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METHOD OF MAKING INSULATED CABINETS

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Fig. 1.

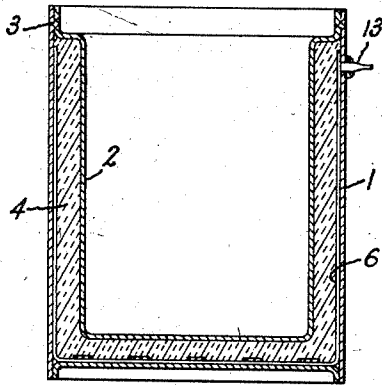


Fig. 3.

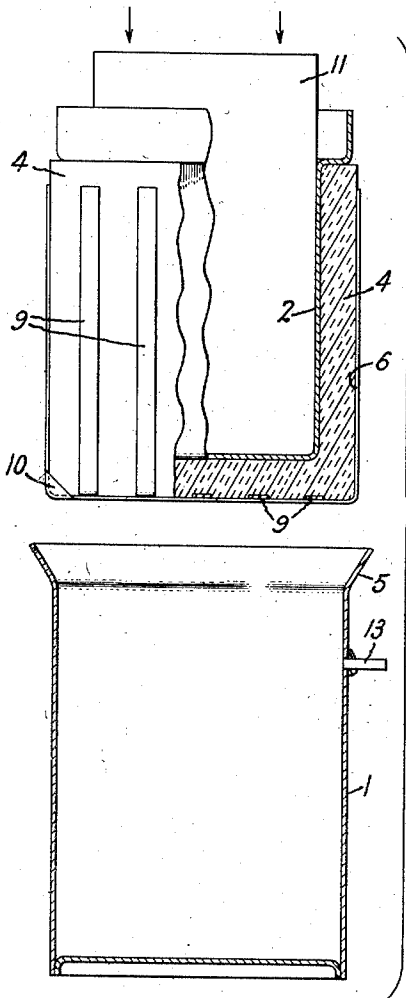
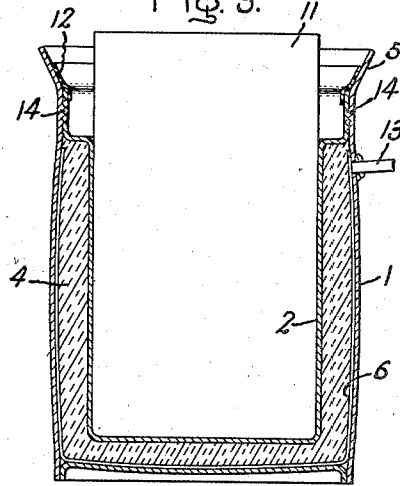
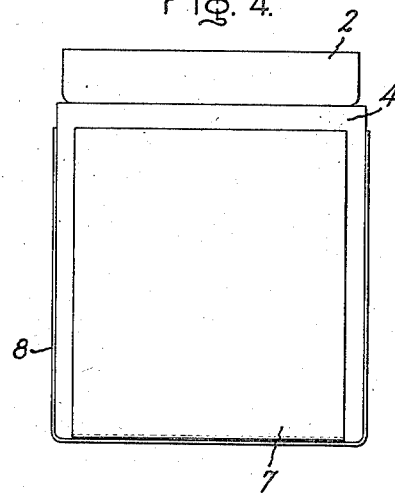


Fig. 2.

Fig. 4.



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2,699,583

METHOD OF MAKING INSULATED CABINETS

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10 Claims. (Cl. 20—101)

My invention relates to insulated cabinets and more particularly to cabinets employing vacuum insulation and to methods for making such cabinets.

Vacuum insulated structures may be of the type described and claimed in the copending application of Herbert M. Strong and Francis P. Bundy, Serial No. 236,788, filed July 14, 1951. Such structures employ a compressible filler material for supporting the walls thereof. If, in the making of vacuum insulated cabinets, a compressible filler material of a thickness corresponding to the difference between the dimensions of the inner liner and the outer case were employed, this compressible filler material would be considerably compressed by the external pressure upon evacuation of the space between the walls and the walls would therefore be considerably distorted because of the compression of the insulating material. In accordance with my invention, however, a compressible insulating material of a thickness substantially greater than the distance between the inner and outer walls of the cabinet is employed, so that after evacuation and resultant compression of the filler material, it supports the walls with the proper final spacing and with the walls substantially flat and undistorted.

It is an object of my invention to provide improved methods of making a cabinet of the vacuum insulated type.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In carrying out the objects of my invention, compressible filler material of a thickness substantially greater than the final contemplated spacing between the inner and outer walls of the cabinet is placed around the inner liner and at least partially enclosed with metal sheet. The liner with its surrounding insulating material and envelope is then forced into the outer case, causing a bulging of the outer case. The edges of the outer case in the inner liner are temporarily sealed by suitable arrangement such as tape and the space between the outer case and the inner liner is evacuated. The outer case and inner liner are then permanently sealed by welding along a line inwardly of the tape.

For a better understanding of my invention, reference may be had to the accompanying drawing in which Fig. 1 is a sectional elevation view showing a vacuum insulated cabinet constructed in accordance with my invention.

Fig. 2 is an exploded view, partly in section, showing the cabinet in the process of assembly.

Fig. 3 is a sectional elevation view illustrating the cabinet after assembly and prior to evacuation thereof.

Fig. 4 is an elevation view, partly in section, showing a modified form of my invention.

Referring to Fig. 1, there is shown a vacuum insulated cabinet which includes an outer case 1 and a spaced inner liner 2. The top edges of the outer case and the inner liner are sealed at 3 in any suitable manner, as by welding, as will be described below. The inner liner 2 is preferably made of a material of low thermal conductivity, such as stainless steel, to minimize edge losses. The walls of the outer case and the inner liner are supported against atmospheric pressure by a compressible heat-insulating filler material 4 which may be of the

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type described and claimed in the aforementioned Strong and Bundy application.

Under the heavy loading effected by atmospheric pressure the compressible heat-insulating material is substantially reduced in thickness, for example to a thickness one half or less than that which it has under atmospheric conditions. It will be apparent, therefore, that should heat-insulating material having a thickness corresponding to the difference between the dimensions of the outer case and the inner liner be employed, there would be substantial deformation of the walls of the outer case and inner liner upon evacuation and resultant application of atmospheric load. In accordance with my invention, this deformation is avoided by providing heat insulating material having an initial thickness substantially greater than the difference between the dimensions of the inner liner and the outer case. Further, in accordance with my invention, provision is made for facilitating the insertion of the inner liner with surrounding compressible heat-insulating material into the outer case, and provision is further made for doing this in such a manner that, although the outer case bulges outwardly at the time of insertion of the inner liner and its surrounding heat-insulating material, the outer case resumes its original shape with flat walls upon evacuation of the space between the outer case and the inner liner.

The arrangement for accomplishing these results is illustrated in Fig. 2. In Fig. 2 the outer case 1 is shown in the form employed to facilitate assembly of the inner liner and the surrounding material into the outer case. In this form the top edge of the outer case is flared as indicated at 5 to provide a mouth for receiving the material to be assembled therein. As also shown in Fig. 2, the bottom and sides of the inner liner are enclosed by heat-insulating material 4. This heat-insulating material 4 may conveniently be in the form of a plurality of batts of the shape conventionally employed in making refrigerated cabinets and the like. To minimize shifting of the heat-insulating material out of position during the insertion of the liner and the surrounding heat-insulating material into the outer case, the exterior surface of the heat insulating material is at least partially enclosed within a surrounding sheath 6. This sheath may take a number of different forms, for example, it may be in the form of an enclosure including bottom and four side walls but of a material sufficiently thin and flexible that can easily assume the reduced size necessitated by forcing the assembly into the outer case. Preferably, however, a plurality of separate flexible sheets or strips are employed. For example, as illustrated in Fig. 4, the envelope may be made from one sheet 7 extending across the bottom and upwardly along the front and back walls of the heat-insulating material and a second sheet 8 extending across the bottom and up the two end walls of the heat-insulating material.

For the purpose of retaining the heat insulating material in position, it is not essential that it be completely enclosed. For example, the sheath may comprise a plurality of separate strips in lieu of the full width sheets shown in Fig. 4. This modified form is illustrated in Fig. 2 wherein a plurality of flexible metal strips 9 are employed. In addition, corner pieces 10 may be employed to minimize the tendency for the heat-insulating material to be pushed away from the corner areas during assembly. Although thin metal sheet or strip provides the most convenient material for this purpose, it will be apparent that the sheets or strips need not be formed of metal but any material having sufficient strength and flexibility may be used.

In order to minimize deformation of the inner liner during assembly, a solid mass or block 11 is preferably employed within the inner liner 2. This block has exterior dimensions closely conforming to the internal dimensions of the inner liner 2, and may conveniently be formed of wood or any other material having sufficient strength.

To effect assembly of the inner liner and the heat-insulating material and the surrounding sheath 6 into the outer case, a downward force is exerted on the block 11 as indicated by the arrows in Fig. 2. Reception of the inner liner and its associated external material within

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the outer case 1 is facilitated by the flared edge or mouth 5 which guides the lower end of the metal sheath inwardly as the assembly is forced downwardly into the outer case. As pressure is exerted on the block 11 and the inner liner and its associated external material is forced into the outer case, the relatively thin metal wall 1 of the outer case is bulged outwardly as indicated in Fig. 3. After the elements have been urged to the assembled position shown in Fig. 3, a flexible sealing tape 12, which may conveniently be of a polyvinyl adhesive type, is applied at the adjacent top edges of the outer case and the inner liner to provide a temporary seal for the space between the outer case and the inner liner.

A conduit 13 is provided extending through an opening in the outer case. Suitable evacuating apparatus (not shown) is connected to the conduit 13 for evacuating the space between the outer case and the inner liner. As the pressure within this space is substantially reduced, the external atmospheric pressure on the outer case 1 effects a substantial compression of the heat-insulating material, reducing the thickness thereof and causing the walls of the outer case 1 to substantially regain the original flat shape shown in Fig. 2. While the tape 12 would not be satisfactory to provide a permanent seal, it provides a sufficiently complete seal on a temporary basis that the pressure within the space between the outer case and the inner liner may be reduced to a value sufficiently low that the external atmospheric pressure forces a return of the outer case to its original shape. Moreover, the tape does not provide a rigid seal and hence permits some movement of the edges of the outer case and inner liner during evacuation so as to keep stresses in the material of the case and liner to a minimum. Any straightening of the cabinet which may be necessary is done at this point in the manufacturing process because the tape permits relative movement of the edges. If this shifting is accomplished before welding, there should be no distortion in the cabinet after welding. After evacuation and while the vacuum is being maintained by the evacuating apparatus, the adjacent edges of the outer case and the inner liner are welded within a region inward of the tape 12, for example, in the area 14. While a continuous line weld may be made at this time so as to complete the final sealing of the cabinet, the presence of the block 11 may make this inconvenient. As an alternative, therefore, the edges may be spot welded together in the area 14 and the line welding may then be accomplished after the block 11 has been removed. The spot welding establishes the relationship of the outer case and the inner liner and holds them in this relationship pending final welding.

I have found that even though there should be some leakage of air into the space between the outer case and the inner liner and resultant bulging of the outer case before the final line welding is accomplished, the outer case will immediately resume its flat shape as soon as the space is again evacuated. This is true because the spot welding establishing relationship of the inner liner and outer case is accomplished while the space therebetween is evacuated and while the heat-insulating material is compressed to its final thickness. After the sealing has been completed the edges may be cut in any suitable manner just outwardly of the sealing area 14 to provide the finished cabinet.

By forming the cabinet in the manner described above, stresses which might tend to distort the final cabinet are avoided. Thus the edges are not welded together to provide a fixed relationship between the inner liner and the outer case until after the parts have been placed in their assembled relationship and after the space between the outer case and the inner liner has been evacuated and the heat-insulating material compressed, thus providing conditions the same as those existing in the final cabinet. Accordingly, after final line welding, and the re-evacuation if that be necessary, the stresses in the walls of the cabinet are at a minimum and hence the flat shape of the outer case will easily be maintained over a long period of time.

By way of example, glass fiber insulation of approximately 6 pounds per cu. ft. and a thickness of approximately $\frac{7}{8}$ inch may be employed about the exterior surfaces of the interior liner. The metal sheath or envelope for maintaining this glass fiber insulation during assembly may be made from pieces of 0.10 inch sheet steel in the form, for example, shown in Fig. 4. Corner pieces made of steel of the same thickness may be employed. During assembly of a 4 to 6 cu. ft. cabinet a pressure estimated at 1000 to 2000 pounds may be exerted on the block

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11 for effecting the assembly and the glass fiber insulation, as a result of this assembly, compressed to approximately $\frac{1}{2}$ inch in thickness. A polyvinyl adhesive tape may be employed for temporarily sealing the top edges of the outer case and inner liner so that initial evacuation may be accomplished. Then the edges may be first spot welded and then later line welded in a region inward of the polyvinyl tape area.

While I have shown and described the specific embodiments of my invention, I do not desire my invention to be limited to the particular construction shown and described, and I intend, by the appended claims, to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible insulating material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, at least partially enclosing said insulating material with a flexible sheath, forcing said inner liner and said insulating material and said sheath into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, temporarily sealing said cabinet at the top edges of said inner liner and said outer case, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, and permanently sealing said edges to each other to seal the space between said outer case and said inner liner.

2. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, placing a plurality of flexible strips around at least a portion of the exterior of said insulating material with said strips extending across the bottom and up the sides of said insulating material, forcing said inner liner and said insulating material and said strips into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, temporarily sealing said cabinet at the top edges of said inner liner and said outer case, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, and permanently sealing said edges to each other to seal the space between said outer case and said inner liner.

3. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible insulating material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, at least partially enclosing said insulating material with a flexible sheath, forcing said inner liner and said insulating material and said sheath into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, temporarily sealing said cabinet at the top edges of said inner liner and said outer case, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, correcting any minor deformities of said outer case while the vacuum is being maintained and permanently sealing said edges to each other to seal the space between said outer case and said inner liner.

4. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible insulating material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, at least partially enclosing said insulating material with a flexible sheath, forcing said inner liner and said insulating material and said sheath into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, temporarily sealing said cabinet at the top edges of said inner liner and said outer case, evacuating the space between said outer case and said inner liner thereby caus-

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ing said outer case to resume substantially its original shape, permanently sealing said edges to each other to seal the space between said outer case and said inner liner, and making a final evacuation of the space between said outer case and said inner liner after said permanent sealing has been completed.

5. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible insulating material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, at least partially enclosing said insulating material with a flexible sheath, forcing said inner liner and said insulating material and said sheath into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, applying flexible sealing tape to the top edges of said outer case and said inner liner for temporarily sealing said edges, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, and welding said edges to each other inwardly of said tape for permanently sealing the space between said outer case and said inner liner.

6. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible insulating material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, at least partially enclosing said insulating material with a flexible sheath, forcing said inner liner and said insulating material and said sheath into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, applying flexible sealing tape to the top edges of said outer case and said inner liner for temporarily sealing said edges, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, spot welding said edges of said outer case and said inner liner inwardly of said tape, and line welding said edges of said outer case and said inner liner inwardly of said tape for permanently sealing the space between said outer case and said inner liner.

7. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible insulating material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, at least partially enclosing said insulating material with a flexible sheath, flaring the top edge of said outer case to provide a mouth for receiving said inner liner and said insulating material and said sheath, forcing said inner liner and said insulating material and said sheath into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, temporarily sealing said cabinet at the top edges of said inner liner and said outer case, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, and permanently sealing said edges to each other to seal the space between said outer case and said inner liner.

8. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible inner material having a thickness exceeding the difference between the dimensions of said outer

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case and said inner liner, at least partially enclosing said insulating material with a flexible sheath, providing within said inner liner a solid mass having dimensions corresponding to the interior dimensions of said inner liner for bracing said inner liner against deformation, applying a downward force to said mass for forcing said liner and said insulating material and said sheath into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly temporarily sealing said cabinet at the top edges of said inner liner and said outer case, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, and permanently sealing said edges to each other to seal the space between said outer case and said inner liner.

9. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible insulating material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, at least partially enclosing said insulating material with a flexible sheath, forcing said inner liner and said insulating material and said sheath into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, applying flexible sealing tape to the top edges of said outer case and said inner liner for temporarily sealing said edges, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, spot welding said edges of said outer case and said inner liner inwardly of said tape, line welding said edges of said outer case and said inner liner inwardly of said tape for permanently sealing the space between said outer case and said inner liner, and trimming said edges of said outer case and said inner liner along a line outward of said line welded portion.

10. The method of making a vacuum insulated cabinet which comprises providing an inner liner and an outer case, placing a compressible heat-insulating material adjacent the outer surface of said inner liner, said compressible material having a thickness exceeding the difference between the dimensions of said outer case and said inner liner, placing a plurality of flexible strips around at least a portion of the exterior of said insulating material with said strips extending across the bottom and up the sides of said insulating material, providing corner pieces adjacent each of the lower corners of said insulating material, forcing said inner liner and said insulating material and said strips into said outer case thereby compressing said insulating material and causing said outer case to bulge outwardly, temporarily sealing said cabinet at the top edges of said inner liner and said outer case, evacuating the space between said outer case and said inner liner thereby causing said outer case to resume substantially its original shape, and permanently sealing said edges to each other to seal the space between said outer case and said inner liner.

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