July 10, 1973 T. D. TROUGHTON ET AL 3,745,035

CONTAINER LINING METHOD

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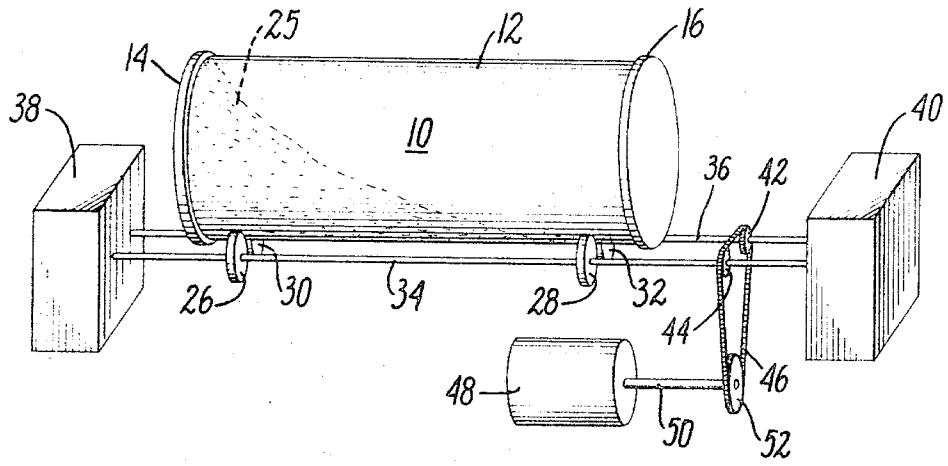


FIG. 1

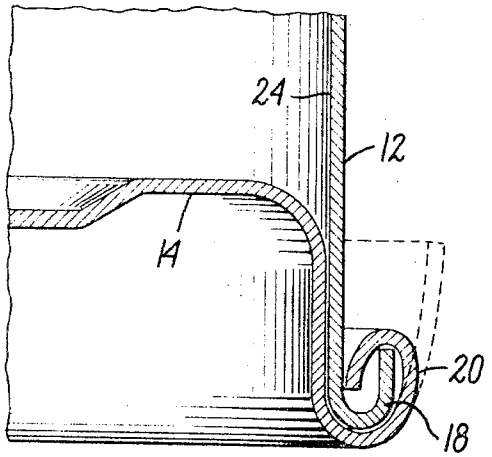


FIG. 2

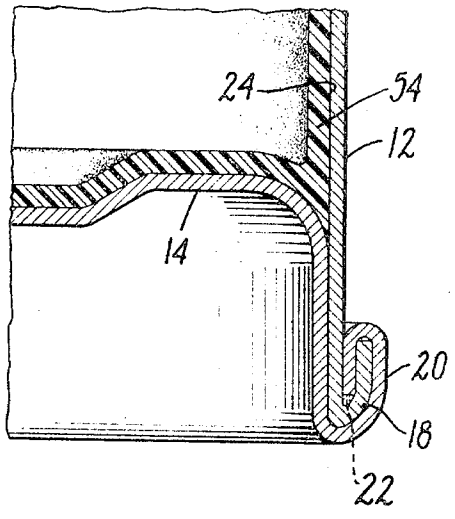


FIG. 3

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CONTAINER LINING METHOD

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Int. Cl. B44d 1/094
U.S. Cl. 117—18 10 Claims

ABSTRACT OF THE DISCLOSURE

A method for protectively lining containers by heating liner-forming material disposed on the container interior surfaces wherein a single end-closure member is secured in air-permeable relation to the container casing and so maintained during heating of the liner-forming material.

BACKGROUND OF THE INVENTION

(a) Field of the invention

This invention relates to protectively lining containers and more particularly to a method for forming a coating on the interior of a closed-end metal container.

(b) Description of the prior art

The widespread use of polymeric and like compositions, e.g. polyethylene, for protecting the surfaces of containers from contamination by chemicals stored therein has occasioned numerous container lining processes. In general, these processes are initiated with the introduction of thermoplastic lining material in an unlined container through the open end thereof, the container being heated either prior to or after such material introduction to a temperature above the melting temperature thereof. The introduced material, typically in powdered form, is agitated, e.g by container rotation, to distribute the same on the container interior sidewalls and the interior surface of the container end-closure member. By virtue of the preheating of the container, the material is softened and particles thereof adhere to the container. Upon further heating of the container, generally referred to as the baking step, the material is elevated to a temperature above its melting point and becomes flowable, thereby coalescing to form a continuous lining adhering to the container. Following completion of the baking step, the container is cooled to solidify the lining, thus providing a container having a liner comprising a continuous pinhole-free film.

During the initial course of the baking step, as air entrapped by the lining expands, large bubbles and "pipes" appear throughout the interfaces between the lining and container sidewalls and end-closure member and particularly in the fillet at the juncture of the container sidewalls and end-closure member. In practice, in order to "heal" such bubbles and pipes to yield a continuous air-free fillet and film, it is desirable to bring about a contraction of such entrapped expanded air. Thus, in practice, baking is preferably performed as a two-stage step, involving a first stage conducted at an elevated temperature above the lining material melting point providing said flowability with attendant entrapped air expansion and a second stage conducted at a lower elevated temperature at which air contraction occurs. This practical need for two-stage baking in known container lining processes is evidently disadvantageous as respects production efficiency.

Another shortcoming of such processes is the extent of time required for the cooling of lined containers. This shortcoming takes on particular significance where cooling is accomplished by ambient air and involves function other than mere lowering of container temperature to a level permitting handling thereof. Thus, in instances wherein it is desired that the lining adhere to the upper

portion of the container sidewalls, but not adhere to the lower portions of the container sidewalls and the interior surface of the end-closure member, a release agent is applied to the preheated container prior to the material introduction step. The release agent adheres to the surfaces to which it is applied and the lining adheres to the release agent during the course of the process generalized above. In the course of the cooling step thereof, as the container cools to a temperature substantially below the preheating temperature, the lining contracts and the release agent permits the lining to pull away from the container sidewalls. By such release feature, the container lining is rendered less susceptible to cracking when the container is subjected to shock in handling. To provide such release, it is necessary to provide complete cooling of the lined container and to this extent "quenching" baths for cooling the heated lined container or like forced cooling apparatus are sometimes provided. Such apparatus evidently increases production costs. On the other hand, the extensive time required where cooling by ambient air is employed derogates production efficiency.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a simplified and efficient method for protectively lining containers.

It is a more particular object of this invention to provide a method for protectively lining containers with thermoplastic compositions permitting simplification of the baking step and reduction in cooling time and apparatus requirements.

In the efficient attainment of these and other objects, the method of the invention provides for a preconditioning of the container to be lined such that a uniform temperature may be used throughout the baking step and such that increased communication is provided between the lining and a cooling ambient environment.

In brief summary of the invention, in such preconditioning, the container is provided with a single mechanically unsealed and unseamed end-closure member whereby the container end-closure is rendered air-permeable. Subsequent to the completion of all lining process steps, the end-closure member is mechanically sealed and may also be seamed.

The foregoing and other objects and features of the invention will be evident from the following detailed description of preferred methods and from the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a container in association with apparatus for practice of the invention.

FIG. 2 is a partial sectional view of the end-closure member of the container of FIG. 1 arranged prior to practice of the invention.

FIG. 3 is a sectional view of the end-closure member of the container of FIG. 1 upon completion of practice of the inventive process.

DETAILED DESCRIPTION OF PREFERRED PROCESSES

Referring to FIG. 1, container 10 comprises a cylindrical hollow metal casing 12 having a bottom end-closure member 14. The top or open end of container 10 typically includes a bead 16 adapted to facilitate openable closure thereof in usage as a storage unit for metal-corrosive liquids or the like.

In FIG. 2 it will be seen that casing 12 includes a curled lip 18 at the bottom end thereof and that end-closure member 14 includes a skirt 20 adapted to be turned over lip 18 for securing end-closure member 14 and casing 12. Upon completion of this securing operation, the

container closure thereby provided is air-permeable and it has been customary heretofore to fill the trough intervening skirt **20** and casing **12** with a plastic sealant such as is indicated in FIG. 3 by reference numeral **22** and to crimp members **18** and **20** as shown. In accordance with the invention, such crimping or seaming is postponed and container **10** is employed initially with the air-permeable container closure of FIG. 2.

Upon the FIG. 2 preconditioning of container **10**, the container is preferably heated in an oven (not shown) to a temperature above the melting point of the intended lining material. Thus, where it is intended to line the container with polyethylene, the container is preheated to approximately 525° F. The interior surfaces of container sidewall **24** in the vicinity of bottom end-closure member **14** and the interior surface of bottom end-closure member **14** are preferably coated with a composition adapted to release an adhering polyethylene film in a low temperature environment. By way of example, such release agent may be applied, by roller coating or by spraying, to the entire bottom end-closure member of an eighteen-gauge fifty-five gallon full open head container and to the lower-most nine inches of the interior sidewall thereof. Various epoxy phenolic release agents are commercially available for selectively releasing adherent polyethylene films and can withstand the process temperatures without degradation.

Upon removal of the container from the preheating oven, a measured amount of particulate liner-forming material **25**, e.g. polyethylene powder, sufficient to provide a lining of desired thickness, is introduced into the container while same is in a vertical position. Various low, medium and high density polyethylene resins are commercially available for such use, and it is preferable to use such resins having melt indices of unity and larger with stabilizers added to provide heat stability.

The container is next displaced to a horizontal position as shown in FIG. 1 whereby the lining material not "picked up" by or otherwise adhering to the interior surface of end-closure member **14** and lower portions of sidewall **24** is distributed along the lowermost sidewall surface. The outer surface of the casing is supportably disposed on rollers **26, 28** and **30, 32** respectively mounted on shafts **34** and **36**. Bearing supports **38** and **40** are associated with the shafts and sprocket wheels **42** and **44** secured to the respective shafts are rotated by endless chain **46** itself driven by drive means **48** through shaft **50** and sprocket wheel **52**. Container **10** is rotated by the apparatus of FIG. 1 to distribute the introduced material throughout the interior sidewall surfaces.

Whereas the preheat temperature was above the melting point of the lining material, complete melt of the lining material does not occur during such material distribution step since the container is not provided with additional heat to compensate its heat loss to the lining material and the environment.

Following material distribution, the container is introduced into another oven which is maintained at a temperature sufficiently elevated to provide complete melting of the distributed material. A continuous lining **54** (FIG. 3) is thereby provided and adheres to the interior sidewalls of the container and the interior surface of the end-closure member, extending into the fillet area. Baking is maintained for a readily predetermined time period in accordance with the lining material which is employed.

The lining, during the course of baking, and upon completion thereof, is characteristically distinct from linings heretofore provided for lined containers after baking at a single baking temperature in that the customary "pipes" and air bubbles are not evident or are substantially minimized therein.

Presumably, in the course of the material distribution step and in the initial portion of the baking step, air, either resulting from natural aeration of the porous lining mixture or air ambient thereto, tends, as in prior practice, to be enveloped interiorly of the lining as same forms. Apparently, under the continued influence of the baking heat, such air expands, as in prior practice. Where the container is not preconditioned as discussed above, this air is entrapped, causing large bubbles and "pipes" to be evident in the film. During the requisite second stage of baking in the prior practice, presumably, such entrapped expanded air contracts with the lower temperature during this stage, and upon completion of baking or more particularly upon completion of the second stage of baking in the prior practice, wherein oven temperature is maintained below the melting point of the lining material, the bubbles and "pipes" disappear from the film or are substantially minimized therein.

By way of explanation of such improved performance as is evidenced in the method of the invention, it is posited that the air-permeability of the bottom end-closure member permits free communication between the ambient environment and the lining-container interfaces throughout practice of the method, and more immediately, between the ambient environment and the fillet at the juncture of the lower sidewall and end-closure member. Thus, air tending to expand upon baking of the lining is apparently not entrapped between the film and casing as evidenced by the substantial absence of air bubbles and "pipes" in the film throughout practice of the method of the invention. Presumably, such air tending to expand migrates freely to and through the air-permeable end-closure member.

With such presumed substantially free egress of air tending to expand from lining-container interfaces, the requirement heretofore for enforced contraction of entrapped expanded air is eliminated. Thus, simplified baking is performed at a single temperature above the crystalline melting point of polyethylene in the referenced example without need for continuance of baking thereafter at a further lower temperature, with attendant improvement in production efficiency.

Upon completion of the baking step, the lined container is removed from the oven and the cooling step commences. This step is preferably practiced without accessory cooling apparatus, such as quenching baths or the like, by merely allowing the lined container to stand for a period of time in such position that the entire surface of the unseamed end-closure member is in communication with the ambient environment.

Whereas egress of air tending to expand during baking was advantageously enabled by the air-permeable end-closure feature as above described, ingress of ambient air through the end-closure member to the fillet presumably occurs during this cooling step, as is evidenced by the increased speed at which cooling takes place as contrasted with prior practice. Thus, the lined container is readied for normal handling in a substantially shorter period of time. Where a release agent is used, the lined container is likewise readied for use in shock environments in a substantially shortened time period, since concomitant advantage resides in the increased speed with which the release agent becomes operative to bring about the desired condition of non-adherence of the lining to the container lower sidewall and interior end-closure member surface. In terms of relative cooling times in ambient air, the improvement in practice in accordance with the invention results in time reductions in the order of hours versus days.

After liner release, the air-permeable end-closure member of the lined container is crimped as shown in FIG. 3. By this operation a mechanical seal, i.e. a permanent securement, is provided for casing **12** and end-closure member **14**. As indicated by the dotted line showing for sealant **22** in FIG. 3, use of such sealant is optional. Where the sealant is used, the same is so placed in the trough intervening members **18** and **20** (FIG. 2) during the aforementioned preconditioning of the container as

to permit permeation around the sealant compound. The end-closure assembly thus retains air permeability even where the sealant is used.

The use of the release agent in the foregoing preferred practice of the method of the invention is also optional. Thus, where the container is not likely to be subjected to such handling as to transmit cracking or rupturing shock to a liner adhering to the entire interior surface thereof, the release agent may be dispensed with.

Further evident variations of the foregoing preferred practice may be introduced, such as, for example, distribution of introduced material by means other than container rotation apparatus and preconditioning of the container to render same air-permeable other than by the preferred loose mechanically unsealed securement of the container casing and end-closure member. By way of example of the latter variation, the end-closure member of a sealed container may be provided with minute apertures below the fillet area prior to baking, and the apertures may be sealed upon completion of cooling. Thus, the foregoing preferred method is intended in an illustrative and not in a limiting sense. The true spirit and scope of the invention will be evident from the following claims.

What is claimed is:

1. A method for providing a lined container comprising the steps of:

(a) providing a hollow casing and securing a closure member in air-permeable relation to one end thereof to form a container having a fillet extending between said casing and said closure member; then

(b) applying particulate liner-forming material to the interior surfaces of said container; and then

(c) heating said container to a temperature sufficient to cause and liner-forming material to form a continuous film adhering to said container,

thereby providing a continuous lining on said interior surface of said casing and on the interior surface of said closure member and extending into said fillet.

2. The method claimed in claim 1 wherein said securement of said casing and end-closure member is rendered substantially air-impermeable after completion of said material heating by application of a sealant to said securement.

3. The method claimed in claim 1 wherein said liner-forming material is polyethylene.

4. The method claimed in claim 1 including the further step of applying to a portion of said casing and to said closure member a substance adapted to release said adhering film upon cooling of said container to below said heating temperature, said further step being practiced prior to said step of applying liner-forming material to the interior surfaces of said container.

5. The method claimed in claim 1 wherein said casing and closure member securement is rendered substantially air-impermeable upon solidification of said film.

6. A method for providing a lined container comprising the steps of:

(a) providing a hollow casing and securing a closure member in air-permeable relation to one end thereof to form a container having a fillet extending between said casing and said closure member; then

(b) applying particulate liner-forming material to the interior surfaces of said container; then

(c) heating said casing and closure member to a temperature above the crystalline melting temperature of said material to melt said material; then

(d) cooling said casing and closure member in ambient air to solidify said melted material; and then

(e) rendering said casing and closure member securement substantially air-impermeable,

thereby providing a continuous lining on said interior surface of said casing and on the interior surface of said closure member and extending into said fillet.

7. The method claimed in claim 6 further including the step of heating said container, prior to said material-applying step, to a temperature above said lining material crystalline melting temperature.

8. The method claimed in claim 6 further including the step of applying to portions of said interior casing surface and to said closure member surface, prior to said material-applying step, a substance adapted to release therefrom adhering liner-forming material at a temperature below said heating temperature.

9. The method claimed in claim 6 wherein said liner-forming material is polyethylene.

10. The method claimed in claim 6 wherein said step of rendering said casing and closure member securement substantially air-impermeable is performed by applying a sealant thereto.

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U.S. Cl. X.R.

117—21, 72, 138.8 E, 161 ZB

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,745,035 Dated July 10, 1973

Inventor(s) Thomas D. Troughton and Leonard B. McKee

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 66, after "such" insert --known--.

Column 5, line 35 (claim 1), "and" should read --said--.

Signed and sealed this 19th day of March 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.