

Sept. 7, 1965

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3,204,825

MULTI-PLY LINER BAGS

Filed Oct. 23, 1961

3 Sheets-Sheet 1

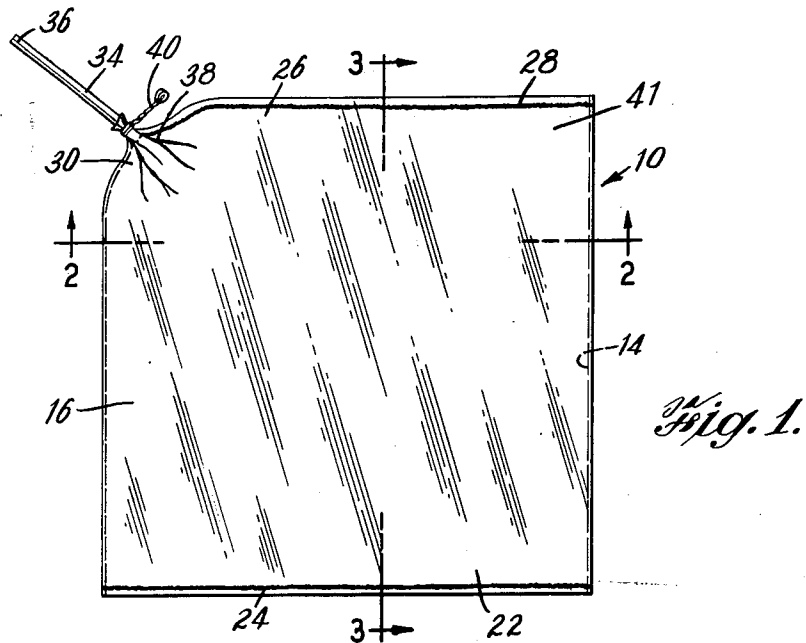


Fig. 1.

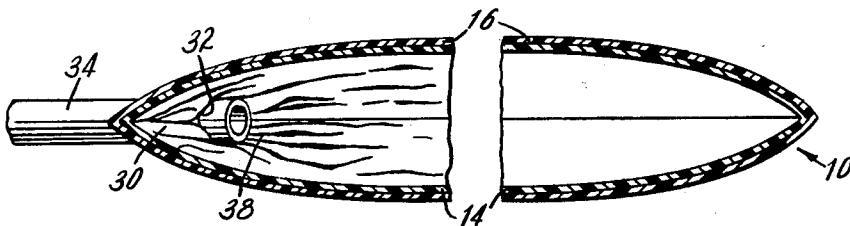


Fig. 2.

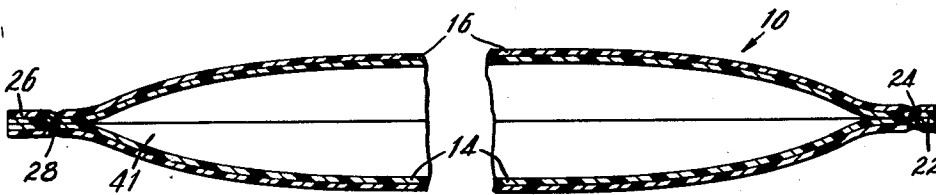


Fig. 3.

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3 Sheets-Sheet 2

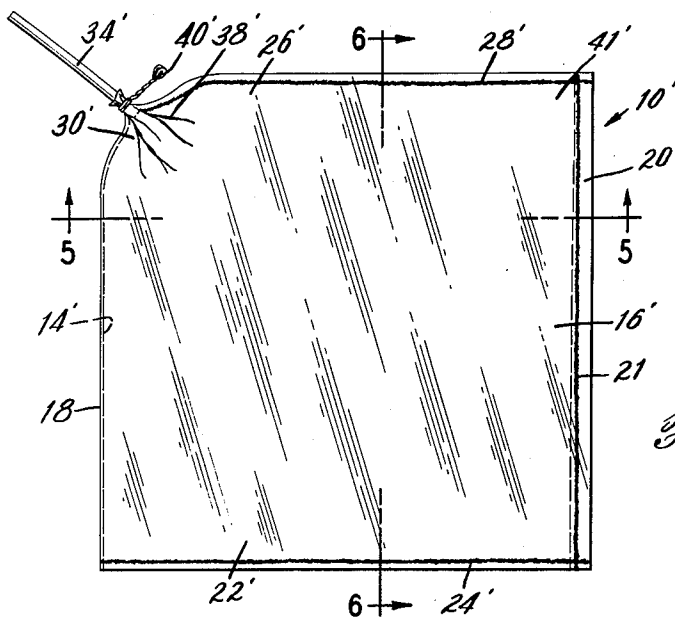


Fig. 4.

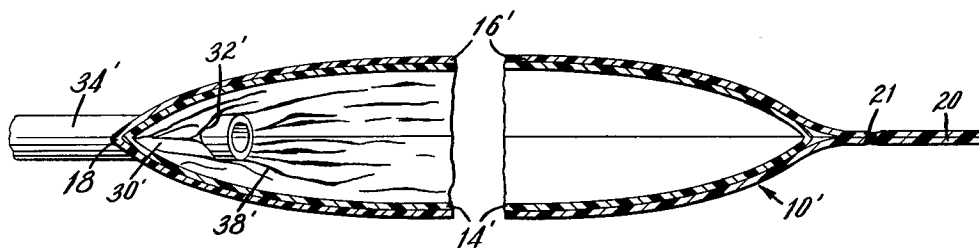


Fig. 5.

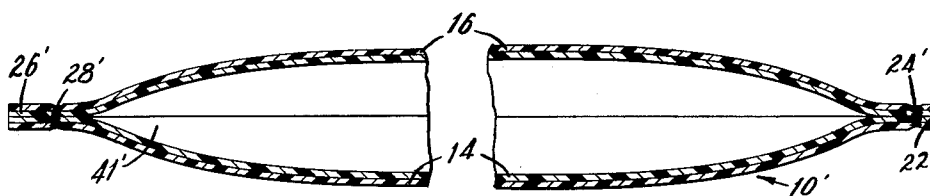


Fig. 6.

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MULTI-PLY LINER BAGS

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3 Sheets-Sheet 3

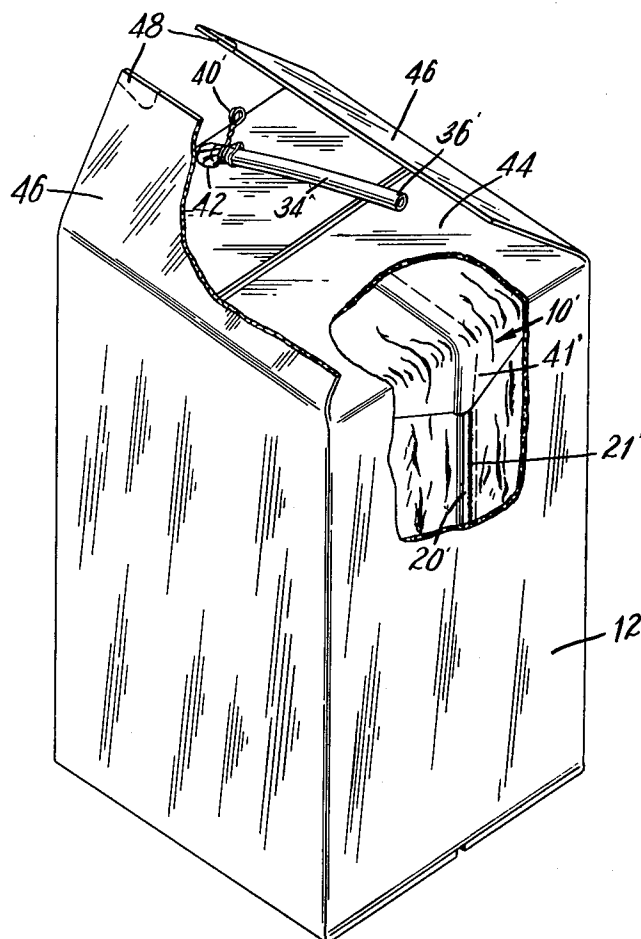


Fig. 7.

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3,204,825

MULTI-PLY LINER BAG

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Filed Oct. 23, 1961, Ser. No. 146,758
11 Claims. (Cl. 222-105)

This invention relates to a multi-ply thermoplastic film liner bag. More particularly, this invention relates to the use of said multi-ply liner bag in a rigid container for shipping, storing and dispensing such diverse items as milk, fruit juices, syrups and other liquids, as well as ice cream and pasty and pulverulent materials.

In an attempt to overcome the deficiencies of using metal, glass and wax-lined cardboard containers for shipping, storing and dispensing flowable materials, such as milk, plastic film liner bags shaped and supported in a rigid container commonly made of corrugated paper, are being used.

At the dairy, the plastic film liner bag generally having a filling and pouring spout is placed in the corrugated paper container and filled with milk. The container is then distributed, as a package, to restaurants and institutions for dispensing the milk therefrom. At the restaurant, the pouring spout is withdrawn from the package, and the package is set into a well-known refrigerated dispenser unit in an inverted position, and the pouring spout is passed through a (pinch clamp) dispensing valve.

In using such liner bags of plastic film for shipping milk, a high incidence of liner leakage has resulted from defects and particularly pinholes in the plastic liner bag, caused by a variety of factors most of which are related to the severity of the conditions in shipping milk in a plastic liner bag, within a rigid container, over rough country roads from the dairy to the user. Pinholes below the liquid level within the plastic liner bag cannot be tolerated because of leakage during the shipment. Pinholes at or above the liquid level line within the plastic liner bag are objectionable because when the package is inverted for dispensing, leakage will occur.

The presence of pinholes in the plastic film of the liner bag has been found to primarily result from environmental stress corrosion and flex fatigue of the plastic film especially where folds in the film existed. Such adverse effects are related to normal shipping motion which sloshes or moves the milk in and about the bag, thereby producing the physical effects of wave vibration and hydraulic hammer that result in the environmental stress corrosion and flex fatigue. The physical effects of wave vibrations and hydraulic hammer have been found to be particularly concentrated in any folds in the plastic film of the liner bag, flexing and unflexing said film folds; and this is where the greatest damage due to environmental stress corrosion and flex fatigue has occurred.

Also, the lactic acid and butter fat content of the liquid milk tend to react chemically with the plastic film of the liner bag, and thus promote environmental stress corrosion, and flex fatigue in the liner walls, particularly at or above the normal liquid level within the liner bag. In addition, punctures or abrasion in the liner bag from handling and contact with the rigid container, have contributed to the high incidence of pinholes in the liner bags of plastic film.

Furthermore, any slight leakage of the liquid-filled plastic liner bag is accentuated by the absorptive attraction of the supporting corrugated paper walls of the rigid container, and by the hydraulic head of the liquid contents on the pinhole.

Additionally, in using such liner bags for shipping milk or other perishable food products, if the bags are not formed with an essentially sterile interior and maintained

in such condition, undesirable flavor, odor and bacterial growth tend to be imparted to said products.

Among the objects of the present invention are to provide a novel multi-ply liner bag of flexible thermoplastic film for flowable materials and especially for milk; to provide such a multi-ply flexible thermoplastic liner bag which will resist stress corrosion, flex fatigue, abrasion and puncture from handling, shipping movement and prolonged storage in the inverted position; to provide such a bag which is flexible and will collapse to void all its contents; to provide such a multi-ply thermoplastic liner bag which is essentially sterile; to provide such a multi-ply flexible thermoplastic liner bag which is leakproof; to provide such a bag which can be made of a sufficiently inexpensive material that it can be disposed of after one use; and to provide such a bag which can be easily and economically made.

The objects of this invention are, in general, accomplished by providing a rigid container with a multi-ply leakproof, flexible collapsible liner bag for flowable food products comprising an inner ply of flexible polyolefin film characterized by being resistant to environmental stress corrosion and flex fatigue and by having an essentially sterile interior surface, said inner polyolefin film ply being a high molecular weight film-forming polyolefin resin having an intrinsic viscosity of at least about 1.0 and an outer ply of flexible polyolefin film characterized by being resistant to puncture and abrasion, said outer polyolefin film ply being a film-forming polyolefin resin having an intrinsic viscosity of not less than about 0.6, said inner and outer plies being separate, self-supporting, non-conjoint films.

The nature of the invention and the manner in which it may be practiced will become clear from the detailed description when taken in conjunction with the accompanying drawings forming this specification and wherein two illustrative types of multi-ply bags composed of the film plies of the present invention are shown. More particularly:

FIG. 1 is a side elevation of one form of a multi-ply thermoplastic liner bag which can be composed of the film plies of the present invention;

FIG. 2 is an enlarged cross-sectional view of the multi-ply thermoplastic liner bag of FIG. 1 taken along the lines 2-2 thereof;

FIG. 3 is an enlarged longitudinal sectional view of the multi-ply thermoplastic liner bag of FIG. 1 taken along the lines 3-3 thereof;

FIG. 4 is a side elevation of another form of a multi-ply thermoplastic liner bag which can be composed of the film plies of the present invention;

FIG. 5 is an enlarged cross-sectional view of the multi-ply thermoplastic liner bag of FIG. 4 taken along lines 5-5 thereof;

FIG. 6 is an enlarged longitudinal sectional view of the multi-ply thermoplastic liner bag of FIG. 6 taken along the lines 6-6 thereof; and

FIG. 7 is a pictorial view of a rigid container broken away to show the multi-ply thermoplastic liner bag of FIGS. 4-6 filled with a flowable material.

Referring to the details of FIGS. 1-3, there is shown a two-ply leakproof liner bag 10 having concentric inner and outer tubular film plies 14, 16.

The high incidence of liner leakage resulting from defects and particularly pinholes, is avoided by the present invention by providing such a multi-ply liner bag 10 with an inner ply 14 of flexible thermoplastic film and preferably polyolefin film resistant to environmental stress corrosion and flex fatigue, especially in any film folds, and an outer ply 16 of flexible thermoplastic film and preferably polyolefin film, resistant to abrasion and puncture.

ture, particularly caused by handling and contact with a rigid container 12, such as shown in FIG. 7.

The inner and outer film plies 14, 16 of the multi-ply liner bag 10 are concentric, coextensive flattened interiorly essentially sterile seamless tubular films of the required dimensions. For a five gallon capacity, such film plies 14, 16 are each typically 0.0015 inch thick, 20 inches in flat width and 23¼ inches long.

The bottom end 22 of the coextensive inner and outer film plies 14, 16 is sealed together with a transverse controlled pressure heat seal 24 extending across the width of the multi-ply liner bag 10. The top end 26 of the coextensive inner and outer film plies 14, 16 is sealed together with a transverse controlled pressure heat seal 28 leaving a ⅞ inch gap between one corner 30 of the top and film plies 14, 16 and the terminus of the heat seal 28, to provide a flattened opening 32 communicating with the interior of the multi-ply liner bag 10. Such opening 32 is provided for the insertion of a filling and pouring spout 34 in the form of a ⅞ inch diameter by 8 inch long rubber tube closed at its outer end 36 by a plug (not shown). The filling and pouring tube or spout 34 is inserted into the opening 32 in a sanitary manner and the bag inner and outer film plies 14, 16 at the corner 30 are gathered about the tube 34 into an overlapped twisted fold 38 and fastened to the rubber tube 34 by a conventional twist wire fastener 40.

To insure filling the multi-ply liner bag 10 with flowable material, such as milk, to a predetermined volume, such as 5 gallons, the length of said bag 10 is such as to provide a "freeboard portion" 41, such as about ½ inch. Accordingly, after filling the multi-ply liner bag 10 with flowable material, the film walls comprising the freeboard portion 41 can be loosely infolded to the normal milk level as shown in FIG. 7.

Referring to FIGS. 4-6 wherein like reference numerals are used to designate like elements shown in FIGS. 1-3, except that a prime (') is used after the numeral, a two-ply, leakproof, flexible, collapsible thermoplastic liner bag 10' is shown including an inner ply 14' of flattened, essentially sterile seamless flexible thermoplastic tubular film and an outer ply 16' of center-folded flexible thermoplastic sheeting circumscribed about said inner ply 14'.

As in FIGS. 1-3, the high incidence of liner leakage resulting from pinholes, is avoided by the present invention by providing such multi-ply liner bag 10' in combination, an interiorly essentially sterile inner ply 14' of flexible thermoplastic film and preferably polyolefin film resistant to environmental stress corrosion and flex fatigue especially in the film folds; and an outer ply 16' of flexible thermoplastic film and preferably polyolefin film resistant to abrasion and puncture, particularly caused by handling and contact with the rigid container 12 shown in FIG. 7.

In the multi-ply liner bag 10' shown in FIGS. 4-6 the thermoplastic sheeting center-fold 18 of the outer ply 16' is juxtaposed along one longitudinal edge of the inner flattened seamless tubular film ply 14' and the free edges 20 of the sheeting opposite its center-fold 18 are sealed together by a longitudinal controlled pressure heat seal 21 in juxtaposition with the other longitudinal edge of the inner flattened seamless tubular film ply 14'.

The bottom and top ends 22', 26' of the multi-ply liner bag 10' are heat sealed in the same manner as described and illustrated in FIGS. 1-3 with transverse heat seals 24', 28'. In the present embodiment the top end heat seal 28' terminates inwardly from the corner 30' adjacent said sheeting center fold 18, to provide a flattened opening 32' in the liner bag 10' for the filling and pouring spout 34', in the form of a tube, about which the film plies 14', 16' are gathered into the overlapped twisted fold 38' and fastened thereto by the conventional twist wire fastener 40'.

As in FIGS. 1-2, the length of the multi-ply liner bag 10' of concentric tubular film plies 14', 16' is such so as

to provide the freeboard portion 41' which can be loosely infolded to the normal milk level.

Typically, for a five gallon capacity multi-ply liner bag 10' the inner ply 14' of flattened seamless tubular film is 0.0015 inch thick, 20 inches in flat width and 23¼ inches long, while the sheeting of the outer ply 16' is 0.0015 inch thick, 42 inches wide in its unfolded condition, and 23¼ inches long.

Multi-ply liner bags of polyolefin film plies having inner and outer tubular film plies with the particular properties herein described, are admirably suited for containing flowable materials and particularly perishable materials, such as milk, because as mentioned they are essentially sterile and the high incidence of pinholes is avoided.

Among the reasons the multi-ply liner bags of the invention are admirably suited for the described purposes is that the physical effects in normal usage of wave vibration and hydraulic hammer on the inner film ply do not result in adverse film defects due to environmental stress corrosion and flex fatigue. This is particularly true in any folds in the multi-ply liner bag, such as the infolded free board portion 41 or 41' of bag 10 or 10', respectively, even with the flexing and unflexing of said folds incurred during normal shipping movement. Secondly, the inner film ply is selected for properties resisting chemical reaction from contact with the lactic acid and butter fat content of the liquid milk or other liquids. Thirdly, the outer ply of the multi-ply bag resists punctures or abrasion, particularly resulting from handling of the bag, and contact of said bag with rigid container. Fourthly, the interior of thermoplastic film melt-extruded into seamless tubing, such as by the blown-tube method described in U.S. Patent 2,461,975, is essentially sterile.

Moreover, multi-ply polyolefin liner bags having the aforescribed properties, are admirably suited for containing flowable materials, such as milk, because they do not impart an undesirable flavor thereto, and are heat sealable to prevent leakage thereof. In addition, a multi-ply liner bag of such polyolefin film plies is flexible and will collapse to void all its contents and is a sufficiently inexpensive material that it can be disposed of after one use.

Of particular preference for a liner bag for the shipping and dispensing of milk in a rigid container, is a multi-ply construction comprising in combination, an inner ply of polyethylene seamless tubular film that has a high tensile strength and flex modulus and is interiorly essentially sterile, and an outer ply of a polyethylene film that has a relatively high tear strength and elongation to break and a low coefficient of friction and is non-conjoint and non-laminated to the inner ply. A multi-ply liner bag having such an inner ply is resistant to environmental stress corrosion and flex fatigue and does not impart undesirable flavor, odor and bacterial growth to the products contained therein. Additionally, a multi-ply liner bag having such an outer ply is resistant to puncture and abrasion.

To obtain a multi-ply liner bag with the necessary combination of properties herein described, it is preferred to have an inner ply made of a high molecular weight film-forming polyethylene resin having an intrinsic viscosity of at least about 1.0 and preferably about 1.0 to 2.5 and optimally about 1.3 to 2.0; a melt index of less than about 2.0 and preferably less than 0.2 and optimally about 0.05 to 0.10; a density of not greater than 0.935, and preferably less than 0.925 g./cc. and formed into tubular film such as by the blown-tube method described in U.S. Patent No. 2,461,975. In such a construction, a multi-ply liner bag is preferred wherein the outer ply is made of a film-forming polyethylene resin, which when formed into film, is resistant to puncture and abrasion and has a low coefficient of friction. For the outer ply we prefer a film-forming polyethylene resin having an intrinsic viscosity of at least about 0.6, and optimally greater than 1.0; a melt index of less than 10, and preferably less than about 2.0; and preferably a density of not more than 0.935.

Surprisingly, multi-ply liner bags comprising, in combination, an inner ply made of the polyethylene herein described and thereafter formed by the blown-tube method and an outer ply made of the polyethylene herein described, have been found to avoid the high incidence of defects which produce the undesired leakage to a significantly greater extent than single ply film liner bags or multi-ply liner bags wherein the plies are laminated.

This is clearly shown by a shipping and storage test for leaks that shows good agreement with actual shipping conditions of milk in trucks operated over country roads, followed by a storage period. The simulated shipping-

CONTROL BAGS

2-----	A-----	.003 single ply ³ -----	16	16
3-----	B-----	.003 single ply ³ -----	20	20
4-----	A-----	Two-ply: ² .0015-----	83	83
5-----	B-----	.0015-----	83	66

¹ Vibration test hereinbefore described.

² Two-ply bags of construction herein described and shown in Figs. 4-6.

³ Bags made from seamless tubing such as described in U.S. Patent No. 2,461,975.

⁴ Four three minute vibration cycles.

TABLE III

Properties of resins from which polyethylene films blown tube method ¹

Polyethylene resin	Film thickness (inches)	Tensile strength (p.s.i.)		Flex modulus (p.s.i.)		Elong'tn to break (percent)		Impact (in.-lb./mil)	Coeff. of friction
		M.D.	T.D. ²	M.D.	T.D.	M.D.	T.D.		
A-----	.0014	³ 4,300	³ 4,400	³ 27,100	³ 32,000	660	1,160	24.7	.46
B-----	.0015	2,620	2,360	15,100	17,900	4862	4,130	8.9	.35

¹ Blown tube method, such as described in U.S. Patent 2,461,975 wherein the blow ratio was 12 transverse direction to 4 machine direction.

² M.D. (Machine Direction), T.D. (Transverse Direction).

³ Desirable tensile strength, flex modulus for inner film ply of present invention.

⁴ Desirable elongation to break and coefficient of friction for outer film ply of present invention.

storage test is conducted by filling the liner in the rigid container with 45° F. tap water, closing it off and placing it on a platform which is vertically oscillated a distance of one inch at 300 vibrations per minute in succession of three minute vibration cycles and thereafter subjecting it to a 480 minute storage period. Each cycle was considered to be the equivalent of 100 miles of truck shipping over country roads.

The following tables show the results of such leakage for liner bags made of multi-ply bags of the present invention as compared to single ply and multi-ply bags employing the same films but not in the required combination of the present invention.

Table I sets forth the polyethylene resin properties of the films used to form the bags. Table II sets forth the percentage of bags surviving such a vibration and storage test. Table III sets forth suitable film properties for the inner and outer film plies of the multi-ply liner bag of the present invention.

TABLE I

Liquid-filled liner bags surviving vibration-storage test ¹ are formed

Polyethylene resin	Intrinsic viscosity	Melt index	Density
A-----	1.3	0.097	.920
B-----	0.8	1.60	.919

TABLE II

Liquid-filled liner bags surviving vibration-storage test ¹

Example of two-ply bags ² of this invention			Percent of liner bags with no leaks	
Test	Type of liner bags		12 minutes ⁴ vibration	480 minutes storage
	Polyethylene resin	Film ply thickness (inches)		
1-----	{ A----- B-----	Two-ply: ² .0015 inner ply----- .0015 outer ply-----	100	100

The test methods determining the values and units for such values set forth herein and particularly in Tables I and III are:

Tensile strength (in pounds per square inch) as measured by test procedure ASTM D882-56T

Flex modulus at 1% elongation (in pounds per square inch) as measured by test procedure ASTM D1530-58T

Elongation at break (in percent) as measured by test procedure ASTM D882-56T modified to be conducted at 135° C.

Impact (inch pounds per mil) at room temperature as measured by a 2.3 pound steel ball dropped 2.58 feet (Modern Packaging, p. 150, June, 1954)

Coefficient of friction (film-to-film) is the numerical result of dividing the force in grams required to slide 4.5 square inches of film of the same composition at a rate of 24 inches per minute and under a weight load of 240 grams in sliding contact, by 240

Intrinsic viscosity (in deciliters per gram) as measured by test procedure ASTM D1601-58T

Melt index (flow in grams per 10 minutes) as measured by test procedure ASTM D1238-52T

Density (in grams per cubic centimeter) in a gradient column made up of water, methanol, and sodium acetate at 25° C.

As shown in Test 1 of Table II, the multi-ply bag of the present invention; i.e., multi-ply bag with the desired differing film-forming resin properties for the inner and outer plies did not develop any defects which produce leakage. In contrast, however, both the single ply bags (Tests 2 and 3) and two-ply bags (Tests 4 and 5) being laminated and not having the desired differing film-forming resin properties for the inner and outer plies had developed appreciable defects which produced water leakage. Furthermore as shown in Table II, the percent of liquid-filled liner bags surviving the vibration tests increased markedly as the construction was changed from a single ply bag of 3 mil thickness of Tests 2 and 3 to a multi-ply construction of two plies, each of 1½ mil thickness.

Table III shows that films, such as polyethylene film type "A," characterized by high tensile strength and flex

modulus and employed as an inner ply of a multi-ply liner bag, in combination with films such as polyethylene film Type "B," characterized by high resistance to "percent elongation to break" and a low coefficient of friction and employed as an outer ply of a multi-ply liner bag, provided a multi-ply liner bag wherein no bags failed due to leakage when subjected to a vibration test simulating actual shipping conditions.

Table I shows the intrinsic viscosity, melt and density characteristics of the film-forming resins for a preferred embodiment of multi-ply liner bag. An important physical characteristic of film-forming polyolefin resins, such as used in the preferred embodiment, is the intrinsic viscosity. Polyethylene film "A" is preferably made from a film-forming resin that has an intrinsic viscosity about 1.0, characteristic of a resin that has a high molecular weight and properties ideally suited for an inner ply of a multi-ply liner bag. Film "B" is preferably made from a film-forming resin that has an intrinsic viscosity of at least about 0.6 and a density of not more than 0.935, and properties suited for an outer ply of a multi-ply liner bag.

While it is preferred to form the inner and outer plies of the multi-ply bags with polyethylene film herein described, other polyolefin films including polyethylene copolymers, polypropylene, copolymers of ethylene and propylene, and mixtures of polyethylene and polypropylene, as well as mixtures of such polyolefins and other film-forming polymers which have the aforescribed properties, can be used. Desirably, the inner film ply of the multi-ply liner bag is made of film-forming polyolefin resins having an intrinsic viscosity of at least about 1.0 and the outer film ply is made up of film-forming polyolefin resins having an intrinsic viscosity of not less than about 0.6. Other flexible thermoplastic films having a flex modulus of at least about 25,000 pounds per square inch in the longitudinal and transverse directions can also be used for the inner ply of the multi-ply liner bags. Furthermore, flexible thermoplastic materials having a coefficient of friction of less than about 0.40 can be used for the outer ply.

The size of the liner bag can vary, depending on the amount of flowable material to be handled. The liner bag 10 or 10' herein described and illustrated in the drawings has a five-gallon capacity. Liner bags having a three-gallon, ten-gallon, etc. can also be used.

The number of plies for any given liner bag will depend on among other things, the weight, volume and type of material to be contained in the bag, and the shipping conditions likely to be encountered. For example, the five gallon, two-ply polyethylene liner bag 10 or 10' herein described and illustrated is ideally suited for use in combination with the rigid container 12 for shipping milk over rough country roads and storing it for long periods of time. When more than two plies are desired, the intermediate ply(ies) can be made of film which is resistant to environmental stress corrosion and flex fatigue.

Depending upon the number of plies used, individual ply thickness need only be $\frac{1}{2}$, $\frac{1}{3}$ or $\frac{1}{4}$ as thick as a single ply liner. Moreover, multi-ply liner bags have been found to be stronger and more flexible than single ply bags of the same total weight of material.

Each ply of film of the liner bag 10 is self-supporting. Films having a thickness to provide the required durability, typically of .0010 to 0.0020 inch or more, have been found satisfactory for such usage.

While it is preferred to have multi-ply liner bags which are made of separate and distinct plies; i.e., non-conjoint and non-laminated, if desired multi-ply bags made of laminated film plies, as well as film which can be made by coaxially melt-extruding tubular films can also be used.

With respect to forming the essentially sterile multi-ply thermoplastic liner bag, the interior of thermo-

plastic film melt-extruded into seamless tubular film, such as by the blown-tube method described in U.S. Patent 2,461,975, is sterile.

Accordingly, one method of fabricating the liner bags 10' of FIGS. 4-6 is by forming the inner film ply 14' from a continuous length of flattened seamless tubular film, and forming the outer concentric film ply 16' by center-folding and circumscribing sheeting about said continuous length of flattened seamless tubular film with the sheeting center-fold 18 in juxtaposition with one side of said flattened seamless tubular film and heat sealing the free edges 20 of the sheeting 16' together in juxtaposition with the other side of the flattened seamless tubular film. The bottom end 22' of the multi-ply liner bag 10' is formed by transversely heat sealing the inner and outer plies 14', 16' of flattened seamless tubular film and center-folded heat sealed, tubular sheeting, together across the width of said bag 10'. The top end 26' of multi-ply liner bag 10' is formed by transversely heat sealing said inner and outer plies 14', 16' together, spaced from the heat seal of the bottom end 22', in such manner so as to leave a gap 32' in the corner 30' adjacent the sheeting center-folded 18'. Thereafter, the thusly heat sealed film plies 14', 16' can be cut into unit bags 10' and the filling and dispensing spout can be inserted in the gap 32' and open to the interior of the inner film ply 14' to maintain the essentially sterile interior of the inner film ply, such as by inserting the rubber tube 34' in the gap 32', gathering the film plies 14', 16' into a twisting, leakproof fold about the tube 34', and fastening the overlapped twisted fold of film plies 14', 16' such as by a conventional twist wire 40'.

A production operation for the fabrication of liner bags for milk shipping containers made according to the described method is regularly tested for sterility of the liner bag interior. This test is conducted by the procedure described in the "Standard Methods for the Examination of Dairy Products," 11th Edition, 1960, published by the American Public Health Association, Inc. The allowable total bacterial colony count is stated in the regulation to be 18,900 for a five-gallon size of milk container.

Assembled liner bags made by the described method are regularly tested on a production basis of one test bag per 500 per operator. Ninety-five percent of the bags tested are sterile. Five percent of the liner bags are showing a total count of never more than 2 colonies per plate, or a total of 100. Thus, it is seen that this method is a distinct and useful advance in the art of making shipping containers for milk.

In forming an interiorly essentially sterile multiply thermoplastic liner bag 10 of FIGS. 1-3, continuous lengths of concentric lengths of flattened seamless tubular films formed by the blown tube method can be used as the inner and outer plies 14, 16. The bottom and top ends 22, 26 can be formed by the same method employed for unit liner bags of FIGS. 4-6. Thereafter, the thusly transversely heat sealed film plies 14, 16 can be cut and the tube 34 inserted into and fastened to the multi-ply bag 10, also as hereinbefore described.

The heat seals in the multi-ply liner bags herein described can be formed by well-known techniques, such as by rotating heated sealing wheel cooperating with a resilient surface for the longitudinal seals 21 of the bag 10' of FIGS. 4-6; and by an intermittently operated heated bar or impulse sealing bar for the transverse seals 24, 28 of multi-ply liner bag 10 (FIGS. 1-3) and 24', 28' of multi-ply liner bag 10' (FIGS. 4-6).

In using the multi-ply liner bags 10' for milk, a liner bag 10' is placed in a rigid container, such as the paper-board container 12 shown in FIG. 7. The multi-ply bag 10' is that shown in FIGS. 4-6, but it is to be understood that the liner bag 10 of FIGS. 1-3 can be used instead. The plug (not shown) in the tube or spout 34' is removed and after drawing a vacuum on the liner bag

10', it is filled with a measured amount of milk in place in the container 12. The spout 34' is then closed off again such as by another plug and pulled through a hole 42 in one of the first folded flaps 44 of the container 12. The freeboard portion 41' of the liner bag 10' is thereafter loosely folded about the normal milk level. The spout 34' is then laid flat upon the first fold flaps 44 and held in place by the second fold flaps 46 of the container 10 when they are pasted down over the first fold flaps 44.

The milk containing container 12 is delivered to dairy customers, such as restaurants and institutions. The tube or spout 34' is then withdrawn by removing tabs 48 from the second fold flaps 46, the container 12 is inverted and placed into a refrigerated dispenser unit, and the tube 34' threaded through a pinch valve (not shown). The plug in the tube 34' is removed and the dispensing of the milk from the container 12 is commenced.

In place of the milk, the multi-ply liner bag of the present invention can also be used for shipping, storing and dispensing other flowable materials, including fruit juices, syrups, and other liquids, as well as ice cream and pasty and pulverulent materials, such as pudding, jellies, cake mixes, etc.

It will be obvious to those skilled in the art that various changes and modifications may be made in the foregoing description without departing from the spirit and nature of the present invention.

What is claimed is:

1. A flexible, leakproof, collapsible multi-ply liner bag for flowable food products comprising an inner ply of flexible polyolefin film characterized by being resistant to environmental stress corrosion and flex fatigue and by having an essentially sterile interior surface, said inner polyolefin film ply being a high molecular weight film-forming polyolefin resin having an intrinsic viscosity of at least about 1.0; and an outer ply of flexible polyolefin film characterized by being resistant to puncture and abrasion, said outer polyolefin film ply being a film-forming polyolefin resin having an intrinsic viscosity of not less than about 0.6, said inner and outer plies being separate, self-supporting, non-conjoint films.

2. A package for holding, shipping and dispensing a flowable material, comprising in combination a rigid container, and the flexible, leakproof, collapsible, multi-ply liner bag of claim 1.

3. The multi-ply liner bag according to claim 1, wherein the inner and outer polyolefin film plies comprise film-forming polyethylene resins.

4. In a flexible, leakproof, collapsible multi-ply liner bag for a flowable material, an inner polyethylene film ply comprising a film-forming polyethylene resin having an intrinsic viscosity of at least about 1.0 and a density of not more than 0.935, and wherein said inner polyethylene film ply is characterized by being resistant to environmental stress corrosion, flex fatigue; and an outer polyethylene film ply comprising a film-forming polyethylene resin having an intrinsic viscosity of not less than about 0.6 and a density of not more than 0.935, and wherein said outer polyethylene film ply is characterized by being resistant to puncture and abrasion, said inner and outer plies being separate, self-supporting, non-conjoint films.

5. In a flexible leakproof, collapsible multi-ply liner bag for perishable flowable products, an inner polyethylene film ply comprising a film-forming polyethylene resin having an intrinsic viscosity of about 1.0 to 2.5 and a density of not more than 0.935, and wherein said inner polyethylene film ply is characterized by being resistant to environmental stress corrosion, flex fatigue and interiorly essentially sterile; and an outer polyethylene film ply comprising a film-forming polyethylene resin having an intrinsic viscosity of at least about 0.6 and a density of not more than 0.935, and wherein said outer polyethylene film ply is characterized by being resistant to puncture and abrasion, said inner and outer plies being separate, self-supporting, non-conjoint films.

6. In a flexible, leakproof, collapsible multi-ply liner bag for milk, an inner ply of seamless polyethylene tubular film comprising a film-forming polyethylene resin having an intrinsic viscosity of about 1.0 to 2.5 and a density of not more than 0.935, and wherein said inner seamless polyethylene tubular film ply is characterized by resistance to environmental stress corrosion, flex fatigue and interiorly essentially sterile; and an outer polyethylene film ply comprising a film-forming polyethylene resin having an intrinsic viscosity of at least about 0.6 and a density of not more than 0.935, and wherein said outer polyethylene film ply is characterized by being resistant to puncture and abrasion, said inner and outer plies being separate, self-supporting, non-conjoint films.

7. The multi-ply liner bag according to claim 6 wherein the inner ply of seamless polyethylene tubular film has a flex modulus of at least about 25,000 pounds per square inch, and the outer ply of polyethylene film has a coefficient of friction of less than about 0.50.

8. A package for holding, shipping and dispensing milk comprising a rigid container, a flexible, leakproof, collapsible, multi-ply liner bag for containing said milk, and a filling and dispensing tube affixed to said multi-ply liner bag and open to the interior of said milk containing multi-ply liner bag, said multi-ply liner bag having an inner ply of seamless tubular film comprising film-forming polyethylene having an intrinsic viscosity of about 1.0 to 2.5 and density of less than 0.935 and wherein said inner film ply is characterized by being interiorly essentially sterile, resistant to environmental stress corrosion and flex fatigue, and an outer ply of concentric tubular film comprising film-forming polyethylene having an intrinsic viscosity of at least 0.6 and a density of less than 0.935 and wherein said outer film ply is characterized by being resistant to puncture and abrasion, said inner and outer plies being separate, self-supporting, non-conjoint films.

9. In combination with a rigid container, a flexible, leakproof, collapsible multi-ply liner bag within said container for holding, shipping and dispensing a flowable material, said multi-ply liner bag being of such length so as to provide a freeboard portion to insure filling the flowable material to a precise predetermined volume, thereby effecting a normal material level within said multi-ply liner bag below the upper end thereof and with said freeboard portion being loosely infolded to said normal material level, the inner ply of said multi-ply liner bag comprising a polyolefin film characterized by being a high molecular weight film-forming polyolefin resin having an intrinsic viscosity of at least about 1.0 and by being resistant to environmental stress corrosion and flex fatigue primarily effected by normal shipping motion which causes the flowable material to move in and about the film folds of the infolded freeboard portion, thereby flexing and unflexing the folds therein, the outer ply of said multi-ply liner bag comprising a polyolefin film characterized by being a film-forming polyolefin resin having an intrinsic viscosity of not less than about 0.6 and by being resistant to puncture and abrasion caused by handling and contact with the rigid container, said inner and outer plies being separate, self-supporting, non-conjoint films, and a material filling and pouring spout affixed to the multi-ply liner bag and open to the interior of the liner ply.

10. The multi-ply liner bag according to claim 9, wherein the inner polyolefin film ply comprising a film-forming polyethylene resin having an intrinsic viscosity of at least about 1.0 and a density of not more than 0.935, and the outer polyolefin film ply comprising a film-forming polyethylene resin having an intrinsic viscosity of at least about 0.6 and a density of not more than 0.935.

11. The multi-ply liner bag according to claim 1, wherein the inner and outer polyolefin film plies comprise film-forming polyethylene resins, said inner polyethylene film ply being a film-forming polyethylene resin having an

11

intrinsic viscosity of about 1.0 and 2.5 and a density of not more than 0.935, and said outer polyethylene film ply being a film forming resin having an intrinsic viscosity of at least about 0.6 and a density of not more than 0.935.

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