Sept. 10, 1963 M. DOBBINS 3,103,410

METHOD OF PRODUCING A SOUND ABSORBING STRUCTURE

Filed May 23, 1960

FIG.1.

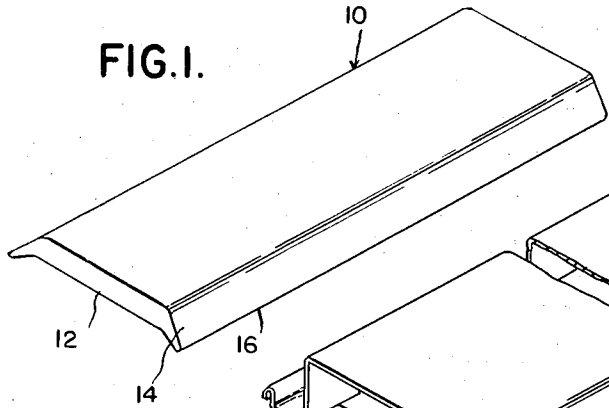
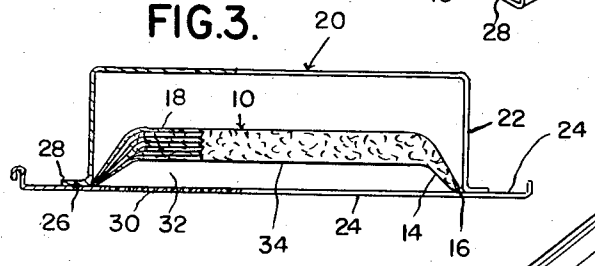


FIG.2.

FIG.3.



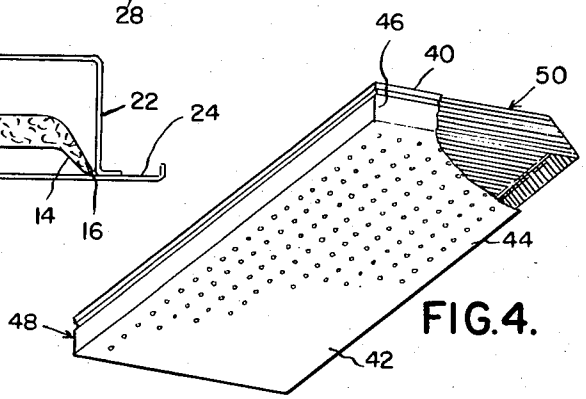


FIG.4.

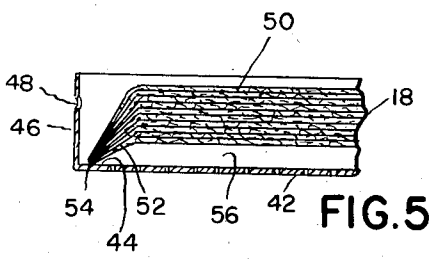


FIG.5.

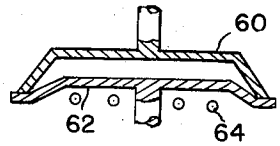


FIG.6.

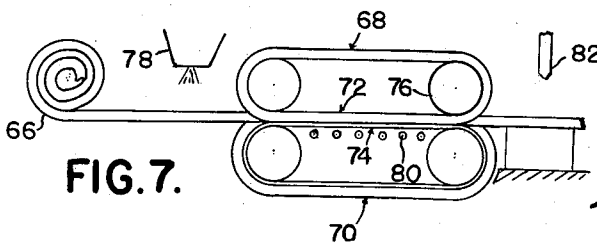


FIG.7.

INVENTOR.
MARK DOBBINS
BY Whittemore Hulbert & Belknap
ATTORNEYS

United States Patent Office 3,103,410 Patented Sept. 10, 1963

3,103,410
METHOD OF PRODUCING A SOUND ABSORBING STRUCTURE

Mark Dobbins, New York, N.Y., assignor to Fenestra, Incorporated, Detroit, Mich., a corporation of Michigan

Filed May 23, 1960, Ser. No. 30,873
1 Claim. (Cl. 18—56)

The invention relates to sound absorbing structure and refers more particularly to a method of producing sound absorbing pads for use with acoustically treated metal ceiling panels to absorb sound.

The present application is a continuation-in-part of copending application, Serial No. 636,823, filed January 28, 1957, now Patent No. 2,944,622.

Metal ceiling panels are acoustically treated by perforating the panels to provide small apertures or perforations in the metal so that they are exposed to the room, and by placing sound absorbing material over the panels to absorb sound waves that pass through the apertures. It is desirable that the sound absorbing material be in a form that will not allow loose particles to fall through the apertures. It is also desirable that the sound absorbing material be spaced rearwardly from the apertures so that the apertures will not become plugged, so that the sound absorbing material is not visible to an observer standing on the floor level, so as to facilitate maintenance such as washing or painting, and so as to provide a sound plenum which increases the sound absorbing characteristics when the optimum spacing is used.

Heretofore, in order to accomplish the foregoing it was the practice in the industry to provide the sound absorbing material in the form of fibrous pads and to support these pads on a wire grid or wire chair.

It is an object of the present invention to provide a method for producing a self-supporting sound absorbing pad for use with acoustically treated metal ceiling panels.

Another object is to provide a method of producing a sound absorbing pad of molded construction having outstanding legs along each lateral edge with the material in each leg being compacted to stiffen and strengthen the leg.

Another object is to provide a method of producing a sound absorbing pad as set forth above wherein the legs are tapered to provide gradually increasing density, stiffness and strength.

More specifically it is an object of the present invention to provide a novel method of producing sound absorbing pads which comprises molding a batt of loosely arranged fibrous material having a binder therein and of generally rectangular cross-section to provide an intermediate partially compressed flat portion, shaping the edge portions of the batt to provide gradually tapered legs of increasing density and strength, and causing the edge portions to extend beyond one side of the batt to form supporting legs.

Still more specifically it is an object to provide a method of producing a sound absorbing pad as set forth above including the steps of lightly impregnating an elongated fibrous batt of rectangular cross-section with an adhesive material, applying pressure directly to opposite sides of the batt by means of movable die members, additionally compressing the edge portions of the batt into

tapered legs, simultaneously shaping the tapered legs to extend from the same side of the pad, and causing the adhesive material to set by the application of heat during compression of the batt.

Another object is to provide a method of continuously producing a sound absorbing pad as set forth above by the method set forth above from a continuous batt of fibrous material.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, illustrating preferred embodiments of the invention, wherein:

FIGURE 1 is a perspective view of a pad of sound absorbing material produced in accordance with the method of the present invention.

FIGURE 2 is a perspective view of a pad produced in accordance with the present invention in place in a hollow metal ceiling panel.

FIGURE 3 is a cross-sectional view taken through a plane at right angles to the panel shown in FIGURE 2.

FIGURE 4 is a perspective view of a pad positioned in a unit type acoustical pan system.

FIGURE 5 is an enlarged fragmentary sectional view showing the relationship between the edge of a pad and the housing.

FIGURE 6 illustrates a die used to produce the acoustic pad shown in FIGURE 1.

FIGURE 7 illustrates apparatus for continuously producing an acoustic pad according to the invention.

Referring now to the drawings, a pad of sound absorbing material is generally indicated at 10. The pad is in a molded form of generally rectangular cross-sectional shape having a flat intermediate portion 12 and provided with tapered inclined edge portions providing supporting legs 14 terminating in rounded feet 16. In accordance with the preferred embodiment of the invention, the pad is fabricated from fibrous material although any suitable equivalent material may be employed. Excellent results have been obtained when the pad is fabricated from glass fibers, which have excellent sound absorbing properties, and when lightly impregnated with a suitable binder such as a phenolic resin are readily moldable to the desired form. Excellent results have been obtained when the diameter of the fibers is generally within the range of from .0001 to .0004 inch.

In fabricating the pad, an elongated batt of the fibers is laid-up in parallel layers so that the layers have a horizontal orientation as indicated by the lines 18. The unidirectional properties of the layers of fibers give the material resiliency in a direction perpendicular to the horizontal arrangement of the fibers.

The strength of the pad of course varies with the density of the fibers, being higher when the density of the fibers is greater. In a specific example which has established its utility in practice, pads are produced from glass fiber batts having an initial thickness of about 1½ inches and being loosely arranged to be of about one pound per cubic foot density. The fibers are provided with a suitable binder, such for example as a light distribution of a phenolic resin therethrough, whereby on compression of the fibres the surface strata thereof are bonded together. The resin is provided in a quantity sufficient to produce the required binding action without

at the same time substantially interferring with the porosity and sound absorbing properties of the pad.

In this condition the batt is molded between relatively movable die members **60** and **62** as shown in FIGURE 6 to have the cross-sectional shape illustrated in the figures, the edge portions of the batt being tapered and at the same time shaped to incline toward and extend beyond one side of the batt so as to produce the supporting legs **14**. Due to the relatively greater increasing compression of the fibrous material towards the edges of the pad, the legs are of increasing density and hence of increasing strength, the extreme edge portions of the pad thus providing relatively hard, strong and dense supporting feet well adapted to resist wear. As best seen in FIGURE 3, it will be apparent that the tapered shape of the legs is such as to provide a thickness thereof at a point adjacent the extreme ends of the legs less than half the thickness of the intermediate portion of the pad. The compression existing at the extreme edge portions of the pad is of course even greater.

The molding operation is accompanied by heating by conventional steam or electric means **64** which causes the resinous material to cure or set. Upon completion of the molding process the acoustical pad is in its finished condition.

The molding operation is carried out so as to produce some reduction in thickness of the intermediate portion of the batt. Excellent results have been obtained when the thickness of the intermediate portion of the batt is reduced from about 1½ inches to one inch in the finished pad. Inasmuch as this compression takes place initially and primarily at the top and bottom surfaces of the batt, the finished pad is of unequal density and the surface strata of the pad are somewhat compacted forming a shell-like surface providing extra strength. This shell tends to prevent separation of individual fibers from the pad and so prevents shifting of the fibers which might otherwise tend to close or reduce the effective area of the perforations in the panel.

Accordingly, the pad, while of no very great strength, is nevertheless form-sustaining and self-supporting, the self-supporting property being attributable largely to the provision of the relatively denser and gradually compacted tapered supporting legs. Moreover, these legs terminate in rounded still further densified supporting feet well adapted to resist wear while in contact with supporting surfaces.

In FIGURES 2 and 3 the pads are shown as received in hollow acoustically treated metal ceiling panels **20** comprising hat-shaped portions **22** attached to flat plates **24** as by spot welding at **26** along the flanges **28**. The plates **24** are perforated as indicated at **30** to allow sound waves to enter the chamber **32**. The pad **10** is inserted through the open end and into the chamber **32** with the legs **14** extending downwardly and the feet **16** resting on the upper surface of the plate **24**.

It will be observed in FIGURE 2 that the portions of the plate **24** just inwardly from the side walls of the hat section **22** have no perforations and thus constitute imperforate supporting ledge portions upon which the foot portions of the pads rest.

When installed in the panels the foot portions **16** of the pad space its lower surface **34** upwardly from the upper surface of the plate **24**, thus forming a plenum chamber and preventing blocking of the perforations **30** to allow sound waves to enter the plenum and to strike the pad to be absorbed thereby.

In FIGURES 4 and 5 the pads are illustrated in use in another suitable structure which comprises a pan **40** having a perforated bottom wall **42**, the perforations being spaced from the edges to leave imperforate ledge portions **44**. The pan has upwardly extending side walls **46** which may have indented grooves or channels **48** for erection, and is open at the top. In this structure, the pad herein designated **50** has downwardly and outwardly inclined tapered edge portions **52** terminating in rounded feet portions **54** resting upon the imperforate ledge portions **44** to support the body of the pad **50** above the perforated portion of the bottom wall **42**. This leaves a space **56** therein above the bottom wall **42** and prevents the pad from closing any of the apertures. In this case the edge portions **52** of the pad are preferably continuous around all four sides of the pad **50**.

Referring now to FIGURE 7 means are shown for producting a continuous pad having the cross-section shown in FIGURE 3 from a continuous fibrous batt **66**. The apparatus of FIGURE 7 comprises a pair of continuous flexible belts **68** and **70** having adjacent portions **72** and **74** which are held in the shape of dies **60** and **62** as shown in FIGURE 6 as such belts are rotated about drive wheels **76**. The fibrous batt **66** impregnated with resin by means **78** is fed between the moving belts **68** and **70** whereby it is formed as shown in FIGURE 1. During the passage of the batt through the belts **68** and **70** the resin is cured by heat applied thereto from heaters **80**. The continuous batt in finished form as fed from the belts **68** and **70** may be cut into acoustical pads of desired lengths by cutting means **82**.

With the acoustic pad produced according to the invention it will be apparent that the area of the surface of the pad available for absorbing incidental sound waves within the pad is substantially increased by the arched construction providing a concave surface exposed to the sound. Thus, the arched configuration of the pad not only provides for suitable support of the pad without the necessity of the wire grids or chairs previously used, but also actually improves the efficiency in a pad provided in a panel of a given size due to the increase in area of sound absorbing material exposed to the sound.

The production of the acoustical pads from a batt of generally rectangular cross-section having a preferably thermo-setting binder therein provides for the production of pads on the most economical basis possible. Moreover, these pads are produced by a novel method of molding the pads in a manner to provide some compression throughout the entire surface of the batt so as to form a shell-like structure, with increasing compression and densification of the tapered leg portions to provide relatively strong, durable pad supporting legs.

In the specific example described in the foregoing, it will be recalled that the fibrous material of the batt before compression and molding to the desired shape of the pad was of about one pound per cubic foot density. Since the intermediate portion of the pad is reduced in thickness from approximately 1½ to about one inch, it will be appreciated that the average density of the fibrous material in the intermediate portion of the pad between the supporting legs in the completed pad is about 1½ pounds per cubic foot. Average density is referred to since the operation described above results in effecting a compacting action of strata adjacent the top and bottom surfaces of the pad to a greater extent than portions located generally midway between the top and bottom surfaces.

The drawings and the foregoing specification constitute a description of the improved sound absorbing structure in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claim.

What I claim as my invention is:

The method of continuously making form sustaining and self-supporting sound absorbing pads comprising the steps of impregnating an elongated continuous fibrous batt of rectangular cross-section with a heat settable binder, moving the impregnated continuous fibrous batt longitudinally between two vertically opposed endless, batt forming belts, continuously compressing the entire batt, continuously turning the longitudinal edge portions of the batt at angles having the same magnitude with respect to the central portion of the batt on the same side of the batt, continously compressing the longitudinal

edge portions of the batt a substantially uniformly progressively greater amount toward the longitudinal edges of the batt to form diverging wedge-shaped supporting legs of progressively varying density continuously along the length of the batt as the continuous batt passes between the endless belts, heating the continuous batt to set the binder as the batt passes between the endless belts to set the binder and subsequently and intermittently cutting the formed continuous batt into individual form sustaining and self-supporting sound absorbing pads.

References Cited in the file of this patent

UNITED STATES PATENTS

1,118,315	Trist	Nov. 24, 1914
2,332,792	Gross et al.	Oct. 26, 1943
2,486,091	Adams et al.	Oct. 25, 1949
2,690,820	Raes	Oct. 5, 1954
2,881,110	Walker et al.	Apr. 7, 1959