

PATENT SPECIFICATION

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(54) FLAME RESISTANT MATERIAL

(71) We, ROHM AND HAAS COMPANY, a corporation organized under the laws of the State of Delaware, United States of America, of Independence Mall West, Philadelphia, Pennsylvania 19105, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The invention is concerned with laminated, flame resistant textile material useful in the manufacture of such articles as mattresses, pillows, sleeping bags and cushions. The invention is also concerned with the articles containing the material. In making ironing board covers it is known to apply a coating of metal particles, such as of aluminum, to the face or back of the cover to provide rapid dissipation of heat. However, ticking fabric materials are in general, relatively thin and generally have a printed decorative design on the exposed face. Consequently, coating the face with metal particles would obscure the design and coating the back or inside surface of the ticking fabric, would result in an undesirable appearance of the coated ticking because the metal layer would be visible to observers as they look at the outside of the covered article, such as a mattress (the effect observed being commonly referred to as "grin-through"). In addition, the metal-coated covering fabric is undesirably stiffened. polyurethane foam cushioning layers between mattress ticking and the stuffing or padding thereof commonly serve as self-extinguishing and insulating layers between the ticking and the stuffing for the purpose of preventing accidental ignition of the mattress. We have found however, that in areas where the polyurethane foam is greatly compressed, for example, reduced in thickness from 1/2 or 5/8 inch to 1/8 or 1/6 inch or less by tying means such as stitching or tufting, the insulating properties of the polyurethane foam are significantly reduced or lost, and a lighted cigarette placed on that compressed area may ignite the cotton or other stuffing underlying the polyurethane foam layer causing a smoldering fire.

This invention counteracts this deficiency by providing, at least in localized areas such as edges or tufted or stitched areas where the foam is compressed, a heat conductive layer of metal or metal-containing material, usually powdered or flaked metal held together by a binder, whereby the heat in the areas of compression of the foam, that would otherwise be conducted to the flammable material, is conducted away by the metal before the filler ignites. In an extreme case the heat dissipation may be enough to extinguish a burning or smoldering ticking. The metal coating may be either on the face of the foam adjacent to the ticking or on the face adjacent to the filler, preferably the latter in order to prevent "grinning" of the metal through the ticking. The ticking may be of damask or a loosely woven nylon fabric, either having a decorative design thereon by printing or by weaving.

According to the invention, therefore, there is provided a laminated textile material comprising a first layer of a flammable filling material, a layer of woven fabric superimposed over said layer of filling material and forming a cover; moreover, said layer of woven fabric being secured to the filling layer at intervals, a layer of soft, flexible flame resistant foam having an uncompressed thickness of 0.1 to 1.0 inch positioned between said filling and said fabric, said foam layer being compressed between the filling and the fabric layer in those regions where the two are joined, and a heat conducting metal or metal-containing layer over- or under-lying the foam layer at least in those areas where the fabric and the filling are joined and the foam is compressed.

The accompanying drawings illustrate two embodiments of the invention. Figure 1 shows a damask ticking (1) attached to a polyurethane cushioning foam layer (2), in turn bearing a metallized coating (3). The ticking and metallized polyurethane foam are secured to the stuffing at (4) by stitching (6) through the respective layers including a fabric backing (5). In the embodiment of Figure 2 the metallized coating (3a) is on the surface of the polyurethane layer adjacent the ticking, rather

than adjacent the stuffing. The cushioning foam is 0.1 to 1.0 inch in thickness uncompressed and suitably has a density of 0.25 to 10 pounds per cubic foot.

5 The thickness of the metal coating or layer may preferably be from 1/2 to 6 mils, most preferably 2 to 4 mils. The metal in the coating may be a powdered metal the particles being bonded together by an organic binder
10 preferably of a combustion-resistant material, or the metal may be applied by a chemical plating or an electroplating process wherein no organic binder is used. Again, the metal may be applied by a sputtering process or by
15 a vacuum metallizing process wherein a small amount of metal is vaporized in a vacuum within which a crushed foam/ticking laminate is either disposed with the ticking surface as well as the crushed foam surface exposed or
20 disposed with a removable protective film, e.g., of polyethylene, against the front face of the ticking to prevent its being coated by the metal, the protective film being removed after the metallizing operation, if desired. A wide
25 variety of metals may be used, such as aluminum, nickel, silver, bismuth, antimony, tin, gold, and alloys, such as stainless steel, brass, bronze, solder and Wood's metal. Aluminum is preferred.

30 When the metal is deposited by applying a coating composition comprising the metal particles in a polymeric binder, the proportion of metal should preferably be at least 25 percent by weight of the binder, and more preferably is at least 40 to 50 percent or more
35 by weight thereof. The amount of the metal-containing coating is preferably from 0.5 to 4 oz./sq. yard and more preferably 1 to 2 oz./sq. yard.

40 The metal layer may be continuous or it may be in the form of a foamed or a crushed foam layer wherein it is somewhat discontinuous, but has the advantage of being somewhat permeable, i.e., it has the quality of
45 breath-ability, which makes it more comfortable to a person sitting or lying upon the pad, cushion or mattress, especially in hot weather.

50 When the metal layer is formed from a metal powder/binder composition, the binder used should preferably be of a flame-resistant polymer, such as a polymer of vinyl chloride, vinylidene chloride, or other halogen-containing vinyl monomer. Regardless of what type
55 of polymer is used, it should be one that is flexible, rather than stiff, nature.

60 Preferred metal-containing compositions are those based on aqueous dispersions of emulsion copolymers of monoethylenically unsaturated monomers having a group of the formula $H_2C=C<$ including vinyl monomers, especially of vinyl chloride, vinylidene chloride or mixtures thereof as binders. Since these monomers produce hard and rigid homopolymers, they are copolymerised with monomers which, when homopolymerized produce

polymers which are soft and flexible. Examples of the latter type of monomers are ethylene, ethyl acrylate, butyl acrylate and 2-ethylhexyl acrylate which are included in the general class of acrylic acid esters of alcohols having 1 to 18 or more carbon atoms and amyl methacrylate, 2-ethylhexyl methacrylate and octadecyl methacrylate which are included in the general class of methacrylic acid esters of alcohols having 5 to 18 carbon atoms. The copolymers may also include appreciable amounts of other hardening monomers, such as styrene, vinyltoluene, acrylonitrile, and vinyl acetate provided the particular softening monomer in the amount used is able to provide the desired flexibility for the particular laminated covering material in its intended use without requiring a reduction of the halogenated monomer to such an extent as to make the binder of the metal layer too susceptible to combustion. The copolymer may also comprise small amounts (0.1 to 2 percent by weight) of an acid such as acrylic acid, methacrylic acid, and itaconic acid, to provide improved stability of the emulsion polymer and ease of thickening by adjustment of pH of the system. Small amounts (0.5 to 5 percent by weight) of other reactive monomers may be included to provide self-crosslinking properties to the copolymer and/or to favour reaction of the metal layer binder with the intermediate foam layer and thereby provide advantageous chemical bonding.

100 The amount of powdered metal in such coating compositions is preferably at least 20 percent by weight, based on the total solids weight of the composition, and is more preferably 40 to 50 percent or more by weight of the total solids.

105 The dry weight of the powdered metal-containing coating layer is preferably 0.5 to 4 ounces per square yard, per coating, using a single or double coating. The metal particles may have a wide range of sizes. Metal particles of sizes in the range of 0.02 to 0.1 mm., preferably 0.03 to 0.05, are quite practical. The selection of size is made to assure extensive contact between the metal particles to provide for rapid conduction of heat from one area to another in the coating.

110 In the metal coatings obtained by chemical or electrical plating, by sputtering, or by vacuum metallization, it is only necessary to provide adequate weight of metal deposit to obtain essential continuity of the metal coating film deposited, but much heavier thicknesses of the metal are permissible. Generally, a metal deposit of about 0.1 ounce or more, e.g., to 0.5 oz./sq. yard is adequate. The upper limit of thickness or weight of metal is determined by the amount of flexibility necessary in the particular use. While a metal foil may be used, it is preferably avoided because

it would tend to make a crackling noise when the composite cover fabric is flexed.

The laminates of the invention may be used in a wide variety of articles such as pads, sleeping bags, mattresses, pillows, cushions, upholstered chairs, beds and sofas.

Preferred embodiments of the invention will now be described in the following examples, which are given for the purposes of illustration only and in which parts and percentages are by weight and temperatures are °C. unless otherwise specified.

Example 1

a) An aluminium powder (25 parts) containing metal particles of about 0.02 to 0.04 mm. size is mixed with 100 parts of a 46 percent solids aqueous dispersion of an 80/20 weight ratio mixture of (1) an emulsion copolymer of about 66 percent vinylidene chloride, 29 percent butyl acrylate, 0.5 percent itaconic acid, about 3 percent acrylamide, and about 2 percent N - methylolacrylamide, and (2) an emulsion copolymer of about 96 percent of butyl acrylate, 2 percent of methacrylamide and 2 percent of N - methylolacrylamide, 2 parts of methylene - bis - diamylphenoxypoly(9)ethoxyethanol, 8 parts of a 25 percent aqueous solution of diammonium hydrogen phosphate, 15 parts of a 50 percent aqueous solution of a copolymer of about 6 percent ethyl acrylate, 39.5 percent methyl methacrylate and about 0.5 percent of diallyl phthalate, and 42.5 parts of water. The mixture is thoroughly stirred, yielding a 40 percent solids coating composition.

b) The 40 percent solids composition obtained in part a) is coated onto the exposed surface of an uncompressed, resilient polyurethane foam (uncompressed thickness 3/16 inch) to provide a 6-mil thick layer thereon. The coated assembly is then dried 4 minutes at 280°F., yielding a deposit of about 2 oz./sq. yard.

c) A simulated mattress for testing purposes is made by placing a piece of cotton wadding (such as is used as mattress stuffing) 6 inches wide 15 inches long and 4 inches thick in the center of an 80² cotton ticking fabric 12 inches wide by 15 inches long so that the 15-inch dimensions of the wadding and the fabric extend in the same direction. Then a 12-inch by 15-inch piece of the polyurethane foam cover fabric is laid on top of the wadding with its 12-inch and 15-inch dimensions coinciding with the corresponding dimensions of the bottom fabric layer and with its metal-coated face in contact with the wadding, followed by an overlay of damask ticking. The two fabrics are sewn together along the 15-inch edges of the wadding to compress the wadding and the foam along the edges. Also, the wadding and foam are compressed along a central line parallel to the sewn edges by sewing the assembly together

along such central line. The resulting simulated pad or mattress may then, if desired, be stretched taut by fastening the extended edges of one or both cotton fabrics to opposite sides of a square frame having a square opening within the four edge members thereof. The resulting pad has a trough formed by the central sewn line between two parallel bulged ridges one on each side of the central line. For testing, a burning cigarette is placed on the pad, either on top of one of the ridges, but preferably in the groove between them. The cigarette is allowed to burn itself out; if the wadding ignites, the ticking is a failure but if the wadding does not ignite before the cigarette burns out, the ticking passes the test. d) The simulated mattress obtained above, when tested as described in part c) passes the test.

Example 2

The procedure of Example 1 is repeated except that in part a) thereof, the metal-containing composition is modified by inclusion of a foam stabilizer or agent, specifically a mixture of about 4.3 parts of a 33 percent aqueous solution of ammonium stearate and 1.4 parts of a 33 percent aqueous solution of sodium lauryl sulfate. The mixture is beaten into a foam which is spread on the surface of the polyurethane foam to provide a thickness of about 60 mils and after drying for 2 minutes at 280°F., the composite is passed through squeeze rolls of a textile pad to crush the foamed metal-containing layer after which curing is completed by heating 4 minutes at 280°F., yielding a composite material in which the metal-containing coating is present in an amount of about 3.5 oz./sq. yard. This metal-coated resilient polyurethane foam, when made into simulated mattress, passes the test described in Example 1d).

Example 3

Example 1 is repeated except in part a) thereof the aqueous dispersion is a 90/10 weight ratio mixture of (1) an emulsion copolymer of about 69 percent vinyl chloride, 29 percent butyl acrylate, 1 percent methylolacrylamide, 1/2 percent acrylamide and 1/2 percent itaconic acid and (2) an emulsion copolymer of about 96 percent butyl acrylate, 2 percent methacrylamide and 2 percent methylolmethacrylamide.

Example 4

The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of stainless steel powder, the particles of which range in size from 0.05 to 0.1 mm. The simulated mattress passes the test.

Example 5

The process of Example 1 is carried out except that in part a) the aluminium powder

is replaced with 23 parts of silver powder, the particles of which range in size from 0.03 to 0.07 mm. The simulated mattress passes the test.

Example 6

The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of nickel powder, the particles of which range in size from 0.03 to 0.06 mm. The simulated mattress passes the test.

Example 7

The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of tin powder, the particles of which range in size from 0.02 to 0.04 mm. The simulated mattress passes the test.

Example 8

The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of anodized aluminium powder, the particles of which range in size from 0.02 to 0.04 mm. The simulated mattress passes the test.

Example 9

The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of bronze powder, the particles of which range in size from 0.03 to 0.7 mm. The simulated mattress passes the test.

While self-extinguishing polyurethane foamed plastics has been specified, other foamed plastics having the desired cushioning, heat insulating, and self-extinguishing properties may serve as the functional equivalent thereof.

The term "self-extinguishing" as applied to plastic foams herein is intended to include ordinary polyurethane foams which, because of their uncompressed condition and porosity, will not become ignited by a lighted match or cigarette. Also included are chemically treated foams which will not ignite or continue to smolder when exposed to a blowtorch flame.

WHAT WE CLAIM IS:—

1. A laminated textile material comprising a first layer of a flammable filling material, a layer of woven fabric superimposed over said

layer of filling material and forming a cover thereover, said layer of woven fabric being secured to the filling layer at intervals, a layer of soft, flexible flame resistant foam having an uncompressed thickness of 0.1 to 1.0 inch positioned between said filling and said fabric, said foam layer being compressed between the filling and the fabric layer in those regions where the two are joined, and a heat conducting metal or metal-containing layer over- or under-lying the foam layer at least in those areas where the fabric and the filling are joined and the foam is compressed.

2. A textile material as claimed in claim 1 in which the foam is a polyurethane foam.

3. A textile material as claimed in claim 1 or 2, in which the metal-containing layer comprises crushed foam.

4. A textile material as claimed in any preceding claim, in which the thickness of the metal layer or metal-containing layer is 0.5 to 6 mils.

5. A textile material as claimed in any preceding claim in which the metal is aluminium, nickel, silver, bismuth, antimony, tin, gold, stainless steel, brass, bronze or Wood's metal.

6. A textile material as claimed in claim 5 in which the metal-containing layer comprises aluminium having a particle size of 0.02 to 0.1 mm. in an organic binder.

7. A textile material as claimed in claim 5 or 6 in which the metal is anodized aluminium.

8. A textile material as claimed in claim 5 in which the metal-containing layer comprises stainless steel having a particle size of 0.02 to 0.1 mm. in an organic binder.

9. A textile material as claimed in any preceding claim in which the metal-layer or metal-containing layer is on the foam on the side adjacent to the filler.

10. A textile material as claimed in any preceding claim substantially as hereinbefore described with reference to the accompanying drawings.

11. A textile material as claimed in claim 1 wherein the metal-containing layer is substantially as described in any of the foregoing Examples.

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is replaced with 23 parts of silver powder, the particles of which range in size from 0.03 to 0.07 mm. The simulated mattress passes the test.

5 Example 6

The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of nickel powder, the particles of which range in size from 0.03 to 0.06 mm. The simulated mattress passes the test.

Example 7

15 The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of tin powder, the particles of which range in size from 0.02 to 0.04 mm. The simulated mattress passes the test.

Example 8

20 The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of anodized aluminium powder, the particles of which range in size from 0.02 to 0.04 mm. The simulated mattress passes the test.

Example 9

30 The process of Example 1 is carried out except that in part a) the aluminium powder is replaced with 23 parts of bronze powder, the particles of which range in size from 0.03 to 0.7 mm. The simulated mattress passes the test.

35 While self-extinguishing polyurethane foamed plastics have been specified, other foamed plastics having the desired cushioning, heat insulating, and self-extinguishing properties may serve as the functional equivalent thereof.

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2. A textile material as claimed in claim 1 in which the foam is a polyurethane foam.

3. A textile material as claimed in claim 1 or 2, in which the metal-containing layer comprises crushed foam.

4. A textile material as claimed in any preceding claim, in which the thickness of the metal layer or metal-containing layer is 0.5 to 6 mils.

5. A textile material as claimed in any preceding claim in which the metal is aluminium, nickel, silver, bismuth, antimony, tin, gold, stainless steel, brass, bronze or Wood's metal.

6. A textile material as claimed in claim 5 in which the metal-containing layer comprises aluminium having a particle size of 0.02 to 0.1 mm. in an organic binder.

7. A textile material as claimed in claim 5 or 6 in which the metal is anodized aluminium.

8. A textile material as claimed in claim 5 in which the metal-containing layer comprises stainless steel having a particle size of 0.02 to 0.1 mm. in an organic binder.

9. A textile material as claimed in any preceding claim in which the metal-layer or metal-containing layer is on the foam on the side adjacent to the filler.

10. A textile material as claimed in any preceding claim substantially as hereinbefore described with reference to the accompanying drawings.

11. A textile material as claimed in claim 1 wherein the metal-containing layer is substantially as described in any of the foregoing Examples.

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