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[54] **HOLLOW STRUCTURE WITH CORE OF INTERWOVEN STRIPS**

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[56] **References Cited**

UNITED STATES PATENTS

3,318,064 5/1967 Mayfield et al.....52/613

3,214,321 10/1965 Graham.....161/131

FOREIGN PATENTS OR APPLICATIONS

1,484,323 3/1969 Germany.....52/618

1,166,394 6/1958 France.....52/145

28,213 4/1964 East Germany.....52/618

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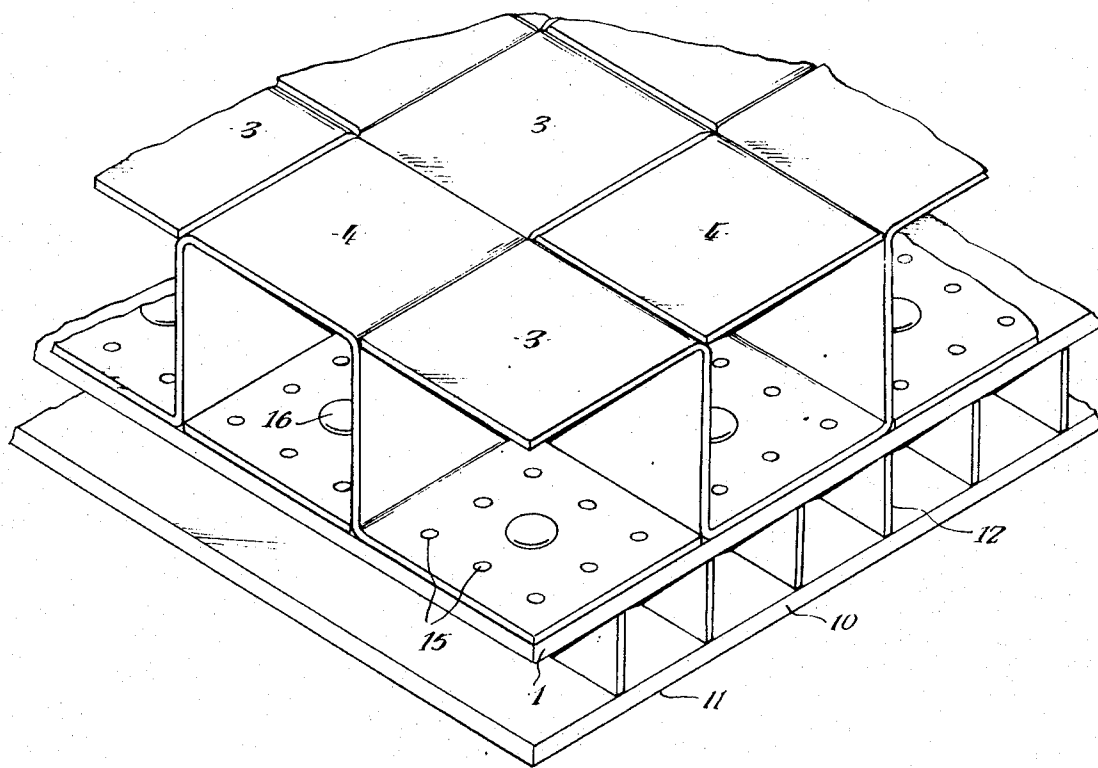
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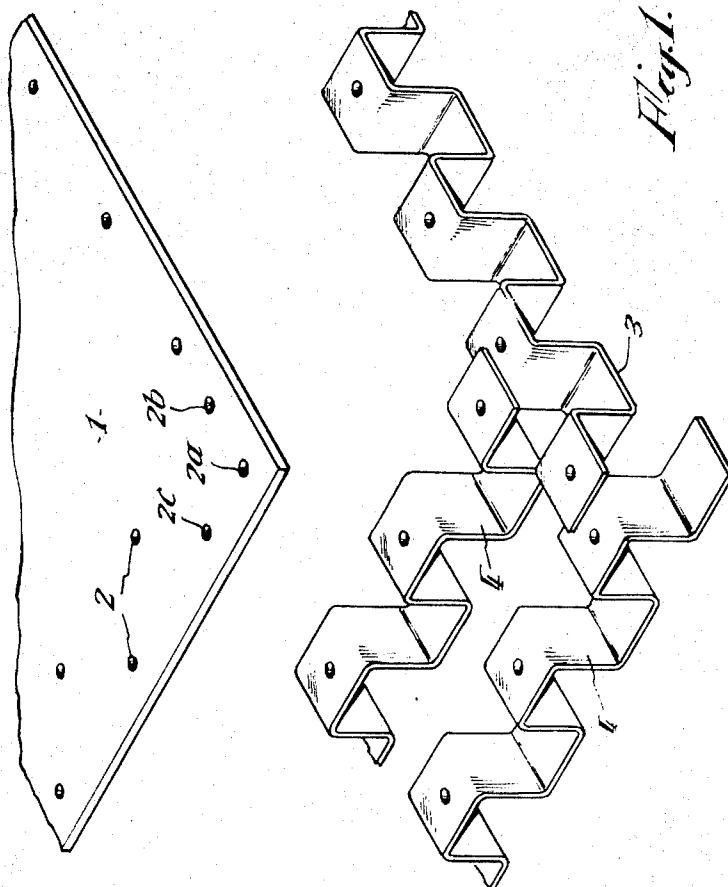
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ABSTRACT

A liner for a wall is made from strips of rigid material bent into a rectangular wave form and woven to form two substantially plane surfaces with chambers in between. The strips are perforated and attached to a backing member either (a) with the perforations facing away from the backing member to act as an acoustic liner, or (b) with the perforations in contact with the backing member and aligned with perforations therein for supply of cooling fluid, so that the structure can be used as an impingement cooled heat shield.

8 Claims, 3 Drawing Figures





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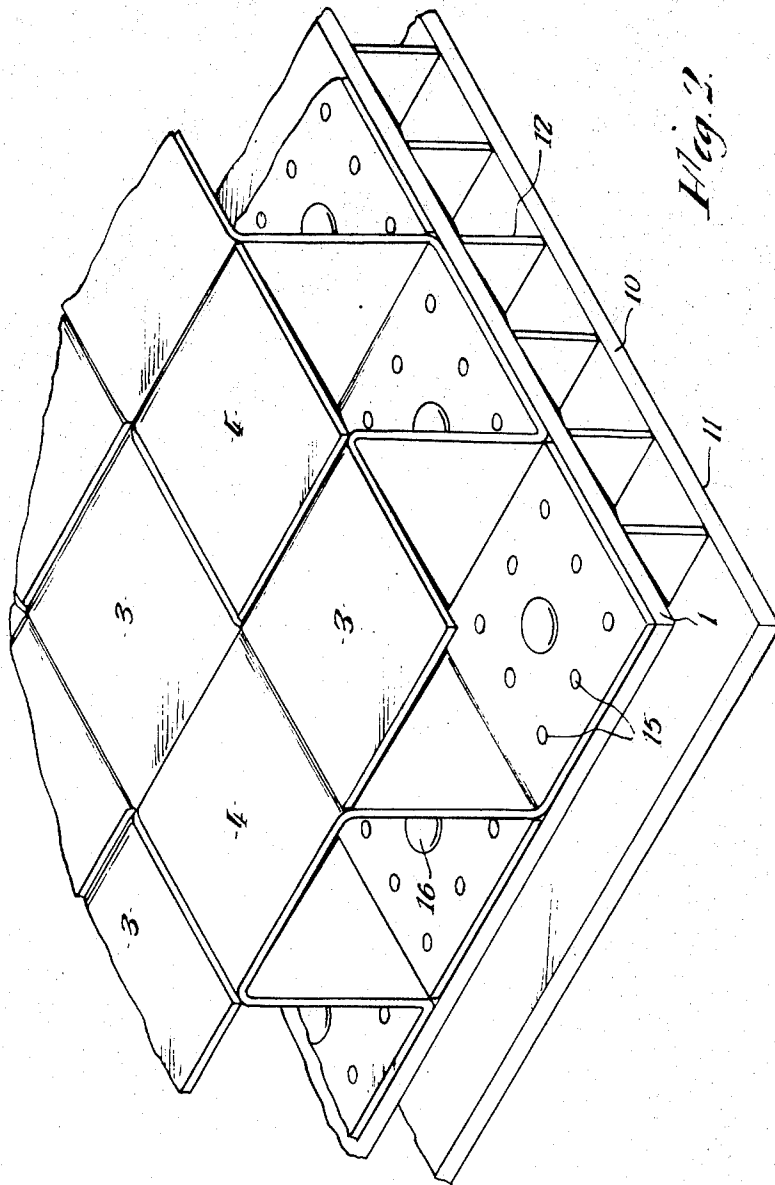
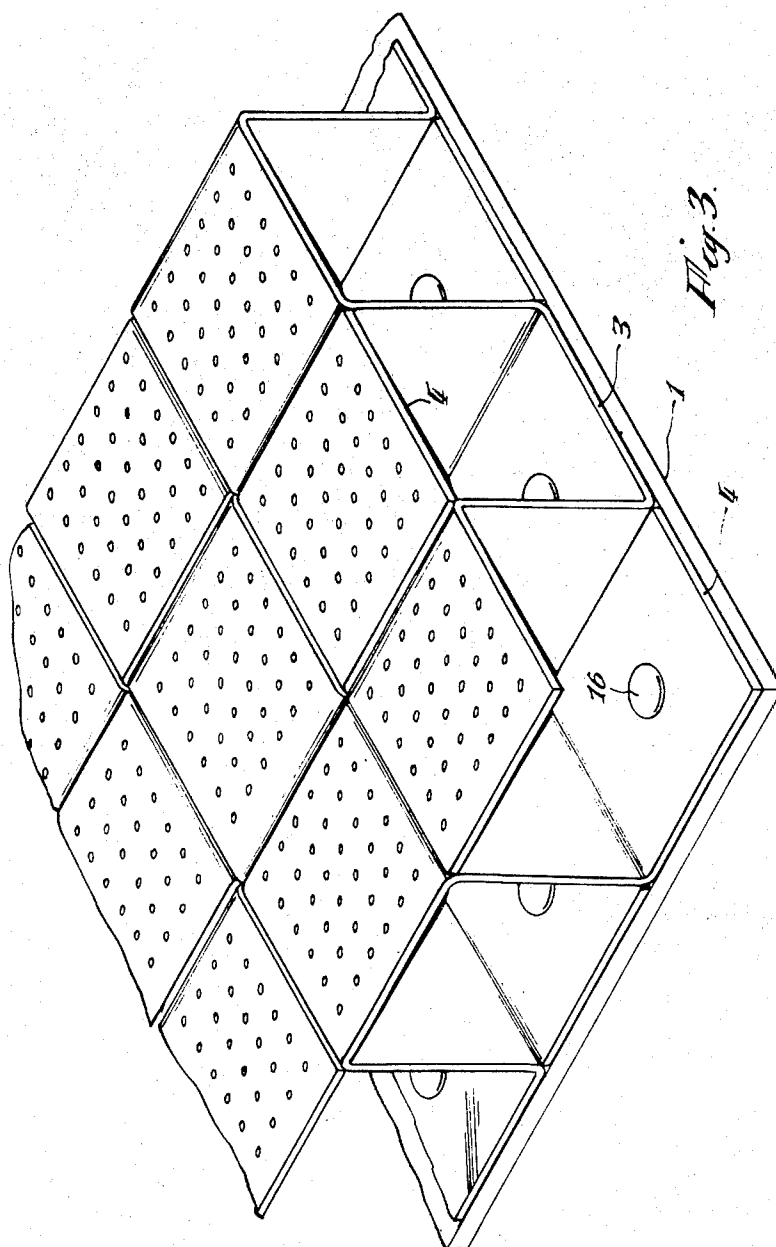


Fig. 2

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HOLLOW STRUCTURE WITH CORE OF INTERWOVEN STRIPS

The present invention relates to hollow structures and relates in particular to a hollow structure suitable for use as a lining for a wall.

According to the present invention a hollow structure comprises a plurality of strips of relatively rigid material each of which is formed into a rectangular wave-form and which are woven together to form a hollow structure having two opposite substantially continuous surfaces with chambers there-between.

The structure may be used as a liner for a wall and one of the surfaces may therefore be attached to a wall by any suitable means, for example riveting or spot welding.

The strips may be metallic, in which case the structure formed according to the invention is capable of withstanding high temperature gradients across it without distortion and is therefore suitable as a lining for hot gas ducts.

In one embodiment of the invention the structure is designed as a cooled liner for a wall exposed to high temperatures and one of the surfaces is perforated so that cooling fluid can be passed through the perforations to impingement cool the inside of the opposite surface which is exposed to high temperatures in use. The perforated surface in this case is attached to a wall which is also perforated, the perforations being aligned, and cooling fluid is passed through the wall.

In a preferred form of the invention the wall to which the liner is attached is a surface of a honeycomb structure or other hollow structure, to the interior of which cooling fluid is supplied to effect said impingement cooling of the liner.

In another embodiment of the invention the structure is designed as an acoustic liner for a wall. In this case the structure may be made from metallic strips where the wall is exposed to high temperatures. Alternatively the structure may be made from plastic resinous or fiber re-inforced composite materials which are moulded into the rectangular wave-form. The structure is attached by one surface to the wall and the other surface is perforated. Sound pressure waves impinging on the wall therefore pass through the perforations and are attenuated in the chambers between the surfaces of the structure.

The wave-form of each strip is preferably square so that the chambers formed in the woven structure are square, otherwise strips of different widths would have to be used if chambers having sides of unequal length were required.

The word rectangular in this context should be taken to include the special case of a square, which is a rectangle having sides of equal length.

The invention will now be more particularly described, merely by way of example, with reference to the accompanying drawings in which:

FIG. 1 is an exploded pictorial view of the parts of the structure and a backing plate.

FIG. 2 is a pictorial view of a structure assembled onto a hollow backing structure for use as an impingement cooled liner.

FIG. 3 is a pictorial view of a structure mounted on a single backing member and perforated for use as an acoustic liner.

Referring now to FIG. 1 there is shown a backing plate 1 in which are formed a plurality of holes 2 for rivets (not shown), and three metal strips 3 and 4 which are bent into a square wave form. The strips 3 and 4 are woven, in a manner very similar to cloth weaving, and are eventually disposed at right angles with the tops of the waves of one strip 3 corresponding with the bottoms of the waves of another strip 4, so that in the assembled form the strips form two substantially continuous, opposing surfaces with individual chambers in between (see FIG. 2).

Simultaneously with the weaving process the strips are riveted to the backing plate 1.

The method of weaving is to start with two strips (3 and 4) which are to form the two edges of an assembly, and to rivet the strip 3 at the rivet hole 2a. The adjacent strips 3 and 4 are then positioned and riveted at the holes 2b and 2c and the process continued until the whole structure has been built up. A structure made in this way is capable of withstanding temperature differentials of up to 400°C without buckling since the folded strips are capable of expansion without affecting the backing plate.

Turning now to FIG. 2 there is shown an embodiment of the invention in which the structure forms a liner for an outer wall 10 and is cooled so that it can withstand even higher differentials. The backing plate 1 forms one side of the outer wall 10 which itself is a sandwich construction having surfaces 1 and 11 spaced apart by a plurality of webs 12 which define passages for the flow of cooling air therebetween.

The metal strips 3 and 4 are perforated with cooling air holes 15 and rivet holes 16 prior to bending so that when they are bent into the correct form the perforations all lie on the same side of the wave form. When the structure is woven from the strips therefore it presents a perforated surface and an unperforated surface.

The backing sheet is also perforated with corresponding cooling air holes and rivet holes and the strips are woven and attached to the backing plate so that the perforated surfaces are in contact and the perforations aligned.

In use, cooling fluid is passed along the spaces between the webs 12 in the outer wall, and passes through the perforations so that jets of cooling fluid impinge on the inside of the unperforated surface which is exposed to a high temperature.

An application for such a structure is as a liner for a jet pipe or exhaust cone of a gas turbine engine. By impingement cooling the surface which is exposed to the exhaust gases the temperature difference across the liner can be brought down to the region of 400°C, which the liner can withstand without distortion.

The hollow outer wall may be replaced by a honeycomb structure as long as apertures are provided for passing cooling air to the perforations in the liner.

Where the opposite side of the base plate is accessible the method of attachment may be by blind rivetting or spot welding, otherwise explosive rivets may be used.

Another embodiment of the invention is shown in FIG. 3 wherein the structure is adapted to act as a sound absorbing structure.

As in the previous embodiments metal strips 3 and 4 are woven together and attached by rivets to a backing plate 1 but in this case perforations are formed in the opposite side of the wave to the rivet holes so that the perforated surface is exposed to a gas stream in use. The perforations should cover approximately one quarter of the surface area of the surface of the liner.

The chambers formed between the surfaces of the liner have metallic walls and the energy in sound waves entering the chambers through the perforations is destroyed by reflection from the walls and turbulence in the chamber.

A liner constructed from folded metal strips has the capability of withstanding thermal gradients across it as described above and can therefore be used as an acoustic liner for jet pipes of gas turbine engines.

In cases where there is no temperature gradient to resist, the liner may be formed from moulded plastic strips or fiber reinforced resin materials which can be bonded to a backing plate.

We claim:

1. A hollow structure comprising a plurality of longitudinally and transversely arranged and interwoven strips of relatively rigid material, said strips being of the same width and each strip being of a rectangular wave-form so that each strip has successive top and bottom portions lying in spaced apart parallel planes and interconnected by vertical web portions, the longitudinal strips and the transverse strips being interwoven in such a manner that the top portions of any one longitudinal strip overlie aligned bottom portions of adjacent transverse strips, and the bottom portions of said longitudinal strip are overlaid by top portions of said adjacent transverse strips, each top portion of any strip being congruent with the bottom portion overlaid by it, and all of the vertical web portions being of the same height, said interwoven strips forming substantially

closed chambers in which each web forms a common wall for two adjacent chambers, and all the top and bottom portions of the strips being contiguous with the top and bottom portions respectively of the adjacent longitudinal and transverse strips to form two continuous surfaces in spaced apart parallel planes.

2. A hollow structure according to claim 1 and wherein one of said surfaces is attached to a backing member which is in the form of a ducting and the other one of which presents a smooth surface to a flow of fluid in the ducting.

3. A hollow structure according to claim 2 and wherein the strips are metallic and are rivetted onto a backing plate.

4. A hollow structure according to claim 2 and wherein means are provided defining perforations in both the backing member and in one of the surfaces formed by the strips and the strips are attached to the backing member so that said one perforated surface contacts the backing member with the perforations in the surface aligned with those in the backing member for the passage therethrough of a cooling fluid.

5. A hollow structure according to claim 4 and wherein the backing member comprises two spaced apart walls with passages therebetween for the supply of a cooling fluid to the perforations.

6. A hollow structure according to claim 1 and wherein means are provided defining perforations in one of the surfaces formed by the strips, and a backing member attached to the other of the surfaces formed by the strip.

7. A hollow structure according to claim 6 and wherein the areas of the perforations total substantially one quarter of the area of the surface.

8. A hollow structure as claimed in claim 6 and in which the strips are made from a non-metallic material.

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