May 7, 1957 D. A. PROUDFOOT ET AL 2,791,289

PROCESS OF FORMING FISSURED FIBER ACOUSTICAL TILE AND PRODUCT THEREOF

Filed Dec. 10, 1952 2 Sheets-Sheet 1

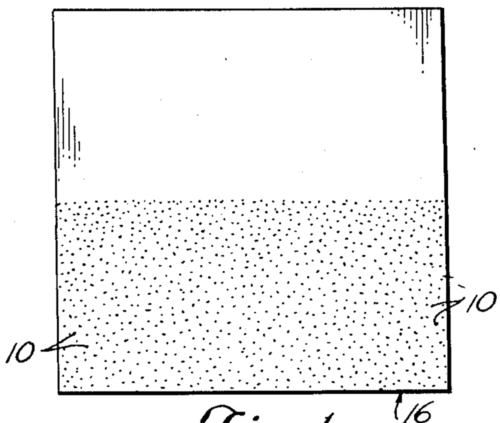

Fig. 1.

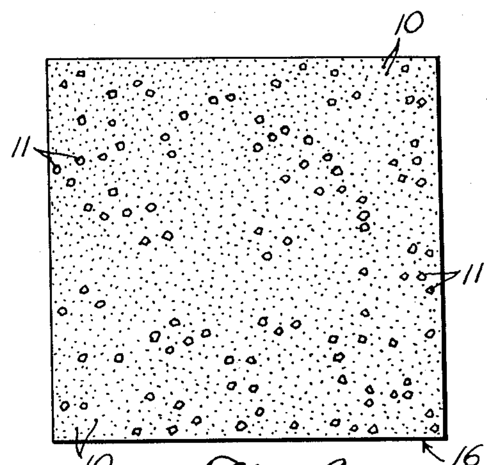

Fig. 2.

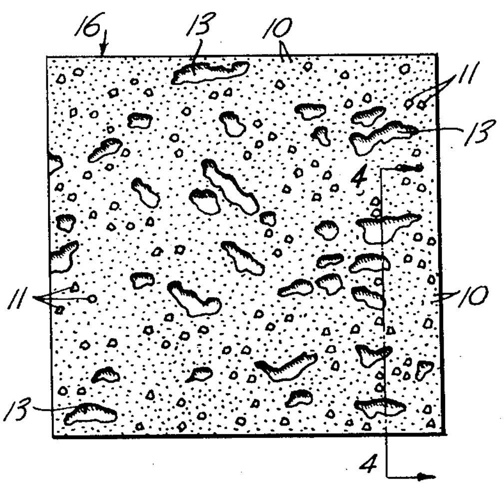

Fig. 3.

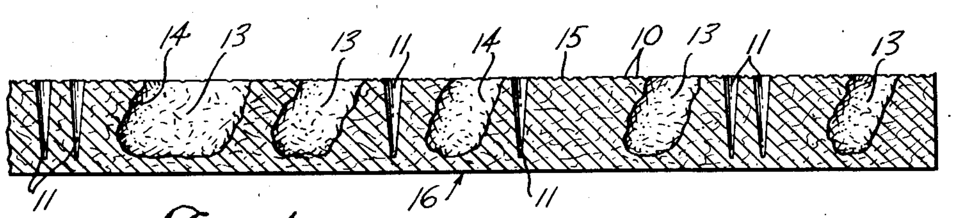

Fig. 4.

INVENTORS.
DON A. PROUDFOOT
DONALD K. MEISSNER
ARTHUR T. WALTON
BY Clinton L. Mathis
ATTORNEY

May 7, 1957 D. A. PROUDFOOT ET AL 2,791,289

PROCESS OF FORMING FISSURED FIBER ACOUSTICAL TILE AND PRODUCT THEREOF

Filed Dec. 10, 1952 2 Sheets-Sheet 2

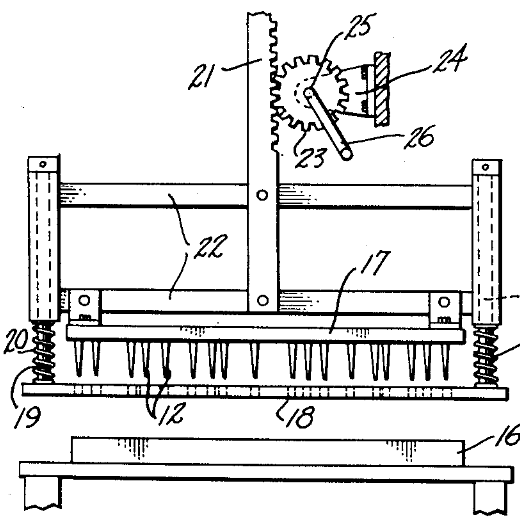

Fig. 5.

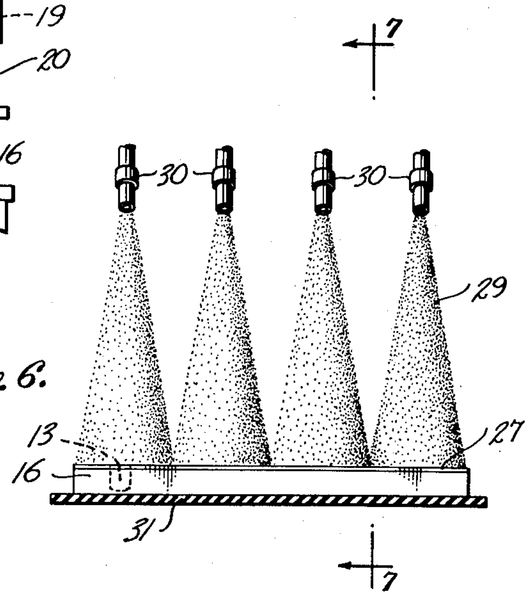

Fig. 6.

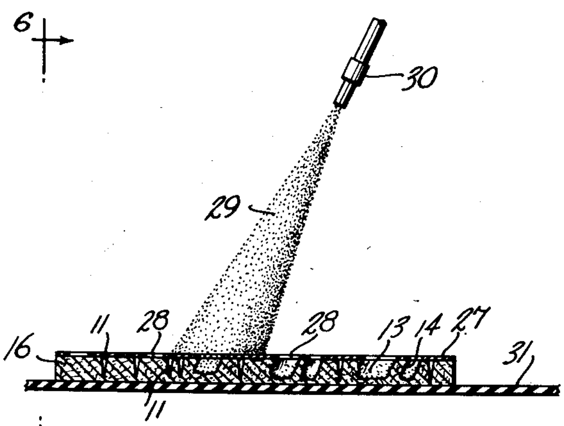

Fig. 7.

INVENTORS.
DON A. PROUDFOOT
DONALD K. MEISSNER
ARTHUR T. WALTON
BY
Clinton L. Mathis
ATTORNEY

United States Patent Office 2,791,289
Patented May 7, 1957

1

2,791,289

PROCESS OF FORMING FISSURED FIBER ACOUSTICAL TILE AND PRODUCT THEREOF

Don A. Proudfoot, Bellevue, Donald K. Meissner, Seattle, and Arthur T. Walton, Shelton, Wash., assignors to Simpson Timber Company, Seattle, Wash., a corporation of Washington

Application December 10, 1952, Serial No. 325,204

8 Claims. (Cl. 181—33)

This invention relates to a method of producing fissured acoustical tile and the product thereof.

More particularly this invention relates to the method of producing acoustical tile and the product thereof formed from fiber tile board having a front surface lying substantially in a common plane and wherein the end product has therein various size openings, including fissures, disposed in a random pattern in the surface of the tile to be exposed or in other words the front surface of the tile.

Heretofore lignocellulose fiber acoustical tile and glass fiber ("Fiberglas") acoustical tile were generally provided with drill openings in a uniform pattern on the front surface of the tile and which openings extended inwardly toward the back of the tile. Also lignocellulose fiber acoustical tile and glass fiber acoustical tile have been sold with an imperforate front surface lying substantially in a common plane. By providing sufficient openings in the tile as by drilling, the sound absorption characteristics of the tile were, in general, satisfactory for commercial needs. However, such prior art tile had the substantial shortcoming of providing a very, very monotonous pattern in that each square of tile (generally 12 inches by 12 inches on the front surface) had the same effect as a neighboring square. The edges of the squares were beveled and the holes were generally in a uniform pattern. While satisfactory sound absorption characteristics obtained, the decorative effect was indeed harsh to the aesthetic senses.

A variety of base materials and processes may be used to form the blank tile to be processed in accordance with this invention. The blank tiles to be processed in this invention may be of suitable surface area and suitable depth such as 12 inches by 12 inches and ¾ of an inch thick. If such blank tiles are to be made of lignocellulose materials, the lignocellulose materials to be employed broady include annual products such as corn stalks, straw, sugar cane, etc. as well as wood from various species of trees, both hard and soft, as the source of the lignocellulose fiber to be processed to form blank tiles with a front surface face lying substantially in a common plane. Also glass fiber may be employed as well as mineral wool as the source of the fiber to produce an acoustical tile blank. Thus the tile blank may be formed of various fibers and may include most standard blank acoustical or imperforate tiles now on the market.

It is a further object of this invention to provide a fissured acoustical tile which has good sound absorption characteristics, and at the same time is pleasing to the eye and permits the tile to be used without beveled corners so that a ceiling or wall having a continuous appearance obtains. The continuous appearance of a wall formed with tile of our invention is to be distinguished from the checkerboard design or plurality of individual squares which is the appearance of most tile (drilled tile) that is presently on the market.

It is a further object of this invention to produce a fissured acoustical tile by a process which is simple, economical, and practical, so that fissured tile may be produced at comparative costs to drilled tile.

2

Other objects and advantages of our invention will become apparent as the description of the same proceeds and the invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings forming a part of the specification, with the understanding, however, that the invention is not to be limited to the exact details of construction shown and described since obvious modifications will occur to a person skilled in the art.

In the drawings,

Figure 1 is a plan view of a tile blank, a portion of which has been treated by abrasives which are impinged upon the surface thereof and a portion of the surface of which has not been treated;

Fig. 2 is a plan view of a tile which has been not only treated as indicated by the treated portion of Fig. 1 but has been further treated to provide intermediate sized random and irregular openings which openings are of a size in between those provided as indicated in Figure 1 and those fissures as provided as indicated in Fig. 3;

Fig. 3 is a plan view of an acoustical tile where the openings mentioned in connection with Figs. 1 and 2 are provided and in addition random arranged fissures have been added in the front surface of the tile;

Fig. 4 is a sectional view on a larger scale than Figs. 1 to 3 inclusive and taken substantially on broken line 4—4 of Fig. 3;

Fig. 5 is a view in side elevation diagrammatically illustrating a punch and stripper means to provide the openings which were added as indicated in Fig. 2 of the drawings;

Fig. 6 is a view in end elevation indicating a method of impinging abrasives through openings in a templet to provide the fissures illustrated in Figs. 3 and 4 of the drawings; and

Fig. 7 is a view in side elevation of the structure indicated in Fig. 6 of the drawings.

In discussing lignocellulose fiber acoustical tile board, a wood fiber tile board will be considered as this is the most common source of lignocellulose fiber acoustical tile boards. In present day practice, the fibers for such a board are mechanically obtained as distinguished from chemical means and the fibers are obtained by a "Bauer" or an "Asplund" defibrator. Also stone grinders are employed in some instances to provide mechanical wood fibers. The size of the fibers as to coarseness has a direct relation to the final density of the board. Of course other changes in the process of forming the board can be made to change its density without changing the size of the wood fiber. However, one way of readily controlling the final density of the board is to control the coarseness of the fibers which are produced by the defibrator.

Many features enter into the selection of the final density of a lignocellulose acoustical tile board. These will include mechanical handling of the board, the drillability of the board, the sawing characteristics of the board, and others. However, it is now rather common in the industry to provide a density of 14 to 18 pounds per cubic foot where the wood fiber tile board is to be drilled. Such a density provides a wood fiber tile board which can be satisfactorily handled, drilled, sawed, and still has the desired acoustical properties needed by industry. Customary procedure in drilling wood fiber tile boards is to drill openings in a uniform pattern of about 3⁄16 of an inch in diameter, spaced between centers substantially ½ to 9⁄16 of an inch, and where the drill openings extend inwardly from the front of a ¾ inch tile board toward the back and approach the back by approximately ⅛ of an inch.

The foregoing is an example of a ¾ inch thick acoustical tile board but many other thicknesses of acoustical tile boards are commonly sold on the market.

There are other wood fiber acoustical tile boards on the market which are not drilled and they are generally of a much lower density than the drilled wood fiber acoustical tile boards as such lower density is necessary to provide desired acoustical properties because of the failure to drill the boards. Such undrilled tile boards generally have a density from about 10 to about 13 pounds per cubic foot. Due to this lighter density, the sound absorption characteristics of such tile boards are better than those of higher density where both have the same characteristics of not being drilled. However, lower density tile boards have not been found completely satisfactory for drilling because they lack the desired mechanical properties for handling under drilling conditions such as being compressed by the tile board holding means employed incident to drilling.

Another disadvantage of a low density lignocellulose fiber tile board having a front surface lying substantially in a common plane, is that there are a great number of microscopic openings which are employed to permit the sound waves to enter the tile board. These microscopic openings provide a surface which is very porous and wherein the microscopic openings are readily closed by the application of ordinary paint.

As distinguished from prior low density lignocellulose fiber tile boards on the market, we provide for a process of opening up the surface of the tile boards so that they have increased acoustical properties and at the same time the tile boards can be readily painted without appreciable loss of desired acoustical properties.

Also prior art glass fiber acoustical tiles were commonly drilled to improve their acoustical properties similar to the drilling of wood fiber acoustical tile. With our invention, we can produce fissured tile from glass fiber base acoustical tiles as well as other fiber acoustical tiles.

If the base of the board is lignocellulose fibers, preferably the outer surface of the board is treated by what we term an embrittling step. This embrittling step involves coating the tile or board (preferably during the wet stage for economical purposes) with suitable agents to provide brittle or friable fibers on the front surface of the board. Materials used in connection with this step and found to give reasonably satisfactory results were:

1—30% alum aqueous solution—used at the rate of 140 grams of solution on a 14 inch by 14 inch sheet.

2—Carbose (carboxymethyl cellulose) 2% aqueous solution—used at the rate of 106 grams of gel per 14 inch by 14 inch board.

3—Borax (industrial grade) 20% aqueous solution—used at rates of from 25 to 245 grams of solution per sheet of 14 inches by 14 inches.

4—Borax—boric acid—starch solution. The said ingredients were mixed on the ratio of:

 10 moles borax—18 parts by weight
 Boric acid 2 parts by weight
 Cornstarch 1 part by weight
 Water 40 parts by weight
 Mixed and applied at approximately 180° F. to maintain solids in solution.

5—A 10% aqueous alum solution and a 10% aqueous silicate solution—applying first one and then the other in such proportions as accomplishes neutralization, and at the rate of 16 grams of salt solids per 14 inch by 14 inch board.

6—A 30% aqueous sodium chloride solution—used at the rate of 15 grams of solids for 14 inch by 14 inch boards.

The embrittlement of the surface of the lignocellulose boards is for the purpose of providing sharper lines of cleavage of the side walls of the fissures as hereinafter discussed. In order to provide a roughened surface after the application of said embrittling surface, the cutting with an abrasive which will be next mentioned is preferred to provide a desired roughened appearing surface.

If the base of the board is glass fibers or mineral wool fibers, the embrittling step may be dispensed with as such board, because of the nature of the fibers, has brittle friable fibers on the front surface of the board.

Referring to Fig. 1 of the drawings a blank tile which has had its front surface embrittled is shown. The upper portion thereof has had no further treatment while the lower portion is shown treated by impingement of an abrasive therewith. The abrasive may be sand, Carborundum, metal particles, mineral wool shot, finely divided peach, apricot or almond pits, etc. The abrasive is directed against the embrittled surface of the fiber tile board at sufficient velocity to cause the formation of a plurality of rather fine openings and to roughen the appearance of the surface of the board, such as by means of an air blast or a centrifugal abrasive throwing device. The said treatment to roughen the surface of the board and open up rather small openings **10** to produce an area having a pock marked-like appearance will be utilized when the outer surface of the board is first treated with the embrittling treatment previously described as such embrittling treatment tends to close small openings in the front surface.

In the event that a low density lignocellulose board of 10 to 13 pounds is employed and the low density is obtained by large particle size of the fibers, then the impingement step which is mentioned in connection with Fig. 1 can, in many instances, be eliminated. Normally with large fibers to produce the low density board, a mere sanding of the front surface of the board is sufficient to tear fibers loose and roughen the board to provide a roughened effect, when desired. However in many instances sanding of the front surface of a low density board is not necessary as many low density boards are inherently roughened on their surface due to the large size of the fibers.

Preferably in this invention low density wood fiber acoustical tile boards are employed. Such a type of tile is often referred to in the art as "wild formed" tile in that it is coarser and less uniform and hence "wilder" than tile commonly employed where the tile is to be perforated. Also preferably there is added to the tile stock, a normal amount of starch i. e. cooked potato starch (5% starch, 95% water) at the rate of about 2% based on the dry weight of the solids in the starch to the dry weight of the wood fiber. This is employed to provide mechanical strength to the low density tile so it can be properly and conveniently handled during processing.

With any one of the three bases mentioned, or their equivalents, the next step is to provide holes **11** which are somewhat larger than the microscopic or minute openings **10** which were provided by an abrasive when desired. The holes **11** will be in the order of $\frac{1}{16}$ to $\frac{3}{16}$ of an inch cross-sectionally considered while the openings **10** will be in the nature of less than $\frac{1}{16}$ of an inch and will be merely surface openings. Also the openings **11** extend from the front of the board towards the back of the board and approach the back of the board preferably up to approximately ⅛ of an inch. In other words, it is desired that the openings **11** extend inwardly of the board as far as possible without completely perforating the board through the back.

The said holes **11** may vary in shape and may be in cross section circles, squares, triangles or irregular shapes. The said openings **11** may be provided by tines **12** which will be described in connection with Fig. 5 of the drawings.

As illustrative of a way to provide the openings **11**, there is diagrammatically shown in Fig. 5 of the drawings a punch type of means. Obviously the punch type of means may be operated by fluid pressure means or by mechanical means. Thus, as a diagrammatical illustration, we have shown the punch plate base **17** carrying punch tines **12**. A stripper plate **18** is connected with the punch plate **17** by a nut and bolt means **19** on each corner and each bolt carries a compression spring **20** disposed between the plates **17** and **18**. The nut and bolt means are rigid with the plate **17** but and the plate means **18** is slideably mounted on the bolts of the nut and bolt means **19**. A reciprocating rack **21** is rigid with the plate **17** through brackets **22**. A pinion **23** is carried by a fixed plate or support **24** and the rack **21** is slidable vertically. A shaft **25** is carried by the pinion **23** and the shaft **25** may be rotated by any suitable means such as by a lever **26**. Thus by rotation of the pinion **25** in the appropriate direction, the plates **17** and **18** may be caused to move downwardly and the plate **18** will contact the upper surface of the tile **16**. Thereupon the springs **20** will be compressed and the tines **12** will pierce the tile **16** to the desired extent. Thereupon and upon rotation of the pinion **23** in the appropriate direction, the tines **12** and plates **17** will be moved away from the tile **16** and the springs **20** will urge the stripper plate **18** towards the tile **16** and thus cause the tines **12** to be removed from the tile.

The step to provide the fissures **13** which are illustrated in Figs. 3 and 4 of the drawings will be next discussed. It is desired that the walls **14** of the fissures **13** meet the upper surface **15** of the tile **16** at well defined angles. This provides for sharply defined fissures and enhances the demarcation of the fissures from the upper surface **15** of the tile **16**.

Referring now to Figs. 6 and 7 of the drawings, the fissures **13** are cut by abrasives which are impinged on the tile **16** through a templet **27** having the desired pattern thereon. Preferably the templet **27** is relatively thin such as $\frac{1}{16}$ of an inch and is made of metal and coated with an abrasive resistant surface such as rubber. If the templet is too thick the sharp corners desired are not obtained. The particles of abrasive are urged through openings **28** in the templet **27**. The abrasives which can be used will include such abrasives as Carborundum, sand, and ground materials of organic origin such as peach pits, almond pits, walnut shell, etc. The said pieces of abrasive **29** may be caused to strike the tile **16** through the openings **28** by a blast of air or a centrifugal abrasive throwing machine. Such devices and their equivalents are readily obtained on the market and hence in Figs. 6 and 7 of the drawings I have shown a plurality of nozzles **30** which are connected to any suitable source of air and abrasives under pressure (not shown). Also preferably as is indicated in Fig. 7 of the drawings, these nozzles **30** in side elevation are angularly disposed to the vertical when the templets and the pieces of tile lie in a horizontal plane. The said angle to the vertical is in the order of 30 degrees to the vertical. Obviously the angle may be changed and the desirability of such angle is to provide for undercutting and rather sharp defined lines of demarcation between the top surface **15** of the tile **16** and the side walls **14** of the fissures **13**. Also in said Figs. 6 and 7 there is shown the top flight **31** of a conveyor so as to provide for relative motion between the tiles **16** with the templets **27** thereon and the nozzles **30** delivering abrasives **29** on the surface of the templet **27**.

If the tile is abraded with abrasive **29** being delivered downwardly on the surface of the tile, it will be desirable to air clean the fissures to remove the abrasives after the cutting operation. Thus it is often desirable to rotate by 180° the construction shown in Fig. 6 of the drawings and abrade the tile from the bottom or the tile may be abraded while disposed in a vertical plane to provide for self-cleaning. Thus it is to be understood that the showing in Figs. 6 and 7 is illustrative but it is not a limitation in this invention.

We have found that cutting the fissures **13** by impinging abrasives through a templet provides results which we cannot obtain by other ways of cutting the tile. First the impingement of said abrasive on the tile seems to somewhat open up the tile and is consistent with providing a tile having high sound absorption characteristics. Next the fissures have a more natural appearance and a product having the desired aesthetic qualities is provided.

We have attempted to use wire brushes of the rotary variety to provide the fissures **13** but it is difficult and impractical in that the fissures do not have the sharp lines of demarcation between the upper surfaces **15** and the sidewalls **14** of the fissures **13**. Undercutting and sharp lines of demarcation provide for a better commercial acoustical tile.

We have also attempted to use mechanical means, as saws and the like, in providing the fissures **13** but again a product was not obtained by acceptable and practical commercial practices.

In the foregoing we have illustrated a templet **27** in Figs. 6 and 7 of the drawings, which templet is substantially the same size as the tile **16** which is to be fissured. Obviously other forms of templets such as a continuous metal belt can be employed for a continuous process. Thus it is to be understood that the showing of the templet **27** in said Figs. 6 and 7 of the drawings is not a limitation but is merely an illustration. The pattern of the random openings in the templet **27** may be obtained by routing, etching, die stamping, or any other suitable means.

Also in the foregoing we have illustrated the roughening step to provide the surface openings **10**, the piercing step to provide the openings **11** and the apparatus to form the fissures **13** in a certain series. However, it is to be expressly understood that the sequence of the various steps may be changed and that our invention is not to be limited to performing said steps in any particular sequence. If the embrittled surface is to be employed, of course this will be performed first in the sequence and thereafter the other steps can be employed in such sequence as may be desired but preferably the step to provide the fissures **13** should be last in the sequence.

Tile made in accordance with our invention can be processed like any other acoustical tile such as providing bevels on the edges or preferably not using such bevels. Also kerfs may be provided in the side walls of the tiles for purposes of installation. Also the edges can be cut back so that the edges taper inwardly from the front towards the back so as to provide for a snugger fit between the edges. Also the edges can be trued up by sawing and the like—all in accordance with the normal handling of standard fiber tile.

In connection with Fig. 5 of the drawings, we have shown the tines **12** to provide the openings **11**. It is to be understood that if desired drills may be utilized in providing said openings **11**. However, tines are preferred as they lend themselves to the providing of irregular shaped openings.

Preferably the openings **11** and the fissures **13** are in a random pattern so that the tiles may be placed one against the other and the said random pattern tends to camouflage the lines of juncture between various tiles.

Also from the foregoing it will now be obvious that we have devised a process and a product therefrom which comprises forming fissured fiber acoustical tile from acoustical tile material having a front surface which lies substantially in a common plane. In the event of lignocellulose acoustical tile material, we preferably embrittle the front face of a piece of said acoustical tile material and then roughen said acoustical tile material by the use of abrasives to provide the surface openings **10** indicated in Fig. 1 of the drawings and thus provide relatively small surface openings of the size less than 1/16 of an inch in diameter. Also there are provided openings 11 of preferably irregular shape and of a diameter from about 1/16 to about 3/16 of an inch and which extend from the front surface of the tile material toward but not through the back surface of the tile material. Also a templet is disposed over the front surface of the tile material and then by abrasives the tile material is eroded away to form fissures which extend toward but not through the back of the tile material.

Obviously changes may be made in the forms, dimensions, and arrangements of the parts of our invention without departing from the principle thereof, the above setting forth only preferred forms of embodiment of our invention.

We claim:

1. The process of forming fissured acoustical tile from an acoustical tile blank containing lignocellulose fibers and having the front surface of said blank lying substantially in a common plane comprising embrittling the front surface of said blank; reducing the moisture content of said embrittled blank and providing a set acoustical tile blank; providing random and irregular openings in the front of said blank, the majority of said openings not exceeding approximately 3/16 of an inch cross sectionally considered; placing on the front of and in contact with said blank, a templet having openings therein defining a random pattern of the outlines of fissures desired on the front of the final acoustical tile; and impinging abrasives on the front surface of the blank through the said openings in said templet to cut random fissures in said blank, said fissures extending toward but not through the back surface of the blank, whereby the said fissures will be sharply defined in the acoustical tile and the openings provided will tend to maintain their original form.

2. The process of forming fissured acoustical tile from an acoustical tile blank containing lignocellulose fibers and having the front surface of said blank lying substantially in a common plane comprising embrittling the front surface of said blank; reducing the moisture content of said embrittled blank and providing a set acoustical tile blank; placing on the front of and in contact with said blank, a templet having openings therein defining a random pattern of the outlines of fissures desired on the front of the final acoustical tile; and impinging abrasives on the front surface of the blank through the said openings in said templet to cut random fissures in said blank, said fissures extending toward but not through the back surface of the blank, whereby the said fissures will be sharply defined in the acoustical tile.

3. The process of forming fissured acoustical tile from an acoustical tile blank containing lignocellulose fibers and having the front surface of said blank lying substantially in a common plane comprising embrittling the front surface of said blank; reducing the moisture content of said embrittled blank and providing a set acoustical tile blank; piercing random and irregular openings in the front of said blank; placing on the front of and in contact with said blank, a templet having openings therein defining a random pattern of the outlines of fissures on the front of the final acoustical tile; said fissures being substantially larger than said random and irregular openings; and impinging abrasives on the front surface of the blank through the said openings in said templet to cut random fissures in said blank, said fissures extending toward but not through the back surface of the blank, whereby the said fissures will be sharply defined in the acoustical tile and the openings provided will tend to maintain their original form.

4. The process of forming fissured acoustical tile from an acoustical tile blank in set form containing brittle and friable fibers on the front surface of the blank and having the said front surface lying substantially in a common plane comprising providing random and irregular openings in the front of said blank, the majority of said openings not exceeding approximately 3/16 of an inch cross sectionally considered; placing on the front of and in contact with said blank, a templet having openings therein defining a random pattern of the outlines of fissures desired on the front of the final acoustical tile; and impinging abrasives on the front surface of the blank through the said openings in said templet to cut random fissures in said blank, said fissures extending toward but not through the back surface of the blank, whereby the said fissures will be sharply defined in the acoustical tile and the openings provided will tend to maintain their original form.

5. A fissured acoustical fiber tile comprising a body portion formed of lignocellulose fibers and having a front surface lying substantially in a common plane and having randomly spaced and irregular shaped openings having a diameter at the front surface of less than three sixteenths of an inch cross sectionally considered and extending from said front surface toward but not through the back surface of said body portion and fissure-like openings extending from said front surface toward but not through the back surface of said body portion, the said fissure-like openings being a plurality of times greater in cross-section size than said openings and being a plurality of times greater in length than in width along said front surface.

6. The process of forming fissured acoustical tile from an acoustical tile blank in set form containing brittle and friable fibers on the front surface of the blank and having said front surface lying substantially in a common plane comprising placing on the front surface of and in contact with said blank, a templet having openings therein defining a random pattern of the outlines of fissures, each having a length of plurality of times greater than its width along the front surface of the final acoustical tile; and impinging abrasives on the front surface of the blank through the said openings in said templet to cut random fissures in said blank, each fissure having a length a plurality of times greater than its width along said front surface, said fissures extending toward but not through the back surface of the blank, the said fissures being sharply defined in the acoustical tile.

7. A fissured acoustical fiber tile comprising a body portion formed of lignocellulose fibers and having a front surface lying substantially in a common plane and having through said front surface a substantial number of miscroscopic openings to permit sound waves to enter the body portion and having fissure-like openings extending from said front surface toward but not through the back surface of said body potrion, said fissure-like openings being a plurality of times greater in length than in width along said front surface.

8. A fissured acoustical fiber tile comprising a body portion formed a lignocellulose fibers and having a front surface lying substantially in a common plane and having through said front surface a substantial number of microscopic openings to permit sound waves to enter the body portion and having fissure-like openings extending from said front surface toward but not through the back surface of said body portion, said fissure-like openings being a plurality of times greater in length than in width along said front surface, the intersecting portion of each fissure-like opening and said front surface forming a well defined angle.

References Cited in the file of this patent

UNITED STATES PATENTS

203,395	Whittaker	May 7, 1878
835,541	Leisegang	Nov. 13, 1906
1,554,179	Trader	Sept. 15, 1925
1,900,522	Sabine	Mar. 7, 1933
1,959,057	Kliefoth	May 15, 1934
2,096,233	Ericson	Oct. 19, 1937
2,124,086	Slidell	July 19, 1938
2,302,020	Frederick, Jr.	Nov. 17, 1942
2,388,880	Stitt	Nov. 13, 1945