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ELECTRIC BLANKET

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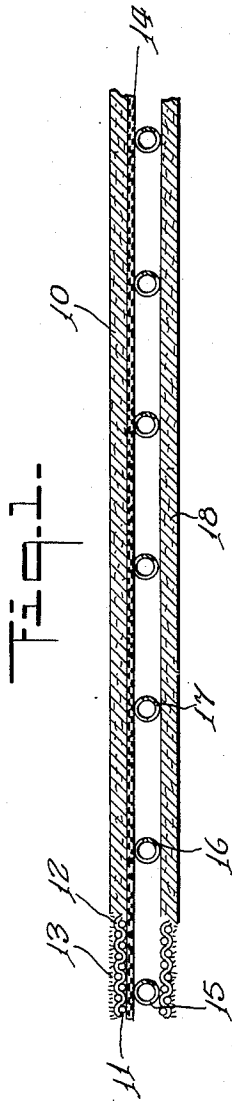
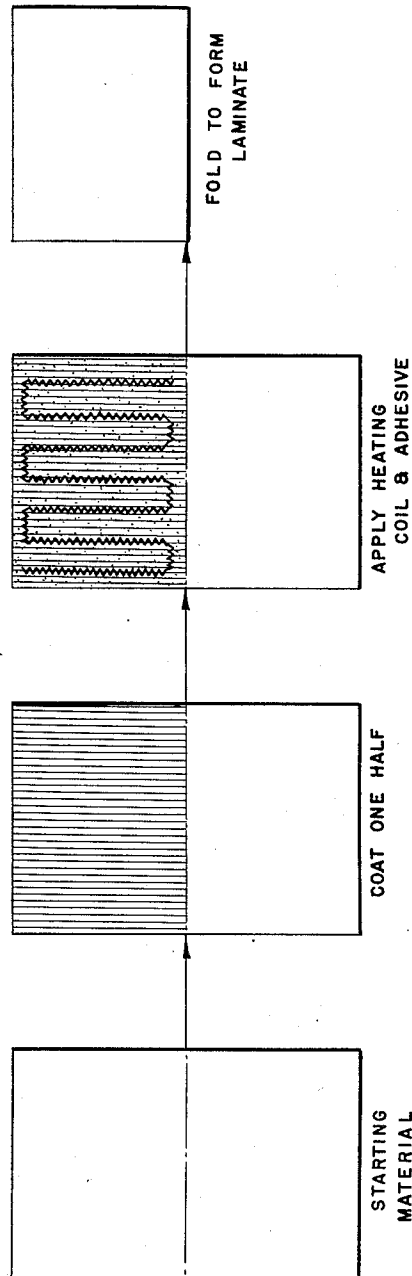


Fig. 2--



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ELECTRIC BLANKET

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6 Claims. (Cl. 219—46)

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This invention relates to electric blanket construction, and in particular to a construction for improvement of the efficiency of electric blankets in use.

The fundamental object of the instant invention is to provide an electric blanket construction which improves the efficiency of the operation of an electric blanket by materially reducing the radiation heat loss therefrom.

A second object of the invention is to provide an improved method of making electric blankets whereby a structure is produced which is more efficient in operation in that the amount of heat lost therefrom is reduced.

Other objects and advantages of the invention will in part be obvious and in part appear hereafter.

The invention thus comprises an electric blanket structure characterized by being a laminated structure which includes a first layer of material to be oriented toward the user, and electric heating network, a radiation reflective barrier applied over the network, and a final blanket layer to be applied over the said radiation reflective barrier so that in operation a material reduction in the heat loss from the electric blanket is obtained.

The drawings accompanying the instant specification comprise an illustration of the laminated structure characterizing the blanket and in:

Figure 1 there is shown a cross-section through a typical electric blanket structure made in accordance with the invention; and in

Figure 2 there is a diagrammatic illustration of a method of making the blanket.

Referring now specifically to Figure 1, 10 represents a first layer of blanket material which will comprise the usual weave of yarns running in mutually perpendicular directions, as indicated at 11 and 12, which material preferably is relatively smooth on one side and carries a nap 13 on the other. Applied to the smooth side of the material 10 there will be a foliated heat reflective layer made up of a multitude of discrete metallic particles adhered to the superficial surface of the material, as indicated at 14, thereby to provide in the blanket a heat reflective surface which leaves the material substantially as pliable as it was in its original state. Under the heat reflective surface are the heating elements of the electric blankets which generally take the form of insulated resistance wires 15, 16 and 17, which weave their way back and forth over the blanket. Applied against the heating element is the final lamination constituting material 18 which can be adhered to that surface by means of a suitable organic resinous binding material.

Illustrated in Figure 2 is a preferred method of assembling the blanket. As starting material a sheet twice the width of the finished blanket is

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coated, preferably by spraying, over one-half of its area with a binder composition containing metal flakes to form a reflective layer. To this is applied an appropriate network of resistance wires to form the heating coils and additional resinous material as an adhesive. The blanket is then folded to size, dried, baked at a temperature in the range from about 350° F. to 390° F. to free it of solvent and bring the binder to a state of incipient fusion. In this step the solvent is driven off and resin softened so that it clinches the fibers and adds the flakes thereon as a reflective layer, yet leaves the fabric permeable to air and moisture.

Though the lamination by adhesion is a neat method of construction, it is to be understood an effective one is also made by quilting or sewing the second layer to the first.

An important part of the mechanism in maintaining body temperature substantially uniform is the dissipation of heat from the body through radiation so that the inclusion of a barrier to radiant heat, which barrier has the effect of reflecting the heat back toward the source, will function quite efficiently in maintaining body temperature at a reasonably constant level. The development of the conventional electric blanket was based on the theory, not of conserving the heat loss through radiation from the body, but of replacing the heat lost through radiation. To analyze the dynamic system comprising a body covered with an electric blanket in operation, the body radiates heat out to and through the blanket, thereby tending to cool off. When the room temperature is quite low, the radiation lost from the body becomes sufficiently high to cause discomfort. The electric blanket or any blanket provides substantially no barrier to radiant heat and functions principally to keep the body warm through retaining a layer of warm air around the body. The electric blanket has gone a step beyond the conventional blanket in attempting to replace the heat lost by radiation and by inserting close to the body a source of radiant heat which will supply heat to the body as fast as it is thrown off. The optimum use of the electric blanket calls for balancing its load against the body so that heat is supplied to the body by the blanket as rapidly as it is lost by the body. At that point a maximum of comfort is obtained and the lightest blanket can be used.

However, in so doing the conventional electric blanket compounds the error involved in attempting to keep the body warm by supplying radiation sources close thereto, for one half of the source can "see" the body to radiate thereto. Thus any individual wire in the heating network in the blanket has at most only half its surface available to radiate heat to the body lying thereunder, that is the lower half. The upper half of

the surface of the heating element in the blanket radiates into the space around the body. At this point inclusion of the heat reflective layer in the blanket structure above the heating network has the effect of improving the efficiency of the electric blanket by reducing the radiant heat lost therefrom or increasing the amount of radiant heat it throws toward a body. The result is a material improvement in efficiency of operation of the blanket whereby it can be used to maintain a body at a comfortable temperature with a substantially lower load and lower temperatures in the heating elements.

The various metals which may be used to form the foliated heat reflective layers in the blanket and also the binding materials which may be used to adhere these metal flakes to the surface thereof as well as laminate the several parts of the blanket together are described in detail in my copending applications Serial No. 181,756, filed August 28, 1950, entitled Coated Fabric, now abandoned; Serial No. 181,755, filed August 28, 1950, entitled Process of Preparing Heat Reflective Coated Fabric, now abandoned; and Serial No. 191,656, filed October 22, 1950, entitled Improved Process for Preparing Heat Reflective Coated Fabric.

The fundamental consideration governing the blanket structure is to incorporate between layers of the material a heat reflective layer of metal flake which will serve to reflect heat substantially as efficiently as a continuous metal sheet, yet will be porous enough to allow vapors of moisture thrown off by the body to pass therethrough. That is to say, the blanket is made up to be an efficient heat reflector yet porous or permeable to moisture.

The metal flake to be used in the coating may be any of those metals which are inherently malleable, preferably corrosion resistant, of high reflectivity, and can be worked into fine leaf or flake form, such as aluminum, gold, silver, copper, iron, steel, stainless steel, brass, Monel metal, zinc, or platinum, may be used. However, in the selection of the metal flake, considerations of economics as well as operative characteristics will dictate the selection of a metal which is light, corrosion resistant and easily available commercially, such as aluminum or bronze flakes.

The binding ingredient for holding the metallic flake in place may be any film forming polymer, plasticized or unplasticized, even including some of the synthetic polymeric materials commonly used as fibers for textile manufacture. Upon dispersion or solution in a suitable solvent with the metal flake in suspension, there is formed a metallic composition which, after the solvent has evaporated upon application, forms a thin metallic layer composed of metal flakes bound in place by the polymer.

The following synthetic film forming polymers may be used as the binding agent; vinyl polymer types, such as polyvinyl chloride, polyvinyl acetate and copolymers of the vinyl compounds with other film forming compounds, vinylidene chloride, and even substituted vinyl compounds, such as polystyrene; acrylic acid resins, such as methyl, ethyl, propyl, butyl, acrylates or methacrylate and various copolymers thereof; alkyd resins such as the condensation products of glycerol and phthalic acid or anhydride; linear polyamides, the best known of which is nylon; organo silicon polymers such as polymethyl siloxane; melamine resins characterized as condensation products of melamine and formaldehyde.

The blanket formed by the lamination of materials with a reflective coating of this nature is heat reflective but air permeable because of the composition used in forming the heat reflector layer as well as the manner of depositing it. In the course of preparing the fabric, it is found that the application of the resinous coating in a spray and the final baking shrinks and clinches the application onto the outer points or surfaces of the fabric weave, while the interstices remain substantially free of metallic particles, thereby providing minute apertures or pores for the passage of air therethrough. Where shrinking has occurred and where the metallic particles extend somewhat away from the fabric thread, an air pocket is formed bounded by the thread and metallic particles, thus entrapping air which serves as an excellent insulating or heat-absorbing medium. Where air is entrapped at these points, any heat absorbed by the pocket of air may be reflected back by the metallic particles thus increasing efficiency of the coated fabric as a heat barrier. At the same time permeability is provided since the metallic particles do not completely cross over the interstices provided by the juncture of the warp and weft threads. It is found the metallic particles cover the larger part of each mound where a warp thread surmounts a woof thread or vice versa. Microscopic examination reveals that a metallic particle or aggregate of particles covers the complete surface of each thread up to a point which is somewhat short of its juncture with a thread crossing it laterally. Since the juncture point is the place where there is air transfer through the fabric, the resulting fabric carrying the metallic application and containing these air transfer points or pores is permeable to the extent determined by the spraying techniques used. At the same time, since the metallic particles cover the major superficial area of each thread, it is found that the fabric is efficiently utilized for reflective purposes. In this manner both qualities of permeability and heat reflectivity are obtained without impairment of either characteristic.

The polymer used as the binding agent should be of a sufficiently high molecular weight to be solid at ambient temperatures, which means it should have a molecular weight exceeding about 2500 or 3000. On the other hand, however, it is best that the molecular weight be not too high, for extremely high molecular weight polymers, those of several hundred thousand, are of such limited solubility in the common solvents that they render them too difficult to use. Also they are so frangible that they do not form flexible films without plasticizers. Normally polymers having molecular weights of the order of 5000 to 10,000 or 20,000 will be adequate for the purpose. A further criterion of a suitable molecular weight for the polymer is that it should be solid and dry to the touch at ambient temperatures and reach a state of incipient fusion at a temperature level which will not injure the fabric to which it is applied.

The general formula for preparing the solution of binder in which the metallic flake is suspended involves dispersing the finely divided polymer in a solvent for the polymer, and a small amount of plasticizer, and milling or mixing while raising the temperature slowly to about 50° C. to form a clear solution or stable organosol. The smallest amount of binder which will give effective adhesion of the flake should be employed. Usually the weight of binder should be at least about

the weight of metal flake used, but amounts from 2 to 10 times that weight will do. Hydrocarbons such as benzene, toluene, xylene, hydroformer residues, or others of similar aromatic nature, serve as extenders of the primary solvent for the binding agent. To a solution of the binding agent of this type there is added the metal flake in finely divided form preferably 300 mesh or finer, to form the suspension which is used in the coating operation.

The proportioning of ingredients will be best understood from the following few typical examples:

Example 1

105 parts of polyvinyl chloride having a molecular weight of about 8000 is dissolved in 145 parts by weight of toluol, and to this is added a paste made by wetting 21 parts by weight of aluminum flake of at least 300 mesh with 29 parts by weight of toluol. The solution thus formed will have the aluminum flake in suspension in a 39 per cent by weight solution of polyvinyl chloride and is ready for being sprayed onto a material. It is to be understood, of course, that variation in the amount of thinner used in the process will develop viscosities for use in spraying. Similarly variation in the amount of resin will effect that result. Any of the metal flake materials mentioned, such as bronze, steel, copper, silver, etc., may be used.

Also, it should be understood that the various metal flakes will have widely different specific gravities and may have quite different areas per unit weight, so that adjustment of the proportions of resin and solvent to carry the metal powder will be in order. Where a relatively heavy metal such as copper is used, it may be necessary to prepare a spray suspension having a lesser proportion of solids and possibly a higher viscosity than that described. This, of course, is readily adjustable by persons skilled in the art. Polymers for use in formulating the composition for the metallic application can be conveniently used if first prepared as organosols or pastes which are characterized as dispersions of the organic polymer in a plasticizer. Polyvinyl chloride organosols are good examples of this kind of formulation.

Briefly, a polyvinyl chloride organosol is prepared from conventional emulsion polymerized vinyl chloride which, if necessary, is reduced to the desired state of subdivision by grinding after drying. The polymer powder is mixed with the plasticizer in any suitable mechanical mixer for such materials. In this mixing operation the polyvinyl chloride particles are dispersed in the plasticizer to produce a high viscosity paste. As may be needed, the viscosity of the paste is reduced by blending with additional plasticizer. The paste can also be prepared by polymerizing the starting material in the presence of the desired plasticizer. When prepared in this form with any of the common plasticizers, the paste is very useful in formulating the binding compositions for the metallic application characterizing this invention.

From this example, the general principle governing the formulation of binder composition for the metal application will be seen as requiring solution of the polymeric binder in a volatile solvent to give a low viscosity consistent with retaining good spraying characteristics and quick drying when the solution is sprayed. There should be sufficient binder present to hold the metal flake on the surface of the fabric and, gen-

erally, the amount of binder will vary with its identity, but will be in the range from a weight about equal to that of the flake used to about 5 times that weight.

The choice of binding agents is wide, and with the common solvents permits a wide variety of combinations which allows for adjustment of volatility of the new composition to match the processing of the fabric. Typical hydrocarbon solvents are benzene, toluene, xylene and hydroformer residues which represent a moderate choice of aromatic solvent; aliphatic hydrocarbons such as petroleum ether, hexane and standard solvents have only limited solvent power for many polymers and for that reason are not as useful as the volatile aromatics. Ester solvents include methyl formate, ethyl acetate, amyl acetate, isobutyl propionate, butyl lactate, and are quite useful but relatively expensive. Also the various Cellosolves, such as ethylene glycol monoethyl ether, propylene glycol monoethyl ether, etc. may be used. Similarly, chlorinated hydrocarbons such as methylene chloride, chloroform, carbon tetrachloride, ethylene dichloride and chlorobenzene may be used. Ketones such as acetone, methyl ethyl ketone, cyclohexanone and similar volatile ones find use as solvents in the composition. Certain volatile ethers such as diethyl ether, dioxane, or diisopropyl ether also may be used. Certain alcohols such as isobutanol and cyclohexanol and even some acids have some use as solvents for some resins. The classes of solvents may also be used in admixture with each other consistent with the principles set forth.

Though the choice of solvents is wide, it will usually be governed by cost and volatility to match the processing rate of the fabric. Also the polymers vary in their solubility in the various solvents. Briefly, the composition to be used for spraying the coating on the fabric should be of a viscosity which permits it to break up into a cloud of discrete droplets and the volatility of the solvent should be such that it evaporates substantially as fast as the composition strikes the fabric.

Common plasticizers which may be used in the coating composition in amounts of about 10 to 150 per cent or more of the binding agent are: abietic acid esters, castor oil, tung oil, linseed oil, soy bean oil, as typical natural products; dimethyl phthalate, dibutyl, phthalate di octyl phthalate (2-ethyl hexyl), di- β -butoxy ethyl phthalate and various mixed phthalates, butyl stearate and related esters, methyl glycolate and tricresyl phosphate as typical esters.

The method of application of the foliated metallic flake coating to the material is based on spraying of the composition by means of conventional spray equipment, but other techniques, such as roller or printing operations are feasible. For example, a variation of the technique is to apply a first light coating to the fabric, which may be clear binder, prior to the reflective coating. Also the application of a very light clear coating over the reflective layer is sometimes desirable. The spraying operation has the virtue that the pressure of the spray tends to lay the flakes of metal on the superficial surface of the textile fabric as represented by the tops of the threads in the weave and does not penetrate into the interstices of the individual fibers or the opening defined by crossing of threads, which leaves the fabric pliable and porous. Since it is important to apply a predetermined amount of the material per unit area

of the fabric to insure retention of its porosity, close control of the amount of metallic flake and binder deposited per unit area of the fabric should be observed. This cannot be stated generally, for it varies with the weight of the material and the degree of reflectivity desired to be developed. In general, the reflective coating is substantially uniform over the entire superficial area of the textile fabrics and is the equivalent of at least about a single layer of the metal flake over the superficial surface of the material. Measurement of the amount of deposition can be based on the altered weight of the fabric, but as pointed out above, it is best controlled by means of a measurement of either transmitted or reflected radiation.

Following the coating operation and drying of the coating, it will be observed that the fabric will develop a slight stiffness somewhat resembling that of lightly starched material, but this is readily overcome by distorting the material, for example, through application of tension on the bias. The result is that the coherence among particles of binder, formed by the discrete droplets of the spray, holding metal flakes on the fabric is broken but the adherence of the flake to the fabric is undistributed and the tiny microscopic particles of binder permit the fabric to develop its original pliability.

Though this invention has been described with reference only to the single embodiment shown in the drawings, it is understood that variations thereof may be made without departing from its spirit or scope.

What is claimed is:

1. As a new product a blanket comprised of at least two fabrics, each of said fabrics being pliable, porous, and comprised of a preformed textile weave of warp and weft threads, a discontinuous film composed of a multiplicity of heat-reflective metallic flakes applied to one side of one of said fabrics, a binder between the heat-reflective metallic flakes and the threads to adhere said flakes to the threads, the opposite side of said one fabric being substantially free of said metallic flakes and binder, said one fabric being permeable to moisture, the warp and weft threads at the intersections thereof providing interstices in said one fabric, said interstices and the surface of the fibrous warp and weft threads at said points of intersection being substantially free from said metallic flakes, the outer exposed surface of the threads of said one fabric on the coated side thereof being substantially completely covered by the discontinuous heat-reflective metallic film, the metallic film enveloping the upper exposed surfaces of each warp and weft thread of said one fabric but being discontinuous adjacent the areas of intersection of the warp and weft threads of said one fabric, whereby said one fabric is porous, pliable and reflective to radiated heat, and an electric element disposed between said two fabrics and adjacent said heat-reflective metallic film.

2. The product as defined in claim 1 in which said warp and weft threads of said one fabric define additional substantially large interstices, which interstices are substantially free of metallic flakes.

3. The product as defined in claim 1 in which each of the warp and weft threads of said one fabric is composed of a plurality of filaments having interstices therebetween, said interstices

between said filaments being substantially free of metallic flakes forming the film.

4. The product as defined in claim 1 in which each of the fabrics has a nap on its respective outer sides.

5. As a new product, a blanket comprised of at least two fabrics, each of said fabrics having a nap on the respective outer sides thereof, each of said fabrics being pliable, porous, and comprised of a preformed textile weave of warp and weft threads, a discontinuous film composed of a multiplicity of heat-reflective metallic flakes applied to one side of one of said fabrics, a binder between the heat-reflective metallic flakes and the threads to adhere said flakes to the threads, the opposite side of said one fabric being substantially free of said metallic flakes and binder, said one fabric being permeable to moisture, the warp and weft threads at the intersections thereof providing interstices in said one fabric, said interstices and the surface of the fibrous warp and weft threads at said points of intersection being substantially free from said metallic flakes, the outer exposed surface of the threads of said one fabric on the coated side thereof being substantially completely covered by the discontinuous heat-reflective metallic film, the film of metallic flakes being adhered to the outermost fibers of each of the individual threads of said one fabric without substantial penetration into the body of said threads, whereby a multitude of air pockets is formed between said film of metallic flakes on said one fabric and said threads, said air pockets being substantially free of said metallic flakes, the metallic film enveloping the upper exposed surfaces of each warp and weft thread of said one fabric but being discontinuous adjacent the areas of intersection of the warp and weft threads of said one fabric, whereby said one fabric is porous, pliable and reflective to radiated heat, and an electric element disposed between said two fabrics and adjacent said heat-reflective metallic film.

6. The product as defined in claim 3 in which the warp and weft threads of said one fabric form substantially large interstices which are substantially free of metallic flakes and in which each of the warp and weft threads of said one fabric is composed of a plurality of filaments having interstices therebetween, said interstices between said filaments being substantially free of metallic flakes forming the film.

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