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Kronenberger

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[54] **REFRIGERATOR CABINET CONSTRUCTION FOR RELEASING FOAM INSULATION**

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[52] **U.S. Cl.** ..... **220/9 F**

[51] **Int. Cl.** **B65d 25/18**

[58] **Field of Search** ..... 220/9 R, 9 F, 9 CC; 312/214

[56] **References Cited**

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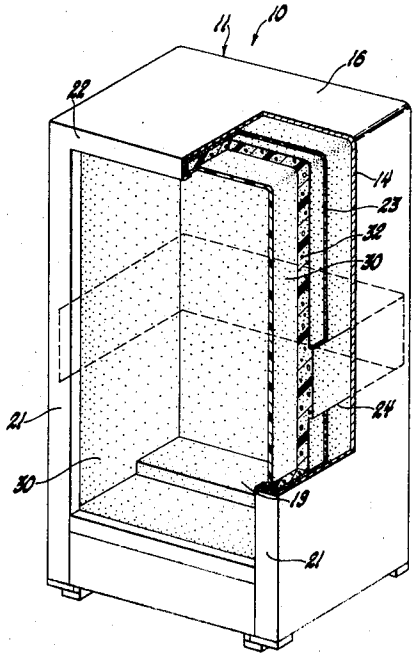
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[57] **ABSTRACT**

A refrigerator cabinet having an outer metal shell, a plastic inner liner, and foamed-in-place insulation therebetween together with the application of a foam insulation release agent coextensive with the inner surface of the metal shell except for a single horizontal adherence seam devoid of the release agent on both sides and the rear wall of the shell to produce a cabinet capable of maintaining interior dimensions while allowing for differences in coefficients of thermal expansions between the liner and shell.

2 Claims, 2 Drawing Figures



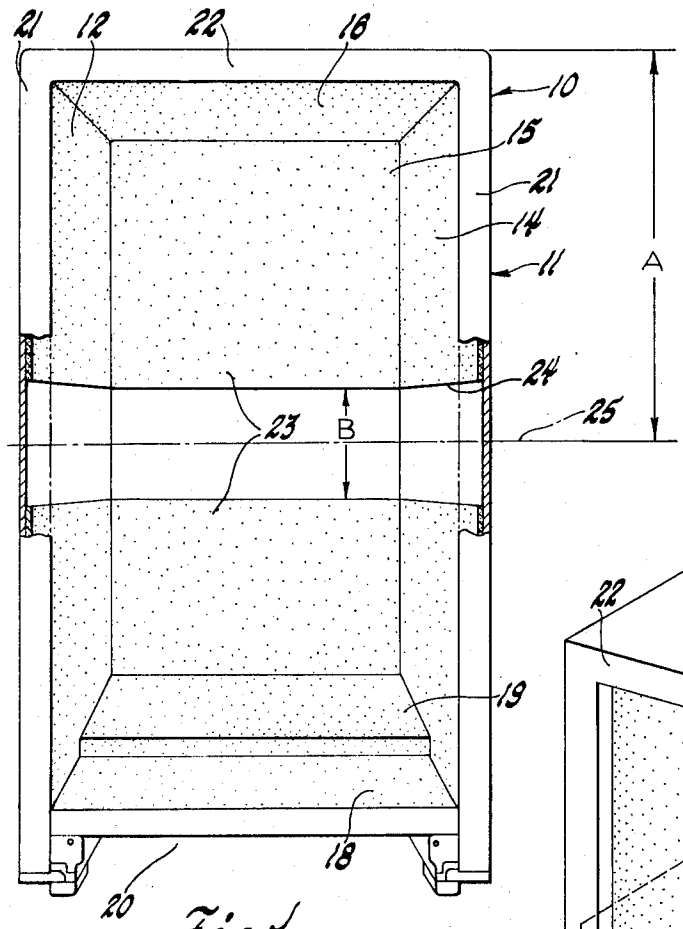


Fig. 1

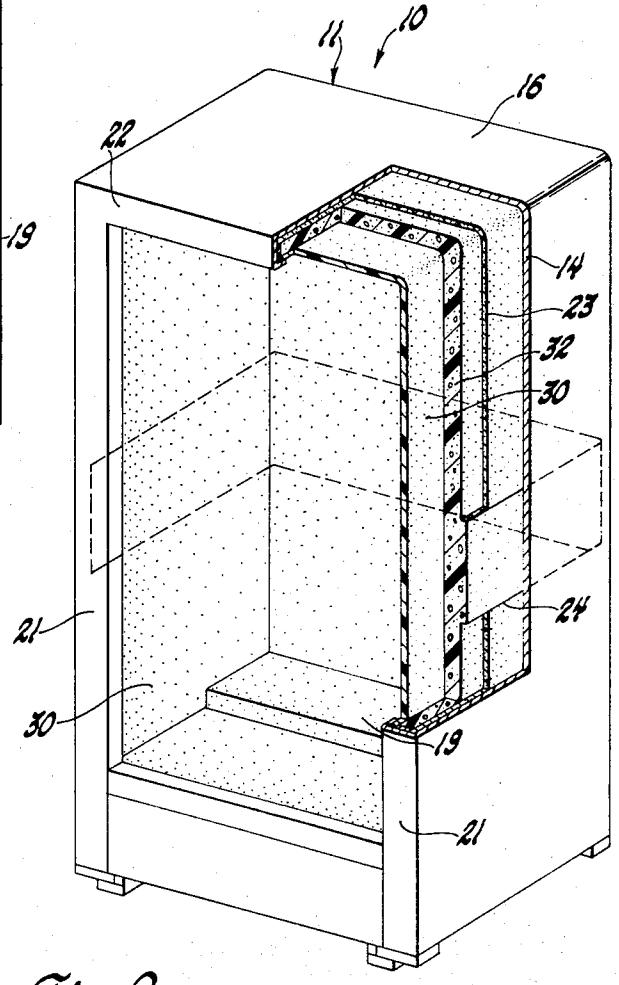


Fig. 2

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REFRIGERATOR CABINET CONSTRUCTION FOR RELEASING FOAM INSULATION

This invention relates to insulated cabinets and more particularly to the construction of wall sections for a refrigerator cabinet having a plastic inner liner and an outer metal shell with foamed-in-place plastic insulating material located in the space therebetween.

In the construction of refrigerators and freezers having foamed-in-place insulation, adherence of the foam insulation to the outer metal cabinet and inner liner has certain advantages together with one outstanding disadvantage. The advantages include the complete adhesion of the insulation with both the liner and shell thereby adding rigidity to the liner walls and helping maintain interior dimensions for better fit of internal parts such as shelving. The disadvantage of complete adhesion of the insulation is that no allowance is made for the difference in coefficients of thermal expansion between the refrigerator plastic liner and the metal shell. As a consequence when the cabinet is subject to extremely cold temperatures of the order of −20° F. to −40° F., which may occur for example, during shipment or storage in unheated warehouses, the resultant stress of the plastic liner could cause it to fracture or crack. One means of solving the stress cracking problem is by capping or wrapping the upper and lower end portions of the plastic insulation with polyethylene sheeting. This is a costly procedure, however, and results in some waviness of the liner walls in the polyethylene sheeting release areas, especially if the cabinet is shipped or warehoused during extremely hot weather.

The present invention embodies a refrigerator cabinet construction retaining the adhesion advantages mentioned above for foamed-in-place insulation while compensating for the difference in coefficient of expansion disadvantage to eliminate stress cracking of the refrigerator plastic liner. Applicant has devised a structure involving the application of a foam insulation release agent coating to the inner surfaces of the metal shell in a pattern such that in a region extending in a continuous horizontal adherence band or seam located on both side walls and the rear wall the shell inner surface is exposed to the foamed-in-place insulation. The adherence band is positioned midway between the cabinet shell top wall and bottom wall whereby upon the foaming of the insulation a firm bond is established in the adherence band region and a readily separable area is provided over the major wall regions occupied by the release agent coating. The adherence band is sufficiently wide to maintain workable interior dimensions but narrow enough not to result in stress cracking of the liner when the refrigerator is subjected to extremely cold temperatures.

It is therefore an object of this invention to provide an improved refrigerator cabinet having foamed-in-place insulation between the inner plastic liner and outer metal shell of a cabinet together with a continuous release agent coating covering the inner surface of the metal shell except for a horizontal adherence band on the inner surface of both side walls and the rear wall of the shell devoid of the release agent wherein a firm bond is established between the exposed shell surface and insulation to eliminate problems of temperature variations resulting in possible stress cracking of the plastic liner.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the Drawings:

FIG. 1 is a front perspective view of a coated refrigerator outer shell to which my invention is applicable.

FIG. 2 is a perspective view of a refrigerator cabinet partially in section showing the inner plastic liner, foamed insulation, release agent coating and outer metal shell.

Referring now to the drawings, for illustrating my invention, I show in FIGS. 1 and 2 thereof a household refrigerator cabinet **10** having an outer metal shell **11** such that the outer shell walls identified as opposite side walls **12** and **14**, rear wall **15**, top wall **16** and bottom wall **18** including an upper offset portion **19** which forms the ceiling of the machinery compartment **20** therebelow. A flange structure peripherally defines the open front face of the outer shell and includes inwardly directed flanges **21** on both sides and a flange **22** along the top.

The metal shell side walls **12** and **14**, rear wall **15**, bottom wall **18**, **19** and top wall **16** have their entire inner surfaces coated with a release agent **23** being arranged in a pattern such that in a continuous region a non-coated adhesive band or bonding seam **24** is located on both side walls and the rear wall of the shell. In the preferred form the release agent is a soap film coating that is applied to the inner surface of the metal shell such that the inner surface of the shell in the band region is exposed to foamed-in-place insulation to establish a firm bond in the continuous band region. It will be noted that while a specific soap film coating is disclosed other release agents such as wax coatings, for example, or a thin sheet of polyethylene as release agent from an asphalt coated bottom wall could be used without departing from the scope of the invention.

Experimentation has shown that the best location of the adherence band is that shown in FIG. 1 of the drawing in which the band center line **25** is oriented in a horizontal plane approximately midway between the shell top wall **16** and the shell bottom wall **18**. Thus in the disclosed form the band center line **25** is positioned a distance indicated at A in FIG. 1 of approximately 27.50 inches and 30.25 inches for shells whose overall heights are of the order of 60 and 65 inches respectively. It has also been determined by experimentation that the adherence band width indicated at B in FIG. 1 be of the order of 9.00 to 12.00 inches.

The soap film release agent preferably includes a blue liquid dye to the extent that a definite blue color or tint is visible. Thus when the soap film is applied, preferably by spraying a soap solution on the shell inner side, back and top walls the operator is able to determine that the continuous coverage in the pattern area has been attained. An example of the formulation of the release agent is as follows:

EXAMPLE OF SOAP FILM RELEASE AGENT

Mix: One part by volume of Soap Stock with seven parts by volume of water to which a 0.5 percent Methylene Blue Liquid Dye Solution is added to produce a Blue Release Agent.

The soap stock in the preferred embodiment is a hand soap designated oil soap, class A, 50 percent grade and may be purchased from a commercial supplier such as Davey-Young Soap Co., Dayton, Ohio.

The application of the above-described foam insulation release agent to the inner surfaces of the sheet metal shell is preferably preformed by spraying the soap solution on the walls while a blocking strip or mask such as an aluminum sheet is affixed to the shell to cover the band pattern **24**. Streaks or runs of the soap film release agent may occur in the adherence band region **24** and can be tolerated so long as the total surface covered by such runs does not exceed approximately 20 percent on either side wall or back wall of the adherence band. The soap film release agent must be dry at the time of foaming the insulation to insure an acceptable release between the shell and insulation.

In FIG. **2** there is shown the refrigerator cabinet **10** comprising the outer inverted substantially U-shaped sheet metal shell member **11**, preferably of steel having a coefficient of thermal expansion of the order of 0.00000636 in. per in. of length per deg. F having a thickness of about 0.033 inch, forming the exterior side and back walls of the cabinet shell. An inner plastic box-like member or liner **30**, preferably formed of a continuous ABS (acrylonitrile-butadiene-styrene) plastic sheet having a thermoformed average wall thickness of the order of 0.087 inch, and a coefficient of thermal expansion of about 0.000040 to 0.000050 in. per in. of length per deg. F. The liner is spaced from shell member **11** forming the walls of a food storage chamber and held in proper relation to the outer shell by some suitable fixture. The space between the inner liner **30** and outer shell is then filled with foamed-in-place plastic foam resin which fills the bottom, top, rear and side walls between the inner liner and outer shell. This insulation is preferably foamed-in-place polyurethane plastic insulation having a thickness of about 1¾ inches. A specific example of the composition is as follows:

MIXING SCHEDULE

	By Weight
Master Batch	
Resin	96.37% ± 1%
Amine Catalyst	1.93% ± 0.1%
Dibutyl Tin Dilaurate (DBTDL)	0.49% ± 0.1%
Surfactant	1.13% ± 0.1%

Prep – 11

Prepolymer	68.03% ± 1%
Freon 11 Foaming Agent	31.97% ± 1%
Control temperature of foaming agent at	55 ± 5° F.

Control of Material at Time of Foaming

a. Temp. of "Master Batch",	110° F. ± 4° F.
b. Temp. of "Prep – 11",	60°F. +5°F. –10°F.
c. Flow into mixer the following:	

	By Weight
Master Batch	37.50% ± 1%
"Prep – 11"	62.50 % ± 1%

The aforedescribed cabinet construction results in a composite plastic structure or laminate formed by the bonding of the plastic liner layer **30** and the foam insulation layer **32**. Applicant's soap film release agent pattern prevents the polyurethane foam from adhering to the cabinet shell inner side, top, bottom and back walls except in the intermediate adhesive band region **24** thereby allowing the remaining wall portions of the composite plastic structure to move relative to the steel shell in areas other than the adherence band region when the cabinet is subjected to severe high and low temperature extremes. The foam insulation and liner thus are permitted to expand and contract in unison independently of the steel shell and thereby to obviate stress cracking of the plastic liner at reduced temperatures of the order of –40° F. and obviate thermal deformation of the plastic liner at elevated temperatures of about 140° F.

Experimentation has shown that an adherence band **24** width in the range of 9.00 to 12.00 inches in width is sufficiently wide relative to the overall cabinet wall height to maintain workable interior dimensions while permitting the relative movement described. The location and width of the adherence band **24** prevents the foam insulation and plastic liner composite structure upon curing from excessive inward bowing or curving which could result in reduced interior dimensions to the extent that tolerances between internal parts such as refrigerator shelves would be lost and their assembly within the cabinet impossible. It will be noted that the rigid foamed polyurethane insulation being of a like or similar plastic composition has a similar coefficient of thermal expansion to that of the plastic liner. In the preferred form with the foam composition described the insulation has a coefficient of thermal expansion in the range of 0.000030 to 0.000060 in. per in. per deg. F. Although this is a somewhat wider range than the ABS liner material, the composite liner and insulation can be considered as having a combined coefficient of thermal expansion of about seven times relative to that of the steel outer shell.

Prior to the application of the soap film release agent the bottom wall **18** and offset portion **19** is preferably coated with an asphaltic or bituminous sealing material to provide a moisture barrier. As it is important that the composite plastic liner and foam insulation not adhere to the bottom wall **18**, **19** this area is covered with a polyethylene sheet release material (not shown) to prevent the bonding of the insulation to the shell in this region.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

I claim:

1. a refrigerator construction comprising, an outer steel shell member providing rear, side, bottom and top walls defining a refrigerator cabinet, a substantially box-like preformed liner member of A.B.S. plastic material nested substantially within said shell member, each of said members having coextensive surfaces disposed in spaced-apart face-to-face relationship with a rigid polyurethane insulation foamed into the space therebetween and adhering to said liner member to form a composite plastic structure, said steel shell member having a lesser coefficient of thermal expansion than said composite plastic structure, wherein the improvement comprises a release agent coating on the inner face of the side, back, bottom and top walls of said shell member and generally coextensive therewith, said release agent coating having a non-adherence characteristic with respect to the interface between

said composite plastic structure and said shell member, said release agent coating being arranged in a pattern such that in a continuous horizontal adherence band region having a width of approximately 9 to 12 inches on the inner face of said shell member in which said shell member is devoid of said release agent coating, said band region extending the full width of each of said side walls and across the back wall of said shell member with the center line of said band region positioned approximately midway between the upper and lower ends of said side and back walls whereby a firm adherence bond is established coextensive with said continuous band region between said composite plastic structure and said shell member to retain said steel shell member in generally fixed relationship with said composite plastic structure thereby to maintain interior dimensions of the cabinet, said release agent coating preventing the bonding of said composite plastic structure and said steel shell member to allow for relative thermal expansion and contraction of said steel shell member with respect to said composite plastic structure in areas other than said adherence band region when said cabinet is subjected to high and low temperature extremes thereby to obviate stress cracking of said liner member.

2. The refrigerator cabinet construction as defined in claim 1 wherein said release agent coating on side, back and top walls is a soap film material and said release agent coating on said bottom wall is a thin sheet of polyethylene.

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