Jan. 22, 1963 K. W. SCHULZ 3,074,505

ACOUSTICAL TILE OR THE LIKE AND ITS MANUFACTURE

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Fig. 1

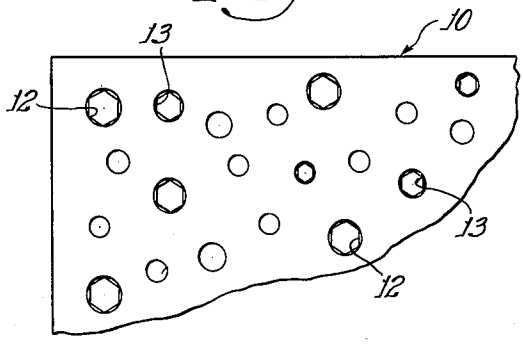


Fig. 2

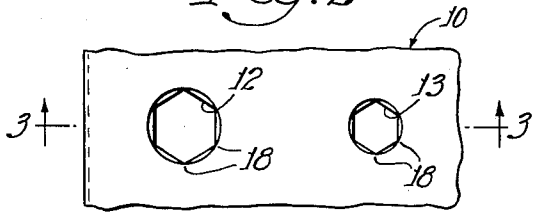


Fig. 3



Fig. 4

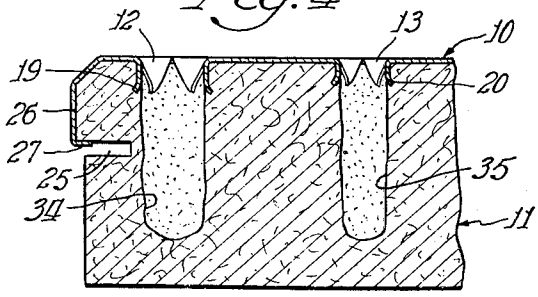


Fig. 7

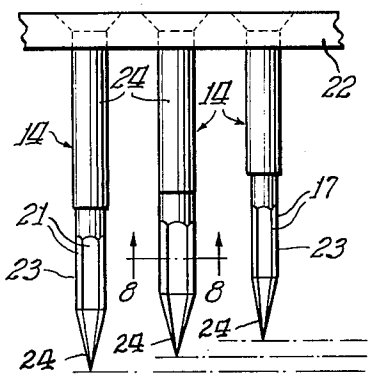


Fig. 8

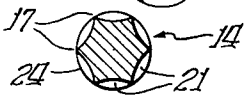


Fig. 9

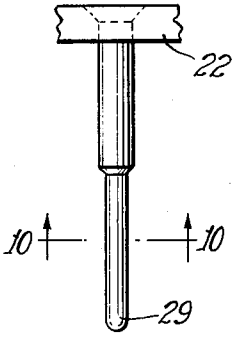
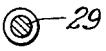


Fig. 10



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Fig. 6

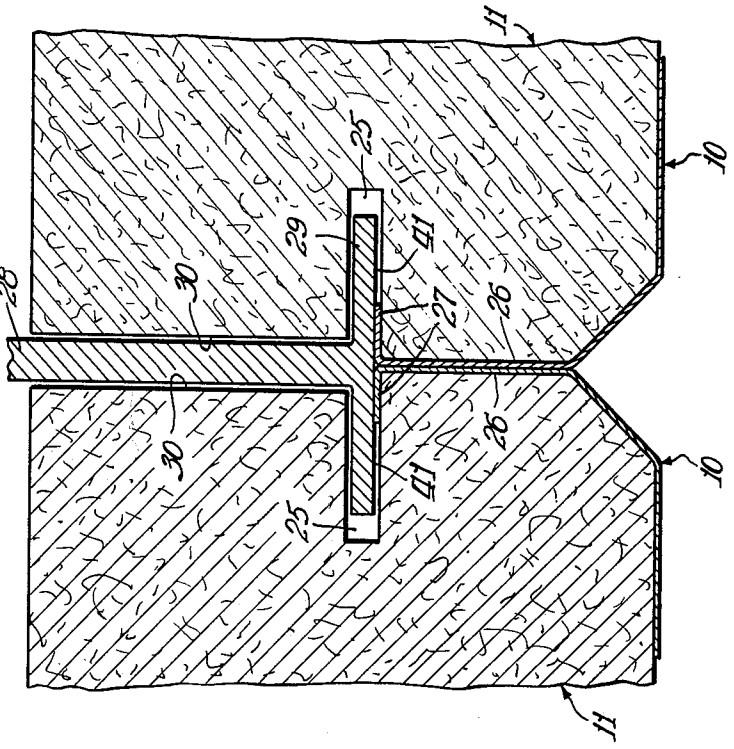
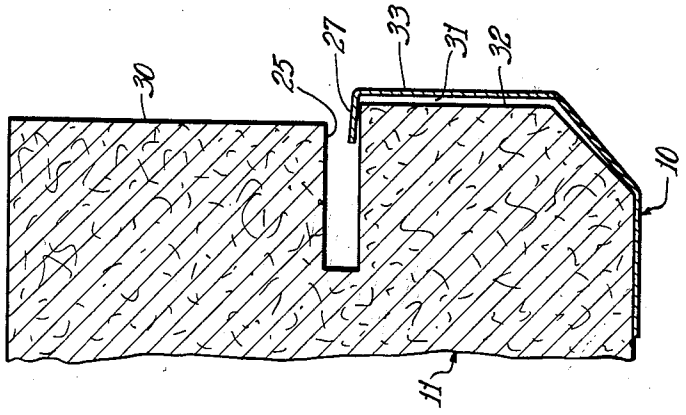


Fig. 5



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ACOUSTICAL TILE OR THE LIKE AND ITS MANUFACTURE

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Substituted for abandoned application Ser. No. 758,011, Aug. 29, 1958. This application Nov. 3, 1959, Ser. No. 850,632

9 Claims. (Cl. 181—33)

This invention relates to improvements in metal faced acoustical tile and its method of manufacture.

The tile has superior sound absorbing efficiency and embodies means for improving the appearance of a tiled surface and for facilitating installation.

This application is a substitute for my co-pending application Serial No. 758,011, filed August 29, 1958, now abandoned.

The nature and further details of the invention will be readily understood by reference to one illustrative tile and its method of manufacture herein described and shown in the accompanying drawings.

In said drawings:

FIG. 1 is a fragmentary plan view of the exposed face of a tile showing a random arrangement of perforations or holes in the face of the tile;

FIG. 2 is a fragmentary plan view on an enlarged scale showing details of the perforations in the face of the tile;

FIG. 3 is a fragmentary section through the tile taken on the plane **3—3** of FIG. 2, showing the tile in an intermediate stage of formation, with the flexible margin of the facing material lying in contact with the edge of the backing material (as in FIG. 6) to illustrate by comparison with FIG. 5, the range of flexibility of such margin;

FIG. 4 is a sectional view similar to that of FIG. 3, showing the punching of the backing material to enlarge the recesses in the backing material to improve sound absorption;

FIG. 5 is a fragmentary section on a greatly enlarged scale taken on the same plane **3—3** of FIG. 2 but with the edge covering margin flexed away from the edge of the backing material to illustrate one edge of a tile to show the yielding or compensating character of the metal covering along the edge of the tile, the other edges of the tile being similarly constructed;

FIG. 6 is a similarly enlarged section of abutting edges of a pair of installed tiles, illustrating one function of the compensating or self-adjusting feature of the tile and the gripping action of the spring flange;

FIG. 7 is an elevation on an enlarged scale of a small portion of the piercing device for piercing and fastening the facing sheet to the backing, as shown in FIG. 3;

FIG. 8 is a section of a single piercing tool (taken on the plane **8—8** FIG. 7) on a scale larger than that of FIG. 7 to show the hollow ground contour of the faces of the tool;

FIG. 9 is an elevation of a portion of the punching device for enlarging the recesses or perforations in the backing material as shown in FIG. 4; and

FIG. 10 is a section taken on the plane **10—10** of FIG. 9.

Acoustical tile made of fiber or composition board and the like and perforated with numerous perforations or holes (of the order of 3/16" in diameter) while efficient and relatively low in cost, has a number of serious defects: They are combustible, readily soiled and difficult to clean. Paint (to freshen the surface) cannot be used because it tends to bridge and thus close the perforations which must be open for the tile to function effectively. Vegetable fiber or other combustible composition tile cannot be used where building codes require a non-combustible tile. This has resulted in the use of perforated metal which is fireproof and can be cleaned and painted but which is very expensive.

The illustrative tile presents a smooth flat surface and possesses the advantages of both the metal and the fiber or composition tiles but is much cheaper and more efficient than the conventional metal tile. Herein the term tile is used in a generic sense to cover all acoustical surfacing regardless of size or shape of the pieces of material.

A large proportion of acoustical tiles are suspended from ceilings by systems of inverted T or spline members and the like whose flanges fit in kerfs in the edge of the tile. The kerfs necessarily provide some play on the supporting member, thereby permitting displacement of adjacent tiles out of co-planar relationship of their lower or exposed surfaces with adjacent tiles, which is magnified or exaggerated in a tiled ceiling much more than in a continuous plastered or other plain surfaced ceiling. Also very slight misalignment of joints between a line of tiles detracts very greatly from the appearance of the tiled surface and particularly ceilings where most acoustical tiles are used.

The illustrative tile embodies a facing **10** of very thin and flexible metal such as steel or aluminum. The metal may be of the most economical or inexpensive thickness, since it is not required to be self-supporting as is the conventional metal tile. Illustrative metal thicknesses are .005 to .010 inch. Strength, stiffness and full support of the metal sheet is contributed by the fiber or composition board or backing **11** to which the metal facing **10** is intimately bonded so as to make it in effect an integral part of the backing board in the sense that the latter so intimately contacts the metal facing that any tendency of the metal facing to be set in vibration by sound impulses is effectively dampened by the backing.

The aforesaid bonding is advantageously effected in this instance during the initial stage of formation of the sound absorbing perforations or holes **12** and **13** in the tile. As here shown, the assembled backing with its metal facing is pierced by piercing tools **14** which pierce the holes **12** and **13** in the metal facing and form depressions **15** and **16** (FIG. 3) in the backing material extending nearly but not quite through the material. The piercing tools are constructed and arranged not only to pierce the metal facing and penetrate the backing as aforesaid, but to curl the metal displaced by the piercing operation into the backing and thereby to clamp or bond the facing to the backing. (See FIG. 3.)

In the present instance, the piercing tools are non-circular (i.e. polygonal) in shape to present sharp edges or corners **17** which make correspondingly sharp corners or recesses **18** in the holes in the metal (FIG. 2), producing points where stress is concentrated in the metal as the piercing operation proceeds, thereby to cause the metal to split or tear at these points in the form of relatively regular or uniform tongues or prongs **19** and **20** of metal. As the piercing operation continues these prongs **19** and **20** curl into the backing as illustrated in FIG. 3 to anchor the facing to the backing. Any tool section which provides the aforesaid sharp edges in the perforation in the metal, may be employed. A hexagonal section, as here shown, is simple and effective but it may be triangular, rectangular or star-shaped, for example. A tool of round section would also produce tongues which would curl as aforesaid, but the tongues would lack uniformity and would be very irregular and inefficient. The formation and curling of the tongues **19** and **20** is a progressive one, since, as the metal is split or torn by the advance of the tool, the tongues are progressively formed, curled and forced into the material to a substantial depth.

Greatly improved results can be obtained by making the polygonal faces of the piercing tool slightly hollow ground as illustrated at **21** in FIG. 8. This has the ef-

fect of making the metal prongs **19** and **20** curl back into the material gradually thereby to penetrate more deeply into the body of the backing material and thus anchor the sheet more firmly to the body of the backing material. With a piercing tool having flat faces, the prongs are curled back abruptly and anchor much more shallowly into the material with the result that the facing sheet is in effect anchored only to the surface skin or layer of the backing material. The depth to which the prongs penetrate into the backing material may be regulated by the depth to which the tool faces are hollow ground.

The piercing tools may act successively or progressively as the tile is advanced, or, as in this case, the entire face of the tile may be pierced in one operation by a platten **22** having multiple piercing tools **14**. The arrangement and spacing of the tools may be uniform, or as here shown, may be random, and advantageously the holes may be of different sizes (illustrated in this instance by three sizes in FIG. 1 and two sizes of holes **12** and **13**) to accentuate the random arrangement and to depart even farther from the monotony of the conventional arrangement of uniformly spaced and sized holes. Whether or not the tools are of different sizes, their shanks **24** (round) are of uniform diameter so that the random arrangement of tool sizes or pattern may be changed easily.

To minimize the force required to effect the piercing operation, the piercing tools advantageously have slightly different lengths (shown somewhat exaggerated in FIG. 7) so that all of them do not simultaneously engage the facing sheet. In this instance about a third of them engage at about one time, followed by another third as soon as the main piercing force of the first third has been exerted, and so on for the last third of the tools. This requires only a very slight difference in tool length since the main force is exerted in making the initial penetration of the metal. The different tool lengths are distributed generally uniformly over the platen.

Preferably the polygonal portion **23** of the tools is very slightly tapered (i.e. given draft) downwardly further to reduce concentration of the piercing load and particularly to facilitate withdrawal of the tools from the sheet. The draft or taper of the tool is particularly advantageous in the latter instance since it avoids distortion or lifting of the thin metal facing away from the backing material as the tool is withdrawn. This tapering may be of the order of .005" in the length of the portions **23** of the tool.

The above mentioned tapering does not refer to the sharply pointed tips **24** of the tool which are thus sharply pointed to facilitate initial penetration of the facing sheet.

The piercing load is further substantially reduced by grinding or finishing the pointed portions and the portion **23** of the tools by an operation which cuts or grinds the metal longitudinally of the tool rather than transversely. Thus the minute finishing marks on the tool surface extend longitudinally of the tool rather than transversely, thereby greatly reducing the friction between tool and sheet throughout the piercing operation.

The backing material is advantageously grooved or kerfed at the edges as at **25**, and the edge of the metal facing bent around the edges of the backing as at **26**, thereby to protect the edges of the backing and to provide a finished edge for the tile. The free edge **27** of the facing extends partly into the kerf **25**. The tile may be fastened to the ceiling or other surface to be soundproofed, by the conventional suspending system, or by cementing the tiles directly to the ceiling. Any method of attachment employed for conventional tiles may be employed for the present tile. Any efficient backing board may be embodied in the tile.

In many instances the conventional suspending system involving an inverted T suspending member **28** or the equivalent is employed to support the tile, the flanges **29** of the supporting T or other spline entering the kerf **25** in the tile. The kerfs **25** are wider than the thickness of the supporting flanges or spline to facilitate application of the tile to the supporting system. Back of the kerf **25** the backing member is reduced in width as at **30** to provide space for the suspending member **28**.

The tile is given the aforesaid compensating or self adjusting character by providing a small clearance **31** between the edge **32** of the backing member and the facing material **33** at the edge of the tile (FIG. 5). This may be as little as $\frac{1}{32}$" at each of the edges of the tile, since over a large ceiling or other surface, an adjustment of $\frac{1}{16}$" per tile aggregates a substantial amount. FIG. 5 is somewhat exaggerated to illustrate this feature. The clearance is provided in this instance by making the tile undersize along each edge so that the overall dimension of the tile from edge to edge of the metal facing is standard. The amount of clearance at the edges between facing and backing material may of course be varied to suit conditions, simply by appropriately trimming the edges of the backing material. No change is required in the overall dimension of the facing material. This adjusting feature of the tile may be used not only to maintain alignment of the joints of a series of tiles but also to compensate for the aggregate effect of minute differences in overall dimensions of the tile. Also, it may be used to provide a gap in a line of tiles to facilitate the removal of the tile if this should become necessary.

The adjusting or compressible character of the tile is also useful where the tile is attached by cement. The adhesive strength of the cement is strong enough to hold the tile against creeping even though its edge **33** be pressed against an adjacent tile, since the resilient expanding force of the thin margin **33** is insufficient to overcome the holding force of the cement.

The free edge **27** of the backing material is resilient and in this instance is formed so that initially it inclines away from the backing material at the kerf **25** instead of lying flat against it. This resilient flange therefore acts to exert pressure against the under faces of the flange or spline **41** of the supporting member. The tiles are thus positioned (see FIG. 6) with the surfaces of the kerfs **25** all pressed against the top surface of the flange thereby positioning the exposed faces of the tile all flush or in co-planar relationship. As stated above, a flush or co-planar arrangement is much more important from the standpoint of appearance in a tiled surface than in a plastered or other unbroken surface since very slight departure from a flush co-planar arrangement is generally exaggerated by the tile patterned surface.

Since the tile may be adjusted laterally by means of the yielding or compensating edge of the tile, the resilient flange is very useful in holding the tile in the position in which it is located in alignment with adjacent tiles.

To improve the efficiency of the sound absorbing recesses **15** and **16** as they are initially formed in FIG. 3, they are advantageously enlarged and cleared as shown in FIG. 4 by a punching or sheering operation which not only enlarges and deepens the recesses to cylindrical form, thereby greatly increasing their efficiency, but shears off fragments of backing material which projected into the recesses when initially formed. This is effected in the present instance by the application of cylindrical blunt nosed punches **29** (corresponding in size to perforations **12** and **13**) which clear away the material from the walls of the tapered recesses shown in FIG. 3, to the cylindrical forms **34** and **35** shown in FIG. 4. If a gang punching device be used to punch the entire tile in one operation, the several punches must of course register exactly in size and position with the perforations in the tile.

When very small sized piercing tools are used, e.g. those making holes of the order of $\frac{3}{32}$" in diameter, the subsequent shearing operation with punches **29** usually is not necessary, because with such small holes the number in a given area will so greatly exceed the pattern and

number as shown in FIG. 2 comprising much larger holes, that increase in sound absorption is unnecessary.

One particularly effective board as regards acoustical efficiency and low cost is one made of a major amount of expanded perlite held together with a network of fiber and preferably a small amount of binder, to form a rigid strong board. The proportion of perlite is so high that even if vegetable fiber and a combustible binder be used, the perlite so effectively isolates the fiber and binder, that the board cannot transmit or support combustion, as is acceptable where fireproof tile must be used. One illustrative board comprises about 70% by weight of expanded perlite, 20% fiber and 10% binder. The product thus conforms to regulations and ordinances specifying a non-combustible acoustical tile.

Obviously the invention is not limited to the details of the illustrative embodiment since these may be variously modified. Moreover it is not indispensable that all features of the invention be used conjointly, since various features may be used to advantage in different combinations and sub-combinations.

Having described my invention I claim:

1. An acoustical tile or the like comprising in combination a metal facing sheet, a porous backing board behind and in contact with said sheet, the latter being anchored to the backing by integral curved metal tongues of said sheet penetrating deeply into said backing, the margins of said sheet extending entirely around the edge of said backing material but spaced slightly therefrom to provide yielding edges for said tile.

2. An acoustical tile or the like comprising in combination a facing sheet of metal, a rigid relatively thick rectangular backing member underlying and in contact with said sheet, the edges of said backing member having a slot extending around its periphery, said sheet having sound receiving openings therein to register with recesses in said backing member to absorb sound, the metal at the margins of said openings comprising deeply curved tongues integral with said sheet and extending deeply into and penetrating the backing material surrounding said recesses to anchor the sheet to the backing material, the margins of said sheet extending entirely around the edge of said backing material and into said slots but spaced from said edges to provide yielding margins.

3. An acoustical tile or the like comprising in combination a facing sheet of metal, a rigid relatively thick backing material underlying said sheet and in contact therewith, said sheet having a plurality of polygonal openings surrounded by integral curved and pointed tongues penetrating deeply into said backing member surrounding said openings to anchor said facing sheet to said backing material, said backing material having deep recesses therein registering with said openings, the margins of said metal sheet extending around the edge of said backing material but spaced slightly from said edges to form yielding edges for said tile.

4. A building tile comprising in combination a metal facing sheet, a relatively thick rectangular backing underlying and in contact with said metal sheet, said backing having its edges grooved entirely around its periphery, the margins of said sheet extending entirely around said edges of the backing and into said grooves, said margins being flexible and spaced from said edge.

5. A building tile comprising in combination a metal facing sheet, a relatively thick rectangular backing underlying and in contact with said metal sheet, said backing having slots extending entirely around its edges, the margins of said sheet extending around and over said edges but slightly spaced therefrom and capable of yielding to permit slight variation in the lateral dimensions of said tile.

6. A building tile comprising in combination a metal facing sheet, a relatively thick rectangular backing underlying and in contact with said metal sheet, said backing having slots at its edges extending entirely around the periphery of said backing, the margins of said sheet extending around the periphery of said edges but slightly spaced therefrom and capable of yielding to permit slight variation in the lateral dimensions of said tile, said margins extending into said slots.

7. In the manufacture of acoustical tile comprising a backing board faced with a pierceable metal facing, the method of attaching the metal sheet to the backing which comprises piercing progressively larger openings of polygonal section in the sheet and underlying backing material with a tapered piercing tool of sharp cornered polygonal section, the sharp corners of said tool being adapted to split the metal at such corners to form a plurality of metal tongues surrounding the pierced opening, then forming relatively small recesses in the backing material and curling said tongues into the backing material to anchor said sheet thereto by advancing said tool through the metal and into the backing material, and then clearing and deepening said recesses to improve sound absorption.

8. In the manufacture of acoustical tile comprising a backing board faced with a pierceable metal facing, the method of attaching the metal sheet to the backing which comprises piercing openings of polygonal section in the sheet and underlying backing material with a tapered piercing tool of sharp cornered polygonal sections, the sharp corners splitting the metal at such corners to form a plurality of metal tongues surrounding the pierced openings, then forming relatively small tapered recesses in the backing and curling said tongues deeply into the backing material to anchor said sheet thereto by advancing said tool through the metal and into the backing material, and then shearing the walls of said rcesses in the backing material to form larger cylindrical sound absorbing recesses.

9. In the manufacture of acoustical tile comprising a backing board faced with a pierceable metal facing, the method of attaching the metal sheet to the backing which comprises piercing the sheet at a plurality of points to form a plurality of metal tongues by piercing the same with sharp pointed tapered tools of polygonal section, and advancing the tools through the facing to increase the length of the tongues and simultaneously curl the same into the backing board, the facets of the polygonal section of the tool being concave longitudinally of the tool thereby to curl said tongues outwardly progressively as the tongues are forced downwardly.

References Cited in the file of this patent

UNITED STATES PATENTS

D. 168,763	Prisland	Feb. 3, 1953
420,654	Hayes	Feb. 4, 1890
1,613,766	Parcher	Jan. 11, 1927
1,837,451	Lee	Dec. 22, 1931
2,028,272	Burgess	Jan. 21, 1936
2,076,807	Burgess	Apr. 13, 1937
2,186,511	Welch	Jan. 9, 1940
2,289,634	Dieter	July 14, 1942
2,355,454	Lucius	Aug. 8, 1944
2,459,121	Willey et al.	Jan. 11, 1949
2,667,925	Dalphone	Feb. 2, 1954
2,668,123	Copeland	Feb. 2, 1954
2,694,233	Page	Nov. 16, 1954
2,791,289	Proudfoot et al.	May 7, 1957
2,825,407	Widell	Mar. 4, 1958
2,935,152	Maccaferri	May 3, 1960
2,968,327	Mariner	Jan. 17, 1961

FOREIGN PATENTS

768,826	Great Britain	Feb. 20, 1957