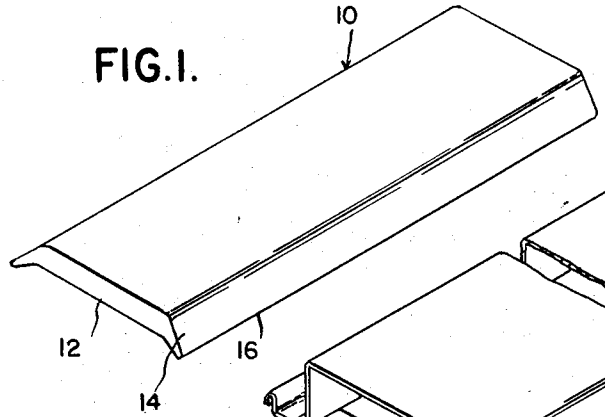
July 12, 1960 M. DOBBINS 2,944,622

SOUND ABSORBING STRUCTURE

Filed Jan. 28, 1957

FIG.1.



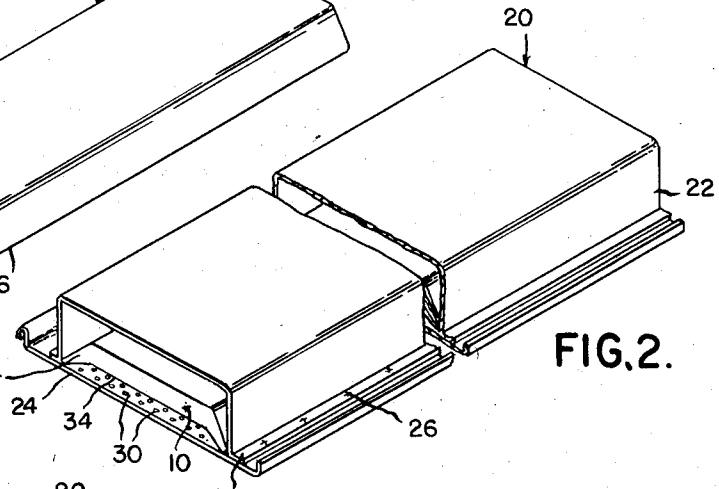
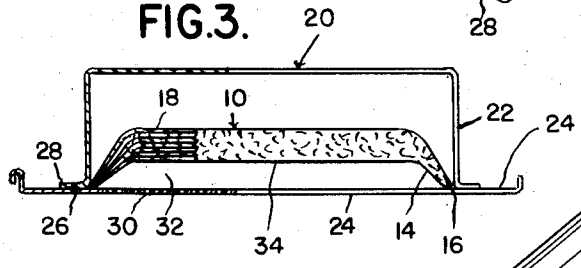


FIG.2.

FIG.3.



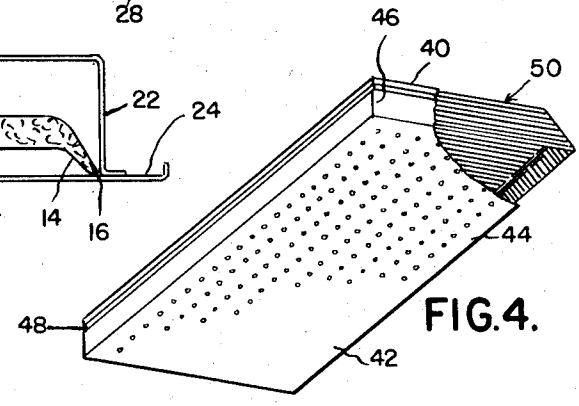


FIG.4.

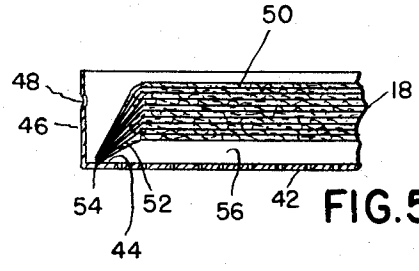


FIG.5.

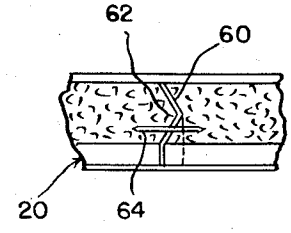


FIG.6.

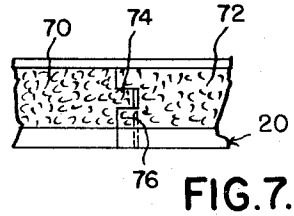


FIG.7.

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SOUND ABSORBING STRUCTURE

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Filed Jan. 28, 1957, Ser. No. 636,823

7 Claims. (Cl. 181—33)

The present invention relates to sound absorbing structure and more particularly, to insulating and sound absorbing pads used with acoustically treated metal ceiling panels to absorb sound.

The present application is a continuation-in-part of my prior copending application Serial No. 583,235, filed May 7, 1956, now abandoned.

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 sound absorbing material, for use with metal ceiling panels, the material being molded from a fibrous batt into a pad having outstanding legs along each lateral edge for supporting the pad and for spacing the intermediate portion of the pad away from the perforations in the panel and which, because of the resulting arched configuration, provides a greater surface area exposed to the sound waves, thus increasing the surface of the pad while still maintaining the pad housing dimensions.

It is a further object of the present invention to provide 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.

More specifically, it is an object of the present invention to provide a pad as defined in the preceding paragraph in which the legs are tapered to provide gradually increasing density, stiffness and strength.

It is a further 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.

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 constructed in accordance with the present invention.

Figure 2 is a perspective view of a pad 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.

Figures 6 and 7 are diagrammatic sectional views showing end modifications of pads.

Referring now to the drawing, 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 fibers 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 interfering with the porosity and sound absorbing properties of the pad.

In this condition the batt is molded between relatively movable die members 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 which causes the resinous material to cure or set and

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.

Referring now to Figures 4 and 5 there is illustrated another embodiment of the present invention 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 which are open at the top. In this embodiment of the invention, 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 aperatures. In this case the edge portions **52** of the pad are preferably continuous around all four sides of the pad **50**.

Referring now to Figures 6 and 7 there are illustrated modified pad constructions applicable particularly to the arrangement of Figures 1–3. In this case the panels **20** may be very long and it is contemplated that the pads **10** will be provided in much shorter length, such for example only a few feet. Thus, a plurality of pad sections will be required to fill one panel from end to end. In Figure 6 there is illustrated one form of interfitting ends provided on the acoustical pads. In this figure each pad section has a concave V-recess **60** at one end and a convex V-shape **62** at the other, the two interfitting as shown. This prevents direct passage of sound waves through the spaces above the pads in the panels **20**. Normally, the pads may be assembled only by sequential insertion from one end. If desired, some mechanical interconnection between adjacent pads may be provided as by pointed pins **64** inserted as the pads are inserted.

In Figure 7 a similar arrangement is shown, the pads **70** and **72** having tongue and groove end portions **74** and **76** respectively, adapted to interfit on assembly.

In all embodiments of 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 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. 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.

It will be observed that the pad has the general configuration of an elongated body having a width several times its thickness. Accordingly, the body may be considered as having opposed flat sides, ends, and edges. Thus, where the edge portions are defined as inclined to extend beyond one side surface of the pad, a side surface such as the side **34** in Figure 3 is intended.

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 claims.

What I claim as my invention is:

1. A sound absorbing member for use in a hollow panel having a perforated lower wall, said member being a unitary elongated body composed of loosely aggregated fibers lightly held together in form-sustaining relation, the upper and lower surfaces of said body along the edge portions thereof extending downwardly from an intermediate portion of said body and forming supporting leg portions for said member, said downwardly extending leg portions having substantially greater density than the density of the intermediate portion of the member between said legs.

2. A sound absorbing member for use in a hollow panel having a perforated lower wall, said member being a unitary elongated body composed in its entirety of loosely aggregated fibers lightly bonded together in form-sustaining relation, the upper and lower surfaces of said body along the edge portions thereof extending downwardly from an intermediate portion of said body and forming supporting leg portions for said member, said downwardly extending leg portions having substantially greater density than the density of the intermediate portion of the member between said legs.

3. A sound absorbing member as set forth in claim 2 wherein the downwardly extending edge portions of the upper and lower surfaces of said body converge toward each other outwardly of the sound absorbing member.

4. A sound absorbing member as set forth in claim 2 wherein the edge portion of the upper and lower surfaces of said body extend outwardly as well as downwardly from the intermediate portion of said body and converge toward each other outwardly of the sound absorbing member.

5. A sound absorbing member as set forth in claim 2 wherein the density of the fibers in said intermediate portion and legs is substantially inversely proportional to the thickness thereof.

6. A sound absorbing member as set forth in claim 2 wherein the density of the fibers in the intermediate portion of said member is about 1½ pounds per cubic foot.

7. A sound absorbing member as set forth in claim 2 wherein the surface portions of said body have an appreciably greater density than the interior portions thereof.

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