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(54) **PLASTIC HEAT EXCHANGER AND CORE THEREOF**

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(57) **ABSTRACT**

A heat exchanger and a heat exchanger core are disclosed. The heat exchanger core is formed from a strip of synthetic resin molded into multiple panels which are accordion folded to form the heat exchanger core. One embodiment is a counterflow core in which sides of each panel parallel to the longitudinal axis of the strip are divided to form a closed portion and an open portion. The opposite longitudinal sides are similarly formed but the portions are reversed. The sides of each panel perpendicular to the longitudinal axis of the strip are closed either by a hinge formed in the strip or by panel borders abutting each other. A second embodiment discloses a strip also formed into multiple panels and accordion folded. However, every second hinge has an opening so that when folded, a cross flow core is created. Both cores are mated with appropriately designed molded plastic housings to form effective but simple and economical heat exchangers.

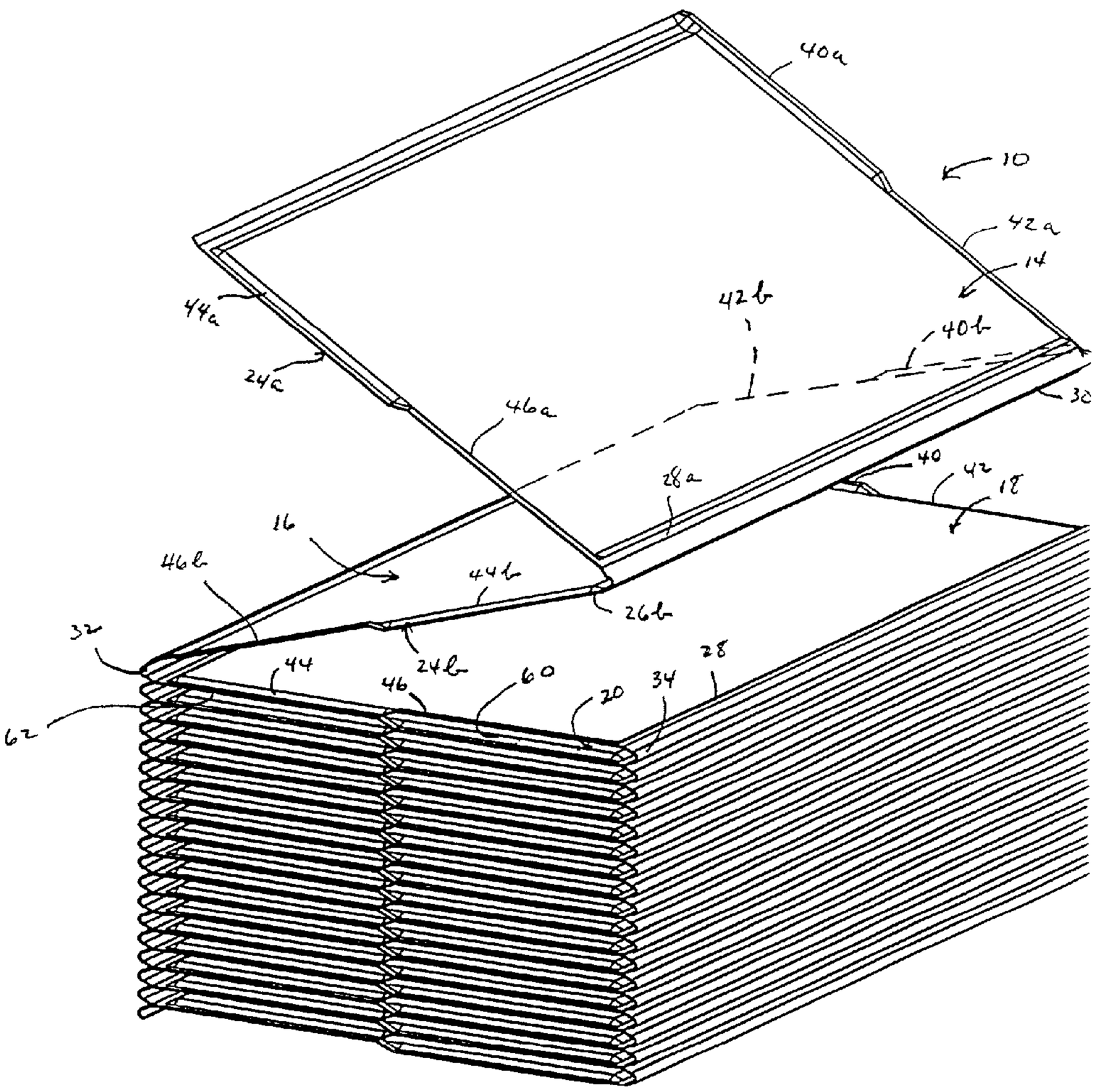


FIG 1

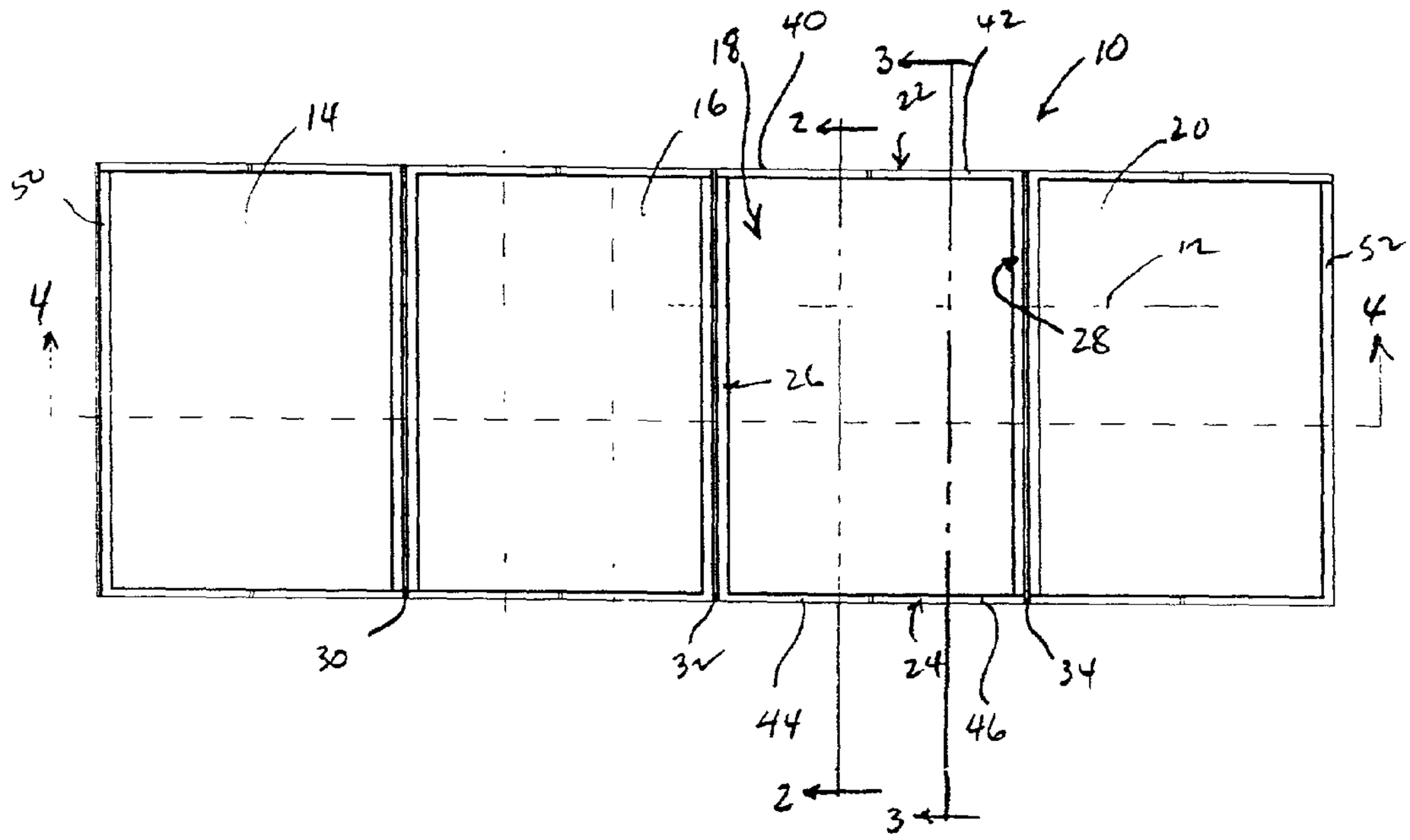


FIG 2

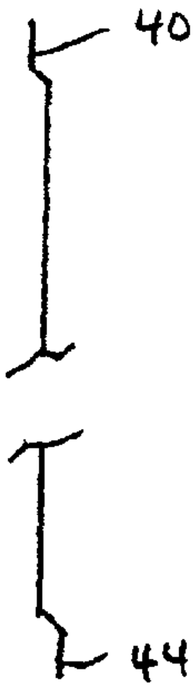


FIG 3

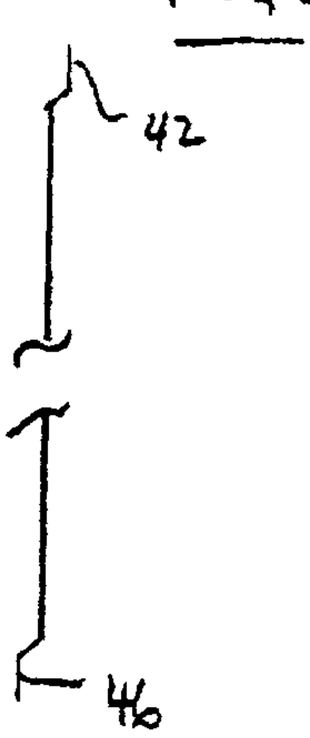


FIG 4

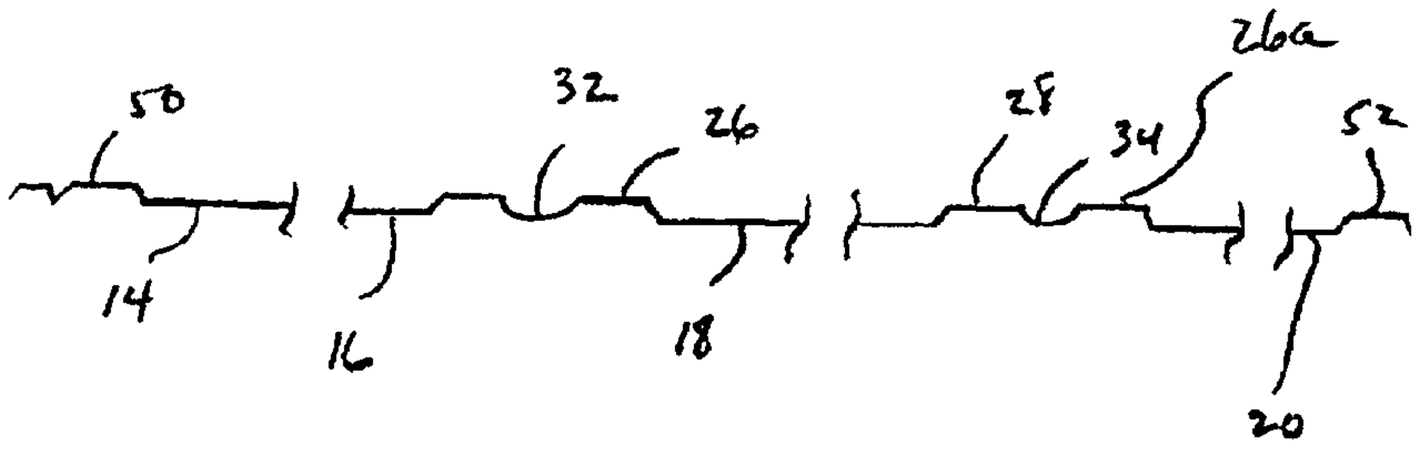
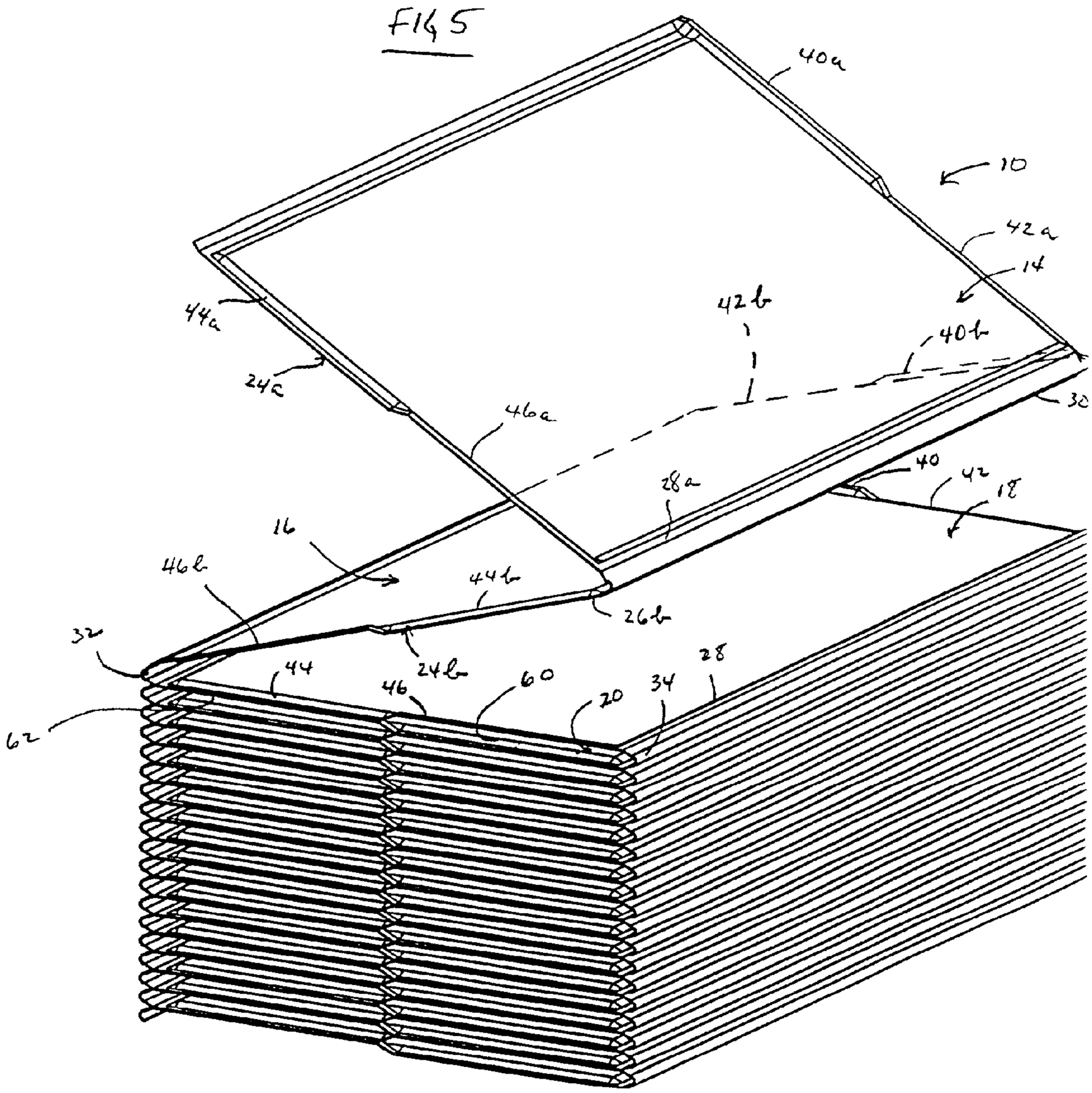


FIG 5


40a
10
42a
14
42b
40b
44a
24c
46a
30
28a
40
42
18
16
46b
44b
26b
32
24b
44
46
60
20
28
34
62

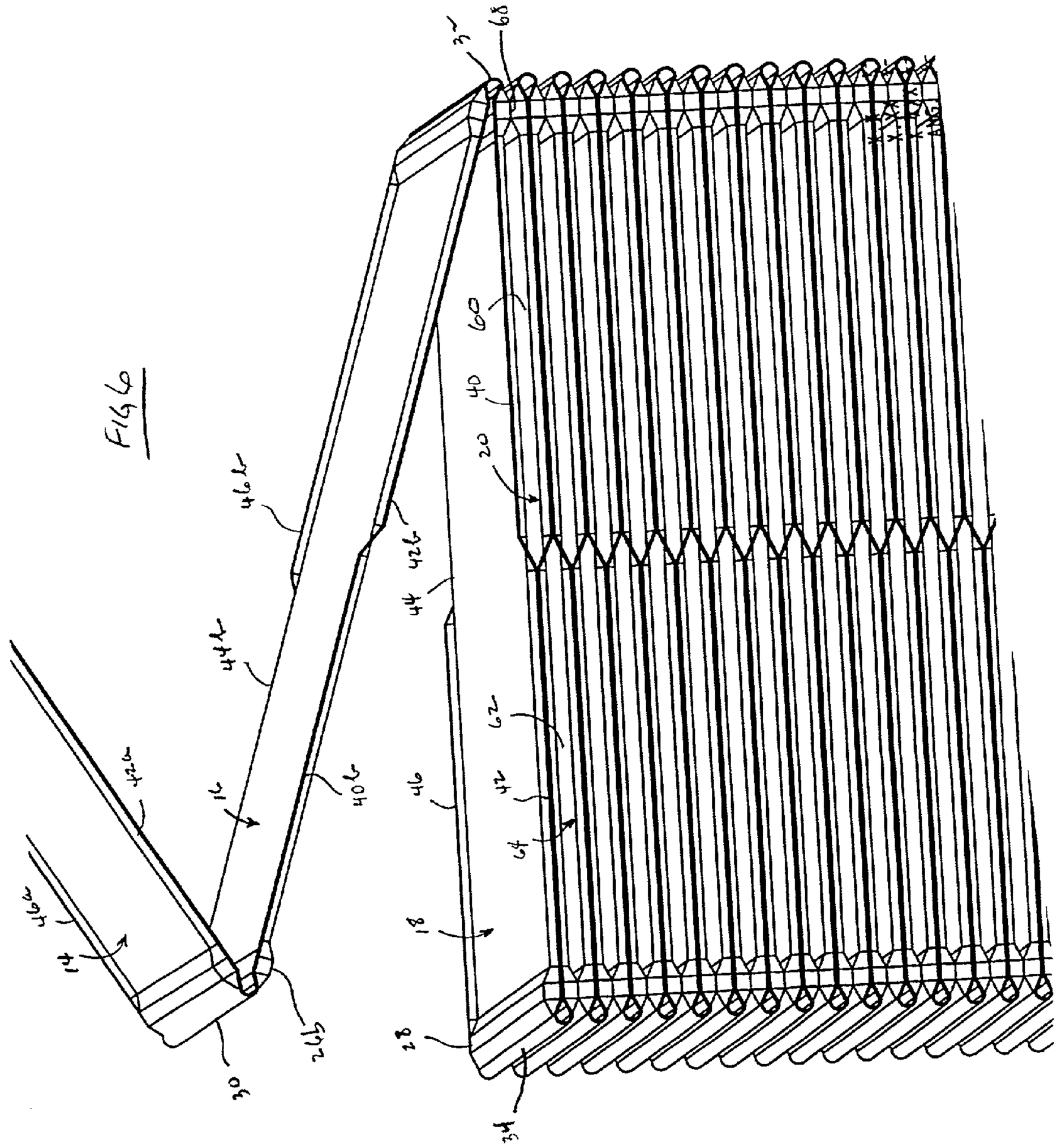


FIG 6
68
66
60
40
20
46a
44a
44
42b
62
42
46
64
18
28
34
42a
16
40b
14
46b
30
26b

FIG 7

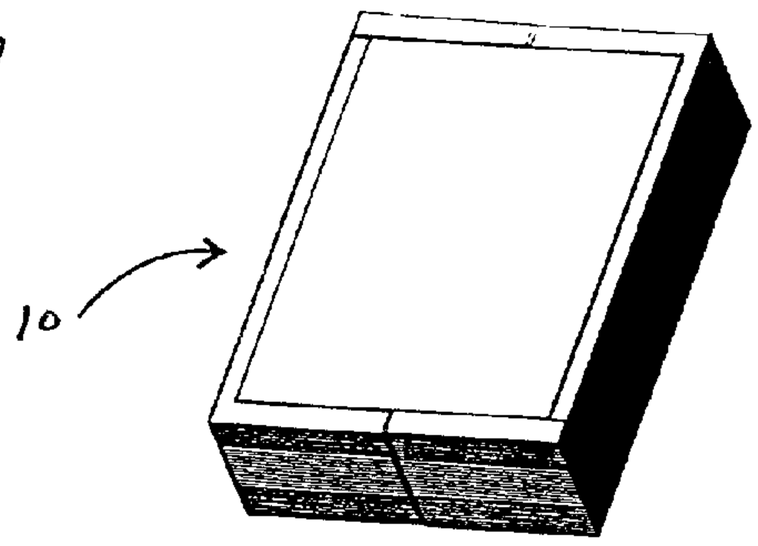


FIG 8

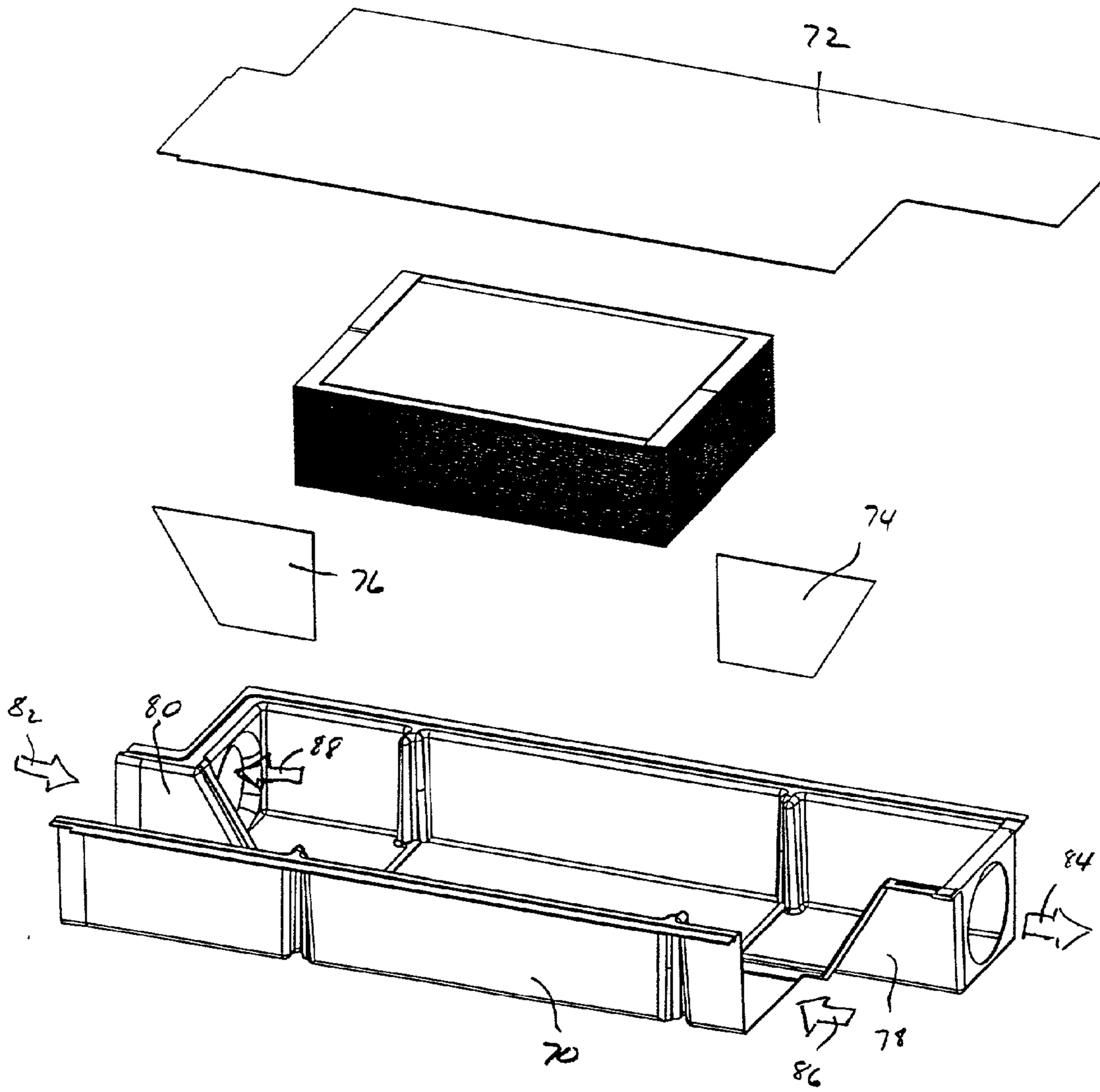


FIG 9

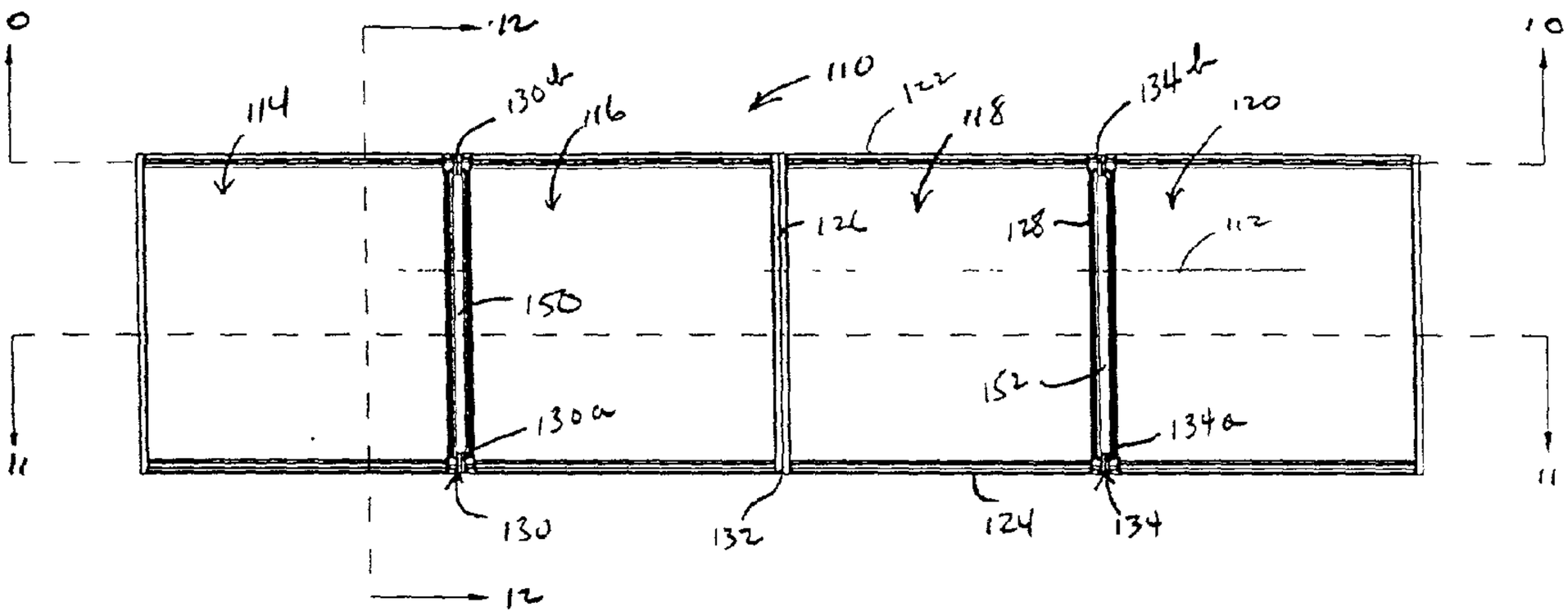


FIG 10

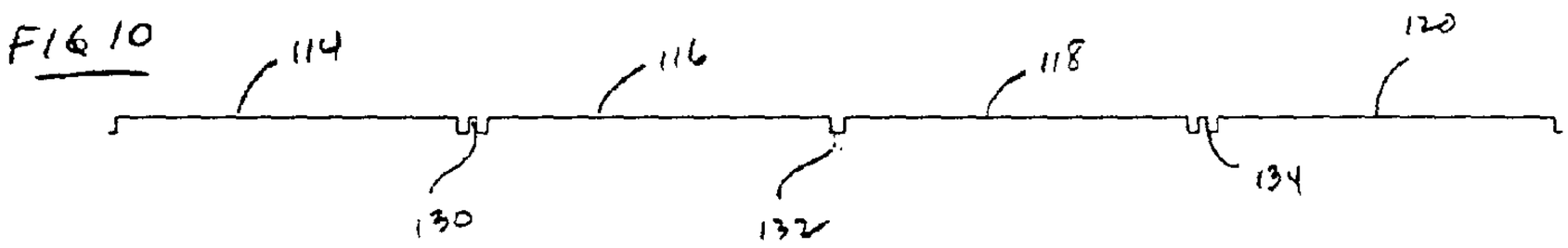


FIG 11

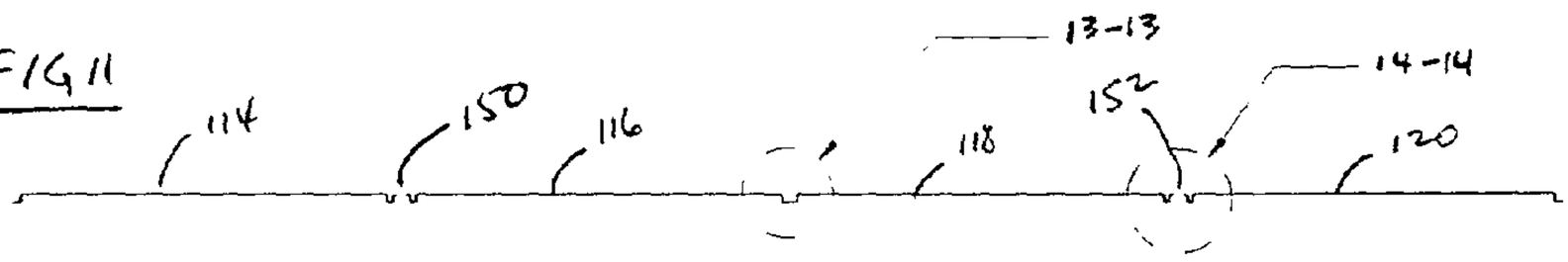
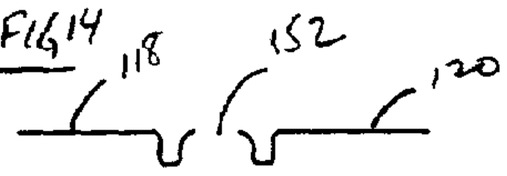


FIG 12

FIG 13

FIG 14



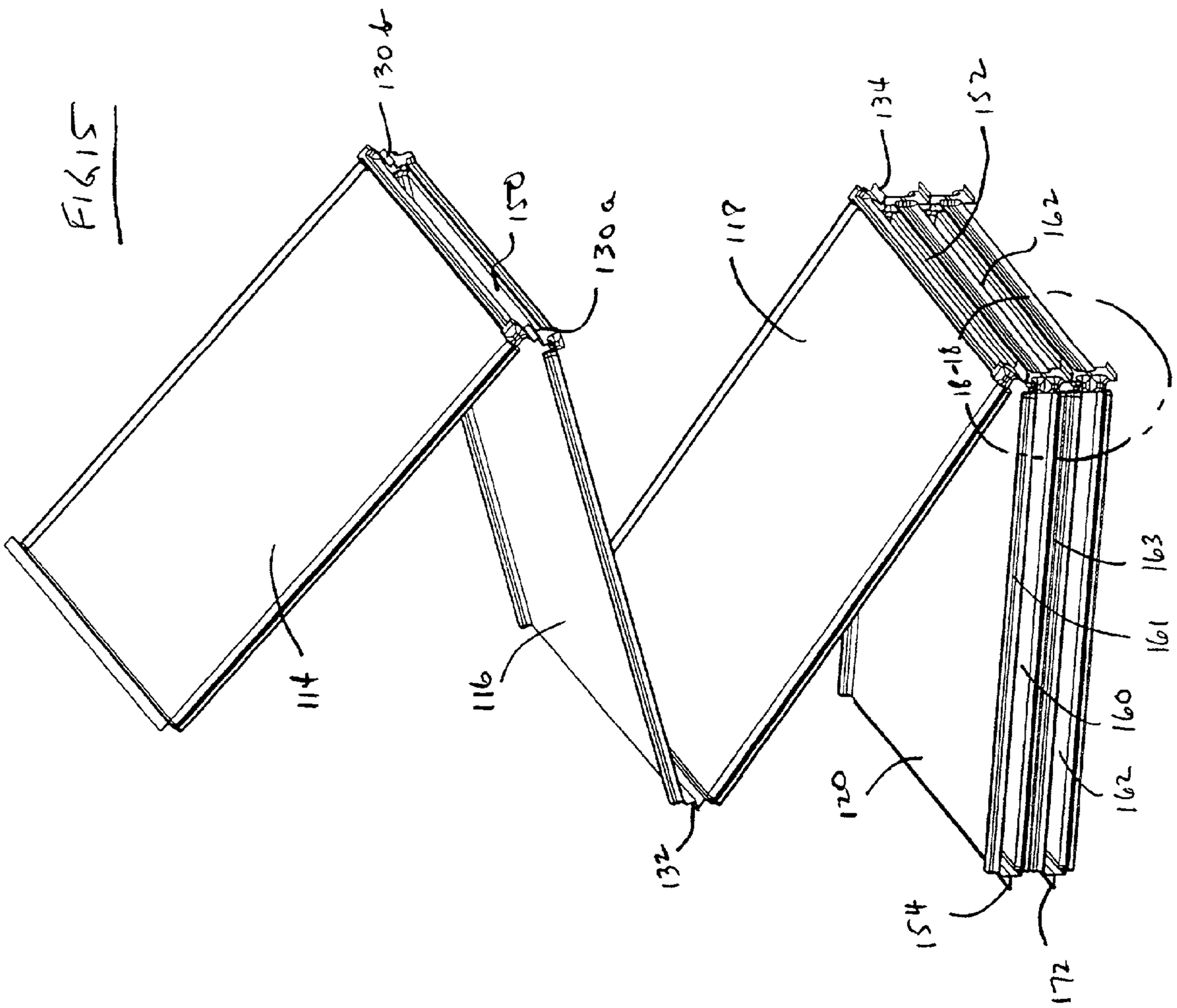


FIG. 6
130b
152
130a
134
152
119
162
18-18
163
161
160
162
120
154
172
114
116
132

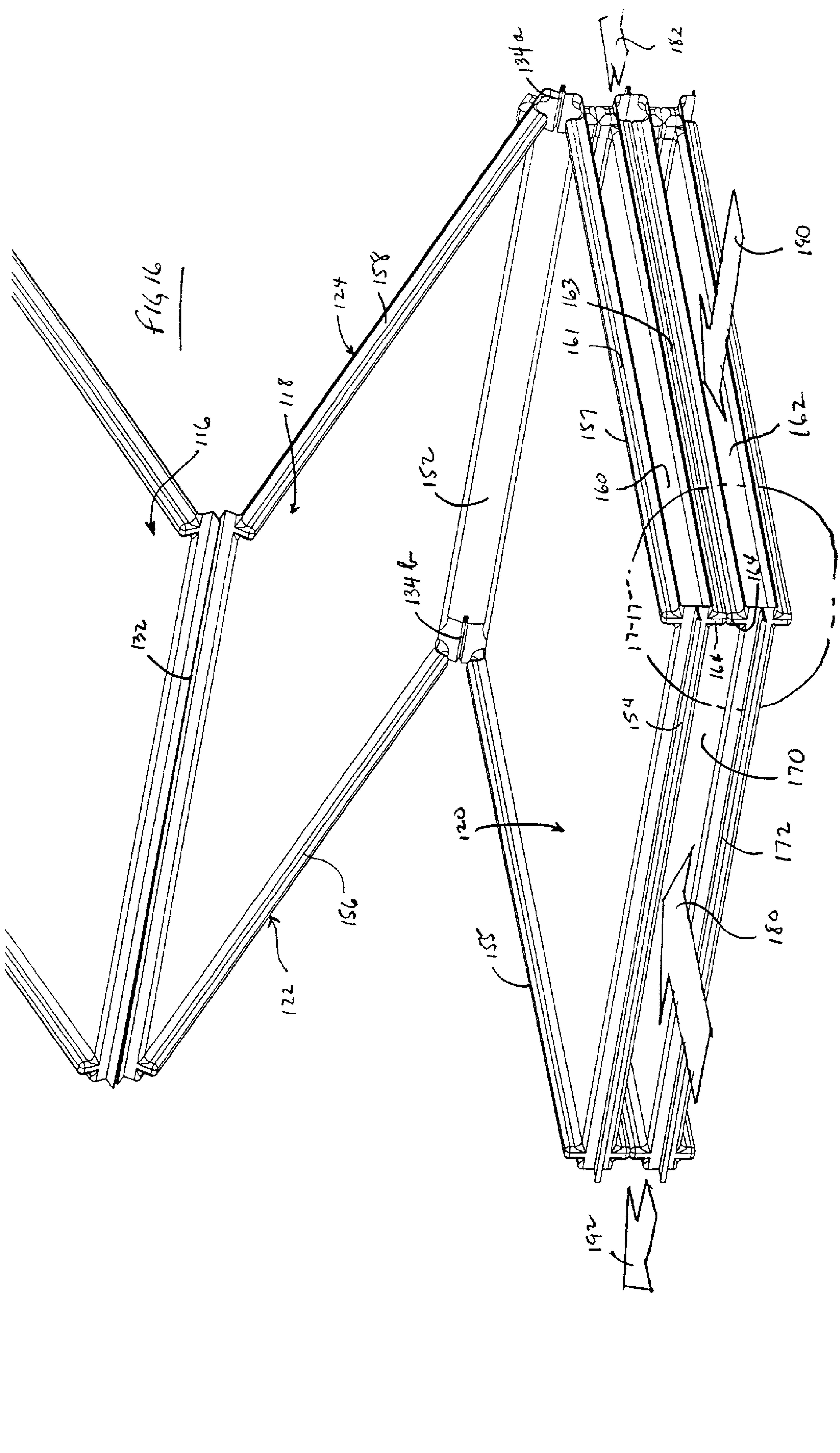


FIG 16
116
118
124
158
134a
182
190
161
163
157
162
160
152
132
134b
164
17-17
154
170
120
172
156
122
180
155
192

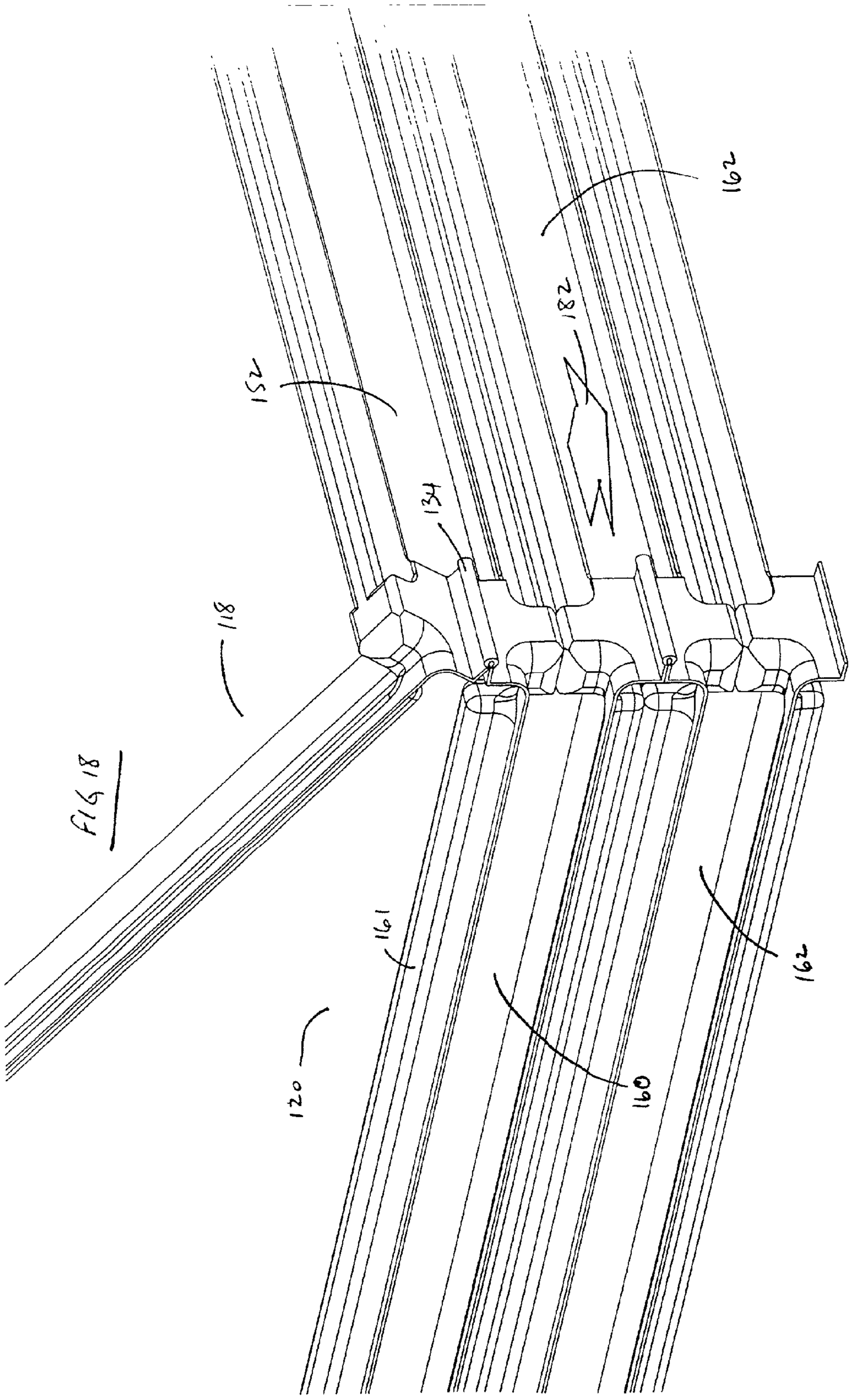
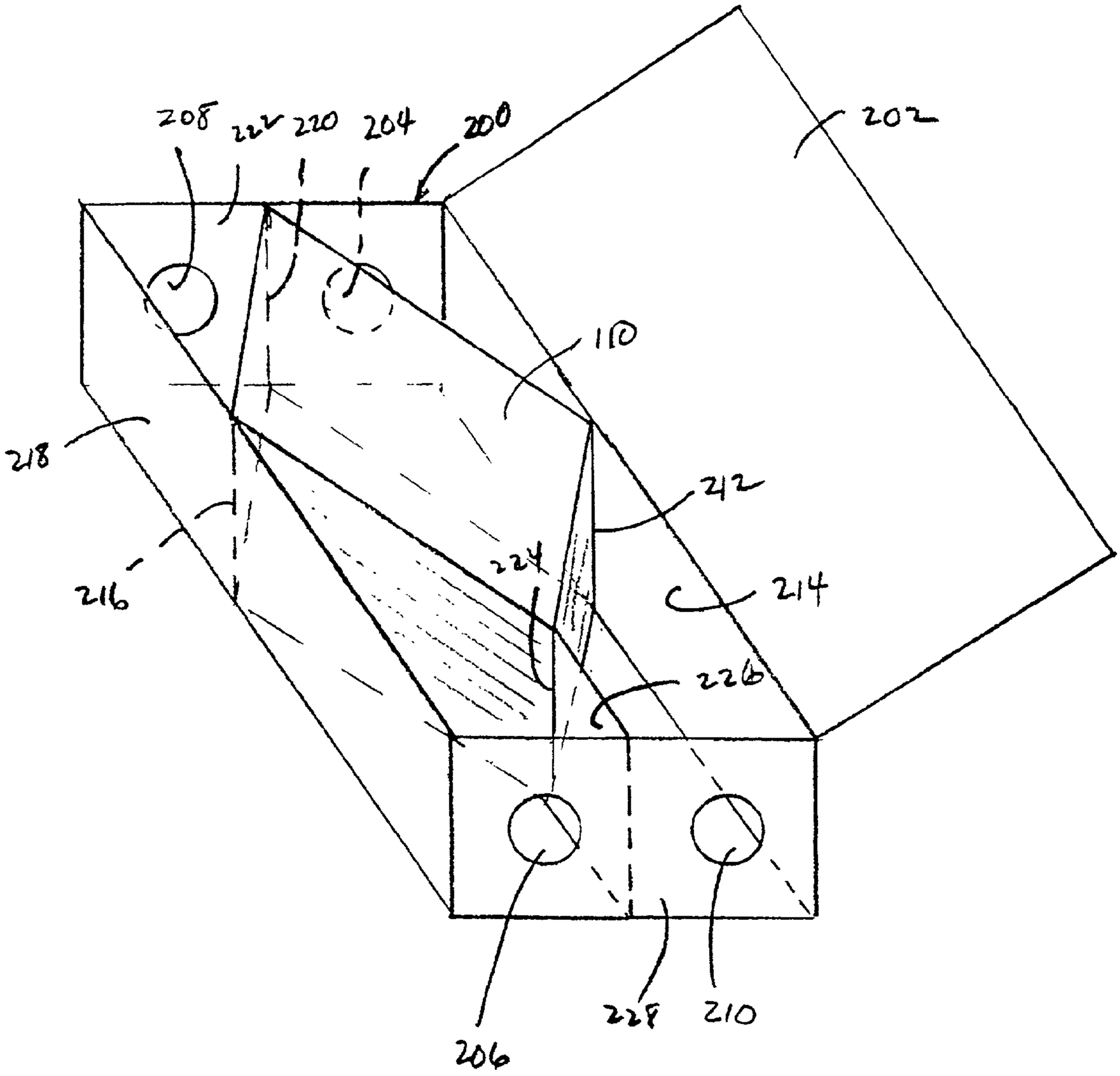


FIG 18

FIG 19



PLASTIC HEAT EXCHANGER AND CORE THEREOF

BACKGROUND OF THE INVENTION

[0001] 1. Field Of The Invention

[0002] The present invention relates to a heat exchanger and a core thereof and more particularly to an economical heat exchanger and core which are simple, reliable and easy to assemble.

[0003] 2. Description Of The Related Art

[0004] Heat exchangers are used in many applications and are made of different materials, most notably metal and plastic. Such heat exchangers are disclosed in U.S. Pat. Nos. 6,119,768, 4,997,031; 4,907,648; 4,874,035; 4,858,685; 4,820,468; 4,738,311; and GB 2158569, and PCT Applications SE82/00393 and GB98/03368. Typically, metal heat exchangers are relatively expensive. Plastic heat exchangers tend to be more economical. Examples of recent plastic heat exchangers are shown in U.S. Pat. Nos. _____ (09/665,462) and _____ (09/664,624). In PCT/GB98/03368 the heat exchanger core is formed of identical sheets of plastic where every other sheet is rotated 90 degrees to construct a cross flow type heat exchanger. As is apparent, there continues to be efforts to create an economical, simply constructed and easily assembled heat exchanger to bring costs down and to enhance operation.

BRIEF SUMMARY OF THE INVENTION

[0005] The difficulties encountered in the past have been overcome by the present invention. What is described here is a heat exchanger comprising an outer housing, an elongated strip of synthetic resin material located in the outer housing, the strip having a longitudinal axis. The elongated strip also has longitudinal sides and lateral sides and is divided into a plurality of panels. A plurality of hinges is formed in the elongated strip where each of the plurality of hinges extends generally perpendicular to the longitudinal axis and connecting lateral sides of adjacent panels. Alternate hinges are bendable in opposite directions so that the elongated strip assumes an accordion folded disposition. Each of the plurality of panels is aligned generally parallel to and spaced from adjacent panels of the plurality of panels when folded and the plurality of panels forms first and second passages between adjacent pairs of panels where one panel of each of the adjacent pairs of panels is common to both adjacent pairs. Latitudinal sides of a pair of adjacent panels opposite a hinge connecting them form a closure.

[0006] There are a number of advantages, features and objects achieved with the present invention which are believed not to be available in earlier related devices. For example, one advantage is that the present invention provides an economical heat exchanger and core. Another object of the present invention is to provide an economical heat exchanger and core which is simply constructed and easily assembled. Still another feature of the present invention is to provide an economical heat exchanger and core which may be easily disassembled, cleaned and reassembled.

[0007] A more complete understanding of the present invention and other objects, advantages and features thereof will be gained from a consideration of the following description of the preferred embodiment read in conjunction with the accompanying drawing provided herein.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0008] **FIG. 1** is a plan view of a flat strip of synthetic resin material formed as disclosed herein.

[0009] **FIG. 2** is an enlarged broken sectional view taken along line **2-2** of **FIG. 1**.

[0010] **FIG. 3** is an enlarged broken sectional view taken along line **3-3** of **FIG. 1**.

[0011] **FIG. 4** is an enlarged broken sectional view taken along line **4-4** of **FIG. 1**.

[0012] **FIG. 5** is a front isometric view of a partially folded heat exchanger core made from the flat strip illustrated in **FIG. 1**.

[0013] **FIG. 6** is a rear isometric view of the partially folded heat exchanger core shown in **FIG. 5**.

[0014] **FIG. 7** is a downward looking isometric view of the heat exchanger core shown in **FIGS. 5 and 6**, but in a fully folded position.

[0015] **FIG. 8** is an exploded isometric view of the heat exchanger core shown in FIGS. **5-7** installed in a heat exchanger housing.

[0016] **FIG. 9** is a plan view of another embodiment of a flat strip of synthetic resin material formed as disclosed herein.

[0017] **FIG. 10** is a sectional view taken along line **10-10** of **FIG. 9**.

[0018] **FIG. 11** is a sectional view taken along line **11-11** of **FIG. 9**.

[0019] **FIG. 12** is a sectional view taken along line **12-12** of **FIG. 9**.

[0020] **FIG. 13** is an enlarged view taken within the circle **13-13** of **FIG. 11**.

[0021] **FIG. 14** is an enlarged view taken within the circle **14-14** of **FIG. 11**.

[0022] **FIG. 15** is a right side, downward looking isometric view of a partially folded heat exchanger core shown in FIGS. **9-14**.

[0023] **FIG. 16** is an enlarged left side, downward looking isometric view of the heat exchanger core shown in **FIG. 15**.

[0024] **FIG. 17** is an enlarged view of a portion of the heat exchanger core taken within the circle **17-17** of **FIG. 16**.

[0025] **FIG. 18** is an enlarged view of the heat exchanger core taken within the circle **18-18** of **FIG. 15**.

[0026] **FIG. 19** is an isometric view of the heat exchanger core of FIGS. **9-18** placed in a housing.

DETAILED DESCRIPTION OF THE INVENTION

[0027] While the present invention is open to various modifications and alternative constructions, the preferred embodiments shown in the drawing will be described herein

in detail. It is understood, however, that there is no intention to limit the invention to the particular forms disclosed. On the contrary, the intention is to cover all modifications, equivalent structures and methods, and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

[**0028**] The simplicity and economical features of the present invention are apparent by referring to FIGS. **1-4**. There is illustrated a portion of a formed elongated strip **10** of synthetic resin material. For purposes of orientation, a longitudinal axis **12** for the strip is illustrated in phantom line. The elongated strip portion is shown divided into four panels **14**, **16**, **18**, **20** with each panel having opposed longitudinal sides and opposed latitudinal sides, such as the longitudinal sides **22**, **24** of the panel **18** and the latitudinal sides **26**, **28** of the same panel. Each panel has two longitudinal and two latitudinal sides. It is further to be understood that while only four panels are illustrated, the elongated strip will usually contain far more panels as will be explained hereinbelow. Between adjacent panels is an integral hinge, such as the hinge **30** between the panels **14** and **16**, the hinge **32** between the panels **16** and **18** and the hinge **34** between the panels **18** and **20**. Also, as will be shown in detail below, the hinges are made to fold in alternate directions to achieve an accordion like disposition when the strip is folded at the hinges during assembly.

[**0029**] The longitudinal sides **22**, **24** are each divided into first and second generally equal portions. For example, the longitudinal side **22** includes a first portion **40** and a second portion **42**. In a like manner, the longitudinal side **24** includes a first portion **44** and a second portion **46**. As shown more clearly in **FIGS. 2 and 3**, each portion of the longitudinal sides includes a bent border but in an alternating fashion. For example, the longitudinal side portion **40** has a downward or closed bend whereas the longitudinal side portion **42** has an upward or open bend. The opposite longitudinal side portions of a panel are bent in opposing directions. For example, the longitudinal side portion **44** is bent upwardly or in an open position whereas the longitudinal side portion **46** is bent downwardly or in a closed position. The concept of opened and closed portions will also be explained in more detail below. Each of the latitudinal sides, such as the sides **26**, **28** has a raised border which will act as a spacer to separate the adjacent panels when the strip is folded. The latitudinal sides of each panel are integrally formed adjacent a hinge except for the end latitudinal sides **50**, **52** of the end panels **14**, **20**, respectively of the strip.

[**0030**] Referring now to **FIGS. 5 and 6**, the elongated strip **10** is shown enlarged and in a partially folded position where the folded hinges bend in alternate directions, accordion-like. It can now be appreciated that the longitudinal side portions alternately provide openings to form first and second sets of fluid flow passages through the folded stack of panels, the fluid flow passages being generally parallel to the latitudinal sides of the panels. For example, the first portion **44***a* of the longitudinal side **24***a* of the panel **14** is bent downwardly to meet the upwardly slanting second portion **46***b* of the longitudinal side **24***b* of the panel **16**. When these side portions come together, a closure is formed against fluid flow entering or leaving through the left side portion of the space between the panels **14**, **16** as viewed in **FIG. 5**. The right side portion of the space, however, formed by the side portion **46***a* and the side portion **44***b* are bent upwardly so as to provide an opening to fluid flow on the right side between the panels **14** and **16**. On the opposite longitudinal side of the panel, the edge portions **40***a* and **42***b* are bent upwardly to form an opening whereas the edge portions **42***a* and **40***b* are bent downwardly to form a closure.

[**0031**] Referring to the latitudinal sides **28** and **26***a* surrounding the hinge **34**, **FIG. 4**, it is seen that there are raised borders for the purpose of spacing adjacent panels from one another. This can be seen by way of example between the two panels **18**, **20**, **FIG. 6**. It can also now be observed by referring to **FIG. 5** that the hinges alternate in the direction of folding from counterclockwise to clockwise to counterclockwise, etc. When the elongated strip is fully folded as shown in **FIG. 7**, two sets of fluid passages are formed. This is clearly shown in **FIG. 6** where there is formed a first set of fluid passages, exemplified by the passage **60** formed between the panels **18** and **20**, and a second set of fluid passages, exemplified by the passage **62** formed between the panel **20** and its adjacent panel **64**. A passage identical to the passage **62** is also formed between the panels **16** and **18** whereas an identical passage to the passage **60** is formed between the panels **14** and **16**. The two types of passages alternate between adjacent pairs of panels where one panel of the adjacent pairs is common to both pairs. Thus, the two pairs of panels **14**, **16** and **16**, **18** have the panel **16** in common. It is also noted that because of the alternating design, the set of passages, like the passage **60**, is open on the right side of the stacked panels when viewed from the front (**FIG. 5**) and is open on the right side when viewed from the rear (**FIG. 6**). Stated another way, the passages "cross" the panels when moving in a direction generally perpendicular to the longitudinal axis **12** of the strip. In a similar but opposite manner the other set of passages, like the passage **62**, also cross the panel. Nevertheless, most of the flows in the passages are such that it can be said that the core produced is of the counterflow variety.

[**0032**] It has already been disclosed that alternate portions of the longitudinal sides of the panels are closed and open. Referring now to the latitudinal sides, they are, in all cases, closed. For example, each of the hinges **30**, **32**, **34** connect adjacent panels as a solid integral piece. Further, between hinges a closure is formed by abutting raised latitudinal sides, such as the sides **26***b*, **28**, **FIGS. 5 and 6**. In a similar manner a closure or seal **68**, **FIG. 6**, is formed along the latitudinal sides of the panels **18** and **20**.

[**0033**] When the elongated strip is fully folded as shown in **FIG. 7**, two sets of fluid flow passages are formed which alternate along the stack as exemplified by the fluid flow passages **60**, **62**. The passages are formed between alternate pairs of panels and by the structure of the individual panels and related hinges. Seals or closures are formed by abutting panels to keep the two sets of fluid passages separate. Thus, a fluid flow entering from the front, right side through the passage **60** is separated from another fluid flow entering from the rear, left side through the passage **62**. This latter fluid flow will exit from the left, front side of the stacked panels. The flow passages are sealed because the hinges are solid material and the contacting portions of opposite latitudinal sides may be pressed together to prevent leakage. Or, an adhesive may be used to seal the contacting portions or heat may be used to cause bonding of these portions. The flow passages are further separated by the panels them-

selves. It is readily understood that if lower as a function of the desired heat transfer. The same is true of the dimensions of the panels. These may also change depending upon the heat transfer characteristics desired.

[**0034**] The simplicity and versatility of the present invention is shown by reference to FIGS. **9-18**. There is illustrated another embodiment of a heat exchanger core which is similar to the embodiment illustrated in FIGS. **1-8** except that the second embodiment is for a cross-flow heat exchanger rather than a counterflow heat exchanger. There is illustrated a portion of an elongated strip **110** of synthetic resin material having a longitudinal axis **112**. The elongated strip is formed into a series of connected or integral panels **114, 116, 118, 120**. Each of the panels includes longitudinal sides and latitudinal sides, such as the longitudinal sides **122, 124** and latitudinal sides **126, 128** of the panel **118**. Hinges **130, 132, 134** are formed integral with the panels and are positioned between panels to allow the strip to be alternately folded in an accordion fashion. The longitudinal and latitudinal sides have raised borders so that when folded, each panel is spaced from an adjacent panel whereby fluid flow passages between panels are created.

[**0035**] The most striking difference between the heat exchanger core embodiment shown in **FIG. 1** and that shown in **FIG. 9** is that the core in **FIG. 9** has a region of every second hinge which is mostly open. When the elongated strip is folded, this opening forms an inlet or outlet for a fluid flow passage. Also, longitudinal sides of the panels either form a closure or an opening. In this manner, two series or sets of fluid flow passages are provided, the passages being at right angles to each other. One set of passages conducts flows parallel to the longitudinal axis **112** whereas the other set of passages conducts flows perpendicular to the first mentioned set and to the longitudinal axis.

[**0036**] Referring to FIGS. **9-16** in more detail, the openings between the panels are seen in more detail. For example, between the panel **114** and the panel **116** the hinge **130** includes a forward portion **130***a* and a rearward portion **130***b* separated by an opening **150**. The hinge **132** extends across the strip of material without any opening. The hinge **134** is also divided between a forward portion **134***a*, a rearward portion **134***b* and a central opening **152**. Following the open hinge **134** is a closed hinge **154** which is identical to the hinge **132**. In this fashion, closed and open hinges alternate with each other.

[**0037**] Referring again to **FIG. 16**, the raised borders **156, 158** are illustrated along the upper and lower longitudinal sides **122, 124**, respectively, of the panel **118**. The longitudinal sides of the adjacent panel **120** also include projecting borders **155, 157**. When the projecting borders **155, 157** of the panel **120** engage or abut the projecting borders **156, 158** of the panel **118**, closures are formed longitudinally. However, between the adjacent pair of panels **116, 118**, the longitudinal sides do not have raised or abutting borders and thus openings are formed. Referring now to **FIGS. 17 and 18**, the alternating openings **160, 162** in the longitudinal sides between panels is shown alternating with closed or sealed longitudinal sides **161, 163** caused by raised or projecting borders, such as the raised borders **164, 166**. The latitudinal sides have openings, such as the opening **170**, alternating with closed hinges, such as the hinges **154, 172**. As with the earlier embodiment, nesting elements of two panels may also be used to close sides of the panels to fluid flow.

[**0038**] The cross flow may best be seen by reference to FIGS. **16-18** where a fluid flow passage having the opening **170**, parallel to the longitudinal axis, has an inlet, depicted by an inlet arrow **180**, and an outlet, depicted by an outlet arrow **182**. A fluid flow passage having the opening **162** includes an inlet, depicted by the inlet arrow **190**, and an outlet, depicted by the outlet arrow **192**, **FIG. 16**.

[**0039**] Referring to **FIG. 19**, there is illustrated the folded stacked strip **110** forming a core. The core is positioned in a heat exchanger housing **200** having a cover **202**, a first inlet **204**, a first outlet **206**, a second inlet **208** and a second outlet **210**. One comer **212** of the core is sealed against a wall **214** of the housing, an opposing comer **216** of the core is sealed to an opposite wall **218**, a third comer **220** of the core is sealed to a third wall **222** and a fourth comer **224** of the core is connected to a partition **226** which is sealed to a fourth wall **228**. This arrangement also allows for oppositely directed fluid flows if desired.

[**0040**] In operation, the core is formed from a long strip of PVC material which is formed by any suitable process, such as vacuum forming or embossing, to fold in an accordion-like fashion. The folded core may be used as is and placed in a heat exchanger housing or the abutting borders or edges or surfaces may be bonded and sealed in some fashion such as with an adhesive polymeric cure-in-place compound, a preformed seal system, such as a molded or die-cut gasket or by the use of an RF welder, thermal border or a combination of these or other methods. The heat exchanger housings include two inlets and two outlets which define flow paths to and from the fluid passages formed in the core. In the case of the embodiment shown in FIGS. **1-8**, a counterflow heat exchanger is formed whereas with the embodiment shown in FIGS. **9-19**, a cross-flow heat exchanger is formed.

[**0041**] The specification describes in detail two embodiments of the present invention. Other modifications and variations will, under the doctrine of equivalents, come within the scope of the appended claims. For example, dimensional differences for the core, a greater or lesser number of panels in a core, differences in geometries and the like are all considered equivalent structures. Also, fluid flow directions designated first and second may be perpendicular to each other, or parallel to each, and when parallel, they may be in opposite directions or in the same direction. That is, the first and second directions may be generally the same though separated. Further, the fluid in one flow may be a gas such as air while the fluid in the second flow may be a liquid. These are all equivalent. Still other alternatives will also be equivalent as will many new technologies. There is no desire or intention here to limit in any way the application of the doctrine of equivalents.

1. A heat exchanger core comprising:

an elongated strip of synthetic resin material, said strip having a longitudinal axis;

said elongated strip being divided into a plurality of panels and having longitudinal sides and latitudinal sides;

a plurality of hinges formed in said elongated strip, each of said plurality of hinges extends generally perpendicular to said longitudinal axis and connects latitudinal sides of adjacent panels;

said plurality of hinges being alternately bendable in opposite directions whereby said elongated strip assumes an accordion folded disposition;

when folded, each panel of said plurality of panels is aligned generally parallel to and spaced from adjacent panels, said plurality of panels forming first and second fluid flow passages between adjacent pairs of panels where one panel of each adjacent pair is common to both adjacent pairs; and

said latitudinal sides of a pair of adjacent panels opposite the hinge connecting said pair of adjacent panels form a closure.

2. An apparatus as claimed in claim 1 wherein:

longitudinal sides of every second pair of panels abut each other.

3. An apparatus as claimed in claim 1 wherein:

the entire length of said longitudinal sides of every second pair of adjacent panels abut each other.

4. An apparatus as claimed in claim 2 wherein:

a portion of the length of said longitudinal sides of every pair of adjacent panels are closed.

5. An apparatus as claimed in claim 1 including:

portions of latitudinal and longitudinal sides of each of said plurality of panels include projections for spacing one panel away from an adjacent panel.

6. An apparatus as claimed in claim 5 wherein:

every second hinge includes an opening extending along a portion of said hinge.

7. An apparatus as claimed in claim 5 wherein:

a portion of each longitudinal side of each panel of said plurality of panels abuts a portion of a longitudinal side of an adjacent panel.

8. An apparatus as claimed in claim 7 wherein:

said portion of each longitudinal side of each panel of said plurality of panels that abuts a portion of a longitudinal side of an adjacent panel alternates with another portion of each longitudinal side of each panel of said plurality of panels that abuts another portion of a longitudinal side of an adjacent panel.

9. An apparatus as claimed in claim 1 including:

a plurality of first passages alternating with a plurality of second passages; wherein

said plurality of first passages forms a first fluid flow path;

said plurality of second passages forms a second fluid flow path; and

each portion of the first flow path being separated from an adjacent second flow path by a panel whereby heat from a flowing higher temperature fluid is transferred to a flowing lower temperature fluid through said panel.

10. An apparatus as claimed in claim 4 wherein:

portions of latitudinal and longitudinal sides of each of said plurality of panels include projections for spacing one panel away from adjacent panel; and including

a plurality of first passages alternating with a plurality of second passages; wherein

said plurality of first passages forms a first fluid flow path and said plurality of second passages forms a second fluid flow path, each portion of said flow paths being separated from an adjacent flow path by a panel whereby heat from a flowing higher temperature fluid is transferred to a flowing lower temperature fluid through said panel.

11. An apparatus as claimed in claim 10 wherein:

a portion of each longitudinal side of each panel of said plurality of panels abuts against a portion of a longitudinal side of an adjacent panel; and

each portion of said longitudinal side of each panel of said plurality of panels that abuts a portion of a longitudinal side of an adjacent panel alternates with another portion of each longitudinal side of each panel of said plurality of panels that abuts another portion of a longitudinal side of an adjacent panel.

12. An apparatus as claimed in claim 3 wherein:

portions of latitudinal and longitudinal sides of each of said plurality of panels include projections for spacing one panel away from adjacent panel; and including

a plurality of first passages alternating with a plurality of second passages; and

said plurality of first passages forms a first fluid flow path and said plurality of second passages forms a second fluid flow path, each portion of said fluid flow paths being separated from an adjacent flow path by a panel whereby heat from a flowing higher temperature fluid is transferred to a flowing lower temperature fluid through said panel.

13. An apparatus as claimed in claim 12 wherein:

every second hinge includes an opening extending along a portion of said hinge.

14. A heat exchanger comprising:

an outer housing;

an elongated strip of synthetic resin material located in said outer housing, said strip having a longitudinal axis;

said elongated strip having longitudinal sides and latitudinal sides and being divided into a plurality of panels;

a plurality of hinges formed in said elongated strip, each of said plurality of hinges extending generally perpendicular to said longitudinal axis and connecting latitudinal sides of adjacent panels;

said plurality of hinges being alternately bendable in opposite directions whereby said elongated strip assumes an accordion folded disposition;

when folded, each panel of said plurality of panels is aligned generally parallel to and spaced from adjacent panels of said plurality of panels, said plurality of panels forming first and second fluid flow passages between adjacent pairs of panels where one panel of each adjacent pair is common to both adjacent pairs; and

said latitudinal sides of a pair of adjacent panels opposite the hinge connecting said pair of adjacent panels form a closure.

15. An apparatus as claimed in claim 14 wherein:

longitudinal sides of every pair of adjacent panels abut each other.

16. An apparatus as claimed in claim 14 wherein:

the entire length of said longitudinal sides of every second pair of panels abuts each other.

17. An apparatus as claimed in claim 15 wherein:

a portion of the length of said longitudinal sides of every pair of adjacent panels abut each other.

18. An apparatus as claimed in claim 14 including:

portions of latitudinal and longitudinal sides of each panel of said plurality of panels include projections for spacing one panel away from an adjacent panel.

19. An apparatus as claimed in claim 18 wherein:

every second hinge includes an opening.

20. An apparatus as claimed in claim 18 wherein:

a portion of each longitudinal side of each panel of said plurality of panels abuts a portion of a longitudinal side of an adjacent panel.

21. An apparatus as claimed in claim 20 wherein:

said portion of each longitudinal side of each panel of said plurality of panels that abuts a portion of a longitudinal side of an adjacent panel alternates with another portion of each longitudinal side of each panel of said plurality of panels that abuts another portion of a longitudinal side of an adjacent panel.

22. An apparatus as claimed in claim 14 including:

a plurality of first passages alternating with a plurality of second passages; and wherein

said plurality of first passages forming a first fluid flow path and said plurality of second passages forming a second fluid flow path, each portion of said flow paths being separated from an adjacent flow path by a panel whereby heat from a flowing higher temperature fluid is transferred to a flowing lower temperature fluid through said panel.

23. An apparatus as claimed in claim 17 wherein:

portions of latitudinal and longitudinal sides of each of said plurality of panels include projections for spacing one panel away from an adjacent panel; and including

a plurality of first passages alternating with a plurality of second passages; and wherein

said plurality of first passages forming a first fluid flow path and said plurality of second passages forming a second fluid flow path, each portion of said fluid flow paths being separated from an adjacent flow path by a panel whereby heat from a flowing higher temperature fluid is transferred to a flowing lower temperature fluid through said panel.

24. An apparatus as claimed in claim 23 wherein:

a portion of each longitudinal side of each panel of said plurality of panels abuts a portion of a longitudinal side of an adjacent panel; and

said portion of each longitudinal side of each panel of said plurality of panels that abuts a portion of a longitudinal side of an adjacent panel alternates with another portion of each longitudinal side of each panel of said plurality of panels that is sealed to another portion of a longitudinal side of an adjacent panel.

25. An apparatus as claimed in claim 16 wherein:

portions of latitudinal and longitudinal sides of each of said plurality of panels include projections for spacing one panel away from an adjacent panel; and including

a plurality of first passages alternating with a plurality of second passages; and wherein

said plurality of first passages forming a first fluid flow path and said plurality of second passages forming a second fluid flow path, each portion of said flow paths being separated from an adjacent flow path by a panel whereby heat from a flowing higher temperature fluid is transferred to a flowing lower temperature fluid through said panel.

26. An apparatus as claimed in claim 25 wherein:

every second hinge includes an opening.

27. A heat exchanger core comprising:

an elongated strip of synthetic resin material, said strip having a longitudinal axis;

a plurality of panels formed in said strip of material;

a plurality of integral hinges formed in said strip of material, each of said plurality of hinges formed between two adjacent panels, said strip of material being folded in an accordion style;

first fluid flow passages formed between a first group of pairs of panels; and

second fluid flow passages formed between a second group of pairs of panels, said first group of pairs of panels alternating with said second group of pairs of panels.

28. An apparatus as claimed in claim 27 wherein:

each of said panels includes sides generally parallel to and generally perpendicular to said longitudinal axis; and

at least portions of said sides parallel to said longitudinal axis of each panel abut at least portions of said sides parallel to said longitudinal axis of adjacent panels.

29. An apparatus as claimed in claim 28 wherein:

a side perpendicular to said longitudinal axis of each panel abuts a side perpendicular to said longitudinal axis of an adjacent panel at a location opposite the hinge connecting said first mentioned panel and said adjacent panel.

30. An apparatus as claimed in claim 27 wherein:

every second hinge includes an opening.

31. An apparatus as claimed in claim 27 wherein:

each of said panels includes sides generally parallel to and generally perpendicular to said longitudinal axis; and

every second pair of panels includes borders along said sides parallel to said longitudinal axis that abuts one another.

32. An apparatus as claimed in claim 31 wherein:

every second hinge includes an opening.

33. A heat exchanger comprising:

an outer housing;

an elongated strip of synthetic resin material placed in said housing, said strip having a longitudinal axis;

a plurality of panels formed in said strip of material;

a plurality of integral hinges formed in said strip of material, each of said plurality of hinges formed between two adjacent panels, said strip of material being folded in an accordion style;

first fluid flow passages formed between a first group of pairs of panels; and

second fluid flow passages formed between a second group of pairs of panels, said first group of pairs of panels alternating with said second group of pairs of panels.

34. An apparatus as claimed in claim 33 wherein:

each of said panels includes sides generally parallel to and generally perpendicular to said longitudinal axis; and

at least portions of said sides parallel to said longitudinal axis of each panel abut at least portions of said sides parallel to said longitudinal axis of adjacent panels.

35. An apparatus as claimed in claim 34 wherein:

a side perpendicular to said longitudinal axis of each panel abuts a side perpendicular to said longitudinal axis of an adjacent panel at a location opposite the hinge connecting said first mentioned panel and said adjacent panel.

36. An apparatus as claimed in claim 33 wherein:

every second hinge includes an opening.

37. An apparatus as claimed in claim 33 wherein:

each of said panels includes sides generally parallel to and generally perpendicular to said longitudinal axis; and

every second pair of panels includes borders along said sides parallel to said longitudinal axis that abuts one another.

38. An apparatus as claimed in claim 37 wherein:

every second hinge includes an opening.

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