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(54) METHOD OF MAKING FLANGED HONEYCOMB CORE

VERFAHREN ZUR HERSTELLUNG VON MIT FLANSCHEN VERSEHENER WABENKERN

PROCEDE DE FABRICATION UNE STRUCTURE EN NID D'ABEILLES A RABATS

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(73) Proprietor: **Johnson, Jeffrey Don**
Witchita, KS 67206 (US)

(72) Inventor: **Johnson, Jeffrey Don**
Witchita, KS 67206 (US)

(74) Representative: **Jones Day**
Rechtsanwälte, Attorneys-at-Law, Patentanwälte
Prinzregentenstrasse 11
80538 München (DE)

(56) References cited:
FR-A- 2 251 773
US-A- 2 335 070
US-A- 2 556 470
US-A- 2 719 807
US-A- 3 774 365
US-A- 3 774 365
US-A- 4 045 268
US-A- 4 251 579
US-A- 5 437 936
US-A- 5 437 936

EP 1 358 023 B9

Description

TECHNICAL FIELD

[0001] This invention relates to a method of fabricating a flanged honeycomb core structure. A metallic honeycomb core structure which is laser-welded is shown in U.S. Letters Patent No. 5,437,936.

BACKGROUND ART

[0002] A core structure of the type disclosed in U.S. Letters Patent No. 5,437,936 does not incorporate flanges but, rather, includes at the opposite extremities of the cells a very thin edge which is customarily secured, in the case of metallic foil honeycomb core, to the inner surface of facing sheets to define a structural panel. It is not necessary to braze the metallic honeycomb core structure to the facing sheets which is a complicated and expensive process and which materially increases the weight of the structural panel which results from such brazing. Most metallic honeycomb core is glued to the face sheets. The flanged core disclosed herein can be brazed, glued, resistance welded, or diffusion bonded to face sheets.

[0003] In paper or paper-like honeycomb core structures, the honeycomb core is glued to the inner surfaces of facing sheets which are customarily provided in the form of paper or paper substitutes or which may, on occasion, be fabricated from metallic foil.

[0004] Where the utilization of glue occurs, it adds materially to the weight of the resultant panel because the glue must be spread across the contacting surfaces of the honeycomb core and face sheets, thus adding to the amount and weight of glue in the resulting panel.

[0005] Although the teachings of the '936 patent are directed to the use of the laser weldment between adjacent sheets of metallic foil, the teachings of the present invention are relevant to both paper and paper substitutes and various types of flexible materials, including metallic foils of the character disclosed in the '936 patent since the formation of the flange tabs on paper or metallic structures can be accomplished by identical method steps.

DISCLOSURE OF INVENTION

[0006] The invention is defined by the claims.

[0007] An assemblage of flexible sheets or strips is shown, which is useful for understanding the invention, wherein the sheets or strips are arranged in superimposed, stacked relationship with the assemblage having opposite edges and upper and lower surfaces and the superimposed sheets having surfaces in engagement with and secured to each other at alternate locations to provide a honeycomb core configuration when the assemblage is expanded to assume said honeycomb core configuration, said edges having flange tabs thereupon.

[0008] Further, an assemblage is shown, which is useful for understanding the invention, in which securement means depending on the nature of the stacked material is provided. In the case of paper or paper-like materials, various types of glues, including resinous glues can be applied to the sheets of paper or paper-like material at the intervals determining the shape of the cells of the resultant honeycomb core. On the other hand, if the teachings of the '936 patent are followed, the foil sheets or strips can be secured to one 10 another by the laser weldments disclosed in said patent.

[0009] Further, opposite edges of said assemblage, which is useful for understanding the invention, are provided whether fabricated from paper or paper-like materials or metallic foils, of flange tabs capable of being deformed into flanges on the honeycomb core structure after expansion of the assemblage to define said honeycomb core structure.

[0010] Further, the provision of an assemblage of the aforementioned type is shown in which the flange tabs are defined by cutting or grooving the opposite edges to provide the desired shape and size of the flange tabs.

[0011] An object of my invention is the provision of a method of fabricating the flange tabs which includes the grooving of the opposite edges of the assemblage.

[0012] A further object of my invention is the provision of a method of providing flanges upon the opposite edges of the aforesaid honeycomb core by deforming the flange tabs on said edges.

BRIEF DESCRIPTION OF DRAWINGS

[0013] Other objects and advantages of the invention will be apparent from the following specification and the accompanying drawings which are for the purposes of illustration only and in which:

- FIG. 1 is a view showing the assemblage after the flange tabs have been cut in the opposite edges thereof;
- FIG. 2 is isometric view showing a portion of an expanded assemblage with the flange tabs extending laterally from the opposite surfaces of the honeycomb core;
- FIG. 3 is a fragmentary plan view showing the flange tabs after deformation into co-- planarity with one another on opposite sides of the honeycomb core structure; and
- FIG. 4 is a showing of a forming roller which can 20 be utilized in deforming the laterally- extending flange tabs into co-- planarity with one another to provide flanges on the opposite surfaces of the honeycomb core structure.

BEST MODE FOR CARRYING OUT THE INVENTION

[0014] Referring to the drawings and, particularly, to Figs. 1-3 thereof, I show an assemblage 10, which is

useful for understanding the invention of metallic foil sheets 12 which are secured in operative relationship by spaced laser weldments 14.

[0015] The assemblage 10 has upper and lower surfaces 16 and 18, respectively, and opposite edges 22 and 24.

[0016] The opposite edges 22 and 24 of the assemblage 10 include laterally-extending flange tabs 30, said flange tabs 30 being defined by a series of grooves 32 and 34 on the opposite edges of said assemblage 10.

[0017] Although the showing in Figs. 1-3 of the structure of the assemblage and the method of forming the same is directed to the laser weldment of metallic foils, it will be obvious to those skilled in the art that paper or paper-liked products can be substituted for the metallic foils in the manufacture of the assemblage with the proviso that the means of securement, in substitution for laser weldment of foils, will be various types of glues including heat-setting resinous glues.

[0018] In the case of the provision of the grooves 32 and 34 in the opposite edges 30 of the assemblage 10, the grooves can be formed by mechanical sawing or cutting; by the use of chemical methods of removing predetermined amounts and shapes of metallic materials; and by electrical removal of material. The shape of the grooves 32 and 34 determines the ultimate shape of the flange tabs 30.

[0019] In the case of assemblages such as the assemblage 10 wherein paper or paper-like products are utilized, the grooves can be cut by the utilization of brass or steel rule dies which are well-known expedients in the art of cutting paper.

[0020] The subsequent description of the formation of the flanged honeycomb core applies equally to the utilization of paper or paper-like materials and/or metallic foils. Obviously, any sheet or strip of material can be utilized as long as it is capable of maintaining the ultimate honeycomb core flanged configuration disclosed herein.

[0021] After the formation of the grooves 32 and 34, the 15 top and bottom surfaces 16 and 18 are placed under tension to expand the sheets or strips 12 into the honeycomb configuration 40 shown in Fig. 2 of the drawings. The honeycomb cells 42, as best shown in Figs. 2 and 3 of the drawings, are of square configuration and the grooving operation forms the walls 44 into a lozenge shape having the flange tabs 30 at the opposite extremities thereof. The strips 12 are secured to each other at nodal areas 46 which define the square shape of the cells 42.

[0022] It will be noted that the nodes 46 on successive strips 12 are staggered in respect to each other, as best shown in Fig. 3, to establish the square configuration of the cells 42. In the expanded honeycomb configuration 40, the flange tabs 30 extend laterally from the opposite sides of the core 40 and do not provide the flange surface for which they are intended. To accomplish the creation of the flanges 50, as best shown in Fig. 3, the flange tabs 30 must be bent into the flange configuration by any suitable means such as applying pressure individually to the flange tabs 30 or by utilizing mechanical means to accomplish the deformation of the flange tabs 30 into the flanges 50.

[0023] A flanging device 60 is shown in Fig. 4 of the drawings as including a roller 62 traversible by any suitable means across the honeycomb core 40 and including deformation surfaces 64 and clearance means 66. The roller 62 is shown as moving in the direction of the arrow 68 with certain of the flange tabs 30 deformed into flanges 50 while other sets of flange tabs 30 are received in clearance grooves 72 in the roller 62 as the flanges 50 are being created in the direction in which the roller is rotated. After completion of the first set of flanges 50, the roller 62 can then be applied to the remaining undeformed flange tabs 30 to accomplish the deformation of the same.

[0024] As is well known to those skilled in the art, the provision of flanges on the opposite surfaces of the honeycomb core structures is of extreme importance because it provides an interface between the honeycomb structure and the inner surfaces of face sheets not achievable where the raw honeycomb absent flanges is utilized. By providing the flanges, a sufficient area for the application of glue, in the case of paper or paper products, or weldments, in the case of metallic structures, is achieved. The flanges materially enhance the performance of the resultant structural panel because of secure engagement of the respective honeycomb and face sheet surfaces.

[0025] Further, the panels are greatly reduced in weight because the use of brazing in metallic panels and excessive amounts of glue in paper or paper-like panels is obviated.

[0026] Although an embodiment of the flanged core and method of making the same has been disclosed hereinabove, it is not intended to limit the teachings of the invention to the specificity of the disclosure.

Claims

1. A method of making a honeycomb core, comprising the steps of:

   providing a plurality of sheets or strips (12) of flexible material, superimposing said sheets or strips (12) in stacked orientation wherein the adjacent surfaces of said sheets or strips (12) are in juxtaposition to one another;
   securing said sheets or strips (12) to one another at alternate locations to form an assemblage that defines a honeycomb core structure when said assemblage (10) is expanded, the assemblage (10) having top and bottom surfaces (16,18) and opposite edges (22,24);
   then cutting flange tabs (30) into said opposite edges (22, 24);
   then expanding said assemblage (10) to define

a honeycomb structure, and bending said flange tabs (30) right-angularly to said honeycomb structure to provide flanges (50) on the opposite edges (22, 24) thereof, preferably in which said cutting is accomplished by grooving said edges (22, 24) of said assemblage (10) to define the shape of said flange tabs (30).

2. The method of claim 1 wherein the sheets or strips (12) are metallic foil and said sheets or strips (12) are secured to one another by welding preferably in which said grooves (32, 34) are located coincident with alternate weldments (14).

Patentansprüche

1. Verfahren zur Herstellung einer Bienenwabenkernstruktur mit den Schritten:

Bereitstellen von mehreren Platten oder Streifen (12) aus flexiblem Material;
Aufeinanderlegen der mehreren Platten oder Streifen (12) in gestapelter Orientierung, wobei angrenzende Oberflächen der Platten oder Streifen (12) nebeneinander angeordnet sind;
gegenseitiges Fixieren der Platten oder Streifen (12) an abwechselnden Positionen, um eine Anordnung zu bilden, die eine Bienenwabenkernstruktur darstellt, wenn die Anordnung (10) auseinander gezogen ist, wobei die Anordnung (10) obere und untere Oberflächen (16, 18) und gegenüberliegende Kanten (22, 24) umfasst;
anschließendes Schneiden von Flanschlappen (30) in die gegenüberliegenden Kanten (22, 24);
anschließendes Auseinanderziehen der Anordnung (10) um eine Honigwabenstruktur darzustellen, und
Abwinkeln der Flanschlappen (30) im rechten Winkel zu der Honigwabenstruktur um Flansche (50) an den gegenüberliegenden Kanten (22, 24) bereitzustellen;
wobei vorzugsweise das Schneiden durch Nuten der Kanten (22, 24) der Anordnung (10) erreicht wird, um die Form der Flanschlappen (30) darzustellen.

2. Verfahren nach Anspruch 1, wobei die Platten oder Streifen (12) eine Metallfolie sind und die Platten oder Streifen (12) durch Schweißen aneinander angeordnet werden; wobei vorzugsweise die Nuten (32, 34) in Übereinstimmung mit abwechselnden Schweißpunkten (14) angeordnet sind.

Revendications

1. Procédé de fabrication d'un panneau en nid d'abeilles, comprenant les étapes suivantes:

préparation d'une pluralité de feuilles ou bandes (12) en matériau flexible, superposition des feuilles ou bandes (12) dans une direction d'empilement, les surfaces adjacentes des feuilles ou bandes (12) étant juxtaposées les unes aux autres ;
fixation des feuilles ou bandes (12) les unes contre les autres à des emplacements en alternance pour former un assemblage définissant une structure en nid d'abeilles lorsque l'assemblage (10) est déployé, l'assemblage (10) présentant des surfaces de sommet et de base (16, 18) et des bords opposés (22, 24) ;
découpe consécutive de pattes de rabats (30) dans les bords opposés (22, 24);
déploiement consécutif de l'assemblage (10) pour définir une structure en nid d'abeilles, et cintrage des pattes de rabats (30) perpendiculairement à la structure en nid d'abeilles pour obtenir des rabats (50) sur les bords opposés (22, 24) de celle-ci, la découpe étant de préférence exécutée par encochage des bords (22, 24) de l'assemblage (10) pour définir la forme des pattes de rabats (30).

2. Procédé selon la revendication 1, où les feuilles ou bandes (12) sont des feuillards métalliques et où les feuilles ou bandes (12) sont fixées les unes contre les autres par soudage, les encoches (32, 34) coïncidant en alternance avec des soudures (14).

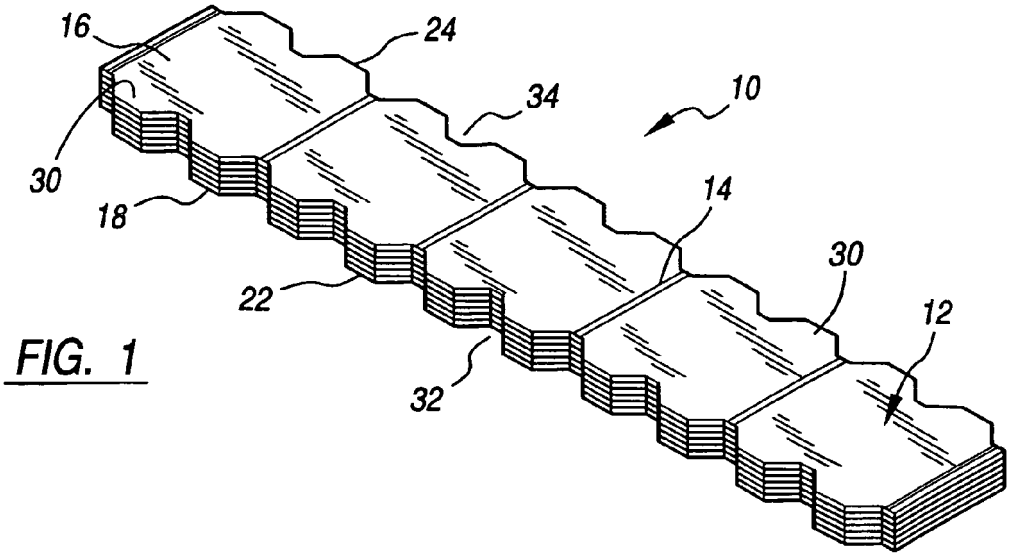

FIG. 1

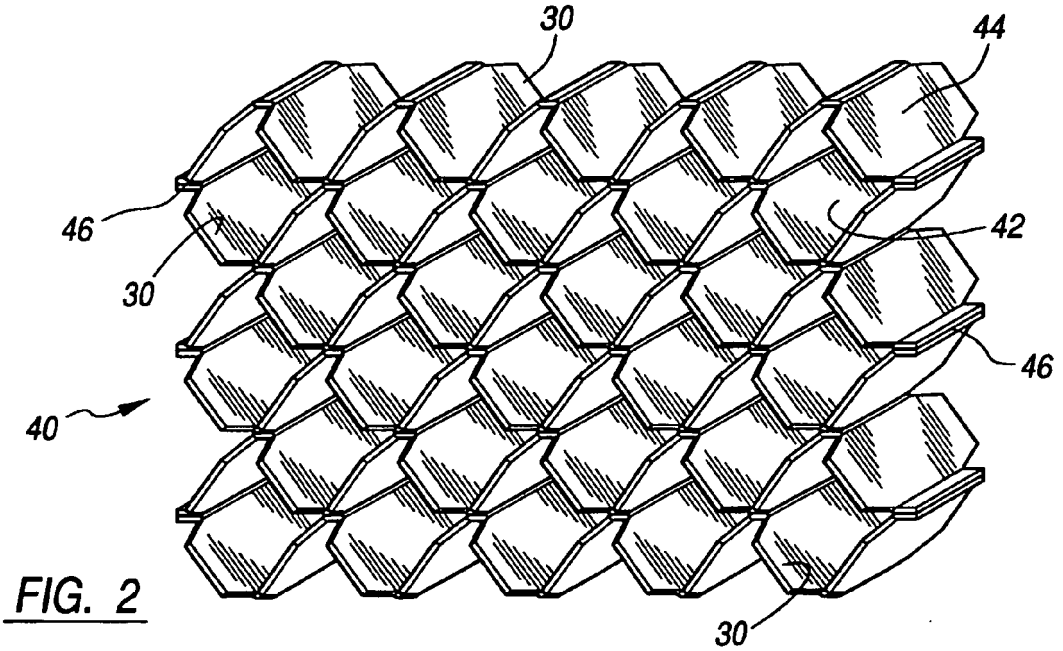

FIG. 2

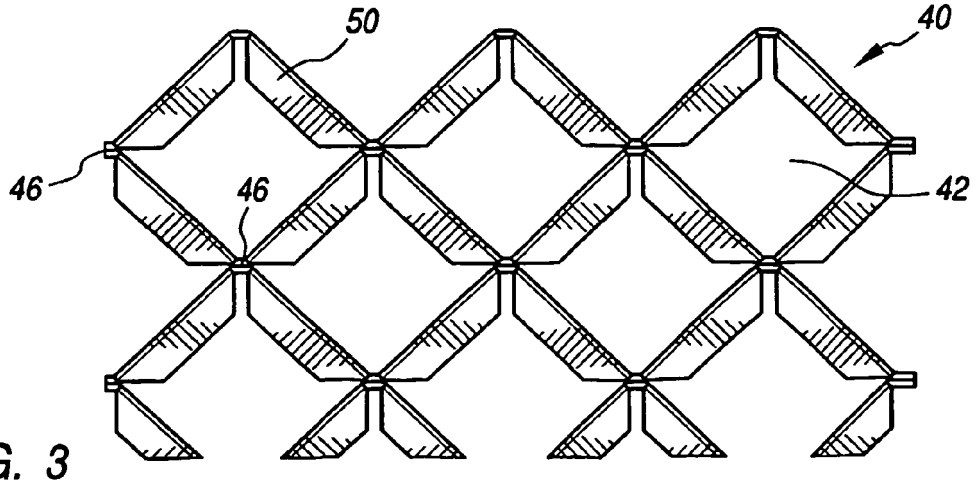

FIG. 3

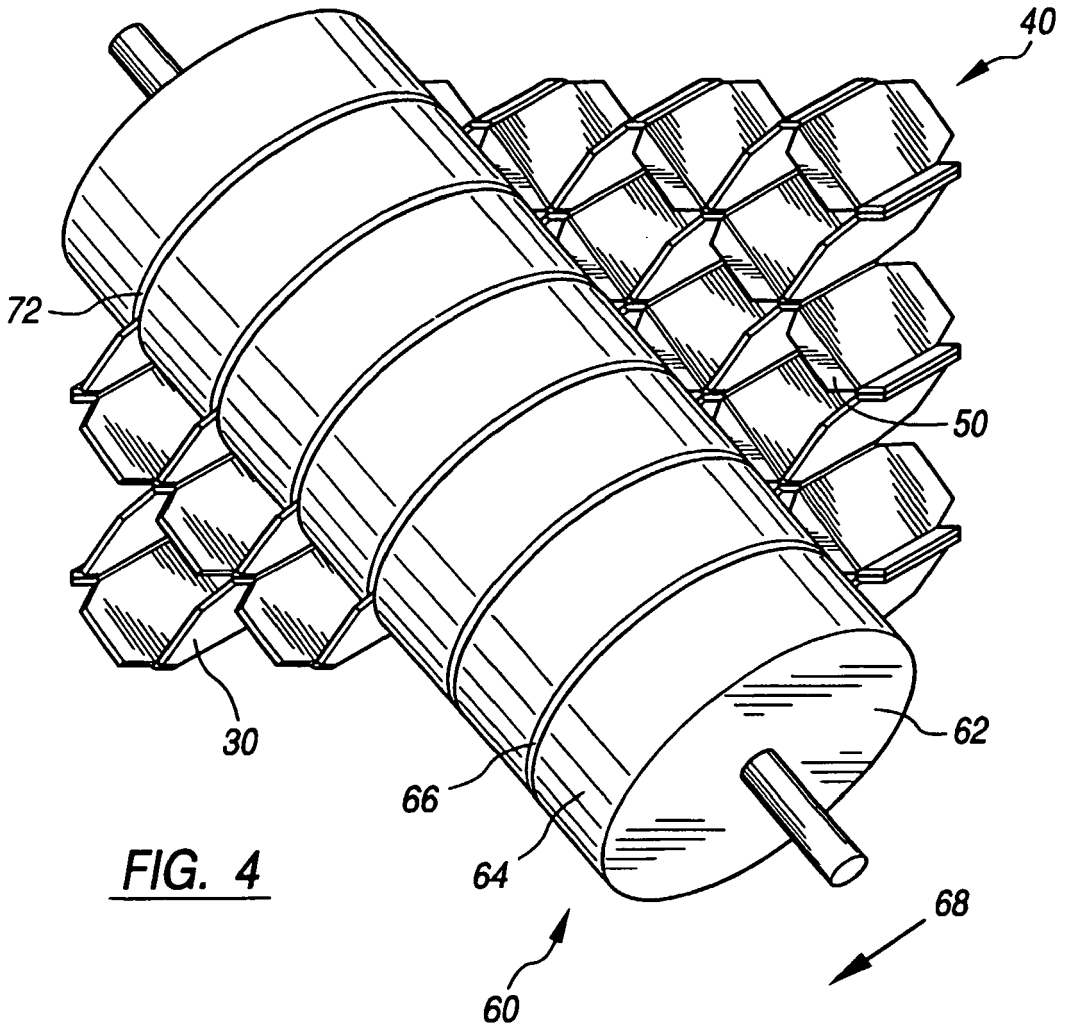

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5437936 A **[0001] [0002]**