

[54] **CORRUGATED ARCUATE MEMBER**

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[73] Assignee: **General Electric Company**

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[52] U.S. Cl. .... 161/117, 156/210, 156/211, 156/257, 156/268, 161/127, 161/135, 161/137

[51] Int. Cl. .... B32b 1/00, B32b 3/28

[58] Field of Search ..... 161/132, 133-137, 161/145, 146, 68, 69, 109, 112, 113, 117, 119, 120, 121, 123, 139; 52/214; 156/210, 211, 207, 257, 268

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[57] **ABSTRACT**

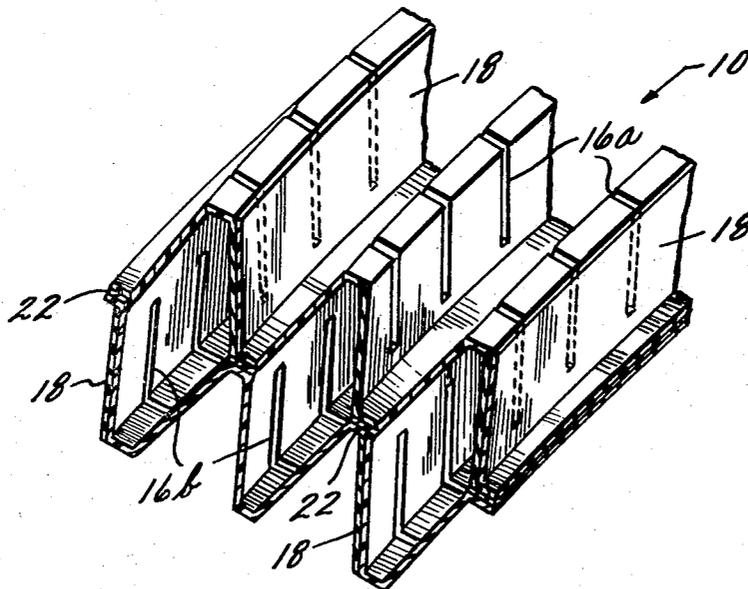
A corrugated arcuate member having a plurality of generally circumferentially disposed substantially rigid corrugations is provided with improved formability as a result of a plurality of generally transverse slots disposed along a radially outer portion of the corrugations. Arc-holding means is secured with the member to hold the member in arcuate shape.

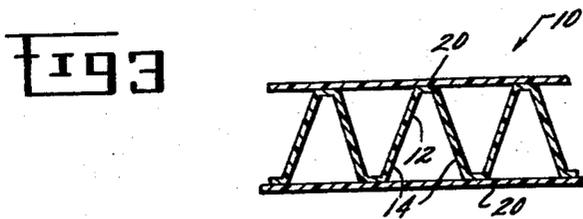
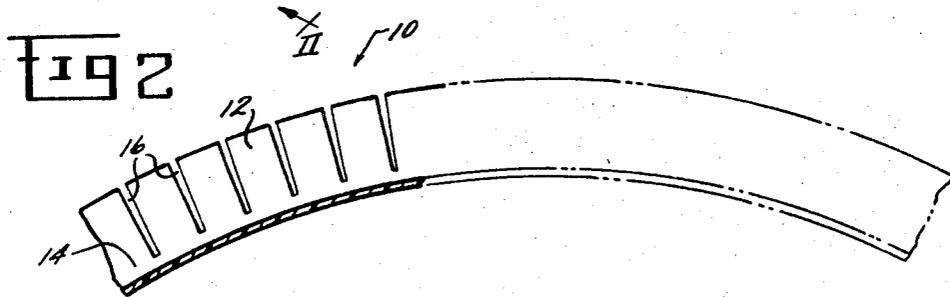
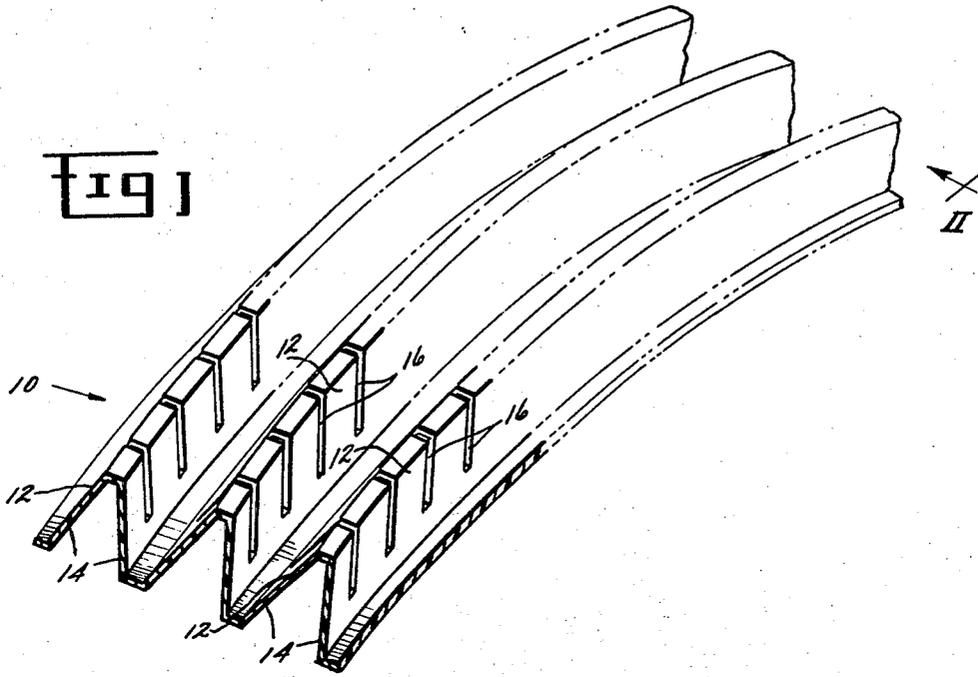
**2 Claims, 6 Drawing Figures**

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Fig 4

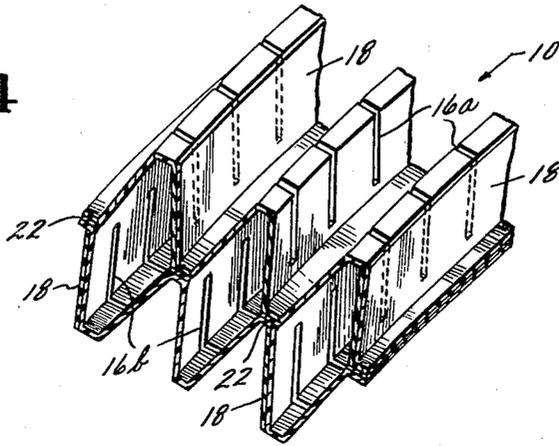


Fig 5

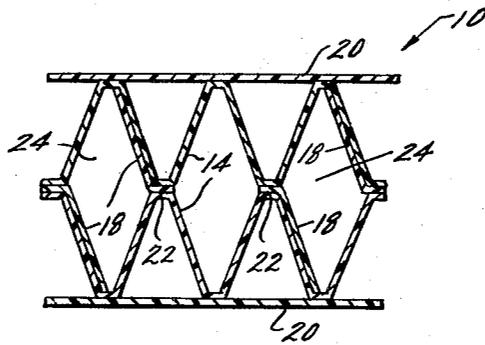
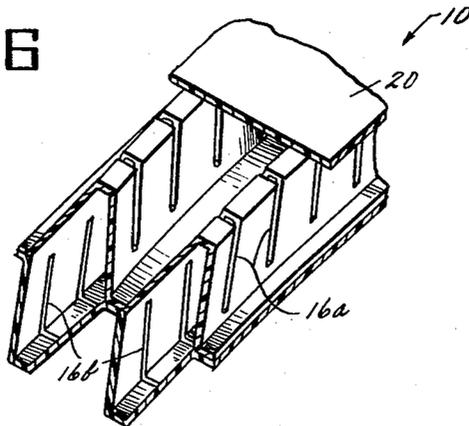


Fig 6



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## CORRUGATED ARCUATE MEMBER

This invention relates to a corrugated arcuate member and, more particularly, to such a member in single or multiple configurations and useful as a core for a panel in combination with one or more face sheets.

Corrugated members, alone or in combination with facing sheets to provide panels or corrugated sheets, when used in an arcuate or contoured configuration dispose the corrugations axially with respect to the arc rather than circumferentially. Axial extension has provided ease of forming. This is particularly true when the corrugated member is formed of generally rigid materials such as of reinforced plastics or metals.

For some applications, such as one form of a sound absorbing panel for use in a jet engine air passage, it can be desirable for moisture removal to dispose corrugations generally circumferentially rather than axially of an arcuate member. For example, corrugations may be extended generally circumferentially with respect to flow through an air passage.

It is a principal object of this invention to provide a corrugated arcuate member having circumferentially disposed substantially rigid corrugations, the radial outward portions of which include slots which allow circumferential formability.

Another object is to provide such a member capable of being joined with similar mating members to provide a core useful with facing sheets in production of a panel unstressed prior to use.

These and other objects and advantages will be more fully understood from the following detailed description, examples and the drawings in which:

FIG. 1 is an isometric sectional view of an arcuate member of the present invention;

FIG. 2 is a fragmentary axial view of the member of FIG. 1 in the direction of II — II;

FIG. 3 is a fragmentary cross-sectional view of the member of FIG. 1 assembled into an arcuate panel;

FIG. 4 is an isometric partially sectional fragmentary view of two corrugated members bonded together;

FIG. 5 is a cross-sectional fragmentary view of the member of FIG. 4 when assembled into a panel; and

FIG. 6 is an isometric fragmentary view of the member of FIG. 1 assembled with a facing sheet to provide an arcuate article.

Briefly, the present invention, in one form provides a corrugated arcuate member having a plurality of substantially rigid corrugations disposed generally circumferentially of the arcuate member. The corrugations are defined by alternating radially inner and outer portions which abut or are continuous one with the other to define the corrugations. Each outer portion includes a plurality of spaced apart generally transverse slots disposed along an outer portion and discontinuous between consecutive outer portions. Holding the member in arcuate shape is an arc-holding means secured with a corrugation.

In another form, the present invention provides a corrugated arcuate article of two of such arcuate members secured one to the other at their inner portions to define between their outer portions a plurality of generally circumferentially disposed chambers.

The corrugated arcuate member or arcuate article or combinations built to desired thicknesses, in another form of the present invention, can be included in panels through the assistance of facing sheets secured with the corrugations.

Although the present invention will be more fully understood from the following detailed description in connection with the drawings, it will be understood that these are typical examples of certain embodiments of the invention rather than limitations on its scope. For example, the cross-section of the corrugations can be sinusoidal, a series of similarly directed hemispheres, etc. rather than the more angularly shaped configuration shown in the drawing.

The corrugated arcuate member, shown generally at 10 in FIGS. 1 and 2, includes outer portion 12 and inner portion 14 abutting one to the other and drawn as a continuous member. As shown in FIG. 2, the corrugation is arcuate generally circumferentially of the arcuate member.

Included in outer portion 12 are a plurality of spaced apart slots 16 disposed along the outer portion 12 generally transverse to the circumferential disposition of the corrugations. Slots 16 are discontinuous between consecutive outer portions to provide structural integrity. However, as shown in the drawing, the slots can extend partially into the inner portion depending upon the flexibility desired in the arcuate member during manufacture. In addition, if desired, similar slots can be included through the inner portion, such as alternating with those of the outer portion to maintain structural integrity of the member.

In order to hold the corrugated member in arcuate shape, there is provided an arc-holding means secured with a corrugation. In the form shown in the drawing, such arc-holding means can be a tape 18 such as of a thermosetting plastic bonded to a corrugation, preferably across consecutive slots of at least a part of the outer portion. However, such an arc-holding function can be performed by a facing sheet or member 20, in FIG. 6, with which the corrugation is assembled in the manufacture of a panel.

A fragmentary cross-section of a panel which can be made from the corrugated arcuate member of the present invention is shown in FIG. 3. The arcuate member 10 is sandwiched between facing members 20, such as in sheet form, to provide such a panel. However, two or more of the arcuate members of the present invention can be secured one to the other such as is shown in FIGS. 4, 5 and 6. Facing sheets or members 20 can be applied to provide a lightweight arcuate panel of desired thickness.

When the corrugated arcuate member of the present invention, held in arcuate form by an arc-holding means such as tape 18, is assembled between preshaped arcuate facing sheets to provide an arcuate panel, such panel has the advantage of being substantially unstressed prior to use. Therefore, its operating life can be lengthened particularly when it is used in such difficult applications as a sound absorbing panel in an air passage of a turbojet engine. In such an application where at least two of the arcuate members of the present invention are secured one to the other as shown in FIGS. 4 and 5, the arc-holding means or tape 18 can be applied for multiple functions. It can operate not only to hold the corrugated arcuate member 10 in arcuate shape, but also to act as a deterrent to axial air flow through the member, the corrugations of which are disposed generally circumferentially of the direction of flow of air through the engine. Such an arrangement is shown in the fragmentary isometric view of FIG. 4 and the fragmentary sectional view of FIG. 5. In addition, for ease of manufacture, such a tape can be applied to the inside of corrugations and can be used to bond together two arcuate members at their inner portions as particularly shown at 22 in FIG. 5.

When assembled as shown in FIGS. 4, 5 and 6, the two corrugated arcuate members define chambers disposed generally circumferentially of the arcuate member. During manufacture of such a structure and bonding of the arc-holding means to the corrugations, the slots 16a, shown in FIGS. 4 and 6, tend to widen at their radially outward portion whereas slots 16b tend to narrow at their radially inward portion. Thus the provision of such generally transverse slots, either in the single corrugated arcuate member configuration shown in FIGS. 1, 2 and 3, or in the multiple configuration shown in FIGS. 4, 5 and 6, provides improved formability during manufacture.

In an example of the manufacture of a corrugated arcuate member of the present invention of the type shown in FIG. 5, two corrugated arcuate members of the type shown in FIG. 1 were prepared from epoxy resin impregnated glass cloth to produce a corrugated arcuate member of about one-half inch in depth. The slots were about 0.05 inch wide, spaced about 0.3 inch one from the other transversely through the outer portion 12.

A thermosetting plastic in the form of a modified epoxy film adhesive or tape 18 was located at 22 between inner portions 14 positioned as shown in FIG. 5. The members thus held were then heated at about 250° F. to cure the adhesive and to bond the members together at 22, thus creating chambers 24.

Additional film adhesive was applied across consecutive slots in the position shown in FIGS. 4 and 5. The corrugated article created by bonding the two corrugated members together was then held in a desired arcuate shape during heating and curing of the additional film adhesive. Such adhesive became bonded to the corrugation across consecutive slots of the outer portion to hold the corrugated member in arcuate shape.

As was mentioned before, such an adhesive can be applied at 22 between inner portions 14 as shown in FIG. 5 at the same time as it is applied across consecutive slots in the manufacture of the arcuate corrugated member. In such a case, a single heating and adhesive curing cycle is performed with the members held in arcuate shape.

Flexibility and formability in the manufacture of the corrugated arcuate member of the present invention has been provided as a result of generally transverse slots through the outer portion of the corrugations. However, it has been found that a very high degree of flexibility can be provided if the slots project partially into the inner portion as shown in the drawings so that the slot projects at least about 75 percent through the entire corrugation. Nevertheless, such slots are maintained as discontinuous between consecutive outer portions to provide structural stability.

An additional advantage of the present invention, particularly useful in the manufacture of air passage panels such as for jet engines, is its three dimensional forming capability. Ac-

ordingly, a member can be contoured using the present invention not only circumferentially of such a duct but also radially and axially in the same panel.

What is claimed is:

1. A corrugated arcuate article comprising: two arcuate members secured one with the other at their inner portions to define therebetween a plurality of substantially diamond shaped circumferentially disposed chambers, each chamber including two pairs of opposed lateral faces; each member comprising:
  - a. a plurality of substantially rigid corrugations disposed generally circumferentially of the arcuate member, the corrugations defined by alternating abutting radially inner and outer portions continuous one with the other;
  - b. each outer portion including a plurality of spaced apart generally transverse slots disposed along the outer portion and discontinuous between consecutive outer portions;
 the article including an arc-holding thermosetting plastic tape secured with the lateral faces of one pair of the two pairs of opposed lateral faces of alternating chambers across portions of consecutive slots in the faces.
2. The article of claim 1 to which has been attached facing members at the outer portions.

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