

Jan. 29, 1957

R. S. GAUGLER ET AL
INSULATED REFRIGERATOR WALL

2,779,066

Filed May 23, 1952

2 Sheets-Sheet 1

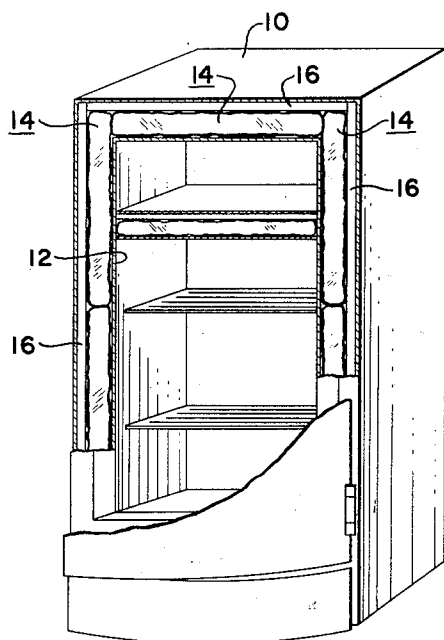


Fig. 1

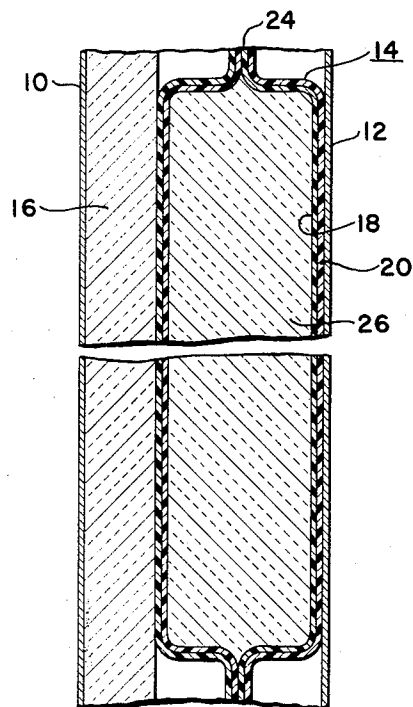


Fig. 2

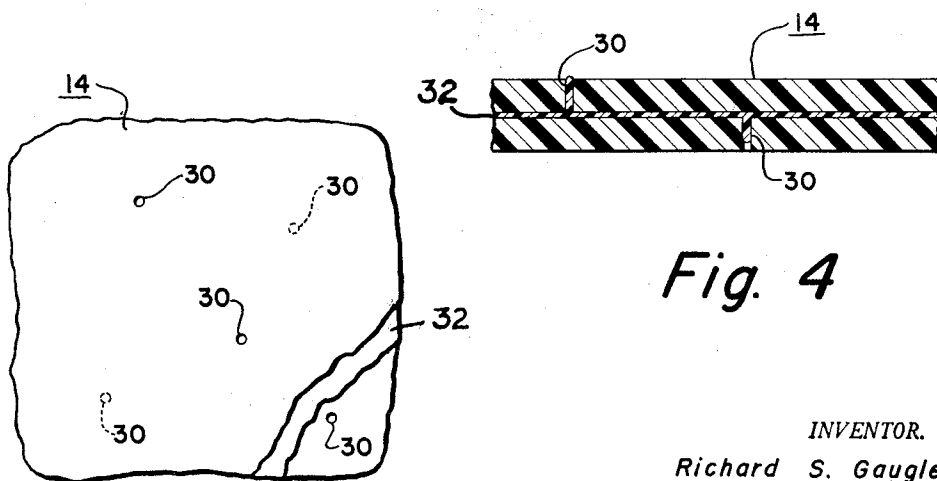


Fig. 3

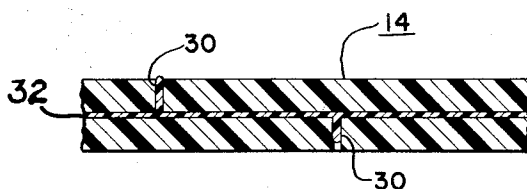


Fig. 4

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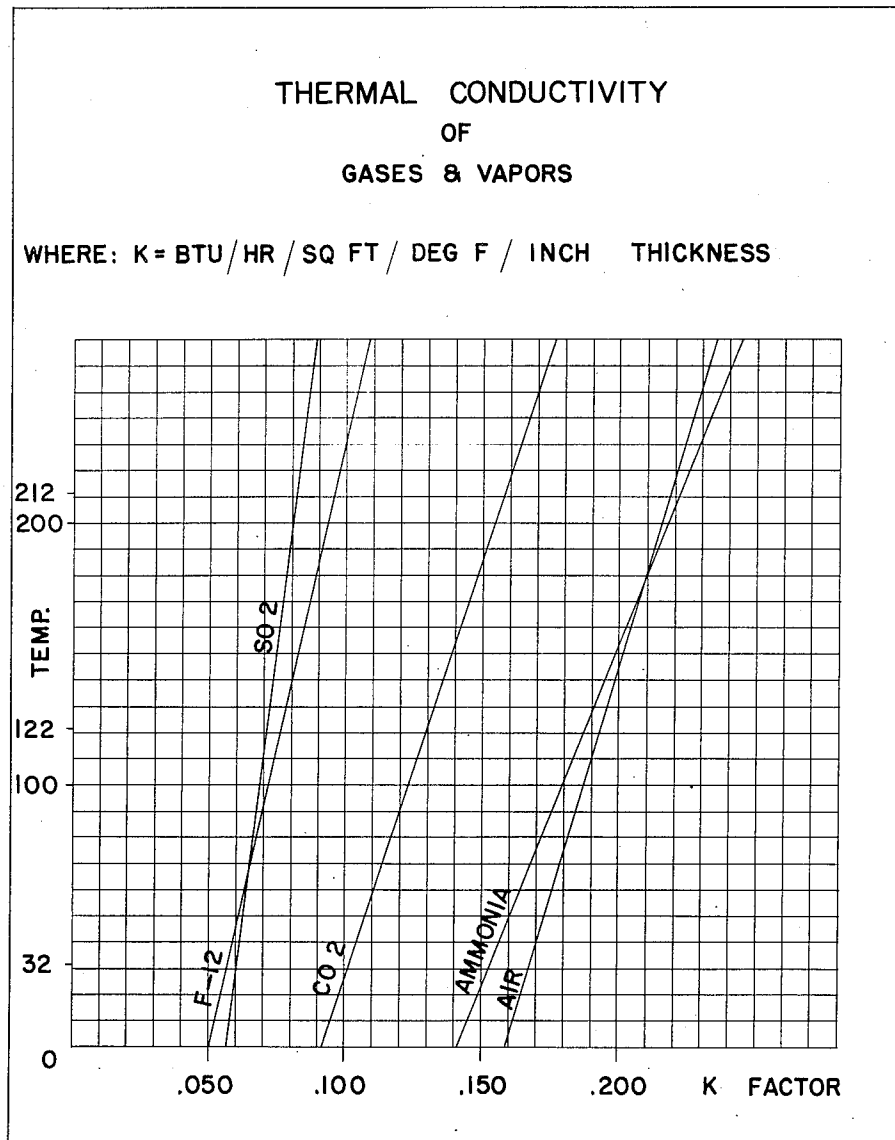


Fig. 5

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INSULATED REFRIGERATOR WALL

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8 Claims. (Cl. 20-4)

This invention relates to refrigerating apparatus and more particularly to an improved arrangement for insulating the walls of refrigerators and the like.

It is an object of this invention to provide an improved and practical insulation in which gas having a low coefficient of thermal conductivity is used in combination with glass fibers or the like.

It is another object of this invention to provide such an insulation which is relatively unaffected in its insulating properties over long periods of years.

Another object of this invention is to provide a material for packaging insulation which will hold up over a long period of years over relatively wide temperature ranges and which will prevent the passing of the insulating gas from the package to the exterior of the package and which will also prevent the passage of air into the package.

Another object of this invention is to provide a packaging material which has the necessary ability to prevent the transfer of moisture into the package as a build-up of moisture in the insulation tends to materially reduce the insulating property thereof.

Still another object of this invention is to provide a laminated packaging material whereby any pin holes in each of the laminations are sealed by an adjacent lamination.

Another object of this invention is to utilize a laminated material wherein the desirable properties of each of the laminae compensate for the undesirable properties of the other laminae and wherein at least one of the laminae may be heat sealed.

A further object of this invention is to provide a refrigerator with bag type insulation having means for compensating for differences in atmospheric pressure. More particularly it is an object of this invention to provide insulation which allows for limited expansion and contraction of the bagged insulation without causing bulging of the walls of the refrigerator.

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 pictorial view, with parts broken away, showing a conventional household refrigerator provided with insulation constructed in accordance with the invention;

Figure 2 is a fragmentary sectional view showing a wall section on an enlarged scale;

Figure 3 is a fragmentary plan view of the material used for enclosing the insulation;

Figure 4 is a fragmentary sectional view on a greatly enlarged scale showing the manner in which the pin holes in one sheet are sealed by the adjacent sheet and showing the manner in which the adhesive used in laminating the sheets further seals the pin holes; and

Figure 5 is a plan view of a chart showing the thermal

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conductivity of various gases and vapors at various Fahrenheit temperatures.

For purposes of illustrating the invention there is shown in the drawings a household refrigerator whereas certain aspects of the invention are equally applicable to the other types of products wherein it is desired to provide heat insulation for preventing the rapid transfer of heat through a wall section or the like.

Referring now to the drawings wherein a preferred embodiment of the invention is disclosed, reference numeral 10 designates the outer shell or housing of a conventional household refrigerator. Reference numeral 12 designates the liner or inner wall of the refrigerator. The space between the inner wall and the outer wall is filled with hermetically sealed bags of insulation 14 and slabs 16 of unbagged insulation.

The bags 14, as best shown in Figure 2 of the drawings, are made up of laminations 18 and 20 which are heat sealed at 24 and which are filled with glass fiber insulation 26 and a gas having a low coefficient of conductivity such as difluorodichloromethane, commonly called Freon or F-12. It has been found that by replacing the air with Freon in each bag of insulation it is possible to materially reduce the rate of heat transfer through the insulation. As shown in the chart in Figure 5 of the drawings, the K factor, which is the factor designating the thermal conductivity of gases and vapors in terms of B. t. u. per hour, per square foot, per degree Fahrenheit, per inch thickness, is much less for Freon than for air, with the result that it is possible to approximately double the insulating ability of bagged insulation when Freon is substituted for the air in the bag.

The big problem in utilizing the insulating properties of Freon or other similar gases is that of providing a bag which will prevent the loss of Freon from the bag during the life of the refrigerator and which will also prevent the ingress of air into the bag. Some materials have been found to be good barriers for Freon but to be relatively poor barriers for air and if one should use such a material the Freon would remain in the bag but air would enter the bag and, consequently, in accordance with the law of partial pressures, the bag would eventually burst or excessively bulge and the insulating value of the bag would be reduced substantially whereas if one were to select a material which would prevent the ingress of air but would not satisfactorily prevent the loss of Freon, the bags would not only lose their insulating value because of the loss of Freon charge, but would also tend to collapse and compress the solid insulation fibers so as to materially reduce the insulating property of the assembly. Metal foil would meet the above requirements but its thermal conductivity is too high to be useful in making the bags.

It has been found that it is not only necessary to provide a material which will prevent changes in pressure resulting from leakage through the walls of the bag but is also necessary to provide an insulation which is not adversely affected by changes in atmospheric pressures. Since some refrigerators are used at or near sea level, whereas other refrigerators are used or are transported over routes where the elevation may exceed ten or more thousand feet, it is apparent a bag filled with Freon at atmospheric pressure at sea level would tend to burst or materially bulge in high altitudes. This problem has been solved by providing extra space between the walls of the refrigerator so as to permit limited expansion of the bags.

As indicated in Figures 1 and 2 of the drawings, this extra space is filled with compressible or loose insulation which is not placed in bags and this then allows the necessary expansion and contraction of the bagged insulation without exerting excessive pressures against the walls of the refrigerator. Thus, if the bags would expand,

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the loose insulation 16 would merely compress without bulging the walls of the refrigerator. The density of the fiber glass insulation 16 is preferably about 1.25 pounds per cubic foot whereas the density of the fiber glass insulation 26 in the bags is preferably about 3.75 pounds per cubic foot.

It has been found that by making the bags of laminated material the passage of air and/or Freon through the walls of the bag is materially reduced. There are several reasons for this; in the first place, the laminations are secured to one another by means of adhesive material such as vinyl chloride or a rubber base type of adhesive which would tend to seal the pin holes as shown in Figure 4 of the drawings. Furthermore, when one secures one sheet of material having pin holes to another sheet having pin holes the likelihood of two pin holes becoming aligned with one another is extremely remote with the result that each sheet or layer serves to seal the pin hole openings in the adjacent sheet. Figures 3 and 4 are intended to illustrate this point and in these figures the reference numeral 30 has been used to designate the pin holes in the adjacent sheets and the reference numeral 32 has been used to designate the adhesive which bonds the sheets together and seals the pin holes.

It has been found that a copolymer of vinyl chloride and vinylidene chloride such as the product known as "Saran" has certain properties which make it ideal for the one layer. Thus, one of the advantages of using such a copolymer for the one layer is that it may be heat sealed whereas most other types of plastic or other sheet material cannot be heat sealed. Furthermore "Saran" seems to be an ideal barrier to the passage of both moisture and air and a fairly good barrier to Freon. Still another advantage of the use of copolymers of this type is that they stand up well at the low temperatures encountered in refrigeration work. The outer layer of the bags is preferably made of "Mylar" which is a polyester of ethylene glycol and terephthalic acid and which is about eight times better than "Saran" as a barrier to the passage of Freon under some conditions. At higher temperatures encountered, "Saran" tends to become plastic whereas "Mylar" does not and, therefore, the combination of the two is very ideal.

Another plastic material which may be used as one of the laminations is polystyrene as this is a very good barrier for Freon but not for air and therefore must be used in conjunction with a material such as "Saran" which will prevent the passage of air.

The sheets used for making the laminations should preferably be .001 inch or more thick. The thicker the laminations the less is the leakage but for cost purposes the thickness should be kept down within reason.

In referring to laminated films it is not only intended to include a film product made by bonding two separate sheets of material together but also to include products made by other processes such as spraying a layer or coating of one material upon a sheet or film of the same or a different material. In other words the method of preparing multiple layers may be varied insofar as certain aspects of the invention are concerned.

By virtue of the particular combination of materials in the laminated sheets and the insulating gas used, a vastly superior type of insulation has been produced which is capable of retaining its insulating properties over long periods of time without being damaged by temperature or pressure fluctuations or other factors such as moisture, oil, etc.

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. In a refrigerator, an outer wall, an inner wall spaced from said outer wall, insulation between said walls, said insulation comprising outer bag means, filler material within said bag means having voids therein, and a gas

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filling said voids, said gas having a coefficient of thermal conductivity less than that of air, said bag means having a thickness less than the distance between said walls, and compressible insulation in the space between said bag means and said walls whereby expansion and contraction of said bag means is permitted without distortion of said walls.

2. In a refrigerator, an outer wall, an inner wall spaced from said outer wall, insulation between said walls, said insulation comprising outer bag means, filler material within said bag means having voids therein, and a gas filling said voids, said gas having a coefficient of thermal conductivity less than that of air, said bag means having a thickness less than the distance between said walls, and compressible insulation in the space between said bag means and said walls whereby expansion and contraction of said bag means is permitted without distortion of said walls, said filler material having a density in excess of the density of said compressible insulation.

3. In a refrigerator, an outer wall, an inner wall spaced from said outer wall, insulation between said walls, said insulation comprising outer bag means, filler material within said bag means having voids therein, and a gas filling said voids, said gas having a coefficient of thermal conductivity less than that of air, said bag means having a thickness less than the distance between said walls, and compressible insulation in the space between said bag means and said walls whereby expansion and contraction of said bag means is permitted without distortion of said walls, said filler material having a density in excess of the density of said compressible insulation, said filler material comprising glass fibers.

4. In a refrigerator, an outer wall, an inner wall spaced from said outer wall, insulation between said walls, said insulation comprising outer bag means, filler material within said bag means having voids therein, and a gas filling said voids, said gas having a coefficient of thermal conductivity less than that of air, said bag means having a thickness less than the distance between said walls whereby expansion and contraction of said bag means is permitted without distortion of said walls, and compressible insulation filling the space between the bag means and said walls, said bag means having laminated walls with adjacent laminations thereof bonded together whereby any holes which may exist in the one lamination are sealed by the adjacent lamination.

5. In a refrigerator, an outer wall, an inner wall spaced from said outer wall, insulation between said walls, said insulation comprising outer bag means, filler material within said bag means having voids therein, and a gas filling said voids, said gas having a coefficient of thermal conductivity less than that of air, said bag means having a thickness less than the distance between said walls whereby expansion and contraction of said bag means is permitted without distortion of said walls, and compressible insulation filling the space between the bag means and said walls, said bag means having laminated walls with adjacent laminations thereof bonded together whereby any holes which may exist in the one lamination are sealed by the adjacent lamination, said filler material and said compressible insulation comprising glass fibers.

6. In an insulated receptacle, an outer wall, an inner wall spaced from said outer wall and insulation between said walls, said insulation comprising a laminated bag in which one lamination comprises a copolymer of vinyl chloride and vinylidene chloride and another lamination comprises a polyester of ethylene glycol and terephthalic acid, filler material within said bag having voids therein, and a gas filling said voids, said gas having a coefficient of thermal conductivity less than that of air.

7. In an insulated receptacle, an outer wall, an inner wall spaced from said outer wall and insulation between said walls, said insulation comprising a laminated bag having one layer substantially impervious to the passage

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of air and having a second layer substantially impervious to the passage of a given gas, filler material within said bag having voids therein and a quantity of said given gas in said voids, said gas having a coefficient of thermal conductivity less than that of air.

8. In combination, a heat insulating material having voids therein, a bag enclosing said material, a gas having a coefficient of thermal conductivity less than that of air filling said voids, said bag comprising a laminated film having a first layer substantially impervious to the passage of air and having a second layer substantially impervious to the passage of said gas, one of said layers comprising a copolymer of vinyl chloride and vinylidene chloride and another of said layers comprising a polyester of ethylene glycol and terephthalic acid, and bonding material between said layers and sealing any pinholes in either of said layers.

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