

[54] CELLULAR CORE

[75] Inventors: Paul Eugene Myers; Omer L. Carroll, both of Middletown, Ohio

[73] Assignee: Aeronca, Inc., Middletown, Ohio

[22] Filed: Jan. 18, 1972

[21] Appl. No.: 218,849

Related U.S. Application Data

[63] Continuation of Ser. No. 2,829, Jan. 14, 1970, abandoned.

[52] U.S. Cl. 29/191, 29/191.4

[51] Int. Cl. B32b 15/04

[58] Field of Search... 29/191, 470.9, 458 W, 191.4; 161/135, 137, 68; 52/729

[56] References Cited

UNITED STATES PATENTS

2,056,563	10/1936	Budd et al.	52/729 X
2,333,343	11/1943	Sendzimir	29/470.9
2,758,047	8/1956	Dowd	161/135 X
3,084,770	4/1963	Wirsing, Jr.	29/191.4
3,205,109	9/1965	Schudel	161/68 UX

Primary Examiner—L. Dewayne Rutledge

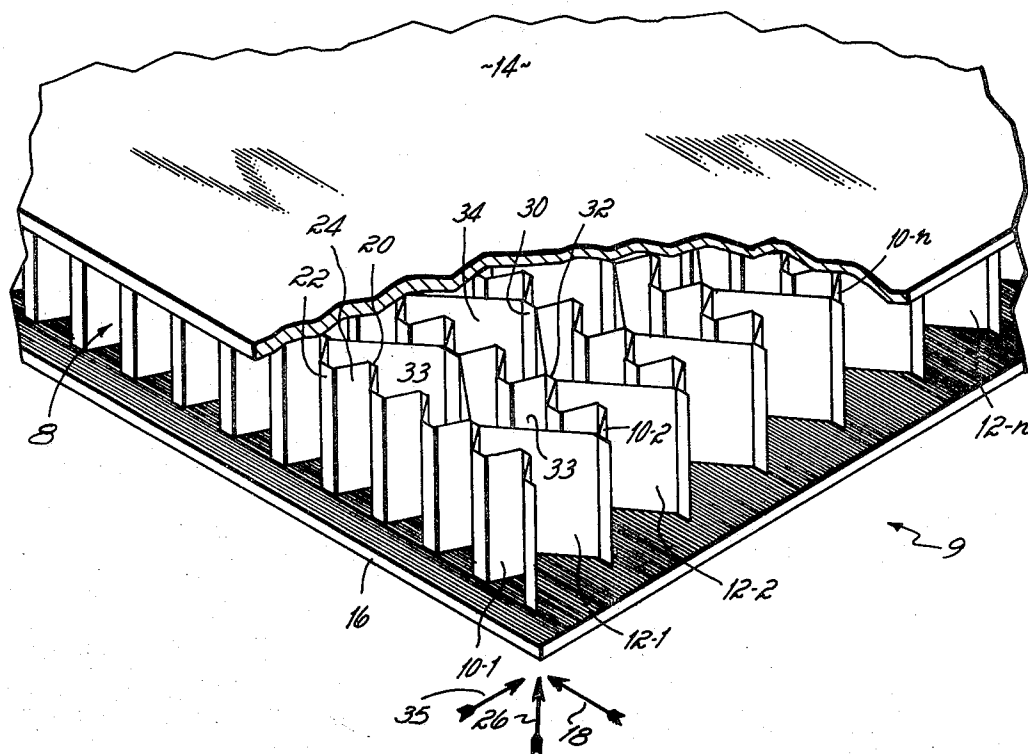
Assistant Examiner—O. F. Crutchfield

Attorney, Agent, or Firm—Wood, Herron & Evans

[57] ABSTRACT

A highly formable cellular, or honeycomb, core fabricated of two sets of interleaved corrugated ribbons running parallel to each other and to the plane of the core. The ribbons of the two sets run in the same direction and have the same height measured in a direction perpendicular to the plane of the core, but have different corrugation pitches with the pitch of one set being an integral multiple, for example, three times, the pitch of the other set. The ribbons having the larger corrugation pitch also having larger corrugation amplitudes, for example, approximately $2\frac{1}{2}$ times that of the other ribbon. In a preferred form the corrugated ribbon core is sandwiched between and secured to a pair of spaced parallel faces, or skins, of thin sheet stock material, enhancing the structural strength of the core.

12 Claims, 5 Drawing Figures



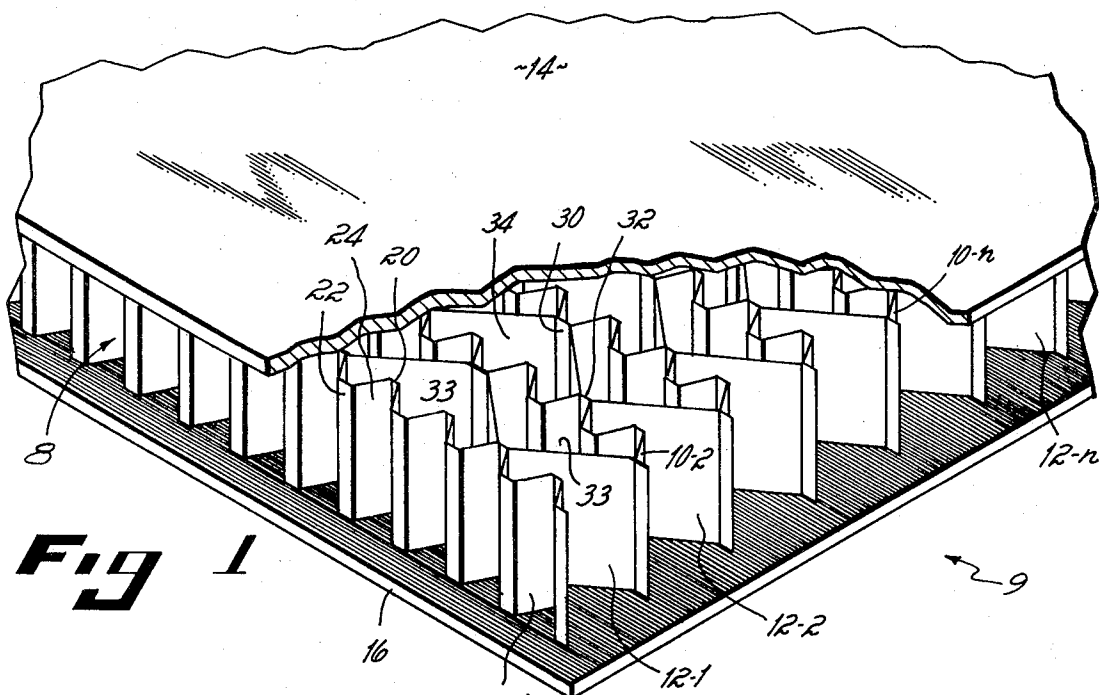


Fig 1

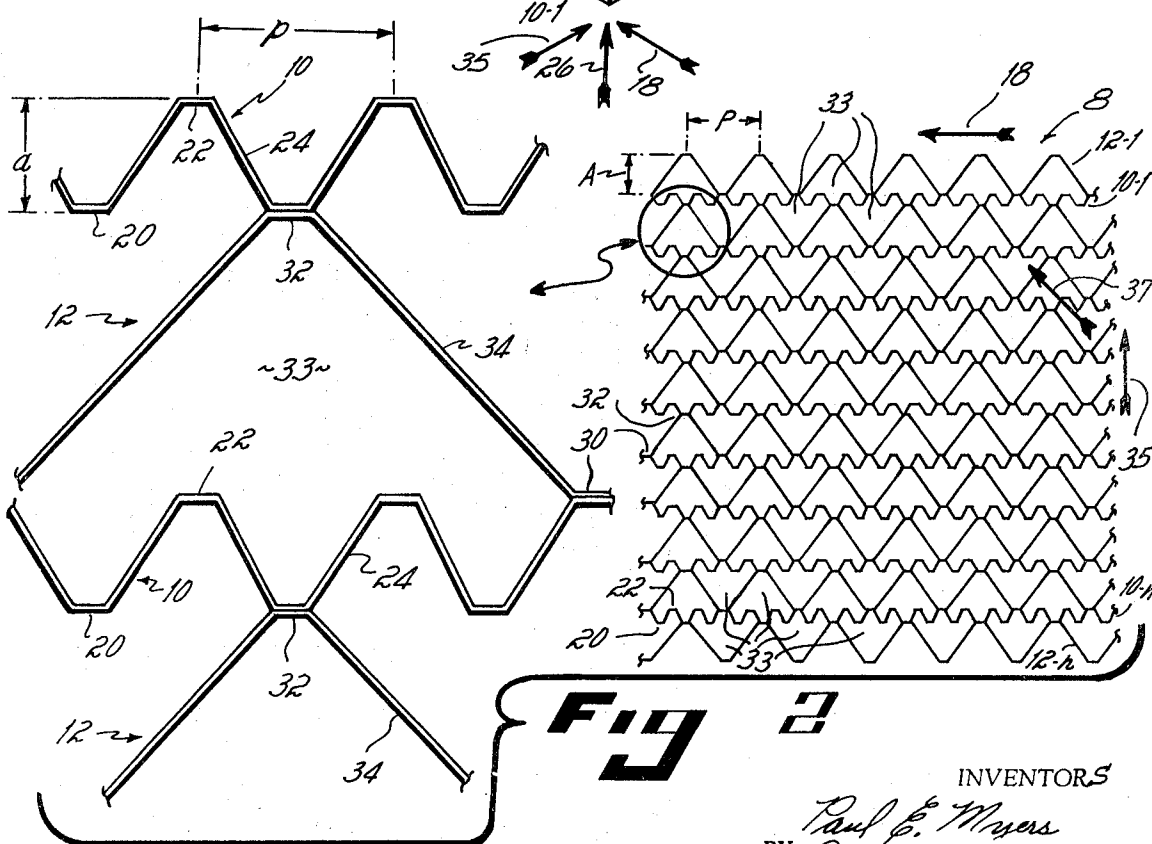


Fig 2

INVENTORS

Paul E. Myers
BY Omer A. Carroll
Wood, Herron & Evans
ATTORNEYS

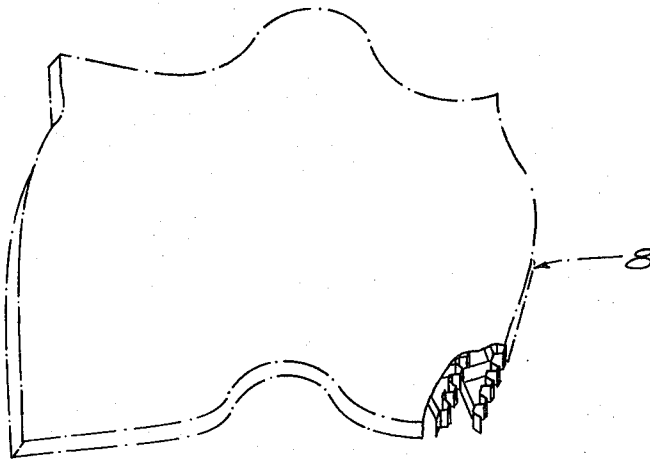


Fig 3

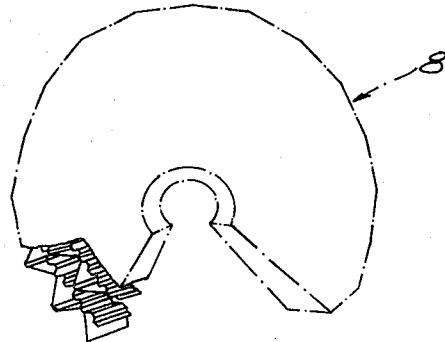


Fig 4

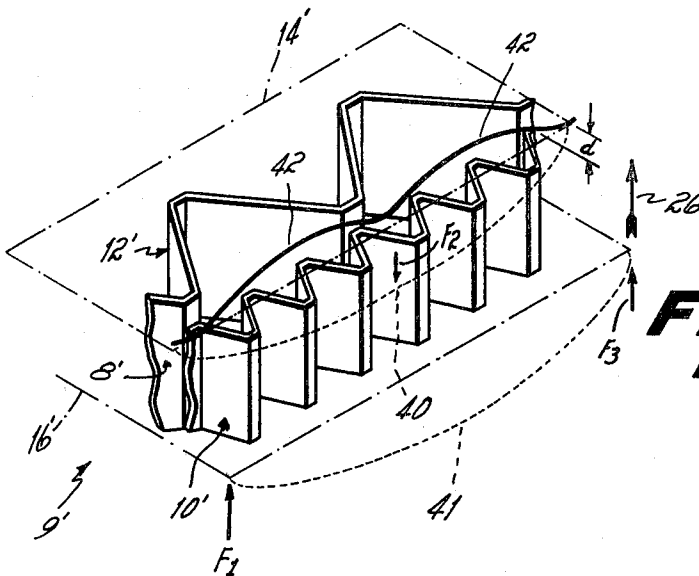


Fig 5

INVENTORS

Paul E. Myers
BY Omer L. Carroll
Wood, Heron, & Evans
ATTORNEYS

CELLULAR CORE

This is a continuation of application Ser. No. 2,829, filed Jan. 14, 1970, now abandoned.

This invention relates to cellular, or honeycomb, core structures and more particularly to honeycomb core structures capable of being easily formed to conform to compound contours of relatively small radii without undue cell distortion, sacrifice of strength-to-weight ratio, or appreciable nonuniformity in cell density from point-to-point along the core.

Honeycomb, or cellular, cores have long been used for structural members because of their high strength-to-weight ratios, and their ability to be formed to conform to single and/or compound contoured shapes, and thereby obtain structural configurations of irregular shape. Honeycomb, or cellular, cores typically include a plurality of cells arranged in a periodic grid, lattice or matrix type network. The cells are defined or established by interconnected elongated ribbons extending in a direction such that the plane of the ribbons at any point is perpendicular to the plane of the core and such that the longitudinal axes of the ribbons, termed the "ribbon direction," is parallel to the plane of the core.

The width of the elongated ribbons, that is, the dimension of the ribbon measured normal, or perpendicular, to the ribbon direction and the core plane, defines the height, depth, or thickness of the honeycomb or cellular core plane structure. Typically, all of the ribbons, or alternatively, alternate ribbons, are corrugated, that is, bent into some type of repeating generally sinuous or zig-zag pattern comprised of alternating peaks and valleys. Depending upon the exact geometrical configuration of the corrugations, and upon whether all ribbons or only alternate ribbons of the core plane are corrugated, the cells of the honeycomb core structure may assume any one of a variety of different shapes. Typical cell shapes are hexagons, rectangles, squares, cruciforms, and the like.

The ability of the honeycomb core to be formed to conform to single and/or compound contours, which ability is termed the "formability" of the core, is effected in varying degrees by a number of factors. For example, the formability of the core is dependent upon core size, that is, the diameter of a cell measured in a direction parallel to the core plane. Cell size is often defined in terms of the diameter of the largest circle which can be inscribed within the cell. Core formability also depends upon the shape of the cell, for example, whether the cell is square, hexagonal, rectangular, etc. Also affecting the formability of a honeycomb core is the depth, height, or thickness of the cores measured in a direction perpendicular to the core plane, with formability decreasing as the depth, thickness or height increases. The gauge of the ribbons from which the core is fabricated also affects the formability of the core, the formability decreasing as the ribbon gauge increases.

In certain applications where the honeycomb core is to be shaped to conform to the contours of an irregular shaped object, it is desirable that the core have a high degree of formability to single and compound contours of small radii. In such applications, however, it is also essential that the formability of the core not be obtained with appreciable sacrifice of other desirable core characteristics, such as high strength-to-weight ratio, absence of excessive distortion of the cell walls, or

constancy in cell density from point-to-point along the core.

It has been an objective of this invention to provide a honeycomb core having a high degree of formability with respect to the ability of the core to conform to both single and compound contours, and yet produce a core which has a satisfactory strength-to-weight ratio and which maintains its cell shape and cell density throughout the cell core plane. This objective has been accomplished in accordance with the principles of this invention by providing dissimilar sets of elongated equal height ribbons running in a direction parallel to each other and to the core plane. The ribbons of the sets are interleaved and respectively have large and small accordion-like corrugations which are connected to adjacent ribbons at nodal points to form cells. The cells have a generally triangular shape defined by a single corrugation of the large corrugation ribbon, which includes a pair of angulated flat sections of the large corrugation ribbon extending on either side of a node thereof, and an integral multiple of corrugations of the small corrugation ribbon. By virtue of the novel cell shape of this invention, a core is produced which provides a high degree of formability without sacrificing strength-to-weight ratio, or introducing undue cell distortion or unequal density throughout the core plane.

In accordance with a preferred form of this invention, a core structure of the foregoing type is provided in which the pitch ratio of the large to small corrugation ribbons is 3, and the amplitude ratio of the large to small corrugation ribbons is approximately 2.5. A core plane having these parameters provides an optimum combination of formability, strength-to-weight ratio, cell density uniformity and cell shape integrity.

In accordance with still further principles of this invention a honeycomb core structure of the above type is sandwiched between and secured to a pair of spaced parallel skins, or faces, of thin sheet stock. This enhances the strength of the core, as well as maintains the desired contour of a core once formed.

These and other advantages and objectives of the invention will become more readily apparent from a detailed description of the preferred embodiment thereof taken in conjunction with the drawings in which:

FIG. 1 is a perspective view, partially cut away, of a preferred embodiment of a formable honeycomb core sandwich constructed in accordance with the principles of this invention.

FIG. 2 is a plan view of a portion of the formable core of FIG. 1, showing in enlarged scale a single core cell.

FIG. 3 is a perspective view of a formable core constructed in accordance with the principles of this invention showing the core after it has been subjected to compound contouring in the process of conforming to an object such as a standard telephone.

FIG. 4 is a perspective view of a formable core constructed in accordance with the principles of this invention showing the core after it has been subjected to compound contouring in the process of conforming to a spherical object such as a 2-inch diameter ball.

FIG. 5 is a perspective view of a honeycomb core sandwich having unequal height ribbons, showing the manner in which the upper skin buckles when compressively loaded.

Referring to FIGS. 1 and 2, the honeycomb core 8 of this invention is seen to include a first plurality, set or group 10 of corrugated ribbons 10-1, 10-2, . . . 10-n

and a second, and dissimilar, plurality, set or group 12 of corrugated ribbons 12-1, 12-2, . . . 12-n. The ribbons 10-1, 10-2, . . . 10-n of the first ribbon set 10 are interleaved or alternated with the ribbons 12-1, 12-2, . . . 12-n of the second ribbon set 12, as well as being in phase and having their upper and lower edges aligned. Secured to and located on opposite sides of the sets of ribbons 10 and 12 are upper and lower faces or skins 14 and 16 of thin sheet stock, which, together with the interleaved ribbon sets 10 and 12, form a honeycomb core sandwich structure 9. The core plane of the honeycomb core sandwich structure 9 is parallel to the faces or skins 14 and 16.

Considering in detail the structure of the ribbons 10-1, 10-2, . . . 10-n of the first set of ribbons 10, each of the ribbons is seen to be substantially identical in structure. In view of this substantial identity in structure, only the structure of the ribbon 10-1 is considered in detail, the structure of the other ribbons 10-2, 10-3, . . . 10-n of ribbon set 10 being the same.

The ribbon 10-1 is generally elongated as measured in the direction of arrow 18, which direction is termed herein the "ribbon direction." The elongated ribbon 10-1 is corrugated along its length, forming a series of alternating peak nodes 20 and valley nodes 22. The peak nodes 20 are each preferably in the form of a rectangular flat vertical surface, and lie in a common plane which is perpendicular to the sandwich faces 14 and 16 and parallel to the ribbon direction 18. The valley nodes 22 each are, like the peak nodes 20, in the form of a rectangular flat vertical surface and lie in a common plane which is perpendicular to the sandwich faces 14 and 16 of the core sandwich 9 and parallel to the ribbon direction 18. The common plane of the valley nodes 22 is parallel to the common plane of the peak nodes 20, and the perpendicular distance "a" therebetween defines the amplitude of the ribbon 10.

Interconnecting adjacent peak and valley nodes 20 and 22 to each other are flat rectangular surfaces or side walls 24, which are perpendicular to the core sandwich faces 14 and 16. The angle of incidence of the rectangular side walls 24 with respect to the planes of the peak nodes 20 and valley nodes 22 is, for all side walls 24, substantially identical. The angle of incidence depends upon the pitch "p" of the corrugations of ribbons 10, which is the center-to-center distance between adjacent peak nodes 20 (or valley nodes 22) measured in the ribbon direction 18, as well as upon the dimensions of the peak nodes 20 and valley nodes 22 measured in the ribbon direction 18. The area of the corrugation side walls 24 is larger than the area of the peak and valley nodes 20 and 22.

The height of the peak nodes 20, valley nodes 22, and corrugation side walls 24 measured in the direction of arrow 26 is identical and equal to the width of the corrugated ribbon 10, and defines the thickness, height, or depth of the formable core 8.

In one preferred construction of core 8, the corrugated ribbons 10-1, 10-2, . . . 10-n are dimensioned as follows:

- a. the amplitude "a" is 0.096 inches;
- b. the pitch "p" is 0.193 inches;
- c. the dimension of the peak and valley nodes measured in the ribbon direction 18 is 0.03 inches, and
- d. the height of the ribbon 10 measured in the direction of arrow 26 is 0.5 inches.

Considering in detail the structure of the ribbons 12-1, 12-2, . . . 12-n of the second ribbon set 12, each of the ribbons is seen to be substantially identical in structure. In view of this substantial identity in structure, only the structure of ribbon 12-1 is considered in detail, the structure of the other ribbons 12-2, 12-3, . . . 12-n of ribbon set 12 being the same.

The ribbon 12-1 is generally elongated as measured in the ribbon direction 18. The elongated ribbon 12-1 is corrugated along its length, forming a series of alternating peak nodes 30 and valley nodes 32. The peak nodes 30 are each preferably in the form of a rectangular flat vertical surface, and lie in a common plane which is perpendicular to the sandwich faces 14 and 16 and parallel to the ribbon direction 18. The valley nodes 32 are, like the peak nodes 30, in the form of a rectangular flat vertical surface, and lie in a common plane which is perpendicular to the faces 14 and 16 of the core sandwich 9 and parallel to the ribbon direction 18. The common plane of the valley nodes 32 is parallel to the common plane of the peak nodes 30, and the perpendicular distance "A" therebetween defines the amplitude of the ribbon 12.

Interconnecting adjacent peak and valley nodes 30 and 32 to each other are flat rectangular surfaces or side walls 34, which are perpendicular to the core sandwich faces 14 and 16. The angle of incidence of the rectangular side walls 34 with respect to the planes of the peak nodes 30 and valley nodes 32 is, for all side walls 34, substantially identical. The angle of incidence depends upon the pitch "P" of the corrugation of ribbons 12, which is the center-to-center distance between adjacent peak nodes 30 (or valley nodes 32) measured in the direction of arrow 18, as well as upon the dimensions of the peak nodes 30 and valley nodes 32 measured in the ribbon direction 18. The area of the corrugation side walls 34 is larger than the area of the peak and valley nodes 30 and 32.

The height of the peak nodes 30, valley nodes 32, and corrugation side walls 34 measured in the direction of arrow 26 is identical, and equal to the width of the corrugated ribbon 12, and defines the thickness, height or depth of the formable core 8. The width of the ribbon 12 measured in the direction of arrow 26 is equal to the width of ribbon 10 measured in the same direction.

In one preferred construction of the core 8, the dimensions of the corrugated ribbons 12 are as follows:

- a. amplitude "A" is 0.24 inches;
- b. the pitch "P" is 0.580 inches;
- c. the dimension of the peak and valley nodes is 0.03 inches measured in the ribbon direction 18; and
- d. the height of the ribbon 12 measured in the direction of arrow 26 is 0.5 inches.

The repeating unit 33 of the honeycomb core 8 of this invention, herein termed the "cell," is defined by two consecutive side walls 34 and an included peak node 32 of the corrugated ribbon 12 and six consecutive side walls 24 and included peak and valley nodes 20 and 22 of the corrugated ribbon 10. The cell 33 is generally triangular in shape, having two planar walls 34, which are separated by a peak node 30 and along with which collectively constitute one corrugation of the large ribbon 12, and a third accordion-like wall comprising three corrugations of the small ribbon 10 with their respective side walls 24 and nodes 20 and 22.

With the ribbons 10 and 12 of the preferred form constructed as indicated, the amplitude ratio A/a of the

large and small corrugated ribbons 12 and 10, respectively, is 2.5 and the pitch ratio P/p of the large and small corrugated ribbons is 3. While the various dimensions of the core 8 may be varied, it is essential that the ratio of the pitch of the large corrugated ribbon 12 to the pitch of the small corrugated ribbon 10 be an integer of relatively small value in excess of one. By making the pitch ratio an integer, the ribbons 10 and 12 contact each other at nodes. Such nodal contact facilitates uniform adherence of the ribbons to each other along their length. If the pitch ratio of the large and small ribbons 12 and 10 is not an integer, complete nodal contact of the ribbons 10 and 12 along their entire length, that is, in the direction of arrow 18, will not occur and at those places where nodal contact does not occur, the ribbons 10 and 12 are not joined and the core structure is weakened.

While variation of the ratio of the pitch of the large and small ribbons 12 and 10 is possible, if the pitch ratio is too small, an insufficient number of corrugations of the small ribbon 10 occur per corrugation of the large ribbon 12, and the small ribbon 10 does not stretch or extend without distortion in the course of forming the core 8 to complex and irregular shapes. If the ratio of the pitch of the large corrugated ribbon 12 to the small corrugated ribbon 10 is too large, the weight of the formable core 8 per unit area gets too large without appreciable increase in formability.

As noted, the preferred ratio of amplitude for large and small ribbons 12 and 10 is 2.5. This ratio can be varied. However if the ratio A/a is too small, the small ribbon 10 does not compress in accordion-like fashion when formed to complex shapes, but instead the wall of the core cell 33 defined by the multiple corrugations of ribbon 10 buckles. If the amplitude "a" of the small corrugated ribbon 10 is too large, the weight per unit area of the core 8 increases without significant increase in formability of the core.

It is essential that the height of the small corrugated ribbons 10-1, 10-2, . . . 10-n measured in the direction of arrow 26 be substantially equal to the height of large corrugated ribbons 12-1, 12-2, . . . 12-n, also measured in the direction of arrow 26. If the heights of the small and large ribbons 10 and 12 are not substantially equal, then one or both of the faces 14 and 16 will not contact the upper and/or lower edge of the shorter of the two ribbons, causing one of the faces 14 or 16 to buckle when loaded in compression such as occurs when a force is applied to the core in a direction perpendicular to the core plane, that is, is perpendicular to the faces 14 and 16, causing the core to bend.

With reference to FIG. 5 the condition of unequal ribbon heights is depicted. In FIG. 5 the height of the smaller ribbon 10' is less than that of the larger ribbon 12'. Additionally, ribbons 10' and 12' are located relative to each other in the direction of arrow 26 such that the bottom edges of both ribbons 10' and 12' contact the upper surface of face 16', causing the upper edge of the smaller ribbon 10' to lie below the upper edge of the large ribbon 12' by a distance "D." With the upper edge of the smaller ribbon 10' below the upper edge of the large ribbon 12', the lower surface of the upper face 14 contacts only the upper edge of the larger ribbon. With only the upper edge of the large ribbon 12' contacting the lower surface of face 14, the face 14 is supported only by the large ribbon. Hence, the lineal length of ribbon support of face 14 per unit

area is less than if the upper edges of both the large and small ribbons 12' and 10' contacted the face 14.

When the core sandwich 9' of FIG. 5 is subjected to loading by forces F_1 , F_2 , and F_3 having the directions indicated, the core sandwich 9' tends to bend in the direction illustrated by the dotted lines 40 and 41, placing the upper face 14 in compression. With the upper face 14 in compression and supported only by the upper edges of large ribbon 12', the upper face buckles, as shown by the heavy lines 42, where unsupported by the upper edges of the small ribbon 10'. Were the small and large ribbons 10' and 12' of substantially equal height, such that the upper edge of the small ribbon 10' contacted the upper face 14, the upper face 14 would be supported by the small ribbon 10' as well as the large ribbon 12', preventing buckling of the upper face 14.

The height of the ribbons 10 and 12, measured in the direction of arrow 26, may vary depending upon the relative formability desired. Increasing the height of the ribbons 10 and 12 increases the rigidity of the core structure, causing the formability of the core to decrease, while decreasing the ribbon height decreases core rigidity, enabling the core to be formed more easily.

The core which has been described in connection with FIGS. 1 and 2 is characterized by having a very high degree of formability. FIGS. 3 and 4 depict two different examples of the core of this invention formed by hand to conform to different compound contours. FIG. 3 depicts the core of this invention formed by hand to conform to the outline of a conventional telephone, while FIG. 4 depicts the core of this invention formed by hand to conform to a ball having an outside diameter of 2 inches.

The core 8 of this invention is capable of stretching in the plane of the core in a lengthwise direction, that is, in the direction of arrow 18; and/or in a widthwise direction, that is, in the direction of arrow 35; and/or diagonally, that is, in the direction of arrow 37. In the course of forming the core 8 of this invention to conform to different single or compound contour shapes, there is relatively little distortion of the walls of the cell 33 when compared to other honeycomb core structures, such as square cell cores, when subjected to comparable degrees of forming. The ability of the cell walls of the core 8 of this invention to distort relatively little when subjected to high degrees of forming is attributable to the ability of the cell wall defined by ribbon 10 of each cell 33 to extend and/or compress as the core is formed.

Honeycomb core sandwiches 9 of the type shown in FIG. 1, consisting of a honeycomb core 8 between upper and lower faces 14 and 16, can be formed into complex shapes by separately preforming the core 8 and the upper and lower faces 14 and 16, and thereafter assembling and adhering the preformed core and upper and lower faces into an integral unit.

In the preferred embodiment of this invention, the side walls 24 and 34 of the corrugated ribbons 10 and 12 are flat. By virtue of the use of flat side walls 24 and 34 of corrugated ribbons 10 and 12, respectively, the ribbons 10 and 12 can be formed utilizing conventional and commercially available gears having straight-sided teeth. This enables the cost of the equipment needed for corrugating the ribbons 10 and 12 to be kept to a minimum.

The ribbon and face material for the core 8 in one preferred form is Inconel 625 having a thickness of .001-.003 inches. The ribbons 10 and 12 and faces 14 and 16 when formed of Inconel 625 are preferably adhered to each by welding or brazing. A preferred method of welding is described in the copending application of Robert R. Rathbun, entitled "Brazing Method and Apparatus," filed Oct. 12, 1971, Ser. No. 1,234, now U.S. Pat. No. 3,612,387 assigned to the assignee of this invention. The entire disclosure of the above-identified application is incorporated herein by reference. Other materials may be used such as aluminum alloys, stainless steel alloys, titanium alloys, and resin-treated glass fabric. Where non-metallic ribbon and face materials are used, they may be adhered to each other using appropriate adhesives such as epoxy resins, etc.

Having described the invention, what is claimed is:

1. In a structural member of the type comprising a metal cellular core sandwiched between two parallel metal skin sheets, the improvement which comprises:

a cellular core formed of interconnected corrugated metal ribbons comprising

a plurality of identical interconnected core cells, all of which are identically configured, arranged in a matrix pattern and defining a core plane having a specified height, each of said identical core cells established by directly connecting, only at corrugation nodes, alternated and interleaved first and second type ribbons having respectively large corrugations and small corrugations, each of said identical cells being defined by

a. a single large corrugation of said first type ribbon having two relatively large flat rectangular sections separated by a relatively small flat intermediate rectangular section angled with respect to said large sections, said both sections having a height measured normal to said core plane which is equal to the height of said cellular core,

b. an integral number, in excess of one, of small corrugations of said second type ribbon, each corrugation having three flat interconnecting rectangular sections with the height of each section equal to the height of said cellular core, adjacent ones of said three interconnecting sections being angled relative to each other, and the area of any one of said rectangular sections of the corrugations of said second type ribbon being less than the area of said large rectangular sections of the corrugations of said first type ribbon, and

c. said alternated and interleaved interconnected ribbons of said first and second type forming a plurality of identical cells, each of said identical cells being of generally triangular configuration, each of said skin sheets being secured to the edges of said ribbons, between which edges the core height is measured, to orient the axes of the core cells perpendicularly to the plane of said skin sheets.

2. A structural member of the type having sandwiched between two parallel metal skin sheets a metal cellular core characterized by a high degree of formability, comprising:

a pair of faces of thin sheet metal stock,

a plurality of first elongated metal ribbons disposed substantially parallel to each other, said first ribbons each having corrugations which include peri-

odic nodes interconnected by ribbon sections, with the corrugations of said first ribbons having the same phase, pitch and amplitude, and the same height measured between opposite edges thereof, a plurality of second elongated metal ribbons disposed substantially parallel to each other, each of said second ribbons having corrugations which include periodic nodes interconnected by ribbon sections, with the corrugations of said second ribbons having the same phase, pitch and amplitude, and the same height measured between opposite edges thereof, the height of said second ribbons being equal to the height of said first ribbons,

said first and second ribbons being secured at said opposite edges thereof to said faces with the planes of said ribbons being generally perpendicular to said faces,

the ratio of said pitch of said first ribbons to said pitch of said second ribbons being an integer greater than one and of relatively low value,

the ratio of said amplitude of said first ribbons to said amplitude of said second ribbons being greater than one and of relatively low value, and

said first ribbons being alternated and interleaved and in phase with said second ribbons, with said alternated and interleaved first and second ribbons being joined to each other only at nodes thereof, providing a plurality of identical cells of generally triangular configuration having their axes perpendicular to said faces.

3. The structural member of claim 2 wherein said amplitude ratio is approximately 2.5 and said pitch ratio is an integer in the range of 3.

4. The structural member of claim 3 wherein said ribbon nodes of said first and second ribbons and the ribbon sections intermediate said nodes of said first and second ribbons are flat rectangular surfaces, with said rectangular sections of said first and second ribbons larger than said rectangular nodes of said first and second ribbons.

5. A structural member of the type having a metal cellular core sandwiched between two parallel metal skin sheets, comprising:

a pair of faces of metal sheet material,

dissimilar sets of first and second elongated interleaved equal height corrugated metal ribbons running parallel to each other, said first and second ribbons being joined at opposite edges thereof to said faces, the planes of said first and second ribbons being generally perpendicular to said faces, said first and second ribbons having periodically occurring nodes defining first and second corrugation pitches which differ by an integral multiple, said first and second ribbons being joined to each other only at nodes, and said first and second ribbons also having respectively different amplitudes with the amplitude of the lesser pitch ribbons less than the amplitude of the greater pitch ribbons, said alternated and interleaved first and second joined corrugated ribbons forming a plurality of generally triangular-shaped cells, all of which are identical and oriented with the axes of said cells perpendicular to said faces.

6. The structural member of claim 5 wherein said nodes of said first and second ribbons and the ribbon sections intermediate said nodes of said first and second sections are flat rectangular surfaces, with said in-

intermediate rectangular ribbon sections of said first and second ribbons larger than said rectangular nodes of said first and second ribbons.

7. A structural member of the type having sandwiched between two parallel metal skin sheets a metal cellular core plane structure characterized by a high degree of formability, comprising:

a plurality of first elongated metal ribbons, disposed substantially parallel to each other with their respective edges aligned, said first ribbons each being corrugated to include periodic nodes interconnected by ribbon sections, with the corrugations of each first ribbon having the same phase, pitch and amplitude,

a plurality of second elongated metal ribbons, disposed substantially parallel to each other with their respective edges aligned with each other and to said edges of said first ribbons, each of said second ribbons being corrugated to include periodic nodes interconnected by ribbon sections with the corrugations having the same phase, pitch and amplitude,

said first and second ribbons having equal height, the ratio of said pitch of said first ribbons to said pitch of said second ribbons being an integer greater than one and of relatively low value,

the ratio of said amplitude of said first ribbons to said amplitude of said second ribbons being greater than one and of relatively low value,

said first ribbons being alternated and interleaved and in phase with said second ribbons, with said first and second alternated and interleaved ribbons being joined to each other only at nodes thereof to form a core having identical generally triangular cells,

the widths of said first and second ribbons being defined as the ribbon dimension transverse of the elongated ribbon direction, said widths being less than said elongated ribbon direction, and said widths being less than the combined amplitudes of said first and second ribbons,

whereby said widths of said first and second ribbons define the thickness of said cellular core, and the lengths of said ribbons in said elongated ribbon direction and said combined amplitudes define the dimensions of said cellular core, and

a pair of metal sheets secured to the opposite edges of said first and second ribbons whereby the axes of the core cells extend perpendicularly to the plane of said sheets.

8. The structural member of claim 7 wherein said amplitude ratio is approximately 2.5 and said pitch ratio is an integer in the range of 3.

9. The structural member of claim 8 wherein said

nodes of said first and second ribbons and the ribbon sections intermediate said nodes of said first and second ribbons are flat rectangular surfaces, with said intermediate rectangular ribbon sections of said first and second ribbons larger than said rectangular nodes of said first and second ribbons.

10. A structural member of the type in which a metal cellular core plane structure is sandwiched between metal skin sheets, comprising:

disimilar sets of first and second elongated interleaved equal height metal corrugated ribbons running parallel to each other, said first and second ribbons having periodically occurring nodes defining first and second corrugation pitches which differ by an integral multiple, said first and second ribbons being joined only at nodes, and said first and second ribbons also having respectively different first and second amplitudes with the amplitude of the lesser pitch ribbons less than the amplitude of the greater pitch ribbons,

the widths of said first and second ribbons being defined as the ribbon dimension transverse of the elongated ribbon direction, said widths of said first and second ribbons being less than said elongated ribbon direction, and said widths of said first and second ribbons being less than the combined amplitudes of the plurality of first and second ribbons, a pair of metal skins secured to the edges of said first and second ribbons on opposite sides thereof to orient the axes of said cells perpendicular to said skins,

said widths of said first and second ribbons define the thickness of said cellular core, and the lengths of said first and second ribbons in each elongated ribbon direction and said combined amplitudes of the plurality of said first and second ribbons define the dimensions of the plane of said cellular core, said cellular including a plurality of cells which are identical and of generally triangular cell configuration with the axes of said cells perpendicular to said skins.

11. The structural member of claim 10 wherein said first and second ribbons have a pitch ratio equal to an integer in the approximate range of three, and have an amplitude ratio equal to approximately 2.5.

12. The structural member of claim 11 wherein said ribbon nodes of said first and second ribbons and the ribbon sections intermediate said nodes of said first and second ribbons are flat rectangular surfaces, with said intermediate rectangular ribbon sections of said first and second ribbons larger than said rectangular nodes of said first and second ribbons.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,872,564
DATED : March 25, 1975
INVENTOR(S) : Paul E. Myers & Omer L. Carroll

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 26, before "density" insert the word "cell".

Column 4, line 5, "off" should be --of--.

Column 5, line 9, insert "only" after the word "other".

Signed and Sealed this

fourth Day of November 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks