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(54) **REINFORCED BULK CONTAINER LINER**

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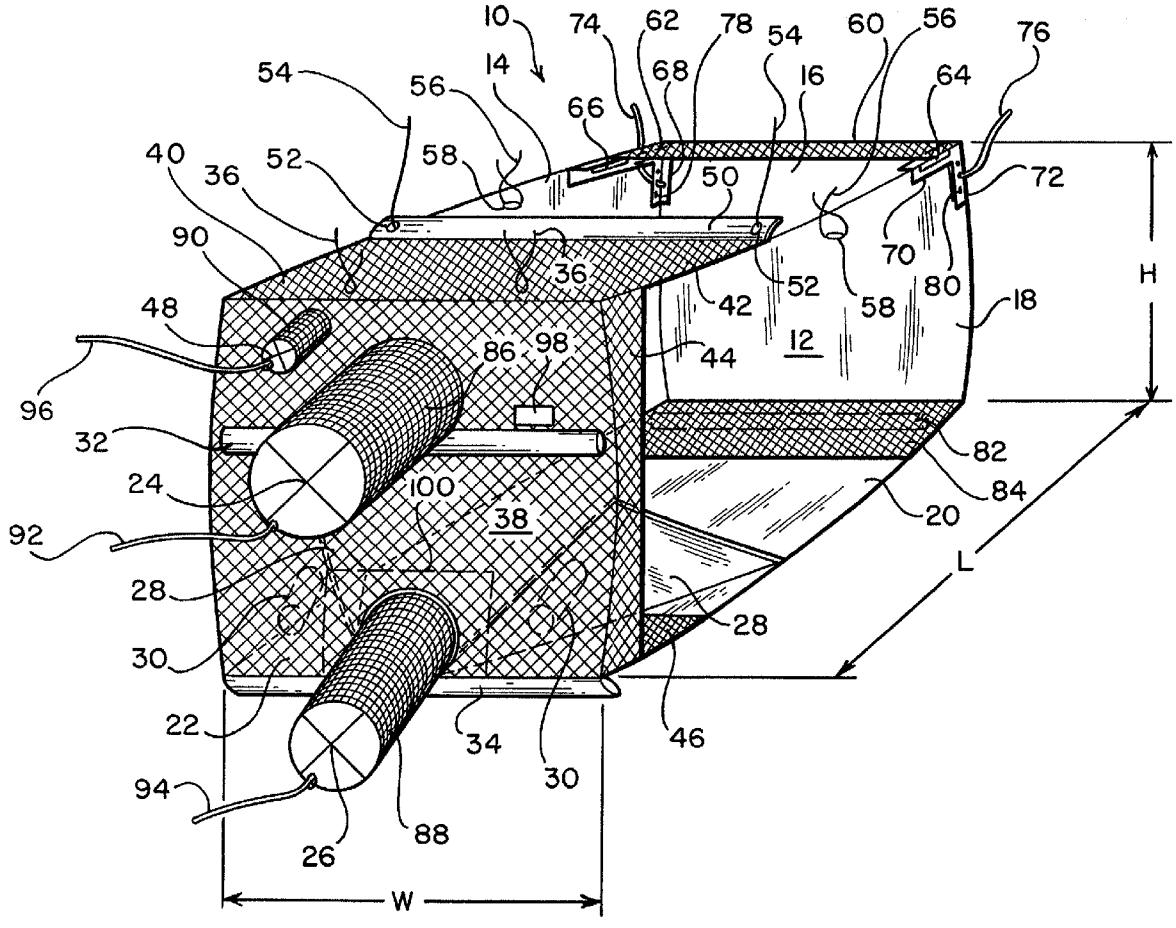
(57) **ABSTRACT**

A bulk container liner for use in conjunction with bulk material cargo containers comprises a woven reinforcement sheet integrally secured upon a rear wall surface of the bulk container liner for effectively forming a bulkhead structure therewith in order to provide the rear portion of the bulk container liner with enhanced strength and load resistance within the rear door region of the bulk material cargo container. Support ropes, straps, or cables are also operatively connected to upper regions of the bulk container liner so as to facilitate the erection and support of the bulk container liner within the bulk material cargo container, particularly during cargo unloading operations which conventionally comprise the tilting of the bulk material cargo container around the lower rear edge portion thereof. The unloading or discharge port of the bulk container liner also has operative associated therewith structure which variably constricts or expands the diametrical extent thereof so as to permit the unloading or discharge port of the bulk container liner to be universally useable with different bulk material receiver mechanisms.



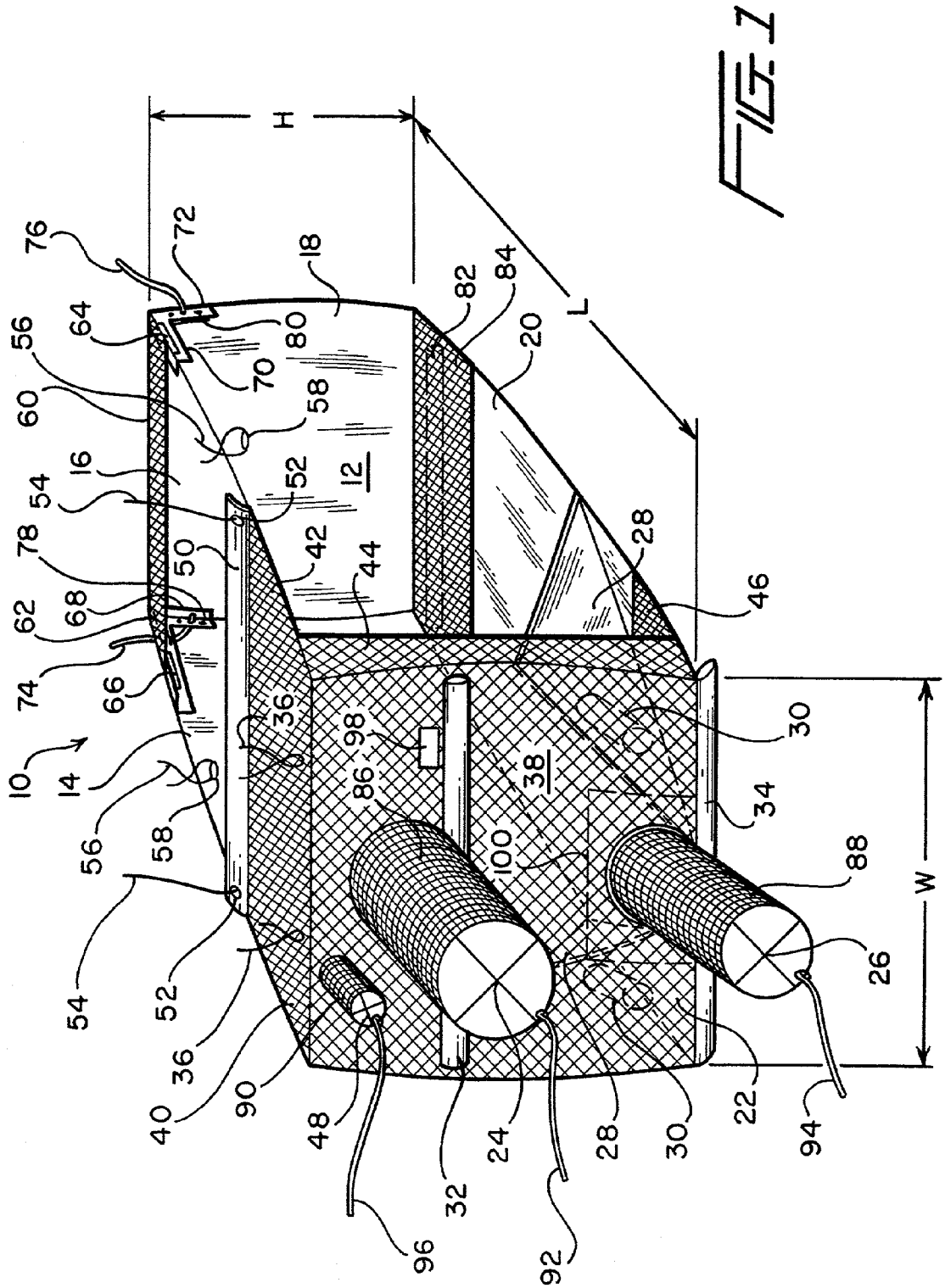

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FIG. 1

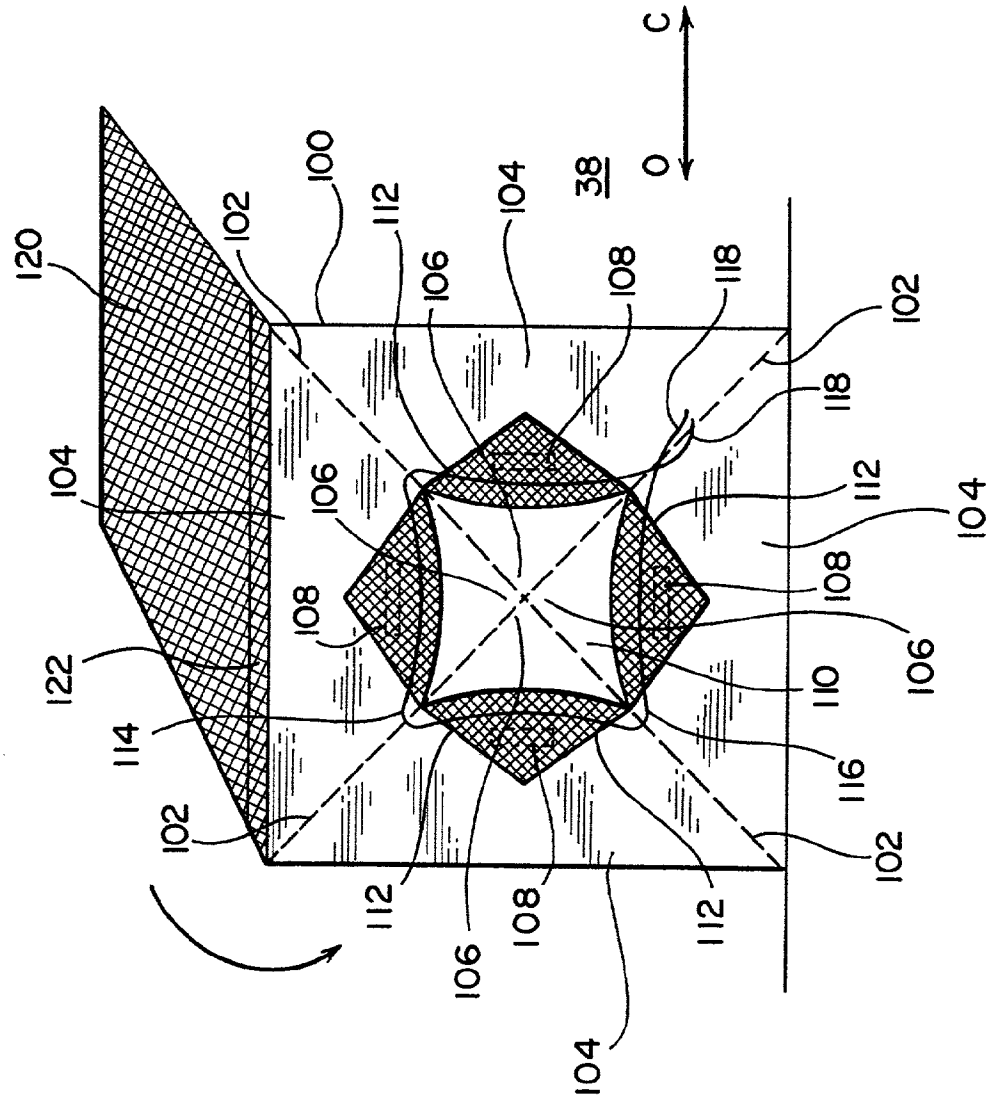

FIG. 2

REINFORCED BULK CONTAINER LINER

FIELD OF THE INVENTION

[0001] The present invention relates generally to bulk containers within which fluid-like or flowable cargo materials, such as, for example, dry bulk chemicals, powdered and pelletized resins, flour, coffee beans, grain, and the like, are to be housed or contained while being shipped or transported, and more particularly to a new and improved reininforced bulk container liner, for use in conjunction with such bulk containers, wherein the new and improved reinforced bulk container liner exhibits substantially improved or enhanced strength characteristics as well as structural support features which enable the bulk container liner to be fully expanded so as to facilitate the filling of the bulk container liner, and therefore the bulk container, with a maximum amount of cargo material.

BACKGROUND OF THE INVENTION

[0002] Bulk containers are conventionally used, at different times, to house or contain different fluid-like or flowable cargo materials, such as, for example, dry bulk chemicals, powdered and pelletized resins, flour, coffee beans, grains, rice, sugar, and the like, while the cargo materials are being shipped or transported from one location to another by means of, for example, ship, truck, railroad, and the like. Since different materials are going to be shipped or transported within the containers at different times, it is imperative that the containers effectively be clean so as not to contaminate the materials comprising a particular cargo load with residual materials which may remain within the container from a previously shipped or transported cargo load.

[0003] Accordingly, in order to eliminate the necessary cleaning of each cargo container hold after a particular cargo material load has been unloaded or discharged from a particular one of the cargo container holds, it has become conventional within the industry to employ removable bulk container liners within the cargo holds of the bulk containers wherein, after a particular cargo load is delivered to its destination and discharged or unloaded, the liner is simply removed from the bulk container whereby the bulk container is again useable, without a significant amount of cleaning, for carrying another cargo load of fluid or flowable material. Examples of bulk container liners as used within bulk containers for shipping or transporting fluid or flowable materials may be found within U.S. Pat. No. 5,489,037 which issued on Feb. 6, 1996 to Stopper, U.S. Pat. No. 5,193,710 which issued on Mar. 16, 1993 to Podd, Sr. et al., and U.S. Pat. No. 4,884,722 which issued on Dec. 5, 1989 to Podd.

[0004] While the noted removable liners have obviously performed satisfactorily from an overall point of view in connection with the achievement of their primary objectives as noted hereinbefore, such removable bulk container liner have exhibited several operational difficulties. For example, due to the various forces or loads which are normally impressed upon the liners during, for example, both the cargo material loading operation as well as the actual transportation or shipping period, PRIOR ART liners have been subjected to tearing or rupture. In addition, liners usually require the use of a structural bulkhead between the rear end portion of the liner and the rear end wall of the bulk container which is conventionally formed by means of a pair of pivotal doors such that the internal loads are not transferred to the rear doors.

[0005] While removable bulkheads have been employed within conventional or PRIOR ART bulk containers, such bulkheads have not been deemed satisfactory in view of the fact that such bulkheads often comprise heavy, wall-like structures which require substantial support in order to withstand the loads inherent within the system. In addition, such bulkheads add a significant amount of weight to the cargo load and do not enable the viewing of the interior of the liner and bulk container whereby, for example, monitoring of the inflation of the bulk container liner and the charging of the bulk materials into the bulk container liner is not able to be readily achieved. Still further, while the liners may be effectively erected within the bulk containers through means of known inflation techniques, such inflation techniques per se, that is, by themselves, have not proven to be sufficient for achieving the complete inflation or expansion of the liners so as to permit the maximum amount of the fluid or flowable materials to in fact be loaded, deposited, and accommodated within the liners and the bulk containers. Lastly, the conventional or PRIOR ART bulk containers, and the bulk container liners incorporated therein, are often required to discharge their cargo loads at their destination points into receiver mechanisms which may vary in size, however, such conventional or PRIOR ART bulk containers, and the bulk container liners incorporated therein, are not readily adaptable for use in connection with different sized receiver mechanisms.

[0006] A need therefore exists in the art for a new and improved bulk container liner which will be capable of providing enhanced tear or rupture resistance, particularly under inflation and cargo load forces, which will be capable of facilitating the inflation, expansion, and erection of the bulk container liner within the bulk container so as to in turn facilitate the filling of the bulk container liner, with a predetermined cargo load or bulk material, to its maximum extent, which will be capable of effectively providing a substantially rigid or semi-rigid bulkhead structure which is integrally incorporated within the existing bulk container liner structure so as to effectively prevent extensive bulging of the bulk container liner and the impression of the inflation and cargo load forces upon the rear doors of the bulk container, and which is capable of being diametrically adjustable so as to be capable of being used in conjunction with different cargo load receiver mechanisms having different diametrical extents or dimensions whereby the cargo loads from the particular bulk container can nevertheless be expeditiously unloaded or discharged.

OBJECTS OF THE INVENTION

[0007] Accordingly, it is an object of the present invention to provide a new and improved bulk container liner for use within bulk containers to be filled with bulk material cargo loads.

[0008] Another object of the present invention is to provide a new and improved bulk container liner, for use within bulk containers to be filled with bulk material cargo loads, which effectively overcomes the various structural and operational drawbacks and disadvantages characteristic of PRIOR ART bulk container liners.

[0009] An additional object of the present invention is to provide a new and improved bulk container liner for use within bulk containers to be filled with bulk material cargo loads wherein the new and improved bulk container liner has structural adjuncts operatively connected thereto so as to facilitate and ensure the properly desired inflation, expansion, and erection of the bulk container liner within the bulk container so as to in turn facilitate and ensure the proper and desired filling of the bulk container liner, with a predetermined bulk material cargo load, to its maximum extent.

[0010] A further object of the present invention is to provide a new and improved bulk container liner for use within bulk containers to be filled with bulk material cargo loads wherein the new and improved bulk container liner is structurally reinforced by means of a substantially rigid or semi-rigid bulkhead structure which is suitably attached to or incorporated within the rear surface portion of the bulk container liner so as to exhibit enhanced strength and tear or rupture resistance, particularly in connection with, but not limited to, the vicinity of, the loading, discharging, and venting ports, and in addition, which effectively prevents the cargo load and inflation forces from being unduly transmitted to or impressed upon the rear doors of the bulk container whereby such integrally incorporated bulkhead structure thereby exhibits the positive attributes of removable bulkheads without the aforenoted negative characteristics of such removable bulheads.

[0011] A last object of the present invention is to provide a new and improved bulk container liner for use within bulk containers to be filled with bulk material cargo loads wherein the new and improved bulk container liner is provided with diametrically adjustable discharge port structure which effectively enables the bulk container liner of the present invention to be used in connection with the unloading or discharge of cargo loads into, or in connection with, receiver structures or mechanisms which may have different diametrical extents or dimensions whereby the cargo loads can in fact be expeditiously unloaded or discharged from the bulk container within which the new and improved bulk container liner of the present invention is being employed.

SUMMARY OF THE INVENTION

[0012] The foregoing and other objectives are achieved in accordance with the teachings and principles of the present invention through the provision of a new and improved bulk container liner which, in accordance with a first major or primary unique and novel feature thereof, comprises a reinforcing semi-rigid bulkhead, formed from woven polypropylene or woven polyethylene, which is secured to the rear surface of the bulk container liner so as to effectively reinforce the rear surface of the bulk container liner against tearing and rupture thereof, and more particularly, to effectively withstand the interior inflation and cargo load forces so as to thereby, in turn, effectively prevent the over-expansion or bulging of the bulk container liner whereby such inflation and cargo load forces would otherwise be transmitted to the rear doors of the bulk container. In addition to the provision or integral incorporation of the reinforcing bulkhead structure upon or within the rear surface portion of the bulk container liner, the discharge port of the bulk container liner has structure integrally incorporated therein which permits the discharge port to be varied in its diametrical extent. In this manner, the diametrical extent of the discharge port can effectively be predeterminedly varied in order to permit the discharge port to be used in conjunction with different receiver structures or mechanisms, which may have different diametrical extents or dimensions, where by the bulk material cargo load can be discharged or unloaded without inordinate forces or pressures being placed upon the discharge port and the bulk container liner during a particular bulk material unloading or discharging operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Various other objects, features, and attendant advantages of the present invention will be more fully appreciated from the following detailed description when considered in connection with the accompanying drawings in which like reference characters designate like or corresponding parts throughout the several views, and wherein:

[0014] **FIG. 1** is a perspective view of a new and improved bulk container liner which is constructed in accordance with the teachings and principles of the present invention and which shows the cooperative parts thereof such that the new and improved bulk container liner of the present invention can be effectively utilized within bulk containers for holding and transporting bulk materials; and

[0015] **15FIG. 2** is a perspective view of a new and improved discharge port which is integrally incorporated in conjunction with the new and improved bulk container liner illustrated within **FIG. 1** and which is also constructed in accordance with the principles and teachings of the present invention so as to have an adjustable or variable diametrical extent or dimension whereby the variably or adjustably sized discharge port can be readily and easily utilized in a substantially universal manner in conjunction with different bulk material receivers characterized by different diametrical extents or dimensions so as to readily and easily facilitate the unloading or discharge of the bulk materials from the bulk container regardless of the diametrical size of the bulk material receiver.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] Referring now to the drawings, and more particularly to **FIG. 1** thereof, a new and improved bulk container liner, which is constructed in accordance with the teachings and principles of the present invention and which shows the cooperative parts thereof such that the new and improved bulk container liner of the present invention can be effectively utilized within bulk containers for holding and transporting bulk materials, is illustrated and is generally indicated by the reference character **10**. As can be readily appreciated, the new and improved bulk container liner **10** of the present invention is fabricated from a suitable material, such as, for example, extruded polyethylene, and has a geometrical configuration which substantially comprises that of a rectangular parallelepiped. Accordingly, the bulk con tamer liner **10** is seen to include, as viewed in **FIG. 1, a** front or forward surface **12**, a left side surface **14**, an upper or top surface **16**, a right side surface **18**, a lower or bottom surface **20**, and a back or rear surface **22**. More particularly, the bulk container liner **10** has a width dimension W of ninety-two inches (92") or approximately eight feet (8.00'), a length dimension L of two hundred thirty-two t inches or

approximately nineteen and one-third feet (19.33'), and a height dimension H of ninety-four inches (94") or approximately eight feet (8.00'). In order to load the bulk container liner **10** with bulk material, the bulk container liner **10** is provided with a loading port or sleeve member **24** which is located upon or along a longitudinally extending central plane of the bulk container liner **10**, and in order to unload the bulk material from the bulk container liner **10**, the bulk container liner **10** is provided with a discharge port or sleeve member **26** which is likewise located upon or along the longitudinally extending central plane of the bulk container liner **10** at an elevational level which is beneath that of the loading port or sleeve member **24**. As is conventional in the art, and as has been previously disclosed, for example, within the aforenoted U.S. Pat. No. 5,489,037 which issued to Stopper on Feb. 6, 1996, the lower rear corner regions of the bulk container liner **10** are provided with corner bag structures **28** for facilitating or expediting the discharge of the bulk materials from such lower rear corner regions of the bulk container liner **10** when the bulk material contained within the bulk container liner **10** is to be unloaded from the bulk container line **10**. Each one of the corner bag structures **28** comprises an inflatable and deflatable structure and is therefore accordingly provided with a tube member **30** by means of which the corner bag structures **28** may be respectively inflated and deflated when such tube members **30** are fluidically connected to suitable inflation and deflation equipment, not shown. When the corner bag structures **28** are inflated, it is noted further that each one of the corner bag structures **28** will have a substantially pyramidal geometrical configuration such that interior, inclined surface portions of such inflated corner bag structures **28** will cause the bulk material contained within the bulk container liner **10** to effectively move toward the discharge port **26**.

[**0017**] In order to ensure that the bulk container **10** is fully, completely, and properly inflated and erected by a suitable means, which is not shown but which is disclosed within the aforenoted U.S. Pat. No. 5,489,037 which issued to Stopper on Feb. 6, 1996, and in order to further ensure that the bulk container liner **10** is maintained in such inflated or erected condition or state in preparation for and during a bulk material cargo load loading operation, during the housing and transportation of the bulk material cargo load which has been loaded into the bulk container liner **10**, and particularly during a bulk material cargo load discharging or unloading operation, the bulk container liner **10** of the present invention has been provided with additional novel and unique structural components. More particularly, it is noted that a first tubular sleeve member **32**, which may be fabricated from a suitable fabric or other material, is fixedly secured to the rear surface portion **22** of the bulk container liner **10** by suitable means, such as, for example, by being stitched or sewn thereto. The first tubular member **32** extends transversely with respect to the longitudinal extent of the bulk container liner **10** and is disposed at an elevational level which is immediately below that of the loading port or sleeve member **24**. The tubular sleeve member **32** is adapted to have a steel bar or beam member, which is not shown but which comprises a structural member or component of the bulk container, inserted therethrough.

[**0018**] In addition, a second tubular sleeve member **34** is fixedly secured within the vicinity of the lower rear edge or corner region of the bulk container liner **10** as defined at the intersection of the rear surface portion **22** of the bulk container liner **10** and the lower or bottom surface portion **20** of the bulk container liner **10**. Nailing straps, not shown, are adapted to be passed through the second tubular sleeve member **34** and fixedly secured to the floor section of the bulk container so as to in turn fixedly secure the lower rear portion of the bulk container liner **10** to the floor section of the bulk container.

[**0019**] Still further, in order to similarly secure or fixedly support the upper portion of the rear surface **22** of the bulk container liner **101** which extends upwardly from the elevational level at which the first tubular sleeve member **32** and the steel bar or beam member are disposed, so as to thereby facilitate the proper and full erection of the bulk container liner **10**, as well as to properly dispose and support such upper portion of the rear surface **22** of the bulk container liner **10** during a bulk material discharge or unloading procedure, and still further in order to properly dispose and support the bulk material loading port or sleeve member **24** in conjunction with a bulk material loading operation, a pair of ropes, straps, cables, or the like **36** are fixedly secured at first ends thereof to the bulk container liner **10** within the vicinity of the upper rear edge or corner region defined at the intersection of the rear surface portion **22** of the bulk container liner **10** and the upper or top surface portion **16** of the bulk container liner **10**. In this manner, when the other or second opposite ends of the support ropes, straps, or cables **36** are fixed to appropriate structure of the bulk container, the upper portion of the rear surface **22** of the bulk container liner **10** which extends upwardly from the elevational level at which the first tubular sleeve member **32** and the steel bar or beam member are disposed, can be effectively stretched tight or taut.

[**0020**] In accordance with another unique structural feature characteristic of the new and improved bulk container liner **10** constructed in accordance with the principles and teachings of the present invention, the entire rear surface portion **22** of the bulk container liner **10** is reinforced by means of a sheet of woven polypropylene, or woven polyethylene, **38** which is secured or affixed to the rear surface portion **22** of the bulk container liner **10** by suitable means, such as, for example, two-sided adhesive tape or the like which is disposed upon interior surface portions of the woven reinforcement sheet **38** which correspond to the peripheral edge portions of the rear surface portion **22** of the bulk container liner **10**. The woven reinforcement sheet **38** therefore effectively structurally cooperates with the underlying rear surface portion **22** of the bulk container liner **10** so as to effectively define a substantially semi-rigid bulkhead structure for the rear surface portion **22** of the bulk container liner **10**.

[**0021**] Consequently, as can readily be appreciated from **FIG. 1**, when the steel bar or beam member, not shown, is inserted through the first tubular sleeve member **32** and fixed in position within the bulk container, when the nailing strips are inserted through the second tubular sleeve member **34** and are likewise fixed to the floor section of the bulk container, and when the second ends of the ropes or straps **36** are fixed to the bulk container, the bulkhead structure **38**, comprising the reinforced rear wall surface portion **22**, is effectively secured or fixed within the bulk container. Accordingly, such bulkhead structure **38** effectively presents or defines a reinforced, rigidified wall structure for the bulk container liner **10** which not only advantageously serves or

promotes several functional objectives with respect to or for the bulk container liner **10** per se, but in addition, serves or promotes additional functional objectives with respect to or in conjunction with the rear door members of the bulk container, not shown.

[**0022**] More particularly, such reinforced, rigidified rear wall surface structure **38** serves to, in part, properly j maintain the rear surface portion **22** of the bulk container liner **10** in its inflated and erected state or condition, the reinforced, rigidified rear wall surface structure **38** also enables or facilitates the proper disposition of the bulk material loading port or sleeve member **24** in connection with a bulk material cargo loading operation or procedure, and the reinforced, rigidified rear wall surface structure **38** also enables or facilitates the proper disposition of the bulk material unloading or discharge port or sleeve member **26** in connection with a bulk material cargo unloading operation or procedure. In addition, and just as or even more importantly, the rigidified rear wall surface structure **38** serves to reinforce the rear end portion of the bulk container liner **10**, and in conjunction therewith, to uniformly withstand and distribute the cargo load forces and stresses, whereby such load forces and stresses are not conveyed to or impressed upon the rear doors of the bulk container, not shown. Still further, the rigidified rear wall surface structure **38** serves to reinforce the rear end portion of the bulk container liner **10**, and in conjunction therewith, to uniformly withstand and distribute the cargo load forces and stresses, particularly those attendant a bulk material cargo unloading or discharge operation or procedure which conventionally comprises the tilting of the cargo bulk container around the lower rear edge portion of the bulk container. As can be appreciated from **FIG. 1**, the woven reinforcement sheet **38** is applied over the entire expanse of the rear surface or wall section **22** and the first tubular sleeve member **32** is affixed upon the exterior surface of the reinforced bulkhead structure **38** such that load forces and stresses are properly distributed and accommodated.

[**0023**] It is to be further appreciated that when the woven reinforcement sheet **38** is applied or adhered to the rear surface **22** of the bulk container liner **10**, it necessarily extends beyond the peripheral edge regions of the rear surface **22** of the bulk container liner **10**. There are several reasons for incorporating such structure into the the new and improved bulk container liner **10** of the present invention in this particular integrated manner. Firstly, it is to be appreciated that all of the wall sections of the bulk container liner **10**, other than the rear surface wall section **22**, that is, the front or forward surface or wall section **12**, the left side surface or wall section **14**, the upper or top surface or wall section **16**, the right side surface or wall section **18**, and the lower or bottom surface or wall section **20**, are effectively continuously supported by the respective wall sections of the bulk container when the bulk container liner **10** is installed within the bulk container, inflated to its erected state, and loaded with the bulk material cargo. The rear surface wall section **22** of the bulk container liner **10**, however, is not similarly supported by a corresponding wall section of the bulk container because the rear wall section of the bulk container is provided with the openable and closable rear access doors. Consequently, the rear surface or wall section **22** of the bulk container liner **10** must effectively independently self-support, or self-resist, the various load forces and stresses impressed thereon. This state or condition is also true of the sealed regions defined between each one of the peripheral edges of the rear surface or wall section **22** and the corresponding rear edge regions of the left side surface or wall section **14**, the upper or top surface or wall section **16**, the right side surface or wall section **18**, and the lower or bottom surface or wall section **20**.

[**0024**] Accordingly, not only does the woven sheet **38** provide reinforcement to the rear surface or wall portion **22** of the bulk container liner **10**, but in addition, and secondarily, the extension of the woven reinforcement sheet **38** onto the left side surface or wall section **14**, the upper or top surface or wall section **16**, the right side surface or wall section **18**, and the lower or bottom surface or wall section **20**, effectively forms reinforcement regions **40**,**42**,**44**,**46** upon the left side surface or wall section **14**, the upper or top surface or wall section **16**, the right side surface or wall section **18**, and the lower or bottom surface or wall section **20**, respectively, so as to integrally reinforce the aforenoted sealed peripheral edge regions defined between each one of the peripheral edges of the rear surface or wall section **22** and the corresponding rear edge regions of the left side surface or wall section **14**, the upper or top surface or wall section **16**, the right side surface or wall section **18**, and the lower or bottom surface or wall section **20**. Thirdly, it is also noted that the woven reinforcement region **42** secured or attached to the rear portion of the upper surface or wall section **16** of the bulk container liner **10** has an axial extent or length which is somewhat greater than those of the other woven reinforcement regions **40**,**44**,**46**, and the reason for this is that when, for example, the bulk container liner **10** is being loaded or charged with powder-type bulk material cargo through means of the loading port or sleeve **41** member **24**, dust collector equipment, not shown, is fluidically connected to vent port structure **48** which is also formed or integrally incorporated within the rear surface or wall section **22** of the bulk container liner **10**. A closed-loop or recirculation flow path is thus effectively operatively or fluidically created in conjunction with the interior of the bulk container liner **10**, particularly within the upper rear region thereof, thereby requiring additional or extended reinforcement in order to withstand or accommodate the additional load forces, pressure, and stresses attendant the powder bulk material loading and dust collection procedures.

[**0025**] In conjunction with the free end portion of the upper surface woven reinforcement region **42**, there is provided a transversely oriented support strip **50** which is fixedly attached thereto by any suitable means, such as, for example, by sewing or stitching, and opposite ends of the support strip **50** are provided with grommets **52** through which first end portions of suitable support ropes, straps, or cables **54** are passed, the opposite or second end portions thereof being connected to suitable structure comprising the bulk container. It is to be noted that while the upper surface woven reinforcement region **42** appears from the illustrated drawing to extend axially forwardly so as to have an axial extent of approximately one-half the axial extent or length of the bulk container liner **10**, the illustrated drawing is not in fact to scale and in reality the axial extent of the upper surface woven reinforcement region **42** comprises only a small fractional portion of the overall axial extent or length of the bulk container liner **10**. Accordingly, it is to be appreciated and understood further that the support ropes, cables, or straps **54** operatively cooperate with the support

ropes, straps, or cables **36** for fixing and supporting the entire rear region or portion of the bulk container liner **10** within the bulk container.

[**0026**] In a similar manner, it is likewise noted further that in order to facilitate the proper inflation, erection, and support of the bulk container liner **10** in its inflated and erected state, particularly in connection with the axially central upper region of the bulk container liner **10**, first ends of additional support ropes, straps, or cables **56** are fixedly attached to upper, axially central portions of each one of the left and right side surfaces **14,18** of the bulk container line **10** by means of suitable fixtures **58**, and the second opposite ends of the support ropes, straps, or cables **56** are adapted to be fixedly connected to the bulk container. Still yet further, in order to facilitate the proper inflation, erection, and support of the bulk container liner **10** in its inflated and erected state, particularly in connection with the upper forwardmost region of the bulk container liner **10**, similar support rope, cable, or strap means are likewise utilized. The reason for this is that it is to be remembered that the bulk container liner **10** is inflated as a result of a suitable source of pressurized or compressed air, not shown, being fluidically connected to the interior portion of the bulk container liner **10** through means of, for example, the loading port or sleeve structure **24** provided within or upon the rear surface portion **22** of the bulk container liner **10**. It can therefore be appreciated that the forwardmost region of the bulk container liner **10** is located furthest from the rear wall surface **22** of the bulk container liner **10** and, in turn, furthest from the source of pressurized or compressed air fluidically connected to the loading port or sleeve structure **24**. The lower forwardmost region of the bulk container liner **10** normally does not present any problems with inflation and erection because gravitational and bulk material loads will serve to erect and expand the lower forwardmost region of the bulk container liner **10** into contact with the forward interior wall structures of the bulk container. However, such gravitational and bulk material loads are obviously unable to similarly erect and expand the upper forwardmost region of the bulk container liner **10**.

[**0027**] Accordingly, it sometimes conventionally occurs that such upper forwardmost region of the bulk container liner is not in fact fully inflated, erected, and expanded into contact engagement with the interior wall portions of the bulk container whereby such region of the bulk container liner is not adequately supported by the interior wall portions of the bulk container. As a result of such a state or condition, internal pressure forces present within the bulk container liner can lead to tearing and rupture problems with a consequent compromise in the integrity of the seal located at the intersection defined between the upper edge portion of the front or forward surface portion **12** of the bulk container liner **10** and the rear edge portion of the upper or top surface portion **16** of the bulk container liner **10**, as well as with respect to the seals located at the rear corner regions of the bulk container line **10** as defined between the upper horizontally disposed rear edge portion of each one of the left and right side surface portions **14,18** of the bulk container liner **10** and opposite axially oriented rear side edge portions of the upper or top surface portion **16** of the bulk container liner **10**, and as defined between the upper vertically oriented rear edge portion of each one of the left and right side surface portions **14,18** of the bulk container liner **10** and opposite vertically oriented side edge portions of the front or forward surface portion **12** of the bulk container liner **10**.

[**0028**] In accordance with the principles and teachings of the present invention, the upper front region of the bulk container liner **10** is reinforced with woven reinforcement material which is similar to the woven reinforcement sheet **38** secured or adhered to the rear surface portion **22** of the bulk container liner. More particularly, a first woven reinforcement strip **60** is secured at the intersection defined between the upper edge portion of the front or forward surface portion **12** of the bulk container liner **10** and the rear edge portion of the upper or top surface portion **16** of the bulk container liner **10** such that the woven reinforcement strip **60** encompasses or overlaps such upper edge or corner region of the bulk container liner **10** and extends onto and is secured upon both the front or forward surface portion **12** of the bulk container liner **10** and the rear edge portion of the upper or top surface portion **16** of the bulk container liner **10**. In this manner, the seal region defined between the front or forward surface portion **12** of the bulk container liner **10** and the upper or top surface portion **16** of the bulk container liner **10** is fully reinforced. In addition, second and third woven reinforcement strips **62** and **64**, which may actually be integral extensions of the first woven reinforcement strip **60**, are similarly provided at the upper rear corner regions of the bulk container liner **10** as defined between each one of the side surface portions **14,18** of the bulk container liner **10** and the upper or top surface portion **16** of the bulk container liner **10**, as well as between each one of the side surface portions **14,18** of the bulk container liner **10** and the front or forward surface portion **12** of the bulk container liner **10**. Each one of the second and third woven reinforcement strips **62,64** has a substantially L-shaped configuration wherein second woven reinforcement strip **62** comprises a horizontally disposed leg member **66** and a vertically disposed leg member **68**, while third woven reinforcement strip **64** comprises a horizontally disposed leg member **70** and a vertically disposed leg member **72**.

[**0029**] It can therefore be appreciated that horizontally disposed leg member **66** of second woven reinforcement strip **62** encompasses or overlaps the upper rear edge or corner region of the bulk container liner **10**, as defined between the left side surface portion **14** of the bulk container **10** and the upper or top surface portion **16** of the bulk container **10**, and extends onto and is secured upon both the left side surface portion **14** of the bulk container **10** and the upper or top surface portion **16** of the bulk container **10** so as to reinforce the sealed upper rear edge or corner region defined therebetween. In a similar manner, horizontally disposed leg member **70** of third woven reinforcement strip **64** encompasses or overlaps the upper rear edge or corner region of the bulk container liner **10**, as defined between the right side surface portion **18** of the bulk container **10** and the upper or top surface portion **16** of the bulk container **10**, and extends onto and is secured upon both the right side surface portion **18** of the bulk container **10** and the upper or top surface portion **16** of the bulk container **10** so as to reinforce the sealed upper rear edge or corner region defined therebetween.

[**0030**] In a like manner, it is appreciated that vertically disposed leg member **68** of second woven reinforcement strip **62** encompasses or overlaps the upper rear edge or corner region of the bulk container liner **10**, as defined

between the left side surface portion **14** of the bulk container **10** and the front or forward surface portion **12** of the bulk container **10**, and extends onto and is secured upon both the left side surface portion **14** of the bulk container **10** and the front or forward surface portion **12** of the bulk container **10** so as to reinforce the sealed upper rear edge or corner region defined therebetween. Still further, vertically disposed leg member **72** of third woven reinforcement strip **64** encompasses or overlaps the upper rear edge or corner region of the bulk container liner **10**, as defined between the right side surface portion **18** of the bulk container **10** and the front or forward surface portion **12** of the bulk container **10**, and extends onto and is secured upon both the right side surface portion **18** of the bulk container **10** and the front or forward surface portion **12** of the bulk container **10** so as to reinforce the sealed upper rear edge or corner region defined therebetween.

[**0031**] In conjunction with the second and third woven reinforcement strips **62,64**, a pair of support ropes, straps, or cables **74,76** are respectively provided whereupon, when first ends of the ropes, straps, or cables **74,76** are respectively fixedly secured to the reinforcement strips **62**, **64**, and second ends of the support ropes, straps, or cables **74,76** are fixedly secured to suitable structure integrally incorporated upon the bulk container, the upper front or forwardmost regions of the bulk container liner **10** will be adequately supported so as to in fact facilitate the aforenoted inflation, erection, and expansion of the bulk container liner **10** in preparation for a bulk material cargo loading operation. In addition, it is further noted that the support ropes, straps, or cables **74,76** serve the additionally important function of maintaining the upper forwardmost region of the bulk container liner **10** suitably fixed in position during bulk material cargo unloading operations, particularly in view of the aforenoted conventional tilting of the bulk container around the lower rear edge portion thereof. In order to in fact secure the first ends of the support ropes, straps, or cables **74,76** to the woven reinforcement strips **62,64**, it is further seen that each one of the vertically oriented leg members **68,72** of the reinforcement strips **62,64** is respectively provided with a vertically extending serial array of apertures **78,80** within which suitable grommets are adapted to be disposed. Snap-hook fasteners, fixed upon the first end portions of the support ropes, straps, or cables **74,76**, are adapted to be engaged within the apertures **78,80**, the provision of the plurality of apertures **78,80** serving to accommodate different structural connections inherent to or characteristic of different bulk containers.

[**0032**] Further in conjunction with the critically important fixation of the lower forwardmost region of the bulk material container **10**, particularly during the bulk material cargo unloading operation whereby it is again noted that the bulk container is conventionally tilted, tipped, inclined, or pivoted around the lower rear edge portion thereof, it is seen still further that the lower or bottom surface portion **20** of the bulk container liner **10** is provided with a third tubular sleeve member **82**, which is similar in structure to the first tubular sleeve member **32**, fixedly attached thereto within the vicinity of the front or forward surface portion **12** of the bulk container liner **10** by suitable means, such as, for example, sewing or stitching. The third tubular sleeve member **82** is likewise adapted to have a steel bar or beam member, not shown but which is integrally or fixedly connected to or operatively associated with the floor structure of the bulk container, passed therethrough so as to fixedly secure the lower or bottom and front regions of the bulk container liner **10** to the floor structure of the bulk container. In conjunction with such tubular sleeve member **82**, and the steel beam or bar member adapted to be passed therethrough in connection with securing the lower or bottom and front regions of the bulk container liner **10** to the floor structure of the bulk container, the rear region of the lower or bottom surface portion or wall section **20** of the bulk container liner **10** is adapted to be reinforced by means of a woven reinforcement sheet **84** which has its upper or interior surface adhesively bonded or otherwise fixedly secured to the lower or exterior face of the lower or bottom surface or wall section **20** of the bulk container liner **10**. As was the case with the reinforcement sheet **38** secured upon the rear surface or wall section **22** of the bulk container liner **10**, the woven reinforcement sheet **84** is applied over the entire rear region of the lower or bottom surface or wall section **22** of the bulk container liner **10** and the third tubular sleeve member **82** is affixed upon the exterior surface of the woven reinforcement sheet **84** such that load forces and stresses are properly distributed and accommodated.

[**0033**] With reference continuing to be made to **FIG. 1**, it is seen that the loading port or sleeve member **24**, the discharge or unloading port or sleeve member **26**, and the vent port or sleeve member **48** are also respectively provided with woven reinforcement sheets **86,88,90** which are suitably secured or attached to the loading port or sleeve member **24**, the discharge or unloading port or sleeve member **26**, and the vent port or sleeve member **48** so as to respectively circumferentially envelop the loading port or sleeve member **24**, the discharge or unloading port or sleeve member **26**, and the vent port or sleeve member **48**. In this manner, the woven reinforcement sheets **86,88,90** reinforce and support the load mg port or sleeve member **24**, the discharge or unloading port or sleeve member **26**, and the vent port or sleeve member **48** when the loading port or sleeve member **24**,the discharge or unloading port or sleeve member **26**, and vent port or sleeve member **48** are moved to their axially extended positions for respective use in conjunction with a bulk material loading operation, a bulk material unloading operation, and a venting operation. In order to in fact be able to respectively move each one of the loading port or sleeve member **24**, the discharge or unloading port or sleeve member **26**, and the vent port or sleeve member **48** from its axially recessed or collapsed position to its axially extended or expanded position, each one of the loading port or sleeve member **24**, the discharge or unloading port or sleeve member **26**, and the vent port or sleeve member **48** is respectively provided with a rope, strap, or cable **92,94,96** which may be suitably secured to an inner peripheral wall portion of each port or sleeve member **24,26,48**. In order to view or determine the height of or depth to which the bulk material has been loaded into the bulk container liner **10**, a view port **98** extends **3** through or is effectively cut out from the reinforcement sheet **38** and is incorporated within the rear surface portion or wall section **22** of the bulk container liner **10**.

[**0034**] In accordance with a last unique and novel structural feature characteristic of the present invention, and as be best appreciated as a result of additional reference being made to **FIG. 2**, the bulk material unloading or discharge port or sleeve member **26** of the bulk container liner **10** of the present invention has operatively associated therewith

structure or means for adjustably varying the diametrical extent of the bulk material unloading or discharge port or sleeve member **26** such that the bulk material unloading or discharge port or sleeve member **26** is effectively universally useable with different bulk material unloading receiver mechanisms having different diametrical extents. More particularly, then, it is seen from **FIG. 2** that in accordance with the principles and teachings of the present invention, a substantially square-shaped portion **100** of the woven reinforcement sheet **38**, which is disposed within the vicinity of or immediately surrounds the discharge port or sleeve member **26**, is cut or severed along both diagonal loci **102** thereof so as to effectively define four, triangularly shaped flap members **104**. The axially central apex portion **106** of each flap member **104** is folded backwardly upon and is adapted to be fixedly secured to itself, as at **108** by any suitable means, such as, for example, adhesive means, sewing, stitching, and the like, such that an axially open region **110** is defined within the woven reinforcement sheet **38** through which the discharge sleeve or port member **26** of the bulk container liner **10** can be extended.

[**0035**] In addition, as a result of the aforenoted backward folding of the apex portions **106** of the flap members **104**, an open loop region **112** is effectively defined internally within each one of such folded regions of the flap members **104** such that a rope, strap, or cable member **114** can be serially threaded through the plurality of open loop regions **112** so as to define an enveloping or encircling rope, strap, or cable noose **116**. In this manner, when the opposite free ends **118** of the rope, strap, or cable noose **116** are both pulled together in the direction C of the double arrowhead O-C, the diametrical extent of the rope, strap, or cable noose **116** will be constricted so as to effectively tend to correspondingly adjustably or variably close or constrict the diametrical extent of the axially open region **110**, while conversely, when the free ends **118** of the rope, strap, or cable noose **116** are permitted to move in the direction O of the double arrowhead O-C, the diametrical extent of the rope, strap, or cable noose **116** will be expanded so as to effectively tend to correspondingly adjustably or variably open or expand the diametrical extent of the axially open region **110**. In order to ensure that the axially open region **110** is effectively closed during those periods when the bulk material discharge port **26** is axially retracted or collapsed and is not being used in conjunction with the performance of a bulk material discharge or unloading operation, it is seen further that a woven reinforcement flap member **120** is secured along a linear locus **122** to the rear wall surface portion **22** of the bulk container liner **10** by means of, for example, sewing, stitching, or the like.

[**0036**] In particular, the flap member **120** is illustrated within **FIG. 2** as being in a raised position, however, this is simply for clarity in connection with the same. In reality, the flap member **120**, after being secured along the linear locus **122** to the rear wall surface portion **22** of the bulk container liner **10**, is disposed in a vertical oriented hanging mode so as to be interposed between the rear wall surface portion **22** of the bulk container liner **10** and the square-shaped portion or region **100** of the woven reinforcement sheet **38**. Therefore, when the bulk material discharge port **26** is axially retracted or collapsed and is not being used in conjunction with the performance of a bulk material discharge or unloading operation, the flap member **120** effectively covers and closes off the axially open region **110**, however, when the bulk material discharge port **26** is to be axially extended so as to be used in conjunction with the performance of a bulk material discharge or unloading operation, since the flap member **120** is only secured to the rear surface wall portion **22** of the bulk container liner **10** along the linear locus **122** so as to effectively freely hang in a suspension mode between between the rear wall surface portion **22** of the bulk container liner **10** and the square-shaped portion or region **100** of the woven reinforcement sheet **38**, the flap member **120** can be grasped by means of an operator and pulled axially through the axially open region **110** to as to effectively uncover and open the axially open region **110**. Thereafter, the discharge or unloading port or sleeve member **26** can be axially extended through the axially open region **110** so as to be readily accessible for fluidic connection to the bulk material receiver mechanism.

[**0037**] In conjunction with such fluidic connection, the rope, strap, or cable noose **116** can also be diametrically adjusted so as to variably adjust the diametrical extent of the axially open region **110** so as to in turn variably adjust the diametrical extent of the unloading or discharge port of sleeve member **26** to match the diametrical extent of the particular bulk material receiver mechanism being employed in conjunction with the discharge or unloading of the bulk material from the bulk container liner **10**. It is also to be noted that in conjunction with the pull-through of the flap member **120** through the axially central open region **110**, the flap member **120** can be secured to the rear surface wall portion **22** of the bulk container liner **10** by removable stitching whereby the flap member **120** can actually be detached from the rear surface wall portion **22** of the bulk container liner **10** and then removed from the bulk container liner assembly in lieu of remaining attached thereto along the linear locus **122**.

[**0038**] Thus, it may be seen that in accordance with the principles and teachings of the present invention, there has been provided a new and improved bulk container liner assembly or structure wherein a woven reinforcement sheet is structurally secured to the rear wall surface portion of the bulk container liner so as to effectively define a bulkhead structure which provides enhanced strength and reinforcement thereto within such rear surface wall portion thereof which faces and operatively cooperates with the rear door region of the bulk container. In addition, structure is integrally incorporated within the bulk container liner for facilitating the inflation, erection, and support of the bulk container liner in order to in turn facilitate the proper loading and filling of the same with bulk material cargo, as well as for fixedly securing the bulk container liner within the bulk container, particularly during bulk material cargo unloading operations.

[**0039**] Obviously, many variations and modifications of the present invention are possible in light of the above teachings. It is noted, for example, that the elevational level, at which the first tubular sleeve member **32** is affixed upon the exterior surface of the reinforced bulkhead structure **38**, as well as the corresponding elevational level at which the loading port or sleeve member **24** is located, can be varied depending upon the height or depth to which the bulk material cargo is to be loaded into the bulk container liner **10**. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be protected by Letters Patent of the U.S. of America, is:

1. A bulk container liner for use within a bulk material cargo container having rear door structures, comprising:

a bulk container having a substantially rectangular parallelepiped structure when erected for disposition within a bulk material cargo container and therefore comprising a front wall surface, a pair of side wall surfaces, a top wall surface, a bottom wall surface, and a rear wall surface; and

reinforcement structure fixedly secured over substantially the entire expanse of said rear wall surface of said bulk container liner so as to integrally form with said rear wall surface of said bulk container liner a bulkhead structure for reinforcing said rear wall surface of said bulk container liner disposed opposite the rear door structures of the bulk material cargo container.

2. The bulk container liner as set forth in claim 1, wherein:

said reinforcement structure comprises a woven reinforcement sheet bonded to said rear wall surface of said bulk container liner.

3. The bulk container liner as set forth in claim 2, wherein:

said woven reinforcement sheet comprises woven polypropylene.

4. The bulk container liner as set forth in claim 2, wherein:

said woven reinforcement sheet comprises woven polyethylene.

5. The bulk container liner as set forth in claim 2, wherein:

said woven reinforcement sheet extends beyond each one of edge regions defined between said rear wall surface and said pair of side wall surfaces, between said rear wall surface and said top wall surface, and between said rear wall surface and said bottom wall surface so as to reinforce seal regions defined between said rear wall surface and said pair of side wall surfaces, between said rear wall surface and said top wall surface, and between said rear wall surface and said bottom wall surface.

6. The bulk container liner as set forth in claim 2, wherein:

at least one tubular sleeve member fixedly secured upon said bulkhead structure for accommodating a structural member of the bulk container in order to fixedly secure said bulk container liner within the bulk container when the structural member of the bulk container is fixedly disposed within said at least one tubular sleeve member of said bulk container liner.

7. The bulk container liner as set forth in claim 6, wherein said at least one tubular sleeve member of said bulk container comprises:

a first tubular sleeve member fixedly secured upon said bulkhead structure of said bulk container liner at an elevational level which is interposed between an upper edge region defined between said rear wall surface and said top wall surface, and a lower edge region defined between said rear wall surface and said bottom wall surface; and

a second tubular sleeve member fixedly secured upon said bulk head structure within the vicinity of said lower edge region defined between said rear wall surface and said bottom wall surface.

8. The bulk container liner as set forth in claim 7, further comprising:

a third tubular sleeve member fixedly secured upon said lower wall surface of said bulk container liner within the vicinity of a lower edge region defined between said front wall surface and said bottom wall surface.

9. The bulk container liner as set forth in claim 8, further comprising:

a woven reinforcement sheet, bonded to said lower wall surface of said bulk container liner and upon which said third tubular sleeve member is attached, for reinforcing a front region of said bulk container liner and for distributing stress forces impressed upon said bulk container liner during bulk material cargo unloading operations.

10. The bulk container liner as set forth in claim 1, wherein:

said bulk container liner having said substantially rectangular parallelepiped has a predetermined longitudinal extent; and

support structure is fixedly secured to upper regions of said bulk container liner within the vicinity of said rear wall surface of said bulk container liner, within the vicinity of said front wall surface of said bulk container liner, and at longitudinally central regions of said bulk container liner so as to facilitate the erection and support of said bulk container liner within the bulk material cargo container so as to enable filling of said bulk container liner with bulk material cargo.

11. The bulk container liner as set forth in claim 10, wherein:

said support structure fixedly secured to said upper regions of said bulk container is selected from the group comprising ropes, straps, and cables.

12. The bulk container liner as set forth in claim 10, further comprising:

a reinforcement strip fixedly secured to said bulk container liner at the edge portion defined between said front wall surface and said top wall surface of said bulk container liner for sealing said edge portion defined between said front wall surface and said top wall surface of said bulk container liner.

13. The bulk container liner as set forth in claim 12, wherein:

said reinforcement strip comprises integrally connected side extensions for sealing upper rear edge portions of said bulk container liner as defined between each one of said side wall surfaces rear end portions of said top wall surface.

14. The bulk container liner as set forth in claim 13, wherein:

each one of said side extensions of said reinforcement strip is provided with a plurality of arrayed grommets to which said support structure for said front wall surface of said bulk container liner can be adjustably connected depending upon the structure of the particular bulk container within which said bulk container liner is to be disposed.

15. The bulk container liner as set forth in claim 2, further comprising:

a view port defined through said woven reinforcement sheet for viewing the depth to which bulk material cargo has been loaded into said bulk material liner.

16. The bulk container liner as set forth in claim 1, further comprising:

a bulk material tubular loading port operatively connected to said rear wall surface of said bulk container liner;

a bulk material tubular unloading port operatively connected to said rear wall surface of said bulk container liner; and

reinforcement sleeves respectively secured around each one of said bulk material tubular loading and unloading ports in an enveloped manner for respectively reinforcing each one of said bulk material tubular loading and unloading ports.

17. The bulk container liner as set forth in claim 16, wherein:

each one of said bulk material tubular loading and unloading ports is axially collapsible and extensible; and

a manually-operable member is operatively secured to an interior surface portion of said each one of said bulk material tubular loading and unloading ports so as to permit an operator to move said each one of said bulk material tubular loading and unloading ports from its axially collapsed position to its axially extended position.

18. The bulk container liner as set forth in claim 2, further comprising:

an axially collapsible and extensible bulk material tubular unloading port; and

means operatively associated with said bulk material tubular unloading port for adjusting the diametrical extent of said bulk material tubular unloading port such that said bulk material tubular unloading port can be universally useable with different bulk material receiver structures.

19. The bulk container liner as set forth in claim 18, wherein said means for adjusting said diametrical extent of said bulk material tubular unloading port comprises:

loop regions defined within said woven reinforcement sheet and defining an axial open region through which said bulk material tubular unloading port can be disposed when said bulk material tubular unloading port is disposed in its axially extended state whereby said loop regions surround said extended bulk material tubular unloading port;

means disposed within said loop regions for achieving variable diametrical constriction and expansion of said loop regions around said bulk material tubular unloading port.

20. The bulk container liner as set forth in claim 19, wherein:

a region of said woven reinforcement sheet surrounding said bulk material tubular unloading port comprises a plurality of flap members; and

said loop regions comprise portions of said flap members folded back upon and secured to themselves.

21. The bulk container liner as set forth in claim 19, wherein:

said means disposed within said loop regions for constricting and expanding said loop regions comprises a member selected from the group comprising ropes, straps, and cables.

22. The bulk container liner as set forth in claim 19, further comprising:

a reinforcement flap member fixedly attached to said rear wall surface of said bulk container liner and interposed between said rear wall surface of said bulk container liner and said woven reinforcement sheet for closing said axial open region when said bulk material tubular unloading port is disposed in its axially collapsed state.

23. A bulk container liner for use within a bulk material cargo container having rear door structures, comprising:

a bulk container having a substantially rectangular parallelepiped structure when erected for disposition within a bulk material cargo container and therefore comprising a front wall surface, a pair of side wall surfaces, a top wall surface, a bottom wall surface, and a rear wall surface;

an axially collapsible and extensible bulk material tubular unloading port operatively connected to said rear wall surface of said bulk container liner; and

means operatively associated with said bulk material tubular unloading port for adjusting the diametrical extent of said bulk material tubular unloading port such that said bulk material tubular unloading port can be universally useable with different bulk material receiver structures.

24. The bulk container liner as set forth in claim 23, further comprising:

a woven reinforcement sheet bonded to said rear wall surface of said bulk container liner so as to integrally form with said rear wall surface of said bulk container liner a bulkhead structure for reinforcing said rear wall surface of said bulk container liner disposed opposite the rear door structures of the bulk material cargo container.

25. The bulk container liner as set forth in claim 24, wherein said means for adjusting said diametrical extent of said bulk material tubular unloading port comprises:

loop regions defined within said woven reinforcement sheet and defining an axial open region through which said bulk material tubular unloading port can be disposed when said bulk material tubular unloading port is disposed in its axially extended state whereby said loop regions surround said extended bulk material tubular unloading port; and

means disposed within said loop regions for achieving variable diametrical constriction and expansion of said loop regions around said bulk material tubular unloading port.

26. The bulk container liner as set forth in claim 25, wherein:

a region of said woven reinforcement sheet surrounding said bulk material tubular unloading port comprises a plurality of flap members; and

said loop regions comprise portions of said flap members folded back upon and secured to themselves.

27. The bulk container liner as set forth in claim 25, wherein:

said means disposed within said loop regions for constricting and expanding said loop regions comprises a member selected from the group comprising ropes, straps, and cables.

28. The bulk container liner as set forth in claim 25, further comprising:

a reinforcement flap member fixedly attached to said rear wall surface of said bulk container liner and interposed between said rear wall surface of said bulk container liner and said woven reinforcement sheet for closing said axial open region when said bulk material tubular unloading port is disposed in its axially collapsed state.

29. The bulk container liner as set forth in claim 23, further comprising:

a manually-operable member is operatively secured to an interior surface portion of said bulk material tubular unloading port so as to permit an operator to move said bulk material tubular unloading port from its axially collapsed position to its axially extended position.

30. The bulk container liner as set forth in claim 23, wherein:

a reinforcement sleeve is secured around said bulk material tubular unloading port in an enveloped manner for respectively reinforcing said bulk material tubular unloading port.

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