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PUNCHED ACOUSTICAL BOARD

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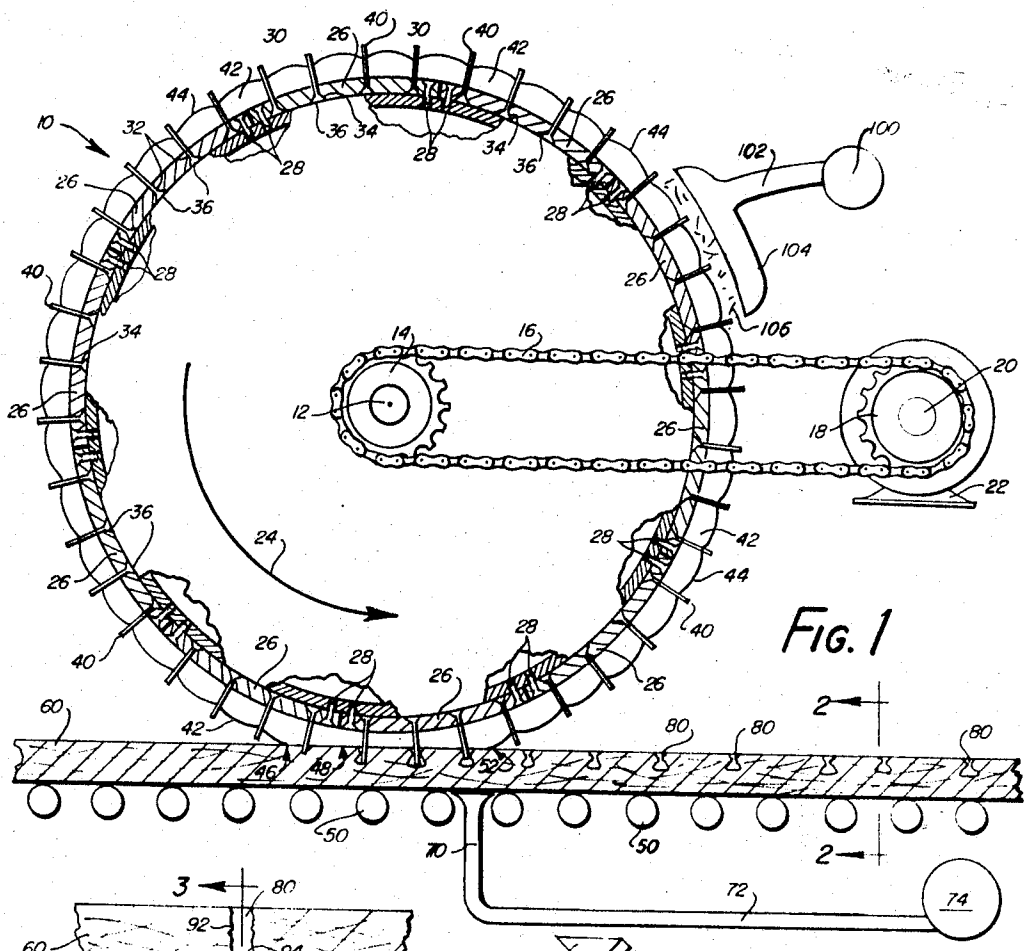

FIG. 1

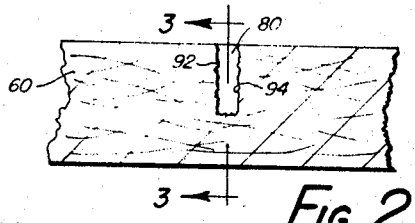

FIG. 2

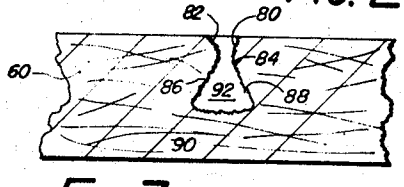

FIG. 3

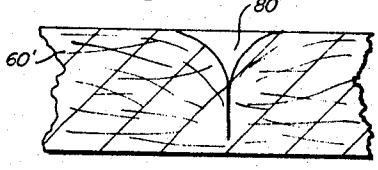

FIG. 4

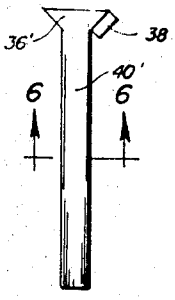

FIG. 5

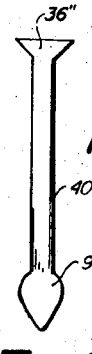

FIG. 8

FIG. 6

FIG. 7

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PUNCHED ACOUSTICAL BOARD

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ABSTRACT OF THE DISCLOSURE

A mineral fiberboard is provided with a multiplicity of acoustical openings. The acoustical openings, beneath the front surface of the board, have two first parallel walls and two other walls at a right angle to said first walls. Said two other walls diverge away from each other inwardly of said front surface.

The punching of acoustical openings into fiberboard, particularly fiberboard of the mineral fiber variety, has been commercially accomplished for a number of years by the use of flat press plates bearing pins which are pressed into the surface of the board.

It has been suggested in the past that rollers or drums provided with pins could be utilized to punch acoustical openings into a board; however, to applicants' knowledge such suggestions have never proved commercially successful.

One of the objects of applicants' invention is to provide a punched acoustical board having equivalent acoustical value to commercially available acoustical board but with enhanced strength. Another object of the invention is to provide for continuous and rapid punching of acoustical openings into mineral fiberboard by means of a rotating drum without the attendant damage usually associated with the use of such rotating drums with pins.

These and other advantages will become apparent to those skilled in the art from the following specification and drawings in which:

FIG. 1 is a partly schematic showing of the rotating pin drum of this invention,

FIG. 2 is a cross-section through an acoustical opening of a piece of mineral fiber acoustical board taken along the lines 2—2 of FIG. 1 and enlarged,

FIG. 3 is a cross-sectional view taken along the lines 3—3 of FIG. 2,

FIG. 4 is a cross-sectional view similar to FIG. 3 showing an opening made too deep,

FIG. 5 is a view of a modified pin that may be used with the drum of the invention,

FIG. 6 is a cross-sectional view taken along the lines 6—6 of FIG. 5,

FIG. 7 is an enlarged view of an acoustical opening looking down at the surface of a board which opening was produced by the pin of FIG. 5 utilized in the drum of FIG. 1 and showing only the surface of the board, and

FIG. 8 is another modified pin for use in the drum of the invention.

In FIG. 1 a rotatable drum **10** fixed to a shaft **12** and journaled in a suitable frame (not shown) is rotated about the axis of the shaft **12** by means of a sprocket **14**, a chain **16** trained about the sprocket **14** and about a sprocket **18** on the end of a shaft **20** of a suitable prime mover such as the motor **22**. It will be seen that upon operation of the motor **22** the chain **16** and the sprockets **14** and **18** will cause the rotation of the drum **10** in the direction of the arrow **24**.

Secured to the outer surface of the drum **10** are a

plurality of plates **26**. The plates **26** are secured to the drum **10** by means of bolts or screws **28** passing through suitable openings in the plates **26** and into tapped openings in the surface of the drum **10**. The screws **28** are suitably countersunk so that the tops of such screws are flush with the outer surface **30** of the plates **26**. Each of the plates **26** is provided with a multiplicity of openings **32** which openings **32** are provided with a tapered counter sink **34** at the inner side of the plate **26**. Passing outwardly through the openings **32** are a multiplicity of pins **40**, one for each opening **32**. The pins **40** have tapered heads **36** thereon mating with and cooperating with the tapered counter sink **34** of each hole **32**.

Each of the plates **26** may be, for example, approximately one square foot in area and has its openings **32** so arranged therein as to be directed radially outward with respect to the axis of the shaft **12**. The holes **32** are quite numerous with from 1,000 to 2,000 holes per square foot, 1,500–1,600 being a common number. Depending upon the pattern to be produced in the acoustical board the openings **32** are of various sizes for the reception of pins **40** of various sizes. In one common pattern the pins **40** are of four different diameters, such diameter sizes being 0.078", 0.062", 0.047", and 0.035". The arrangement of such pins **40** and the openings **32** for this common pattern are generally random in arrangement and mixed in sizes thus providing an irregular and nonlinear pattern in the punch pattern produced in the acoustical board. The diameter sizes referred to, of course, refer to the shank and not to the larger diameter of the tapered heads **36**. The pins **40** may have any desired shape in cross-section such as round, square, triangular, crescent, and the like. As described in more detail hereinafter, certain pin cross-section shapes may be used to further aid in diminishing or eliminating the elongation of the holes.

It will be seen that with such a multiplicity and density of pins (for example, 1,600 per square foot) there is great pressure applied to the acoustical board and a tendency for the board to lift from its roller conveyor support **50** and follow the pins about the path of the drum **10**. Such, of course, cannot be permitted since it results in cracking and destruction of the board. In order to insure prompt release of the board from the pins a layer of compressed sponge rubber **42** is provided about the outer circumference of the drum **10**. This sponge rubber layer **42** is actually, in its uncompressed state, thicker than the exposed length of the shaft of the pins **40**, however, it is compressed when applied so that the ends of the pins **40** extend just beyond the surface of the sponge rubber layer **42**. The layer **42** is held in place by friction against the multiplicity of pins **40** and results in a slight doming of the sponge rubber in the area **44** between the pins. For example, the pins may extend 1" from the outer surface **30** of the plate **26** and the sponge rubber may be ⅜" in thickness; however, because of its compressed state the ends of the pins **40** extend beyond the outer surface and the doming **44** of the sponge rubber **42**. While, as specifically referred to throughout this application a sponge rubber is preferred for use as the stripper means **42**, any suitable elastomeric material may be used.

In operation, the pins **40** penetrate into the board **60** the sponge rubber **42** begins to become further compressed in the area indicated generally by the arrow **46** and becomes still further compressed in the area indicated generally by the arrow **48**. As the board passes beneath the drum **10** the board **60** is pushed away from the ends of the pins by the expansion of the sponge rubber layer **42** generally in the area indicated by the arrow **52**.

Since the board may be warm from the forming dryer and the plant is generally at an elevated temperature the

life of the sponge rubber layer 42 may be somewhat shortened. Of course, certain high temperature resistant elastomers are available. To insure that there is adequate removal of the board 60 from the pins 40 and further to insure that the board 60 is held down in contact with the conveyor 50, there is additionally provided a vacuum slice 70 extending transversely of the conveyor 50 for the full width thereof utilized by the width of the board 60 being processed. The vacuum slice 70 is connected by means of a conduit 72 to any suitable conventional vacuum pump such as indicated at 74. Either the vacuum slice 70 or the sponge rubber layer 42 serve as stripper means and either will suffice to properly hold the board 60 in position against the conveyor and 50 to remove the same from the pins 40; however, the sponge rubber layer 42 is preferred. As an added precaution both the sponge rubber 42 and the vacuum slice 70 may be used to insure proper operation in the event of failure of the sponge rubber layer 42.

Since the board 60 is carried in a substantially rectilinear path by engagement with the pins 40 of the drum 10, and since the pins 40 follow a circular path intercepting the straight path of the surface 62 of the board 60, the openings 80 formed in the board tend to be elongated at the surface 62 of the board in the direction of the passage of the board through the device. This elongation of the openings 80 is, in many instances, considered aesthetically unsatisfactory since it gives the appearance of long black streaks to the surface of the board. Of course, by increasing the diameter of the drum 10 the elongation of the openings 80 can be somewhat reduced; however, even with extremely large diameter drums such as 3', 4', or even larger, the openings 80 will tend to be unaesthetically elongated. Applicants have found, however, that by minimizing the depth to which the pins 40 penetrate the board 60 the elongation of the openings 80 can be greatly reduced for any given diameter of drum 10. That is to say, that a difference in one only one- or two-sixteenths of an inch in depth of penetration of the board 60 by the pins 40 has a much greater effect upon improvement of the elongation of the openings at the surface than would be accounted for by what is, in effect, an increase in diameter of one- or two-sixteenths of an inch in the drum. It is theorized, but not known, that when the pins 40 are pressed into the board 60 to an excessive depth the pins tend to flex and bend, particularly the smaller ones, thus elongating the opening 80 beyond the length that would be accounted for due to the divergence in the path being traversed by the board 60 and the pins 40. This theory would seem to be borne out in part, at least, by the fact that the cross-section of the openings 80 in the direction of the travel of the board 60 is unique as shown in FIG. 3. As shown in FIG. 3 the opening 80 has a slight elongation at the surface 82 and then is smaller or "necked down" in the area indicated at 84. Below this the walls 86 and 88 of the opening diverge away from each other toward the bottom 90 of the opening. It will be seen that the pins 40 have rocked or swung about a point creating an enlarged fan shaped area beneath the restriction 84 and bounded on two sides by the walls 86 and 88 and on the opposite two sides by the substantially parallel walls 92 and 94, see also FIG. 2.

It will be seen that the openings 80 beneath the surface have an increased volume in the area bounded by the walls 86 and 88 thus providing for enhanced acoustics and accordingly permitting the opening 80 to be penetrated into the board 60 to a reduced depth. It has been found, for example, that whereas previous practice had been to penetrate mineral fiber acoustical board to a depth of 7/16 of an inch or more that with the enlarged opening represented by the walls 86 and 88 a depth of only 5/16 of an inch is sufficient to produce equivalent acoustical absorption. At the same time, since more of the back of the board is left undisturbed there is an increase in board strength. While there is some elongation as represented at 82 at the surface of the board due to the "rocking" movement of the pins relative to the board, it has been found that because the pins can move readily beneath the surface such elongation is reduced. When the pins are penetrated to excessive depths the walls 86 and 88 do not diverge but rather converge. As indicated above, it is believed that the tips of the pins become in effect lodged at a given point in the board and the pin flexes creating a crater or cone shaped opening into the board with an attendant greatly increased elongation of the opening 80 and a reduction in the sound absorption efficiency of the board. Such an opening, indicated by the numeral 80' in the board 60', is shown in FIG. 4 wherein the opening was produced by inserting a pin 40 to the normal depth of 7/16 of an inch. It will be seen that while the pin extended to such depth the actual opening is much shallower and the area at the top of the opening at the board surface 62' is greatly elongated.

FIG. 5 shows a modified pin 40' which may be used with the drum of the invention which pin is, as shown in FIG. 6, oval in cross-section. This configuration permits the insertion of the pin 40' in place of the pins 40 with the longer axis of the oval cross-section of the pin 40' substantially parallel to the axis of rotation of the drum 10. When pins of the type shown in FIG. 5 are used the top surface of the board as indicated at 62'' in FIG. 7 has an opening 80'' therein which is a rounded square. That is to say that the opening is substantially square but has rounded corners. When a board having openings like 80'' is coated, the coating tends to further round the opening thus making it appear almost circular. This arrangement greatly reduces the elongation effect created by normally cylindrical pins 40. In order to assist in inserting the pins 40' with the longer axis of its cross-section parallel to the axis of rotation of the drum 10 it is preferred to use a key 38 on the head 36' in line with the longer axis of the oval which is mated with a companion key notch (not shown) in the plate 26. Such key 38 also serves to prevent accidental rotation of the pin 40' thus insuring that the longer axis of the oval of the cross-section of the pin 40' remains parallel to the axis of rotation of the drum 10.

Another modified pin 40'' shown in FIG. 8 may be used with the drum of this invention to further decrease or eliminate the hole elongation above referred to. The pin 40'' has a reduced shank, a tapered head 36'', and an enlarged bulb-like head 94. By use of a pin of the shape of pin 40'' the bulb-like head creates an opening in the board that is substantially round at the surface and the shank, being smaller, will not elongate the opening 80 at the surface 62 due to the "rocking" movement of the pin relative to the board as above described.

While the drum 10 is shown as being driven by the motor 22 and the conveyor 50 is shown as being undriven, it is obvious that either or both of the drum 10 and the conveyor 50 may be driven.

As the drum is operated, broken fibers, bits of board and like debris tend to accumulate on the outer surface of the rubber layer 42 and around the pins. Such debris, if left in place, tends to scratch the board on the next revolution. Accordingly, a fan or blower 100 is provided which has its outlet connected by means of conduit 102 to a manifold 104. In this way jets of air 106 are impinged upon the outer surface of the rubber layer 42 to clear away any debris picked up by that surface or by the pins 40.

It is to be understood that while the pins 40 in FIG. 1 are generally shown in a straight line around the drum this was for ease of illustration only. In actuality the pins may be located in any of almost an infinite number of patterns one common one being a dense (say 1,500 pins per square foot) random pattern.

We claim:

1. An acoustical mineral fiberboard having a front surface and a back surface, a multiplicity of acoustical openings extending into said board from said front face there-

of toward but not through said board, each of at least a number of said acoustical openings beneath said front surface having two substantially parallel first walls, two other walls beneath said front surface substantially at a right angle to said first walls, and said two other walls diverging away from each other inwardly from said front surface.

2. The acoustical board of claim 1 in which said openings extend no more than about 5/16" into said board from the front surface thereof.

3. The acoustical board of claim 2 in which said openings at the front surface of said board are square in shape with the corners thereof rounded.

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ROBERT S. WARD, JR., Primary Examiner

U.S. Cl. X.R.

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