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INSULATING MEANS
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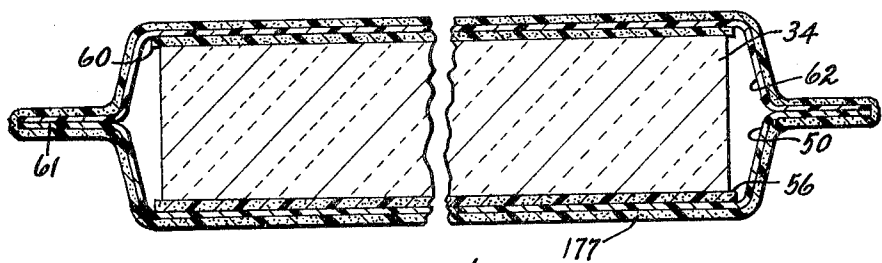


Fig. 1

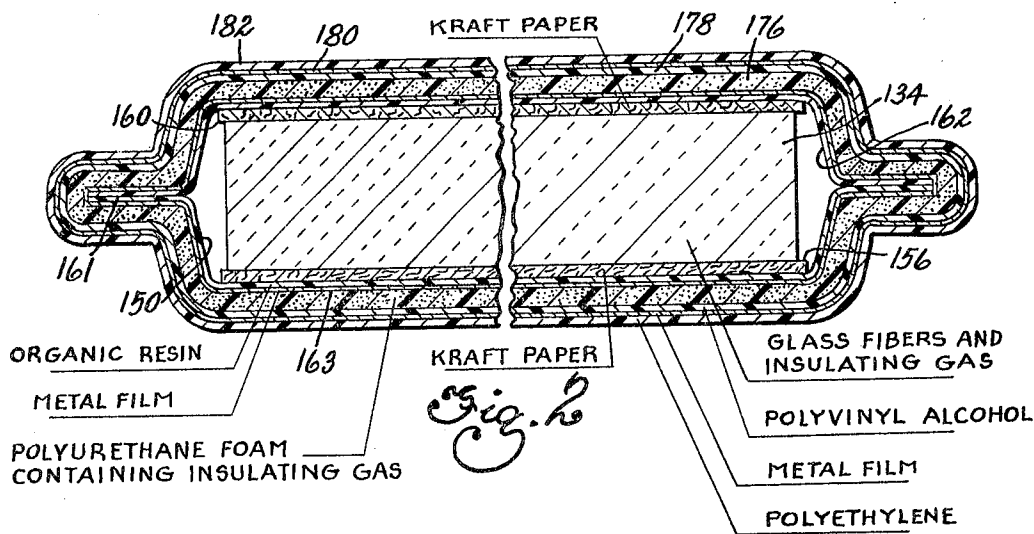


Fig. 2

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INSULATING MEANS

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This application is a continuation-in-part of my copending application S.N. 160,009 filed December 18, 1961 now Patent No. 3,206,345.

This invention relates to improved insulating means. It has been recognized that certain gases with inherently low coefficients of heat transmission after displacing air from insulating materials will substantially increase the insulating properties of good insulating material such as glass fibers or mineral wool. However, it has been difficult to provide for permanently enclosing such gases in the glass fibers or mineral wool. It has also been difficult to prevent the leakage of such gases and to prevent the puncturing of the enclosure during the handling of it afterward. Various means have often been proposed for accommodating the expansion and contraction of the gas during extreme changes in temperature and also in barometric pressure.

It is an object of my invention to provide a permanently sealed resilient insulation containing a gas having a low coefficient of heat transmission.

It is another object of my invention to provide a simple improved means having high insulating value for protecting the enclosure of the sealed resilient insulation from puncture and leakage during processing and subsequent handling and also to accommodate the expansion and contraction of the gas sealed therein.

These and other objects are attained in the first form shown in the drawings in which a piece of glass fiber or mineral wool is provided on its opposite faces with the protective strips of open cell foam or paper. This assembly is enclosed in a thermoplastic film formed of sheets located on the opposite faces of the protection strips with the protruding edges heat sealed together to complete the enclosure. The entire interior of the thermoplastic film enclosure containing the protective strips and the piece of glass fibers or mineral wool is provided with a gas having a low coefficient of heat transmission which is substantially permanently contained therein. To seal and protect the film and to provide a resilient outer layer, the entire outer surface of the film is provided with a thick coating of a closed cell substantially impervious resilient foamed polymer preferably also substantially permanently containing a gas having a low coefficient of heat transmission.

In the second form of the invention the interior is similar, but the thermoplastic film is provided with a vapor deposited film of a suitable metal such as aluminum. The closed cell substantially impervious resilient foamed polymer containing a gas having a low coefficient of heat transmission is provided in a thick coating over the thin metal film. A sealing coating of organic resin is applied over the foamed polymer and a second metal film similar to the first may be applied over the sealing coating. Over the second metal film is a second sealing coating of a suitable organic resin such as polyethylene. The interior of the second form contains glass fibers or mineral wool and a protective strip on opposite sides of the glass fiber or mineral wool and also contains a gas having a low coefficient of heat transmission. The metal films as well as the sealing coatings for the foam polymer substantially prevent the escape of any of the insulating gas for an extremely long period.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein pre-

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ferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a diagrammatic transverse sectional view of the first form of insulating means embodying my invention;

FIGURE 2 is a diagrammatic transverse sectional view of the second form of insulating means embodying my invention.

FIGURE 1 shows an insulation package in which there is a piece 34 in the form of a rectangular slab of glass fibers or mineral wool. Some glass fibers and mineral wool contain sharp needle-like pieces which may puncture the enclosing thermoplastic film or sheet. To avoid this possibility of puncturing provided such materials are used, I provide on opposite sides of the glass fiber or mineral wool piece 34 upper and lower sheets 60 and 56 of thin open cell foam elastomeric sheeting or craft paper of substantially the same width as the glass fibers or mineral wool piece 34. The assembly of the glass fiber or mineral wool piece 34 and the protective sheets 56 and 60 is enclosed on opposite sides by sheets 50 and 62 of heat sealable thermoplastic film or sheet which are heat sealed together at all their edges 61 to complete the enclosure. Examples of such film or sheet are one or more layers of vinylidene chloride sheet or a copolymer of vinyl chloride and vinyl chloride acetate or a polyester of ethylene glycol and terephthalic acid. The air within the enclosure provided by the sheets 50 and 62 is preferably replaced by a gas having a low coefficient of heat transmission such as difluorodichloromethane or sulphur dioxide.

According to my invention, this film is protected by a thick outer coating 177 of a flexible resilient closed cell substantially impervious foamed polymer directly adherent to the film. This foamed polymer contains in its cells a gas having a low coefficient of heat transmission. Preferably the foam polymer 177 is of the polyurethane type and contains as the insulating gas monofluorotrichloromethane.

As one example of materials forming a flexible closed cell substantially impervious foam polymer, such as the foam polymer 177, there is supplied for one component A in parts by weight a mixture of 44 parts of toluene diisocyanate and 15 parts of monofluorotrichloromethane. The toluene diisocyanate consists of a mixture of 80 parts 2,4 toluene diisocyanate and 20 parts of 2,6 toluene diisocyanate. For the second resin component B, there is provided a mixture in parts by weight of 90 parts castor oil, 10 parts of distilled tall oil and 3 parts catalysts including one half part of N-ethyl morpholine, .2 part stannous octoate, 1.0 part of tetramethylguanidine. The resin component B also includes a surfactant in the amount of 1.5 parts of organosiloxane. These components are mixed and sprayed onto the entire outer surface of the films 50 and 62 in sufficient thickness to provide a thick protective coating of the films sufficient to protect the film from puncturing, tearing and abrasion during handling and installation.

It should be understood that it is especially important to protect the film 50, 62 from being punctured by external means since the loss of the insulating gas, difluorodichloromethane or sulphur dioxide, from the interior greatly reduces the insulating properties of the package. The foam 177 protects the film 50, 62 from being punctured by external means and in addition seals the film to further prevent the escape of the gas therein having the low coefficient of heat transmission and also prevents the ingress of air thereto. It makes it possible for the package to withstand the normal abuses imposed during handling which was a problem with film enclosed insulation.

The cellular structure of the foam is especially effective in sealing any minute holes which may be present in the film. The cellular structure of the foam also makes it effective in preventing cutting and penetration by sharp objects. The cellular structure of the foam and the presence of the insulating gas in the foam have sufficient insulating properties to minimize the effect of external temperature changes on the gas in the interior of the film and thereby minimizes consequent changes of the pressure of the gas therein. The resiliency of the cellular structure makes it possible to expand and contract to fill voids in the insulation space and to absorb increases in pressure of the gas during contraction and expansion of the insulation gas within to fill any voids in the insulation space within which the package may be lodged.

The second form of the invention embodies an insulation package shown in FIGURE 2 in which there is a flat rectangular piece of glass fibers or mineral wool 134. As in FIGURE 1, this piece 134 is covered on its upper and lower faces by a lower protector sheet 156 and an upper protector sheet 160 of open cell elastomeric foam or kraft paper. These protector sheets prevent the possibility that some sharp needle-like piece within the glass fibers or mineral wool 134 will puncture the enclosing film. As in FIGURE 1, the assembly of the piece of glass fibers or mineral wool 134 and the protector sheets 156 and 160 is enclosed by lower and upper sheets 150 and 162 of a thin thermoplastic film. This film is preferably made up of one or more layers of vinylidene chloride sheet or other heat sealable films or sheets such as vinyl chloride-acetate copolymer or a copolymer of vinyl chloride and vinylidene chloride or a polyester of ethylene glycol and terephthalic acid. The latter sheet material is preferred and preferably is provided with a thin vapor deposited coating 163 of aluminum over its entire surface. However, prior to this deposition of the metal film the interior of the enclosure is evacuated and charged with a gas having a low coefficient of heat transmission such as difluorodichloromethane or sulphur dioxide. The edges 161 are also heat sealed together completely around the assembly of the piece 134 and the protector sheets 156 and 160 before the vapor deposited metal film is applied.

The vapor deposited metal film substantially improves the holding of the insulating gas within the interior and therefore prolongs the effectiveness of the insulation. Where the useful life of the structure in which the insulation package is to be used is relatively short, the metal coating 163 may be omitted.

According to my invention to protect the enclosure from puncturing and tearing and to seal the thermoplastic film and to hold and protect the metal film, I apply a thick coating 176 of a resilient elastic flexible closed cell substantially impervious foamed polymer of the polyurethane type, preferably containing in the cells thereof a gas such as monofluorotrichloromethane having a low coefficient of heat transmission. The specific example may be the same as that set forth for the coating or layer 177 in FIGURE 1 and performs the same functions.

While this foam polymer is capable of retaining the gas in its cells for a long period of time, there is a tendency for its effectiveness to be reduced gradually by penetration by moisture vapor and air. To prolong the insulation properties of the foam polymer, I provide the foam polymer 176 with a thin flexible external coating 178 of polyvinyl alcohol or a polyester of ethylene glycol and terephthalic acid. To provide additional gas sealing properties I provide a second vapor deposited very thin flexible film 180 of aluminum to the external surface of the plastic resin 178. This film 180 may be omitted where some loss of insulating efficiency after a long time is not important. To protect the metal film 180 from puncturing and abrasion, and to protect the polyvinyl alcohol coating from contact with moisture, I provide an outer coating 182 of either polyethylene or a polyester of ethylene glycol and terephthalic acid. These outer coat-

ings and films are sufficiently thin and flexible that they do not substantially interfere with the flexibility and resiliency of the much thicker cellular layer 176 which is composed of the foam polymer.

The external coatings provided make practical this gas filled type of insulation since it is possible for the insulation package to be readily handled without substantial danger of cutting or puncturing the sealing enclosure so that the escape of the gas is permanently prevented. The resiliency and toughness of the coatings 178 and 182 on the outside of the foam polymer 176 add to the effectiveness in preventing cutting and puncturing and also abrasion. The package may be made inexpensively through the use of automatic machinery as illustrated in my co-pending application S.N. 160,009 filed December 18, 1961. The package may be applied to the interior of the hollow walls of refrigerators or other insulating structures such as insulated trucks and refrigerator cars. The foam layer can be compressed during periods of high pressure of the gas within the interior of the package to prevent excessive pressures therein and it may expand during periods of low pressure resulting from cold temperatures to fill any voids in the insulation space. Thus the insulation package by the provision of this resilient foam layer is capable of application to wider changes in temperature than packages enclosed solely in solid films.

While the embodiments of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. Insulation comprising a resilient permeable insulating material containing a gas having good insulating properties, a sealed bag of thin flexible material enclosing said insulating material and sealing said gas in the insulating material, and a resilient foam material bonded to the entire outer surfaces of said bag and completely enclosing the outer surfaces of said bag.

2. Insulation comprising a resilient permeable insulating material containing a gas having good insulating properties, a sealed bag of thin flexible material enclosing said insulating material and sealing said gas in the insulating material, and a resilient foam material bonded to and completely enclosing the outer surfaces of said bag, said foam material containing a preponderance of closed cells containing a gas having good insulating properties.

3. Insulation comprising a resilient permeable insulating material in the form of a relatively thick sheet of extensive area containing a gas having good insulating properties, protector sheeting provided upon opposite sides of said resilient insulating material, a sealed bag of thin flexible material enclosing said insulating material and said protector sheeting and sealing said gas in the insulating material, and a foam material bonded to the entire outer surfaces of said bag.

4. Insulation comprising a resilient permeable insulating material containing a gas having good insulating properties, a sealed bag of thin flexible material enclosing said insulating material and sealing said gas in the insulating material, and a polyurethane foam material bonded to and surrounding and completely enclosing and protecting the entire outer surfaces of said sealed bag.

5. Insulation as specified in claim 4 in which the polyurethane foam material is substantially impervious and has a preponderance of closed cells containing an insulating gas.

6. Insulation as specified in claim 4 in which the polyurethane foam material has an external sealing coating.

7. Insulation as specified in claim 4 in which the polyurethane foam material has an external sealing coating having a layer of organic resin on opposite sides of a metal film.

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8. Insulation comprising a thick rectangular resilient permeable insulation material containing a gas having good insulating properties, a sealed bag of insulating material enclosing and extending throughout both sides and all the edges of said insulating material and sealing the gas in the insulating material, and a foam material extending continuously over and completely enclosing the outer surfaces of said bag and being bonded continuously to the entire outer surfaces of both sides and all the edges of said bag.

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