The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

The invention relates to chemical compositions capable of generating heat and to a novel blanket or bag which provides controlled heat release when activated and which operates automatically subsequent to activation.

Previous proposals for generating heat by chemical agents prescribed various comminuted metals that were reacted with suitable oxidizing agents and in other instances with moisture or air. Difficulties encountered with mixtures of this type stem from the fact that the reactions were vigorously exothermic resulting in rapid heat release which found utility mainly in therapeutic heating pads or in the permanent waving of hair.

Exothermic reactions which are set up by introducing water into a dry powder mixture will often generate steam and gases that are disagreeable or even dangerous. Contamination or possibly objectionable chemical action was heretofore carefully avoided by confining the dry ingredients in a porous bag which in turn was enclosed in a rubberized fabric or other waterproof casing. Structures fabricated in this manner tend to be somewhat rigid and suitable only for localized heat applications in the manner of the ordinary hot water bottle or electric heating pad.

The chemical heating blanket of the present invention provides for the use of a relatively thin, pliable cover or wrapping that can be readily unfolded and spread over a patient as a first aid measure at the scene of an accident, in emergency situations and in warfare. A clinically prescribed expedient for the comfort and survival of the injured and wounded provides for the immediate application of external heat, although such care is seldom available as a first aid treatment. Also, troops and emergency crews deployed in remote, cold regions and operating under adverse conditions may find immediate and temporary relief from the cold by utilizing emergency blankets capable of generating moderate heat for several hours.

It is therefore a primary object of the present invention to provide a novel blanket or bag which is capable of generating moderate heat by means of a chemical reaction.

Another object of the invention is to provide compositions which can sustain a uniform, comfortable heat release for a period of several hours.

A further object of the invention resides in the use of a novel blanket that is chemically treated and stored for emergency situations, said blanket being relatively easy to activate for releasing heat for a prolonged period of unattended operation.

A still further object is to provide novel heating compositions which eliminate operational hazards of the prior art, said compositions being substantially free of gaseous formation and operable without the need for water or other activating chemical.

Other objects and advantages will become apparent from the detailed description that follows.

In accordance with the invention, a paper, fabric, plastic or other pliable material is formed into a blanket or bag structure and impregnated with an exothermic compound or mixture of exothermic compounds to provide a relatively slow release of heat. The blanket may be formed of any suitable absorbent material in any desired thickness that is sufficient to retain in its structure an exothermically reactive compound. Compounds which can be utilized for this purpose are the peraminoethylenes and certain organometallics, namely, the alkylaluminums and alkylzincs. The peraminoethylenes which are effective for this purpose are those which are chemically luminescent, i.e., those which display the property of emitting blue-green light when exposed to air. These peraminoethylenes are also capable of a low release of heat, and they have been found to be effective when used alone, or when mixed with a diluent as an impregnation in the present blanket structures. More specifically, a peraminoethylene by way of example is the liquid compound,

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(OH)_2N\overset{\text{C}}{\text{O}}\overset{\text{C}}{\text{C}}(O)\overset{\text{C}}{\text{C}}\overset{\text{C}}{\text{C}}N(OH)_2
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identified as tetrakis (dimethylamino) ethylene which upon exposure to air reacts with oxygen to produce luminescence and heat. Impregnations of this compound in terry cloth, or other blanket material, will produce temperatures as high as 140° F., while more moderate temperatures of about 100–120° F., may be sustained for several hours.

The term "organometallics" is strictly applied to compounds that contain carbon-metal bonds and more particularly to alkylaluminums and alkylzincs. The compounds, triethylaluminum and triisobutylaluminum, as well as the diethylzinc and dibutylzinc are unstable liquids which become spontaneously flammable in air with considerable release of heat. However, these compounds may be mixed with suitable inert materials or diluents to suppress their pyrophoric nature and yield heat at a relatively low rate which is safe and comfortable for body warmth in covering and wrapping media. When the reactive compound combines with oxygen in the air under controlled conditions the heat of the reaction is distributed throughout the diluent material, and the temperature does not rise drastically or get out of control. Diluents which are suitable for this purpose include the neutral hydrocarbon oils, fluorocarbons and other heat-and-fire-resistant materials.

Thus, the instant impregnating compositions consist essentially of a fire-resistant material in which one or more of the alkylaluminum, alkylzinc or of other organometallic compound becomes highly diluted. A wide range of weight ratios is possible for these ingredients depending on the reactivity of the particular compound used and the extent to which the heat of the reaction will be permitted to develop. The heat of the reaction is controlled by the concentration of the organometallic compound as well as the surface area in which said compound is exposed to air. Heat generation is considerably more rapid when a large surface of reactive composition is exposed at once to the action of the air; a selectively exposed surface on the other hand provides a more gradual heat for a prolonged period of operation. Effective heat release in accordance with the invention is obtained when the organometallics are included in an amount in the range of between 0.25 and 25 percent by weight of the impregnating compositions. Mixtures of TEA and TIBA or of DEZ and DBZ may be used with the diluents with equally effective results.

The peraminoethylenes may also be mixed and used with minor amounts of diluent materials when lesser reactivity and greater control of heat generation is desired.

In order to protect the user or patient from possible ill effects, the impregnated blanket material is treated to form a protective surface barrier of the film plastic or absorbable resin or plastic material. Thus, paper, woven cloth, cellulose matting, and the like, may be resin treated or coated to provide an impervious surface to the liquid
impregnation. The impregnated material may also be protected from the action of air or moisture by storing it in a hermetically sealed container until the time when it is placed in operation.

The invention is illustrated and further described in the following preferred embodiments:

FIGURE 1 is a fragmentary perspective view of a heating blanket conforming to my invention; and

FIGURE 2 is a cross section view of another embodiment of the invention.

Shown in FIGURE 1 is a blanket structure 11 comprising an absorbent layer 12 of terry cloth, felt, crinkled paper, etc., which is impregnated with a heating composition consisting essentially of dibutylzinc mixed with a neutral hydrocarbon oil, the organometallic being present therein in about 0.75 percent by weight. An example of a suitable neutral oil which may be used for this purpose is the Esso product marketed as Number 75 neutral oil. The inner surface 13 is formed of a thin film of Telfon or Mylar. Mylar is the trade name of a film of polyethylene terephthalate resin manufactured by E. I. du Pont de Nemours & Co. and is available in film thicknesses of 0.00025 to 0.00075 inch.

In view of the reactivity of the zinc compound, the impregnation and plastic coating are carried out in an inert atmosphere. After the blanket has been completed, it is placed in a container and sealed under nitrogen or other inert gas. When the sealed container is opened, the blanket is removed and immediately placed in position to cover an individual or as a warm wrapping for his extremities or any object which is to be kept warm. The exposed surface of the blanket allows air and moisture to react with the zinc compound generating heat and causing a rise in temperature on the blanket surface. A temperature of about 108° F. may be readily maintained with a power supply of at least 8 hours.

In the embodiment shown in FIGURE 2, an impregnated pliable layer of a plastic foam 17 having an open cell structure is impregnated with a peraminoethylene compound, or alternately, with a mixture of triisobutylaluminum and fluorocarbon oil, the aluminum compound being present in said mixture in about 0.5 percent by weight. A film of Mylar, polyvinyl chloride, etc. is applied to the surfaces of the foam and including ends 19. Alternately, a thin aluminum foil 21 may be used in place of the plastic to protect the outer surface of said layer. The layer may be folded or rolled for storage without the need for hermetical sealing as in the previous embodiment. In placing the blanket layer in operation, the outer plastic or foil is peeled back or punctured to introduce air to the impregnation. As the reactive compound becomes exhausted during operation, additional sections of plastic or foil are removed to expose fresh quantities of compound to the action of air.

Fluorocarbons which are suitable as diluents for the present blanket impregnations are, for example, the perfluoroheptane, C₇H₆F₇, B.P. 82° C. and the perfluorthemethylcyclohexane, B.P. 76° C. Methods for making these and other fluorocarbons that may be used in the practice of the present invention are described in Industrial & Engineering Chemistry, vol. 39, pp. 236-434 (1947).

It will be seen that the present heating blanket provides a novel heating source which remains reactive for several hours without the need for wetting with water or other initiating agent. It will further be seen that the present chemically treated blanket may be set in operation merely by exposing impregnated surfaces to the action of air. Under the controlled conditions of this invention, an alkylaluminum or other organometallic reacts slowly with oxygen to produce an alkoxide and further with moisture to form hydroxides. Thus, the blanket remains dry and free of obnoxious gases or steam during the course of its operation.

Further it would be apparent that by constructing the blanket of resin treated paper or woven fabric it is possible to provide an inexpensive heating blanket which may be readily disposed after it has served its purpose.

From the foregoing description it is evident that many modifications and variations are possible without departing from the spirit and scope of the instant invention.

What is claimed as new and is desired to be secured by Letters Patent is:

1. A chemical heating blanket comprising a pliable, absorbent layer impregnated with a mixture of an exothermic compound selected from the group consisting of a peraminoethylene, triethylaluminum, trisobutylaluminum, diethylzinc and dibutylzinc and a diluent selected from the group consisting of neutral oil and fluorocarbon, said layer having a surface film impervious to said mixture.

2. A chemical heating blanket comprising a pliable, absorbent layer impregnated with a peraminoethylene, said layer being resin coated to form a surface barrier impervious to said compound.

3. A chemical heating blanket comprising a paper sheet impregnated with a mixture of an alkylzinc and a diluent oil, said alkylzinc comprising about 0.25% to 25% of said mixture by weight, said sheet being coated with a film of polytetrafluoroethylene.

4. A chemical heating blanket comprising a pliable sheet of plastic foam, said sheet being impregnated with a mixture of an alkylaluminum and a diluent oil, said alkylaluminum comprising about 0.25% to 25% of said mixture by weight, said sheet being coated with a resin impervious to said mixture.

5. A chemical heating blanket in accordance with claim 2 wherein said layer is coated with a film of polyethylene terephthalate resin.

6. A chemical heating blanket in accordance with claim 2 wherein said layer consists of terry cloth.

7. A chemical heating blanket in accordance with claim 3 wherein said alkylzinc consists of dibutylzinc.

8. A chemical heating blanket in accordance with claim 4 wherein said alkylaluminum consists of trisobutylaluminum.

9. A chemical heating blanket in accordance with claim 2 wherein said layer consists of woven cloth.

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