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(71) Applicant: **INSTA-BULK, INC.**
8901 Market Street
Houston, Texas 77029(US)

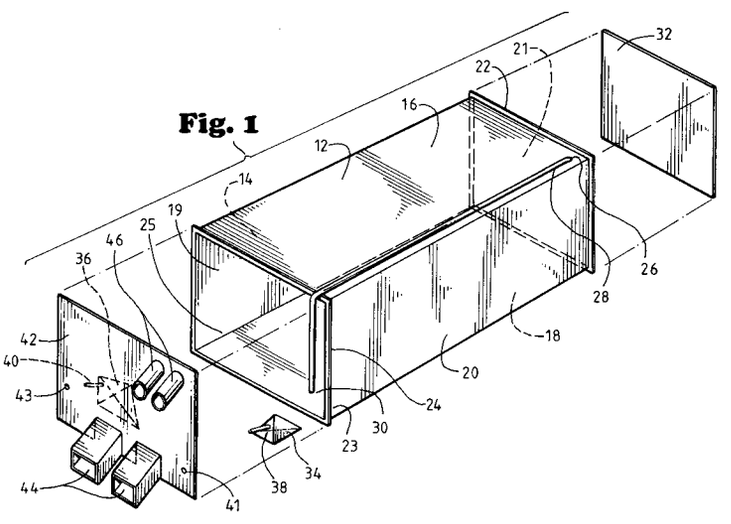
(72) Inventor: **Stopper, Raymond J.**
3325 DelMont
Houston, Texas 77019(US)

(74) Representative: **Altenburg, Udo, Dipl.-Phys. et al**
Patent- und Rechtsanwälte
Bardehle-Pagenberg-Dost-Altenburg
Frohwitter-Geissler & Partner Postfach 86 06 20
W-8000 München 86 (DE)

(54) Container liner system for bulk transfer.

(57) This invention relates to systems of handling flowable cargo in lined cargo containers. An inflatable, self-installing liner configured to line the container, when inflated, is installed and inflated within the container. A transparent, rigid bulkhead keeps the filled liner from transferring load directly to access doors to the container. Special inflatable bags are provided between the liner and the container at positions where cargo tends to remain during unloading of the liner. Fluidizing means and agitation means are also provided to enhance the unloading of the cargo. In another embodiment, there is disclosed a novel modular bulkhead configuration that has an interlocking internal construction. This modular bulkhead can be outfitted to include a compartment for housing the liner during shipment, or to receive a cartridge containing a liner. The modular bulkhead can also include a viewport and sample port.

Fig. 1



EP 0 538 563 A2

Cross Reference To Related Applications

The present application is a continuation-in-part of copending Serial Number 07/738,259, filed on July 30, 1991.

BACKGROUND OF THE INVENTION

A. Field of the Invention

The present invention relates broadly to systems for loading and unloading cargo containers with fluid-like or fluidizable cargos. The invention more particularly concerns a system wherein a self-installing, self-fitting liner is inflated within a cargo container, and a cargo is then charged into the liner. Special features include a transparent bulkhead to permit observation of the cargo and inflatable bags to improve recovery of cargo from the container.

The invention also pertains to a self-bracing, modular cargo container liner system. The self-bracing system includes a self-supporting bulkhead to permit maximum load space by resting on the rear door of the container, and may also include an observation port for the cargo area, and a built-in sample storage area. In one preferred embodiment, the bulkhead includes a recessed storage area for containing the liner prior to installation in the container. In another alternative preferred embodiment, the bulkhead comprises a base unit capable of receiving a cartridge unit which contains the liner.

In another preferred embodiment of the present invention, the liner system bulkhead unloading sleeve is adapted with an openable and recloseable port to facilitate access to the liner for cutting open the liner membrane prior to the discharge operation, and to serve as a venting means for the unloading sleeve.

The invention also pertains to a cargo liner system having a fluidizable floor to enhance the unloading of fluidizable bulk cargo from the container liner.

B. Description of the Related Art

Conventional cargo containers are routinely used to transport flowable bulk cargo such as pelletized plastic, grain, pulverized materials and the like. These containers may be transported on truck beds or rail cars or individually shipped in container ships or on barges. They may also be used to store materials at sites to which they are delivered. Typically, these containers conform to standard specifications regulated by the American Standard Association or similar international associations.

Where flowable bulk cargo, including liquid and semi-liquid material, is to be transported in a conventional cargo container, modern practice typically dictates protecting both the cargo and container with a flexible liner. The dimensions of the liner roughly correspond to the internal dimensions of the container. Containment of the cargo inside such a liner provides many advantages including protection of the container from contaminating cargo, protection of the cargo from contamination, exclusion of dust and moisture from the cargo, and similar functions. Many different styles of liners have been designed to accommodate the various functions required.

The installation, loading and unloading of bulk cargo from liners within containers has been a fertile area for invention. Many liners, for example, require the use of a bulkhead positioned between the liner and the unloading portal. This portal, in most cases, embodies the rear doors of the container. In a typical transportation operation, the load within the liner is transferred to the bulkhead which may serve as a load-bearing retaining wall or may transfer the load to another load-bearing retaining wall such as the doors of the container. As noted above, such doors are normally at the rear end of a container, and they will be referred as the "rear doors" herein.

During a typical unloading process, bulk cargo is removed from a container by first allowing gravity flow, establishing a line of repose of the cargo within the container and then tilting the entire container and achieving further gravity flow of the bulk cargo out of the liner through a portal in the bulkhead positioned near the rear doors of the container. Alternatively, low pressure suction devices may be used to eliminate the requirement for tilting. Unloading with suction, however, requires special equipment. Although it is possible to remove a large percentage of the cargo from a container using the above conventional techniques, typically there is a residual amount of the cargo retained in the corners nearest the unloading portal.

Several bulk cargo handling systems already have been designed which attempt to overcome the above problems. For instance, numerous patents have been issued for bulkheads, liners, and unloading assistance devices. Some patents describe bulk cargo handling systems which include all three such features - i.e., bulkheads, liners, and unloading assistance devices.

Bulkheads

Removable bulkheads used in cargo containers are well known. For the most part, however, such bulkheads are very heavy, wall-like structures requiring substantial support to withstand a load. Cer-

tain designs require the bulkhead to serve as the principal load-bearing member replacing, for example, the rear doors of a container.

In other cases, the bulkhead is not required to serve as a structural support member but may serve instead as a baffle inside a flowable bulk cargo container, or merely as a partition to retain refrigerated air. In yet other designs, the bulkhead may be separate and distinct from the container, relying instead on structural members extraneous to the container to provide the necessary support needed in, for instance, a tilting, gravity unloading process.

In yet other designs, the bulkhead may not serve as the load-bearing wall by virtue of its flexible, yieldable nature. Such a bulkhead, when stressed by a load, flexes toward the rear doors of the container thereby transferring the load directly to those rear doors. In designs such as this, safety during transportation and unloading of the cargo is dependent upon the integrity and safe opening of the rear doors.

Bulkheads may be made from a variety of materials including metal, wood, corrugated cardboard, reinforced plastic, and structurally molded plastic. Where a bulkhead material is used which must be reinforced, typically wooden or metallic supporting framework is added.

The bulkheads described above suffer from several limitations. First, although lightweight bulkheads are known, these bulkheads either must rely on substantial supporting framework or must flex to contact a load-bearing, rear door of a container. As noted, when a bulkhead yields and transfers the load within a liner to the rear doors of a container, safety concerns are raised. Heavier bulkheads improve this aspect of flexible bulkheads; however, such heavy-duty bulkheads are unwieldy, require special equipment or extra manpower for installation, and increase the cargo weight considerably.

Second, the bulkheads described above limit viewability of the inside of a container and its liner. The ability to observe interior cargo spaces while a bulkhead is in place is important to many aspects of the handling of bulk cargo. For instance, where liners are installed for receiving bulk cargo, such liners are first expanded or inflated. With most bulkheads, however, it is difficult if not impossible to ascertain whether the liner is fully expanded or properly aligned. It is also difficult to ascertain the level of cargo within such a liner. This is important information to ascertain, not only during loading, but also during actual transport. The possibilities of cargo shifting, contamination, moisture, field inspection, etc., are all reasons for being able to view a cargo within a liner and behind a bulkhead. Unfortunately, known bulkheads and liners are deficient in this regard.

Liners

Flexible liners used in conjunction with bulk cargo containers are also known in the art. In some cases, the liners are used without a separate bulkhead in addition to the rear doors of the container. In other cases, the liners require elaborate, tedious, man-power intensive installations involving hooks and straps to support the liners in an open configuration. In still other designs, internal structural frameworks are required to suspend a liner. In many cases, liners are made of flexible plastic or rubber materials which are translucent.

Typical liners are provided with a variety of sleeves or other inlets or ports for access to the interior of the liners. These sleeves facilitate loading, venting, and unloading. In many cases, the loading and venting sleeves are placed in close proximity to one another yet distant from and above the unloading sleeve.

In some designs, the liner is made contiguous with at least a rear bulkhead, and the bulkhead then serves as a closure for the liner. In other designs, the liner may remain open on one or another of its faces.

All of the liners described above suffer limitations with regard to ease of installation and requirements for manipulation to prepare the liner to receive cargo. Most importantly, liners are needed which may be installed with a minimum of manpower and skill.

Unloading Assistance Devices

Unloading assistance devices are known in the art and include hoppers with fixed, rigid members providing advantageous angled corners for enhancing gravity flow of bulk cargo. In some cases, such hoppers are used with bottom unloading containers such as rail cars. In other instances, the rigid surfaces which form the unloading assistance device may be fixed in place, and in still others, the inclined surface may be pivotally attached to one or another support structure such as a bulkhead or container wall. In yet other designs, the inclined surface which promotes the unloading of corner spaces in the liner may be provided by particular arrangements of the bulkhead member itself. In this type design, the bulkhead may be placed either upright in a vertical position or angled to form an inclined plane to facilitate unloading.

In some designs, a bulkhead is modified to promote the unloading of the flowable cargo. Thus, the typically flat bulkhead may be replaced by a curved bulkhead providing a funnel-like surface to direct the flow of the cargo during unloading. Again, the typically flat bulkhead may be modified with rigid, planar corner members pivotally at-

tached to the bulkhead to truncate the corners of the cargo space and thereby assist unloading of the corners. In the designs with altered corners or curved bulkheads, a substantial portion of the cargo space is sacrificed. Depending upon the design and the mass/packing density of the cargo, this loss of cargo space may represent up to several hundred pounds of material which could otherwise be transported.

Other designs to date have involved modifications of hoppers by addition of inflatable membranes to the wall of the hopper structure. Still other unloading assistance devices have involved forcing gases or liquids in between a container wall and the liner ("second-skin" type liner) to force bulk cargo to pour out of bottom portals. In yet other designs, liners or small container bags have inflatable and semi-pervious corner members which aerate and agitate the pulverant cargo contained in them by release of air into the flowable cargo. In yet other designs, a folded sheet is provided which, when stretched and unfolded, forms a slanted unloading surface.

Unfortunately, each of the systems for assisting the unloading of bulk cargo mentioned above suffers from one or more deficiencies. In some cases, for example, the unloading assistance device is necessarily attached to either the container or to the bulkhead which restrains the liner. In these cases, however, where a liner is to be used independently of either the container or bulkhead, as the case may be, it is not possible to take advantage of the unloading capability of the device. The same limitation applies to bladders attached to the hopper or container in which a liner is to be used to transport bulk flowable cargo. As mentioned previously, fixed corner-truncating devices substantially reduce the available cargo space. Unloading assistance devices are needed which overcome these and other limitations.

The deficiencies pointed out in the bulk cargo transport systems and elements of systems described above continue to limit the safety, efficiency and utility of such systems. Thus, a long-felt and unfulfilled need continues to exist for a bulk cargo unloading system which minimizes or substantially overcomes the variety of deficits in known designs.

SUMMARY OF THE INVENTION

In a preferred form, the invention comprises a cargo container for flowable cargo, which container includes a self-installing, inflatable liner, a transparent bulkhead, and one or more inflatable bags configured and positioned within the container to promote recovery of cargo from the container. The liner, like the bulkhead, is also preferably transparent in that it is either transparent or sufficiently translucent to enable a viewer to view the extent or disposition of cargo within the liner. The liner is also configured such that, upon inflation, it fills substantially an entire container. The liner has at least one port located near the top of the liner at one end of the liner --normally the rear end abutting a door or other access means to the interior of the container. This port may comprise a flexible tube or the like for venting the liner or for filling the liner with a cargo. At least one second port is also located near the bottom of the liner at its rear end to enable cargo to empty from the liner. A third port is located proximate the top of the front end of the liner and includes a compressible tube or other conduit which is designed to extend along and beyond the length of the liner for the purpose of inflating the liner. The compressible nature of the tube enables the tube to serve as a valve in that it is compressed and sealed upon inflation of the liner.

The liner is folded or otherwise arranged within a cargo container with its filling port toward the front end of the container. Then, as air or other suitable gas is passed into the liner through the filling port, the liner inflates, unfolds and ultimately fills the container. A flowable cargo is then passed through the filling port into the liner. As explained above, the liner ultimately seals itself.

To relieve pressure on the doors or other access means to the container, the invention preferably employs a bulkhead between the back end of the liner and the doors. The bulkhead extends across the container and to a height sufficient to relieve loading on the doors, especially the lower portion of the doors.

The inflatable bags of the invention are positioned in one or more of the corners at the rear end of the container between the liner and the container. Each bag includes a port or is otherwise structured to be inflated and deflated. Thus, air or other suitable fluid is injected into each bag when the liner is emptied to dislodge cargo which otherwise tends to be left in the container when the container is emptied. It is of course possible to cause as many cycles of inflation and deflation as necessary to fully unload the liner.

In another alternative preferred embodiment, the invention comprises a braceless, modular cargo container liner system for flowable cargo. More particularly, this modular container liner system includes a lightweight, reusable and/or recyclable bulkhead liner cartridge having a recessed storage area containing a liner in a folded or stored position. A removable or openable flap capable of covering the recessed liner storage area is provided on the bulkhead liner cartridge to protect the liner prior to installation into a container. The bulkhead

liner cartridge also preferably contains at least one port or other means of accessing the interior of the liner. This port may comprise a flexible tube or the like for venting the liner or for filling the liner with a cargo. The liner is preferably transparent in that it is either transparent or sufficiently translucent to enable a viewer to view the extent or disposition of cargo within the liner. The liner is also configured such that, upon inflation, it fills substantially an entire cargo container. The liner utilized in the braceless modular system can be of any type, such as the liner preferably outfitted with inflatable angle corner bags, and/or a fluidizing pad as described herein.

The braceless modular container liner system also includes a lightweight, reusable and/or recyclable bulkhead base cartridge for receiving the liner cartridge. In this embodiment, the liner cartridge is preferably telescopingly attached to the bulkhead base unit. The base is constructed using a novel, lightweight, interlocking internal cell matrix that is covered by an outer layer, and may also include an observation port for the cargo area, and a built-in sample storage area. The sample storage area is preferably constructed of sufficient size to accommodate a small, self contained sample of the cargo contents, or is constructed as part of the observation port to allow access to a recloseable sample sleeve attached directly to the liner. The base unit also contains a discharge port.

In another alternative preferred embodiment, the braceless modular cargo liner system is configured as an integrated unit containing both the bulkhead base unit and the liner cartridge unit. In this embodiment, the bulkhead includes a recessed storage area for containing the liner prior to installation in the container. The system is configured with the filling, venting, discharge, sample and/or observation ports.

The braceless liner system is positioned or otherwise arranged within a container with its filling port toward the front end of the container. The protective panel is opened to expose the polyethylene liner which is then extended and secured to the front of the container. The braceless bulkhead is uprighted and positioned at the container's threshold proximate the container doors. The bulkhead extends across the container and preferably to a height sufficient to rest behind the upper horizontal cross brace of the container. The remainder of the bulkhead rests against the left hand door. Positioning guides can by employed to advantage to facilitate placement of the liner system proximate the rear doors. Use of the positioning guides on the right hand side of the container facilitates alignment of the bulkhead during the loading phase to ensure that the right door will have proper clearance for closing, and to prevent the bulkhead from falling over during loading, such as may occur due to the arrival of an unexpected gust of wind. As air or other suitable gas is passed into the liner through the filling port, the liner inflates and ultimately fills the container. A flowable cargo is then passed through the filling port into the liner. The liner is ultimately sealed.

An alternative preferred embodiment includes a means for fluidizing the bulk cargo contained within the liner to facilitate its removal from the liner during the unloading process. More specifically, the means for fluidizing the bulk cargo is accomplished by inserting or attaching a fluidizing pad or bed within the interior of the liner, preferably along the bottom or lower horizontal panel of the liner. The fluidizing pad preferably contains a plurality of fluidizing jets, or perforations capable of directing sufficient jet flow into the liner to fluidize the contents of the liner. In a preferred embodiment, the fluidizing jets are energized by the introduction of air through the jets. However, other gases, preferably inert, or mixtures thereof, may be employed to advantageously energize the jets, if desired. The fluidizing pad preferably contains at least one inflation tube to introduce the air or gas source to the fluidizing pad. The inflation tube is preferably sufficiently rigid and self-supporting so that it will not collapse if it is located under the weight of a liner filled with the bulk commodity. Fluidizing pads can be installed along the interior vertical sides of the liner, if desired. This means for fluidizing the contents of the liner is particularly advantageous for the unloading of bulk commodity powders, and the like.

In another alternate preferred embodiment, there is disclosed a means for agitating the liner bag to facilitate the discharge of the bulk cargo contained in the liner. More specifically, a fluidizing pad, such as that mentioned above, is attached beneath the liner bag, such that the fluidizing jets are directed to toward the container. An air source is applied to the agitation pad in an oscillating or pulsating fashion to agitate the liner bag thereby dislodging residual bulk material present in the interior of the liner. This agitation means can be used alone or in combination with the fluidization means.

In another preferred embodiment of the present invention, there is described an apparatus for lining a cargo container, wherein the container has opposed side walls including an access door in a first such wall, a top and a floor, the apparatus comprising: a liner having opposed side walls, a top and a floor defining an interior space corresponding generally to the side walls, top and floor of the container, the liner being positionable within the container in spaced relation with a first wall in the container; a fluid impervious plenum adjacent the

floor of the liner, the plenum corresponding to an area of the floor of the liner and having a plurality of spaced apart perforations for directing a fluid from the plenum into the interior space; a bulkhead positionable between the access door and a side wall of the liner, the bulkhead having a liner inlet port, a liner outlet port, and a plenum inlet port; a liner inlet for introducing material into the interior space through the liner inlet port; a liner outlet for removing material from the interior space through the liner outlet port; a plenum inlet for introducing a fluid into the plenum through the plenum inlet port; the liner, plenum, bulkhead, liner inlet, liner outlet, and plenum inlet being cooperable to create a fluidized bed of material in the interior space when material is introduced through the liner inlet into the interior space and fluid is supplied to the plenum inlet to facilitate unloading of the material through the liner outlet. In this embodiment, the plenum is preferably positioned inside the liner floor.

It is anticipated that the plenum could also be positioned beneath the floor of the liner, in which case, perforations would be provided in the floor of the liner in registry with the perforations in the plenum.

In an alternative preferred embodiment, the cargo liner apparatus further includes a liner compartment in the bulkhead, the compartment being operable to contain the liner when the bulkhead is transported.

In another preferred embodiment, the cargo liner apparatus liner compartment comprises an upper portion of the bulkhead that is detachable from and replaceable on the remaining portion of the bulkhead. The detachable liner compartment can be telescopingly carried by the bulkhead.

In another preferred embodiment, the cargo liner further comprises a positioning guide for positioning the bulkhead adjacent the access door. The positioning guide preferably comprises: a channel engager for engaging a channel on a side wall of the container; a bulkhead engager for engaging the bulkhead; and a connecting web for connecting the channel engager to the bulkhead engager. The channel engager preferably has a box-like cross-section having one dimension substantially the same as the depth of a stiffening member on a side wall of the container. The bulkhead engager preferably engages the bulkhead along only a portion of a width of the bulkhead. In an alternative preferred embodiment, the bulkhead engager engages the bulkhead by penetrating a face of the bulkhead.

In one preferred embodiment, the positioning guide is magnetic. In another alternative preferred embodiment, the positioning guide further comprises an adhesive for adhesive engagement with a side wall of the container.

In another preferred embodiment of the present invention, the liner system bulkhead unloading sleeve is adapted with an openable and recloseable port to facilitate access to the liner for cutting open the liner membrane prior to the discharge operation, and to serve as a venting means for the unloading sleeve. This port allows for access to the discharge area of the liner bag without necessitating a removal of the unloading sleeve from the unloading equipment.

There is also disclosed a method for lining a cargo container, wherein the container has opposed side walls including an access door in a first such wall, a top and a floor. The method comprises the steps of: introducing into a cargo container a liner having opposed side walls, a top and a floor defining an interior space corresponding generally to the side walls, top and floor of the container; positioning the liner within the container in spaced relation with a first wall in the container; positioning a bulkhead between the access door and the first wall of the liner, the bulkhead having a liner inlet port, a liner outlet port, and a plenum inlet port; introducing material into the interior space through the liner inlet port; unloading some material from the interior space through the liner outlet port; introducing fluid through a plenum inlet port into a fluid impervious plenum adjacent the floor of the liner, the plenum corresponding to an area of the floor of the liner and having a plurality of spaced apart perforations for directing a fluid from the plenum into the interior space; directing a fluid from the plenum into the interior space to create a fluidized bed in the interior space; and unloading any remaining material in the interior space through the liner outlet. The method can include the preferable step of positioning the plenum inside the interior space on the liner floor.

In a preferred alternative embodiment, the method can include the step of positioning the plenum outside the interior space beneath the floor of the liner. In this regard, the method also preferably includes the step of perforating the floor of the liner in registry with perforations in the plenum.

This method can also preferably include the step of introducing the liner into a liner compartment in the bulkhead, the compartment being operable to contain the liner when the bulkhead is transported.

The method can also preferably include the step of detaching the liner compartment from an upper portion of the bulkhead.

The method can also further include the step of telescopingly removing the liner compartment from an interior compartment of the bulkhead.

The method also preferably includes the step of positioning the bulkhead adjacent the access door of the container. The positioning step further

includes the steps of: introducing a positioning guide adjacent a channel on a side wall of the container; and displacing the bulkhead to a position where the bulkhead engages a bulkhead engager of the positioning guide. In an alternative preferred embodiment, the positioning step further includes the step of: penetrating a face of the bulkhead with the bulkhead engager. In a preferred embodiment, the method includes the step of magnetizing the positioning guide, and or applying an adhesive to the positioning guide.

It will be recognized that each of the above features of the invention may be employed to advantage either alone, or in combination. Furthermore, it is contemplated that features described herein could be adapted to other cargo liner systems.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an exploded, isometric view of the construction of a self-installing liner system.

Figures 2A and B show construction of a corner bag.

Figure 3 is an isometric view of a completed liner system.

Figures 4A-D are isometric views of rigid bulkheads.

Figure 5 is a partially exploded view of a liner apparatus packaging system.

Figures 6A-D are stepwise, isometric views of a phantom container showing the stepwise self-installation of a liner within the container.

Figures 7A-C are stepwise isometric views, partially sectioned, showing an alternative packaging and attachment system used in conjunction with the self-installing liner.

Figure 8 is an isometric view of a self-installing liner with corner bags, transparent bulkhead and structural support members installed within a container.

Figure 9 is a partially sectioned view of a transparent bulkhead installed within a container with structural support members, corner bags and liner.

Figures 10A-D are stepwise views of the unloading of a phantom container-liner system showing the use of corner bag members.

Figure 11 is an exploded, isometric view of a liner system embodiment of the present invention containing a fluidizing pad.

Figure 12 is an isometric view of a liner system embodiment of the present invention containing a fluidizing pad.

Figure 13A is an isometric view of a modular bulk cargo container liner system embodiment of the present invention.

Figure 13B is an isometric view of a liner unloading sleeve embodiment of the present invention.

Figure 13C is an isometric view of a liner unloading sleeve embodiment of the present invention.

Figure 14A depicts a liner cartridge embodiment of the present invention.

Figure 14B depicts a liner cartridge embodiment of the present invention.

Figure 14C depicts a bulk cargo liner system embodiment of the present invention.

Figure 14D depicts a bulk cargo liner system embodiment of the present invention.

Figure 15A illustrates an isometric, cross-sectional view of a bulkhead portion of a bulk cargo liner system of the present invention as taken from lines 1-1 in Figures 14C and 14D.

Figure 15B illustrates a cross-sectional view of a bulkhead edge or perimeter cap.

Figure 15C illustrates a cross-sectional view of a bulkhead edge or perimeter cap.

Figure 16 is an isometric cross-sectional view of a bulkhead portion of a cargo liner system of the present invention.

Figure 17A is a exploded cross-sectional view of an exemplary braceless bulkhead of the present invention.

Figure 17B is an enlarged cross-sectional view of exemplary bulkhead beams in accordance with the present invention.

Figures 18 and 19 depict exemplary braceless bulkhead systems made in accordance with the present invention.

Figure 20 shows an exploded view of a bulkhead view port cabinet.

Figures 21A and 21B show exemplary bulkhead positioning guides.

Figures 22A and 22B show a top cross-sectional view of a braceless bulkhead positioned with positioning guides.

Figure 23 shows an exemplary means for securing the discharge sleeve fitting of the liner to a retainer bulkhead.

Figure 24 shows an exemplary means for securing the discharge sleeve fitting of the liner to a retainer bulkhead.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As noted above, the present invention relates in one aspect to a rigid bulkhead, at least a portion of which is transparent -- i.e., either clear or sufficiently transparent as to enable viewing through the bulkhead. The rigidity of the bulkhead provides a principal advantage over prior art bulkheads which are flexible or at least yield under load to transfer

the load to the doors or other opening means for the container. The materials from which the bulkhead is made are not so heavy as to require machinery or extensive manpower for installation. Thus, installation of a bulkhead of the invention has been demonstrated to be easily carried out by two persons.

The bulkhead may be constructed, in whole or in part, from transparent, rigid material which is: (1) sufficiently transparent to provide at least some view of the cargo space of the container including the lower corners nearest the bulkhead; and (2) rigid enough to help prevent any substantial portion of a load from bearing upon the bulkhead and other support structures from being transferred to the opening means (doors) of the container.

It has been found that loads in cargo container liners may impose pressure on the lower and most central portion of a bulkhead of about 600 pounds per square foot. On the other hand, the loads at the lower corners of a typical cargo contained behind a bulkhead may run about 400 pounds per square foot. At the topmost corners of such a load-bearing bulkhead, about 50 pounds per square foot are typically encountered. The bulkhead of the present invention counteracts such forces sufficiently to prevent transfer of the load to the rear container doors.

A preferred rigid, transparent bulkhead material is an acrylic resin sheet. However, it is anticipated that a variety of other materials are also suitable, including safety-reinforced glass, fiber reinforced plastic, structurally molded plastic, and other products which possess the necessary rigidity and transparency. As will become more apparent when the bulkhead is described in detail below, some portions of the bulkhead will not be required to be either rigid or transparent, so long as enough overall rigidity and transparency is retained by the bulkhead to provide the advantages of the invention. The overall bulkhead unit, however, should demonstrate both of these characteristics.

By making a bulkhead of the invention of a material through which the interior of the container and liner may be seen, the bulkhead overcomes a substantial limitation of opaque bulkheads or bulkheads with only limited capability to provide such a view. In a preferred embodiment, the bulkhead is clear thereby providing maximum visibility of the cargo space. In any case, the view provided by the bulkhead of the invention facilitates observation of the interior cargo space with relative ease compared with prior art devices. Thus, a preferred embodiment facilitates observation of important aspects of the bulk cargo transport system including: (1) installing of the liner; (2) loading of the bulk cargo; (3) viewing of cargo during transport; and (4) unloading of cargo.

This capability represents a substantial improvement over prior art devices and facilitates bulk cargo handling with reduced manpower requirements. For instance, automated machinery may be used in combination with liner systems for both loading and unloading to minimize handling by personnel of bulky or hazardous materials. Where such automated devices are utilized, the ability of a single handler to view the entire operation is enhanced. Cargoes may include any cargo such as pelletized plastic, grain, particulates, or other flowable cargoes.

The bulkhead of the invention is capable of being positioned between a liner and the opening means for a container. The opening means typically comprises a rear door or doors of the container. Alternatively, the opening means may be openings positioned along any wall of a container wherein an opening is found so long as the bulkhead may be adjusted to function as described above in conjunction with such opening.

Of independent significance, the bulkhead of the invention is capable of relieving the load caused by a cargo within a liner from being transferred directly to the opening means. The ability to restrain the load within the liner relies, in one aspect, upon the rigid and substantial construction of the bulkhead. In addition, the restraining ability relies on the special construction of the bulkhead itself, including the portions of the bulkhead which extend forwardly into the container cargo space. The restraining ability of the bulkhead is increased by a minimal use of structural support members.

Another important aspect of the bulkhead of the invention is that there is no requirement for any attachment to a liner used with the bulkhead. This represents a considerable improvement over those prior art bulkheads which are integral with the liner or which function as a closure for the liner. Such prior art devices do not facilitate use of the bulkhead separate from the liner. The present invention on the other hand uses discrete components. This is especially important in those countries where laws require either reusable shipping container liners or fully recyclable shipping container liners. Many commercially available liners are recyclable, but many bulkheads are not. Inasmuch as the bulkhead of the present invention is not attached to the liner, the bulkhead is fully reusable.

An inflatable air bag used in conjunction with a liner within a container is also a feature of the present invention. The air bag may take a number of configurations depending upon the unloading procedures being used. In a preferred embodiment, the air bag will be attached to the liner to facilitate the unloading of the residual cargo that remains following gravity flow unloading. However, in alternative embodiments, the air bag may be attached

to other elements of the invention such as the transparent bulkhead or the container itself. In addition, air bags need not be attached to any of the other elements of the invention.

Regardless of whether attached or unattached, the air bag is positioned in close proximity to an outlet in the liner. The outlet in the liner is, in turn, positioned in close proximity to the opening means in the container, usually the rear doors.

A self-installing liner capable of containing bulk cargo and separating the cargo from the interior surfaces of a bulk cargo container is also a feature of the present invention. The term "self-installing" means a liner which requires minimal manpower and manipulation for installation and preparation for receiving bulk cargo. More particularly, the self-installing liner of the present invention requires only attachment of the liner to the forward container wall, thereafter relying on forced air inflation of the liner to fully install the liner within the container. Attachment of the liner to the forward container wall is achieved with minimal manpower as well. In one embodiment, the folded liner is placed in the front of the container in a manner exposing a top and bottom edge of the front panel of the liner. In this embodiment, the bottom edge of the front panel is manually attached near the forwardmost container floor with attachment being achieved by nailing, tacking or by applying adhesive. Next, the top edge of the front panel of the liner is attached to a forwardmost container wall or ceiling in a manner to fully extend the front liner panel. The attachment of the top edge of the liner may be by means of a nailing or hanging board or by means of hanging straps looped over a lash bar in the container. In another embodiment, attachment of the liner to the forward container wall and floor portions is achieved with even less manpower or manipulation. In this embodiment, the bottom edge of the front panel of the liner is previously attached to a packaging member. The packaging member comprises at least two panels the outer surface of which panels are coated with an adhesive which adhesive-coated, outer surface is additionally covered with a removable release paper or sheet. Instead of requiring a manual attachment of the bottom edge of the front panel, installation of this embodiment of the invention merely requires removal of the release paper exposing the adhesive-covered panels. These panels are then placed in the front most corner of the container where floor and front wall members join. If greater than two panels comprise the package member, these panels may be unfolded to additionally adhesively attach to the container wall or floor. The top edge of the forward panel of the liner is next attached as noted above. Upon inflation, as described below, the adhesive covered panels of the package member become even more firmly attached to the container. This attachment is enhanced when bulk cargo is placed in the liner. After the front panel of the self-installing liner is attached, inflation is initiated. This is achieved, in a preferred embodiment, by providing an inflation tube for filling with gas the deflated liner. In certain embodiments, this gas will be compressed ambient air, either filtered or unfiltered. In other embodiments, especially where inert gases are preferred due to an explosive, combustible or otherwise reactive nature of certain cargo or due to the need for maintaining low moisture content of the inflating gas and cargo, gases other than air may be used.

A surprising attribute of the invention lies in the lack of necessity for a means to close the inflation tube to prevent gas from escaping from the liner. The position of the inflation tube is such that upon continuing inflation, the liner presses against the inflation tube, progressively causing enough pressure against the inflation tube to effectively seal the liner from losing internal air. Thus, the self-installing liner may be inflated inside a container and bulkhead as much as two days prior to being loaded. This added flexibility in operation provides a considerable advantage.

An additional surprising aspect of the self-installing liner is its automatic inflation limitation feature when using certain forced-air equipment. As the inflation tube delivers the forced air into the liner, the inflow and outflow of air equilibrates to prevent over inflation of the liner and potential rupturing of the liner material. Thus, there is no requirement when using certain forced air equipment, such as a small centrifugal blower as might be found on home leaf-blowing equipment, to monitor a self-installation for possible over inflation. Hanging strap means are provided at the top edge of the rear panel of the liner for positioning and hanging of the liner once the self-installation is achieved.

The invention also pertains to a self-bracing, modular cargo container liner system. The self-bracing system includes a self-supporting bulkhead to permit maximum load space by resting on the rear door of the container, and may also include an observation port for the cargo area, and a built-in sample storage area. In one preferred embodiment, the bulkhead includes a recessed storage area for containing the liner prior to installation in the container. In another alternative preferred embodiment, the bulkhead comprises a base unit capable of receiving a cartridge unit which contains the liner.

The overall self-inflation features of the liner of the invention represent a substantial improvement over conventional systems for installing liners. The self-installing liner employs a relatively few, simple steps for deployment, compared with conventional

liners which use numerous straps, belts, hooks, attached bulkheads, adhesives and the like. Although certain limited use may be made of attachment devices such as these in conjunction with the self-installing liner, such use is kept to a minimum.

The various elements described above individually represent considerable improvements over the existing art. However, they may also be combined in a number of ways to achieve even further improvements. In that regard, it is contemplated that the systems of the invention will be used in connection with a typical walled container having at least side walls, front and rear walls, and a floor. However, the apparatus and methods of the invention may also be applied to cylindrical containers or other irregularly shaped containers. The container should have at least one wall with an opening through the wall to provide access to the interior of the container. This opening in many instances will comprise the rear doors of a container. At the present time, most containers are being configured to provide rear door access to the cargo compartment; and this description, accordingly, has generally assumed that type of access.

Each system of the invention will have a liner bag capable of containing bulk cargo and capable of providing a barrier between the cargo and the interior surfaces of the container. In a preferred embodiment, the liner bag is constructed of lightweight, flexible materials known well in the art. In alternative embodiments, the liner may be constructed of heavier, more durable materials where multiple uses or the characteristics of the cargo so require.

Where the liner bag is to be used with a bulkhead which does not extend the full height of the container, such as where only a lower portion of the container opening is provided with a rigid and transparent bulkhead, the face of the liner bag which will encounter the bulkhead and supporting bracing structures may be reinforced with multiple layers of liner material or with a more substantial plastic material. In a preferred embodiment, even with reinforcement as necessary, the liner bag should be sufficiently transparent to provide a view into the interior of the liner.

Preferably, the liner bag will be constructed of a material through which the cargo may be clearly seen. Moreover, in a preferred form, the liner bag will be constructed to fill, upon complete installation, the space defined by the interior walls of the container.

It will be apparent to those of skill in the art that the bulkheads of the present invention may be used with a wide variety of containers, container liners, and opening mechanisms. Thus, many commercially available containers, fitted in a variety of ways with opening means, may be used in combination with the cargo liner systems of the present invention. Likewise, many commercially available liners may be adapted for use with the bulkhead and other features noted herein.

It is contemplated that the inflatable bags, the fluidizing means, and/or the agitating means of the invention will be placed at positions within a lined container, wherever cargo tends to be left behind when the liner is emptied. Thus, when a container is tilted to drain cargo from a liner through an outlet port or a container door, cargo frequently remains on the floor of the liner and along the outlet end of the container, and especially in the corners of the container. It is, therefore, preferred that the outlet of the liner be positioned in close proximity to the bottom of the container and also in close proximity to the opening means in the container. Inflatable bags placed in the corners at the outlet end of the container may then be most effectively used to promote the unloading of cargo within the liner.

As mentioned above and as is required by any particular bulk cargo handling situation, the inflatable bags may be variously attached to the liner, the bulkhead or the container. Alternatively, the bags may be entirely separate members, unattached to any of the other elements. The air bags need not be uniformly sized, particularly where asymmetry in the position of the opening means in the container and the outlet in the liner require differently sized air bags.

Inflation of the bags may be achieved in a variety of ways. One embodiment involves the use of filler tubes to which may be attached a source of pressurized air or other suitable gas or fluid. It is necessary, of course that the pressure of the gas be sufficient to inflate the bags when covered by cargo material. It is also necessary that the bags, when inflated, have a shape, size and slope sufficient to cause the cargo to flow toward the outlet. Where the cargo is relatively lightweight, centrifugal blowers may provide sufficient pressure. When the container is used in facilities without access to electrically powered compressors, blowers, pumps or the like, compressed gas tanks may be packaged with the other elements of the apparatus.

It will be apparent that the use of the inflatable bags of the invention is not limited to the specific liners and bulkheads of the present invention. Thus, the bags may be used with any bulkhead or container and used effectively with any of a number of liners known in the art. The bags may also be attached to the liners, themselves, or to a baseboard or to elements of the containers. Likewise, the other aspects described herein, such as the fluidizing means, the agitation means, the sample port, and the recloseable access in the discharge port, can be used in a variety of liner systems,

including those described herein and those known in the art.

The self-installing liner of the invention may be used in conjunction with virtually any known cargo container, bulkhead, opening means, and the like. However, their use with the rigid and transparent bulkheads and the inflatable bags of the invention provide particular benefits. Thus, in a preferred embodiment, a rigid and transparent bulkhead, fitted into a container with a self-installing liner and inflatable unloading assistance devices, provide especially safe and efficient transport of bulk flowable cargo. Although the elements discussed above may be provided and shipped separately, they may also be packaged as a unit. Additionally, where it is desirable to do so, a facade which covers the apparatus of the invention may be provided for purposes of identitying the source, the nature, the required handling procedure and other pertinent information relating to the apparatus and its use.

Furthermore, the braceless cargo liner system of the present invention can also be employed in conjunction with virtually any known cargo container. The liner bags employed with the braceless system can be of any variety, and can contain the preferred inflatable angle corners, fluidizing means, and/or agitating means described herein.

Methods for transporting fluid or fluidizable bulk cargo are also achieved by the use of one or more of the elements of the invention. These methods generally require selecting an appropriate apparatus as provided by the invention and matching it with a particular bulk cargo, transporting the bulk cargo therein, and then unloading the cargo in a manner to take advantage of the considerable improvements in safety and efficiency provided by the present invention. The specific improvements available when one or another of the elements, alone or in combination with one or more of the other elements of the invention, is also claimed. Thus, where safety and viewability of the cargo space are of importance, one would select a method of transporting the cargo utilizing at least the rigid and transparent bulkhead of the present invention, or the braceless system employing the viewport. Where efficiency and low manpower requirements are important, one would select a method where at least the self-installing liner of the present invention is used. Where efficiency and the need to remove residual cargo left after unloading are important, a method which at least uses the air bags, fluidizing means, and/or agitating means of the present invention is preferred. Where efficiency and low manpower requirements are important, but bracing is undesirable, one would select the braceless system containing one or more of the features described herein.

DESCRIPTION OF DRAWINGS

In general, the figures depict the construction of the various elements of the liner-bulkhead-corner bag system of the invention including alternative packaging systems therefor. The figures also illustrate the self installation of a liner with alternative attachment means therefor. Certain figures are included to show the fully installed liner-bulkhead systems within containers. Finally, figures are included which illustrate the unloading of cargo from a liner within a container. Although not depicted in the figures to follow, it will be understood by those of skill in the art that certain commonly encountered elements may be used in conjunction with the elements of the invention.

Thus, the elements of the invention will typically be used with containers used in transportation and commerce such as those seen carried on truck beds, rail cars and in vessels. In some instances, these means of conveyance will include means for tilting the container for unloading of the contents therein. It will be readily apparent from the disclosure herein that the elements of the invention may be used to advantage in such containers. It will also be readily apparent that certain modifications of the current invention may be necessary to accommodate the variety of container systems available. These modifications are, as will be apparent to one of skill in the art, intended to be included within the scope of the claims of the present invention.

Turning first to the construction of the various elements of the invention, Fig. 1 shows construction of a self-installing liner system which comprises an appropriately sized tubular section **12** with upper panel **16**, side panels **14** and **20** and lower panel **18**. Panel construction is selected in accordance with the specifications of the container in which the liner is to be used and dimensions of such panels generally conform to the internal dimensions of the container. Materials generally used for construction of tubular sections such as **12** include polyethylene but may also include in special circumstances vinyl film or plastic-coated fabric. Tubular section **12** is further provided at the front open end **21** and again at the rear open end **19** with flared lip members **22** and **24**, respectively, along each of the four panels **14**, **16**, **18**, **20** of tubular section **12**.

Tubular section **12** is also provide with an aperture **26** to which is attached a tubular conduit **28**. Tubular conduit **28** is typically constructed of polyethylene, vinyl film, plastic-coated fabric and extends from the aperture **28** near the front open end **21** along the entire length of tubular section **12** and sufficiently past rear open end **19** of tubular section **12** to allow facile access to end **30** of the

tubular conduit **28** for applying a source of inflating gas or liquid.

Preferably, corner bags to facilitate unloading as described herein are placed inside the tubular section. Construction of such corner pieces is described more fully below in conjunction with Fig. 2A and B, but attachment of the corner bags to the inside corners **23** and **25** is accomplished to provide corner bags **34** and **36** with an airtight seal against the walls of the tubular section **12**. Corner bags **34** and **36** are further fitted with inflation tubes **38** and **40**, respectively, to provide a means of inflating and deflating the respective corner bags.

End panels **32** and **42** are provided for fixed attachment in an airtight manner to the open ends **19** and **21** of tubular section **12**. The rear panel **42** is typically provided with a number of apertures and sleeves to facilitate access to the interior of the liner. Selection of the numbers, sizes and placements of the various apertures is dependent upon the type of cargo and container to be transported. However, most uses will require apertured sleeves for loading and venting such as sleeves **46** attached near the upper edge of rear panel **42**. These sleeves are typically selected to fit standard sized loading and venting equipment well known to those of skill in the art of container liner construction. Similarly, apertured sleeves for unloading such as sleeves **44** will be attached near the lower edge of rear panel **42**. In some cases, more than one sleeve will be provided (as here), while in others only a single unloading sleeve will be provided (as in Fig.3 below). Numbers, sizes and placement of such sleeves are again dependent upon the job to be accomplished. Other apertures and fixtures may be provided in the rear panel **42** such as apertures **41** and **43** for access to inflation tubes **38** and **40**, respectively, of corner bags **34** and **36**, respectively. Fixtures such as loops, straps, hooks, ropes, nailing boards, adhesive straps, reinforcing strips and the like (not shown in this figure) may be attached to the end panels as needed.

End panels such as **32** and **42** are typically constructed from polyethylene, vinyl film or plastic-coated fabric. In preferred aspects, the rear panel **42**, at least, will be constructed of sufficiently transparent materials to allow viewing of the interior of the liner. In a finishing step, end panels **32** and **42** are attached in an airtight manner to tubular section **12** along flared lips **22** and **24**, respectively. The self-installing liner of Fig. 1 is depicted in a completed state in Fig. 3.

Figures 2A and B show construction of a corner bag. In Fig. 2A, two workpieces **48** and **50** are shown which are attached as follows to produce the space-filling corner bag depicted in Fig. 2B. Workpiece **48** is an isosceles triangular piece which may be fashioned from polyethylene, vinyl film, plastic-coated fabric or similar materials. Workpiece **46** has equilateral sides **54** and **56** forming an edge at their intersection whose position **61** above the base of the triangular workpiece coincides with a point **59** which transects the base of the workpiece **48** into two equal sections **58** and **60.** Workpiece **48** is further provided an aperture **52** in the upper corner near the point at which sides **54** and **56** intersect. Workpiece **50** in Fig. 2A is an isosceles triangular workpiece of similar material to workpiece **48** and has equilateral sides **62** and **64**, and a base side **66**.

The following pairwise sides are attached one to the other to form airtight seals: section **60** is attached to side **62** to form side **76** of Fig. 2B; side **58** is attached to side **64** to form side **74** of Fig. 2B**.** The resulting space-filling, tetrahedrally-shaped bag **80** comprises an open face **68** opposite a right triangular corner **72**. The open face of the tetrahedral bag may be attached to a third workpiece matching the first two to produce a freestanding closed bag; or the open face may be attached in an airtight manner to a surface of a liner as shown in Fig. 1. In either case, a final installation of an inflation tube **70** attached at aperture **52** completes the construction.

Figure 3 is an isometric view of a completed liner system. Tubular section **12** comprising side panels **14**, **16, 18** and **20** is attached to rear panel **42** and front panel **32**. Inflation tube **28** is attached to aperture **26** and extends past rear end panel **42** to end **30**. Rear end panel **42** is fitted with upper loading and venting sleeves **46**, lower unloading sleeve **44,** inflation tubes **38** and **40** providing inflatable access to corner bags **34** and **36**, respectively. Inflation tubes **38** and **40** are fitted with a standardized valved tube **37** for fitted attachment to standard sized nozzle **35** providing means for delivering the inflating gas or liquid **33** into the corner bag. Rear end panel **42** is further fitted with hanging straps **88** and **90**. Front end panel **32** is further fitted with hanging means including nailing board **82** and hanging straps **84** and **86**. Lower attachment means **92** are also provided and may consist of a nailing board, an adhesive strip, or a means of attachment as shown in Fig. 7.

The completed liner as shown in Fig. 3 may be deflated and folded to facilitate inflation and unfolding. Furthermore, it is possible with a liner folded in such a manner, to easily package the liner with other elements such as bulkheads, support members, attachment members, and the like.

Figs. 4A-C are isometric views of rigid, transparent bulkheads of the invention. Fig. 4A depicts a bulkhead **94** the length dimension of which corresponds to the dimension required to approximately span the rear opening of a container. Bulk-

head **94** is constructed of a rigid and transparent material according to the details provided in the disclosure above. In this case, a 90 degree bend at **98** is induced in the bulkhead material which causes a horizontal return panel **96** to horizontally return in the direction of the interior of the container. Vertical bulkhead panel **95** and horizontal return panel **96** are contiguous and preferably formed of the same initial workpiece. An aperture **100** is provided in bulkhead panel **95** which is closeable by door **102** hinged to horizontal return panel **96** by hinges **104**. Other apertures may be provided in vertical bulkhead panel **95**, where necessary, such as for inflation tubes providing inflatable access to corner members (not shown).

In Fig. 4B, bulkhead **106** provides similar aperture **100** closeable by door **102** hinged to horizontal panel **108** by hinges **104**. However, in this embodiment, bulkhead panels **107** and **108**, while adhesively made contiguous one to the other, are not constructed of the same workpiece bent to produce a 90 degree return at point **98**.

In Fig. 4C, rigid bulkhead **111** comprises a rigid and transparent vertical panel member **109** and a flexible sheet material **110** adhesively attached thereto to provide the horizontal return panel. Aperture **100** in panel **109** is similarly closeable by door **102**. However, in this embodiment, hinged attachment of the door to the bulkhead is achieved through adhesive attachment to flexible sheet material **110** along joint **112.** A partial sectional end view of the bulkhead depicted in Fig. 4C is shown in Fig. 4D.

Figure 5 is a partially exploded view of a liner apparatus packaging system. A packaged bulkhead, liner and bracing unit **114** is illustrated which is insertable into a 6-paneled package **116**. Bulkhead **118** serves as a base upon which bracing members **126**, **128**, **130**, **136** and **138** immediately rest. On either side of the bulkhead are placed additional bracing members **122** and **134**. The overall height of the bulkhead combined with the width of each of members **122** and **134** establish the minimum width of the package member along panels **148** and **150**. End cap members **140** and **142**, the height of each being equal to the height of the bracing members **122** and **134**, establish a minimum depth for the package member **116**. Deflated and folded liner **120** is placed in the receptacle formed by the bulkhead and bracing members and is additionally retained by bracing members **124** and **132**. The entire unit **114** is then placed inside package member **116**, which package member includes side panels **144** and **148**, end panels **146** and **150**, bottom panel **146** and top panel **152**. Package member **116** may be constructed of any suitable material such as scored corrugated paper sheet. Top panel **152** is closeable to seal the contents of the package member.

Figure 6A-D are stepwise, isometric views of a phantom container showing the stepwise self-installation of a liner within the container. Turning to Fig. 6A, a deflated and coiled or folded, self-installing liner **168** is placed inside a container **154** depicted here in phantom with top wall **156**, side walls **158** and **162**, bottom wall **160**, front wall **164** and rear wall **166** (as described herein, preferably comprising right and left hand doors for gaining access to the container). Initial placement of liner **168** is near the front wall **164**. Liner **168** is partially unfolded to expose top edge attachment devices, such as, nailing board **170** and hanging straps **174** and **175**, as well as bottom edge attachment device **172**. The attachment devices are provided on the outer face of the front panel of liner **168** as shown in previous figures.

As shown in Figs. 6A-D, liner **168** is configured, upon inflation, to fill the container **154**. Thus, the liner **168** has end walls, side walls, top wall and bottom wall formed in a manner to fit within container **168**.

As a second step, shown in Fig. 6B, the bottom edge attachment device is attached to the frontmost corner at the junction of container rear wall **164** and bottom wall **160**. Similarly, top edge attachment devices are attached to the frontmost corner at the junction of container rear wall **164** and top wall **156**. These attachments result in the front panel of liner **168** being fully extended in close proximity to container front wall **164**. Furthermore, as can be seen in the Fig. 6B, attachment results in a further partial unfolding of the liner **168** to expose aperture **182** and inflation tube **180**. Inflation tube **180** is then fully extended from the front of the container to a point outside the container past the rear wall thereof to facilitate inflation of the self-installing liner through inflation tube end **184**.

In Fig. 6C, it can be seen that bulkhead **190** has been installed using structural support members (bracing) **192**. Inflation tube end **184** serves as a means for passing air via inflation tube **180** and into the self-installing liner **168** at aperture **182** (air flow shown here as arrows from end **184** toward aperture **182**). Inflation tube end **184** is also shown to extend past the bulkhead **190** and structural support members **192** past rear wall **158** of the container **154**. As can be seen in the figure, as air passes into liner **168**, further unfolding occurs causing the liner to fill the space delimited by the container walls in a manner progressing from frontmost container space to rearmost container space. Inasmuch as liner **168** does so occupy the space within container **154**, inflation tube **180** becomes increasingly constricted between the liner's upper panel and the container's upper wall as shown between point **186** along the container's top wall

156 and point **188** along the liner's upper panel. The constriction so produced is designed to allow complete inflation and self-installation of the liner; however, the constriction also serves to eventually seal off air flow from inside the container back along the inflation tube which would result in deflation.

Turning now to Fig. 6D, it can be seen that the self-installing liner **168** fully occupies the container **154** interior space fully exposing liner top panel **194**, side panels **196** and **200**, bottom panel **200**, front panel **202** and rear panel **204**. The fully exposed liner panels conform in general to the interior space and dimensions of container **154**. Along rear panel **204**, the liner is contained by bulkhead **190** and support bracing **192**. Full exposure of rear panel **204** further provides access to the loading sleeve **206**, venting sleeve **208**, unloading sleeve **210**, corner bag inflation tube **212** (attached to corner bag **222**), and corner bag inflation tube **218** (attached to corner bag **220**). In this particular construction access for inflation tube **212** and for unloading sleeve **210** is provided through bulkhead **190**. Unloading sleeve **210**, for instance, is directed from inside the container spaces through aperture **214** in bulkhead **190** after opening the hinged door member **216**. It is expected that both the bulkhead and the bracing members will be adjusted accordingly to provide access to all such sleeves and tubes as required. At a time just prior to full inflation, the nearly inflated liner may be adjusted to fit the container space by means of hanging straps near the top edge of rear panel **204** (not shown here).

Figure 7A-C are stepwise isometric views, partially sectioned, showing an alternative packaging and attachment system used in conjunction with the self-installing liner. Fig. 7A illustrates a fragment of an alternative packaging and attachment means **224** containing bulkhead **226** and self-installing liner **228**. Package **224** may be constructed out of any suitable material such as scored corrugated paper sheet material or the like.

Package **224** is introduced into a container as depicted by the arrow, and placed in the forwardmost corner at the junction of front container wall **230** and bottom container wall **232**. As can be seen, the length of package **224** corresponds approximately to the width of the container. Box sealing tape **240** is removed from an outer surface of package **224** thereby allowing panels **234** and **236** to swing freely through an arc of at least 90 degrees and expose the interior of package **224**. The bulkhead **226** is removed from the package **224** and placed aside for installation near the rear of the container as described previously. Adhesive-backed release tape (for example, those tapes shown being removed at **242** and **244**), which completely covers the surfaces of panels **234**, **236** and **238**, is removed to expose the adhesive coated surfaces of the panels.

Panel **234** with adhesive outer surface **246** is brought into contact with the inner surface of container front wall **230** and adhesively attached thereto. Similarly, panels **236** and **238** with adhesive outer surfaces **248** and **247**, respectively, are brought into contact with the inner surface of container bottom wall **232** and adhesively attached thereto. Front panel **250** of liner **228** is next attached by means of nailing board **252** or hanging straps (such as **254**) as previously described. Self-installation of the liner may then proceed as described in Fig. 6.

Figure 8 is an isometric, partially sectioned view of a self-installing liner with corner bags, transparent bulkhead and structural support members installed within a container. In the view provided here more detail is shown concerning the positioning of the self-installing liner and the viewability of the internal portions of the liner and container space through the transparent bulkhead and liner. Container **256** typifies the containers used to ship bulk cargo and includes rear doors of which only the left door **257** is shown in this view for simplicity. Liner **258** is shown fully inflated but not loaded with cargo. Inflation of the liner and the self-installation that results was achieved as described before by attaching a source of forced air to inflation tube end **278** and directing air flow through inflation tube **266** and into the interior portions of the liner via aperture **264**. When fully inflated in this manner, the pinching or collapsing of inflation tube **266** serves to seal air inside the inflated container. Liner rear panel **259** can be seen to be contacting the horizontal structural support members such as **272** which are in turn spaced conveniently by interval attachment to vertical structural support member **274.** Spacing of the structural support members may be adjusted to accommodate attachments to the rear liner panel **259** such as for loading sleeve **286**, venting sleeve **284** or inflation tube **266**.

As illustrated, internal portions of both the liner and the container space are visible through both the rear liner panel **259** and the transparent bulkhead **270**. The view is possible even through both the bulkhead **270** and the liner at position **268**. This degree of viewability which encompasses virtually all of the interior portions of the liner and container is an important aspect of the invention. Access **276** is provided in the bulkhead **270** for unloading sleeve **280**. Importantly, it is possible to see the corner bag **288** (shown here in a deflated condition) through the bulkhead **270** and liner rear panel at position **268**. This ability becomes crucial when using the corner bag to unload residual cargo on

the corners after gravity flow unloading.

Another important aspect of the liner-bulkhead design of the current invention is the manner in which the bulkhead and support members prevent the load exerted by the cargo within the liner from being directly transferred to the rear doors. Spacing **282** between the rear door **259** and any element of the bulkhead, structural support members or liner is provided to help insure no portion of the bulkhead liner system transfers a load directly to the rear doors. As will be shown in Fig. 9 to follow, all load is transferred via the bulkhead and bracing to the container at a position forward of the rear door posts of the container (not shown here).

Figure 9 is a partially sectioned, side and partial top view of a transparent bulkhead installed within a container with structural support members, corner bags and liner visible. As one opens rear doors **302**, it is apparent that there is spacing **300** between the rear doors **302** and the structural support members **296** (vertical) and other support members such as **298** (horizontal). Through the bracing as well as through the transparent bulkhead **294** liner **292** is visible. The contents and space within the liner **292** as well as within the container **290** are visible through both liner rear panel and bulkhead. Corner bag **295** is visible as well.

A partial top view of the positioning of the bracing, bulkhead and liner is also provided in Fig. 9. Container **290**, typical of commercially used containers, possesses along its interior wall, intervally spaced stiffening members **304**, **306** and **308**, which serve to stiffen the walls of the container. In many cases, the stiffening member **304** nearest the rear doors may also serve as a door post for attachment of the door hinges. Horizontal structural support members such as **298** are intervally spaced along vertical structural support members such as **296**, and are inserted into the channel **310** formed by stiffening members **304** and **306** nearest the rear doors. Bulkhead **294** and liner **292**, when cargo is loaded within, transfer the cargo load through horizontal structural support members such as **298** to the container wall via the stiffening member **304**.

Figures 10A-D are stepwise schematic views of the unloading of a filled container-liner system showing the use of corner bag members. The container and/or the liner **312**, each includes a top wall **316**, side walls **314** and **318**, bottom wall **320**, front wall **322** and rear wall **324** as shown in Fig. 10A. The liner and container are shown previously loaded in the manner and methods described herein with a flowable cargo **326**. While the container and liner are maintained in a level position, cargo **326** has been allowed to establish a natural line of repose **328** by flowing out of port **330**. The port **330** is offset toward the right side of the rear wall **324** in order to, for instance, allow access to the unloading port by opening only a single one of the container rear doors. Shown in Fig. 10A, as well, are deflated corner bags **332** and **334**.

Turning next to Fig. 10B, after the line of repose **328** has been obtained through gravity flow with the container level, the container is typically elevated such that the front wall at position **336** is substantially higher than the rear wall at position **338**. This provides for most of the remaining cargo **326** to exit the liner and container through port **330**. However, as shown, typically there is a residual amount of cargo, **340** and **342**, retained in either lower corner nearest the port **330**.

As shown in Fig. 10C, corner bags **348** and **350**, partially inflated, have begun to empty residual cargo **344** and **346** through port **330**. Fig. 10D shows corner bags **348** and **350** fully inflated and all cargo removed from the container.

Referring now to Figure 11 (in conjunction with the numbering in Figure 1) is an exploded, isometric view of a liner system embodiment of the present invention containing a means for fluidizing the bulk cargo contained within the liner to facilitate its removal from the liner during the unloading process. Referring also to Figure 12 (in conjunction with the numbering in Figure 3), the means for fluidizing the bulk cargo is accomplished by a fluid impervious plenum adjacent the floor of the liner, the plenum corresponding to an area of the floor of the liner and having a plurality of spaced apart perforations for directing a fluid from the plenum into the interior space. The fluid impervious plenum is created by inserting or attaching a fluidizing pad or bed **360** within the interior tubular section **12** of the liner, preferably along the bottom or lower horizontal panel **18** of the liner. The outer edges **364** of the fluidizing pad **360** are welded with heat or other known means, to the interior of the liner in the desired location, such as along the seams where the side panels **14** and **20**, and the front panel **32** and the rear panel **42** meet the lower panel **18** such that a plenum or chamber is formed between the fluidizing pad **360** and the liner bottom panel **18**. The fluidizing pad **360** preferably contains a plurality of fluidizing jets, or perforations **362** capable of directing sufficient jet flow into the liner to fluidize the contents of the liner. The fluidizing pad **360** can be constructed out of the same material used for the liner, such as a polyethylene material, that has been modified to contain the perforations **362**. In a preferred embodiment, the fluidizing jets are energized by the introduction of air through the jets. However, other gases, preferably inert, or mixtures thereof, may be employed to advantageously energize the jets, if desired. The fluidizing pad preferably contains at least one infla-

tion tube, or plenum inlet port **364** to introduce the air or gas source to the fluidizing pad. The inflation tube **364** is preferably sufficiently rigid and self-supporting so that it will not collapse if it is located under the weight of a liner filled with the bulk commodity. Fluidizing pads can be installed along the interior vertical sides of the liner, if desired.

It is anticipated that the plenum could also be positioned beneath the floor of the liner, in which case, the perforations would be provided in the floor of the liner **18** in registry with the perforations in the fluidization pad **360**.

In another alternate preferred embodiment, a means for agitating the liner bag to facilitate the discharge of the bulk cargo contained in the liner is created by attaching a fluidizing pad, such as that mentioned above, beneath the liner bag, such that the fluidizing jets are directed to toward the container. An air source is applied to the agitation pad in an oscillating or pulsating fashion to agitate the liner bag thereby dislodging residual bulk material present in the interior of the liner. This agitation means can be used alone or in combination with the fluidization means.

Referring again Figures 10A-D, the unloading of a phantom container-liner system employing corner air bag members would be enhanced with the use of a fluidizing pad. The liner, corner air bags, plenum, liner unloading port and plenum inlet cooperate to create a fluidized bed of material in the interior space when fluid is supplied to the plenum inlet to facilitate unloading of the material through the liner outlet. In this embodiment, the plenum is preferably positioned inside the liner floor.

Referring now to Figures 13A, 14A, 14B, and 14C, there is disclosed an isometric view of a braceless modular bulk cargo container liner system **370**. In this preferred embodiment, the modular cargo container liner system **370** includes a lightweight, reusable and/or recyclable bulkhead liner cartridge **380** having a recessed storage area **390** containing a liner **416** in a folded or stored position. A removable or openable flap **418** capable of covering the recessed liner storage area is provided on the bulkhead liner cartridge to protect the liner prior to installation into a container. The bulkhead liner cartridge also preferably contains at least one port or other means of accessing the interior of the liner, such as a venting port **392** or filling port **394**. This port may comprise a flexible tube or the like for venting the liner or for filling the liner with a cargo. The liner **416** is preferably transparent in that it is either transparent or sufficiently translucent to enable a viewer to view the extent or disposition of cargo within the liner. The liner is also configured such that, upon inflation, it fills substantially an entire cargo container. The liner utilized in the braceless modular system can be of any type, such as the liner preferably outfitted with inflatable angle corner bags, and/or a fluidizing pad as described herein.

The braceless modular container liner system also includes a lightweight, reusable and/or recyclable bulkhead base cartridge **396** for receiving the liner cartridge **380**. In this embodiment, the liner cartridge is preferably telescopingly attached to the bulkhead base unit by tape, adhesive, or other means of attachment **398**. The base is constructed using a novel, lightweight, interlocking internal cell matrix (shown later) that is covered by an outer layer, and may also include an observation port or cabinet **400** for the cargo area, and a built-in sample storage area which could also be located in the cabinet. The sample storage area is preferably constructed of sufficient size to accommodate a small, self contained sample of the cargo contents, or is constructed as part of the observation port to allow access to a recloseable sample sleeve attached directly to the liner. The base unit also contains a discharge port **402**. Additionally, the base unit is preferably equiped with a panel **412** that covers the base during shipment to the end user. The panel **412** can then be folded down along bottom seam **414** and placed on the container floor during installation. A double sided-adhesive strip **420**, with peel off cover can be added to the outside of the panel such that the tape can function to help anchor the panel to the container floor. Additionally, the weight of the bulk commodity placed in the liner will also help anchor the panel to the floor.

Figures 13B and 13C show isometric views of a liner unloading sleeve embodiments, in a gusseted **408** and non-gussetted **404** configuration, such as might be employed in conjunction with the discharge or unloading port **402** of a bulkhead **406**. The sleeves **404** and **408** can be advantageously modified by adding a recloseable access port **410**, preferably along a seam, so that access to the liner bladder can be facilitated without having to disconnect the exits end of the sleeves **404** or **208** from the unloading equipment (not shown). The means for reclosure can be accomplished using standard reclosure devices, such as a "ZipLok"-style closure.

Referring now to Figure 14D, in another alternative preferred embodiment, the braceless cargo liner system **430** is configured as an integrated unit containing both the bulkhead base unit **432** and the liner cartridge unit **434**. In this embodiment, the bulkhead includes a recessed storage area **436** for containing the liner (not shown) prior to installation in the container. The system is configured with the filling, venting, discharge, sample and/or observation ports, such as those described in conjunction

with Figures 13A, 14A, 14B, and 14C. Additionally, the system **430** is preferably equiped with a panel **436** that covers the system **430** during shipment to the end user. The panel **436** can then be folded down along bottom seam **414** and placed on the container floor during installation. A double sided-adhesive strip **438**, with peel off cover can be added to the outside of the panel such that the tape can function to help anchor the panel to the container floor. Additionally, the weight of the bulk commodity placed in the liner will also help anchor the panel to the floor..

The braceless liner system is positioned or otherwise arranged within a container with its filling port toward the front end of the container. The protective panel(s) is opened to expose the polyethylene liner which is then extended and secured to the front of the container. The braceless bulkhead is uprighted and positioned at the container's threshold proximate the container doors. The bulkhead extends across the container and preferably to a height sufficient to rest behind the upper horizontal cross brace of the container, although shorter hieghts are acheivable. The remainder of the bulkhead rests against the left hand door. Positioning guides, such as those described later, can by employed to advantage to facilitate placement of the liner system proximate the rear doors. Use of the positioning guides on the right hand side of the container facilitates allignment of the bulkhead during the loading phase to ensure that the right door will have proper clearance for closing, and to prevent the bulkhead from falling over during loading, such as may occur due to the arrival of an unexpected gust of wind. As air or other suitable gas is passed into the liner through the filling port, the liner inflates and ultimately fills the container. A flowable cargo is then passed through the filling port into the liner. The liner is ultimately sealed.

Referring now to Figure 15A, there is shown a cross-sectional view of an exemplary bulkhead base **474** having a core cell matrix such as that employed in the base sections of the braceless liner embodiments, i.e., across lines 1-1 of figures 14D. 14C or 13A. In this preferred embodiment, the cell matrix or core **440** is preferrably constructed using a single piece of solid fibre, reinforced corrugated fibreboard, such as that manufactured under the trademark "Gaywood" by Gaylord Packaging, Inc., Bogalusa, Mississippi. The core sheet starting material is preferentially 600 # test double wall Gaywood which is scored (and/or reverse scored) on one or more sides of the core sheet **440**, and then folded at the score marks, such as indicated at **440**, **442**, **446, 448, 450, 452, 454 ,456, 458,** and **460**. The top distance **466** between the top edge **462** and the score/fold **442** is preferrably about 4 inches, but can be modified according to the bulkhead size requirements. The bottom distance **468** between the bottom edge **464** and score/fold **460** is substantially the same as distance **466**. The scored/folded core **440** is fixable attached to an outer panel **470** and an inner panel **472** and capped with perimeter caps (such as described in figures 15B and 15C) around all edges. The resultant bulkhead **474** is a sealed unit containing cavities, apertures or void spaces **476**. The width of the bulkhead **474** is preferentially about the same width of the container. The height **480** of the bulkhead **474** can be varied, but is preferrably about 60 inches, which would allow for the creation of about four void spaces. The outer panel **470**, is preferably constructed from a 350 # test double wall corrugated paper or fibre, or the like, while the inner panel **472** is preferrably constructed from a 350 # test single wall corrugated paper or fibre, or the like. Referring now to Figure 15C, there is shown a cross section of the perimeter cap **482** which is preferably constructed from an elongated, rectangular piece of Gaywood, double wall fibreboard or the like **484** fixably or adhesively covered on three sides by an overlapping fibre paper or .120 fibre board previsously scored at locations **486**, such that overlap flaps **488** can slip over and be attached to the outside of the panels **470** and **474**. The bulkhead can then be modified to include the various ports required by the end user. For example, where an inflatable air bag is employed, the air inflation tubes can be routed througth the void spaces of channels **476** created within the bulkhead. Additionally, the uppermost large void space **476**, as defined by scores **442**, **444, 446** and **448** could be employed as the liner cartridge compartment if desired.

Another preferred embodiment pertains to a bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, the bulkhead comprising: a first panel defining a back wall having a first width; a second panel defining a front wall having a second width, the second panel being spaced apart from and substantially parallel to the first panel, the first and the second widths being substantially the same; a plurality of beams arranged side-by-side between the first and the second panels, each of the beams defining a zone within the bulkhead having a quadrilateral cross-section and having a length corresponding generally to the first and the second widths; the first panel, the second panel, and the plurality of beams being cooperable when the bulkhead is positioned across the doorway to resist forces at the doorway of the cargo container when the cargo container contains a flowable load. The first and second widths of the bulkhead preferentially correspond generally to a width of the doorway of the cargo

container. The first and second panels are preferentially constructed from corrugated paper. Some of the beams comprise a single panel of corrugated paper scored with parallel score lines and folded at the score lines. In another embodiment, some of the score lines are on a first side of the single panel and other of the score lines are on a side opposite the first side of the single panel. In yet another embodiment, half the score lines are on the first side of the single panel and half of the score lines are on the side opposite the first side of the single panel to define a beam having a member extending across a diagonal of a rectangular cross section. Some of the beams interlock along a side with adjacent beams to define a laminated beam seam. The laminated beam seam preferentially includes an adhesive and can include a shim to define an additional layer of laminate in the beam seam. The plurality of beams are preferentially parallel to the floor of the cargo container. The bulkhead can also be outfitted to further include a liner compartment in the bulkhead that is operable to contain a liner when the bulkhead is transported.

In another preferred embodiment, the liner compartment comprises an upper portion of the bulkhead that is detachable from and replaceable on the remaining portion of the bulkhead. The liner compartment can be telescopingly carried by the bulkhead.

A bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, the bulkhead comprising: a first panel defining a back wall having a first width; a second panel defining a front wall having a second width, the second panel being spaced apart from and substantially parallel to the first panel, the first and the second widths being substantially the same; a plurality of laminated beams having a length corresponding generally to the first and the second widths, the beams comprising at least four layers of corrugated paper and an adhesive, the plurality of beams arranged in substantially parallel relationship to each other and positioned between the first and the second panels; an adhesive for connecting the first and the second panels to the laminated beams; the first panel, the second panel, and the plurality of beams being cooperable to define a bulkhead for resisting the forces of a flowable load in the cargo container when the bulkhead is positioned in the doorway.

In a preferred embodiment, the laminated beams are comprised of a plurality of side-by-side beams that are interlocked along an edge.Some of the beams comprise a single panel of corrugated paper scored with parallel score lines and folded at the score lines. Alternatively, some of the score lines may be on a first side of the single panel and other of the score lines are on a side opposite the first side of the single panel. in another preferred embodiment, the score lines are on the first side of the single panel and half of the score lines are on the side opposite the first side of the single panel to define a beam having a substantially rectangular cross section and a member extending across a diagonal of the rectangular cross section. The bulkhead of this embodiment can preferably include a liner compartment in the bulkhead, the compartment being operable to contain a liner when the bulkhead is transported. In another embodiment, the liner compartment comprises an upper portion of the bulkhead that is detachable from and replaceable on the remaining portion of the bulkhead. The liner compartment can be telescopingly carried by said bulkhead.

Another preferred embodiment pertains to a bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, the bulkhead comprising: a first panel defining a back bulkhead wall having a first width; a second panel defining a front bulkhead wall having a second width, the second panel being spaced apart from and substantially parallel to the first panel, the first and the second widths being substantially the same; a plurality of beams placed side-by-side between the first and the second panels, each of the beams having a substantially rectangular cross-section and having a length corresponding generally to the first and the second widths; a liner for the cargo container, the liner having opposing side walls, a top, and a floor corresponding to the opposing side walls, top, and floor of the container, the liner being attached to the bulkhead. The bulkhead can be adapted to include a cabinet accessible from at least one of the first and the second panels. The cabinet can comprises a flange, an open ended member corresponding generally in height to the spacing between the first and the second panels and attached to the flange, and a collar for attachment to the open ended member at a location spaced apart from the flange, the flange resting on one panel, the collar resting on the other panel, and the open ended member positioned therebetween. The bulkhead can also be modified to include a port in the cabinet for placing the cabinet in fluid communication with an interior of at least one of the beams.

Preferrably, the first and second widths of teh bulkhead correspond generally to a width of the doorway of the cargo container. The first and second panels opf the bulkhead preferably comprise corrugated paper. Some of the beams comprise a single panel of corrugated paper scored with parallel score lines and folded at the score lines. Some of the score lines can be are on a first side

of the single panel and other of the score lines are on a side opposite the first side of the single panel. Also, in another embodiment, half the score lines are on the first side of the the single panel and half of the score lines are on the side opposite the first side of the single panel to define a beam having a member extending across a diagonal of the rectangular cross section. The bulkhead of this embodiment may have some of the beams interlocking along a side with adjacent beams to define a laminated beam seam. The laminated beam seam may comprise an adhesive or a shim to define an additional layer of laminate in said beam seam. The plurality of beams are parallel to the floor of the cargo container. The bulkhead can further include a liner compartment in the bulkhead, the compartment being operable to contain the liner when the bulkhead is transported. The liner compartment can comprise an upper portion of the bulkhead that is detachable from and replaceable on the remaining portion of the bulkhead. The liner compartment can be telescopingly carried by the bulkhead.

Referring now to Figure 16, there is shown a preferred braceless cargo liner embodiment **500** of the instant invention. In this embodiment the bulkhead comprises a first panel **502** defining back bulk headwall having has a first width, a second panel **506** having a second width, the second panel being spaced apart from and substantially parallel to the first panel, the first and the second widths being substantially the same. This bulkhead also comprises a plurality of beams **508** having a substantially rectangular cross-section and having a length corresponding generally to the first and the second widths. In this embodiment there is shown a recessed aperture **510** in the backside of the bulkhead capable of containing a liner **512** for the cargo container. The liner **512** can be stored in the aperture **510**, or can be first placed into a liner cartridge **514** that is inserted into the aperture **510**. Either the aperture **510** or the liner cartridge **514** can also contain other fixtures and accessories **516** necessary for installing the liner in the cargo container, such as nailing boards, hanging straps and the like. Also in a preferred embodiment, the liner cartridge **514** is fixably mounted within the aperture **510** by using hand puppets **518** that puncture through the lower wall of the liner cartridge **514** and into the lower portion of the aperture **510** as shown at positions **520**. Alternatively, adhesives can be applied to attach the cartridge **514** within the aperture **510**. Also shown in Figure 16 is the outer cover panel **522** which serves to cover the entire back surface of the bulkhead **500** during shipment. The cover panel is preferentially attached to the lower most beam **508** and is scored and folded at line number **524** to allow it to swing down and make contact with the bottom floor of the container. Double-sided adhesive tape **526** can be applied to the backside of the outer cover panel **522** to promote friction between the cover panel **522** and the container floor **528**. In an alternative preferred embodiment, the liner cartridge comprises the top section **530** of the bulkhead **506** and is removable and attachable to the bulkhead.

Referring now to Figure 17A, there is shown an exploded cross-sectional view of the plurality of beams **540** contained within the outer wall **542** and the inner wall **544** of the braceless bulkhead **546**. Also shown is outer cover panel **548**. As constructed, the beams **540** contain internal void space **571** which can be utilized to route necessary air tubing and the like for operation of the bulkhead liner.

Figure 17B shows an enlarged view of two bulkhead beam cross-sections **540** in interlocking relationship with one another. Referring to the left most beam of Figure 17B, the beam is created by taking a core material such as gaywood fiberboard **550** and scored (and/or reverse scored) one one or more sides of the gaywood fiberboard **550**, such as shown at score/folds **552, 554, 556, 558, 560** and **562**. The thus scored and folded beam can be interlocked with an adjacent beam as illustrated in Figure 17B. The beams can also be attached to one another by using adhesives and can be reinforced by affixing one or more shims **564** within the interlocking zone **556**. In a preferred embodiment the outer cover panel **548** comprises a 275 # test single wall with a B flute fiberboard. The inner bulkhead wall **544** is preferably constructed of a 275 # test single wall B flute fiberboard. The bulkhead beams **540** are preferably constructed from a 525 # double wall gaywood type material with an AC flute. Also the bulkhead outer wall **542** is preferably constructed from a 275 # single wall fiberboard. As shown in Figure 17A, a liner cartridge or liner recess area **570** is provided to house a liner bag. As in evident from Figure 17A, the liner cartridge or liner recess area **570** can be interlocked with a bulkhead beam and secured thereto.

Referring now to Figure 18, there is shown a schematic depiction of a one piece braceless bulkhead design installed in a container. The bulkhead **580** has been equiped with a filling port **582** and a venting port **584**. Also shown in Figure 18 is a discharge port **586** which can contain within its inner boundaries an aperture **588** for receiving the air inflation tube **590** utilized for filling the left hand corner air bag **592**. A similar access port **594** can be installed in the right lower corner of the bulkhead for accessing the inflation tube **596** of the right hand corner air bag **598**. The bulkhead cover drop panel **600** is shown in its installed position along the floor of the container. An adhesive layer

602 can be utilized to secure the bulkhead to the floor to prevent the bulkhead from sliding out when loaded. Also shown in Figure 18 is a sample view port or sample storage area **604** for providing access to the sample tube **606** tht may be attached directly to the liner bag **608**. Alternatively, samples can be stored in small containers that fit within the view port access area **604**. Additionally, view port access **604** can be equipped with an aperture for receiving the corner air bag inflation tubes, if so desired.

Referring now to Figure 19, there is disclosed a braceless liner embodiment similar to the one piece design described in conjunction with Figure 18 except having a two piece design. The lower base bulkhead unit **610** is adapted to receive a liner cartridge **612**.

Referring now to Figure 20, there is shown a bulkhead view port cabinet **620** for installation into a bulkhead (not shown) such as the braceless bulkheads depicted in Figures 18 and 19. The cabinet **620** comprises a flange **622**, an member **624** corresponding generally in heigth to the front and back panels of the braceless bulkhead (not shown). The openended member **624** is attached to the flange **622** and is placed in a cutout within the bulkhead. A collar mechanism **626** is utilized in conjunction with the lip **628** of openended member **624** to create a interference fit thereby securing the cabinet to the bulkhead. Other means for securing the cabinet to the bulkhead will be apparent to those of skill in the art. It is anticipated that adhesives and mechanical couplings can be employed to advantage. The openended member **624** can be adapted to contain at least one aperture **630** to allow fluid connection with the internal void spaces of the bulkhead beams (not shown). The view port/cabinet member **620** allows access to, for example, a reclosable sample tube **632** that is connected to the liner bag **634**.

Referring now to Figure 21A, there is shown a schematic view of a bulkhead positioning guide **640** which can be employed in conjunction with the braceless bulkhead depicted in for example, in Figures 18 and 19. The positioning guide **640** contains a channel engaging member **642** for engaging a channel on a side wall of the container. The positioning guide also contains a bulkhead engager **644** for engaging the bulkhead and a connecting web **646** for connecting the channel engager **642** to the bulkhead engager **644**. The channel engager **642** preferably has a box-like cross-section having one dimension substantially the same as the depth of a stiffening member on a side wall of the container. In a preferred embodiment, the bulkhead engager engages the bulkhead only along a portion of the width of the bulkhead. In a preferred embodiment of this invention the bulkhead positioning guide **640** is formed out of ten or twelve gauge galvonized steel and has a length **648** of 30 inches, a depth **650** of 1.75 inches, a width **652** of 1.75 inches and a width **654** of 1.5 inches. The bulkhead **660** rests against the surfaces of the connecting web **646** and bulkhead engager **644**.

Referring now to Figure 21B, there is also shown a alternative preferred bulkhead positioning guide **670** having a channel engager **672** for engaging a channel on a side wall of the container (not shown); a bulkhead engager **674** for engaging the bulkhead; and a connecting web **676** for connecting the channel engager **672** to the bulkhead engager **676**. In this embodiment the bulkhead engager **672** contains a pointed member **678** capable of penetrating a face of the bulkhead. In a preferred embodiment the point **678** has a depth **680** of 1 inch; the bulkhead engager **674** has a depth **682** of 1.5 inches and a width **684** of 3 inches. The channel engager preferably has a depth **682** of 1.75 inches; a height **684** of 1.75 inches and a length **686** of 1.5 inches. The positioning guide **670** is preferably constructed from 1/8 inch flat stock.

Referring again to both Figures 21A and 21B, in a preferred embodiment of the present invention, the positioning guide is magnetic to enhance engagement with the channel of the container wall. In an alternative preferred embodiment, the positioning guide includes an adhesive on the surface contacting the channel of the container wall.

Referring to Figure 22A, there is depicted a cross-sectional top view of a braceless bulkhead **690** employing a positioning guide **640** such as that described in Figure 21A. The channel engager fits within the container channel **692** which typically can be found in most containers adjacent the container stiffening member **694** which is built into the container outer wall **696**. In this configuration, the bulkhead **690** is positioned approximate the container rear door **698** by being placed against the bulkhead engager. The bulkhead engager can be modified to contain cleats **700** for enhancing frictional contact between the bulkhead face and the bulkhead engager.

Similar to Figure 22A, there is depicted a braceless bulkhead **690** being positioned adjacent the cargo container rear door by a positioning guide **702** such as that depicted in Figure 21B.

Referring now to Figure 23, there is disclosed a means for securing the outlet or discharge fitting of the liner bag to the retainer **800**. The retainer **800** is adapted to receive a fitting **802** having a circular flange portion **804**. The retainer **800** is adapted to contain an aperture capable of receiving the flange **804**. The fitting **802** and the retainer **800** are drilled with two holes **806** where the holes in the retainer and the fitting are in substantial alignment with

each other. A knotted rope is then fitted to the fitting **802** and the plastic liner bag **808** is then adhesively attached to the back side of the fitting **802**. Upon isntallation of the liner into the cargo container, the knotted rope can then be passed through the holes **806** in the retainer, and tied off thereby securing the liner bag to the retainer **800**. As also illustrated in Figure 23, the retainer **800** can be attached to the floor of the container by employing a series of self-tapping set screws.

In similar fashion, referring now to Figure 24, the liner bag **820** is adhesively attached to the backside of a fitting **802** containing a circular flange **804**. The retainer **800** is adapted to receive the flange **804** of the fitting **802** by interference fit or other mechanical means of attachment thereby securing the fitting to the retainer.

The present invention has been described in terms of particular embodiments found or proposed to comprise preferred modes for the practice of the invention. Such preferred embodiments are given in the following in the form of aspects of the invention. It is to be understood that all combinations of the features given also represent embodiments of the invention.

ASPECTS OF THE INVENTION

1. Apparatus for lining a cargo container, wherein the container has opposed side walls including an access door in a first such wall, a top and a floor; which apparatus comprises:

(a) an inflatable transparent liner configured when deflated to lie on the floor proximate the wall of the container opposite said first wall and, when fully inflated to display sidewalls, a top and a floor corresponding to the walls, top and floor of the container and fitting within the container in spaced relation with said first wall of the container;

(b) a first inlet connection in the liner positioned, upon inflation of the liner, proximate the top and first wall of the liner for loading a flowable cargo into the liner;

(c) a first outlet connection in the liner positioned, upon inflation of the liner, proximate the floor of the liner and adjacent the access door for unloading a flowable cargo from the liner;

(d) a second inlet connection in the liner positioned, upon inflation of the liner, proximate the top of the liner and the wall of the liner opposite said first wall for flow of gas into the liner; said second inlet connection adapted to be closed upon inflation of the liner;

(e) a transparent bulkhead supported by the container between the liner and said first wall of the container and extending upward from and along the floor of the container; said bulkhead being sufficiently rigid and extensive to resist substantial loading of said access door by cargo within the liner; and

(f) inflatable bags separately inflatable from the liner positioned, upon inflation of the liner, at intersections between the floor of the container and said bulkhead and between the bulkhead and the liner; said bags configured, upon inflation, to displace cargo within the liner from such intersections.

2. The apparatus of aspect 1, wherein the inflatable bags are attached to the liner.

3. The apparatus of aspect 1, wherein the second inlet connection includes a collapsible conduit adapted to extend along the external surface of the liner toward the first wall of the container.

4. The apparatus of aspect 3, wherein the collapsible conduit is adapted to extend between the top of the liner and the top of the container.

5. The apparatus of aspect 1, wherein the bulkhead also extends along the floor of the container toward said opposite wall of the container to define a right angle intersection with the upwardly extending portion of the bulkhead.

6. The apparatus of aspect 5, wherein a separate, said inflatable bag is positioned, upon inflation of the liner, proximate each end of said right angle intersection.

7. Apparatus for lining a box-like cargo container having two sidewalls, a front end wall, a rear end wall having an access door, a floor and a top, comprising:

(a) an inflatable, transparent liner configured, when deflated, to be placed on the floor of the container, and when fully inflated to display two sidewalls, a front wall, a rear wall, a floor and a top corresponding to the sidewalls, front wall, rear wall, top and floor of the container and fitting within the container in spaced relation with the rear wall of the container;

(b) a first inlet connection in the liner positioned, upon inflation of the liner, proximate the top and rear wall of the liner for the loading of a flowable cargo into the liner;

(c) a first outlet connection in the liner positioned, upon inflation of the liner, proximate the floor of the liner and adjacent the access door for unloading of a flowable cargo from the liner;

(d) a second inlet connection in the liner positioned, upon inflation of the liner, proximate the top and the front wall of the liner for the flow of gas into the liner; said second inlet connection adapted to be closed upon

inflation of the liner;

(e) a transparent bulkhead adapted to be supported by the container between the liner and the rear wall of the container and extending upward from and across the floor of the container; said bulkhead being sufficiently rigid and extensive to resist substantial loading of said access door by cargo within the liner; and

(f) inflatable bags separately inflatable from the liner positioned, upon full inflation of the liner, external of the liner at intersections between the bulkhead and the floor of the container; said bags configured upon inflation to displace cargo within the liner from such intersections.

8. The apparatus of aspect 7, wherein the bottom of the front end wall of the liner is adapted to be attached across the bottom of the front end wall of the container, and the top of the front end wall of the liner is adapted to be attached across the top of the front end wall of the container.

9. The apparatus of aspect 8, wherein the top of the rear end wall of the liner is adapted to be attached across the top of the rear end wall of the container.

10. The apparatus of aspect 7, wherein the second inlet connection includes a collapsible conduit extending along the top of the liner to the front end wall of the container for conveying gas to the liner; said conduit adapted to be collapsed to a closed condition between the top of the inflated liner and the top of the container.

11. For use in a cargo container adapted to carry a flowable cargo within a liner in the container, and having two opposed sidewalls, a front end wall, a rear end wall including an access door, a floor and a top, a bulkhead comprising:

a transparent planar member configured to be supported by the container so as to extend upward from the floor of the container and across the rear end wall of the container between said side walls; said planar member being sufficiently rigid and extensive so as to restrain cargo within a liner from loading the access door.

12. The bulkhead of aspect 11, wherein the planar member includes a planar portion which extends along the floor of the container to define a right angle intersection with the portion of the bulkhead which extends upward from the floor.

13. A liner for holding a flowable cargo in a box-like container having a floor, a top, two sidewalls, a front end wall, and a back end wall with an access door, which liner comprises:

(a) a transparent inflatable member foldable when deflated into a compact package and inflatable from such package to form a box-like liner having a floor, a top, front and back end walls and two sidewalls lining said container with the back end walls of the container and the liner facing each other in spaced relation;

(b) a first inlet proximate the front and top of the liner when inflated for loading cargo into the liner;

(c) an outlet proximate the front and floor of the liner when inflated for unloading cargo from the liner through the access door; and

(d) a second inlet proximate the top and front of the liner when inflated for supplying gas to the liner.

14. The liner of aspect 13, wherein the second inlet comprises a collapsible conduit configured to extend along the outer surface of the liner to the back of the liner.

15. A corner member for use in a box-like lined cargo container for flowable cargo, wherein the container has a corner area which tends to retain cargo when the cargo is unloaded, which corner member comprises:

an inflatable member positionable within the corner between the liner and the container and configured when inflated to displace cargo from the corner area.

16. The corner member of aspect 15, wherein the inflatable member, when inflated, defines an orthagonal tetrahedron whose inclined face faces toward the liner at an angle steeper than the angle of repose of the cargo.

17. The corner member of aspect 15, wherein the inflatable member is attachable to the exterior surface of the liner.

18. A liner for a bulk cargo container, which liner is self-installing and capable of containing bulk cargo and separating the cargo from the interior surfaces of the container.

19. A self-installing liner capable of containing bulk cargo and separating the cargo from the interior surfaces of a bulk cargo container.

20. Apparatus for transporting bulk cargo comprising:

(a) a box-like container having a floor, sidewalls, a front wall, and a rear wall including opening means to provide access to the interior of the container;

(b) a liner lining the container and capable of containing the bulk cargo and separating the cargo from the interior surfaces of the container; and

(c) a bulkhead positioned between the liner and said rear wall, at least a portion of said bulkhead being transparent allowing thereby a view of the cargo space forward of the bulkhead, and sufficiently rigid to prevent

load caused by the cargo within the liner from being transferred directly to the opening means.

21. Apparatus for transporting bulk cargo comprising:

(a) a cargo container having sidewalls, front and rear walls, and a floor wall, and at least one wall further comprises opening means to provide access to the interior of the container;

(b) a liner capable of containing bulk cargo and separating the cargo from the interior surfaces of the container and having a bottom outlet for such cargo positioned adjacent said opening means; and

(c) at least one inflatable bag positioned proximate said outlet and configured upon inflation to promote the unloading of cargo from within the liner.

22. Apparatus for transporting bulk cargo comprising:

(a) a cargo container having sidewalls, front and rear walls, and a floor wall, wherein at least one wall further comprises opening means to provide access to the interior of the container;

(b) a transparent, inflatable, self-installing liner within the container capable, upon inflation, of containing the bulk cargo and separating the cargo from the interior surfaces of the container; and

(c) an outlet in the liner positioned proximate said opening means.

23. The apparatus of aspect 22, further comprising a bulkhead, at least a portion of which is transparent, positioned between the liner and the opening means, and sufficiently rigid to prevent load caused by the cargo within the liner from being transferred directly to the opening means.

24. The apparatus of aspect 22, further comprising at least one inflatable bag positioned proximate the outlet in the liner and configured, upon inflation, to promote unloading of cargo within the liner.

25. A method for transporting bulk cargo comprising:

(a) self-installing the liner of any of aspects 21-23;

(b) loading the liner with a flowable bulk cargo;

(c) transporting the loaded container; and

(d) unloading the cargo through the outlet.

26. A method of transporting bulk cargo in a box-like cargo container, which has two sidewalls, front and back walls, and a floor wall, wherein at least one wall further comprises opening means to provide access to the interior of the container, the method comprising:

(a) installing within the container a self-installing, inflatable liner capable of containing the bulk cargo and separating the cargo from the interior surfaces of the container; and

(b) installing a bulkhead, at least a portion of which is transparent, between the liner and the opening means, of sufficient rigidity to prevent load caused by the cargo within the liner from being transferred directly to the opening means.

27. A method of unloading a flowable cargo from a liner within a cargo container, which has a corner in which flowable cargo tends to remain following unloading, which comprises:

(a) installing an inflatable bag in the corner between the container and the liner prior to such loading, said bag configured upon inflation to displace cargo from the corner into the liner; and

(b) inflating the bag during such unloading.

28. A liner for a box-like cargo container having top and bottom walls, four sidewalls and an access door at a first end, which comprises:

(a) an inflatable, transparent member insertable within the container and configured upon inflation to line the container with a first end corresponding to the first end of the container;

(b) an inlet port proximate the top of the first end of the inflatable member, when inflated;

(c) an outlet port proximate the bottom of the first end of the inflatable member, when inflated; and

(d) a compressible conduit member connected to the opposite end of the inflatable member, when inflated, and extending along the top of said inflatable member, when inflated, to said first end of the inflatable member.

29. The liner of aspect 28, which further comprises:

a first connector at said opposite end of the inflatable member adapted to support said opposite end of the inflatable member from the corresponding opposite end of the container.

30. The liner of aspect 29, which further comprises:

a second connector at said first end of the inflatable member adapted to support the inflatable member from said first end of the container.

31. The liner of aspect 30, wherein the first and second connectors and the conduit member are configured to be capable of attachment to conduits outside the container when the access door is open.

32. The liner of aspect 31, which further comprises a rigid, transparent bulkhead adapted to

be interposed between the first end of the inflatable member and the first end of the container.

33. Apparatus for lining a cargo container, wherein the container has opposed side walls including an access door in a first such wall, a top and a floor, said apparatus comprising:

a liner having opposed side walls, a top and a floor defining and interior space corresponding generally to the side walls, top and floor of the container, said liner being positionable within the container in spaced relation with a first wall in the container;

a fluid impervious plenum adjacent the floor of the liner, said plenum corresponding to an area of the floor of the liner and having a plurality of spaced apart perforations for directing a fluid from said plenum into said interior space;

a bulkhead positionable between the access door and a side wall of the liner, said bulkhead having a liner inlet port, a liner outlet port, and a plenum inlet port;

a liner inlet for introducing material into the interior space through said liner inlet port;

a liner outlet for removing material from the interior space through said liner outlet port;

a plenum inlet for introducing a fluid into the plenum through said plenum inlet port;

said liner, plenum, bulkhead, liner inlet, liner outlet, and plenum inlet being cooperable to create a fluidized bed of material in said interior space when material is introduced through said liner inlet into said interior space and fluid is supplied to said plenum inlet to facilitate unloading of said material through said liner outlet.

34. The apparatus of aspect 33 wherein said plenum is positioned inside said liner floor.

35. The apparatus of aspect 33 wherein said plenum is positioned beneath said floor of said liner.

36. The apparatus of aspect 35 and further including perforations in said floor of said liner in registry with perforations in said plenum.

37. The apparatus of aspect 33 and further including a liner compartment in said bulkhead, said compartment being operable to contain said liner when said bulkhead is transported.

38. The apparatus of aspect 37 wherein said liner compartment comprises an upper portion of said bulkhead that is detachable from and replaceable on the remaining portion of said bulkhead.

39. The apparatus of aspect 37 wherein said liner compartment is telescopingly carried by said bulkhead.

40. The apparatus of aspect 33 and further comprising a positioning guide for positioning said bulkhead adjacent the access door.

41. The apparatus of aspect 40 wherein said positioning guide comprises:

a channel engager for engaging a channel on a side wall of the container;

a bulkhead engager for engaging the bulkhead; and

a connecting web for connecting said channel engager to said bulkhead engager.

42. The apparatus of aspect 41 wherein said channel engager has a box-like cross-section having one dimension substantially the same as the depth of a stiffening member on a side wall of the container.

43. The apparatus of aspect 41 wherein said bulkhead engager engages said bulkhead along only a portion of a width of said bulkhead.

44. The apparatus of aspect 41 wherein said bulkhead engager engages said bulkhead by penetrating a face of said bulkhead.

45. The apparatus of aspect 40 wherein said positioning guide is magnetic.

46. The apparatus of aspect 40 wherein said positioning guide further comprises an adhesive for adhesive engagement with a side wall of the container.

47. Method for lining a cargo container, wherein the container has opposed side walls including an access door in a first such wall, a top and a floor, said method comprising the steps of:

introducing into a cargo container a liner having opposed side walls, a top and a floor defining an interior space corresponding generally to the side walls, top and floor of the container;

positioning said liner within the container in spaced relation with a first wall in the container;

positioning a bulkhead between the access door and said first wall of the liner, said bulkhead having a liner inlet port, a liner outlet port, and a plenum inlet port;

introducing material into the interior space through said liner inlet port;

unloading some material from the interior space through said liner outlet port;

introducing fluid through a plenum inlet port into a fluid impervious plenum adjacent the floor of the liner, said plenum corresponding to an area of the floor of the liner and having a plurality of spaced apart perforations for directing a fluid from said plenum into said interior space;

directing a fluid from said plenum into said interior space to create a fluidized bed in said interior space; and

unloading any remaining material in said interior space through said liner outlet.

48. The method of aspect 47 and further including the step of positioning the plenum inside the interior space on the liner floor.

49. The method of aspect 47 and further including the step of positioning the plenum outside the interior space beneath said floor of said liner.

50. The method of aspect 49 and further including the step of perforating said floor of said liner in registry with perforations in said plenum.

51. The method of aspect 47 and further including the step of introducing the liner into a liner compartment in said bulkhead, said compartment being operable to contain said liner when said bulkhead is transported.

52. The method of aspect 51 and further including the step of detaching said liner compartment from an upper portion of said bulkhead.

53. The method of aspect 51 and further including the step of telescopingly removing said liner compartment from an interior compartment of said bulkhead.

54. The method of aspect 47 and further including the step of positioning said bulkhead adjacent the access door of the container.

55. The method of aspect 54 wherein said positioning step further includes the steps of:

introducing a positioning guide adjacent a channel on a side wall of the container; and

displacing said bulkhead to a position where said bulkhead engages a bulkhead engager of the positioning guide.

56. The method of aspect 54 wherein said positioning step further includes the step of:

penetrating a face of said bulkhead with the bulkhead engager.

57. The method of aspect 54 wherein said positioning step further includes the step of:

magnetizing the positioning guide.

58. The method of aspect 54 wherein said positioning step further includes the step of:

applying an adhesive to the positioning guide.

59. A bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, said bulkhead comprising:

a first panel defining a back wall having a first width;

a second panel defining a front wall having a second width, said second panel being spaced apart from and substantially parallel to said first panel, said first and said second widths being substantially the same;

a plurality of beams arranged side-by-side between said first and said second panels, each of said beams defining a zone within said bulkhead having a quadrilateral cross-section and having a length corresponding generally to said first and said second widths; and

said first panel, said second panel, and said plurality of beams being cooperable when said bulkhead is positioned across the doorway to resist forces at the doorway of the cargo container when the cargo container contains a flowable load.

60. The bulkhead of aspect 59 wherein said first and said second widths correspond generally to a width of the doorway of the cargo container.

61. The bulkhead of aspect 59 wherein said first and said second panels comprise corrugated paper.

62. The bulkhead of aspect 59 wherein some of said beams comprise a single panel of corrugated paper scored with parallel score lines and folded at said score lines.

63. The bulkhead of aspect 62 wherein some of the score lines are on a first side of said single panel and other of the score lines are on a side opposite the first side of said single panel.

64. The bulkhead of aspect 63 wherein half the score lines are on the first side of said single panel and half of the score lines are on the side opposite the first side of said single panel to define a beam having a member extending across a diagonal of a rectangular cross section.

65. The bulkhead of aspect 59 wherein some of the beams interlock along a side with adjacent beams to define a laminated beam seam.

66. The bulkhead of aspect 65 wherein said laminated beam seam comprises an adhesive.

67. The bulkhead of aspect 66 wherein said laminated beam seam comprises a shim to define an additional layer of laminate in said beam seam.

68. The bulkhead of aspect 59 wherein the plurality of beams are parallel to the floor of the cargo container.

69. The bulkhead of aspect 59 further including a liner compartment in said bulkhead, said compartment being operable to contain a liner when said bulkhead is transported.

70. The bulkhead of aspect 69 wherein said liner compartment comprises an upper portion of said bulkhead that is detachable from and replaceable on the remaining portion of said bulkhead.

71. The bulkhead of aspect 70 wherein said liner compartment is telescopingly carried by said bulkhead.

72. A bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, said bulkhead comprising:

a first panel defining a back wall having a first width;

a second panel defining a front wall having a second width, said second panel being spaced apart from and substantially parallel to said first panel, said first and second widths being sub-

stantially the same;

a plurality of laminated beams having a length corresponding generally to said first and said second widths, said beams comprising at least four layers of corrugated paper and an adhesive, said plurality of beams arranged in substantially parallel relationship to each other and positioned between said first and said second panels;

an adhesive for connecting said first and said second panels to said laminated beams; and

said first panel, said second panel, and said plurality of beams being cooperable to define a bulkhead for resisting the forces of a flowable load in the cargo container when said bulkhead is positioned in the doorway.

73. The bulkhead of aspect 72 wherein said laminated beams are comprised of a plurality of side-by-side beams that are interlocked along an edge.

74. The bulkhead of aspect 73 wherein some of said beams comprise a single panel of corrugated paper scored with parallel score lines and folded at said score lines.

75. The bulkhead of aspect 73 wherein some of the score lines are on a first side of said single panel and other of the score lines are on a side opposite the first side of said single panel.

76. The bulkhead of aspect 75 wherein half the score lines are on the first side of said single panel and half of the score lines are on the side opposite the first side of said single panel to define a beam having a substantially rectangular cross section and a member extending across a diagonal of said rectangular cross section.

77. The bulkhead of aspect 72 further including a liner compartment in said bulkhead, said compartment being operable to contain a liner when said bulkhead is transported.

78. The bulkhead of aspect 72 wherein said liner compartment comprises an upper portion of said bulkhead that is detachable from and replaceable on the remaining portion of said bulkhead.

79. The bulkhead of aspect 78 wherein said liner compartment is telescopingly carried by said bulkhead.

80. A bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, said bulkhead comprising:

a first panel defining a back bulkhead wall having a first width;

a second panel defining a front bulkhead wall having a second width, said second panel being spaced apart from and substantially parallel to said first panel, said first and said second widths being substantially the same;

a plurality of beams placed side-by-side between said first and said second panels, each of said beams having a substantially rectangular cross-section and having a length corresponding generally to said first and said second widths; and

a liner for the cargo container, said liner having opposing side walls, a top, and floor corresponding to the opposing side walls, top, and floor of the container, said liner being attached to the bulkhead.

81. The bulkhead of aspect 80 and further comprising a cabinet accessible from at least one of said first and said second panels.

82. The bulkhead of aspect 81 wherein said cabinet comprises a flange, an open ended member corresponding generally in height to the spacing between said first and said second panels and attached to said flange, and a collar for attachment to said open ended member at a location spaced apart from said flange, said flange resting on one panel, said collar resting on the other panel, and said open ended member positioned therebetween.

83. The bulkhead of aspect 82 and further including a port in said cabinet for placing said cabinet in fluid communication with an interior of at least one of said beams.

84. The bulkhead of aspect 80 wherein said first and said second widths correspond generally to a width of the doorway of the cargo container.

85. The bulkhead of aspect 80 wherein said first and said second panels comprise corrugated paper.

86. The bulkhead of aspect 80 wherein some of said beams comprise a single panel of corrugated paper scored with parallel score lines and folded at said score lines.

87. The bulkhead of aspect 86 wherein some of the score lines are on a first side of said single panel and other of the score lines are on a side opposite the first side of said single panel.

88. The bulkhead of aspect 87 wherein half the score lines are on the first side of the said single panel and half of the score lines are on the side opposite the first side of said single panel to define a beam having a member extending across a diagonal of the rectangular cross section.

89. The bulkhead of aspect 80 wherein some of the beams interlock along a side with adjacent beams to define a laminated beam seam.

90. The bulkhead of aspect 89 wherein said laminated beam seam comprises an adhesive.

91. The bulkhead of aspect 90 wherein said laminated beam seam comprises a shim to define an additional layer of laminate in said beam seam.

92. The bulkhead of aspect 80 wherein the plurality of beams are parallel to the floor of the cargo container.

93. The bulkhead of aspect 80 further including a liner compartment in said bulkhead, said compartment being operable to contain said liner when said bulkhead is transported.

94. The bulkhead of aspect 93 wherein said liner compartment comprises an upper portion of said bulkhead that is detachable from and replaceable on the remaining portion of said bulkhead.

95. The bulkhead of aspect 93 wherein said liner compartment is telescopingly carried by said bulkhead.

96. The apparatus of aspect 1 wherein the transparent bulkhead further comprises a means for securing the liner bag discharge sleeve to the bulkhead.

97. The apparatus of aspect 96 wherein the means for securing the liner bag discharge sleeve to the bulkhead is achieved by attaching a flanged fitting to the liner, adapting the bulkhead to receive the flange fitting, perforating the fitting in alignment with the bulkhead in one or more positions, and attaching a drawstring through said perforations such that the drawstrings can be tied to secure the bulkhead to the retainer.

98. The apparatus of aspect 96 wherein the means for securing the liner bag discharge sleeve to the bulkhead is achieved by attaching a flanged fitting to the liner, adapting the bulkhead to receive the flange fitting, and securing the flanged fitting to the bulkhead by interference fit.

Claims

1. Apparatus for lining a cargo container, wherein the container has opposed side walls including an access door in a first such wall, a top and a floor; which apparatus comprises:

(a) an inflatable transparent liner configured when deflated to lie on the floor proximate the wall of the container opposite said first wall and, when fully inflated to display sidewalls, a top and a floor corresponding to the walls, top and floor of the container and fitting within the container in spaced relation with said first wall of the container;

(b) a first inlet connection in the liner positioned, upon inflation of the liner, proximate the top and first wall of the liner for loading a flowable cargo into the liner;

(c) a first outlet connection in the liner positioned, upon inflation of the liner, proximate the floor of the liner and adjacent the access door for unloading a flowable cargo from the liner;

(d) a second inlet connection in the liner positioned, upon inflation of the liner, proximate the top of the liner and the wall of the liner opposite said first wall for flow of gas into the liner; said second inlet connection adapted to be closed upon inflation of the liner;

(e) a transparent bulkhead supported by the container between the liner and said first wall of the container and extending upward from and along the floor of the container; said bulkhead being sufficiently rigid and extensive to resist substantial loading of said access door by cargo within the liner; and

(f) inflatable bags separately inflatable from the liner positioned, upon inflation of the liner, at intersections between the floor of the container and said bulkhead and between the bulkhead and the liner; said bags configured, upon inflation, to displace cargo within the liner from such intersections.

2. Apparatus for lining a box-like cargo container having two sidewalls, a front end wall, a rear end wall having an access door, a floor and a top, comprising:

(a) an inflatable, transparent liner configured, when deflated, to be placed on the floor of the container, and when fully inflated to display two sidewalls, a front wall, a rear wall, a floor and a top corresponding to the sidewalls, front wall, rear wall, top and floor of the container and fitting within the container in spaced relation with the rear wall of the container;

(b) a first inlet connection in the liner positioned, upon inflation of the liner, proximate the top and rear wall of the liner for the loading of a flowable cargo into the liner;

(c) a first outlet connection in the liner positioned, upon inflation of the liner, proximate the floor of the liner and adjacent the access door for unloading of a flowable cargo from the liner;

(d) a second inlet connection in the liner positioned, upon inflation of the liner, proximate the top and the front wall of the liner for the flow of gas into the liner; said second inlet connection adapted to be closed upon inflation of the liner;

(e) a transparent bulkhead adapted to be supported by the container between the liner and the rear wall of the container and extending upward from and across the floor of the container; said bulkhead being sufficiently rigid and extensive to resist substan-

tial loading of said access door by cargo within the liner; and

(f) inflatable bags separately inflatable from the liner positioned, upon full inflation of the liner, external of the liner at intersections between the bulkhead and the floor of the container; said bags configured upon inflation to displace cargo within the liner from such intersections.

3. For use in a cargo container adapted to carry a flowable cargo within a liner in the container, and having two opposed sidewalls, a front end wall, a rear end wall including an access door, a floor and a top, a bulkhead comprising:

a transparent planar member configured to be supported by the container so as to extend upward from the floor of the container and across the rear end wall of the container between said side walls; said planar member being sufficiently rigid and extensive so as to restrain cargo within a liner from loading the access door.

4. A liner for holding a flowable cargo in a box-like container having a floor, a top, two sidewalls, a front end wall, and a back end wall with an access door, which liner comprises:

(a) a transparent inflatable member foldable when deflated into a compact package and inflatable from such package to form a box-like liner having a floor, a top, front and back end walls and two sidewalls lining said container with the back end walls of the container and the liner facing each other in spaced relation;

(b) a first inlet proximate the front and top of the liner when inflated for loading cargo into the liner;

(c) an outlet proximate the front and floor of the liner when inflated for unloading cargo from the liner through the access door; and

(d) a second inlet proximate the top and front of the liner when inflated for supplying gas to the liner.

5. A corner member for use in a box-like lined cargo container for flowable cargo, wherein the container has a corner area which tends to retain cargo when the cargo is unloaded, which corner member comprises:

an inflatable member positionable within the corner between the liner and the container and configured when inflated to displace cargo from the corner area.

6. A liner for a bulk cargo container, which liner is self-installing and capable of containing bulk cargo and separating the cargo from the interior surfaces of the container.

7. A self-installing liner capable of containing bulk cargo and separating the cargo from the interior surfaces of a bulk cargo container.

8. Apparatus for transporting bulk cargo comprising:

(a) a box-like container having a floor, sidewalls, a front wall, and a rear wall including opening means to provide access to the interior of the container;

(b) a liner lining the container and capable of containing the bulk cargo and separating the cargo from the interior surfaces of the container; and

(c) a bulkhead positioned between the liner and said rear wall, at least a portion of said bulkhead being transparent allowing thereby a view of the cargo space forward of the bulkhead, and sufficiently rigid to prevent load caused by the cargo within the liner from being transferred directly to the opening means.

9. Apparatus for transporting bulk cargo comprising:

(a) a cargo container having sidewalls, front and rear walls, and a floor wall, and at least one wall further comprises opening means to provide access to the interior of the container;

(b) a liner capable of containing bulk cargo and separating the cargo from the interior surfaces of the container and having a bottom outlet for such cargo positioned adjacent said opening means; and

(c) at least one inflatable bag positioned proximate said outlet and configured upon inflation to promote the unloading of cargo from within the liner.

10. Apparatus for transporting bulk cargo comprising:

(a) a cargo container having sidewalls, front and rear walls, and a floor wall, wherein at least one wall further comprises opening means to provide access to the interior of the container;

(b) a transparent, inflatable, self-installing liner within the container capable, upon inflation, of containing the bulk cargo and separating the cargo from the interior surfaces of the container; and

(c) an outlet in the liner positioned proximate said opening means.

11. A method for transporting bulk cargo comprising:

(a) self-installing the liner of any of aspect 9 or 10;

(b) loading the liner with a flowable bulk cargo;

(c) transporting the loaded container; and

(d) unloading the cargo through the outlet.

12. A method of transporting bulk cargo in a box-like cargo container, which has two sidewalls, front and back walls, and a floor wall, wherein at least one wall further comprises opening means to provide access to the interior of the container, the method comprising:

(a) installing within the container a self-installing, inflatable liner capable of containing the bulk cargo and separating the cargo from the interior surfaces of the container; and

(b) installing a bulkhead, at least a portion of which is transparent, between the liner and the opening means, of sufficient rigidity to prevent load caused by the cargo within the liner from being transferred directly to the opening means.

13. A method of unloading a flowable cargo from a liner within a cargo container, which has a corner in which flowable cargo tends to remain following unloading, which comprises:

(a) installing an inflatable bag in the corner between the container and the liner prior to such loading, said bag configured upon inflation to displace cargo from the corner into the liner; and

(b) inflating the bag during such unloading.

14. A liner for a box-like cargo container having top and bottom walls, four sidewalls and an access door at a first end, which comprises:

(a) an inflatable, transparent member insertable within the container and configured upon inflation to line the container with a first end corresponding to the first end of the container;

(b) an inlet port proximate the top of the first end of the inflatable member, when inflated;

(c) an outlet port proximate the bottom of the first end of the inflatable member, when inflated; and

(d) a compressible conduit member connected to the opposite end of the inflatable member, when inflated, and extending along the top of said inflatable member, when inflated, to said first end of the inflatable member.

15. Apparatus for lining a cargo container, wherein the container has opposed side walls including an access door in a first such wall, a top and a floor, said apparatus comprising:

a liner having opposed side walls, a top and a floor defining and interior space corresponding generally to the side walls, top and floor of the container, said liner being positionable within the container in spaced relation with a first wall in the container;

a fluid impervious plenum adjacent the floor of the liner, said plenum corresponding to an area of the floor of the liner and having a plurality of spaced apart perforations for directing a fluid from said plenum into said interior space;

a bulkhead positionable between the access door and a side wall of the liner, said bulkhead having a liner inlet port, a liner outlet port, and a plenum inlet port;

a liner inlet for introducing material into the interior space through said liner inlet port;

a liner outlet for removing material from the interior space through said liner outlet port;

a plenum inlet for introducing a fluid into the plenum through said plenum inlet port;

said liner, plenum, bulkhead, liner inlet, liner outlet, and plenum inlet being cooperable to create a fluidized bed of material in said interior space when material is introduced through said liner inlet into said interior space and fluid is supplied to said plenum inlet to facilitate unloading of said material through said liner outlet.

16. Method for lining a cargo container, wherein the container has opposed side walls including an access door in a first such wall, a top and a floor, said method comprising the steps of:

introducing into a cargo container a liner having opposed side walls, a top and a floor defining an interior space corresponding generally to the side walls, top and floor of the container;

positioning said liner within the container in spaced relation with a first wall in the container;

positioning a bulkhead between the access door and said first wall of the liner, said bulkhead having a liner inlet port, a liner outlet port, and a plenum inlet port;

introducing material into the interior space through said liner inlet port;

unloading some material from the interior space through said liner outlet port;

introducing fluid through a plenum inlet port into a fluid impervious plenum adjacent the floor of the liner, said plenum correspond-

ing to an area of the floor of the liner and having a plurality of spaced apart perforations for directing a fluid from said plenum into said interior space;

directing a fluid from said plenum into said interior space to create a fluidized bed in said interior space; and

unloading any remaining material in said interior space through said liner outlet.

17. A bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, said bulkhead comprising:

a first panel defining a back wall having a first width;

a second panel defining a front wall having a second width, said second panel being spaced apart from and substantially parallel to said first panel, said first and said second widths being substantially the same;

a plurality of beams arranged side-by-side between said first and said second panels, each of said beams defining a zone within said bulkhead having a quadrilateral cross-section and having a length corresponding generally to said first and said second widths; and

said first panel, said second panel, and said plurality of beams being cooperable when said bulkhead is positioned across the doorway to resist forces at the doorway of the cargo container when the cargo container contains a flowable load.

18. A bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, said bulkhead comprising:

a first panel defining a back wall having a first width;

a second panel defining a front wall having a second width, said second panel being spaced apart from and substantially parallel to said first panel, said first and second widths being substantially the same;

a plurality of laminated beams having a length corresponding generally to said first and said second widths, said beams comprising at least four layers of corrugated paper and an adhesive, said plurality of beams arranged in substantially parallel relationship to each other and positioned between said first and said second panels;

an adhesive for connecting said first and said second panels to said laminated beams; and

said first panel, said second panel, and said plurality of beams being cooperable to define a bulkhead for resisting the forces of a flowable load in the cargo container when said bulkhead is positioned in the doorway.

19. A bulkhead for a cargo container, the container having opposing side walls, a top, and a floor, and an opening in one wall defining a doorway, said bulkhead comprising:

a first panel defining a back bulkhead wall having a first width;

a second panel defining a front bulkhead wall having a second width, said second panel being spaced apart from and substantially parallel to said first panel, said first and said second widths being substantially the same;

a plurality of beams placed side-by-side between said first and said second panels, each of said beams having a substantially rectangular cross-section and having a length corresponding generally to said first and said second widths; and

a liner for the cargo container, said liner having opposing side walls, a top, and floor corresponding to the opposing side walls, top, and floor of the container, said liner being attached to the bulkhead.

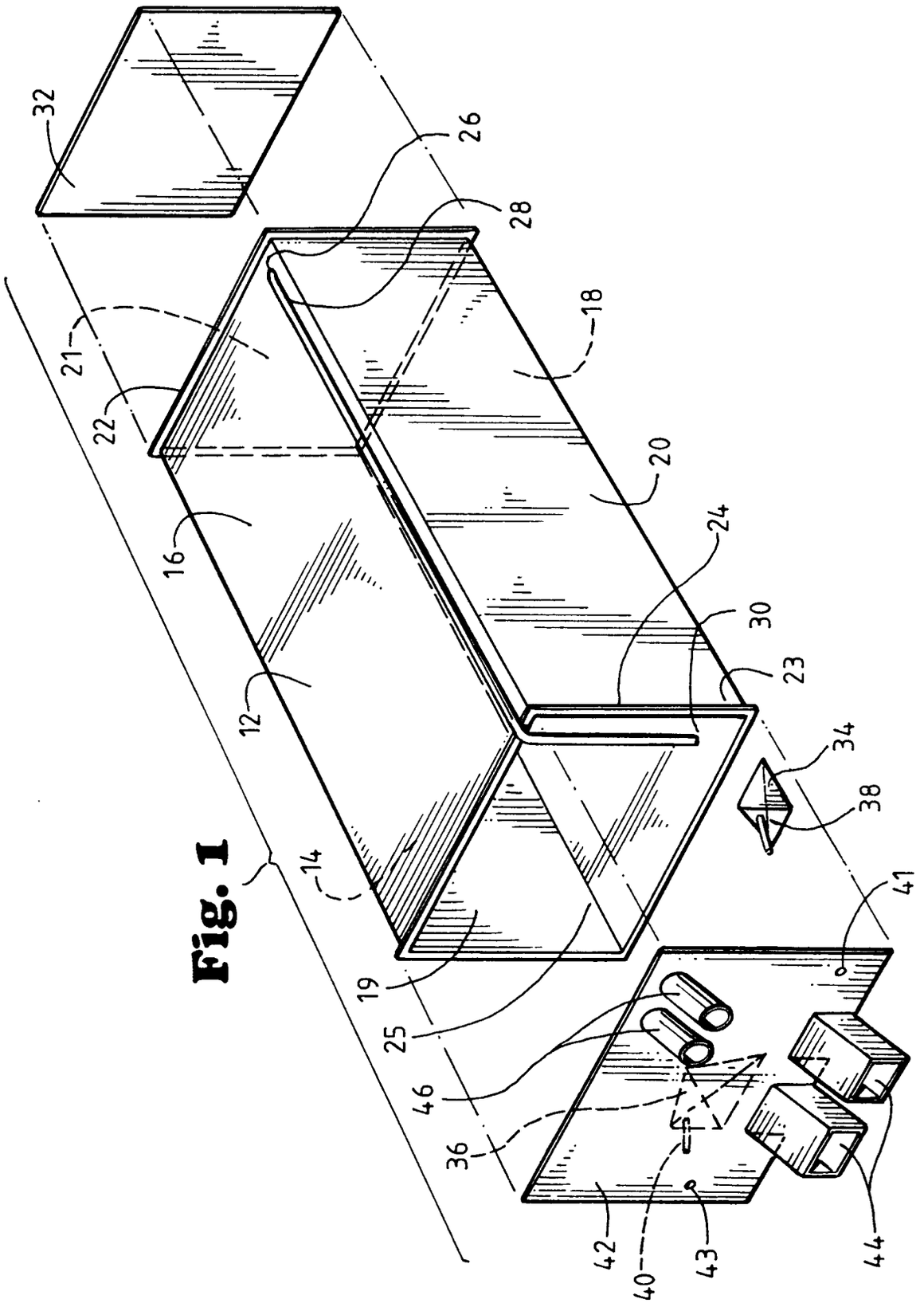


Fig. 1

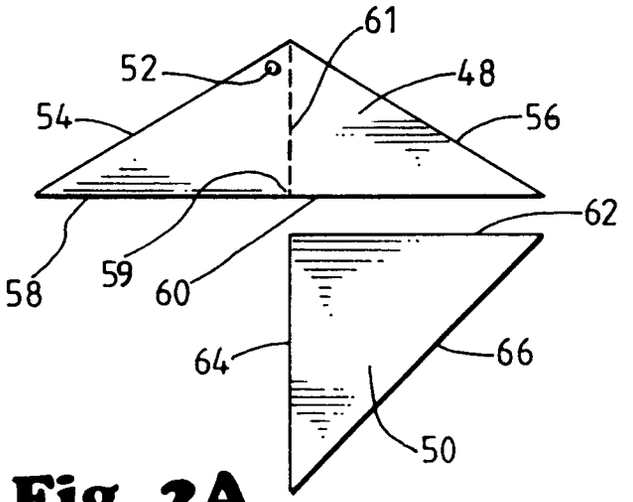


Fig. 2A

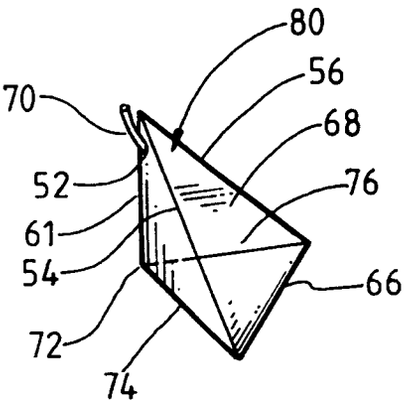


Fig. 2B

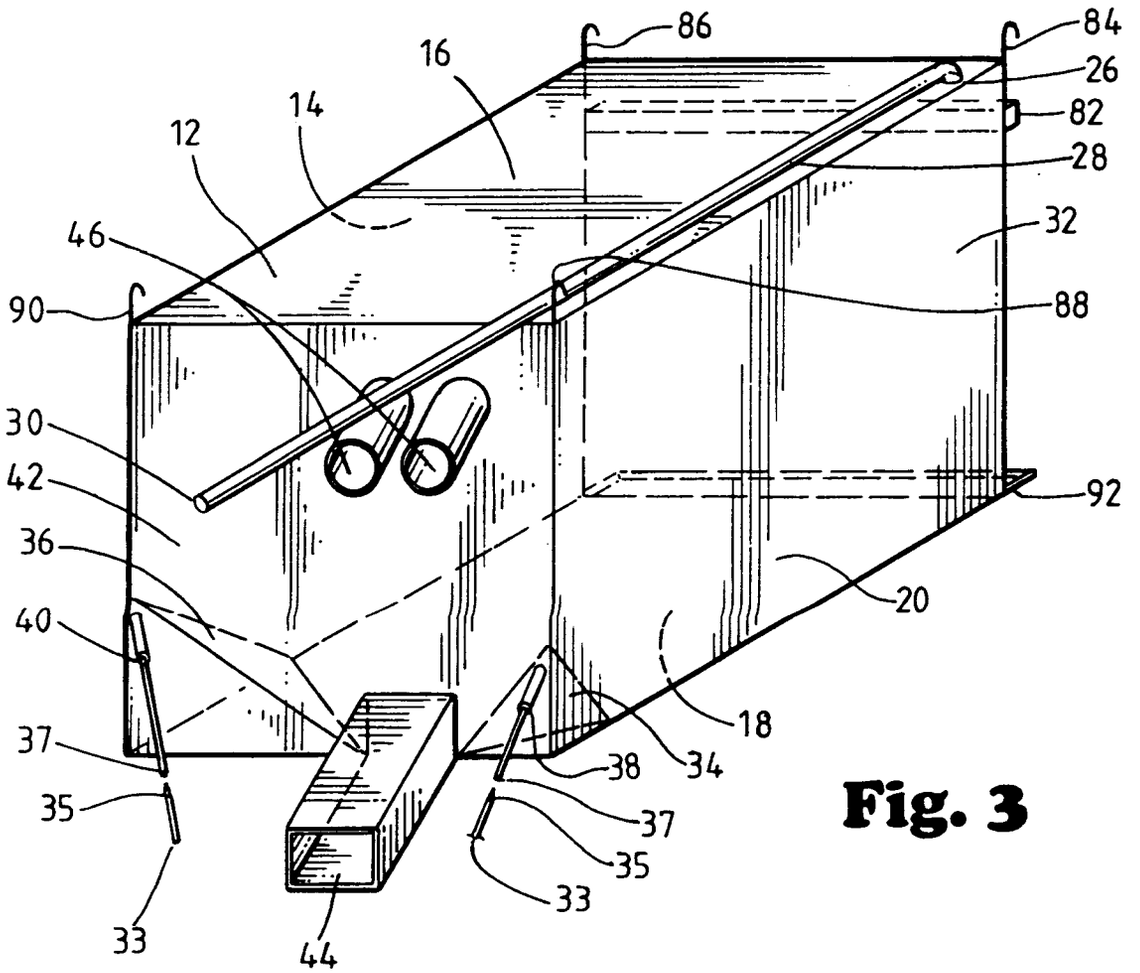


Fig. 3

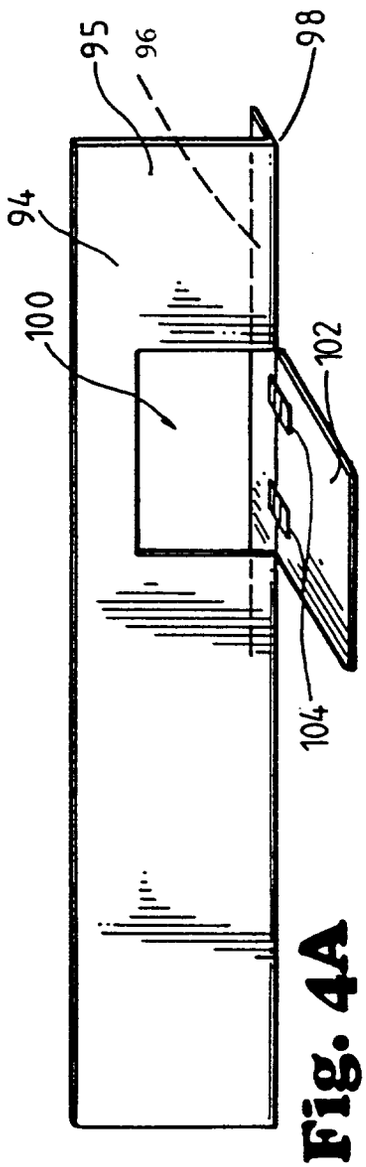


Fig. 4A

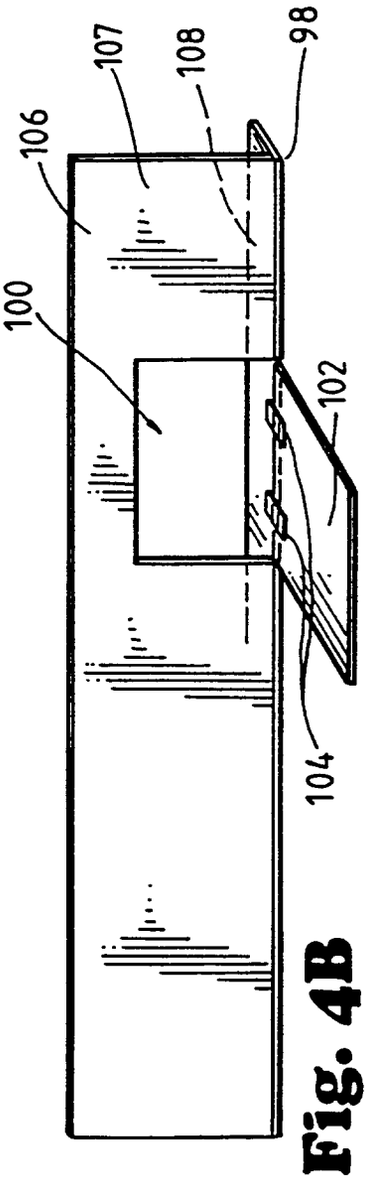


Fig. 4B

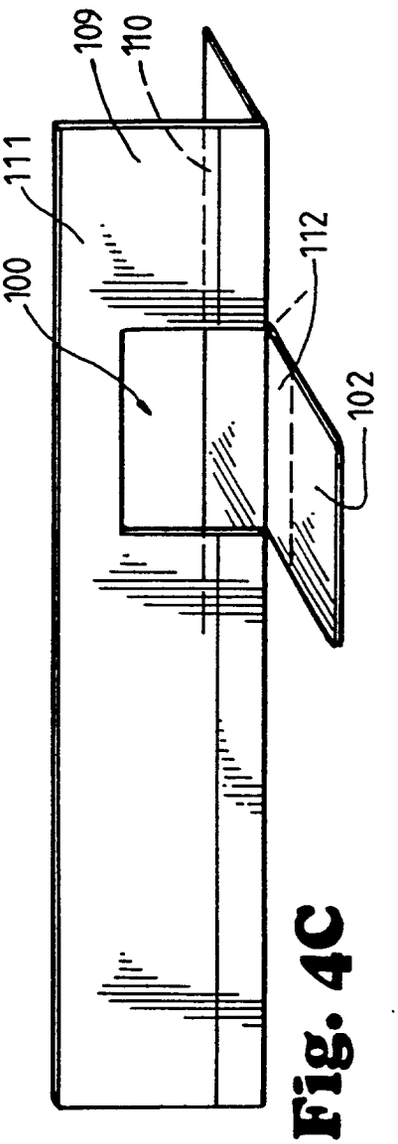


Fig. 4C

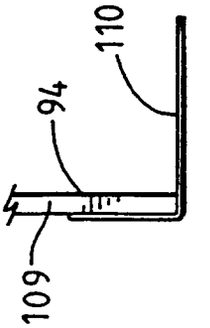


Fig. 4D

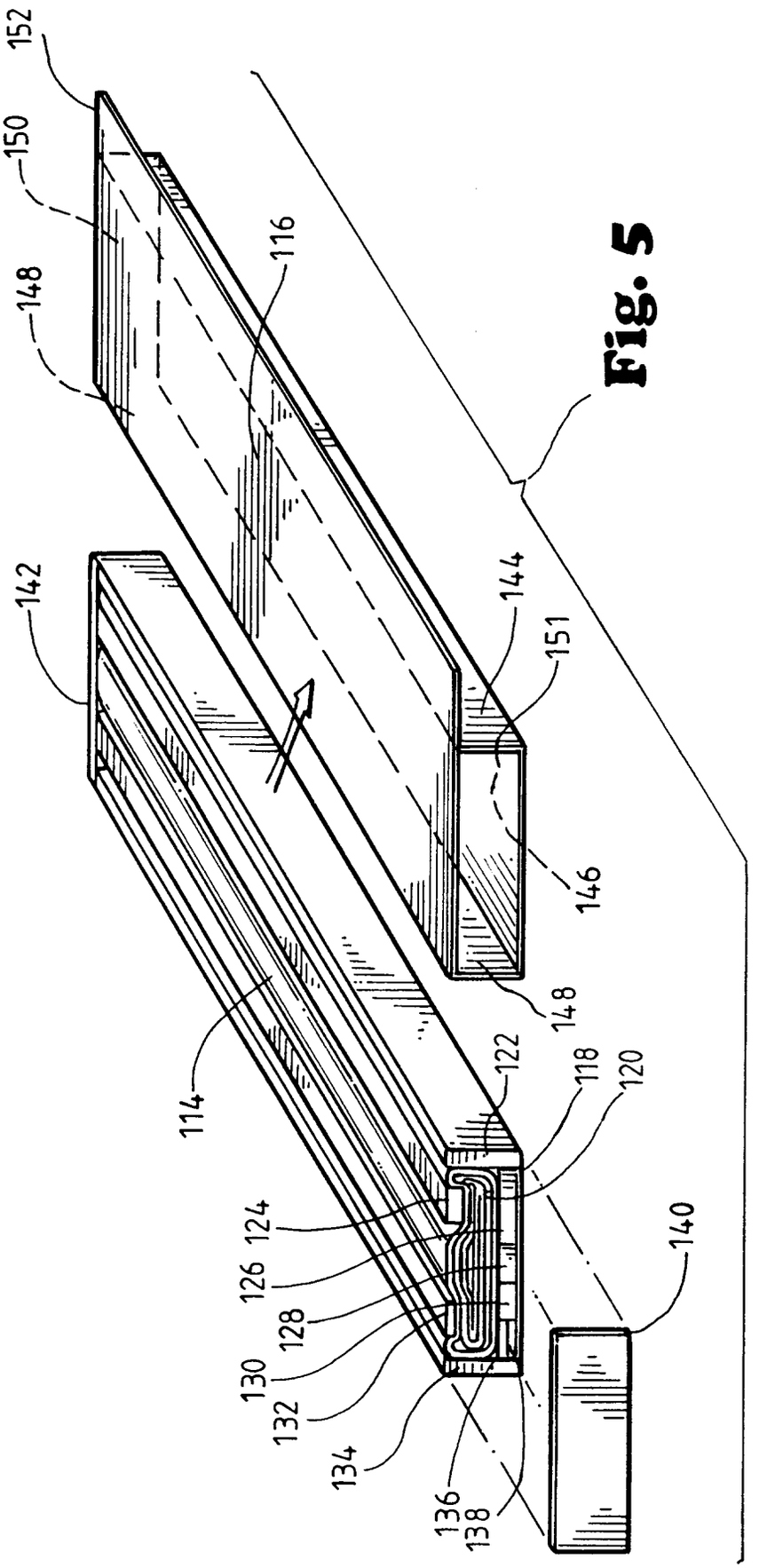

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Fig. 5

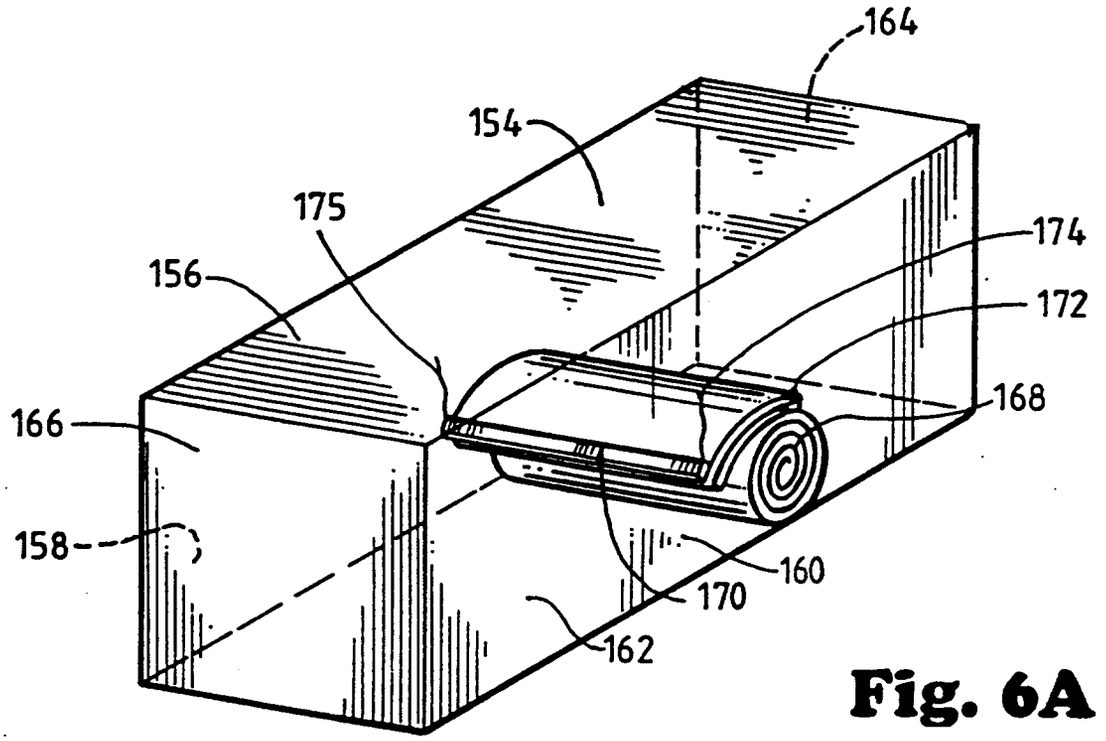
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Fig. 6A

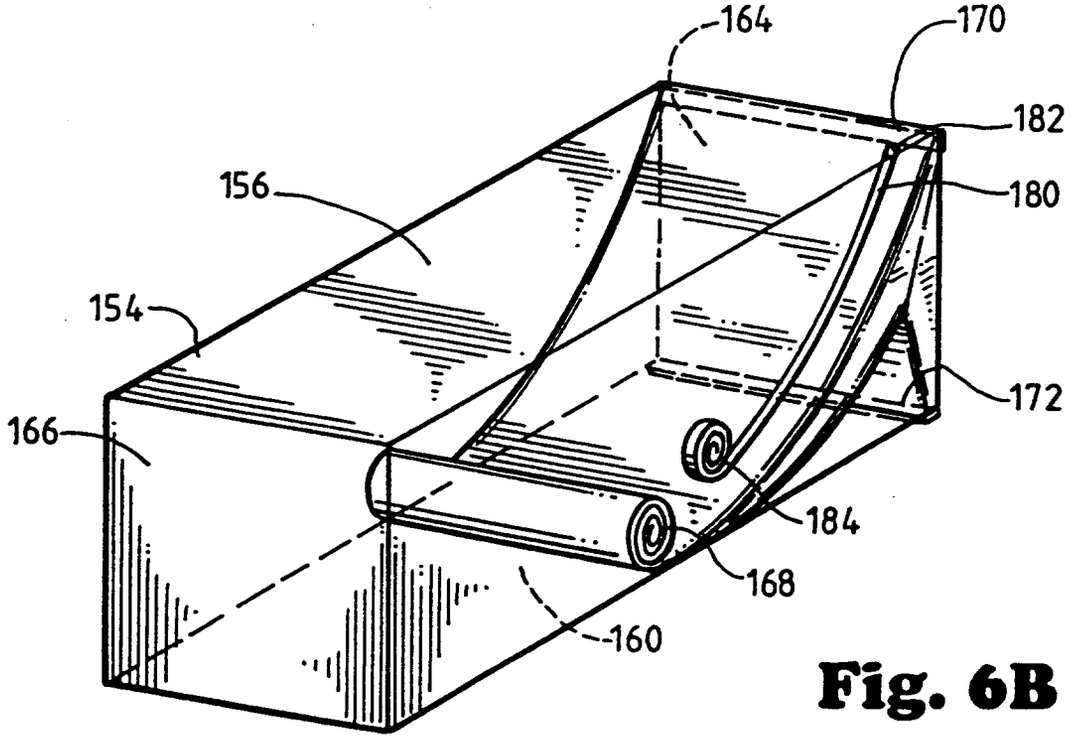
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Fig. 6B

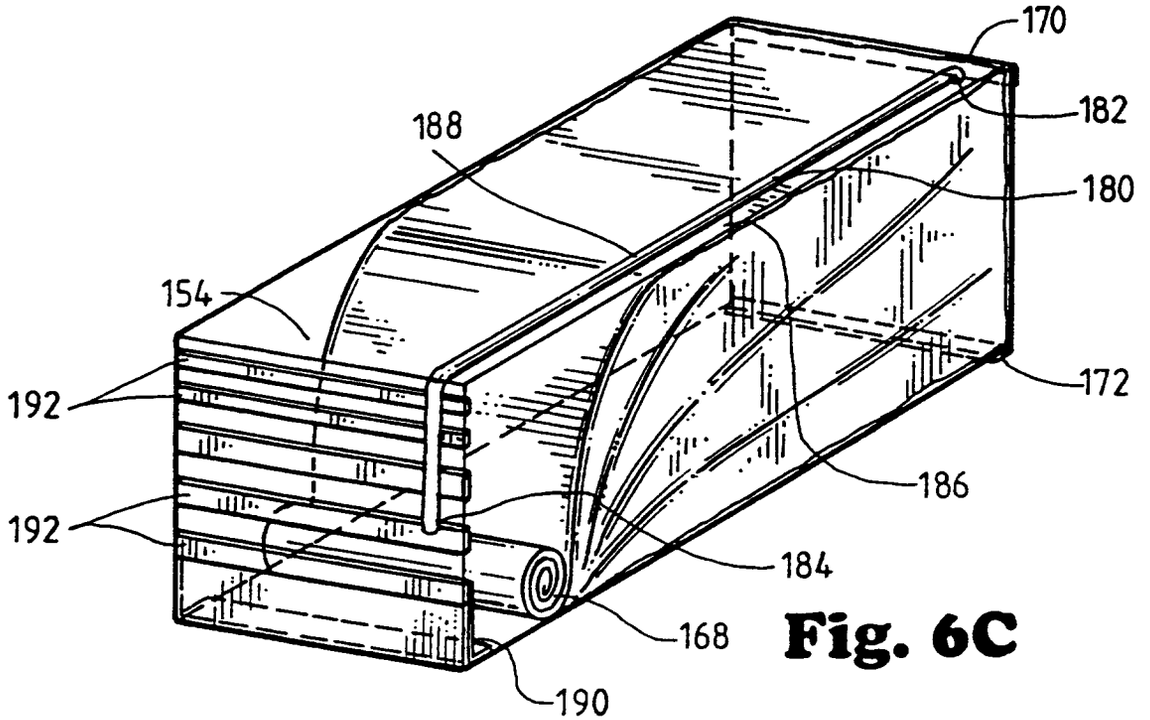
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Fig. 6C

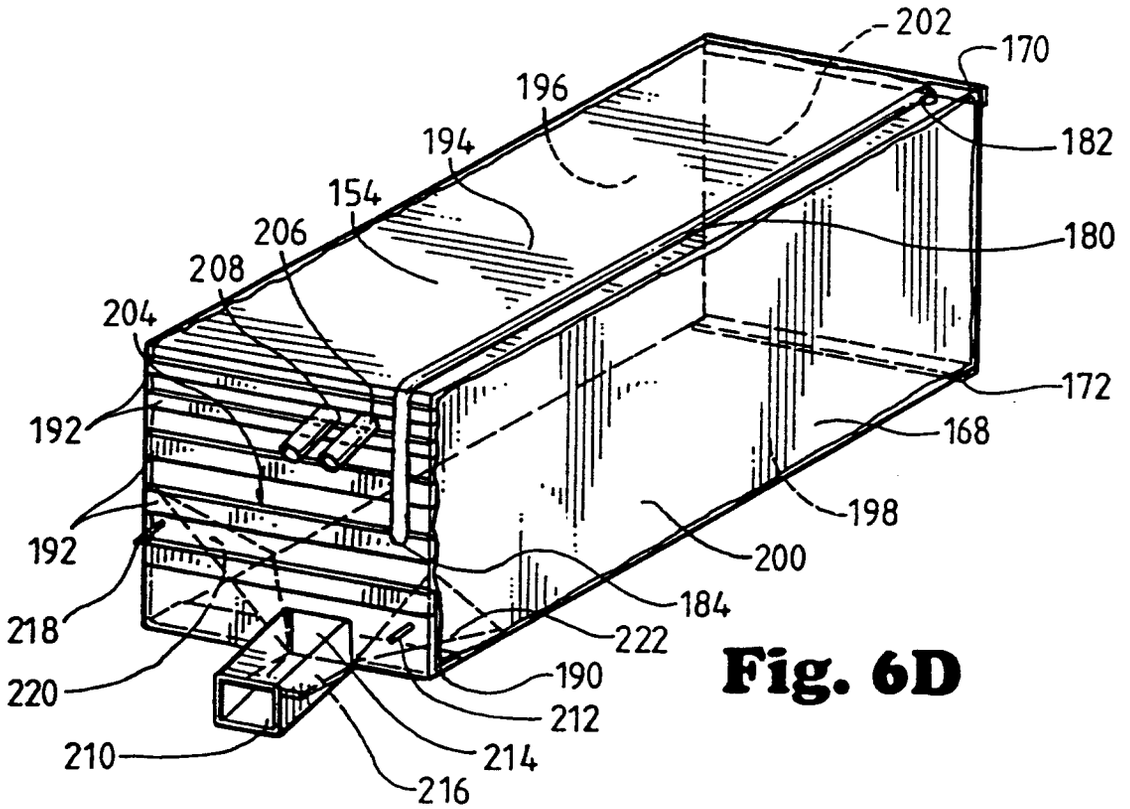
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Fig. 6D

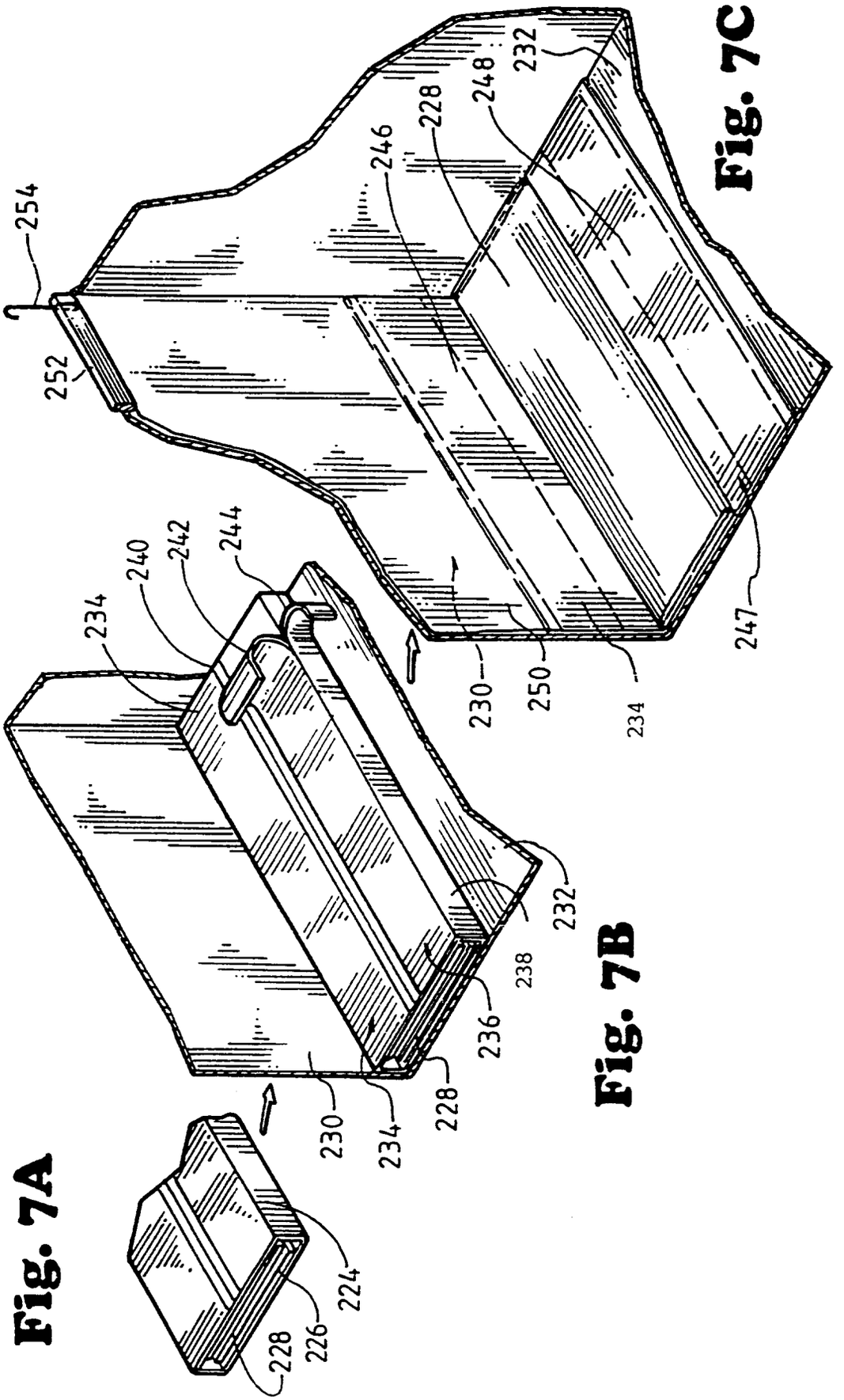

Fig. 7A

Fig. 7B

Fig. 7C

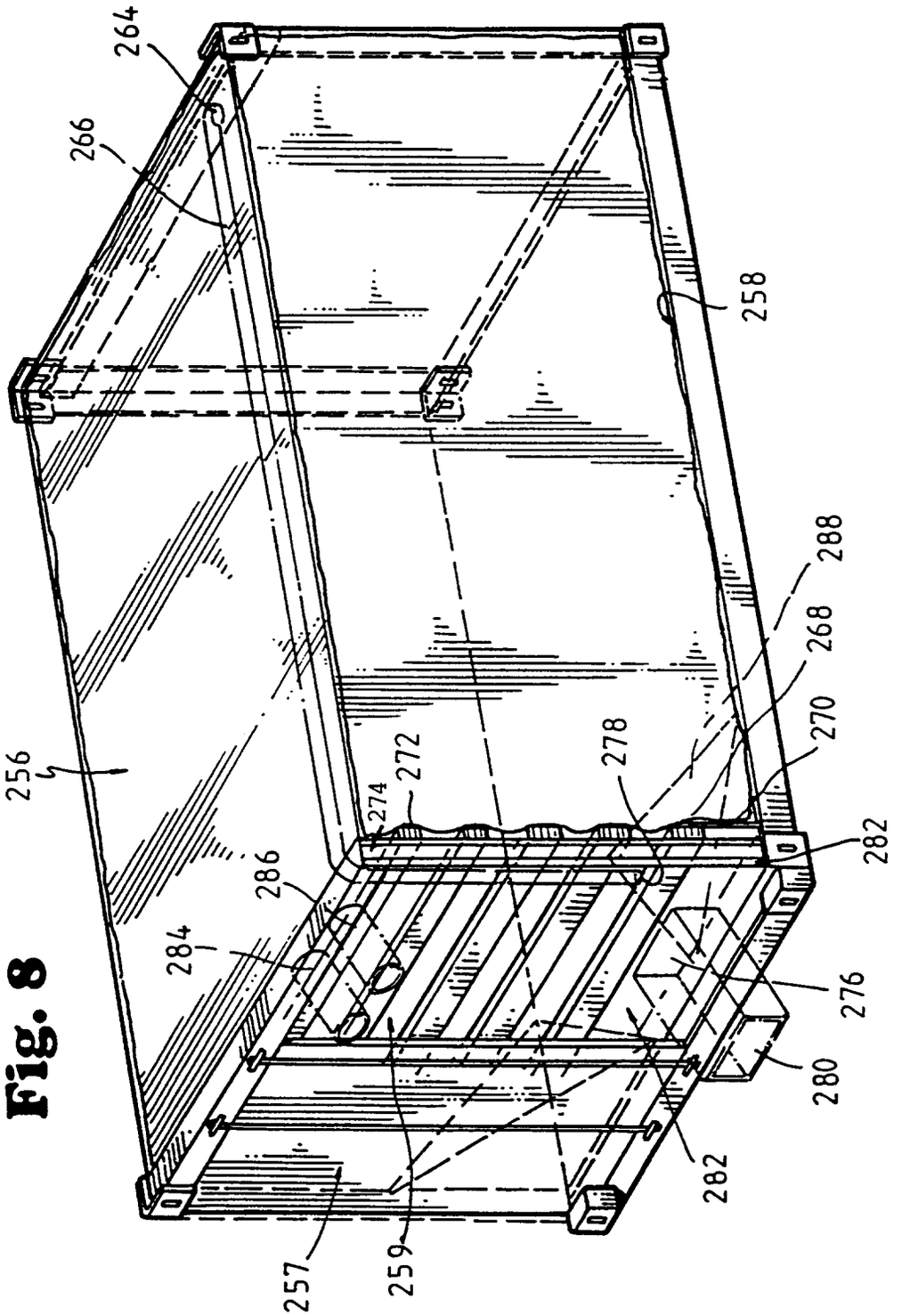
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Fig. 8

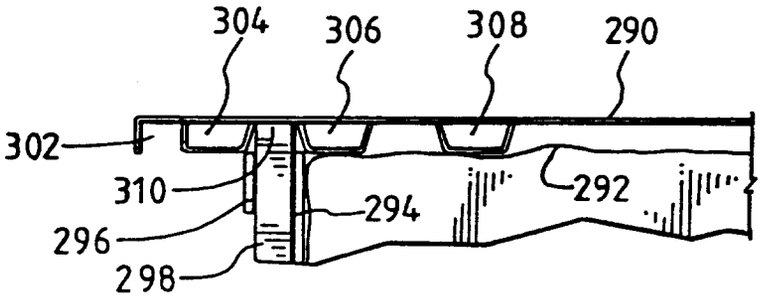
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Fig. 9A

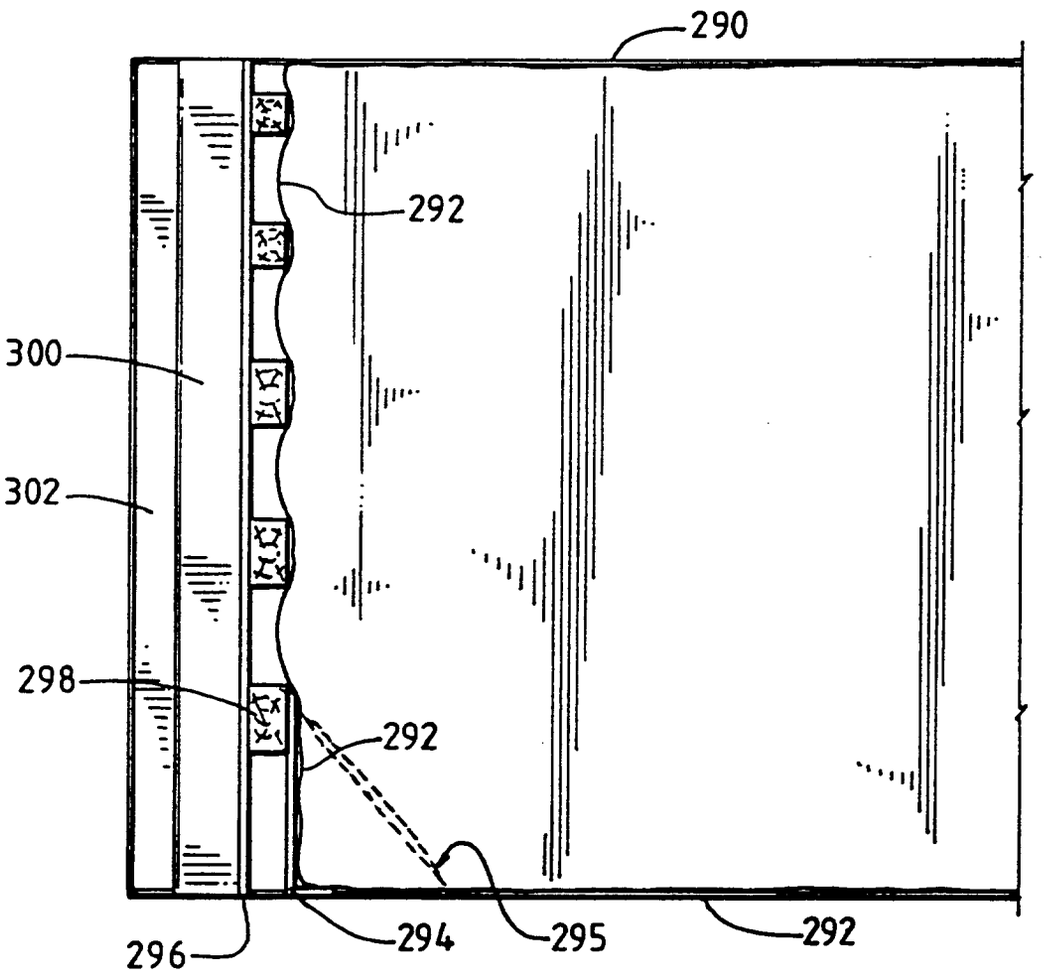
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Fig. 9B

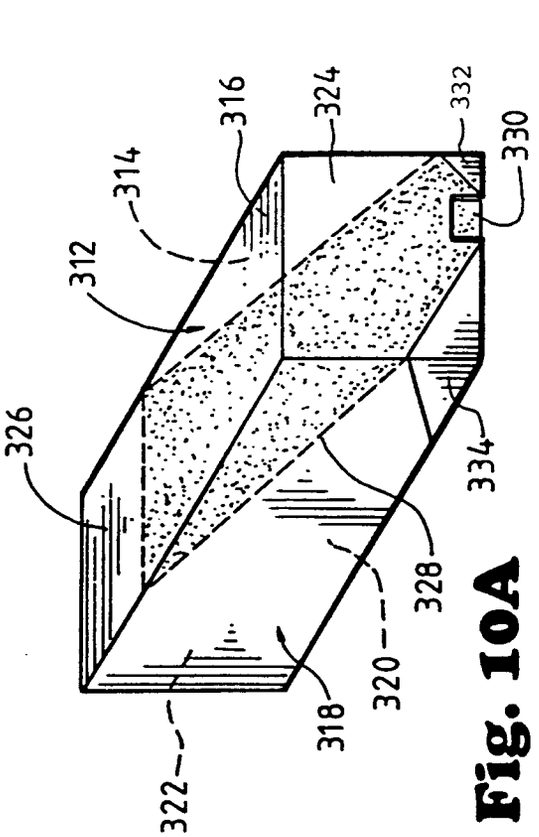

Fig. 10A

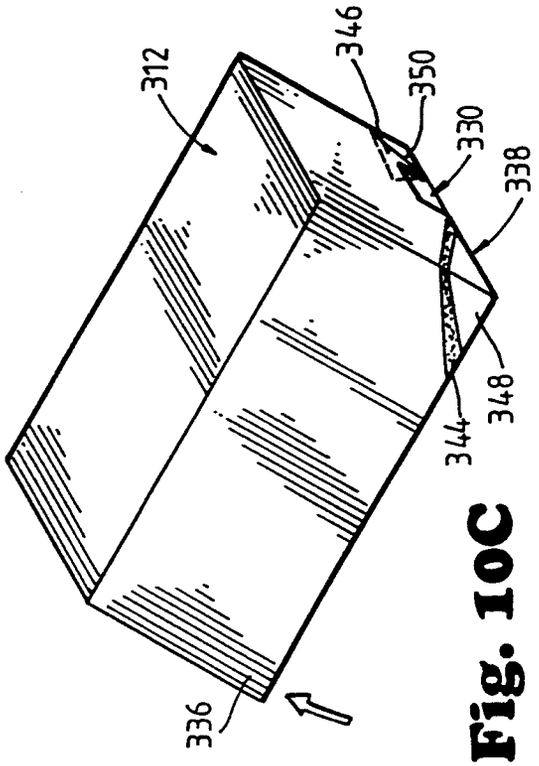

Fig. 10C

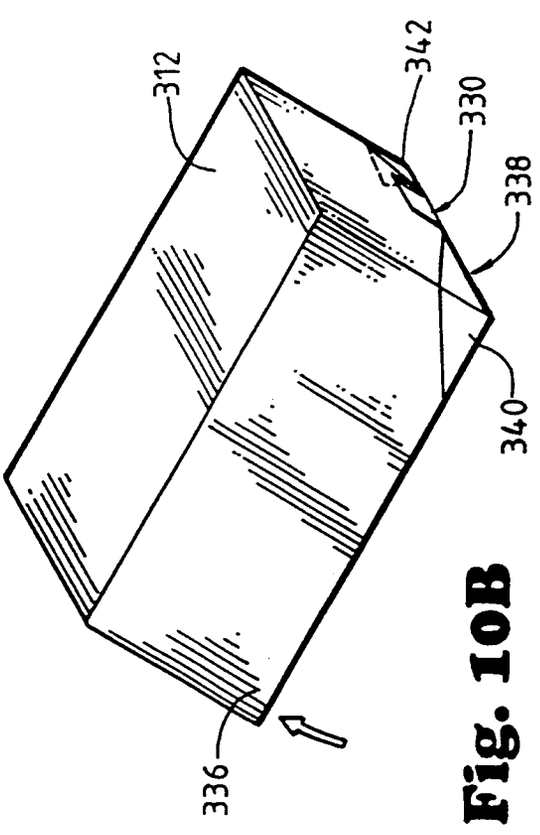

Fig. 10B

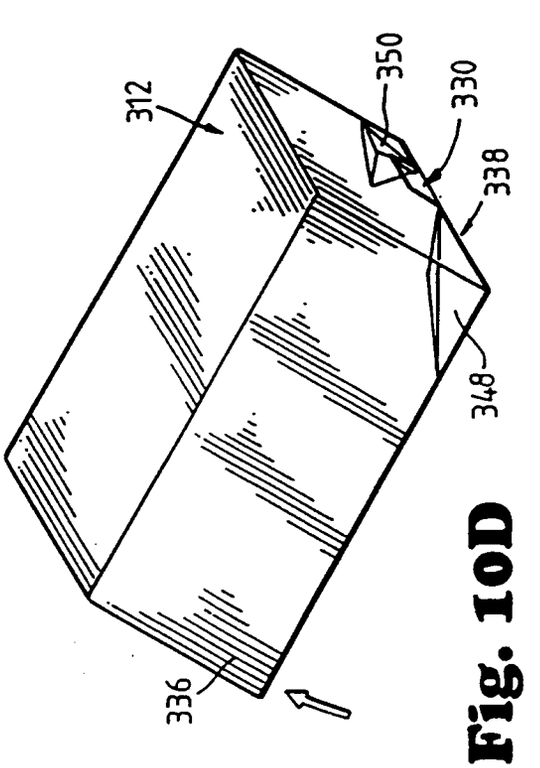

Fig. 10D

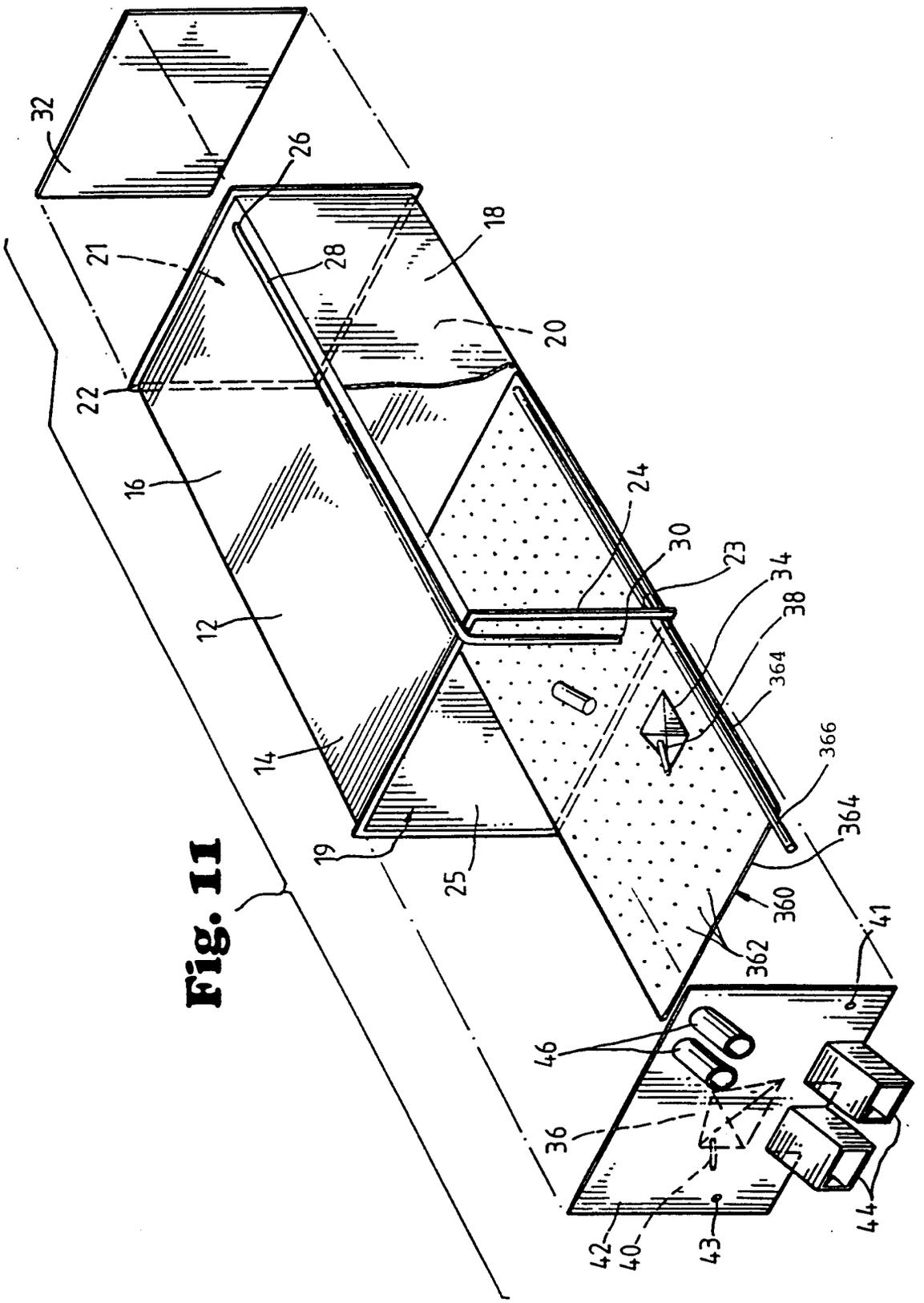
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Fig. 11

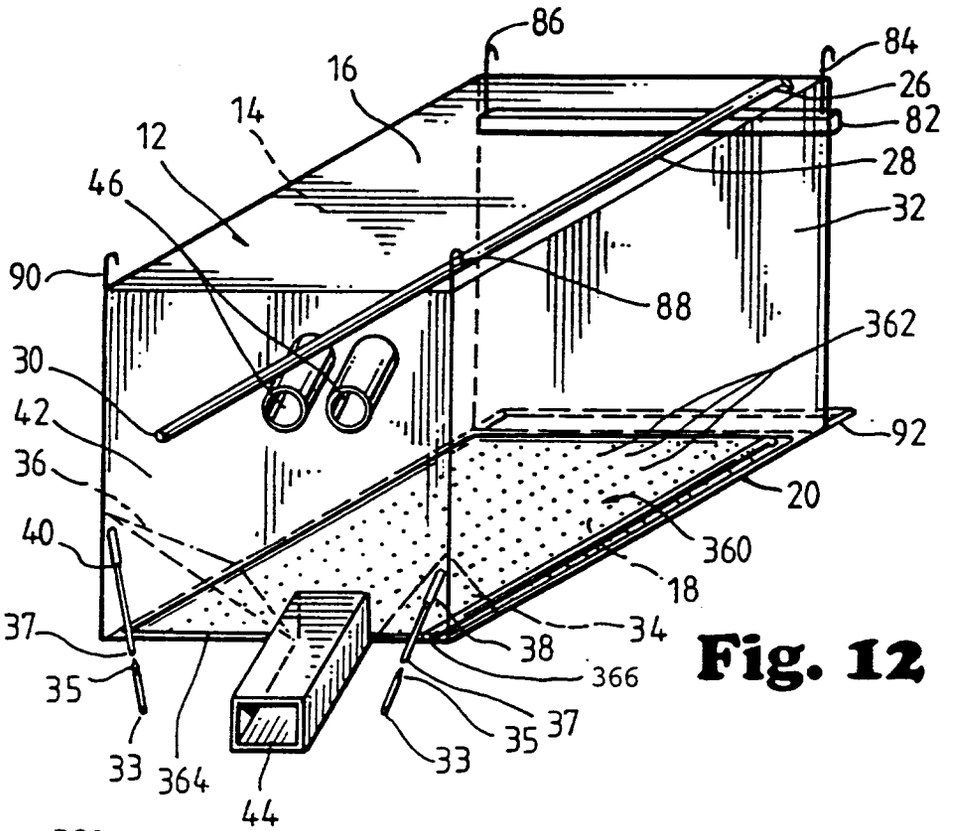


Fig. 12

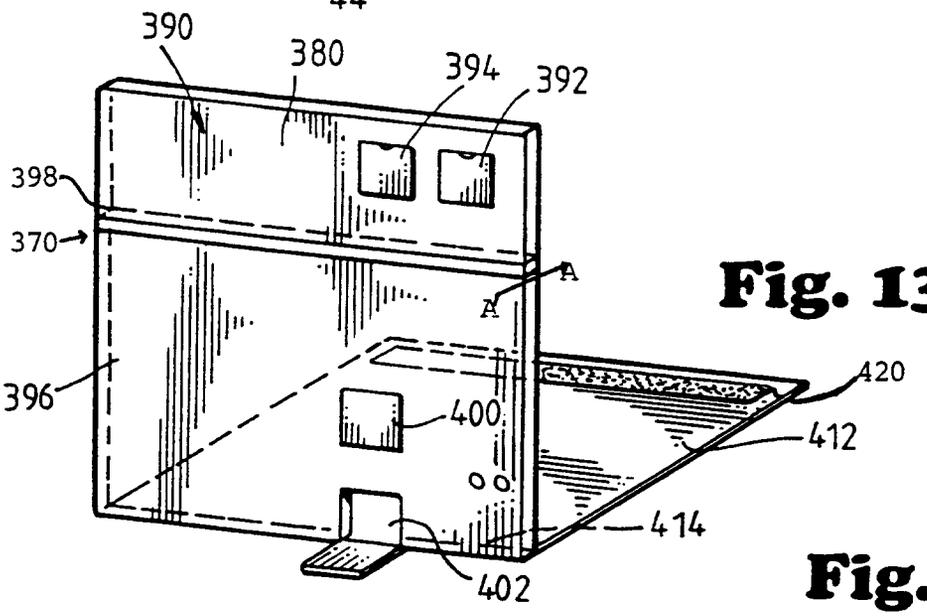


Fig. 13A

Fig. 13C

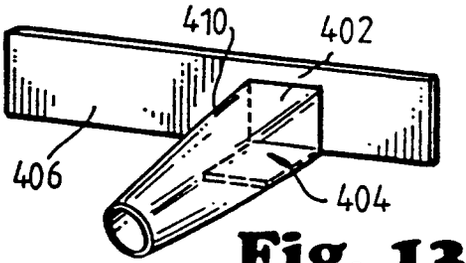
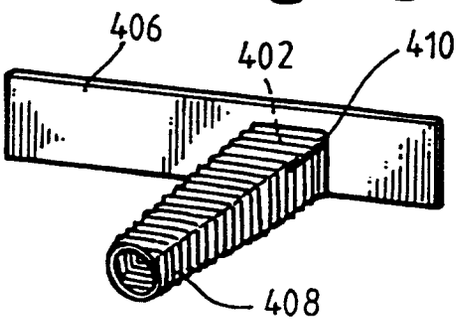


Fig. 13B



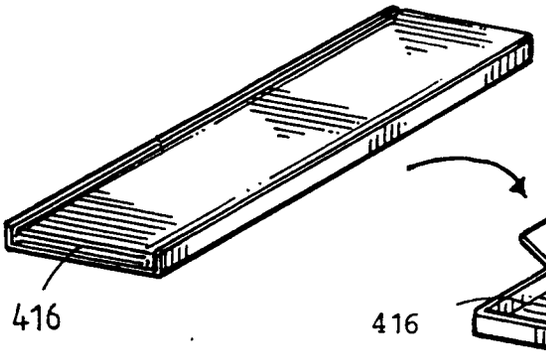


Fig. 14A

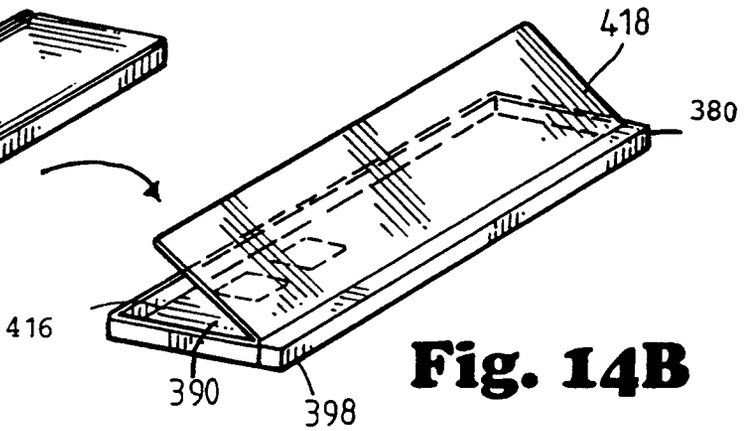


Fig. 14B

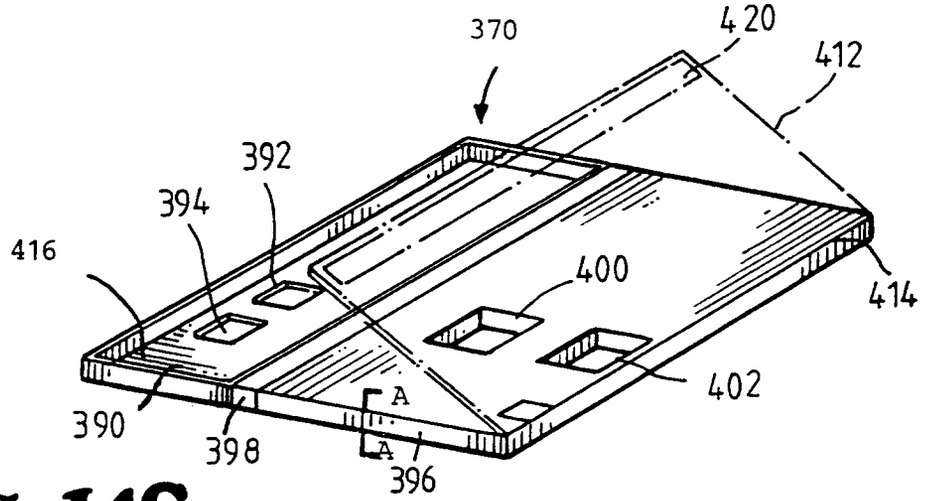


Fig. 14C

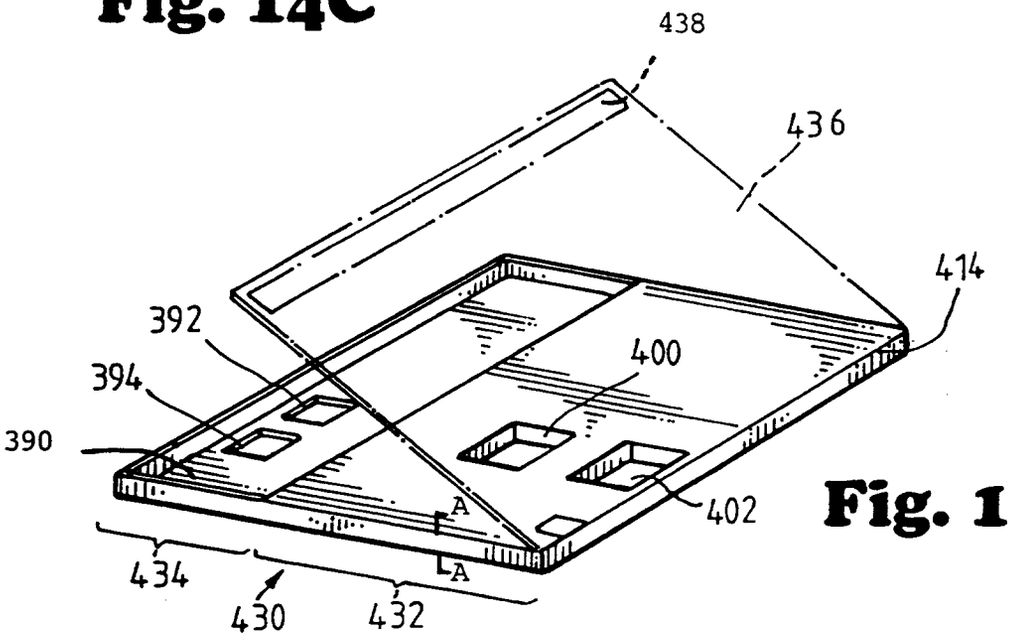


Fig. 14D

Fig. 15A

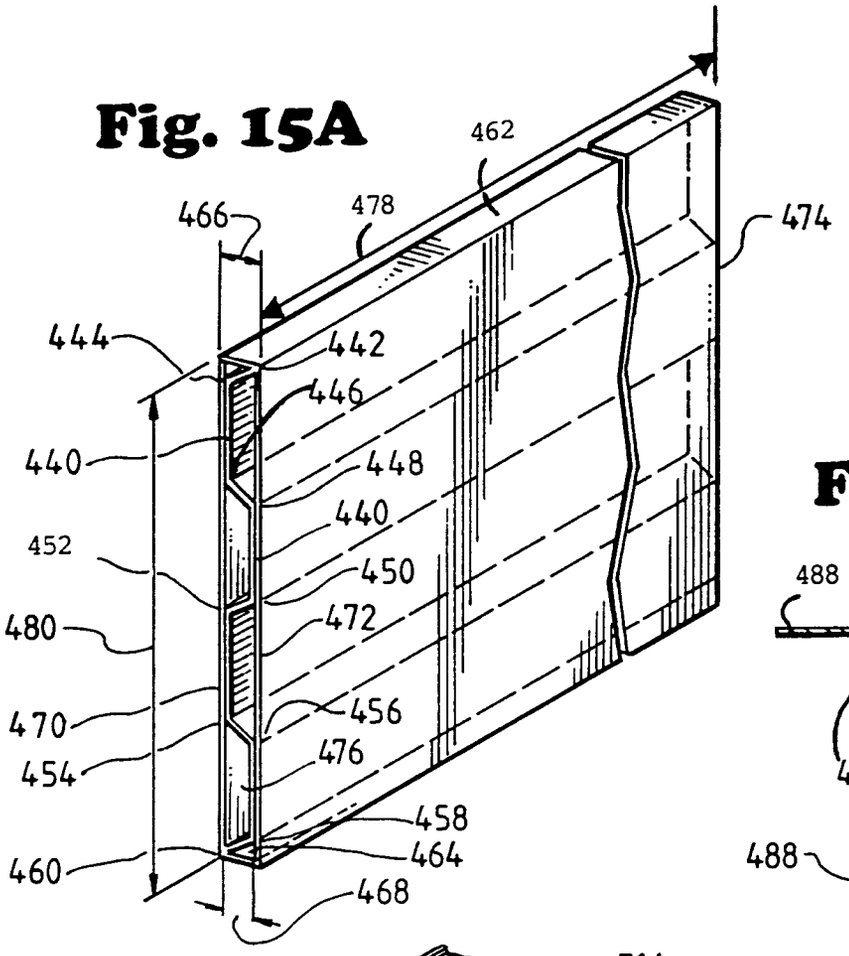


Fig. 15B

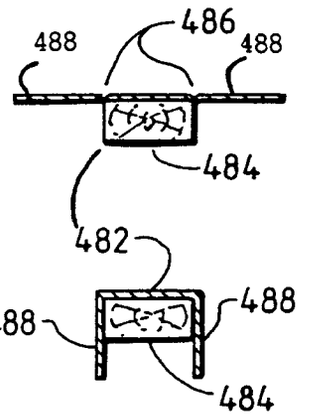


Fig. 15C

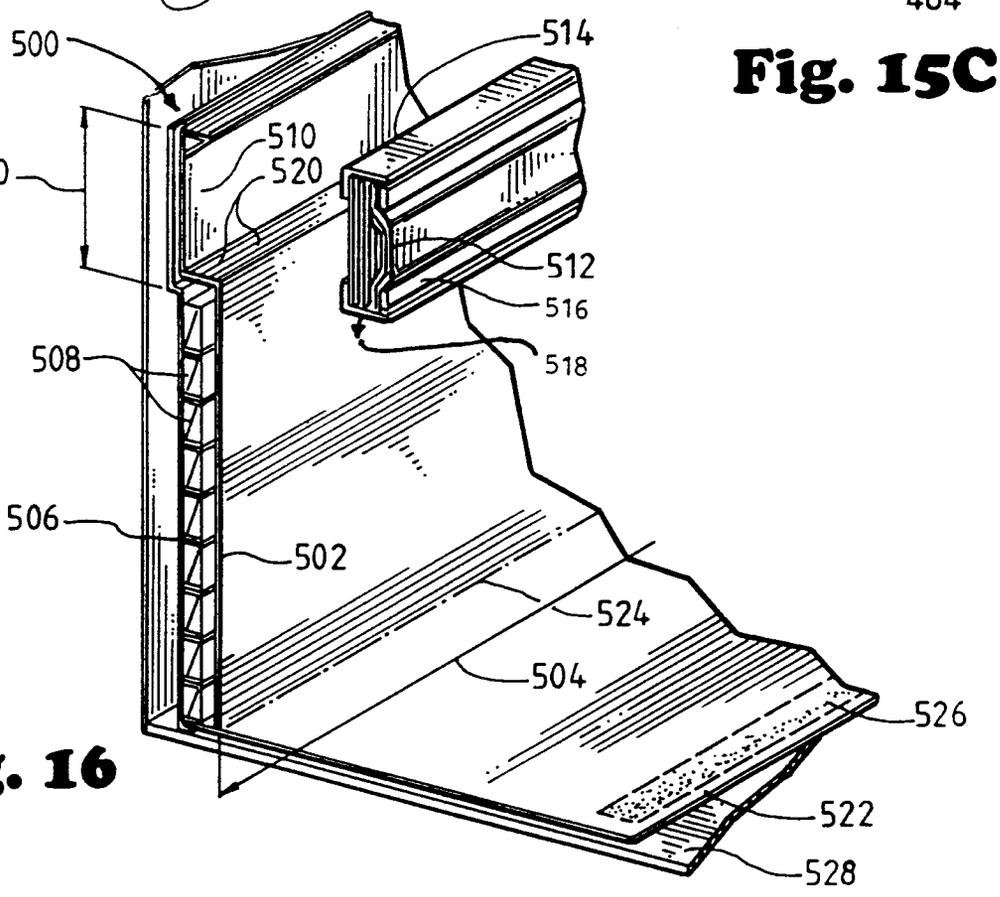


Fig. 16

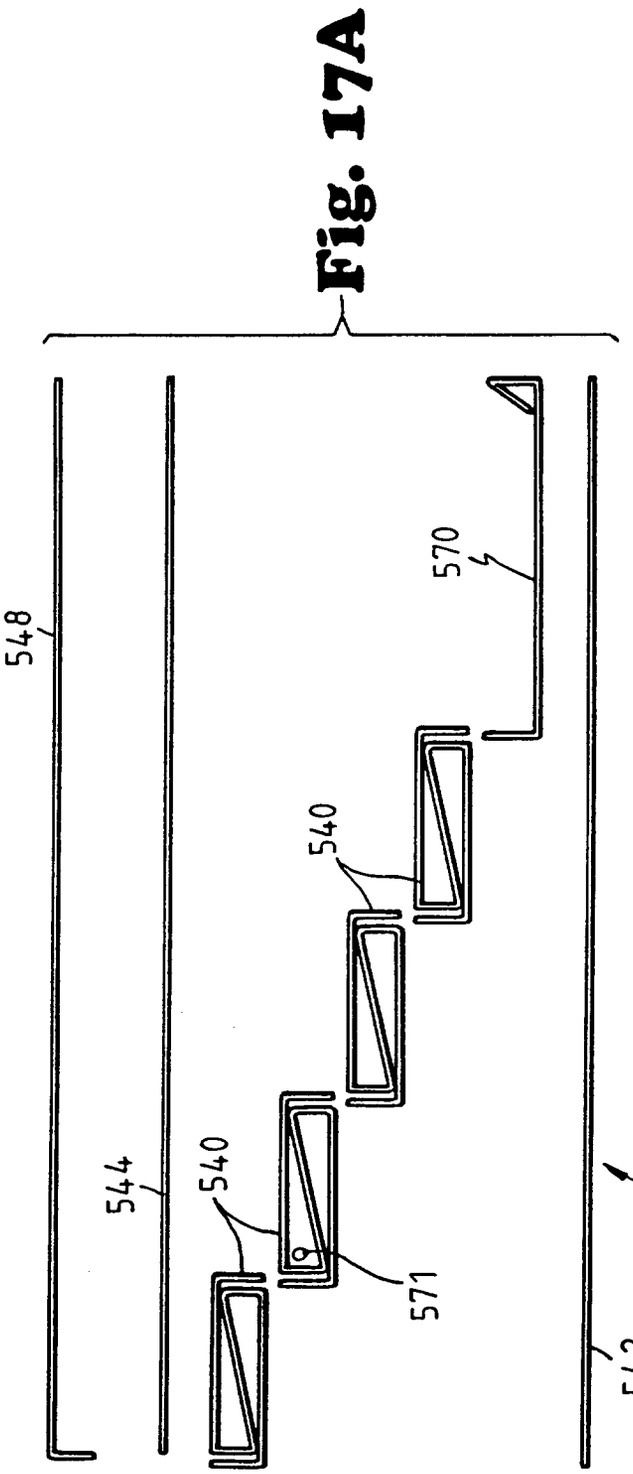


Fig. 17A

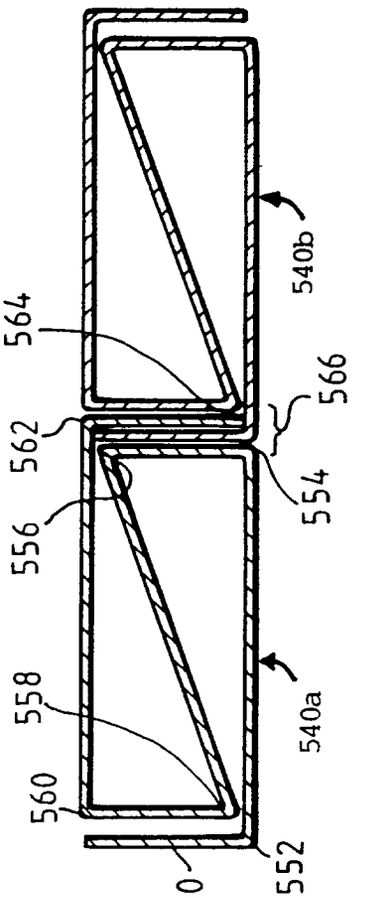


Fig. 17B

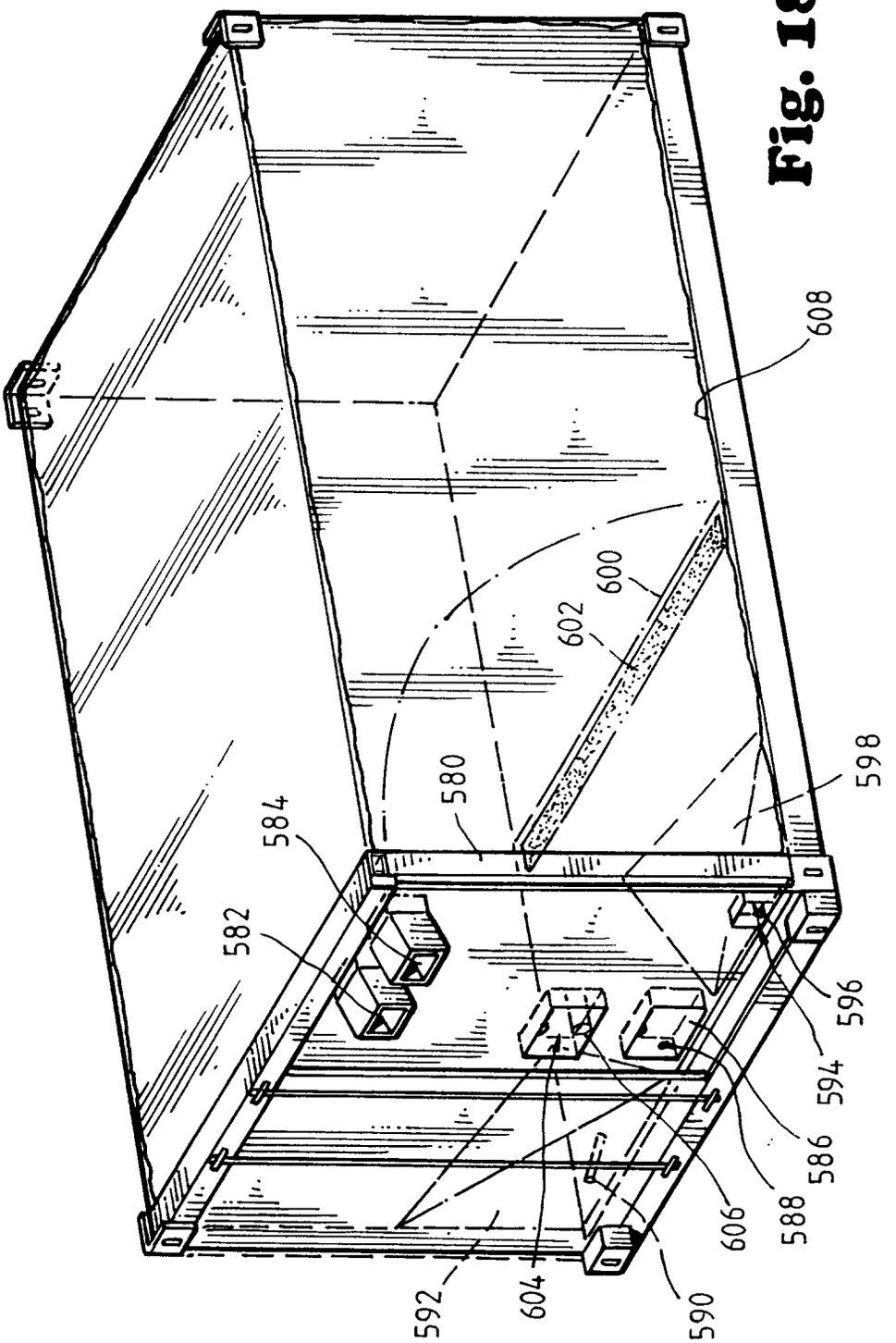
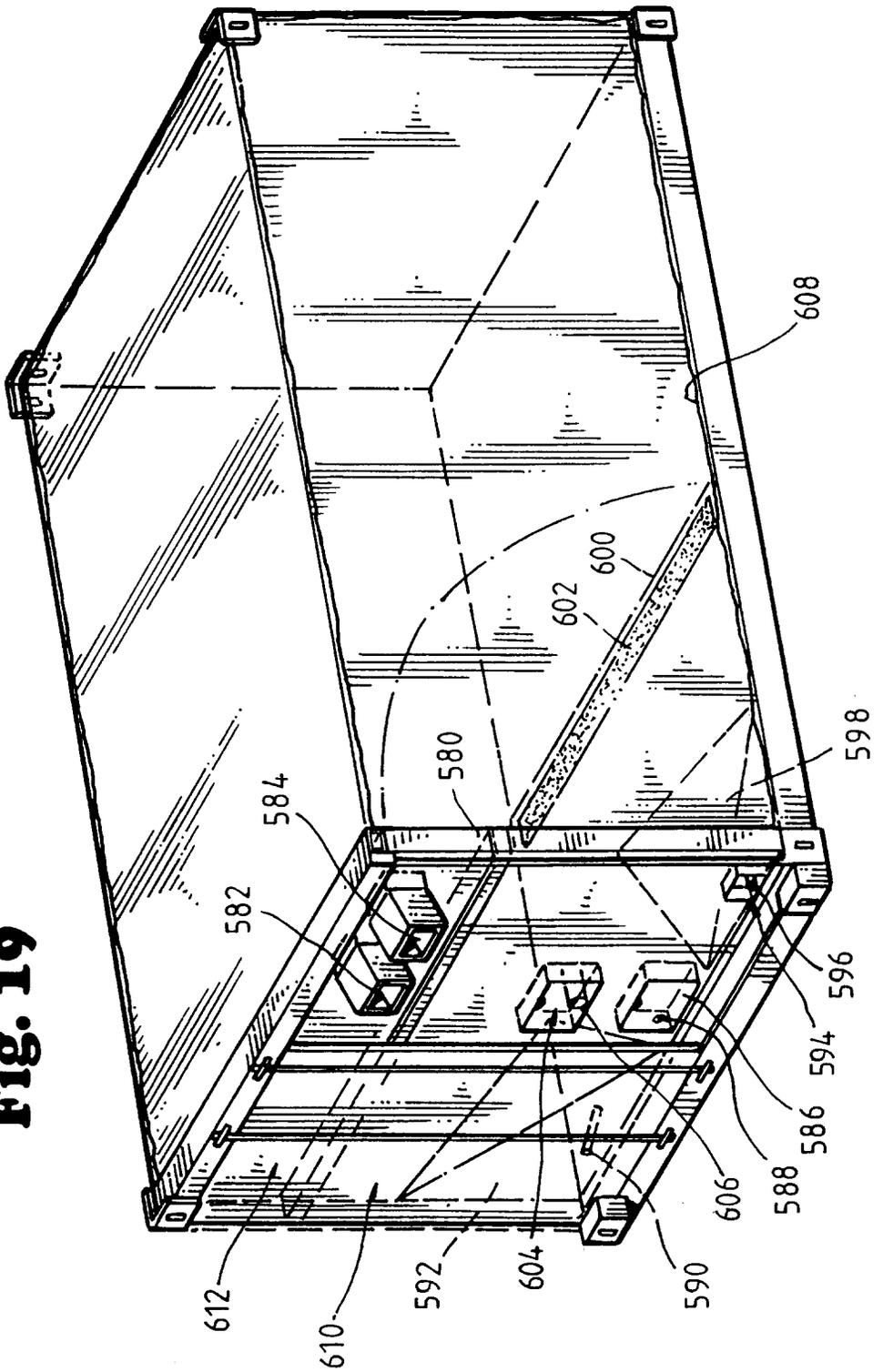


Fig. 18

Fig. 19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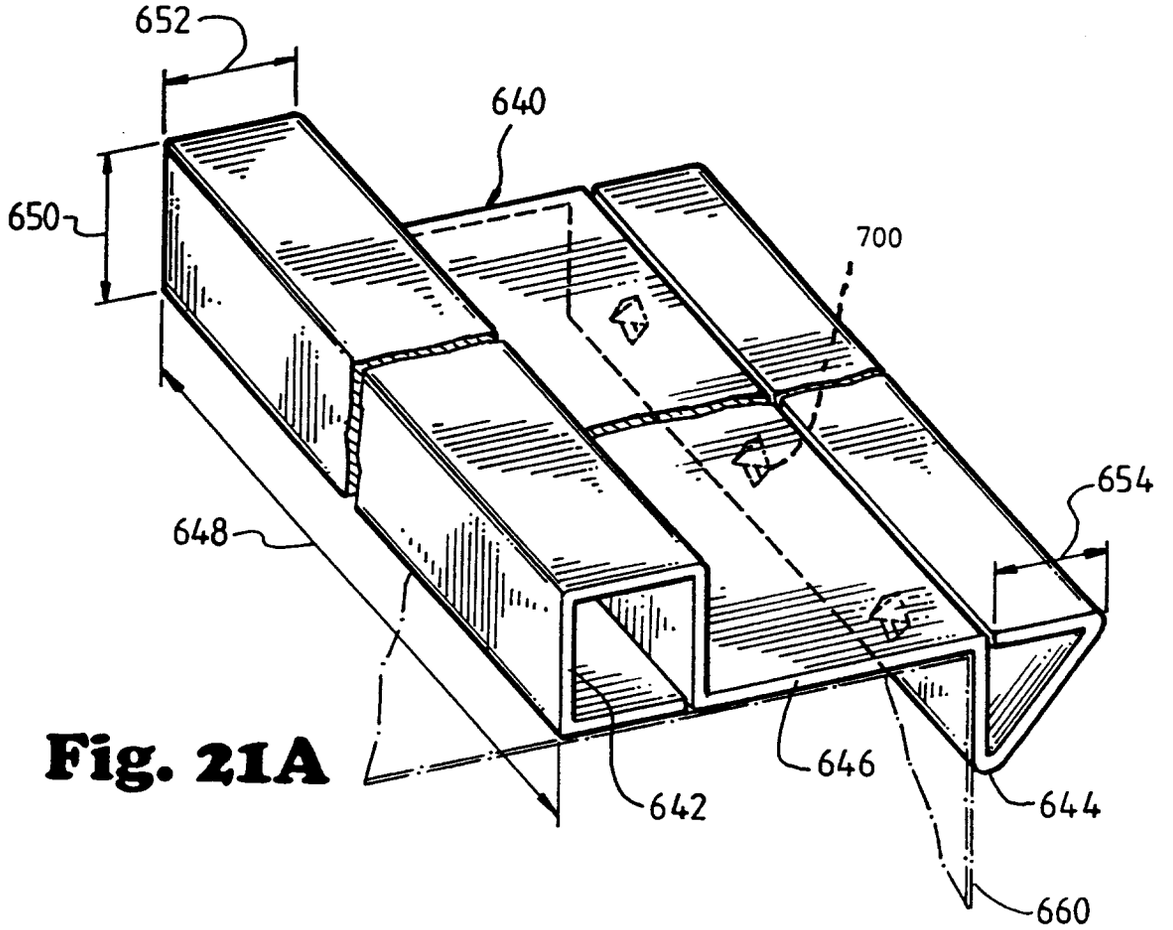

Fig. 21A

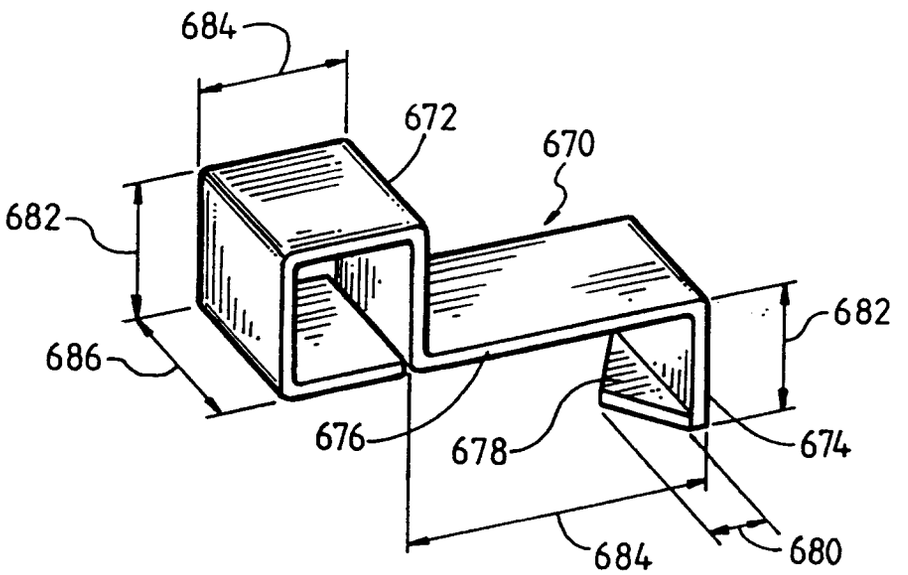

Fig. 21B

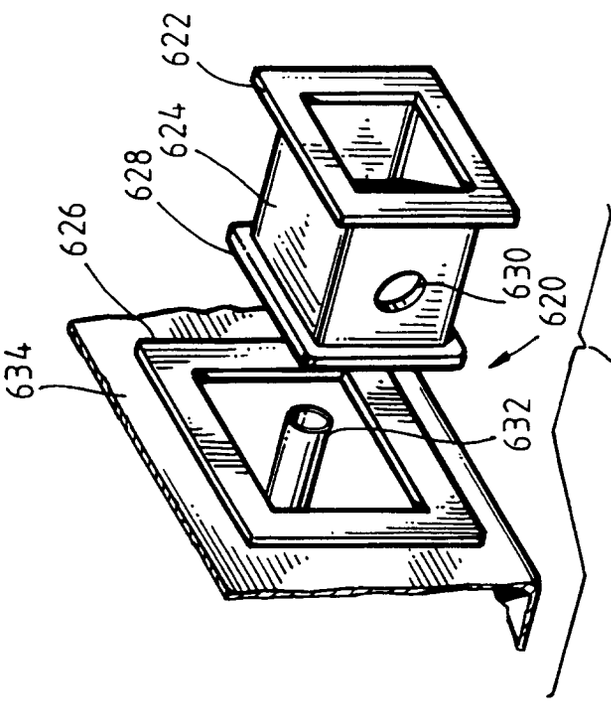

Fig. 20

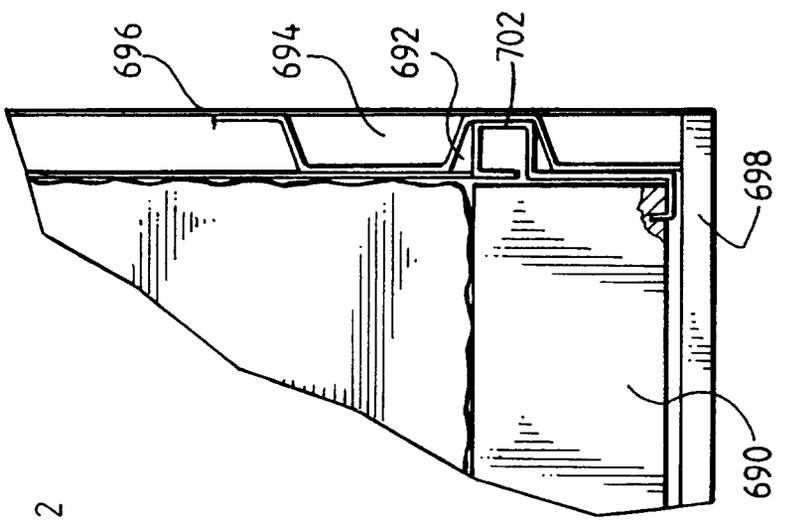

Fig. 22B

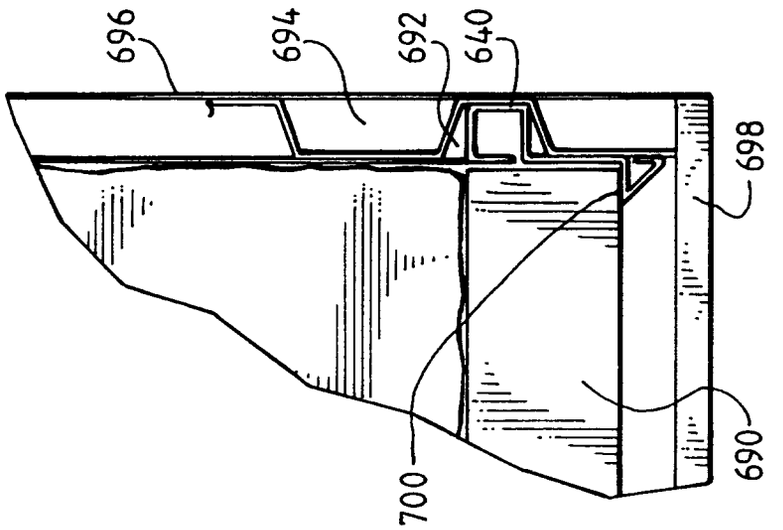

Fig. 22A

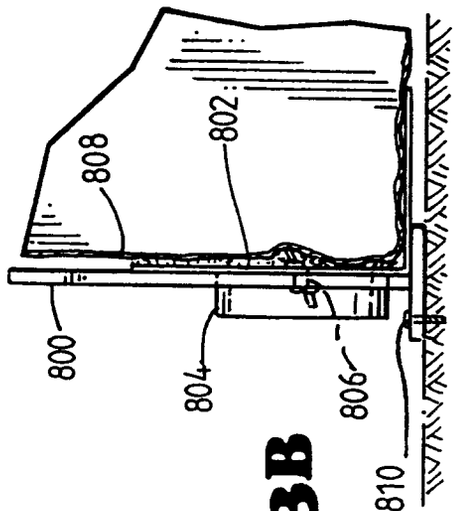

Fig. 23B

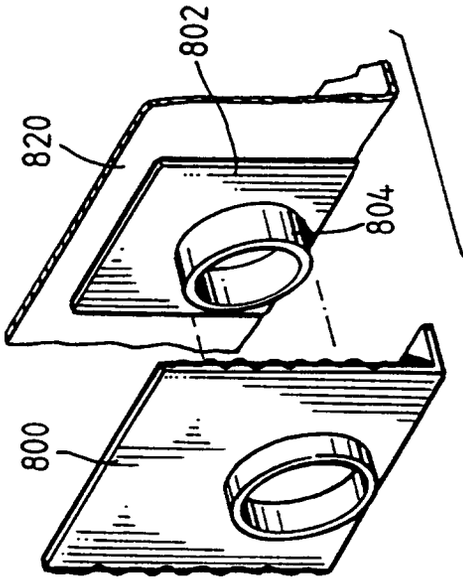

Fig. 24

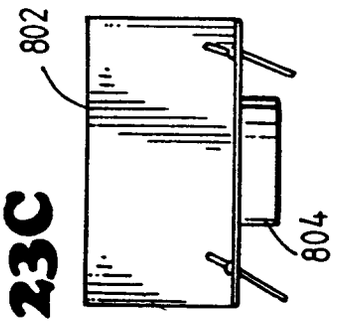

Fig. 23C

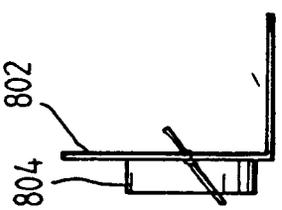

Fig. 23D

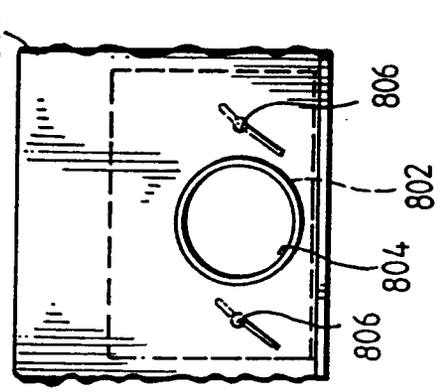

Fig. 23A