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INSULATION

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FIG. 1

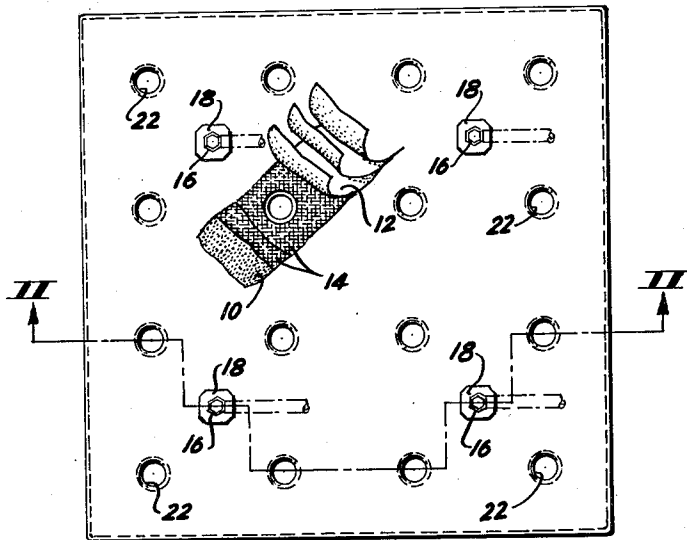


FIG. 2

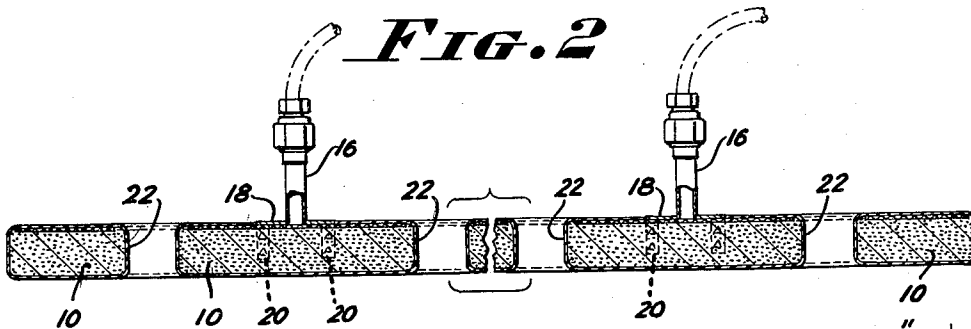
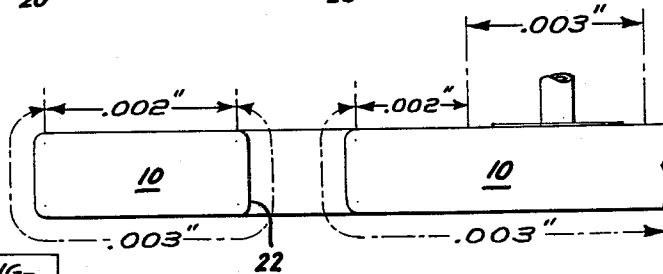
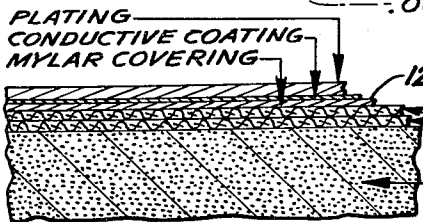


FIG. 3



PLATING
CONDUCTIVE COATING
MYLAR COVERING

FIBERGLASS PAD 14

POWDER
CAKE 10

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FIG. 4

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This invention relates to the method of making heat insulating structures of the type including, but not limited to, panels, blankets, walls, housings, and the like. Such insulating structures may be suitable for both very low temperature and very high temperature uses, for example in connection with the storage and handling of extremely cold liquids such as liquified gases, and the storage and handling of molten metals and the like, or as heat insulating panels for insertion within dual walled aircraft or spacecraft structures, or the like.

It is known that gas-evacuated insulating panels comprising non-compacted mixtures of carrier powders having dispersed throughout particles capable of scattering and/or reflecting and/or absorbing and/or re-radiating radiant energy, operate effectively as high performance type insulators; and the present invention has to do with the problem of facilitating the effective packaging of such insulative mixtures into the form of easily handled modules for mounting in assemblies to be insulated to provide the required heat transfer barriers.

More specifically, it is one object of the present invention to provide an improved method for packaging a mass of heat insulative material into a prescribed shape and dimensional form, to thereby render it form-sustaining and to facilitate subsequent assembly thereof into a heat insulative barrier system.

Another object of the invention is to provide a method as aforesaid which includes certain gas-evacuating and module surface treating steps, thereby rendering the finished product of improved heat insulative characteristics.

Other objects and advantages of the invention will appear from the specification hereinafter, by reference to the drawings herewith wherein:

FIG. 1 is a top plan view of an insulation panel of the present invention, with a portion of the top cover structure thereof partially broken away to illustrate the construction thereof;

FIG. 2 is a fragmentary section, on an enlarged scale, taken along lines II—II of FIG. 1;

FIG. 3 is a fragmentary diagrammatic illustration of a portion of FIG. 2, depicting the preferred thickness variations of the external metal plating applied to the structure, as will be explained hereinafter; and

FIG. 4 is a greatly enlarged fragmentary sectional illustration showing the structural fabrication of the article of the invention.

As explained hereinabove, this invention contemplates use of any preferred type of "filler" material for the insulative modules to be fabricated. Typically, such materials may be selected from the natural or synthetic ceramics; natural or synthetic fibers; or other heat absorbing or scattering or reflecting particle; or mixtures thereof having suitable heat-resistant, refractory, density, compressive strength, heat-softening, sintering, and other chemical-physical characteristics that may be required for the given installation. Such "filler" materials are usually of pulverant form and are substantially free-running in the dry state, and the method of the invention contemplates that this dry pulverant material will first be mixed with a suitable wetting agent, such as naphthalene or the like, so as to render it capable of assuming a cake-like form. Thus, the filler material may now be either packed into a previously fabricated plastic bag designed to inflate to the prescribed shape and dimen-

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sions of the insulation module to be made; or, alternatively, the plasticized filler material may be molded into the desired form and then sprayed with a liquid plastic of a type adapted to "set up" so as to then provide a plastic casing enclosing the "filler" material and subsequently maintaining it in the preformed shape thereof.

In any case, the method of the invention contemplates inclusion of gas vent devices incidental to fabrication of the plastic container for the filler material. Thus, for example, as shown in FIGS. 1 and 2 of the drawing herewith, the filler "cake" of plasticized filler material as indicated at 10, will be encased within a plastic container such as may be provided by spraying liquid Mylar or the like thereover to form an enclosing layer of plastic material as indicated at 12. As shown in FIG. 4, prior to spraying the Mylar in place, one or more layers of fiberglass fabric 14 may be first applied to the surfaces of the filler cake, whereby when the Mylar or other plastic material is sprayed thereon it will coat and partially penetrate the pores of the fiberglass mats so as to provide a structurally reinforced integral casing.

As shown in FIGS. 1—3, evacuation conduits are arranged at suitable intervals over the span of the module to provide vent openings communicating with the interior of the container; the conduits being illustrated herein at 16 and having base plates 18 preferably anchored into the filler cake material by means of barbed legs 20 to stabilize the vent conduits relative to the module upon completion of the device. As indicated at 22, the module may be provided at suitably spaced intervals with internal brace devices 22 formed by including suitable sleeve portions in the plastic bag if a preformed plastic bag is used. Alternatively, if the filler cake is first formed and then sprayed with plastic, the internal reinforcements may be provided by punching suitable openings through the plasticized cake 10, prior to spraying the latter with liquid plastic as explained hereinabove. In either case the collar devices 22 extending through the module will function to relatively brace the opposite faces of the module shell, and may also be used to receive fastening devices for mounting the module against vertical wall surfaces or the like, if desired.

To complete the fabrication of the module of the present invention, the preshaped cake and casing combination is next subjected to a metal plating operation. This may be performed for example by first coating the plastic bag with a suitable paint-like substance to provide an electrically conductive coating over all exterior surfaces of the module casing. The assembly is then subjected to an electro-forming process whereby a metallic coating of nickel, or Inconel, or rhodium, or other suitable metal, depending upon the conditions to be encountered, will be deposited over all external surfaces of the structure. This metallic coating need be only a few thousandths of an inch thick, and will thereupon function to provide a radiant heat-reflective, weather-proof, stiffening coating over the entire assembly, which in cooperation with the fiberglass and plastic layers interiorly thereof will provide a shape-sustaining casing for the entire assembly.

As the next step in the process of the present invention, the liquid, such as naphthalene, which was initially used to plasticize the filler material, is evacuated from the structure by suitable heat applications thereto; the vent conduit 16 remaining open during this stage of the process. Thus, the naphthalene will boil off and will leave the filler "cake" in the form of a foraminous structure of superior heat-reflective characteristics, and then a partial vacuum may be created within the module by connecting the vent conduit 16 to a suitable vacuum pump or the like. When the vacuum reaches the desired

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level the vent conduits 16 may be welded shut, or otherwise closed; and the module is then in condition to be installed for example in an aircraft wall structure or the like, in association with other similar modules so as to provide the desired heat transfer barrier.

It will of course be appreciated that the nature of the filler materials employed will depend upon the service to which the article is to be subjected. Similarly, the precise nature of the plastic casing will be determined by economic as well as engineering and performance considerations; and the nature of the metallic coating to be plated exteriorly of the plastic case will be determined on the basis of emissivity characteristics required, manufacturing facilities, economics, as well as other engineering considerations. Thus, although only one specific form of the method and article of the invention has been illustrated and described in detail herewith, it will be understood that various changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A method for fabrication of a heat-insulative module to a prescribed form comprising, mixing a liquid into a mass of pulverant heat insulation material to render the latter plastic and temporarily form-retentive, shaping the mass to the form prescribed for the module, encasing the formed mass in an envelope of plastic material, metal-coating the casing of plastic material, venting the interior of the casing while heating the contents to volatilize said liquid, applying a vacuum source to the interior of said casing, and then pressure-sealing the casing to provide an evacuated shape-sustaining module for heat insulation purposes.

2. A method for fabrication of a heat-insulative module to a prescribed form comprising, mixing a liquid into a mass of pulverant heat insulation material to render the latter plastic and temporarily form-retentive, shaping the mass to the form prescribed for the module, spraying the formed mass with a settable plastic material to form an envelope thereon, metal-coating the casing of plastic material, venting the interior of the casing while heating the contents to volatilize said liquid, applying a vacuum source to the interior of said casing, and then pressure-sealing the casing to provide an evacuated shape-sustaining module for heat insulation purposes.

3. A method for fabrication of a heat-insulative module to a prescribed form comprising, mixing a liquid into a mass of pulverant heat insulation material to render the latter plastic and temporarily form-retentive, shaping the mass to the form prescribed for the module, spraying the formed mass with plastic material to encase the mass, thinly metal-coating the casing of plastic material, venting the interior of the casing while heating the contents to volatilize said liquid, applying a vacuum source to the interior, and then pressure-sealing the casing to provide an evacuated shape-sustaining module for heat insulation purposes.

4. A method for fabrication of a heat-insulative module to a prescribed form comprising, rendering a mass of pulverant heat insulation material temporarily plastic and form-retentive, shaping the mass to the form prescribed for the module, spraying a settable flexible material on the formed mass to encase the latter, metal-

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coating said casing, venting the interior of the casing while heating the contents to volatilize said liquid, applying a vacuum source to the interior, and then pressure-sealing the casing to provide an evacuated shape-sustaining module for heat insulation purposes.

5. The method of fabricating a heat-insulative module, which comprises

(a) plasticizing a mass of pulverant heat-insulative material by combining and mixing a volatile liquid binder and the mass of pulverant heat-insulative material

(b) in such proportions as to render the mixture shape-retentive,

(c) shaping a quantity of the mixture to a prescribed shape and temporarily supporting casing-forming means, initially incapable of shape retention, in intimate contact with and upon the shaped external surface of the material during such time as the material is still plastic and shape-retentive,

(d) rigidifying the casing-forming means to such extent as to be capable of sustaining the aforesaid prescribed shape in the absence of said binder,

(e) and thereafter venting the casing and volatilizing said liquid to remove the binder from the mixture and thereby leave substantially only the pulverant heat-insulative material within the shape-sustaining casing.

6. The method of fabricating a heat-insulative module, which comprises

(a) combining and mixing a volatile liquid binder and a mass of pulverant heat-insulative material

(b) in such proportions as to render the mixture shape-retentive,

(c) shaping a quantity of the mixture to form a cake of prescribed shape,

(d) coating the cake with hardenable plastic material while the cake is temporarily shape-retentive,

(e) metal coating the plastic material, after hardening, to form with the hardened plastic material a casing sufficiently rigidified as to sustain the prescribed shape in the absence of said binder,

(f) and thereafter venting the casing and volatilizing said liquid to remove the binder from the mixture and thereby leave substantially only the pulverant heat-insulative material within the shape-sustaining casing.

7. The method according to claim 5 wherein

(a) the casing is formed in part by a flexible plastic bag within which the mixture is placed and shaped,

(b) the casing being rigidified by the application of a metal coating to the plastic bag.

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