Aug. 8, 1944. W. I. LUCIUS 2,355,454

METHOD AND APPARATUS FOR THE PRODUCTION OF SOUND-ABSORBING MATERIALS

Filed April 13, 1943

Fig. 1.

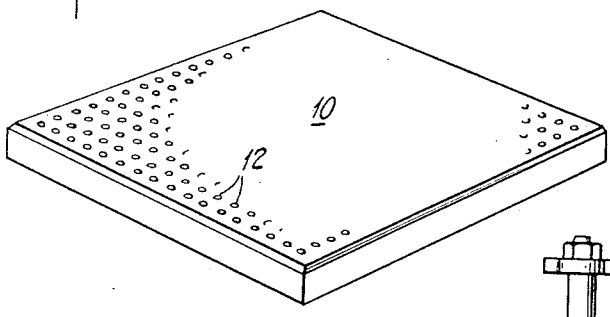


Fig. 3.

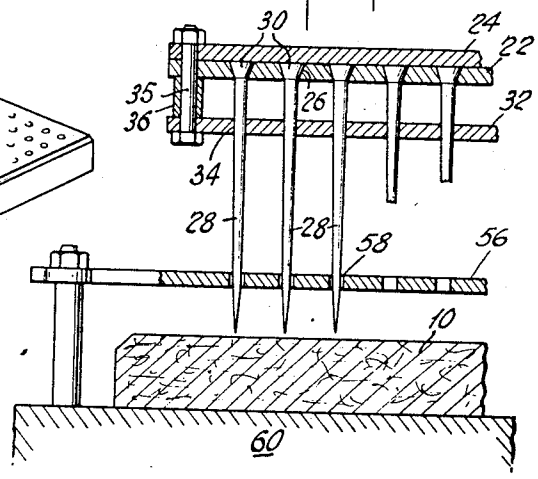


Fig. 2.

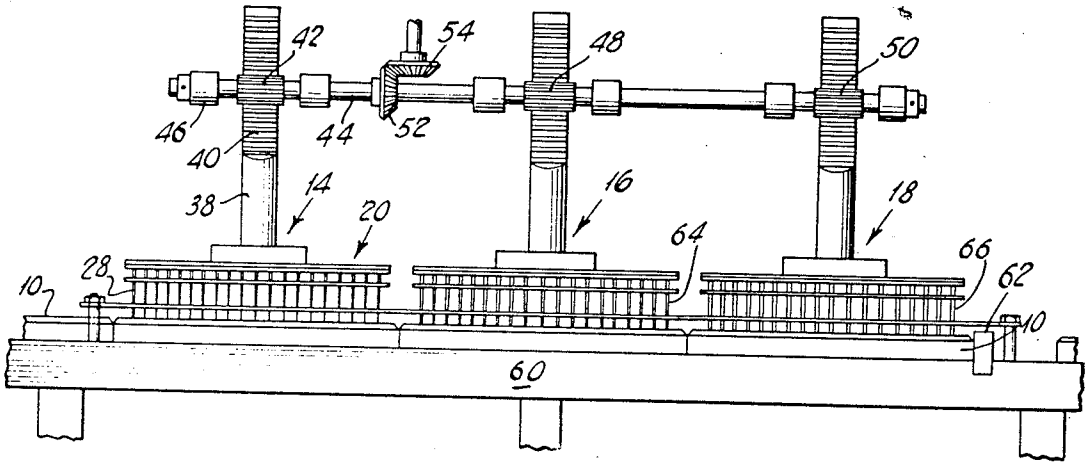


Fig. 4.

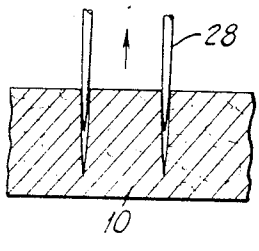


Fig. 5.

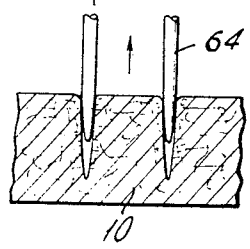
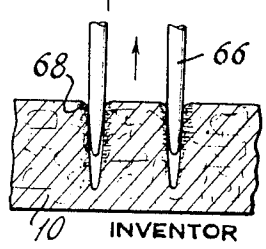


Fig. 6.



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UNITED STATES PATENT OFFICE

2,355,454

METHOD AND APPARATUS FOR THE PRODUCTION OF SOUND-ABSORBING MATERIALS

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Application April 13, 1943, Serial No. 482,878

6 Claims. (Cl. 164—125)

The instant invention relates to a method and apparatus for the production of sound-absorbing materials and, more particularly, to a method and apparatus for modifying fibrous panels and the like to improve their sound-absorbing characteristics.

Heretofore it has been known to employ porous fibrous panels such as those made of conventional fiber board comprising water-laid felted wood fibers or the like as a sound-absorbing facing for the walls and ceilings of rooms, the porous interior of the board serving to dissipate and destroy sound penetrating therein.

The efficiency of such panels has been impaired to a considerable extent by the presence of decorative coatings and the like which give the board a relatively sound-reflective surface. To overcome this difficulty it has been known to drill the panels to form a plurality of elongated perforations or passages extending inwardly from the surface to be exposed, the passages permitting an appreciable proportion of sound of normal frequencies to readily penetrate the surface to reach the porous interior. The passages also substantially increase the total area of the board exposed to sound. The principal object of the instant invention is the provision of an improved method of forming such openings, the improved method, as opposed to the known practice, involving relatively inexpensive apparatus and permitting an increased rate of output.

Another object of the invention is the provision of a method, as referred to, in which the openings are formed by displacement of the fibers laterally into the panel.

A further object of the invention is the provision of a method in which the board or panel is penetrated at the selected locations by a plurality of sharpened, successively operated punches of different diameters.

A still further object of the invention is the provision of a method and apparatus which provides for the simultaneous formation of a multiplicity of openings distributed throughout the area of the panel or board without crushing the same.

My invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the more detailed description thereof which is to follow and to the accompanying drawing, in which:

Fig. 1 is a perspective view of a panel formed in accordance with the instant invention;

Fig. 2 is a diagrammatic elevational view of an apparatus in accordance with the invention and for performing the method;

Fig. 3 is a detail sectional view on an enlarged scale depicting a portion of the apparatus;

Fig. 4 is a fragmentary sectional view illustrating a step in the method;

Fig. 5 is a view similar to Fig. 4 illustrating a further step; and

Fig. 6 is a view similar to Figs. 4 and 5 illustrating a final step in the method.

Referring now to the drawing there is shown in Fig. 1 a panel or board 10 formed of interfelted fibrous material or the like and suitably of fiber board of the type heretofore employed for sound-absorbing facings. Panel 10 includes a multiplicity of openings or perforations 12 extending inwardly from the face of the panel to be exposed to the sound to be absorbed. The openings 12 may be of a size, depth and distribution as determined by the character of the board. For purposes of example, it may be stated that with a relatively low density fiber board, the openings may be, say, from ⅛ to $\frac{3}{16}$'' in diameter, placed approximately ½'' on centers and of a depth to penetrate well into the interior of the board. Usually the panels are made 12'' square, although, of course, the dimensions may be varied as desired.

Referring now particularly to Figs. 2 and 3, an apparatus is illustrated for forming the perforations in accordance with the instant method. The method, as opposed to known practice, consists in punching or piercing the face of the board in such a manner as to displace the fibers laterally into the body of the board. The apparatus comprises a plurality of punch presses, three being shown at 14, 16 and 18 respectively, each of which may be substantially identical with the others, except for the size and character of the punches or piercing needles. Punch press 14 will be described in some detail, it being understood that the description applies equally to the other punch presses with the exception noted.

Punch press 14 includes a platen or a head 20 comprising in its preferred embodiment plates 22 and 24 of substantially the area of the panel to be operated on. Plate 22 includes a plurality of preferably upwardly beveled openings 26 distributed in accordance with the pattern of perforations selected for the panel, the openings being adapted to receive punches 28. The latter are provided with enlarged heads 30 of a size and character to provide a tight driving fit with openings 26. Plate 24 is preferably imperforate and closely overlies plate 22 to prevent retrac-

tion of punches 28. Spaced some distance below plates 24 and 22 is a third plate 32 provided with openings or perforations 34 of a size and distribution to receive punches 28 with a tight driving fit. Plates 22, 24 and 32 are held in assembled relationship by any suitable means, which may, for example, comprise bolts 35 placed at suitable intervals along the edges of the plates. Between plates 22 and 32 a sleeve 36 surrounds each bolt to maintain the spaced relationship of the plates. Platen 20 is carried by a rod 38 supported in suitable guides (not shown) for vertical reciprocating movement. Rod 38 is provided with rack teeth 40 meshing with the teeth of a pinion gear 42 carried by a shaft 44, supported in suitable bearings 46. As will be observed from an inspection of Fig. 2, similar pinion gears 48 and 50 are carried by shaft 44 for meshing engagement with the corresponding racks on the platen rods of punch presses 16 and 18. Shaft 44 is driven in any suitable manner as through bevel gears 52 and 54, and by any suitable means to cause rotation of the shaft alternately in opposite directions to move the platens 20 upwardly and downwardly.

Fixed to a stationary part of the machine in any suitable manner is a guide plate 56 provided with perforations 58 in vertical alignment with the perforations of plates 22 and 32. Perforations 58 are of a size to receive the punches in a relatively loose sliding fit. As will be understood, plate 56 supports the slender, needle-like punches against excessive bending and displacement and also serves as a panel abutment surface to force release of the punches upon upward movement of the platen. Preferably the apparatus is arranged so that upon upward movement of the platen, the punches are withdrawn through or substantially through the perforations 58.

Below the punch presses a table 60 is provided on which the panels are fed beneath the several presses, suitable guides being provided (not shown) for positioning the panels. Table 60 may take the form of a conveyor operated intermittently in timed relationship to the operation of the punches. A retractable stop 62 may be employed as an element of the positioning means.

As pointed out above, the several presses are preferably alike except that the punches of succeeding presses are of successively larger diameter, the punches of the final press being of substantially the diameter of the openings of the completed panel. As shown in Fig. 4, punches 28 of punch press 14 are of relatively small diameter and have a long taper ending in a sharp point. These punches may best be described as being of needle shape. Punches 64 and 66 (see Figs. 5 and 6) of presses 16 and 18 respectively are of enlarged diameters and terminate in relatively blunt points, as shown.

In carrying out the method the panel is first positioned beneath punch press 14 and platen 20 forced downwardly by the driving means, previously referred to, to cause punches or needles 28 to penetrate to the desired distance into the panel. The extent of penetration may be controlled, as desired, but preferably will be the greater part of the thickness of the panel. As the sharp points enter the material they penetrate between the fibers and force them laterally into the body of the material. After withdrawal of the punches by upward movement of platen 20, the panel is shifted beneath punch press 16 and the operation repeated, punches 64 entering the perforations or openings formed by punches 28 and further displacing the fibers to enlarge the openings. The platen of punch press 16 is then moved upwardly to withdraw punches 64 and the panel shifted to underlie punch press 18. The platen of this press is then lowered and punches 66 enter the perforations or openings made by the previous punching operations and cause further displacement of the fibers to enlarge the openings to the desired finished dimensions. In normal operation the panels are preferably continuously fed into one end of the apparatus, the left hand end, as illustrated in Fig. 1, and the completed panels are withdrawn at the other end, each panel being subjected to the several punching actions during its course of travel through the machine. Although three punching operations are shown, it will be understood that any suitable number may be employed depending upon the size and character of the openings to be provided.

As shown somewhat diagrammatically, particularly in Fig. 6, the piercing of the fibrous material in the manner described displaces the fibers laterally and downwardly without severing them to any great extent. This action provides rounded lips at the mouths of the perforations, as indicated at 68, which are of particular importance where the panels carry a surface coating, as the coating is forced over this rounded edge and to some extent into the mouths of the perforations, greatly enhancing the appearance of the panels. Due to the fact that the panels are first penetrated by the needle-like punches 28 and the remaining punches enter performed perforations, no such undue pressure is applied to the face of the board as would tend to collapse the board or cause surface cracks.

Having thus described my invention in rather full detail, it will be understood that these details need not be strictly adhered to, but that various changes and modifications will suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What I claim is:

1. A method of improving the sound-absorbing characteristics of a fibrous sheet material comprising forming at spaced points in the sheet a multiplicity of elongated openings extending inwardly from a face thereof by penetrating said sheet at each of said points with a plurality of punches of successively increasing diameters.

2. A method of improving the sound-absorbing characteristics of a fibrous sheet comprising forming at spaced points in the sheet a multiplicity of elongated perforations extending inwardly from a face thereof by penetrating said sheet at said points with punches of one diameter to displace the fibers of said sheet and form openings therein, and thereafter penetrating said sheet at the same points with punches of larger diameter to further separate said fibers and to enlarge said openings.

3. A method of forming elongated openings in a fibrous panel to improve the sound-absorbing characteristics thereof comprising punching said panel at given points with small diameter, sharp, needle-like elements to force the fibers apart and to define narrow openings at said points, and thereafter punching said panel at said points with larger punches having tapering ends, said second punches entering said narrow openings and further displacing the fibers adjacent the openings to enlarge the same.

4. A method of forming elongated openings in a fibrous panel to improve the sound-absorbing

characteristics thereof comprising simultaneously penetrating said panel at a multiplicity of points distributed throughout the area thereof with a plurality of punches operating successively and of successively increasing diameters.

5. A method of forming elongated openings in a fibrous panel comprising simultaneously penetrating said panel at a multiplicity of points distributed throughout the area thereof with sharpened needle-like elements to force the fibers apart and to define narrow openings at said points, and penetrating said openings at said points with larger punches to further displace the fibers adjacent the openings to enlarge the same without crushing the panel.

6. An apparatus comprising a plurality of presses, each carrying a plurality of punches arranged in identical patterns, the punches of successive presses being of increased diameter with respect to those of preceding presses, means for supporting panels in position to be successively acted upon by the punches of each of said presses, and means for operating said presses.

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CERTIFICATE OF CORRECTION.

Patent No. 2,355,454. August 8, 1944.

WILLIAM I. LUCIUS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 33, for the word "performed" read --preformed--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of November, A. D. 1944.

Leslie Frazer

(Seal) Acting Commissioner of Patents.

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