Sept. 17, 1968 W. A. HANIFAN 3,401,997

REFRIGERATOR WITH SEGMENTED MODULAR INNER LINER

Filed June 15, 1967

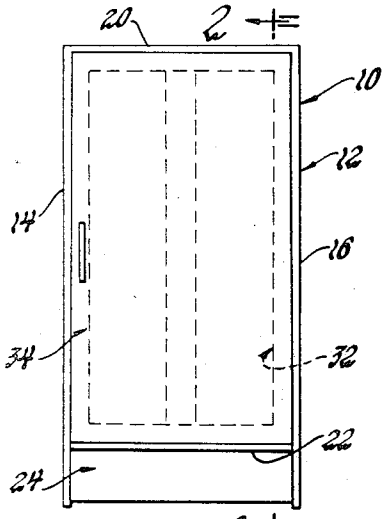



Fig. 1

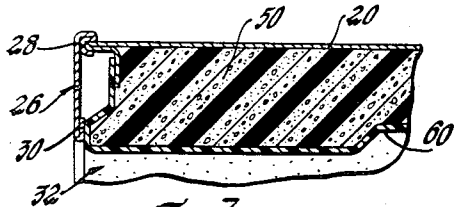



Fig. 3

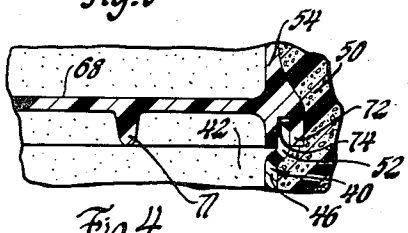



Fig. 4

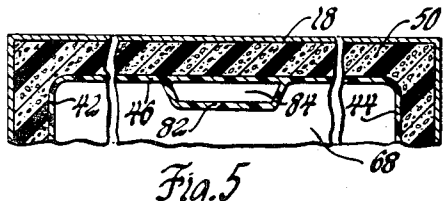



Fig. 5

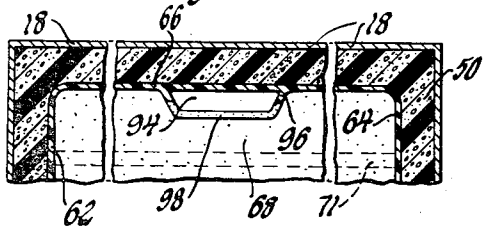



Fig. 6

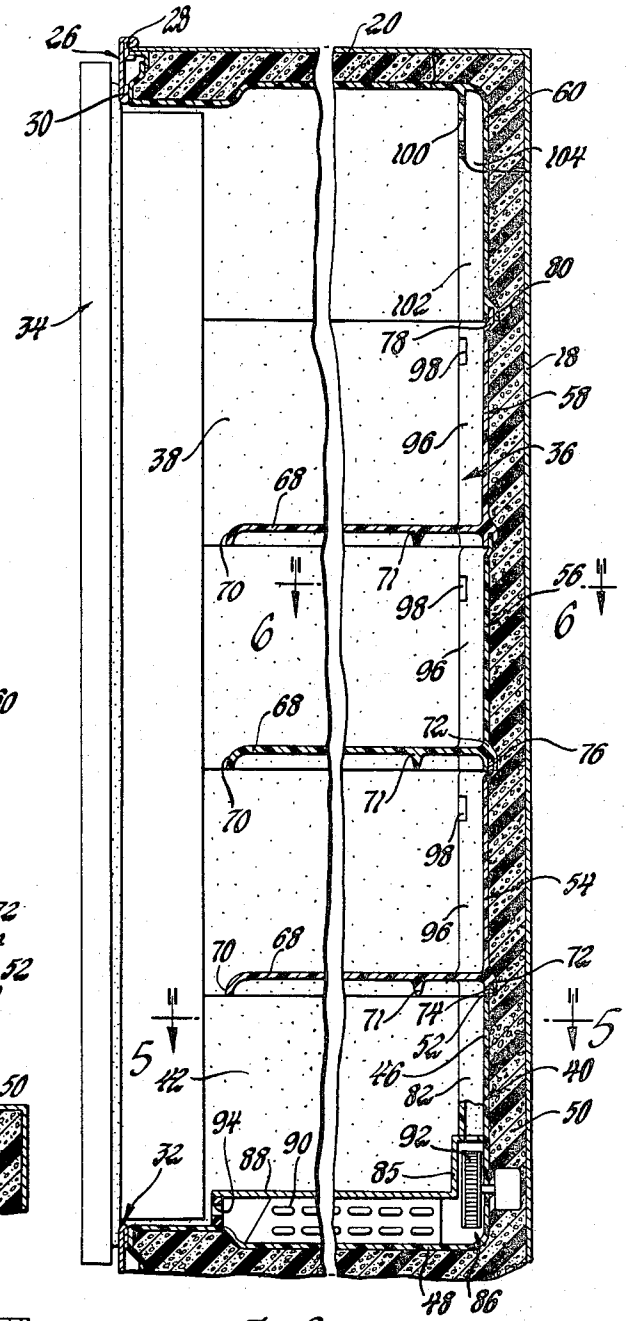



Fig. 2

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# REFRIGERATOR WITH SEGMENTED MODULAR INNER LINER

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## ABSTRACT OF THE DISCLOSURE

In preferred form, a refrigerator cabinet having an outer shell enclosing a segmented inner liner of modular form with one unit having a vertically oriented upper edge in axial alignment with a vertically oriented lower edge on a second unit, the one unit reinforced by an integrally formed shelf member to prevent inward deflection of the walls of the one unit and misalignment of its vertical edge, a tongue and groove on the aligned edges forming a sealed, expansion joint between the connected units and a vapor barrier to thermal insulation behind the liner.

This invention relates to refrigerator cabinet constructions and more particularly to a refrigerator cabinet construction having a low cost segmented inner liner of modular form suitable for use with refrigerators having foamed-in-place urethane thermal insulation or the like.

Plastic components of various types have been proposed for use in the refrigerator cabinet construction to reduce the cost of manufacture of refrigerators. For example, the inner liner of a refrigerator defining the interior food storage volume of the unit can be formed of plastic material without adversely affecting the structural strength of the construction, while retaining desirable appearance characteristics.

One problem, however, with plastic inner liners has been that of excessive inward deflection in the walls of the inner liner making it difficult to locate removable shelving or the like in the cabinet. Another problem is thermally induced stresses that occur in an inner liner when it is fabricated at room temperatures and operated at much lower temperatures.

An additional problem of refrigerator cabinet constructions has been that of varying the size of the inner liner of the cabinet construction between different refrigerator models. Since refrigerator cabinet constructions must meet a wide market demand including small portable or apartment sized refrigerators and up to and including refrigerator cabinet constructions having food storage capacity for large families or commercial establishments, it is readily apparent that single molded plastic inner liners for a complete refrigerator line will of necessity require a substantial amount of tooling.

Accordingly, an object of the present invention is to improve refrigerator cabinet constructions by the provision of a segmented, plastic inner liner of modular construction located within a rectangular box formed outer refrigerator shell having a front access opening and including a plurality of inner liner units each having vertically oriented edges thereon and means for interconnecting the vertically oriented edges to provide a tongue and groove joint between the segmented units of the plastic inner liner capable of structurally connecting the units of the inner liner construction and of a form to vapor seal thermal insulating material behind the liner.

A further object of the present invention is to reduce the cost of manufacture of a refrigerator cabinet construction by the provision therein of a segmented, inner plastic liner of modular form including a plurality of units interconnected to form sides, a rear wall, a top and a bottom of



an enclosed food storage volume having a front access opening thereto and wherein at least first and second ones of the interconnected segmented units of the modular inner liner construction include vertically oriented edges thereon interconnected and arranged to form a vapor sealing expansion joint between the units at the side walls and rear wall thereof to reduce moisture penetration in foamed-in-place thermal insulation behind the inner liner and thermal stress in the liner and wherein at least one of the first and second mentioned units of the modular construction includes a shelf member integrally formed with a side and rear wall of that unit and extending forwardly of the rear wall between the side walls of the unit to prevent inward deflection of its walls and to reinforce its vertically oriented edge against manufacturing misalignment.

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:

FIGURE 1 is a view in front elevation of a refrigerator cabinet construction including the present invention;

FIGURE 2 is an enlarged, fragmentary, vertical sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged fragmentary sectional view showing a part of the front access opening to the interior of the refrigerator construction;

FIGURE 4 is an enlarged view in vertical section showing one of the inner liner segment connecting and thermal expansion points for vapor sealing thermal insulation of the refrigerator construction;

FIGURE 5 is an enlarged fragmentary horizontal sectional view taken along the line 5—5 of FIGURE 2; and

FIGURE 6 is an enlarged fragmentary horizontal sectional view taken along the line 6—6 of FIGURE 2.

Referring now to the drawings in FIGURE 1, a refrigerator cabinet construction **10** is illustrated as including an outer metal shell **12** of rectangular box form including a pair of spaced apart side walls **14, 16** joined by a rear wall **18**, and further including a top **20** and a bottom wall **22** located above the lowest edges of the side walls **16, 18** to define a machinery compartment space **24** within the cabinet construction **10**. Continuously formed around the front edges of the side walls **14, 16** the top **20** and the bottom **22** is a trim strip **26** having a channeled edge **28** that snap fits about the above described edges of the outer shell **12** and an inner peripheral edge **30** that defines a front access opening **32** that is closed by a vertically hinged door closure member **34**.

In accordance with certain principles of the present invention, the cabinet construction **10** further includes a segmented plastic inner liner assembly **36** of modular form which is constructed from a plurality of separate, preformed plastic units to form inner liner walls defining an interior food storage volume **38** in communication with the access opening **32**.

More particularly, the segmented inner liner construction **36** includes a rectangular, box shaped bottom unit **40** that includes spaced apart side walls **42, 44** joined at their rear edges by a rear wall **46** and at their lower edges by a bottom member **48**. The bottom unit **40** has the walls **42, 44, 46** thereof located in spaced relationship to the side and rear walls of the outer shell **12** to form a space therebetween which is filled by a foamed-in-place thermal insulating material **50** such as urethane. The side walls **42, 44** and rear wall **46** are not bent outwardly at the upper edges thereof to define a continuous vertically oriented upper edge **52** completely around the sides and rear wall of the first unit **40**, as best seen in FIGURES 2 and 4.

The segmented, modular inner liner assembly **36** further includes a plurality of like intermediate units **54, 56, 58** that are stack fitted between the lower unit **40** and a top closure unit **60** of the assembly **36.**

Each of the units **54, 56, 58** include spaced apart side walls **62, 64** joined at their rear edges by an integral rear wall **66.** Integrally formed with the side walls **62, 64** and rear wall **66** is a shelf member **68** that extends forwardly of the rear wall **66** between the side walls **62, 64** to a point forwardly of the food storage volume **38,** as best seen in FIGURE 2 where the front edge of the shelf member **68** is bent downwardly at **70.** Each shelf member **68** includes an integral, rearwardly located depending rib **71** for reinforcing the shelf across its width. The member **68** defines a substantial shelf area within the food storage compartment **38** and additionally is located immediately above a continuously formed lower edge on the side walls **62, 64,** and rear wall **66** which is vertically oriented above and axially aligned with the edge **52** and is formed as a channel-shaped member **72** having a groove **74** which receives the edge **52** in a tongue, groove sealed relationship as best seen in FIGURE 4. In accordance with certain principles of the present invention, the shelf member **68** serves to reinforce the side walls **62, 64** and rear wall **66** at the lower vertically oriented continuous edge **72** thereon to prevent undesirable warpage in the continuous edge thereby enabling it to be readily assembled in an interconnected relationship with the edge **52** of a unit of the assembly **36** such as the bottom unit **40** of the modular construction.

Additionally, the shelf member **68,** following connection of adjacent units of the liner assembly **36** will reinforce the side and rear walls of the inner liner against deflection interiorly of the food storage compartment **38.** Accordingly, the interior volume defined by the assembly **36** is able to receive separate, removal preformed storage bins or containers having predetermined widths that are configured to closely fit between the liner walls **62, 64** and liner walls **42, 44.**

Each of the inner liners units **54, 56, 58** further include a continuous vertically oriented upper edge **76** thereon that is received in a lower depending groove forming continuous edge **72** of the unit **56, 58** in the case of the units **54, 56,** respectively.

In the illustrated embodiment of the invention, the inner liner unit **58** includes a continuously formed vertically oriented upper edge **78** that is received in a channel shaped lower edge **80** of the top unit **60.** Unit **60** has the same form as the bottom unit **40** of the inner liner assembly **36** but is located in an inverted relationship to the inner liner segment **58** as best seen in FIGURE 2. The bottom edge **80** is formed continuously about the side walls and rear wall of the unit **60** and is located in a tongue groove interconnected relationship with the edge **78** of the unit **58** to connect the liner units **58, 60.** In the illustrated arrangement, the tongue groove interconnection between the box-like segments or units of the liner assembly **38** performs the further function of defining a vapor sealed joint between the inner liner segments that will prevent moisture penetration into thermal insulating material between the inner liner assembly **36** and the outer shell **20** that can reduce the thermal insulating effectiveness of the refrigerator wall section.

The above described tongue and groove joint also forms an expansion joint that compensates for thermal expansion and contraction in the liner assembly **36** as occurs when the liner is assembled within the refrigerator unit at room temperature and then the refrigerator is operated at substantially reduced temperatures. Under such extremes, the edges **52, 76,** and **78** of the assembly will fill less of the grooved edges **72, 80** but will remain in a vapor sealing relationship in the edges **72, 80** to prevent vapor penetration into the thermal insulation of the cabinet construction.



Since the center units **54, 56, 58** are identical, it will be readily appreciated that different sized refrigerator models are obtained merely by adding or removing such sections to produce commensurate changes in refrigerator volume. These changes are accomplished without added tooling costs or changes in manufacturing procedures. Further, if any one liner unit is damaged by sharp impact loading or the like, it can be replaced without scrapping the entire liner.

A further advantage of the above described refrigerator liner assembly **36** is that different color combinations of liner units are easily obtainable. Thus, the units can be color coded to indicate different operating temperature ranges or humidity levels within the refrigerator interior.

A further advantage is that a particular type of plastic best suited for a given region of the refrigerator can be used in different units of the modular liner construction. By way of example, the top unit **60** might be of a high impact polystyrene material; the load carrying intermediate units **54, 56, 58** of a high strength plastic such as ABS (acrylonitrile-butadiene-styrene); and the lower unit **40** of fiber glass reinforced plastic. Such combinations of plastics can be selected for a particular refrigerator application to result in a minimum cost and required strength characteristics for the entire liner assembly.

Other plastics that might be utilized in making up the component parts of the shelf reinforced thermal expansion compensating, and vapor sealing modular liner assembly **36** of the present invention include acetal plastics, acrylic plastics, nylon, polycarbonate materials, polyvinyl chloride and ABS alloys, expanded polypropolyne and phenoxy and like plastics than can be preshaped by injection molding or vacuum molding into separate modular units interchangeable in different cabinet constructions.

Another feature of the improved inner liner construction of the present invention is the provision of an integrally formed inner convolution **82** on the rear wall of the bottom unit **40** which forms an air flow space **84** communicating with an outlet from a fan housing **85** located within an evaporator space **86** separated from the food storage space **38** by a false bottom wall **88.** Within the evaporator space **86** is located an evaporator unit **90** which is connected in refrigerant flow relationship with a refrigerant system of the type including a compressor, condenser, refrigerant expanding means such as an elongated capillary tube and suitable conduits to complete a refrigerant circuit. Such circuits are well known in the art and for purposes of the present invention it is only necessary to indicate that the evaporator **90** serves as a suitable cold source which has air drawn by a motor driven fan **92** thereacross from an inlet opening **94** through the evaporator space **86** thence for discharge through the opening **84** in the integral duct forming convolution **82** on the rear wall **46** of the inner liner unit **40.** The convolution **82** in addition to providing the opening **84** for air flow also serves to further reinforce the inner liner assembly **36.** In the embodiment of FIGURES 1 through 6, the air flow space **84** formed by the convolution **82** communicates with an air flow opening or space **94** formed by like inwardly directed convolutions **96** integral with the rear wall **66** of units **54, 56, 58.**

In order to secure direct air flow through the spaces between the shelves **68,** if desired, the air flow spaces **94** in each of the units **54, 56, 58** may be communicated with the volume **38** through openings **98** in each of the convolutions **96.**

Also, the aligned air flow spaces **94** in the units **54, 56, 58** direct air upwardly through an opening **100** in a convolution **102** formed integrally with the rear wall of the upper unit **60.** The convolution **102** includes an opening **104** therein communicating the evaporator cooled air flow with the uppermost regions of the enclosed volume **38** of the refrigerator cabinet construction.

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.

What is claimed is as follows:

1. A refrigerator cabinet construction comprising an outer cabinet shell having side wall, a rear wall, a top and a bottom defining an enclosed space, means forming a front access opening in said outer cabinet shell, a first inner liner component located within said outer shell and including side walls, a rear wall and a bottom wall located in spaced relationship with said outer shell, means forming a continuous upwardly facing edge on said side walls and said rear wall of said first inner liner component, means for supporting said first inner liner component in spaced relationship to said outer shell including thermal insulating material, a second inner liner component including spaced apart side walls, a rear wall joining said side walls, said second inner liner component including a lower edge thereon formed continuously on said side and rear walls of said second component disposed in vertical edge to edge relationship with said continuous edge on said first liner component, coacting means on said vertically edge to edge related portions of said first and second liner components forming a tongue and groove interconnection therebetween for forming a sealed joint between said first and second inner wall components and for interconnecting said first and second inner liner components together, a member integrally formed with said side walls and said rear wall of said second inner liner projecting forwardly of said rear wall between said side walls of said second inner liner components for reinforcing said walls of said second liner component against inward deflection, said member extending forwardly of said rear wall at said lower edge thereon to further reinforce said lower edge against warpage, said coacting means including a groove forming member and a tongue slidably received in said groove and movable therein in response to temperature changes to compensate for thermally induced contraction and expansion of said first and second inner liner components.

2. A refrigerator cabinet construction comprising an outer shell having spaced apart side walls, a rear wall joining said side walls, a top and a bottom, means defining as access opening in said outer shell, a segmented inner liner of modular form within said outer shell forming a compartment therein, said segmented inner liner including a first component having spaced apart side walls, a rear wall, and a bottom, said walls of said first liner unit being located in spaced apart relationship with said side walls and rear walls of said outer shell, said first inner liner component including an upper vertical edge thereon formed continuously around said side and rear walls thereof, a second liner component including spaced apart side walls and a rear wall joining said side walls, a shelf member integrally formed with said side walls and said rear wall of said second liner extending from said rear wall between said side walls of said second liner component in a generally horizontal plane to reinforce said side and rear walls of said second liner component against inward deflection, said second liner component including a lower vertically oriented edge formed continually around said side walls and said rear wall of said second liner component at a point immediately below the horizontal plane of said shelf member whereby said lower edge is reinforced by said shelf member, coating means on said first and second liner components for defining a tongue and groove connection between said upper vertical edge on said first component and said lower vertical edge on said second component, means for rigidly supporting said first and second liner units in spaced relationship to said outer shell including thermal insulating material between said outer shell and said first and second shell components, said tongue and groove connection defining a vapor sealed joint between said first and second liner units to said insulating material



3. A refrigerator cabinet construction comprising an outer cabinet shell having side walls, a rear wall, a top and a bottom defining an enclosed space, means forming a front access opening in said outer cabinet shell, a first inner liner component located within said outer shell and including side walls, a rear wall and a bottom wall located in spaced relationship with said outer shell, means forming a continuous upwardly facing edge on said side walls and said rear wall of said first inner liner component, means for supporting said first inner liner component in spaced relationship to said outer shell including thermal insulating material, a second inner liner component including spaced apart side walls, a rear wall joining said side walls, said second inner liner component including a lower edge thereon formed continuously on said side and rear walls of said second component disposed in vertical edge to edge relationship with said continuous edge on said first liner component, coacting means on said vertically edge to edge related portions of said first and second liner components forming a tongue and groove interconnection therebetween for forming a sealed joint between said first and second inner wall components and for interconnecting said first and second inner liner components together, a member integrally formed with said side walls and said rear wall of said second inner liner projecting forwardly of said rear wall between said side walls of said second inner liner component for reinforcing said walls of said second liner component against inward deflection, said member extending forwardly of said rear wall at said lower edge thereon to further reinforce said lower edge against warpage, and means for further reinforcing said rear wall of said first and second liner components against deflection including an integral inwardly deformed convolution forming a hollow space extending vertically of said rear walls of said first and second liner components, said vertically oriented space defining an air flow space within said cabinet construction for the passage of cooling air.


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CASMIR A. NUNBERG, *Primary Examiner.*

# U.S. DEPARTMENT OF COMMERCE

## PATENT OFFICE

## Washington, D.C. 20231

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,401,997

September 13, 1968

William A. Hanifan

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

Column 2, line 68, cancel "not". Column 5, line 6, "side wall" should read -- side walls --; line 31, "components" should read -- component --. Column 6, line 3, "coating" should read -- coacting --.

Signed and sealed this 17th day of March 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents