A lined container (10) includes a rigid-walled vessel (12) having a discharge port (12d), a flexible liner (20) having a discharge fitment (26), and an adapter (30) for connecting the discharge fitment to the discharge port of the vessel. The adapter includes a tubular member (32) having a coaxial bore and a set of male, tapered threads (32a) for engaging with female, tapered threads (26c) of the discharge fitment of the flexible liner. The adapter also includes a flange member (34) for accommodating a sealing ring (40) abutted against an inner wall of the rigid walled vessel. A method of inserting the liner and adapter into the rigid vessel includes guiding the adapter and liner, using a guide leash (70), through a top aperture, into the vessel, and then out the vessel through the discharge port leaving the liner inside the vessel.
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Container With Removable Liner, Fitment, And Adapter

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a bulk container and a removable liner for storing and shipping fluid and semi-fluid materials in bulk, such as fluid and semi-fluid adhesives, polyester resins or the like, paints, photosensitive lithographic compounds, foodstuffs, etc.

In storing and shipping fluid and semi-fluid materials, it is preferable to utilize containers, such as drums, intermediate,bulk containers, and bulk containers varying in size from about 30 to 1000 gallons (114 to 3785 liters). Due to the expense in manufacturing such large containers, it is preferable to reuse the containers as often as possible. However, if the material is stored directly inside the container, the container would desirably need to be cleaned after each use. Such cleaning can be very difficult (and therefore costly) to carry out and sometimes impossible to accomplish effectively, depending upon the type of material used. With some materials, if a delay is
anticipated before cleaning can be effected, it is necessary to fill the container completely with some type of solvent, such as water or acetone, after the supply of the material is exhausted, so that the residual material will not harden against the interior walls of the container and make such cleaning even more difficult. Some solvents, such as acetone, may be classified as a hazardous material that requires strict disposal procedures, thereby making cleaning even more costly.

Furthermore, some materials may be more chemically incompatible with the container, depending upon the composition of the container. Likewise, some materials may chemically react with the container and contaminate the stored material. Moreover, some materials are not authorized to be used in food grade applications.

In order to resolve these problems, it has been proposed to coat the interior walls of bulk containers with a composition that will prevent undesired chemical reactions between the stored material and the interior container walls, such as corrosion, and to provide a more readily cleanable surface. However, such coating involves a complex process and the integrity of the coating cannot always be guaranteed. If an undetected pin hole exists in the coating, an undesirable chemical reaction between the stored material and the container may occur, thus contaminating the entire contents of the container. Also, the walls of the container may corrode and even rupture. In addition, it is still somewhat difficult to clean the interior of the container, especially if there is limited access to it.

It has also been proposed to construct bulk containers out of different materials, specifically selected according to the composition of the material to be stored. However, such a strategy is costly, especially if containers for a wide variety of materials are desired. Also, some materials for
forming the container may have better strength attributes than other materials, thus requiring different wall thicknesses.

Further, an unlined container must be painstakingly cleaned if it is desired to be reused - especially if it is to be used for different contents.

Therefore, it is generally preferred to utilize a removable liner in the bulk containers. Removable liners can protect the container from corrosion by the stored material and can prevent contamination of the stored material by acting as a barrier between the container and the stored material. Further, when the supply of stored material is depleted, the liner, being less massive and, therefore, relatively inexpensive, can be removed and simply disposed of. A new liner can then be inserted and the bulk container can be reused without any need for cleaning. The bulk container can be mass-produced using one preferred material, and one set of parameters for wall thickness, whereas several liners can each be made of a different material, depending upon the type of material to be shipped or stored. That is, each bulk container can be used, during its lifetime, for storing more than one type of liquid because only the liner need be changed.

A typical liner includes an inlet fitment and a discharge fitment and there is a need to connect the discharge fitment of the liner with a discharge port of the bulk container. An adapter has been proposed for connecting the discharge fitment of the liner with the discharge port of the bulk container. One type of adapter that had been designed by inventors of the present invention is shown in Figure 9 of the drawings accompanying this specification. Referring to Figure 9, adapter 100 includes an inner cylinder 102 and an outer cylinder 104. The outer cylinder 104 is connected to the inner cylinder 102 via a flange 106.
On a first or proximal end of the inner cylinder a first set of male, tapered threads 108 is provided. On the second or distal end, a second set of male, tapered threads 110 is provided. In addition, a third set of male, tapered threads 112 is provided on the outer cylinder 104. (The tapers are not shown to scale in the drawings. They can be made to pipefitting standards.) In installing the liner in the bulk container, the adapter 100 must be aligned with the discharge fitment on the liner as it is screwed into the discharge port of the bulk container. It may be necessary to have an aide crawl into the container and hold the discharge fitment in position. The installer then rotates the adapter 100 to simultaneously engage the threads 108 with the discharge fitment and the threads 104 with female threads on the discharge port on the bulk container. After the adapter is tight, a valve can be installed by engaging with threads 110 from outside the bulk container.

Such an assembly process proved tedious and difficult to accomplish. In many bulk containers access can be very limited. Further, simultaneously engaging the threads of the discharge fitment on the liner and the threads of the discharge port with the different sets of threads of the adapter is very difficult if the components are not perfectly aligned, and sometimes requires several attempts. After the adapter is disconnected, residual stored material may leak through the discharge fitment of the liner and drip into the bulk container before the liner can be withdrawn, thereby requiring cleaning.

Furthermore, a typical discharge fitment on a flexible liner, which is in essence a spout to which a valve can be attached, is relatively long in comparison to its diameter. Therefore, when such a discharge fitment is engaged with the adapter 100, which in turn is threaded in the discharge port of the bulk
container, the portion of the liner surrounding the
discharge fitment must necessarily be disposed a
significant distance back from the rigid wall of the
container. When the container is filled, the static
pressure within the liner due to the weight of the
filled material tends to stretch that region of the
liner toward the container walls, thereby giving rise
to a potential of tearing the unsupported liner at that
location.

Summary of the Invention

It is thus an object of the present invention to
provide an adapter between a liner and a bulk container
that can be more readily installed, in particular, in a
bulk container with limited access to its interior. It
is a further object of the present invention to prevent
leakage from the liner when the empty liner is removed.
It is another object of the present invention to
provide an adapter that can readily seal effectively at
all engagements with a minimum number of parts. It is
also an object of the present invention to provide an
adapter that will contain the stored material in the
event the liner ruptures within the container.

To achieve the above objects, one aspect of the
present invention relates to an adapter for connecting
a flexible liner having a threaded discharge or fill
fitment to a port of a rigid container having an inner
wall and an outer wall. The adapter includes a tubular
member and a flange member. The tubular member has a
proximal end, a distal end and a coaxial bore. The
proximal end of the tubular member has a first set of
threads for engaging with the threads on the fitment of
the flexible liner, and the tubular member has near its
distal end a second set of threads for engaging with a
threaded securing member that abuts against the outer
wall of the rigid container when in its securing
position. The flange member is secured to the tubular
member for abutting against the inner wall of the rigid container.

Another aspect of the present invention relates to a lined container including a rigid-walled vessel, a flexible liner and an adapter. The rigid-walled vessel has a port formed in its wall. The flexible liner has a discharge or fill fitment integrally provided therewith, the fitment having female threads. The adapter includes a tubular member having a proximal end, a distal end, and a coaxial bore, for connecting the fitment of the flexible liner to the port of the vessel, and a flange member, secured to the tubular member, for abutting against an interior surface of the wall of the vessel.

Still a further aspect of the present invention relates to a method of lining a rigid container, having an access aperture and a discharge port, with a flexible liner, having a discharge fitment. The method includes a first step of affixing a plug with a tow-line to the fitment of the flexible liner. The tow-line has a free end. Next, the free end of the tow-line is guided through the access aperture into the rigid container and then through the port and out of the rigid container. The flexible liner is fed through the access aperture into the rigid container. Then the tow-line, while still attached to the fitment, is pulled completely through the port of the rigid container. Lastly, the fitment of the flexible liner is secured to the port of the rigid container.

Yet another aspect of the present invention relates to a fitment for an opening of a flexible liner for lining a rigid container having a port. The fitment includes a tubular member and a flexible flange. The tubular member has an internal bore therethrough, the tubular member including means for connecting the fitment to the port of the rigid container. The flexible flange is provided integrally
with the tubular member, for affixing the fitment to the flexible liner at its opening, wherein a ratio between the outer diameter and the length of the tubular member is no less than 2.7 to 1.

These and other objects and aspects of the present invention will be apparent from the drawings and the following description.

**Brief Description of the Drawings**

Figure 1 is a cross-sectional view of a bulk container of the present invention with a liner installed;

Figure 2 is a perspective view of the discharge fitment of the liner of the present invention;

Figure 3 is a perspective view of the adapter assembly of the present invention;

Figure 4 is a cross-sectional view of the adapter assembly of the present invention;

Figure 5 is an exploded cross-sectional view of the liner, adapter assembly, bulk container and valve of the present invention;

Figure 6 is a sectional view taken along section line VI-VI' in Figure 1 of the liner and adapter assembly installed in the bulk container of the present invention;

Figure 7 is an elevational view of the plug and tow-line assembly of the present invention;

Figure 8 is a perspective view of the positioning of the vertical and horizontal guide tubes for use in installing a liner in a bulk container of the present invention; and

Figure 9 is a perspective view of a previously proposed adapter assembly.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring now to Figure 1, a bulk container 10 to which the present invention is particularly applicable
is depicted. Container 10 can be formed of any suitable structural material, for example strong plastic or steel. Preferably, however, it is made of a dicyclopentadiene polymer and can be configured and made as described in International Patent Publication No. WO 92/21575 (Brown et al.) and the various U.S. patents that are referenced therein, all of which are hereby incorporated by reference. Dicyclopentadiene polymers are formed, and molded into the desired shape, by a closed molding process using a core and cavity, called reaction injection molding (RIM).

The bulk container 10 is typically formed with a lower section 12a and an upper section 12b, with a shoulder 12c disposed therebetween. The lower section 12a, upper section 12b and shoulder 12c are integrally formed. The shoulder 12c adds strength to the container.

The container lid 14 is affixed onto a rim of the bulk container in an airtight manner such that the bulk container can withstand internal pressures up to about 15 p.s.i., if necessary. The container lid 14 includes a cap 16 which has male threads that fit into female threads of an access aperture 14a centrally located in the container lid 14. The lid 14 and the cap 16 may also include one or more bung plugs which fit into corresponding bung holes. A lanyard 17, to be described later, has one end affixed to the cap 16.

A liner 20 is insertable into the bulk container. The liner includes an inlet fitment 22 and a bung plug 24 that fits into the inlet fitment in a sealing manner. The other end of the lanyard assembly 17 is connected to the inlet fitment 22 of the liner, such that the liner will not drop completely down to the bottom of the bulk container either before the liner is filled or as its contents are depleted. The liner also includes a discharge fitment 26 provided at a lower end thereof.
The discharge fitment 26 of the liner 20, as shown in Figure 2, includes a flange 26a, a tubular member 26b having a coaxial bore 26c lined with tapered female threads, and ribs 26d. The flange 26a is formed integrally with the tubular member 26b of injection molded, low density polyethylene, for example. The fitment can be fused to the liner 20 by heating or ultrasonic welding or can be adhered to the liner with an adhesive. Ribs 26d facilitate the molding process by preventing the fitment from rotating during molding. Ribs 26b are not necessary if the fitment is machined rather than molded. The outer diameter of the tubular member 26b is sized such that it is no less than 2.6 times the length of the tubular member measured from the flange 26a to the free end of the tubular member 26b. As a result, the fitment has a relatively small profile, the advantages for which will be explained later. In addition, the flange 26a is formed as a thin layer so that it can readily flex with the liner 20. The advantages of this feature will also be explained later. Further, the average inner diameter of the tubular member is no more than 9.5 times the average thickness of the tubular member (i.e., the distance between the inner and outer diameters). As a result, the tubular member of the fitment is sufficiently strong without any need for other structural support.

The discharge fitment 26 of the liner 20 is connected to the discharge port 12d of the bulk container 12 via an adapter assembly 30 shown in Figures 3 and 4. The adapter assembly 30 includes a main cylinder or tubular member 32 and a flange 34. The flange is affixed to the cylinder member 32 at a midpoint thereof by any suitable method, depending on the type of material used. The cylinder member 32 includes a male, tapered, first set of threads 32a on a first or proximal end of the cylinder, a male, tapered, second set of threads 32b formed continuously with a
male, straight, third set of threads 32c on a second or
distal end of the cylinder, and a female, straight,
fourth set of threads also on the second end.

The first set of threads 32a is for connection
with the discharge fitment 26 of the liner 20. The
interconnected tapered threads provide an interference
fit between the discharge fitment of the liner and the
adapter assembly, thereby eliminating the need for a
sealing gasket. Nevertheless, some type of sealant,
such as Teflon® tape or pipe sealant, is preferred to
be provided on the threads before the interconnection
is established. The second set of threads 32b is for
connection with a female-threaded valve 60 to be
described later. These tapered threads 32b also
provide an interference fit.

The straight threads 32c are for connecting with a
retaining nut. The fourth set of threads are tapped
into the inner periphery of the adapter assembly near
the second end thereof. The fourth set of threads is
for engaging a plug 70 for the adapter assembly.

The flange 34 is disposed near the proximal end of
the main cylinder 32, where the first set of threads
32a is provided. This minimizes the profile of the
discharge fitment 26 and the portion of the adapter
assembly that is disposed within the rigid container,
providing advantages which will be explained later.
The flange 34 includes a recess 34a on its distal face
that functions as a seat for a sealing ring. The
flange 34 also includes flats 34b and 34c on its
circumference. At least flat 34b is disposed close to
a complementary flat 12e in the inside of the bulk
container, such that the adapter assembly cannot rotate
after it is properly positioned.

The adapter assembly 30 can be formed of any
material that will suit the requirements for its use,
as long as the selected material is compatible with the
connections to the discharge fitment 26, the valve, the
retaining nut and the plug. For example, if the container is to be used for storing some type of fluid foodstuff, food grade PVC can be used to form the adapter assembly. This type of PVC is compatible with a polyethylene liner fitment, a UHMW lock nut, a polypropylene plug, and a food grade polypropylene valve fitment. For other types of materials to be stored, the adapter assembly can be suitably formed of polypropylene, stainless steel, carbon steel, brass, etc.

Figure 5 is an exploded view illustrating the interrelationship of the various elements of the preferred embodiment of the present invention. When fully assembled, the fitment 26 of the flexible liner 20 is threadedly engaged with the first set of threads 32a of the adapter assembly 30. Flat 34b is positioned parallel to the flat bottom of the rigid vessel 12, with little or no clearance between them. This prevents the adapter assembly from rotating after it is inserted through the port 12d of the container 12, which in turn prevents the flexible liner 20 from twisting and possibly restricting its flow. Instead of a flat, any geometric shape and a complementary recess on the inside of the container can be utilized. A sealing ring 40, which is formed of nitrile, for example, is disposed between the flange 34 of the adapter assembly 30 and the inner wall of the container 12 and sits in recess 34a. Therefore, even if the flexible liner were to accidentally rupture, its contents would still be reliably retained within the rigid walled container.

When the adapter assembly is inserted through the bore 18 of the vessel and the flat 34b of flange 34 is seated against the bottom of the container, a retaining nut 50 is threaded onto the straight set of male threads 32c of the adapter assembly 30 to hold the adapter assembly in place. The nut 50 abuts against a
flat surface 12d of the container. A ball valve 60, which can be formed of polypropylene or stainless steel, for example, is threadable on the tapered threads 32b thereafter. The interconnected tapered threads of the adapter assembly 30 and the valve 60 also provides an interference fit which can be enhanced with a sealing material such as Teflon™ tape. When the valve 60 is not connected to the adapter assembly, the plug assembly 70, having male threads 70a, as shown in Figure 7, can be screwed into the female threads 32d of the adapter assembly to prevent leakage. The plug need not be threaded; it can alternatively be a magnetic or expansion type. In the alternate cases, there is also no need for female threads 32d on the adapter 30.

As shown in Figure 1, the length of the lower liner fitment 26 and the width of the proximal end of the adapter assembly within the container is relatively small compared to the diameter of the lower liner fitment 20. Therefore, when the flexible liner is filled, the portion of the liner proximal to the lower liner fitment is not disposed a great distance from the interior walls of the container 12. If this distance were greater, the liner would tend to stretch from the point of its connection to the lower liner fitment toward the container walls. Too much stress could tear the liner. However, it has been found that as dimensioned, the magnitude of such stretching can be limited to an acceptable level. In addition, the flexible flange 26a of the lower liner fitment reinforces that portion of the liner which is subjected to the undesirable stretching to the greatest extent.

In addition, due to the flat 34b of the flange 34 of the adapter assembly 30 and the flexibility of the flange 26a of the discharge fitment 26, the outlet of the flexible liner 20 can be disposed at a relatively low level, such that it minimizes the amount of stored contents that cannot drain through the discharge port
because they settle below the height of the outlet. To further minimize such waste, the inside bottom of the container 12 can be custom-fitted with an insert that displaces the unusable portion of the liner. This insert is preferably formed of a soft, flexible material to cover any sharp protrusions on the inside bottom of container 12 that might puncture the flexible liner 20.

A method of inserting the flexible liner within the rigid container will now be described.

Initially, the adapter assembly 30 is screwed onto the lower liner fitment 26 of an unused liner 20. A bottom flat 34c of the adapter assembly should be aligned with the bottom of the liner. Teflon® tape or a pipe sealant can be used to improve the sealing between the adapter assembly and the lower liner fitment. Next, the plug assembly 70 is threaded into the distal end of the adapter assembly. An arrow should be marked on the plug assembly designating "up", which points away from the bottom flat 34c of the adapter assembly. Then the plastic bung 24 from the top liner fitment 22 is removed so that excess air can escape while inserting the liner. The cap 16 is removed from the container lid 14 to expose the access aperture 14a. The plug 70 is detachably connected to a first end of a guide leash or tow-line 72 by way of a connector 72a. A magnet 74 is affixed to the free end of the guide leash 72.

A vertical guide tube 80 is then inserted downwardly through the access aperture in the lid of the bulk container, as shown in Figure 8. The vertical guide tube 80 is comprised of a tubular member 82 having a longitudinal slot 82a provided therein and a drop guard 84, also having a slot 84a formed therein. The slots 82a and 84a are aligned so that one side of the vertical guide tube is completely open. The inner diameter of the tubular member 82 is larger than the
largest dimension of the magnet 74 attached to the guide leash 72, but smaller than the diameter of the plug 70. The slots 82a and 84a have a width wider than the diameter of the guide leash 72. The guard 84 has a diameter greater than the diameter of the access aperture 14a of the lid 14, such that the vertical guide tube can never accidentally drop completely into the bulk container. The vertical guide tube is formed of PVC or some other non-magnetic material that will not interfere with free passage of the magnet 74. The tubular member 82 and the guard 84 can be glued together with a PVC cement, for example.

Next, a horizontal guide tube 90 is inserted through the discharge port 12d of the bulk container 12. The horizontal guide tube 90 includes a tubular member 92, a guide shoulder 94, a metal plate 96, and a handle 98. All of the components of the horizontal guide tube 90, with the exception of the metal plate 96, can also be made of PVC and glued together with an appropriate cement. The metal plate 96 is preferably made of a ferrous metal to attract the magnet 74 attached to the guide leash 72. The plate 96 is disposed in a recess of the tubular member 92 to house the magnet 74 after it is attracted to the plate. The guide shoulder 94 is dimensioned so as to snugly fit within the discharge port 12d of the bulk container 12, such that the horizontal guide tube can be held substantially horizontally within the bulk container with the plate 96 being positioned precisely below the vertical guide tube 80.

When the vertical guide tube 80 and the horizontal guide tube 90 are in position, the magnet on the guide leash is inserted into the top of the vertical guide tube and lowered until it makes contact with the plate 96 on the horizontal guide tube. The horizontal guide tube is then removed from the discharge port of the tank with the magnet attached to plate 96. Then the
vertical guide tube is removed from the access aperture while retaining the guide leash in place. The guide leash will slip out of the slot 82a on the tubular member 82 and out of the slot 84a of the guard 84 of the vertical guide tube.

The new liner 20 is then inserted into the container through the access aperture with the portion of the liner that includes the top fitment remaining outside the container. Using the guide leash, which is connected to the plug 70, which in turn is threaded onto the adapter assembly 30, the adapter assembly is pulled through the discharge port 12d of the bulk container 12 until the gasket 40 contacts the inner surface of the container and the flat 34b of the flange 34 is properly seated against the bottom on the inner surface of the bulk container. The flange will be properly seated in the recess of the bulk container when the previously noted arrow on the plug is pointed upwards. Then the retainer nut 50 is threaded onto the straight male threads 32c of the adapter assembly 30 and tightened with a wrench. The plug 70 can be removed from the adapter assembly and a valve 60, such as a ball valve, can be threaded onto the tapered male threads 32b of the adapter assembly.

Next, the lanyard 17 is affixed to the top liner fitment 22. The liner can then be filled with the desired liquid. To ensure unimpeded filling, the liner may first be inflated using a compressed air source. In filling the liner 20, use can be made of a circular fill plate having both a diameter greater than the diameter of the access aperture and a slot into which an annular recess of a reinforced neck of the top liner fitment can slide. The fill plate can rest on the rim of the access aperture and support the upper liner fitment during filling. Then, the bung plug 24 is replaced in the top liner fitment 22. Afterwards, the cap 16 can be replaced in the access aperture 14a and
the bulk container is ready for use. A sight gauge can be placed in the discharge line upstream of the valve 60 to indicate the fluid level in the container 10.

When the contents of the container have been exhausted, the liner can be replaced. First, the valve 60 and the retainer nut 50 are removed from the distal end of the adapter assembly 30. Then the plug assembly with the guide leash connected thereto is replaced into the adapter assembly. Next the adapter assembly 30 with the affixed plug are pushed back into the container. The plug will prevent any residual contents within the liner from leaking into the container during removal. Next the cap from the container lid is removed and the lanyard 16c is used to pull the top end of the liner out of the access aperture. The entire liner is then pulled out of the container through the access aperture, making sure the magnet end of the guide leash is not pulled through the discharge port 12d of the bulk container. Then the adapter assembly is removed from the used liner (and cleaned, if necessary) and attached to a new liner. The insertion process described previously is repeated. However, there is no need to utilize the vertical guide tube 80 or the horizontal guide tube 90, since the guide leash is already in place.

It should be understood that the preferred embodiment described herein is intended only in an illustrative, rather than a limiting, sense. The true scope of the invention is set forth in the claims appended hereto.
WE CLAIM:

1. An adapter for connecting a flexible liner having a threaded discharge or fill fitment to a port of a rigid container having an inner wall and an outer wall, said adapter comprising:
   a tubular member having a proximal end, a distal end and a coaxial bore, the proximal end of said tubular member having a first set of threads for engaging with the threads on the fitment of the flexible liner, and said tubular member having near its distal end a second set of threads for engaging with a threaded securing member that abuts against the outer wall of the rigid container when in its securing position; and
   a flange member, secured to said tubular member, for abutting against the inner wall of the rigid container.

2. An adapter according to Claim 1, wherein said first set of threads comprises a set of male, tapered threads.

3. An adapter according to Claim 1, wherein said second set of threads comprises a set of male, straight threads, said adapter further comprises a third set of threads, located at its distal end, which are male, tapered threads for providing an interference fit with a female-threaded valve.

4. An adapter according to Claim 3, wherein the third set of threads of said tubular member is formed continuously with the second set of threads.

5. An adapter according to Claim 1, wherein said tubular member further comprises a fourth set of threads, which are female, provided in the coaxial bore
at the distal end of said tubular member, for engaging with male threads on a plug member for the bore.

6. An adapter according to Claim 1, wherein said flange member is fused to said tubular member by welding.

7. An adapter according to Claim 1, wherein said flange member is molded integrally with said tubular member.

8. An adapter according to Claim 1, wherein said flange member is substantially circular, but with a flat section on its circumference, the flat section being engageable with a flat surface of the container to prevent rotation of said adapter.

9. An adapter according to Claim 1, wherein said flange member is provided with an annular recess for accommodating a sealing ring for sealing against the inner wall of the rigid container.

10. An adapter according to Claim 1, wherein said flange member is disposed closer to one end, than it is to the opposite end, of said tubular member.

11. A lined container comprising:
   a rigid-walled vessel having a port formed in its wall;
   a flexible liner having a discharge or fill fitment integrally provided therewith, said fitment having female threads;
   an adapter comprising a tubular member having a proximal end, a distal end, and a coaxial bore, for connecting said fitment of said flexible liner to said port of said vessel, and a flange member, secured to
said tubular member, for abutting against an interior surface of the wall of said vessel.

12. A container according to Claim 11, wherein said adapter includes a first set of tapered threads on at least the proximal end thereof for engaging with the threads of the fitment of said flexible liner.

13. A container according to Claim 11, wherein a sealing ring is provided between said flange member and the interior surface of the wall of said vessel.

14. A container according to Claim 13, wherein said flange member is disposed closer to the proximal end of said adapter, which connects to the fitment of said flexible liner, than the distal end.

15. A container according to Claim 13, wherein said flange member of said adapter is substantially circular, but with a flat section on its circumference, the flat section being engageable with a flat surface of said vessel to prevent rotation of said adapter.

16. A container according to Claim 11, wherein the fitment comprises substantially a hollow cylinder having an outer diameter, an inner diameter, and a length, and wherein the ratio of the outer diameter to the length of the fitment of said flexible liner is no less than 2.6 to 1.

17. A container according to Claim 16, wherein the average inner diameter of said fitment is no more than 9.5 times its average thickness.

18. A container according to Claim 11, wherein said adapter is further provided with second and third sets of threads, the second set of threads being
provided near the distal end of said adapter and comprising a set of male, straight threads for engaging with threads on a securing member, the securing member for abutting against an exterior surface of said vessel, and the third set of threads is provided at the distal end and comprises male tapered threads for providing an interference fit with a female-threaded valve.

19. A container according to Claim 18, wherein the third set of threads of said adapter is formed continuously with the second set of threads.

20. A container according to Claim 18, wherein the securing member comprises a nut that is tightened against the exterior surface of said vessel when the nut is in its securing position.

21. A container according to Claim 18, wherein said adapter comprises a fourth set of threads, which are female, provided in the coaxial bore at the distal end of said adapter for engaging with male threads on a plug member for the bore.

22. A method of lining a rigid container, having an access aperture and a discharge port, with a flexible liner, having a discharge fitment, said method comprising the steps of:

   affixing a plug with a tow-line to the fitment of the flexible liner, the tow-line having a free end;

   guiding the free end of the tow-line through the access aperture into the rigid container and then through the port and out of the rigid container;

   feeding the flexible liner through the access aperture into the rigid container and pulling the tow-line, while still attached to the fitment, completely through the port of the rigid container; and
securing the fitment to the port of the rigid container.

23. A method according to Claim 22, wherein said guiding step comprises positioning a vertical guide tube through the access aperture and positioning a horizontal guide tube through the port such that the free end of the tow-line is guided through the vertical guide tube until it meets the horizontal guide tube.

24. A method according to Claim 23, further comprising the steps of securing the free end of the tow-line to the horizontal guide tube upon contact and then withdrawing the horizontal guide tube through the port.

25. A method according to Claim 24, wherein a magnet is provided on the free end of the tow-line and the magnet is attractable to a portion of the horizontal guide tube.

26. A method according to Claim 23, wherein the vertical guide tube is provided with a longitudinal slot throughout its length such that the vertical guide tube can be removed from the container without removing the tow-line.

27. A method according to Claim 22, wherein said step of securing the fitment of the flexible liner to the port of the rigid container is effected via an adapter.

28. A method according to Claim 27, wherein the adapter is provided with at least one set of male, tapered threads for an interference fit with the fitment of the flexible liner.
29. A fitment for an opening of a flexible liner for lining a rigid container having a port, said fitment comprising:
   a tubular member having an internal bore therethrough, said tubular member including means for connecting said fitment to the port of the rigid container; and
   a flexible flange, provided integrally with said tubular member, for affixing said fitment to said flexible liner at its opening, wherein a ratio between the outer diameter and the length of said tubular member is no less than 2.6 to 1.

30. A fitment according to Claim 29, wherein said flexible flange is ultrasonically welded to the flexible liner.

31. A fitment according to Claim 29, wherein said flexible flange is fused to the flexible liner by heat.

32. A fitment according to Claim 29, wherein said means for connecting said fitment to the port of the container comprises female threads.

33. A fitment according to Claim 32, wherein the female threads of said tubular member are tapered.

34. A fitment according to Claim 29, wherein the average inner diameter of said tubular member is no more than 9.5 times its average thickness.

35. A fitment according to Claim 29, wherein said tubular member and said flexible flange are integrally formed.
6. An adapter according to Claim 1, wherein said flange member is fused to said tubular member by welding.

7. An adapter according to Claim 1, wherein said flange member is molded integrally with said tubular member.

8. An adapter according to Claim 1, wherein said flange member is substantially circular, but with a flat section on its circumference, the flat section being engageable with a flat surface of the container to prevent rotation of said adapter.

9. An adapter according to Claim 1, wherein said flange member is provided with an annular recess for accommodating a sealing ring for sealing against the inner wall of the rigid container.

10. An adapter according to Claim 1, wherein said flange member is disposed closer to one end, than it is to the opposite end, of said tubular member.

11. A lined container comprising:
   a rigid-walled vessel having a wall and a port formed in said wall;
   a flexible liner having a discharge fitment integrally provided therewith, said fitment having female threads;
   an adapter comprising a tubular member having a proximal end, a distal end, and a coaxial bore, for connecting said fitment of said flexible liner to said port of said vessel, and a flange member, secured to said tubular member, for abutting against an interior
surface of the wall of said vessel, wherein the distal end of said adapter extends through the port of said rigid-walled vessel.

12. A container according to Claim 11, wherein said adapter includes a first set of tapered threads on the proximal end thereof for engaging with the threads of the fitment of said flexible liner.

13. A lined container comprising:
   a rigid-walled vessel having a wall and a port formed in said wall;
   a flexible liner having a discharge fitment integrally provided therewith, said fitment having female threads; and
   an adapter comprising a tubular member having a proximal end, a distal end, and a coaxial bore, for connecting said fitment of said flexible liner to said port of said vessel, and a flange member, secured to said tubular member, for abutting against an interior surface of the wall of said vessel, wherein a sealing ring is provided between said flange member and the interior surface of the wall of said vessel.

14. A container according to Claim 11, wherein said flange member is disposed closer to the proximal end of said adapter, which connects to the fitment of said flexible liner, than the distal end.

15. A container according to Claim 13, wherein said flange member of said adapter is substantially circular, but with a flat section on its circumference, the flat section being engageable with a flat surface of said vessel to prevent rotation of said adapter.

16. A container according to Claim 11, wherein the fitment comprises substantially a hollow cylinder.
having an outer diameter, an inner diameter, and a length, and wherein the ratio of the outer diameter to the length of the fitment of said flexible liner is no less than 2.6 to 1.

17. A container according to Claim 16, wherein the average inner diameter of said fitment is no more than 9.5 times its average thickness.

18. A lined container comprising:
   a rigid-walled vessel having a wall and a port formed in said wall;
   a flexible liner having a discharge fitment integrally provided therewith, said fitment having female threads;
   an adapter comprising a tubular member having a proximal end, a distal end, and a coaxial bore, for connecting said fitment of said flexible liner to said port of said vessel, and a flange member, secured to said tubular member, for abutting against an interior surface of the wall of said vessel, wherein said adapter includes a first set of tapered threads on the proximal end thereof for engaging with the threads of the fitment of said flexible liner, and said adapter is further provided with second and third sets of threads, the second set of threads being provided near the distal end of said adapter and comprising a set of male, straight threads for engaging with threads on a securing member, the securing member for abutting against an exterior surface of said vessel, and the third set of threads is provided at the distal end and comprises male tapered threads for providing an interference fit with a female-threaded valve.

19. A container according to Claim 18, wherein the third set of threads of said adapter is formed continuously with the second set of threads.
20. A container according to Claim 18, wherein the securing member comprises a nut that is tightened against the exterior surface of said vessel when the nut is in its securing position.

21. A container according to Claim 18, wherein said adapter comprises a fourth set of threads, which are female, provided in the coaxial bore at the distal end of said adapter for engaging with male threads on a plug member for the bore.

22. A method of lining a rigid container, having an access aperture and a discharge port, with a flexible liner, having a discharge fitment, said method comprising the steps of:
   affixing a plug with a tow-line to the fitment of the flexible liner, the tow-line having a free end;
   guiding the free end of the tow-line through the access aperture into the rigid container and then through the port and out of the rigid container;
   feeding the flexible liner through the access aperture into the rigid container and pulling the tow-line, while still attached to the fitment, completely through the port of the rigid container; and
   securing the fitment to the port of the rigid container.

23. A method according to Claim 22, wherein said guiding step comprises positioning a vertical guide tube through the access aperture and positioning a horizontal guide tube through the port such that the free end of the tow-line is guided through the vertical guide tube until it meets the horizontal guide tube.

24. A method according to Claim 23, further comprising the steps of securing the free end of the tow-line to the horizontal guide tube upon contact and
then withdrawing the horizontal guide tube through the port.

25. A method according to Claim 24, wherein a magnet is provided on the free end of the tow-line and the magnet is attractable to a portion of the horizontal guide tube.

26. A method according to Claim 23, wherein the vertical guide tube is provided with a longitudinal slot throughout its length such that the vertical guide tube can be removed from the container without removing the tow-line.

27. A method according to Claim 22, wherein said step of securing the fitment of the flexible liner to the port of the rigid container is effected via an adapter.

28. A method according to Claim 27, wherein the adapter is provided with at least one set of male, tapered threads for an interference fit with the fitment of the flexible liner.

29. A fitment for an opening of a flexible liner for lining a rigid container having a port, said fitment comprising:

- a tubular member having an internal bore therethrough, said tubular member including means for connecting said fitment to the port of the rigid container; and
- a flexible flange, provided integrally with said tubular member, for affixing said fitment to said flexible liner at its opening, wherein a ratio between the outer diameter and the length of said tubular member is no less than 2.6 to 1.
30. A fitment according to Claim 29, wherein said flexible flange is ultrasonically welded to the flexible liner.

31. A fitment according to Claim 29, wherein said flexible flange is fused to the flexible liner by heat.

32. A fitment according to Claim 29, wherein said means for connecting said fitment to the port of the container comprises female threads.

33. A fitment according to Claim 32, wherein the female threads of said tubular member are tapered.

34. A fitment according to Claim 29, wherein the average inner diameter of said tubular member is no more than 9.5 times its average thickness.

35. A fitment according to Claim 29, wherein said tubular member and said flexible flange are integrally formed.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : B65D 37/00
US CL : 222/001, 105, 106, 285/161
According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 222/001, 105, 106, 183; 285/161, 200, 206, 330

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
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<tbody>
<tr>
<td>X -------</td>
<td>US, A, 4,997,108 (Hata) 5 March 1991, col. 3, line 34 to col. 6, line 39.</td>
<td>11</td>
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<tr>
<td>Y -------</td>
<td>US, A, 4,640,535 (Hermann) 3 February 1987, col. 2, line 51 to col. 3, line 68</td>
<td>13-14, 16-17</td>
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<tr>
<td>X -------</td>
<td>US, A, 5,068,494 (Bolante) 26 November 1991, col. 5, line 49 to col. 6, line 31.</td>
<td>1-2, 9</td>
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<tr>
<td>X -------</td>
<td>US, A, 3,749,424 (Greene) 31 July 1973, col. 2, line 15 to col. 3, line 43.</td>
<td>1, 5, 7, 10</td>
</tr>
<tr>
<td>Y -------</td>
<td>US, A, 4,960,227 (Coleman) 2 October 1990, col. 5, line 6-49</td>
<td>2-4, 6, 8-9</td>
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</table>

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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X Special categories of cited documents:

A* document defining the general state of the art which is not considered to be of particular relevance

E* earlier document published on or after the international filing date

L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O* document referring to an oral disclosure, use, exhibition or other means

P* document published prior to the international filing date but later than the priority date claimed

T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

&* document member of the same patent family

Date of the actual completion of the international search: 22 NOVEMBER 1995

Date of mailing of the international search report: 12 DEC 1995

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
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Authorized officer
KENNETH BOMBERG
Telephone No. (703) 308-1113

Form PCT/ISA/210 (second sheet)(July 1992)
<table>
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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>A</td>
<td>US, A, 2,100,796 (Church) 30 November 1937, Fig. 1.</td>
<td>NONE</td>
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</table>
## INTERNATIONAL SEARCH REPORT

### Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

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

1. **Claims Nos.:**
   - because they relate to subject matter not required to be searched by this Authority, namely:

2. **Claims Nos.:**
   - because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. **Claims Nos.:**
   - because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

Please See Extra Sheet.

1. **X** As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. **☐** As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. **☐** As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. **☐** No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- **☐** The additional search fees were accompanied by the applicant's protest.
- **☐** No protest accompanied the payment of additional search fees.

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Form PCT/ISA/210 (continuation of first sheet(1))(July 1992)
BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-10, are drawn to an adapter;
Group II, claims 11-21, and 22-28 are drawn to a dispensing container and method of assembling a dispensing container;
Group III claims 29, are drawn to a fitment for a flexible liner.

The inventions listed as Groups I, II, and III do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: in each group the details of the special technical features have been omitted from the other groups, those omissions resulting in the claims not being so linked as to form a single inventive concept.