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METHOD OF MAKING AN ACOUSTICAL PANEL

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Fig. 1

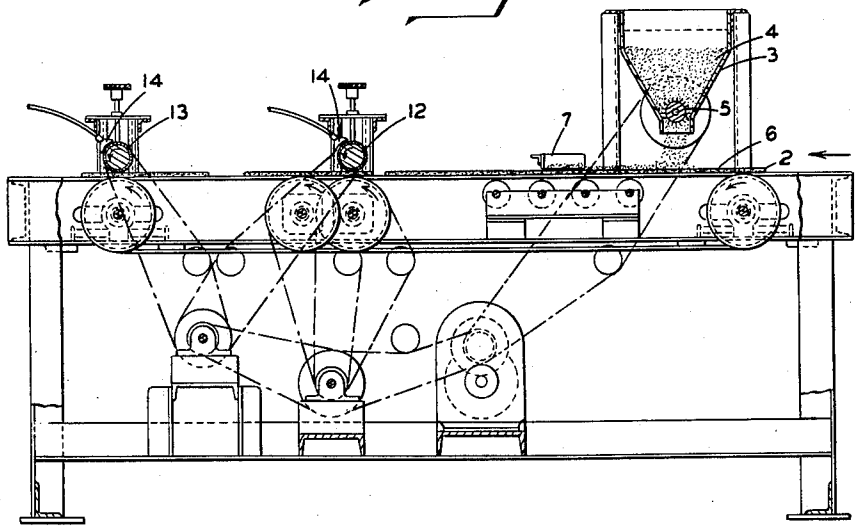


Fig. 2



Fig. 3



Fig. 4

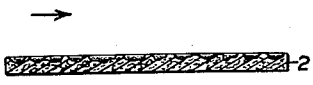


Fig. 5



Fig. 6

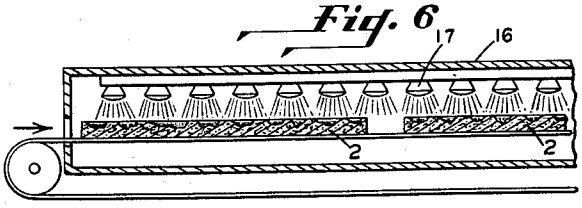


Fig. 7



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METHOD OF MAKING AN ACOUSTICAL PANEL

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6 Claims. (Cl. 117—9)

This invention relates to a method of making an acoustical panel. It is concerned more particularly with a method of providing a fissured acoustical panel with light-reflecting flakes which are disposed within the fissures and are bonded together and to the panel as a reticulated body.

One obvious method proposed for providing light-reflecting flakes in fissures or other depressions in an acoustical panel is to coat the panel in the fissured or depressed areas with an adhesive and then, while the adhesive is wet, deposit the flakes within the depressions. This practice is commonly followed in the flocking art. It is difficult to practice with an irregularly fissured product because of the problems of registering the adhesive-applying devices within the irregularly disposed fissures. It also results in the adherence of a single thickness of flakes which does not provide the desired characteristics for an acoustical panel. Another proposed method is to mix the flakes with a suitable liquid binder and then print or otherwise deposit the flakes and the binder in the fissures. This would require extensive printing or stenciling equipment, and the process would present the same registration problems discussed above if it were to be applied to a randomly fissured panel.

An object of the present invention is to provide a method of securing flakes of light reflective material in fissures or other depressions in a surface without the need for printing or other equipment for registering the deposit of adhesive or the flakes carried in an adhesive matrix in the depressed areas.

Another object of the invention is to provide a method of positioning and securing light reflective flakes in heterogeneous arrangement and presenting a multiplicity of different light-reflecting planes within the fissures or other depressions in a surface.

An additional object is to provide a simple method which may be accomplished with inexpensive equipment or hand tools for positioning and bonding light reflective flakes within fissures or other depressions in a surface.

According to the invention, the flakes of light-reflecting material, such as flakes of aluminum coated with a gold lacquer, are mixed with a dry, solvent-activatable adhesive such as a dry polyvinyl acetate emulsion. The mixture of flakes and dry adhesive powder is distributed over the surface of the fissured panel, the fissures are partially or completely filled with the mixture. Excess flakes and powdered adhesive are removed from the surface of the panel, and then a solvent for the adhesive is applied to the mixture deposited in the fissures. With a polyvinyl acetate powder as the adhesive, the solvent may be water. It preferably is applied as a light spray over the face of the panel. The water solvates the adhesive. The panel is then dried. Drying of the adhesive serves to join the flakes to one another at their points of contact and also to join the flakes to the panel.

In order that the invention may be fully understood, an embodiment of it will be described in conjunction with the attached drawing, in which:

Figure 1 is a diagrammatic view of a device for applying and distributing a mixture of flaked material and powdered adhesive to the surface of panels of an acoustical base material;

Figures 2, 3, 4, 5, and 6 are diagrammatic views illustrating successive steps in the carrying out of the method; and

Figure 7 is a sectional view of a portion of an acoustical panel produced in accordance with the method.

Referring to Figure 1, panels 2 which may be formed of nodulated mineral wool bound with a starch binder and provided with fissures and smaller pore openings in its face are fed under a distribution device including a hopper 3 which contains metal or other flakes 4 to be deposited in the fissures. Reference is made to the concurrently filed copending application of Robert F. Green, Serial No. 757,580, for a more complete description of the types and kinds of acoustical materials which may be used as the base and treated in accordance with the method of this invention and for a listing of types and kinds of light-reflecting flakes which may be used. The copending application of John Marshall Hemphill and Herbert R. Wolf, Jr., Serial No. 815,975, filed May 26, 1959, and entitled "Apparatus for Depositing Flakes on the Surface of an Acoustical Panel" discloses apparatus as shown in Figure 1. The present invention, however, is not limited to any apparatus or to the base materials or flakes disclosed in the copending Green application to which reference is made here for purposes of supplementing the disclosure of this application.

The hopper 3 has a feeding wheel 5 in its bottom which deposits a measured quantity of the flakes and adhesive powder onto the face 6 of the panels 2 thereunder. Usually a volume in excess of that required to fill the fissures in the surface is deposited onto the face. The panel passes under a flexible doctor blade 7 which is disposed at an angle to the direction of travel of the panel through the machine. The doctor blade serves to remove excess flakes and adhesive powder from the face of the panel and to deposit such material into any of the fissures which may be incompletely filled. This has been shown diagrammatically in Figure 2 where fissures 8 which have been passed below the doctor blade 7, the panel moving in the direction of the arrow shown in Figure 2, are filled and the surface 9 of the face 6 of the panel between the fissures has been scraped relatively clear of all flakes and adhesive powder. The fissures 10 on the opposite side of the doctor blade, however, many not be completely filled, and there may be a substantial accumulation of the flakes and adhesive powder lying on the face of the panel as indicated at 11. The function of the doctor blade is to remove the excess material from the face of the panel and to deposit the requisite quantity of the material in the fissures.

In acoustical panels where repaintability may be a factor of significance, it is desirable to remove some of the flakes from within the fissures so that the surface may be repainted with a roller type paint applicator without getting paint onto the light-reflective flakes which would impair their light reflectance. This removal of flakes lying below the general plane of the surface of the panel may be accomplished by use of a rotating brush 12 such as shown in Figure 3. It may be rotated in a direction counter to the direction of movement of the panel being operated upon. The brush 12 serves to remove flakes and adhesive powder from within the fissures, and it also serves to remove any accumulation of adhesive powder which may be passed by the doctor blade and which remains on the surface. The brush also aids in the heterogeneous arrangement of the flakes in the fissures. If desired, a second brush 13 may be mounted in tandem with the brush 12 as shown in Figure 1. Both brushes

may be provided with suction cleaners **14** to remove flakes and adhesive powder which may be carried up by the brushes, as more fully disclosed in the Hemphill and Wolf application mentioned previously.

The panel after removal of some of the material from within the fissures is shown diagrammatically in Figure 4.

As an illustrative example, the flakes may be essentially 1/32" x 1/32" x .0008" thick formed from aluminum foil having a thin coating of transparent gold lacquer or other gold-colored coating material on both of the flat surfaces of the aluminum foil. The binder may be a dry polyvinyl acetate emulsion. The mixture of flakes and adhesive may comprise about equal parts of each on a dry weight basis. The polyvinyl acetate powder is solvent-activatable, and water is a good solvent for it. Since the dry adhesive is in finely powdered form, it is acted upon readily by the solvent. Preferred practice is to apply water in the form of an atomized spray to the whole face of the panel after the mixture of flakes and adhesive has been deposited into the fissures as by operation of the machine shown in Figure 1, for example. By using an atomized spray of solvent, such as water, the finely powdered adhesive, traces of which may remain on the face of the tile even after the doctoring and brushing steps, is carried down into the pores of the panel. The water spray also tends to carry the adhesive powder disposed on the flakes to the points of contact between flakes and between the flakes and the panel surface, thus to concentrate the adhesive at such points. The water serves to solvate the adhesive at such points, rendering it fluid. A spray head **15** is shown in Figure 5 for applying a solvent to a mass of flakes and powdered adhesive disposed within fissured openings in an acoustical panel.

After the application of the solvent, the panels are passed through an oven to dry and set the adhesive. Such a step is shown in Figure 6 where the panels **2** are being conveyed through an oven **16** which houses a plurality of infrared heaters **17**. The temperature maintained within the oven or at the adhesive, as in the case of infrared heating, will vary, depending upon the solvent used, the nature of the base panel, the length of the drier, speed of travel of the material through the drier, and other variable factors. Actually where water is used as the solvent, the adhesive may be dried in open air, without the application of heat. The same is true of many other solvents. Where heat is required to activate the solvated adhesive, or where speed of drying is an important factor, any conventional heated drying system may be used.

Figure 7 illustrates a typical product produced by the method described above. The base panel is formed of nodulated mineral fibers and has a porous body, with interconnecting pores providing good sound absorption qualities in the panel. It will be noted that pores **18** open into the face of the panel between fissures and others open into the fissures. The light-reflecting flakes **19** are heterogeneously arranged and present flat faces disposed in many different planes for light reflectance. The flakes are disposed in the form of a reticulated mass for the ready passage of sound waves and are limited in depth to a position below the general plane of the upper surface or face of the panel. The quantity of flakes used per square foot of panel surface will vary within very wide limits, depending upon the size and depth of the fissures and the number of them. In a typically fissured mineral wool acoustical panel, about 2 grams of aluminum flakes 1/32" square and about .0008" thick have been found to be satisfactory. The quantity of solvent applied to the panel to activate the adhesive also will vary. In the above example, about 10 to 12 grams of water per 12" x 12" panel was found acceptable with a polyvinyl acetate adhesive used in equal proportions by weight with the aluminum flakes.

The invention is particularly applicable to mineral fiber acoustical tile having irregularly shaped and randomly disposed fissures of irregular depth and surface contour, but it is not limited to any particular type or kind of panel. As another illustration, a fibrous acoustical panel made of wood fibers and provided with fissures punched into the face of the panel may be used as a base and treated in accordance with the invention. The fissures need not be of irregular shape and contour; they may be regularly shaped depressions in the face of the panel.

Many different light-reflecting flakes may be used, such as the aluminum foil flakes mentioned above or flakes of other metallic materials. Preferably the flakes are specular light reflectors, or a mixture of such flakes may be used with other materials such as artificial pearl, mica, vermiculite, and the like. The size of the light-reflecting particles may vary, but generally they will be essentially longer and wider than they are thick. For best results in providing a random arrangement of the flakes in the fissures for good light reflection from substantially any angle of viewing with a light source directed into the fissures at substantially any angle, the flakes should be relatively small with respect to the dimensions of the fissures. Generally flakes from about 1/32" up to about 1/8" in maximum dimension are preferred. Generally square shaped flakes give good results. Where mica or vermiculite is used, it will naturally be of irregular shape.

Many different solvent-soluble dry powder adhesives may be used. The polyvinyl acetate is merely illustrative. Materials as inexpensive and readily available as wheat flour may be used. It is preferred to use an adhesive which, when solvated and dried, produces a transparent or translucent film. This is desirable to avoid loss of reflectivity of the flakes. Where the adhesive powder is washed from the faces of the flakes to be concentrated at the points of contact between the flakes, this problem is not so critical; but since there are many readily soluble adhesives which may be mixed in powdered form with the flakes and which when dried produce a clear coating, they are preferred even where the solvent application is effective for carrying the adhesive to the points of contact, as mentioned above.

Where water-soluble adhesives are used, care should be exercised to avoid the presence of any large volume of the adhesive at the face of the panel, for customarily the panels are packed in cartons in face-to-face relationship; and if the material be stored under relatively high humidity conditions, there may be some tendency for the water-soluble adhesive to cause sticking of the panels, necessitating that the workman use care in separating them at the time of installation.

I claim:

1. A method of making an acoustical panel, the steps comprising depositing upon a surface of the panel having a plurality of depressions extending below the general plane of the surface of the panel a heterogeneous mixture of flakes of specular light-reflecting material and a dry, finely powdered solvent-activatable adhesive material, removing substantially all of the mixture from said surface except that disposed in said depressions, solvating said adhesive by wetting the same with a solvent therefor, and drying said solvated adhesive to bond said flakes to each other and to said panel in said depressions.

2. A method of making an acoustical panel, the steps comprising depositing upon a surface of the panel having a plurality of fissures extending below the general plane of a face of the panel a heterogeneous mixture of flakes of specular light-reflecting material and a dry, finely powdered solvent-activatable adhesive material, removing substantially all of the mixture from said face except that disposed in said fissures below the general surface plane of said face of said panel, spraying a solvent for said adhesive onto said face and said flakes and thereby carrying said powdered adhesive to the points of contact be-

tween said flakes and between said flakes and said face of the panel and solvating said adhesive at said points of contact, and thereafter drying said solvated adhesive to bond said flakes to each other and to said panel at said points of contact.

3. A method in accordance with claim 2 in which said adhesive is water-soluble.

4. A method in accordance with claim 2 in which said powdered adhesive comprises a dried polyvinyl acetate emulsion.

5. A method in accordance with claim 2 in which said panel has an open porous face and said solvent is applied to the face of the panel to carry any residual adhesive powder which may be disposed on the face of the panel in the general plane thereof into the pores of the panel below said general plane.

6. A method of making an acoustical panel, the steps comprising depositing upon a face of a panel formed of mineral wool bonded into an open porous panel, said panel having a plurality of fissures extending below the general plane of the surface of the panel, a heterogeneous mixture of specular light-reflecting metallic flakes and a dry, finely powdered solvent-activatable adhesive material, substantially filling the fissures with said mixture, removing a portion of the mixture from within the fissures and substantially cleaning the face of the panel so that the metal flakes and powdered adhesive all substantially lie below the general surface plane of the panel and within said fissures, spraying the surface of the panel in the fissured areas with a solvent for said adhesive to solvate said adhesive and carry it to the points of contact between the metal flakes and the metal flakes and the surface of the panel in the fissured areas to provide a reticulated mass of flakes within the fissures, and drying said solvated adhesive to bond said flakes to each other and to said panel at said points of contact.

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