Dec. 19, 1961 M. G. BROWN ET AL 3,013,626

ACOUSTICAL MATERIAL

Filed June 18, 1957

Fig. 1

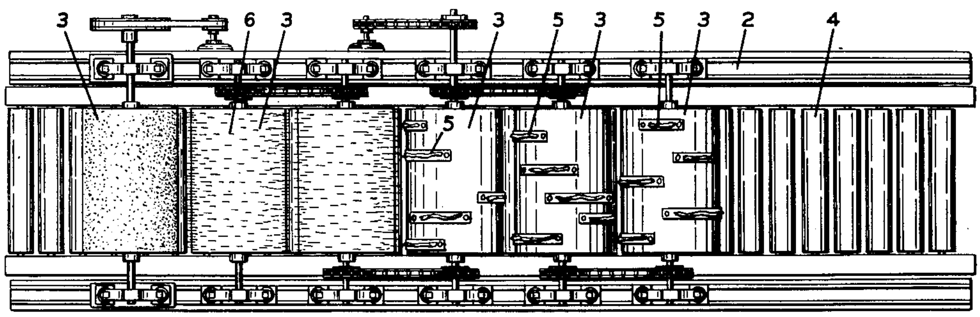


Fig. 2

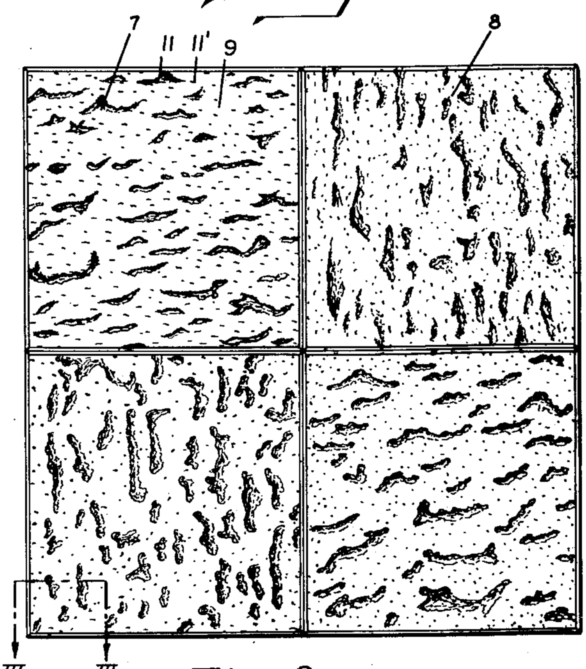
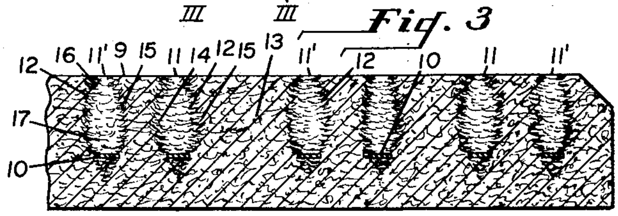


Fig. 3



INVENTOR
MILTON G. BROWN
ROBERT C. PHILIPPI

ATTORNEY

3,013,626

ACOUSTICAL MATERIAL

Milton G. Brown, Lancaster Township, Lancaster County, Pa., and Robert C. Philippi, Troy, N.Y., assignors to Armstrong Cork Company, Lancaster, Pa., a corporation of Pennsylvania

Filed June 18, 1957, Ser. No. 666,406
4 Claims. (Cl. 181—33)

This invention rlates to an acoustical material and method of making the same, and more particularly to a method in which the base material is dried, after which the surface is ruptured to form irregularly shaped elongated sound-absorbing openings to expose the interstices existing between the fibers in the body of the material.

Improvements in the sound-absorbent characteristics have been imparted to fibrous sheet material through two primary methods. The one method is the drilling of holes in the face through substantially the entire depth of the material, and the second method is the reorientation of the fibers of which the material is composed to form openings in the surface leading to fissures between the fibers. The purpose of these methods is to expose the fibrous structure in the interior of the board for entrapping sound and thereby giving the room in which the material is installed the desired acoustical treatment. The fissuring method has been limited to certain types of materials composed of relatively short fibers which are not intertwined to any great extent.

Typical of the acoustical materials which can be fissured during the wet forming process are the ones made from a slurry of mineral wool and/or glass wool and the like in which the fibers are present in clumps and are coated with a starch binder. When this newly formed slurry is screeded or subjected to controlled pressure by a fissuring roll, as shown in United States Patent No. 2,717,538, the clumps are reoriented to such an extent that the lamina of clumps forming the face layer are tilted so as to form a surface on the slurry which is discontinuous by reason of the fact that short sections thereof are disposed at a slight angle with respect to the longitudinal plane of the slurry, exposing crevices or fissures between adjacent areas of disrupted surface. Inasmuch as the starch binder has not set when the surface of the slurry is subjected to this fissuring operation, the individual fibers in the clumps are free to reorient themselves with respect to the other fibers and the clumps are free to reorient themselves with respect to the other clumps. When the water of formation is removed from the fibrous mass and the binder sets, the surface maintains a tilted appearance with the fissures disposed therebetween. When the rough surface is removed by a sanding or grinding operation, the face of the sheet is discontinuous with fissures disposed haphazardly thereover.

In this type of material, which can be wet fissured, the uncontrolled location of the fissures is not desirable because in cutting the dried mat into 12" x 12" tiles or any other desired size, it is difficult to obtain tiles with the same over-all degree of fissuring. Then, too, with this type of fissure, it is ofttimes necessary in cutting the tile from the sheet to cut through a fissure which weakens the edge of the tile, making it unsuitable for use.

Another type of acoustical material currently sold in large volumes is that formed from a water-laid mat of vegetable fibers similar to conventional insulating board. In this type product, in order to attain the necessary strength and still keep the binder content low enough to provide sufficient interstices between the intertwined fibers, it is essential that the fiber length be carefully controlled. If the percentage of short fibers is too great, the sheet is too dense and will not be suitable as a sound-absorbing material. It has been found in making a vegetable fiberboard suitable for sound absorption purposes that it is desirable to have a fiber system having approximately 10% to 12% fibers which are retained on a 10 mesh screen; 16% retained on a 20 mesh screen; 16% retained on a 35 mesh screen; 18% retained on a 65 mesh screen; and the balance of fibers which will pass through a 65 mesh screen. In this structure, the shorter fibers serve as binders to secure the large fibers to one another at their points of contact with one another. The fine fibers migrate to the surface during the wet forming operation and form the smooth outer face of the material back of which is the rigid structure formed of the long fibers bound together by the short fibers forming interstices which do not communicate with the surface of the sheet. With this interlace system, it is impossible to reorient the fibers to form fissures extending from the surface into the interior of the sheet by screeding or by the application of pressure to the surface by means of a roller as in the case of the mineral fiber discussed above.

Because of the lack of practical means for simulating fissures in vegetable fiberboard, most acoustical materials made from this product are limited to those having drilled holes to admit sound to the interior interstices.

This invention has been developed to provide a means whereby the conventional fiberboard type acoustical material, as well as previously dried mineral wool and glass wool material, can be treated to give the same appearance as the mineral wool fibrous materials which have been wet fissured.

The method here under consideration is directed to a punching operation in which a heavy plate is pressed into the surface of the dry fibrous sheet. This plate has in relief thereon the design of the irregularly shaped elongated openings desired for the finished acoustical material. This plate may be made of any of the conventional alloys suitable for withstanding the stress and wear resulting from the high speed operation, and the projections which are forced into the fiberboard have rather rough jagged edges so as to prevent the actual cutting of the fibers in the board but instead merely push a portion of the surface of the sheet into the sheet, leaving exposed edges along the openings as the plate projections enter the material to form sound-absorbing openings in the material. these openings, while devoid of fibers themselves, are lined with loosely entwined fibers which absorb and entrap sound. The projection entering the material does not actually cut the surface but tears a portion from the surface and pushes it into the body of the material.

An object of this invention is to provide a fiberboard acoustical material of the vegetable fiber type which has irregularly shaped elongated openings therein similar in appearance to the wet formed fissures in some of the acoustical materials made from mineral fibers.

Another object of this invention is to provide a method whereby fibrous acoustical material may be treated after it has been formed from a water-laid mass of fibrous material and dried to present irregularly shaped elongated openings on the surface.

In order that our invention may be more readily understood, it will be described in connection with the attached drawing, in which:

FIGURE 1 shows a top plan view of a device suitable for carrying out one embodiment of the method of our invention;

FIGURE 2 shows the acoustical tile formed on the device of FIGURE 1; and

FIG. 3 is an enlarged cross-sectional view taken on the line III—III of FIG. 2.

Referring to FIGURE 1, there is shown a machine having a framework **2** on which are mounted a plurality of rotatable cylinders **3**. In the specific embodiment shown in FIGURE 1, the device is equipped with six of the rotatable cylinders **3** positioned horizontally along the framework of the machine. Immediately beneath the rotatable cylinders **3** is a roller conveyor **4**. This conveyor **4** may be driven or nondriven, depending on the requirements of the equipment. In the embodiment here under consideration, the tiles are fed down a ramp onto the conveyor and the cylinders **3** engage the tile and move it through the machine. The previously formed plates with the projections thereon are wrapped around the cylinders, presenting a surface which has irregularly shaped elongated projections **5** which engage the surface of the tile as it passes through the machine. It has been found that rather than try to position all the projections on one cylinder, a better effect can be obtained by having a plurality of cylinders with some of the projections on each cylinder. The degree of fissuring can, of course, be accurately determined by the number of projections on the cylinders. In the particular embodiment here under consideration, three of the cylinders **3** are utilized for carrying the projections, and the cylinders **3** carry pins **6** which perforate the surface of the tile in the area between the irregularly shaped elongated openings. It will be understood that the projections **5** may be of any configuration; however, in the specific embodiment here shown, they are all disposed in a longitudinal direction with respect to the direction of travel of the tile passing through the device. This produces a tile having the irregularly shaped elongated openings in one direction. Any suitable means may be employed to drive the cylinders **3**.

The design may be varied by turning the tiles at 90° during installation, giving an effect such as that shown in FIGURE 2 in which tile **7** has the irregularly shaped elongated openings running across the sheet and tile **8** has them running from top to bottom of the sheet. Such alternate turning results in a pleasing design effect.

It is desirable in carrying out this invention that the irregularly shaped elongated projections **5** on cylinders **3** and the pins **6** on cylinder **3** be blunt rather than sharp. These blunt portions engaging the surface **9** of the material first do not cut the surface but actually tear a portion of the surface **9** from its engagement with the surrounding surface and push it through to the bottom **10** of the opening **11** formed by the projections **5** or pins **6**. As the projections **5** progress into the tile, they continue to push additional laminae **12** of the fibrous interior **13**, compressing them in the bottom **10** of the opening **11**. This disruption of the laminae **12** and tearing a portion of each lamina **12** from the adjacent area opens the wall **14** of the irregularly shaped elongated openings **11**, exposing the interstices **15** between the fibers **13** of the tile and greatly enhancing the sound absorption characteristics of the tile. During this tearing and delaminating process, not all of the laminae **12** are torn on the same vertical plane, but as the projection **5** continues into the material it tears a larger area from each lamina as it progresses, resulting in an under-cut effect shown at **16**, so that the inner opening **17** is really larger than it appears on the surface **9**.

Because of the irregular shape of the openings **11** made by the projections **5**, no harm results from the irregular appearance of their outline. In the case of the holes **11'** punched by the pins **6** on the cylinder **3**, it is desirable to have the same delaminated conditions along the wall **14** of the opening **11'**, but it is also desirable to have the opening **11'** on the surface **9** smooth and regular so as not to give the appearance of a torn or mangled opening. In order to accomplish this, it has been found desirable to use straight pins with the ends tapered. The pointed tip is then ground off the pin so as to produce a pin having a blunt end approximately one-half the diameter of the diameter of the shank of the pin. With a pin of this type, the desired delaminating process will be accomplished and at the same time any minor amount of tearing or mutilation resulting on the surface of the tile caused by the engagement by the blunt nosed pin is corrected by the taper remaining on the pin which compacts the fibers surrounding the hole to a sufficient extent to take care of any rough edges and form a hole resulting in a pleasing appearance to the observer.

The punching operation merely pushes the surface **9** of the board into the bottom **10** of the opening **11'** and the surface remains exposed towards the exterior to give the desired appearance. This punching operation also tears the fibers along the edges of the opening **11'**, thereby greatly enhancing the sound-absorbing properties of the board. This is somewhat different from the sound-absorbing properties which are acquired when the board is drilled in the conventional manner, in which the fibers are actually cut. In this punching operation, the fibers are not necessarily cut but are merely pushed out of position, opening voids into the interior of the fiber board for the entrance of sound waves for absorption within the board.

In addition to the apparatus illustrated herein for carrying out this method, the method can also be carried out by forming flat plates having the exact design desired on the finished acoustical tile, except that on the plate the areas which are to be indented in the tile will be in the form of raised projections. This plate is placed in a punch press and the tiles are fed thereto so that the plate may be brought into engagement with the surface of the tile under sufficient pressure to force the projections into the tile, pushing the surface of the tile into the bottom of the openings and tearing the edge fibers, opening voids into the interior of the tile to enhance the sound-absorbing characteristics.

In the wet fissuring of acoustical tile such as that produced from mineral wool and glass wool, the fissuring roll exerts pressure on the top lamina and disrupts its continuity by cocking small areas of the surface, exposing fissures into the interior of the mass. When the rough outer surface is removed, these fissures are present on the surface of the tile but do not extend down into the tile at an angle of 90° with respect to the surface but instead are disposed at an angle other than 90°. In the method as described herein, the irregularly shaped elongated openings are not disposed at 90° with respect to the surface because the knives on the roll and the knives on the plate as they are brought directly into engagement with the tile in a downward direction are apt to undercut more on one side than on the other, with the result that the openings have the appearance of being disposed at an angle. If desired, tile can be produced in which the openings are disposed at a greater angle with respect to the surface by producing a plate in which the knives producing the irregularly shaped elongated openings are disposed at an angle with respect to the surface of the plate. This plate is placed in the press in canted position so that on the downward stroke of the press, the projections on the plate are moving in a direction parallel to their axes. The tile to be punched is placed on a support in the bottom of the press in canted position corresponding to angularity of the press platen. With this arrangement, the knives enter the surface of the tile at an angle and are withdrawn at the same angle.

When acoustical tile so produced is installed on a ceiling, the true depth of the sound-absorbing openings is not discernible from mere observation.

It will be clear from the above that we have developed a method and apparatus for producing acoustical tile simulating acoustical tile made of more expensive materials, which effect cannot be produced on fiberboard tiles without the use of our method and apparatus. By using this system, an acoustical tile is produced which has the desired sound-absorbing characteristics but which has not been weakened structurally, inasmuch as the tile is held in flat position while the perforations are embedded therein so as to prevent any weakening of the material structurally.

We claim:

1. An acoustical tile comprising an interior of interlaced vegetable fibers having sound-absorbing interstices disposed therebetween, the front surface of said tile having a plurality of sound-absorbing openings communicating with the interstices in the body of said tile, said openings progressively increasing in cross-sectional area at least a portion of the way from the surface of said tile toward the interior of said tile, the major portion of the bottoms of said openings comprising portions of the front surface of the tile, and the walls of said openings comprising torn fiber lamina.

2. Acoustical tile according to claim 1 in which said openings comprise irregularly shaped elongated openings.

3. Acoustical tile according to claim 1 in which said openings comprise small holes.

4. Acoustical tile according to claim 1 in which said openings comprise irregularly shaped elongated openings and small holes disposed between said irregularly shaped elongated openings.

References Cited in the file of this patent

UNITED STATES PATENTS

238,181	Struppe	Feb. 22, 1881
1,751,249	Rosenblatt	Mar. 18, 1930
1,875,074	Mason	Aug. 30, 1932
1,945,003	Smolak et al.	Jan. 30, 1934
2,459,121	Willey et al.	Jan. 11, 1949
2,577,241	Gibson et al.	Dec. 4, 1951
2,581,993	Willey et al.	Jan. 8, 1952
2,652,126	Mazer	Sept. 15, 1953
2,667,925	Dalphone	Feb. 2, 1954
2,668,123	Copeland	Feb. 2, 1954
2,670,500	Ensslin et al.	Mar. 2, 1954
2,717,538	Alexander	Sept. 13, 1955
2,791,289	Proudfoot	May 7, 1957
2,874,796	Eckert	Feb. 24, 1959