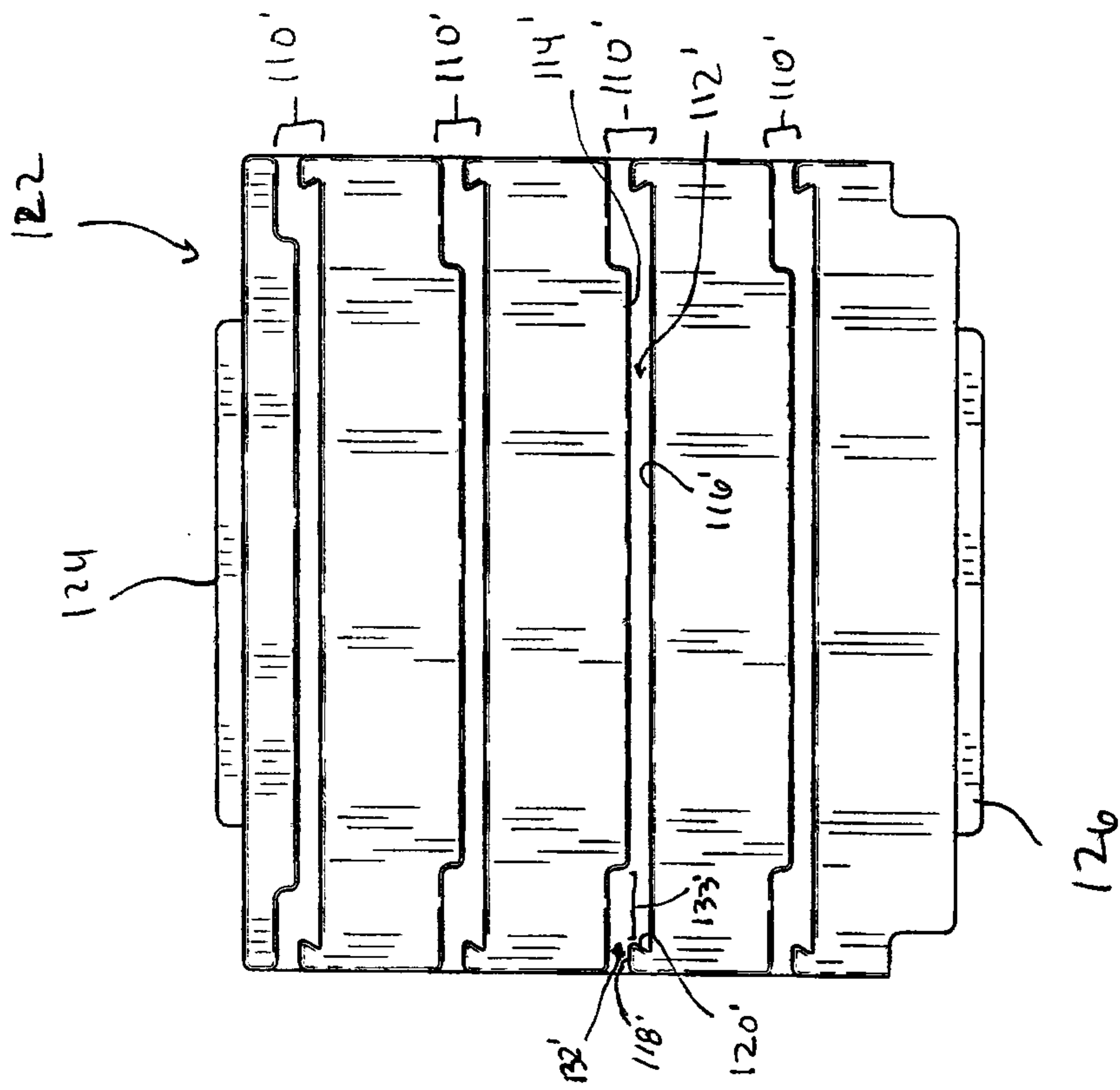


Fig. 9

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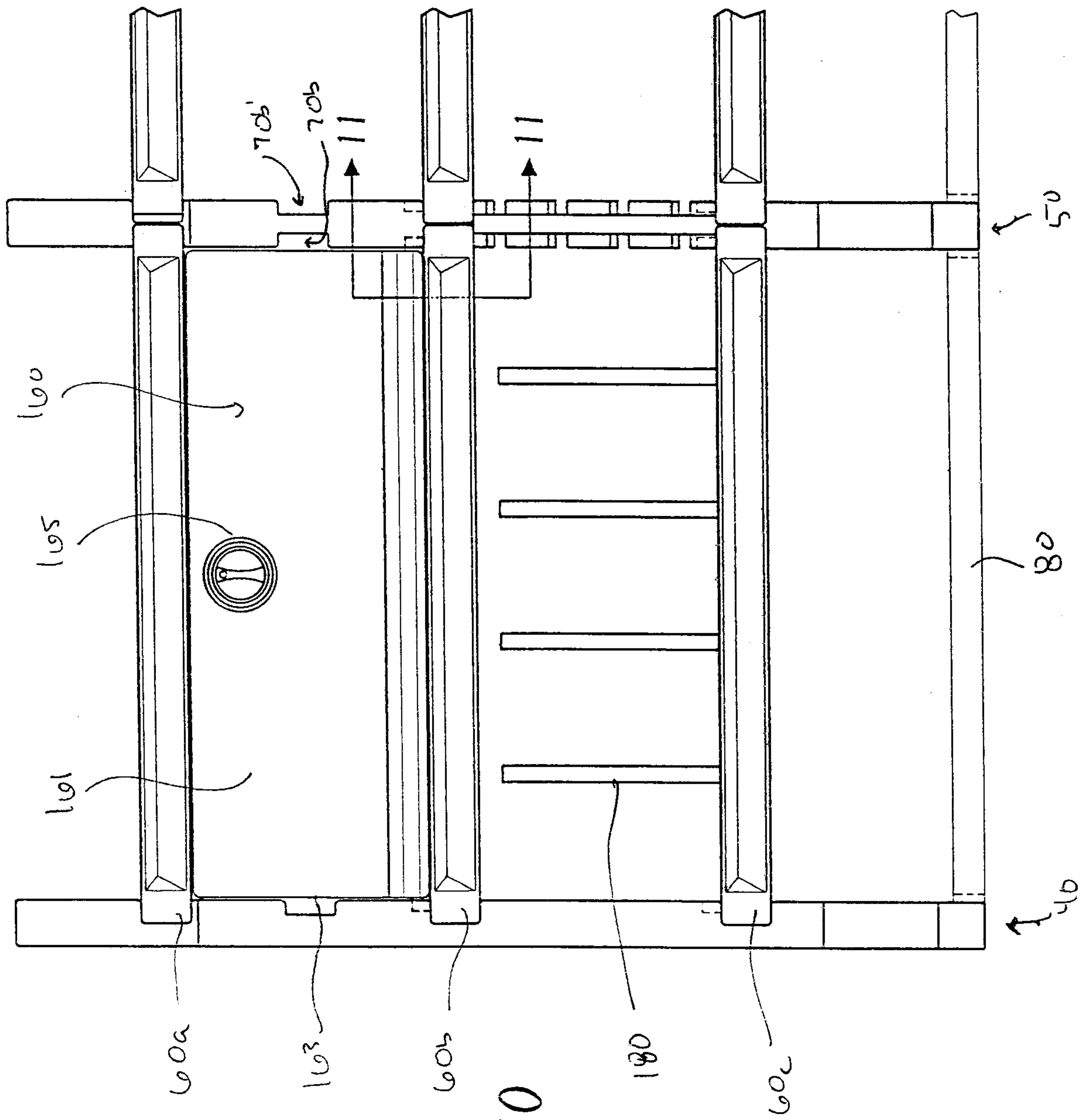


Fig. 10

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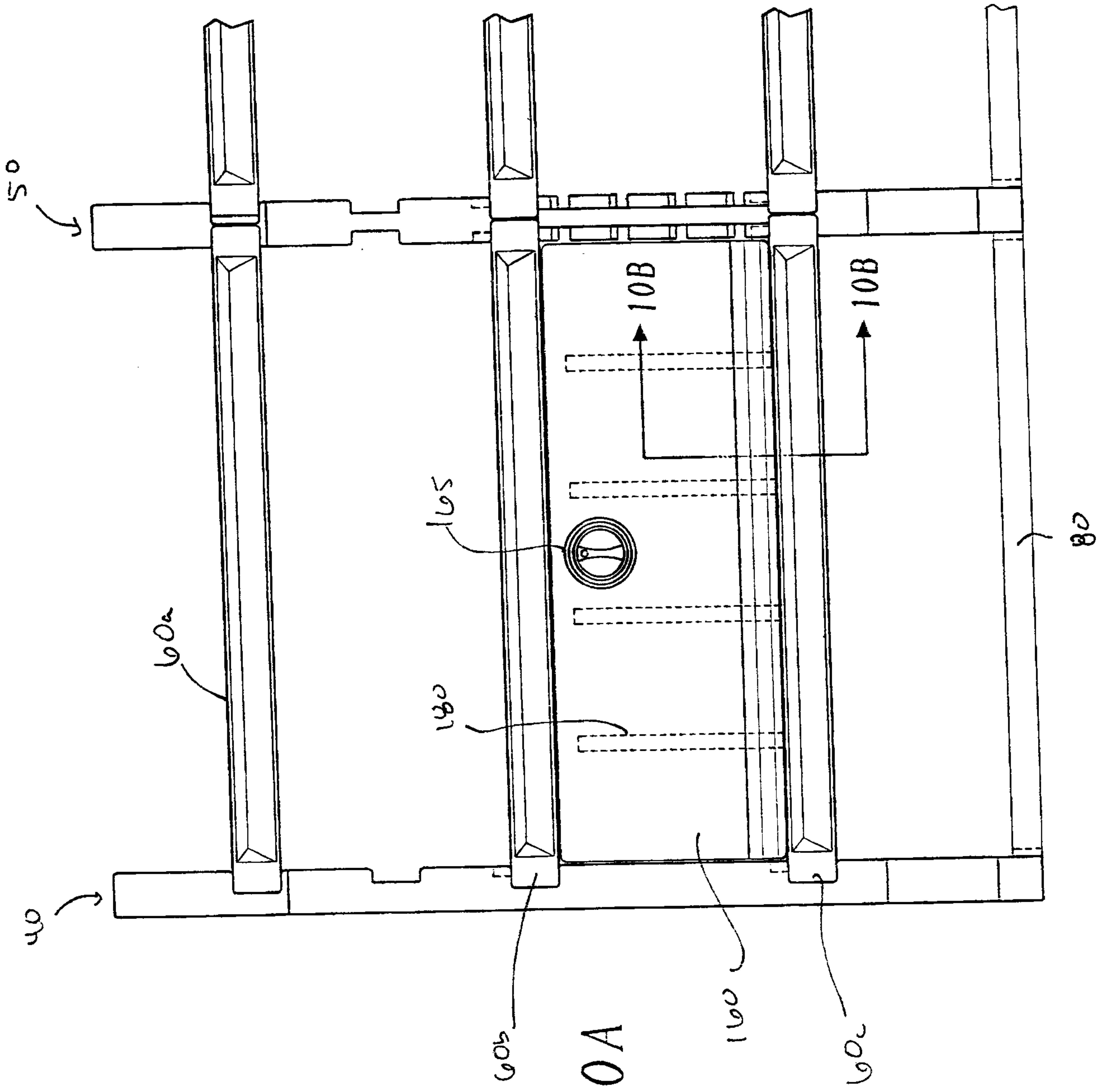


Fig. 10A

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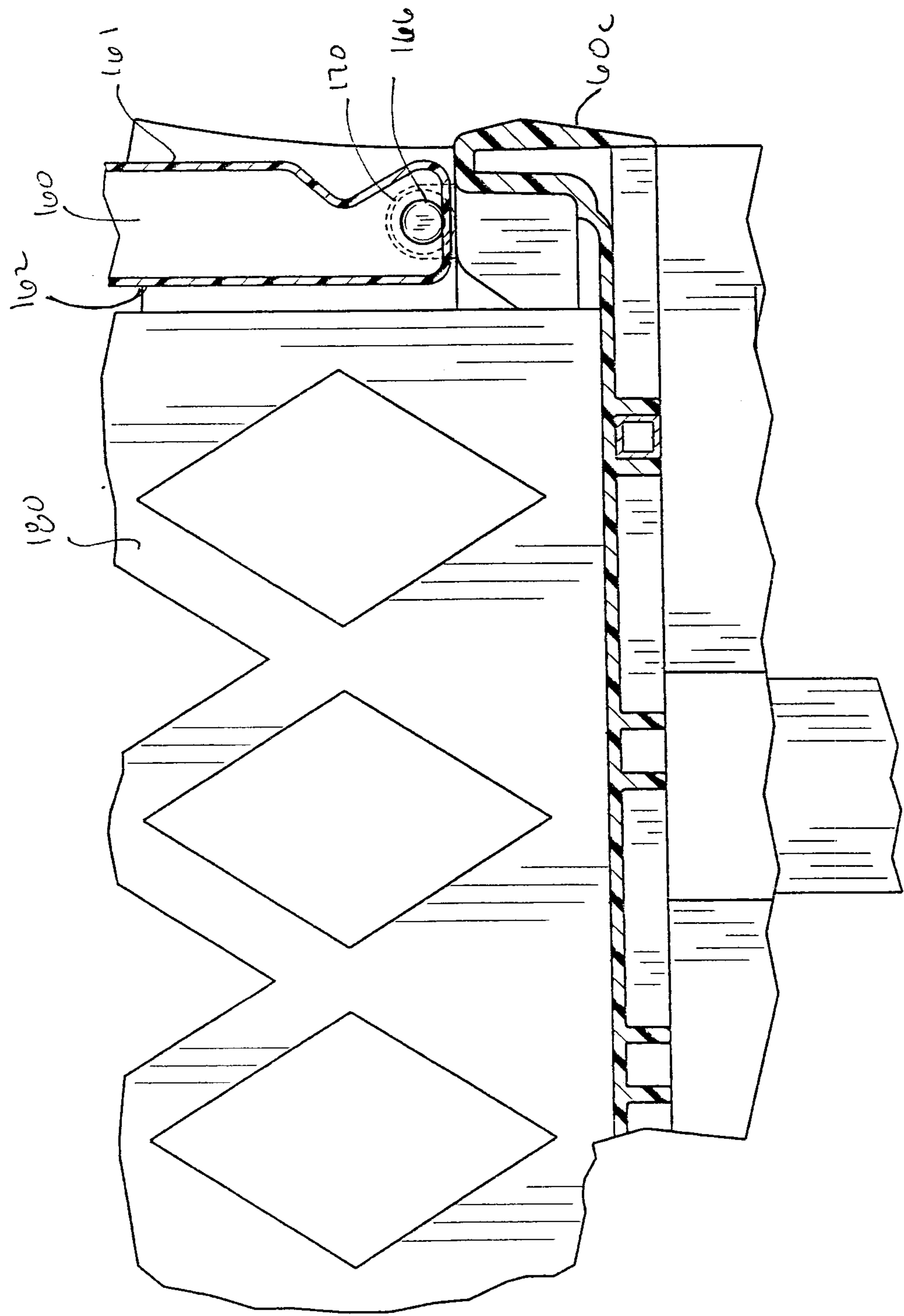


Fig. 10B

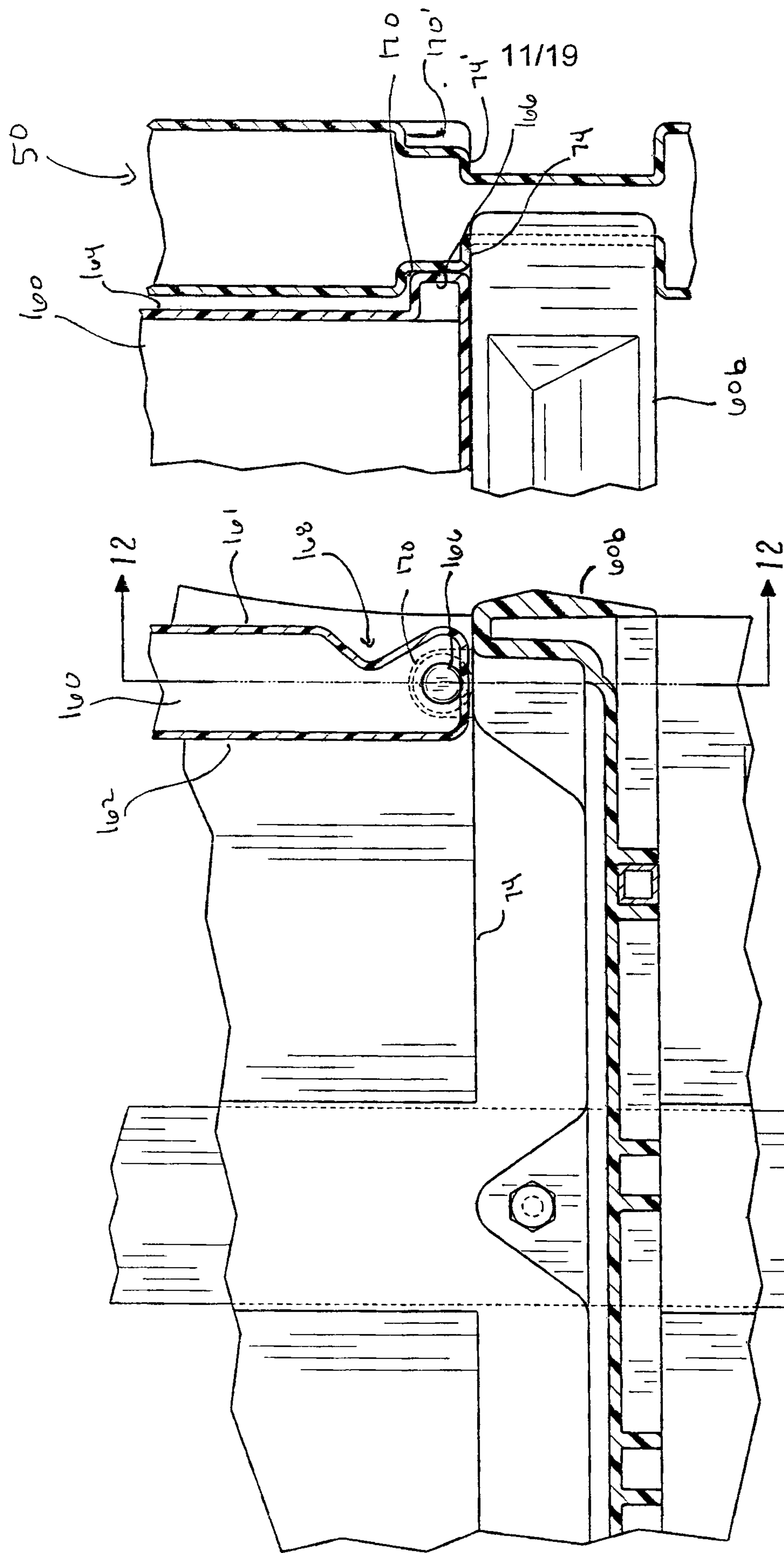


Fig. 11

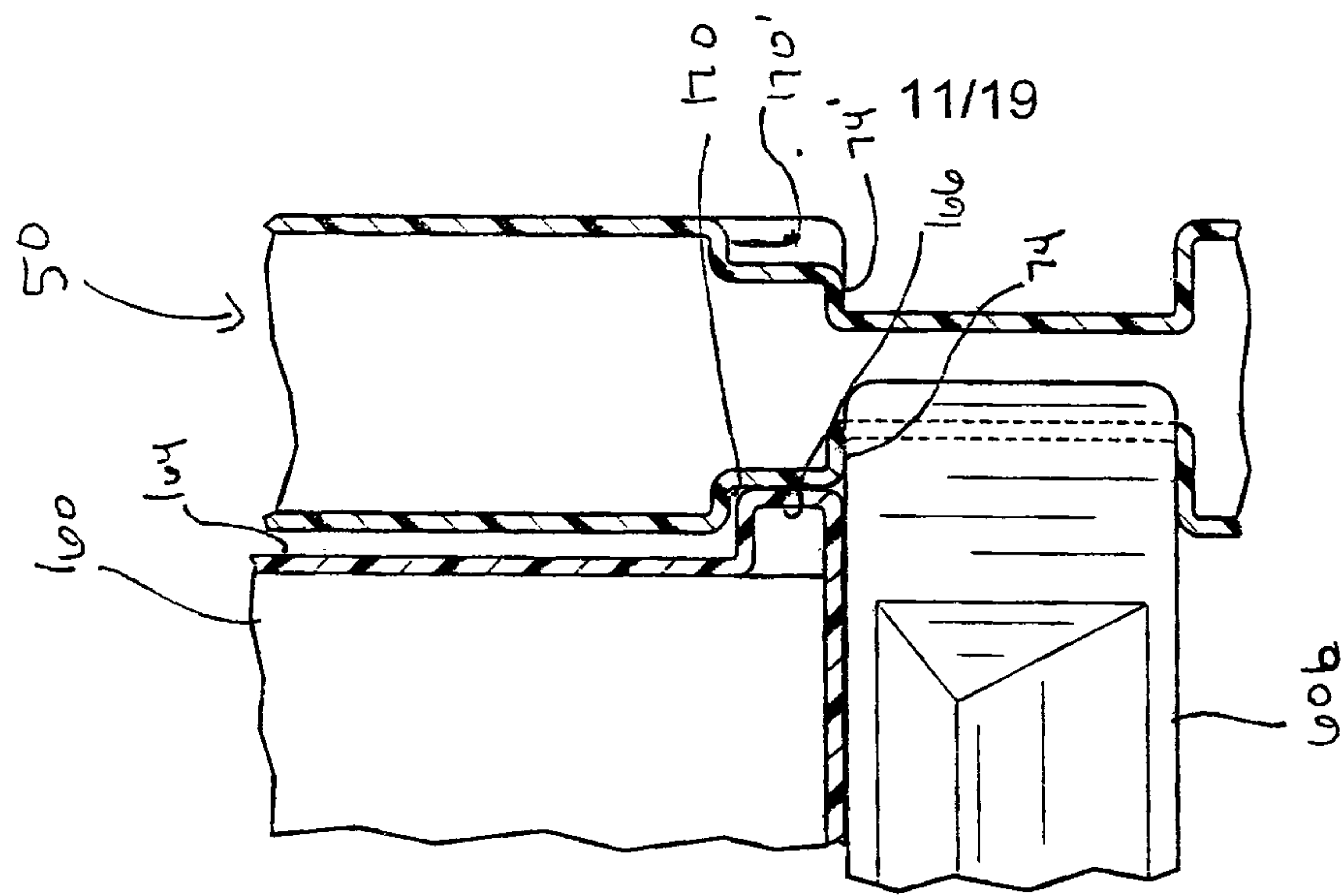


Fig. 12

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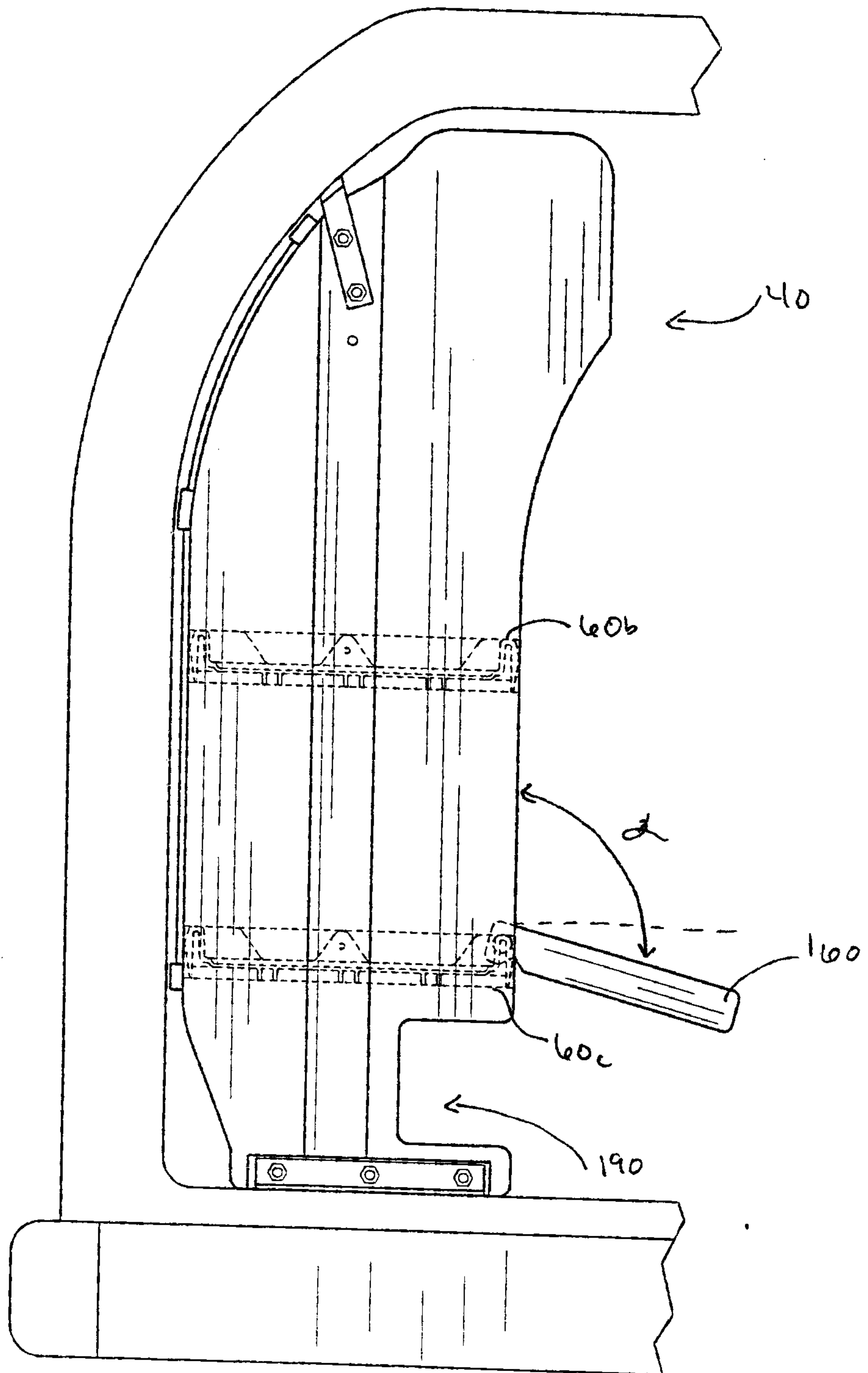


Fig. 13

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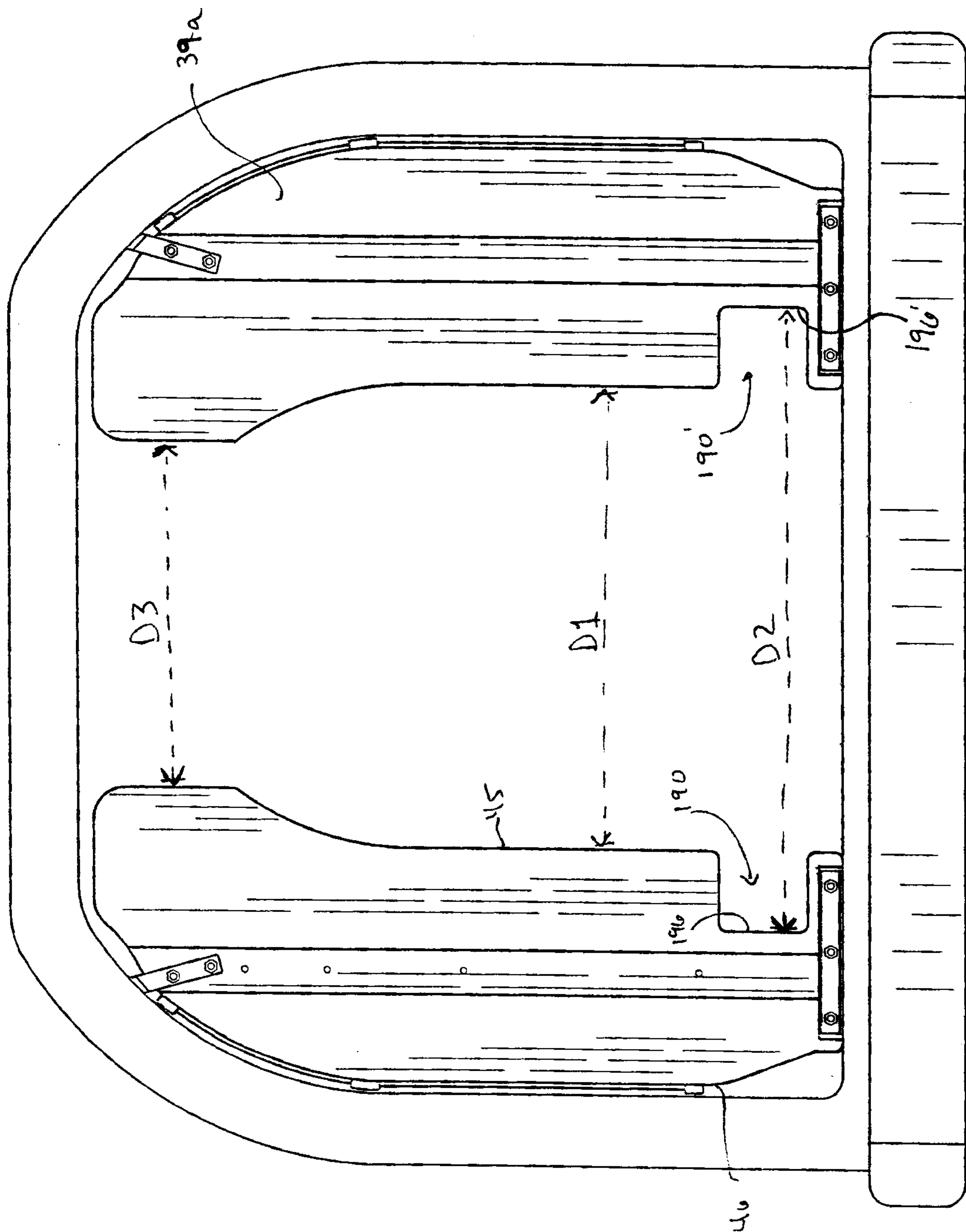


Fig. 14

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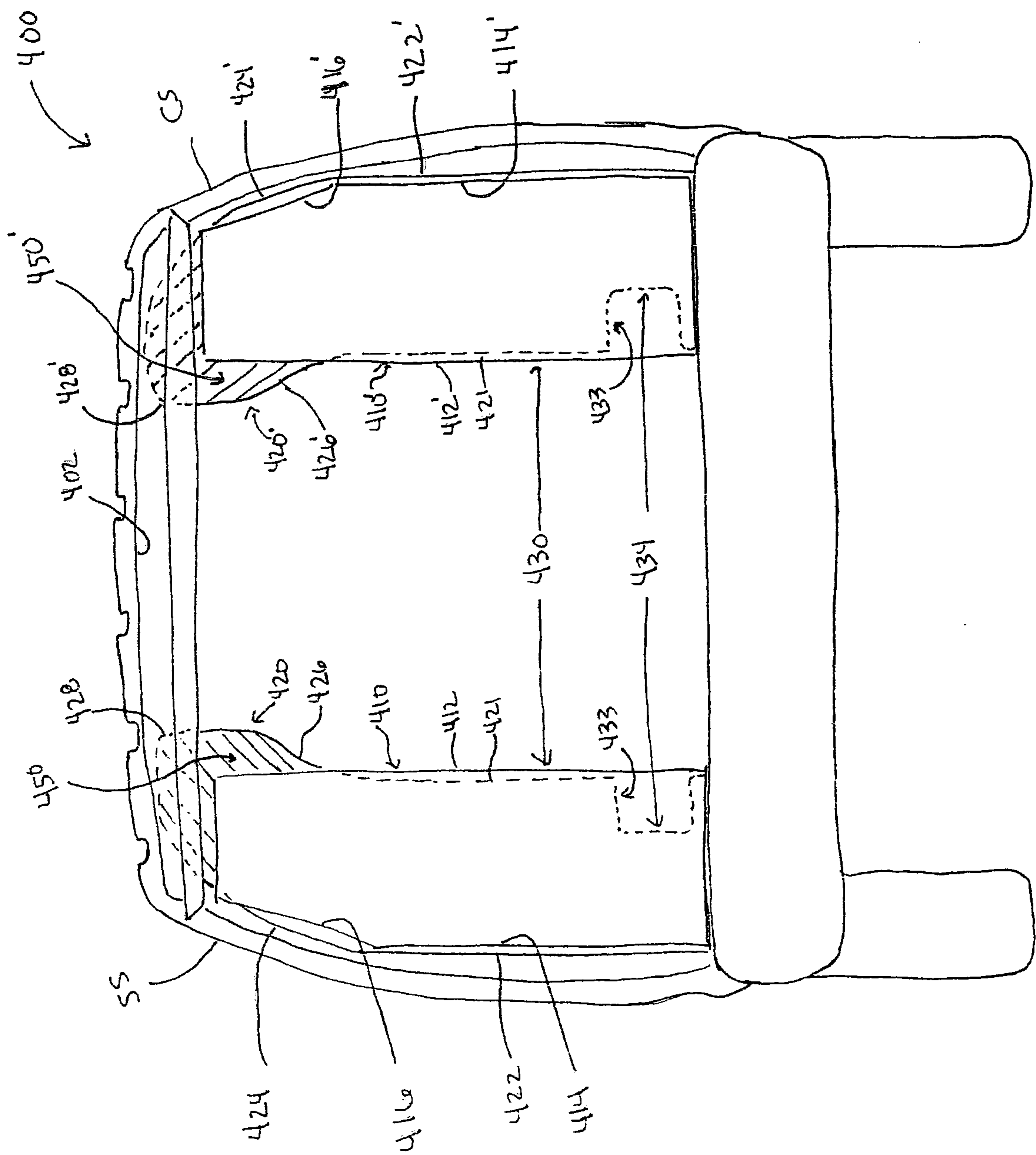


FIG. 14A

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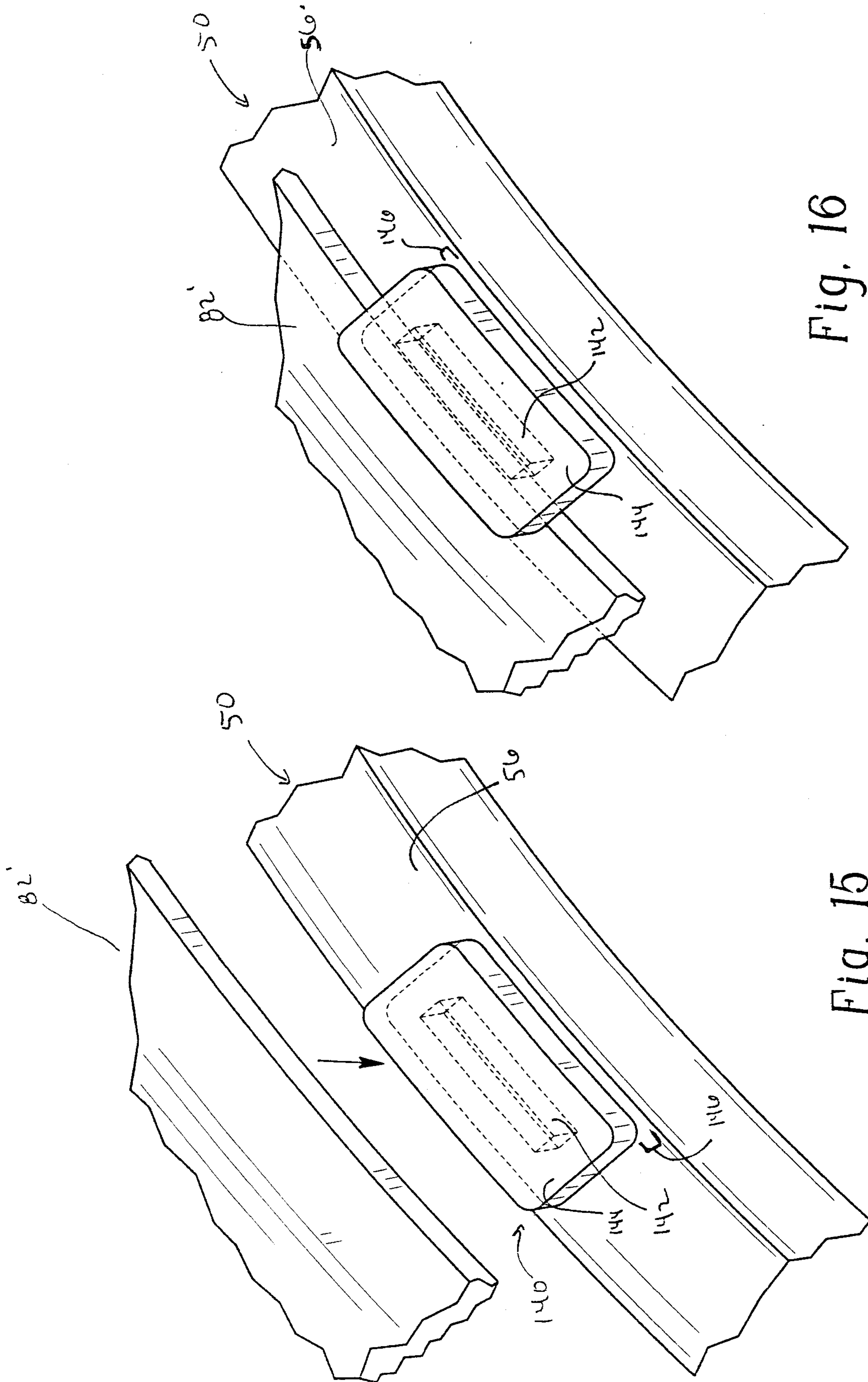


Fig. 16

Fig. 15

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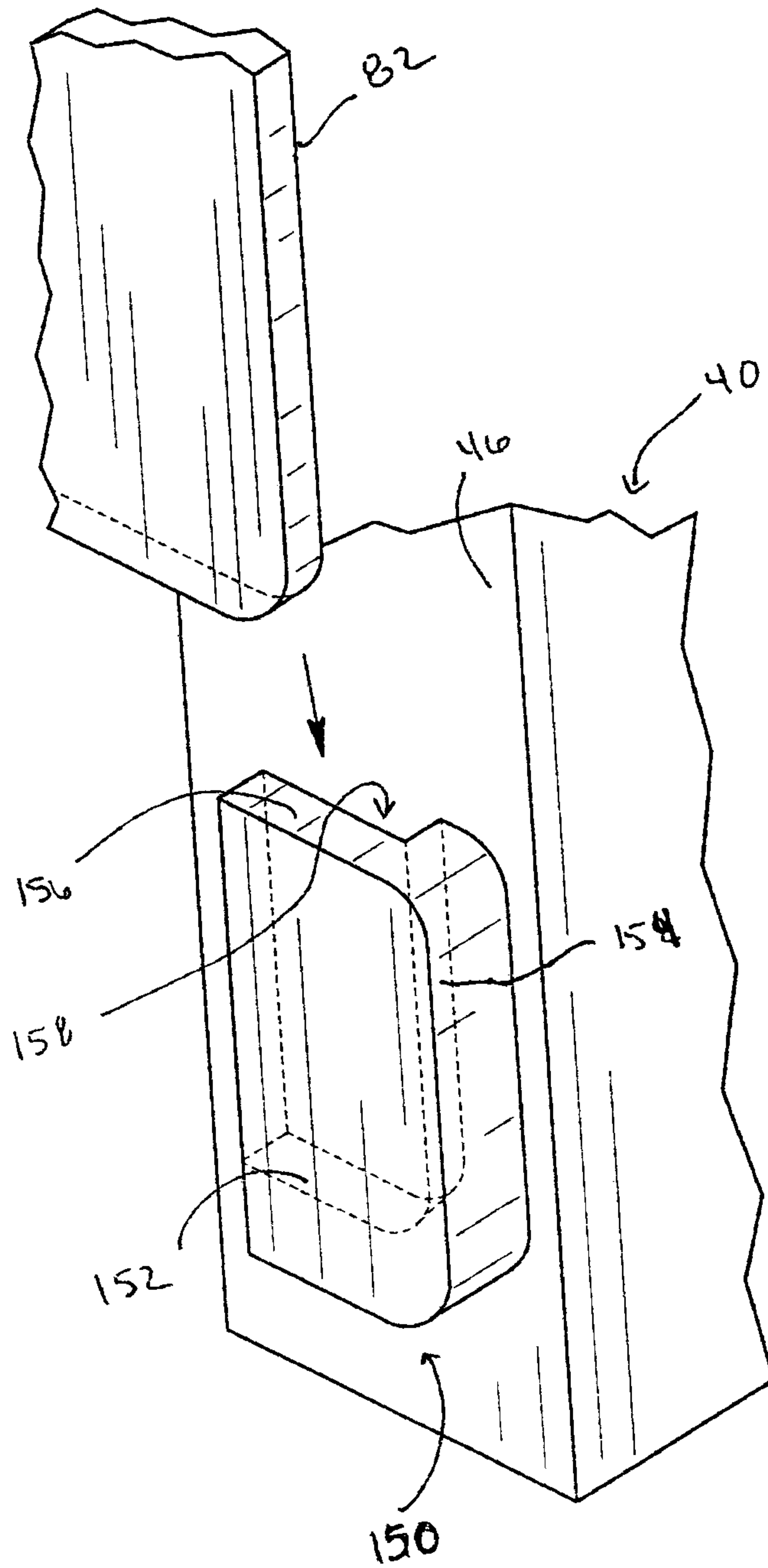
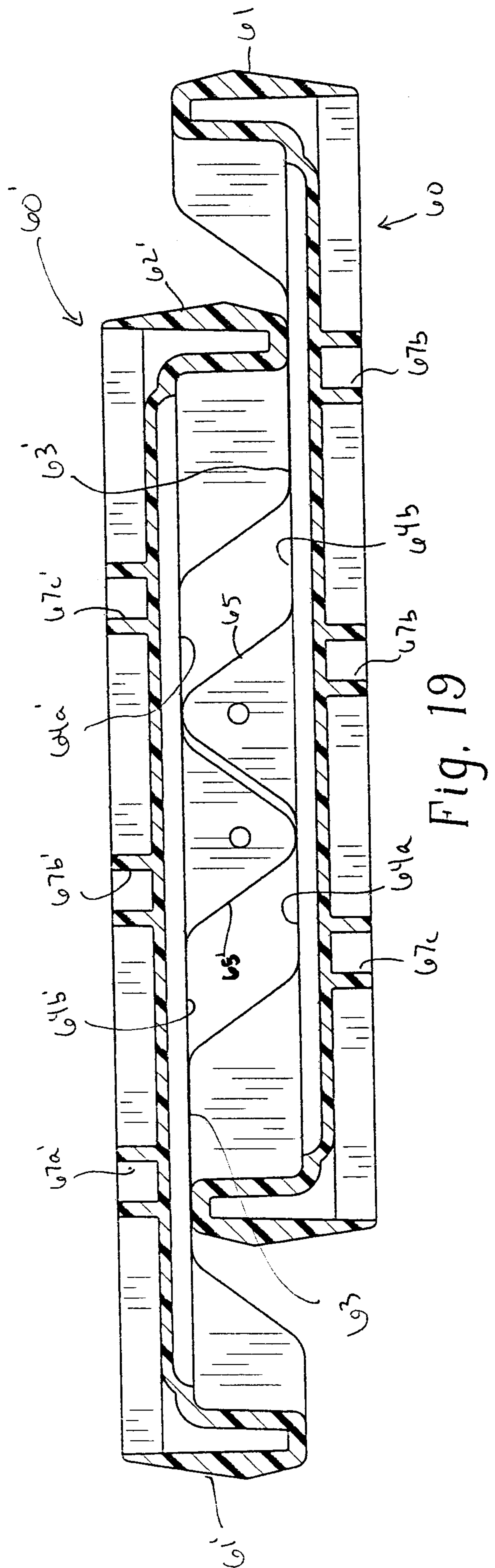
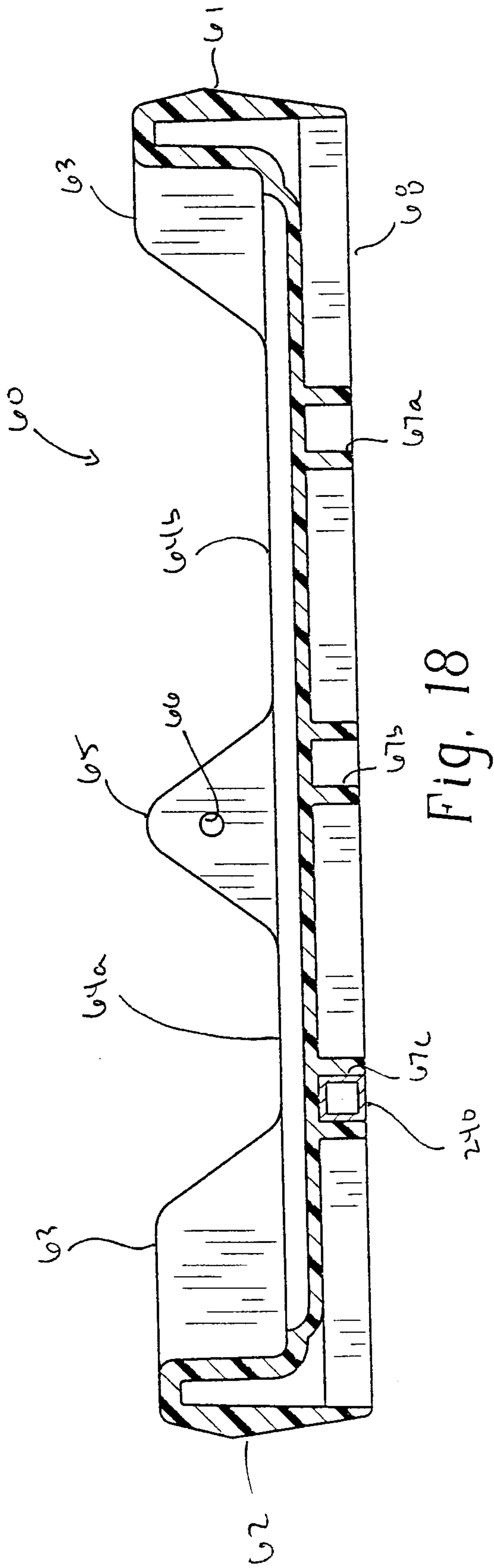


Fig. 17

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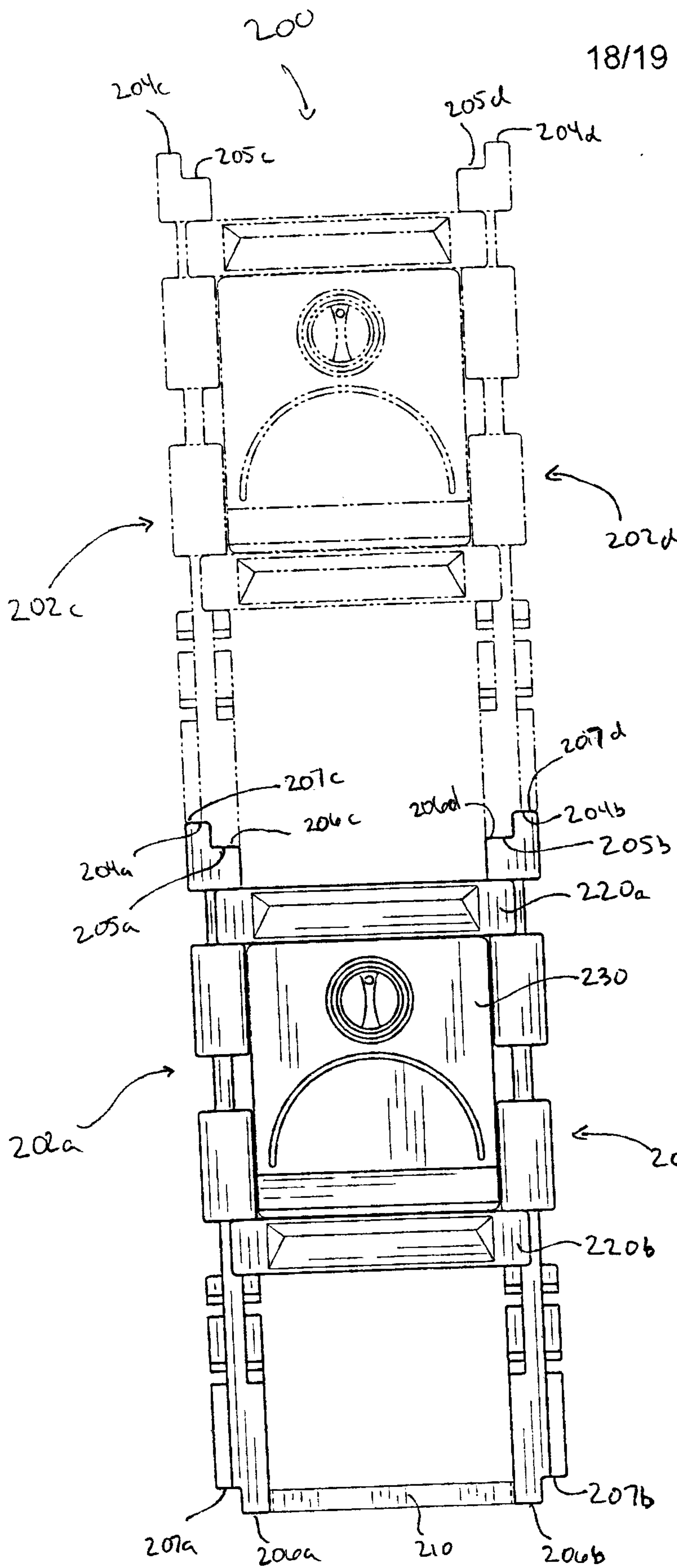


Fig. 20

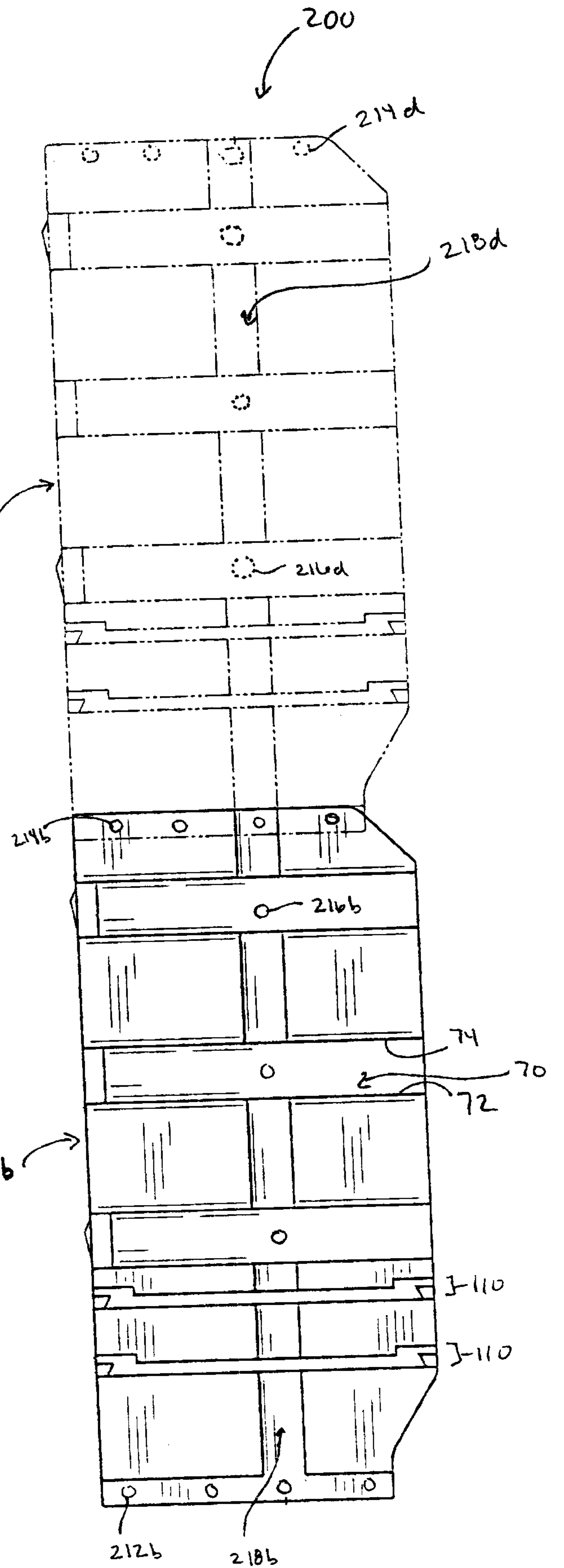


Fig. 21

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