May 17, 1955 O. V. SAUNDERS 2,708,294

REFRIGERATOR DOOR

Filed Sept. 23, 1953 2 Sheets-Sheet 1

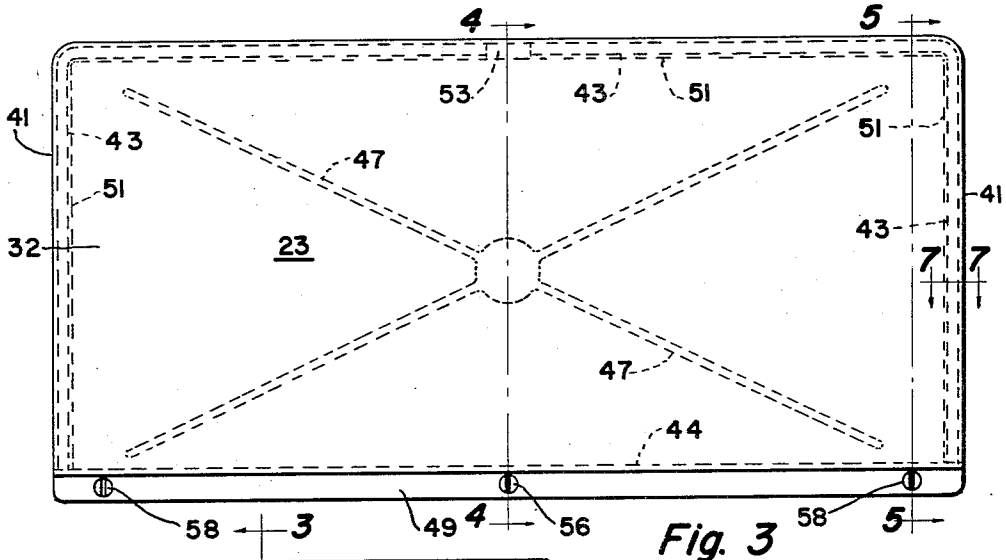


Fig. 3

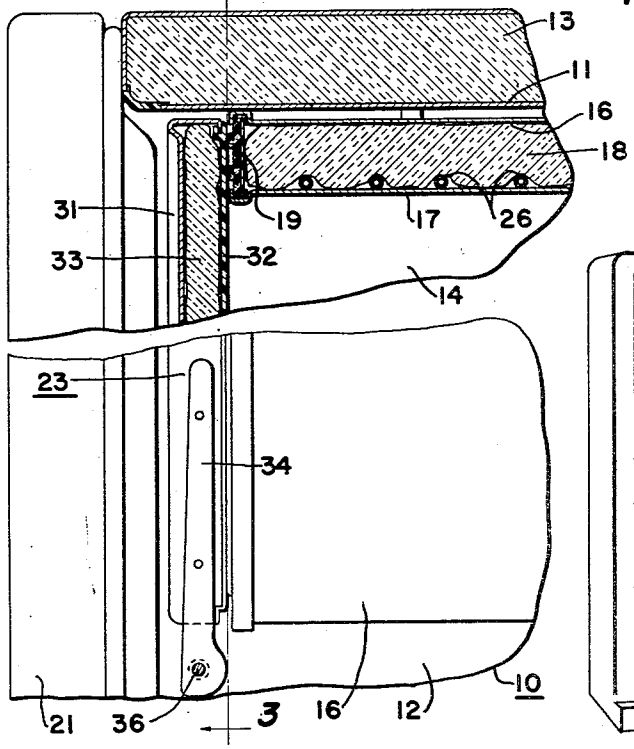


Fig. 2

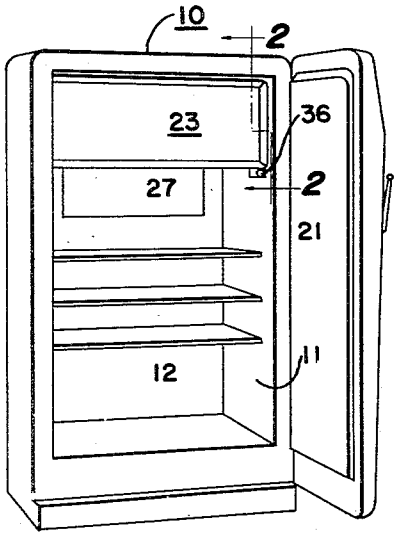


Fig. 1

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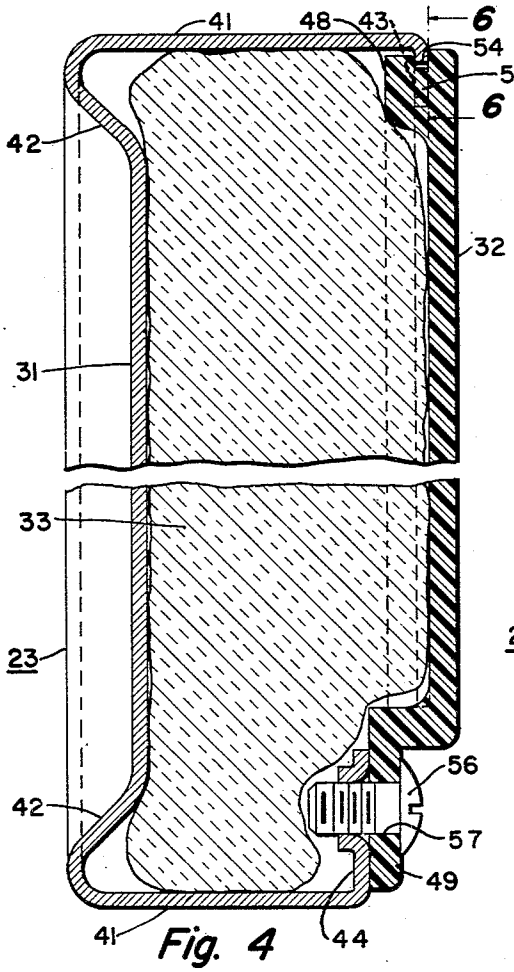


Fig. 4

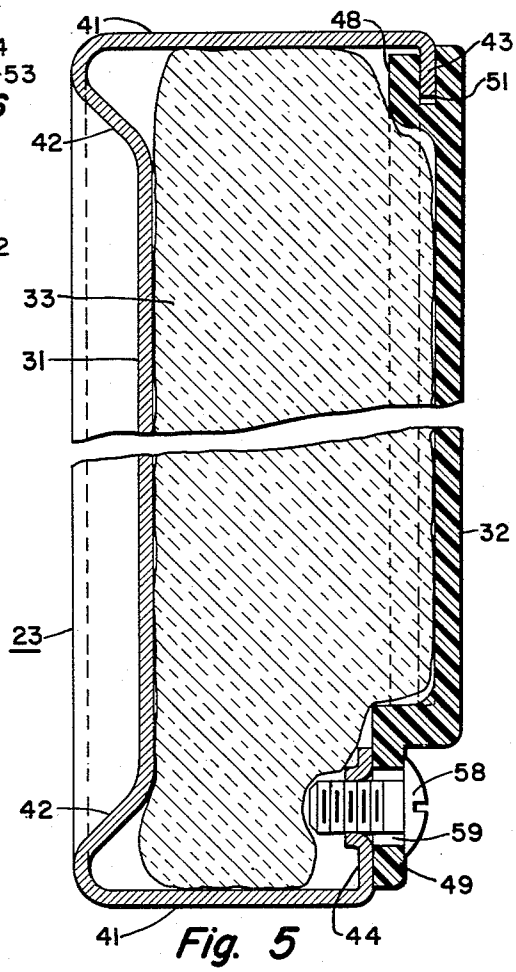


Fig. 5

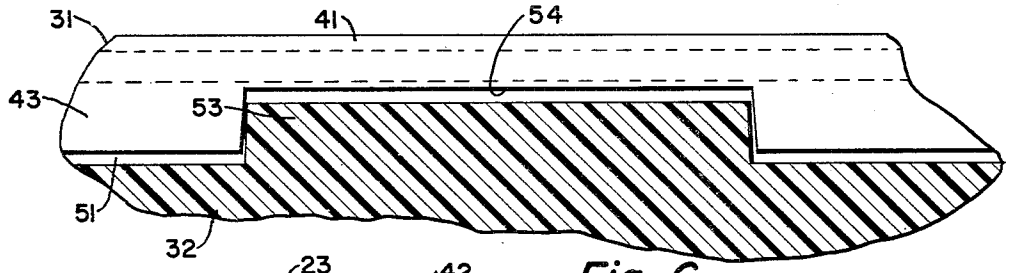


Fig. 6

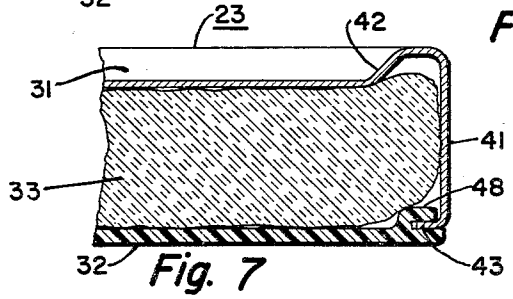


Fig. 7

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REFRIGERATOR DOOR

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2 Claims. (Cl. 20—35)

This invention relates to closure members for freezing compartments of refrigerator cabinets.

In that type of refrigerator wherein frozen foods as well as unfrozen foods are stored in adjacent compartments there is an appreciable temperature differential between the frozen food storage compartment and the unfrozen food storage compartment. It is the practice to provide a freezing or frozen food storage compartment within the conventional food storage chamber of a household refrigerator cabinet and to utilize an insulated door structure for closing the access opening of the frozen food compartment which is separate from and operable independently of an outer door employed to close the access opening of the main food storage chamber containing unfrozen foods. Due to the fact that these inner doors are assembled at room temperature and then mounted in a refrigerator cabinet wherein the temperature to which the inner and outer panels of the door are exposed is considerably different difficulty has been experienced. This difficulty arises because of the fact that the panels of such doors, whether they are formed of like material or dissimilar materials, are usually rigidly connected together at a plurality of points around their sides and when the inner and outer faces of the door are exposed to different temperatures one panel will expand and/or contract more or less than the other panel and cause warpage or twisting of the door resulting in misalignment thereof with the front of a compartment to be closed thereby. This is particularly true of doors having one metal panel and a molded plastic panel.

An object of my invention is to provide an improved door construction of low manufacturing cost which may be assembled at room temperature and thereafter subjected to a higher or a lower temperature without becoming warped or damaged.

Another object of my invention is to provide an elongated or rectangular insulated door structure with a metal outer panel and an inner molded plastic panel each adapted to be exposed to different environment having appreciable temperature differentials therebetween which structure includes means for interlockingly connecting the panels to one another in a fashion to prevent warpage of the door.

A further object of my invention is to interlockingly connect a molded thermoplastic door panel to a sheet metal door panel in a manner to permit expansion and/or contraction of the molded plastic panel in a direction paralleling the extension of the metal panel so as to prevent bowing and twisting of the molded plastic panel and warpage of or damage to the door.

In carrying out the foregoing objects it is a still further and more specific object of my invention to provide flange means along certain sides of an outer metal panel of an elongated or rectangular insulated door structure for slidably receiving a groove along side edges of a molded plastic inner door panel to interlockingly connect the panels to one another and to arrange the interlocking connection in such fashion as to permit free expansion

and/or contraction of the inner panel relative to the outer panel while holding the inner panel against bowing or twisting during its expansion and/or contraction whereby warpage of the door is minimized to prevent misalignment thereof with the front of the compartment to be closed thereby.

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 form of the present invention is clearly shown.

In the drawings:

Figure 1 is a perspective view showing a refrigerator having a door constructed in accordance with my invention mounted therein;

Figure 2 is an enlarged fragmentary view taken on the line 2—2 of Figure 1 partly in section and partly in elevation showing my improved door closing a freezing compartment within the refrigerator cabinet;

Figure 3 is a view looking toward the inner face of my improved door and is taken on the line 3—3 of Figure 2;

Figure 4 is an enlarged fragmentary vertical sectional view taken on the line 4—4 of Figure 3 showing the interlock connection of panels of the door at a point intermediate its sides;

Figure 5 is a view similar to Figure 4 taken on the the line 5—5 of Figure 3 and shows the interlock connection of panels of the door beyond the central part thereof;

Figure 6 is an enlarged view taken on the line 6—6 of Figure 4 showing a thickened central top edge portion of the door inner panel fitting in a cut out part of the outer metal door panel; and

Figure 7 is a sectional view of the interlock between the door panels along the short sides of the door.

Referring now to the drawings, for illustrating my present invention, I show in Figure 1 thereof a refrigerator cabinet generally represented by the reference character 10. Cabinet 10 includes the usual outer walls and a metal liner 11 spaced therefrom and providing walls of a main food storage chamber 12 therein. Any suitable or desirable insulating material 13 (see Figure 2) is placed in the space between liner 11 and the cabinet outer walls as is conventional in the art. An insulated box-like structure is mounted, by any suitable or desirable means, in the upper portion of the main or unfrozen food storage chamber 12 to provide a freezing or frozen food storage compartment 14 within chamber 12. The box-like structure forming frozen food compartment 14 (see Figure 2) includes an outer metal shell 16, an inner metal liner 17, with insulating material 18 disposed therebetween, and a sealing member 19 at the access opening of compartment 14. Sealing member 19 comprises a rigid insulating backing piece secured between and spacing the front edges of walls 16 and 17 of compartment 14 apart. This sealing member is provided with an outer door engaging face of soft resilient foam rubber or the like material. An outer door 21 is provided as shown for normally closing the open front of the refrigerator cabinet, affording access to chamber 12. A separate rectangularly shaped or horizontally elongated inner door structure, generally represented by the reference character 23, is adapted to engage the outer face of the sealing member 19 and serves as a closure member for closing the front access opening of compartment 14. Any suitable or desirable handle means (not shown) may be provided on door 23 to facilitate operating the same. Different low temperatures are maintained in chamber 12 and compartment 14 and therefore they form zones having an appreciable temperature differential. Compartment or zone 14 and chamber or zone 12 are adapted to be refrigerated re-

spectively by means of a conventional refrigerating system (not shown) which may include a primary evaporator or refrigerant evaporating conduit coils 26 wrapped around and secured in intimate thermal contact with the inner liner 17 of the frozen food storage compartment 14 (see Figure 2) and a plate type or sheet metal evaporator 27 suitably mounted in the upper rear portion of the food chamber 12 (see Figure 1). The detailed construction and arrangement of the refrigerating system may be varied at will and for this reason a specific description of the elements and connections therebetween of such a system is unnecessary because the refrigerating system forms no part of the subject matter claimed herein.

The rectangular inner door structure 23 comprises or includes a sheet metal outer front panel 31 and a molded thermoplastic inner or rear panel 32. These door panels are connected together in a manner to be presently described and packaged insulating material 33, preferably of wrapped or spun glass or rock wool, is disposed in the space therebetween. Door 23 is pivotally supported at the proper location within chamber 12, to close the open front of compartment 14, from a pair of side mounting brackets 34 journalled on stationary pins 35 secured to and carried by liner 11. The molded plastic inner door panel 32 is preferably molded from powdered styrene which is heated and forced into a suitable panel forming mold. Other material such as polyvinyl-acetate or polyvinyl-chloride may, if desired, be employed to form panel 32 of door 23. Door 23 is usually assembled at room temperatures and due to the high coefficient of expansion and contraction of plastic materials and the difference in temperature to which the inner and outer faces of door 23 may be exposed special provisions must be incorporated in the door structure 23 to prevent warpage thereof. For example, after door 23 has been assembled at room temperature and then stored or shipped at higher or lower temperatures an appreciable amount of expansion of the molded plastic panel 32 relative to the sheet metal panel 31 and contraction thereof respectively relative to panel 31 will take place. Also when door 23 is mounted in the refrigerator cabinet 10, herein disclosed, and the refrigerator installed and placed in operation the inner molded plastic panel 32 of door 23 is subjected to a low temperature of around 5° to 10° F. of the interior of freezing or frozen food compartment 14 while the outer sheet metal panel 31 of door 23 is exposed to the higher temperature of approximately 38° to 45° F. of the main unfrozen food storage chamber or compartment 12. When both doors 21 and 23 are opened the inner molded plastic panel 32 of door 23 is subjected to a much higher temperature approximating the temperature of the room in which the refrigerator cabinet 10 is installed. The exposure of such an insulated refrigerator cabinet door to these wide temperature differentials renders it difficult to prevent warpage of door 23 and maintenance of a good seal of this door with the door engaging sealing member 19 at the front or access opening of the insulated box-like structure forming the food freezing or frozen food storage compartment 14 within the refrigerator 10.

In accordance with my invention I desire to construct an elongated or rectangular door forming a closure member between zones having an appreciable temperature differential which door will not, under the conditions described, become warped out of its original aligned or flat assembled position or be damaged. In order to accomplish this desideratum I have found that in an insulated paneled door structure for use in a refrigerator cabinet at the location specified its molded plastic panel must be interlocked with the metal panel thereof in a fashion to permit expansion and/or contraction of the molded plastic panel in a direction paralleling the extension of the metal panel. When provisions are made to permit such expansion and/or contraction of the molded plastic panel this panel will not have a tendency to bow or twist and therefore the door does not warp or become damaged. By slidably interlocking a molded plastic door panel to at least two opposed sides of the sheet metal door panel and by rigidly clamping the plastic panel to the sheet metal panel only at points centrally of the length of the door side portions the molded plastic door panel may expand or contract, beyond the rigid clamping points, relative to the metal door panel while being held in parallel relation to the metal panel. Thus in the present arrangement sheet metal panel 31 of door 23 is flanged toward the molded plastic panel 32 as at 41 about four sides of the door and is bent as at 42 to provide a recess in the front face thereof (see Figures 4, 5, and 7). It is believed to be obvious that the flanges or continuous flange 41 and the bent parts 42 of door panel 31 greatly increase its structural strength and provides a rather rigid door pan or panel to which another panel may be attached. A part of flange 41 adjacent its edge is bent substantially at a right angle thereto as at 43 (see Figures 4, 5, 6, and 7) to provide a tongue about the horizontal top side and the two vertical sides of door 23 (see Figure 3). The flange 41 at the bottom of door 23 also has a part adjacent its edge bent upwardly to provide another tongue 44. It will be noted by reference to Figures 4 and 5 of the drawings that another tongue 44 is offset inwardly relative to tongue 43 to provide the door 23 with one long side, the bottom side thereof, which is thinner than the other three sides of the door and is for a purpose to be hereinafter described.

The molded plastic panel 32 of door 23 may have formed on one of its surfaces, preferably the inner surface thereof, any desirable integral embossed strengthening beads or ribs of suitable extension and shape such as the cross 47 indicated in Figure 3 of the drawings. The elongated or rectangular inner molded plastic door panel 32 is provided with a thickened edge portion 48 (see Figures 4, 5, and 7) extending along its long top and opposed short sides. Panel 32 is also provided with a lower inwardly offset flange portion 49 which abuts the tongue 44 on panel 31 and is adapted to be secured thereto. The thickened edge portion 48 about the three sides of panel 32 has a groove 51 provided therein and the opening of this groove faces or is directed toward the edge of these sides of panel 32. Tongue 43 on metal panel 31 fits in the groove 51 to interlockingly connect molded plastic panel 32 to panel 31 about three sides of door 23. It is to be noted that the lips or side walls of grooves 51 firmly abut the sides of tongues 43 and that a clearance is provided between the end or edge of tongues 43 and the inner wall of groove 51. The existence of this clearance is important in that it provides for a predetermined amount of expansion and/or contraction of molded plastic panel 32 in a direction paralleling the tongues 43 and consequently the extension of outer metal panel 31 as will be more specifically described hereinafter. The groove 51 has a short raised portion 53 therein located centrally between the two opposed short sides of door 23 as shown in Figures 3, 4, and 6 of the drawings. Tongues 43 along the upper long side of metal panel 31 are cut out as at 54 (see Figure 7) to receive and straddle the raised portion 53 of panel 32.

A screw 56, located substantially midway between the short sides of door 23 (see Figure 3), passes through an opening 57 in flange 49 of the molded plastic inner panel 32 (see Figure 4) and is threaded into a tapped hole provided in the lower tongue 44 of metal outer panel 31. This screw 56 forms a separate means for securing one edge portion of the panels 31 and 32 together to maintain the interlocking connection between the panels. The opening 57 is of a diameter substantially equal to the diameter of the shank part of screw 56 so that this screw 56 serves to center the plastic panel 32 with respect to metal panel 31 to provide the clearance heretofore mentioned between the end of each of the tongues 43 and the inner wall of grooves 51. This screw 56 is

firmly tightened to rigidly clamp the plastic panel 32 to metal panel 31 at a central point on door 23 intermediate its two opposed short sides (see Figures 3 and 4). A screw 58, located adjacent each end or short side of door 23, passes through an opening 59 in flange 49 of panel 32 (see Figures 3 and 5) and is also threaded into a tapped hole provided in the tongue 44 of the outer panel 31. Openings 59 are larger in diameter than the shank portion of screws 58 to permit that portion of the molded plastic panel 32 adjacent these screws to slide or slip relative thereto under the heads thereof upon expansion and/or contraction of panel 32 in a direction paralleling panel 31. The close fit of raised portion 53 of groove 51 at its vertical side with cut out portion 54 of tongue 43, at the central top part of door 23, together with wall of opening 57 in panel 32 closely embracing the shank part of screw 56 rigidly clamps the panels to one another. The tongue and groove interlocking arrangement of the panels to one another as disclosed permits expansion and/or contraction of molded plastic panel 32 from the points of rigid connection between the panels in a direction paralleling metal panel 31 while holding the molded plastic panel against bowing or twisting.

In assembling door structure 23 the bagged insulating material 33 is placed within the outer metal door pan or panel 31 and the molded plastic inner panel 32 is slid in a direction from the lower or fourth side of the door upwardly relative to panel 31. The tongue 44 being offset inwardly of tongues 43 provides space to align the grooves 51 with the tongues 43 at the short sides of the door and to permit their entry into the grooves 51. The panel 32 is slid upwardly into engagement with panel 31 until the tongues 43 about three sides of door 23 fit into the grooves 51 therealong to interlockingly connect the panels together. Raised portion 53 along the inner wall of groove 51 is guided into the cut out part 54 of tongue 43 at the top of door 23 and this aligns opening 57 with the central tapped hole in the other or lower tongue 44. Screw 56 is then placed in opening 57 and tightly threaded into the central tapped hole in tongue 44 of outer metal panel 31 so as to maintain the interlock between the panels. Thereafter screws 58 are passed through openings 59 and threaded into the tapped holes in the tongue 44 to complete the securement of panels 31 and 32 to one another.

The feature of rigidly holding the molded plastic panel 32 at a point midway between the short sides of the door to the metal panel 31, the interlocking of the three side edges of panel 32 to panel 31 and the provision of clearance between the inner wall of grooves 51 and the ends or edges of the tongues 43 on panel 31 all contribute to permitting the molded plastic panel to expand and/or contract relative to metal panel 31 without twisting or bowing. By interlocking panel 32 to panel 31 in the manner disclosed to allow it to expand and contract in a direction paralleling the extension of metal panel 31 the molded plastic panel does not tend to warp door 23 and therefore this door retains its original flat shape to engage the freezing compartment access opening sealing member 19 uniformly therearound under different temperature conditions to which panel 32 may be subjected. The present structure is a simple arrangement which can be produced at low manufacturing costs because a minimum of parts are employed to accomplish the objects. The rigid metal panel counteracts any tendency of the molded plastic panel to twist or bow and thus warpage of the door is prevented while the outer molded plastic panel thereof may freely expand or contract.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. An elongated rectangular door structure of the type adapted to form a closure between zones having an appreciable temperature differential, said structure comprising inner and outer panels forming a space therebetween, insulating material disposed in and substantially filling the space between said panels, one of said panels being formed of sheet metal and the other of said panels being of molded plastic material having characteristics of greater expansion and/or contraction upon changes in temperature thereof relative to said metal panel, said sheet metal panel being flanged about its periphery and provided with a tongue directed inwardly of at least two short sides thereof, said molded plastic panel having a groove along each of its short sides with the opening thereof facing said tongue on the short sides of said metal panel, said molded plastic panel being slid into engagement with said metal panel from one long side thereof with said tongues fitted in said grooves, means rigidly locking the edge portions of said panels together against slippage relative to one another at a single point on each of the long sides thereof substantially midway between their short sides, the bottom wall of said grooves normally being spaced from the end of said tongues to permit said molded plastic panel to expand and/or contract away from and toward said locking points in a direction paralleling the extension of said metal panel, and the width of said grooves being substantailly equal to the thickness of said tongues whereby the side walls of said grooves each engage an opposed side of said tongues during expansion and/or contraction of said molded plastic panel to prevent twisting thereof relative to said metal panel.

2. An elongated rectangular door structure of the type adapted to form a closure between zones having an appreciable temperature differential, said structure comprising inner and outer panels forming a space therebetween, insulating material disposed in and substantially filling the space between said panels, one of said panels being formed of sheet metal and the other of said panels being of molded plastic material having characteristics of greater expansion and/or contraction upon changes in temperature thereof relative to said metal panel, said sheet metal panel being flanged about its periphery and provided with a tongue directed inwardly of one of its long sides and both of its short sides, said molded plastic panel having a continuous groove along one of its long sides and along both of its short sides with the opening thereof facing said tongue on the three sides of said metal panel, said molded plastic panel being slid into engagement with said metal panel from the fourth side thereof with said tongues fitted in said grooves, means rigidly locking the edge portions of said panels together against slippage relative to one another at a single point on each of the long sides thereof substantially midway between their short sides, the bottom wall of said grooves normally being spaced from the end of said tongues to permit said molded plastic panel to expand and/or contract away from and toward said locking points in a direction paralleling said metal panel, and the width of said grooves being substantially equal to the thickness of said tongues whereby the side walls of said grooves each engage an opposed side of said tongues continuously along their length during expansion and/or contraction of said molded plastic panel to prevent twisting thereof relative to said metal panel.

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