Aug. 26, 1969 J. VONK 3,463,059

METHOD OF CONSTRUCTING A LIQUID-TIGHT SIDE WALL FOR SHIPPING CONTAINERS

Filed Aug. 22, 1966

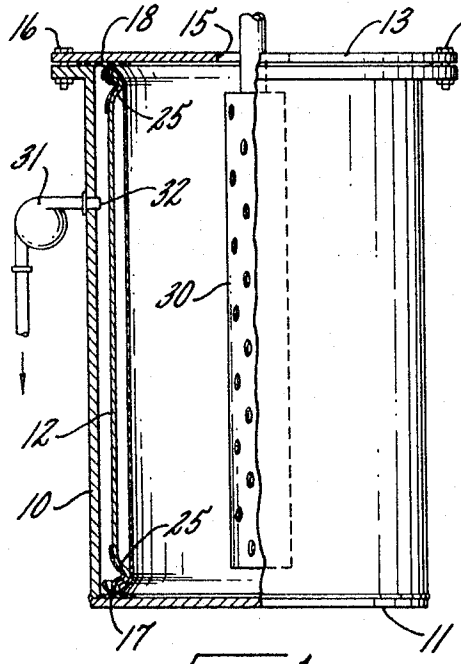

Fig. 1.

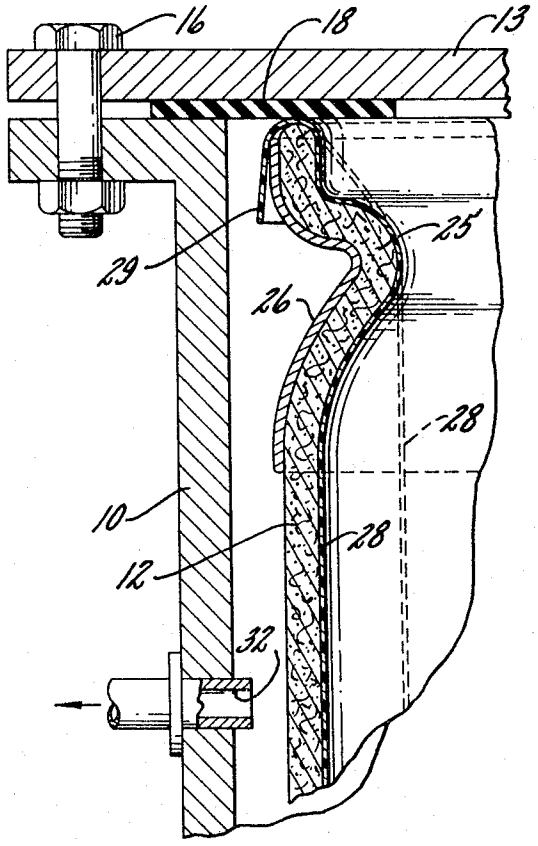

Fig. 2.

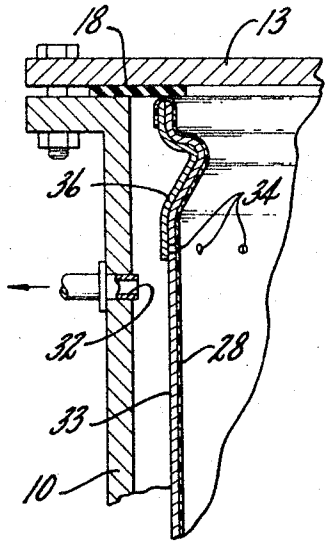

Fig. 3.

INVENTOR:
Johnny Vonk,
BY:-
Wolfe, Hubbard, Voit & Osann,
ATTORNEYS.

United States Patent Office 3,463,059 Patented Aug. 26, 1969

3,463,059

METHOD OF CONSTRUCTING A LIQUID-TIGHT SIDE WALL FOR SHIPPING CONTAINERS

Johnny Vonk, Shertogenbosch, Netherlands, assignor to Inland Steel Company, Chicago, Ill., a corporation of Delaware

Filed Aug. 22, 1966, Ser. No. 574,119
Int. Cl. B31c 13/00
U.S. Cl. 93—77 4 Claims

The present invention relates generally to shipping containers, such as drums, and, more particularly, to lined shipping containers. In its principal aspects the invention is concerned with improved methods and apparatus for forming lined shipping containers, as well as to improved lined shipping containers formed thereby.

Shipping containers of the general type concerned here commonly comprise a cylindrical body having a reinforced inwardly extending circumferential bead and a chime at each end, with the ends being additionally provided with suitable closures. The container wall may be of any suitable material, but the present invention finds particularly advantageous use in connection with containers wherein the body is made of fibre, paper board filaments, or similar porous materials which may be either natural or synthetic. The invention is not, however, limited to use with container side walls formed of such material but, on the contrary, it will also find applicability with containers having side walls formed of steel or other impervious material with certain modifications as described herein.

Containers of this general type are often utilized for the transport of liquids or of materials having a high percentage of liquid content. Since side wall materials such as fibre, paper board and the like are not generally liquid-tight, the interior of the container body wall is provided with a liquid-tight lining of flexible sheet material such as polyethylene. Moreover, when dealing with liquid-tight steel drums or the like, similar internal linings are often provided, particularly where the container is to be used to transport aggressive commodities. With such a lining, difficulties are often encountered in achieving a smooth fit and tight adherence to the container inner wall, particularly in the vicinity of the chime, or in the vicinity of the inwardly extending bead or where a similar inner convolution is present. It is highly desirable to form the chime and other convolutions prior to the installation of the tubular internal lining so as to avoid damage to the lining resulting from the forming process, but this has heretofore presented difficulties. In drawing the lining tightly against the internal walls of the container, the liner is likely to remain stretched between the inwardly extending beads, or between one bead and the opposite chime end of the container, rather than lying smoothly against the inner wall surface. Such a condition is not only wasteful of space because of the trapped volume between the liner and the internal wall, but the liner is substantially unsupported in this position and prone to punctures or other damage.

It is, therefore, a general aim of the present invention to overcome the foregoing difficulties and to provide an improved shipping container side wall and method of manufacture thereof characterized in that the side wall is provided with a liquid-tight internal plastic liner which smoothly conforms and adheres to the inner surface of the container.

In another of its important aspects, it is an object of the invention to provide improved methods and apparatus for forming an internally lined container side wall of the character described characterized by exceptional versatility in that such methods and apparatus find equal applicability in lining a wide variety of different types of side walls whether the latter are made of pervious material such as fibre or impervious materials such as steel.

Other objects and advantages of the invention will become apparent as the following description proceeds, taken in conjunction with the accompanying drawing, in which:

FIG. 1 is a side elevational view, in half-section, here depicting an exemplary apparatus for forming lined shipping containers embodying the features of the invention in accordance with the novel method of the invention, the container and its lining here being shown in an initial stage of the forming process;

FIG. 2 is an enlarged partial section of a corner of the shipping container side wall and apparatus of FIGURE 1 here illustrating the liner in broken lines prior to the forming operation and in solid lines after such operation; and

FIG. 3 is a slightly reduced partial section similar to FIG. 2, but here illustrating a slightly modified side wall construction also embodying the features of the present invention.

While the invention is susceptible of various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawing and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but, on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention as expressed in the appended claims.

Turning now to the drawings, there is shown in FIGURE 1 an exemplary apparatus suitable for carrying out the method of the present invention. The illustrative apparatus comprises a heavy air-tight cylindrical vacuum vessel **10** closed at one end by a welded end plate **11**, such that the resulting vessel defines a chamber of sufficient diameter and depth to accommodate a shipping container side wall **12**. A lid **13** having a vent **15** is provided for the vessel **10** and is secured about its circumference by a plurality of fasteners **16**. The container side wall **12** is not fitted with end closures at this stage of its construction, and its interior is thereby vented to the atmosphere through the vent opening **15**.

For the purpose of defining a sealed annular space between the side wall **12** and the vessel **10** a flat circumferential gasket **17** is provided at the bottom of the vessel **10** of sufficient diameter and width to underlie and seal the lower periphery of the side wall **12**. A corresponding gasket **18** is provided at the top of the vessel **10** where it is clamped in sealing relationship between the vessel and the lid **13** as well as sealing the upper periphery of the side wall **12**. The dimensions of the vessel **10** are chosen such that when a container side wall **12** is lowered into place and the lid **13** is clamped down, the gaskets **17, 18** are deformably urged against the ends of the side wall **12** to form a tight seal. The result is that an annular area surrounding the outside of the side wall **12** is rendered air-tight, while the opening **15** vents the inside of the container to the atmosphere.

For providing reinforcement and stiffness at the vulnerable chime region near the ends of the container, a

circumferential bead or flange **25** is generally formed at each end of the container side wall **12** prior to being placed into the vacuum vessel **10**. Also surrounding the chime area of the container side wall **12**, although not necessarily, is a rolled reinforcing ring **26** which is formed by crimping, wheeling, turning, or any other suitable method so as to conform with the shape of the beaded side wall extremity. As a practical matter, the flange or bead **25** in the side wall is normally formed at the same time as the complemental bead in the reinforcing ring **26** in a manner well known to those skilled in the art.

In carrying out the invention, a tubular section of liquid-tight plastic sheet material **28** is positioned within the previously formed side wall **12**. To temporarily hold it in place, its ends **29** are drawn back over the ends of the side wall **12** as shown in FIG. 2. In this condition (represented by dotted lines in FIG. 2), the liquid liner does not conform to the inner convolutions of the container side wall **12**, but is instead drawn loosely between the upper bead **25** and the corresponding lower bead **25** at the other end of the side wall. The liner **28** is also generally somewhat resilient, and resists being forced into smooth conformity with the inner surface of the side wall **12**.

It should be noted that the inner liner **28** may be made of various materials and with differing construction. Any suitable sheet material may be used, such as polyethylene, polyvinyl chloride, or other similar liquid-tight material. It is formed preferably as a seamless extruded tube, or in the alternative fabricated into tube form from sheet material with a heat-sealed or taped seam where the ends of the sheet abut or overlap.

In carrying out the invention, care is taken that the ends **29** of the inner liner **28** which are turned over the ends of the side wall **12** are located in sealing relationship to the gaskets **17**, **18** when the side wall is placed in the vacuum vessel **10**. After the side wall **12** and its liner **28** are properly located, the lid **13** is clamped securely into place and a heating element **30** is lowered into a central position within the container wall **12** as shown in FIGURE 1. The process is preferably initiated by energizing the heating element **30** to controllably heat the liquid-tight liner **28** to a degree whereby the liner losses its resilience and becomes somewhat plastic, and additionally acquires a degree of adhesivenes.

Pursuant to the invention, the liner **28** is drawn into adherent contact with the side wall **12** by creating a pressure differential between the region within the side wall adjacent the heating element **30** and the annular region between the liner and the side wall.

For achieving the required pressure differential, the annular region exterior to the side wall **12** is evacuated by a vacuum pump **31** through a vacuum fitting **32**. Because of the air-permeable porous nature of the side wall **12**, the air within the annular space is also evacuated, thereby causing the pressure within the region adjacent the heating element **20** (which is vented to the atmosphere by the vent **15**) to force the now-softened liner **28** into conformity with the inner surface of the container side wall **12**. This combination of heat and pressure causes the liner **28** to smoothly conform to and be adhesively secured to the side wall **12**, at which point the heating element **30** is de-energized or removed. The side wall assembly, with the inner liner now firmly bonded to the side wall **12**, is allowed to cool. The vacuum pump **31** may then be turned off and the vacuum within the annular space within the vacuum chamber **10** released. The lid **13** is removed, the bonded side wall and liner assembly **12** taken out, and the process may then be repeated for another side wall assembly and inner liner **28**.

In an alternative embodiment of the present invention, as illustrated in FIG. 3, a container side wall **33** made of steel or other impervious material may also be utilized, but with the additional provision of a plurality of perforations or vent holes **34** provided around its periphery.

As in the case of fibre side walls, a circumferential reinforcing ring **36** is provided for stiffening the vulnerable chime area. In this embodiment it has been found to be possible to extend the lower edge of the reinforcing ring **36** below the level of the vent holes **34**. The entrapped air within the space between the inner liner **28** and the side wall **33** may still escape, however, because the reinforcing ring **36** is not rolled against the side wall **33** so tightly as to completely close off the vent holes **34**. The vent holes **34** are therefore preferably positioned so as to just be covered by the reinforcing ring **36** beneath its lower edge. They are protected by the ring **36** to prevent moisture or dirt from penetrating into the openings, while not being sealed to an extent that the escape of entrapped air is prevented.

It should be noted that it is also possible to carry out the invention by initiating operation of the vacuum pump **31** prior to or simultaneous with energization of the heating element **30**. In either event, the liquid-tight inner liner **28** is softened and made adhesive as it is drawn toward the side wall **12**, and is caused to adhere when contact is achieved through the exhaustion of the entrapped air. When this has been accomplished the heating is terminated, the vacuum released, and the completed side wall assembly removed as before.

The result is a container side wall **12** having, in the preferred embodiment, a continuously adhering liquid-tight lining **28** free of wrinkles and other imperfections. The lining is also free of any damage which might have otherwise been suffered from forming the chime or applying the reinforcing band **22** subsequent to the addition of the liner **28**, as is often encountered when such operations are performed on container materials having a previously applied plastic coating.

A complete container is then formed from the completed side wall assembly **12** by securing suitable top and bottom closures (not shown). For this purpose, the internal convolutions or beads **25** may be used as supports against which the closures may be secured in known fashion.

I claim in my invention:

1. Apparatus for forming a liquid-tight shipping container side wall, said apparatus comprising the combination of an annular vacuum vessel adapted to receive a tubular air-permeable side wall that is open at both ends and a preformed liquid-tight tubular liner of air-impermeable flexible sheet material disposed within said side wall and extending beyond the ends of said side wall, sealing gasket means at both ends of said vacuum vessel for forming a seal between said vacuum vessel and said side wall, said sealing gasket means pressing the end portions of said liner against the corresponding ends of said side wall when said end portions of said liner are turned over the corresponding ends of said side wall, said vacuum vessel and said sealing gasket means forming a substantially uniform annular vacuum chamber between the inner surface of said vacuum vessel and the outer surface of said side wall and extending along substantially the entire length thereof, a heating element disposed within the interior of said side wall to render said tubular liner plastically deformable, and means for drawing a vacuum within said annular vacuum chamber to draw said liner into adherent contact with substantially the entire inner surface of said side wall.

2. Apparatus according to claim **1** in which said side wall includes an inturned annular bead and a chime formed at one inner wall end of said side wall prior to positioning said liquid-tight liner within said side wall.

3. Apparatus according to claim **1** in which the air-permeable side wall is of fibrous material.

4. Apparatus according to claim **1** in which said side wall is of impervious material having a plurality of perforated vents.

(References on following page)

References Cited

UNITED STATES PATENTS

708,642	9/1902	Howard	93—77
1,993,751	3/1935	Reid	93—77
2,364,012	11/1944	Walton	229—14
2,736,065	2/1956	Wilcox	156—160
3,229,593	1/1966	Thompson	93—36.01
3,366,019	1/1968	McGee	93—36.01
3,390,618	7/1968	McArdle	93—36.01
2,328,798	9/1943	Gardner	93—36.01 X

2,748,673	6/1956	Winstead	93—36.01 X
3,126,797	3/1964	Carpenter	93—94
3,195,425	7/1965	Taggart	93—36.01
3,338,020	8/1967	McGee	93—36.01 X

WAYNE A. MORSE, JR., Primary Examiner

U.S. Cl. X.R.

53—27, 175; 93—36.01, 94