Jan. 13, 1959 D. LABINO 2,868,684

DECORATIVE ACOUSTICAL MATERIALS

Filed Jan. 3, 1956 2 Sheets-Sheet 1

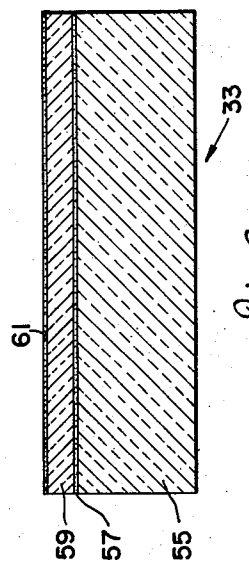


Fig. 2

Fig. 1

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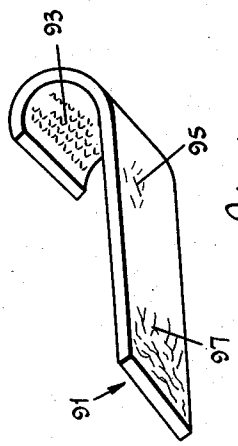


Fig. 4

Fig. 3

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DECORATIVE ACOUSTICAL MATERIALS

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8 Claims. (Cl. 154—45.9)

This invention relates to a glass fiber products and particularly to glass filber products such as ceiling tile, wall board and similar materials; the invention is also concerned with methods of producing such products.

The invention is further directed to novel thin mat products of glass having particular utility in conjunction with ceiling tile and wall board for example.

Products like ceiling tile are required to present a clean and decorative surface and frequently the marketability of such items is very considerably dependent upon keeping maintenance costs for such products at a minimum. This invention particularly contemplates the provision in combination with a non-woven staple glass fiber body of a thin flexible mat of glass fibers which mat provides a plurality of desirable qualities.

The thin mat of the invention is somewhat porous, non-inflammable and exhibits a surface which is highly receptive to surface finish coatings. The micro diameter fibers of the mat are absorbent and will take up as much as twenty times their own weight of surface finish. However in terms of finish this is relatively little as the mat and the absorbent fibers are themselves extremely light in weight.

Further, in the preferred mat there are incorporated with the absorbent fibers non-absorbent filaments of glass which give to the mat an increased rigidity and a very desirable strength characteristic.

The mat itself most suitably has a thickness in the range of 0.003 to 0.010 of an inch and may be constituted substantially wholly of the absorbent micro fibers, which are staple glass fibers having a diameter, in accordance with this invention, of less than 2 microns and preferably less than one micron average.

As noted the mat may suitably have incorporated therein lengths of filaments which filaments may be chopped into relatively short pieces or may be substantially continuous. The percentage of absorbent micro fibers in the mat may be as low as 33 percent of the mat weight, depending upon the particular application to which the mat is to be applied. In general the mat itself has a weight of between ½ to 1½ pounds per hundred square feet, whether or not the filaments are included with the absorbent micro fibers.

In connection with the filaments it is to be noted that not only do the filaments, whether chopped or of continuous length, give considerable strength to the mat, but the continuous filaments in addition provide a desirable wrinkle texture in the mat, which texture is useful in many decorative applications.

A particular feature of the mat is that while it is clearly absorbent, the amount of surface finish material which is required to cover the mat is relatively small. This is because the weight of the mat itself is low and the absolute quantity of finish which is absorbed is low although relatively high in relation to the weight of the mat.

In connection with the surface finishing it is the staple fibers of the mat which are absorbent and tenaciously pick up the surface coatings; the longer filamentary

bodies when employed merely being coated with the surfacing material, since these longer drawn glass filaments are substantially nonabsorbent.

The thin mat is readily bondable to glass fiber backings of a variety of arrangements and provides, in conjunction with such backings, most suitable tiling and ceiling material; the mat functioning as a portion of a normal backing. The backing itself may be a rigid bonded glass fiber body or a high density resilient body of glass fibers; the density usually of such backings being between about 3 to 6 pounds per cubic foot.

Preferably a bonding agent secures the mat to the backing. The backing is also considerably greater in thickness than the mat and of greater weight. However, the mat itself is of considerably tenacity due to the coherence of the fibers constituting the mat and the mat is fully capable of sustaining the stress exerted by the backing.

The invention will be more fully understood by reference to the following detailed description and accompanying drawing wherein:

Figure 1 schematically illustrates apparatus useful in the practice of the method of invention;

Figure 2 is a cross-sectional view illustrating schematically the product of the invention;

Figure 3 schematically illustrates apparatus useful in the production of the thin mat of this invention; and

Figure 4 is a perspective view illustrating the thin mat of this invention.

In the preferred embodiment of the invention both the backing and the mat contain staple glass fiber—that is fiber which is flame blown from the filamentary glass form—and in addition the thin mat most suitably has glass filaments extending throughout the body thereof. The backing itself may be composed of drawn glass filaments, if desired, but the staple fiber form offers advantages in ceiling tile applications with respect to sound absorption, for example.

The staple glass fiber backing is suitably constituted of blown fibers having a diameter of 2–9 microns and a length of about 2–3 inches. In general the backing will have a thickness of 4–7 inches.

In contrast to the backing the thin mat is preferably comprised of absorbent staple fibers having an average diameter in the sub-micron range and substantially all of the fibers are less than one micron in diameter, although fibers up to about, but not greater than about 2 microns, are useful and are included in the term micro as employed in this application. Most suitably the thin mat fibers average between ¾ to 1½ microns in diameter and only occasional fibers exceed 1 micron diameter. The length of such fibers is extremely short about 1/16 to ¼ inch and the fibers are soft, flexible and readily cohere to produce a strong web having a smooth face, particularly so, if the web is compacted by rolling or otherwise pressing the fibers. As already noted most suitably the thin mat has a thickness of between 0.003 to 0.010 inch and weighs between about ½ to 1½ pounds per 100 square feet.

While the micro fibers alone are useful in the invention, it is preferred to incorporate in the mat some bundles of flexible glass filaments which tend to stiffen and strengthen the mat. These filaments may be in roving form, that is a bundle may contain 204 parallel arranged fine filaments, or the bundles may be constituted of a yarn; in either event the bundles extend throughout the mat and the weight per square foot of such a mat may also suitably be between ½ to 1½ pounds per 100 square feet.

Referring now to Figure 1 and the production of a ceiling tiling, the apparatus includes a glass melting pot 1 having therein at 3 a molten body of glass; the pot 1

is surrounded by insulation 5 in which there is positioned induction heating coils 7 supplied with energy from a suitable source (not shown).

The base of the glass melting pot is provided at 9 with nipples through which filaments 11 are drawn past a guide roll 13 by cooperating drawing rolls 15, 17. The filaments pass in substantially parallel relation and are presented to the hot gaseous blast 21 emanating from a burner 23, which burner may suitably exhibit a temperature of 3000–3200° F. at a gas blast velocity of 1600–1800 feet per second.

The effect of the blast is to soften and attenuate the filaments and to cause short length staple glass fibers in the range of 2 to 9 microns to enter the conduit 25. A spray head indicated at 24 may be suitably supplied with a phenolic resin, for example, to coat the fibers as they pass through the conduit.

At the remote end of the conduit as indicated at 27 a suction hood is provided which causes the blown fibers to be drawn to a belt 29 supported on the rollers 31 for movement. The blown fibers form a backing body 33 which is advanced rightwardly beneath an infra red heating unit indicated at 35; the heating unit serves to expel any moisture or solvent from the material constituting the formed body of fibers 33 which is to constitute the backing of the composite product.

A belt 37 supported on rollers 39 receives the entangled staple glass fibers of the backing 33 and the backing is advanced under spray heads indicated at 41 which provide on the surface a glue in the form of a vinyl resinous material for example. The glue emanating from the spray heads 41 may suitably consist of a vinyl-chloride vinyl-acetate copolymer in methyl ethyl ketone, in the proportion of methyl ethyl ketone to the copolymer by weight of between about 2:1. The vinyl glue may also contain up to about 5 percent di-octyl-phthalate as a plasticizer if so desired. In addition to the vinyls other suitable additives known to the art, as the urea formaldehydes, the styrenes or the melamines may be employed if desired.

Positioned at 42 is a guide roller beneath which a sheet from a roll of mat 43 comprised of absorbent fibers passes into contact with a bonding agent-covered backing body. A spray head 44 supplies to the upper surface of the mat 43 a finish, which may suitably take the form of an aluminum paint or coating of a vinyl resin for example. Substantially any suitable surface finishing may be applied to the mat.

With respect to the coating deposited from the spray head 44, the same is most suitable, for indoor applications, of a whitish paint material, as such itself is readily decorable by other paints or surface finishes if so desired.

A belt 45 mounted on rollers 47 supports the composite body as the same is passed to chain 48 of oven 49 wherein the paint is dried, and any residual solvent from the resin solution is driven out through the relatively porous backing body. At the same time the phenolic bonding agent becomes cured providing a relatively rigid backing. At the exit of the oven a table 51 supports the composite product and a knife 53 is arranged to cut the same into convenient lengths.

Referring now to Figure 2, which is a cross-sectional view of the product of invention, the numeral 55 indicates the backing body, the numeral 57 the bonding agent, the numeral 59 the thin staple fiber mat, and the numeral 61 the surface finish. It is to be understood that the surface finish may be applied to the remainder of the composite body either in the course of manufacture or during installation.

The absorbent exposed smooth surface 61 of the mat 59 is receptive to substantially all surface finishes and requires only a minimum of material to completely cover the same. If desired the exposed surface of the mat 59 may be provided with a hard but flexible surface by employing for the surface finishing agent a mixture of white fine sand, vinyl glue and a plasticizer such as di-octyl-phthalate. Further the mat surface itself or after coating with aluminum paint as described above may be colored by the application of paints of the water or oil base type.

With respect to the backing, the backing may itself be compacted, if desired, prior to lamination with the mat, a more dense product being desirable in some sound insulation installations; in all cases, however, the backing is considerably thicker than the mat itself. The production of the backing which has the relatively large fibers therein is less expensive than would be the production of a backing having all submicron diameter fibers.

It is to be noted that where resins are used in the backing, the mat effectively covers, for example, the yellow of the phenolic resins; thus a white mat surface of fine fibers is presented on the surface of the finished material.

In connection with the belts 29, 37, 45 they may be driven at any suitable speeds, and the lineal velocity of the belts together with the rate at which the fibers pass to the belt will determine the thickness of the backing 33. Accordingly, if desired, suitable apparatus may be provided to permit changes of belt speed. Such is well known to the art and the same need not be described in detail.

It is to be noted that in the employment of the product of invention as a ceiling tile the mat will face downwardly and accordingly must sustain a major portion of the weight of the backing itself.

While the bonding agent referred to hereinbefore is entirely suitable to retain the mat and backing in combination, this retention may also be accomplished mechanically as with strapping, but such renders the surface non-uniform and somewhat unsightly, and accordingly in the absence of such a bonding agent the thin mat bears substantially all of the stresses from the weight of the backing. The thin mat being composed of very small and coherent fibers has however very considerable tensile strength even in the thin section and is entirely adequate for the purpose.

To supplement the strength of the mat it is preferable that the mat 43 shown in Figure 1 be constituted of both staple glass fibers having the diameters already noted and filamentary glass. The production of such a mat is illustrated in Figure 3.

Referring to Figure 3 it will be noted that drawing rolls 63, 65 receive therethrough in the manner of Figure 1 a plurality of parallel arranged glass filaments 67 which are passed over the lower edge of a guide block 69 and presented to hot gaseous blast 71 emanating from a burner 73. The gaseous blast may suitably have the temperature of 3300–3500° F. and a velocity of 1800–2000 feet per second. The filaments received in the blast are softened and attenuated thereby and blown into conduit 75 from whence they pass to a collecting belt 77.

In the leftward portion of the conduit at 75 there is indicated an opening 81 through which chopped continuous strand is fed by chopper 81 into the blast in the conduit 75. The chopped strand enters the conduit at a point sufficiently remote from the burner 73 such that it is substantially unaffected by the heat and carried as bundles of filaments in the conduit to the fine mesh screen belt 77 with the staple fibers produced from the filaments 67. As the staple fibers and chopped strand pass to the belt they are subjected to a spray of a resin such as phenol formaldehyde, for example, which coats the fibers and bond the same intimately together. The belt 77 is suitably supported on rollers 78 one of which is driven by means (not shown) in the direction indicated by the arrow. Thus a thin mat 85 is formed which passes on the belt to a roller 87 to be withdrawn from the belt and wound up in any suitable manner as indicated generally at 89.

In this method of producing the mat the absorbent-

staple fibers may suitably constitute ⅓ of the weight of the mat and the relationship between the weights of the absorbent staple fibers and the non-absorbent continuous glass filaments is controlled by regulation of the speed of the drawing rolls **63**, **65** relative to the speed of the chopping unit **83**. The amount of chopped strand present in the mat is not critical to the practice of the invention, but in order to attain the mat product shown in Figure 4 the proportion of staple fibers in the mat should not be greater than about 70 percent by weight, and preferably is about 70 percent by weight, and preferably is about 33–45 percent by weight of the mat.

Referring now to Figure 4, it will be noted that the mat illustrated therein is provided with a wrinkle effect on its lower surface. This wrinkle effect is considered to be present in the thin mat due to unrelieved tensions in the mat, the tensions being unrelieved because of the continuous nature of the filaments in the chopped strand. The effect as illustrated in Figure 4 is most clearly noticeable when the mats are thin, that is, on the order of 0.003–0.005 inch in thickness.

Referring now more specifically to Figure 4 the numeral **91** indicates the mat generally, the numeral **93** indicates the back of the mat, the numeral **95** indicates chopped strand extending over the mat surface, while the numeral **97** indicates the wrinkles on the face of the mat. It is to be noted that the back of the mat **93** is that which was formed on the screen belt **77**. While the wrinkles appear on the free face of the mat the type of belt does not appear to be critical to the formation of these wrinkle effects.

In specific application the wrinkle product of Figure 4 had a thickness of about 0.004 of an inch, a weight of 1 pound per 100 square feet, and the mat was constituted of about 33 percent of staple fibers of an average diameter of about 0.75 micron; binder was present to the extent of about 10 percent by weight and the balance was chopped strand.

It is also to be considered within the scope of this invention to feed continuous glass strands into the opening **81** of the hood **75** of Figure 3 to provide reinforcement to the mat **85**. This can be done by introducing the continuous strand so that it assumes a random or haphazard distribution throughout the staple fibers of mat **85**. Additionally such continuous strand can be fed in parallel arrangement into the hood **75** to be laid into or on the body of mat **85** in a uniform pattern.

It will be understood that this invention is susceptible to modification in order to adopt it to different usages and conditions and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. As an article of manufacture, a composite product of a non-woven staple glass fiber backing having a facing of a thin flexible mat of glass fibers, said mat comprising an admixture of staple glass fibers of a diameter in the range of 0.3 to 2.0 microns, a length in the range of 1/16 to ¼ inch, and multi-filament glass strand, and a bonding agent adhering the fibers of the mat to each other at their points of contact and adhering the mat to the backing.

2. An article of manufacture as defined in claim 1, wherein the surfacing mat is coated with a decorative finish.

3. An article of manufacture as defined in claim 1, wherein the facing mat is of a thickness of 0.003 to 0.010 inch.

4. As an article of manufacture, a composite product of a non-woven staple glass fiber backing having a facing of a thin flexible mat of glass fibers on a surface thereof, said mat comprising an admixture of staple glass fibers of an average diameter of 0.3 to 0.7 micron and a length of 1/16 to ¼ inch, and multi-filament continuous strand in chopped form, and a bonding agent securing the fibers and strand together at their points of contact and bonding the mat to the backing.

5. In combination, a backing comprising a non-woven staple glass fiber mat, a facing on a surface of the mat, said facing consisting of a thin web-like sheet of glass fibers, said sheet comprising a mixture of 30 to 70% by weight of staple glass fibers of a diameter in the range of 0.3 to 2.0 microns and 30 to 70% by weight of multi-filament continuous strand, and a bonding agent adhering the fibers of said sheet to each other at their points of contact and to the backing.

6. As an article of manufacture, a composite product incorporating a thick backing of mineral fibers, a bonding agent on a surface of the backing, a thin flexible mat of cohering glass fibers secured to the backing by the bonding agent and providing a substantially smooth fiber face which is adsorbent to finishes but not substantially absorbent thereto, said mat comprising an admixture of 30 to 70% by weight of staple glass fibers of a diameter in the range of 0.3 to 2 microns, from 30 to 70% by weight of multi-filament continuous glass strand in chopped form, said mat having a thickness in the range of 0.003 to 0.010 inch and being bonded to said backing by said bonding agent.

7. As an article of manufacture, a composite product incorporating a thick backing of glass fibers, and a bonding agent on a surface thereof, a thin flexible mat of cohering glass fibers secured to the backing by the bonding agent and providing a substantially smooth face which is adsorbent to liquid finishes but not substantially absorbent thereto, said mat comprising in admixture 30 to 70% by weight of staple glass fibers of an average diameter in the range from 0.3 to 0.7 micron and of a length of 1/16 to ¼ inch, and continuous multi-filament glass strand.

8. In combination, a thick backing of glass fibers having a thin coating of bonding agent on a surface thereof, a thin flexible mat of cohering glass fibers secured to the backing by said bonding agent and providing a substantially smooth face which is adsorbent to surface finishes but not substantially absorbent thereto, said mat comprising an admixture of staple glass fibers of a diameter of 0.1 to 2 microns and a length of 1/16 to ¼ inch, and continuous length multi-filament glass strand, said mat being of a thickness of 0.003 to 0.010 inch and being bonded together and to said backing by said bonding agent.

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