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(54) FIN PACK, HEAT EXCHANGER, AND METHOD OF PRODUCING SAME

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(57) **ABSTRACT**

A heat exchanger (**40**) includes first and second headers (**44**, **46**). Multiple flat core tubes (**54**) are arranged spaced apart from one another and connected between the headers (**44**, **46**). A fin pack (**56**) has multiple rows (**58**) of fins (**60**) and multiple tabular portions (**62**, **64**). Pairs (**70**, **72**) of adjacent multiple rows (**58**) are interconnected by the tabular portions (**62**, **64**). The tabular portions (**62**, **64**) define channels (**78**) between each of the rows (**58**) of fins (**60**). A method (**90**) for producing the heat exchanger (**40**) entails concurrently inserting multiple core tubes (**54**) into the channels (**78**), with one row of fins (**60**) being disposed between each pair of the core tubes (**54**).

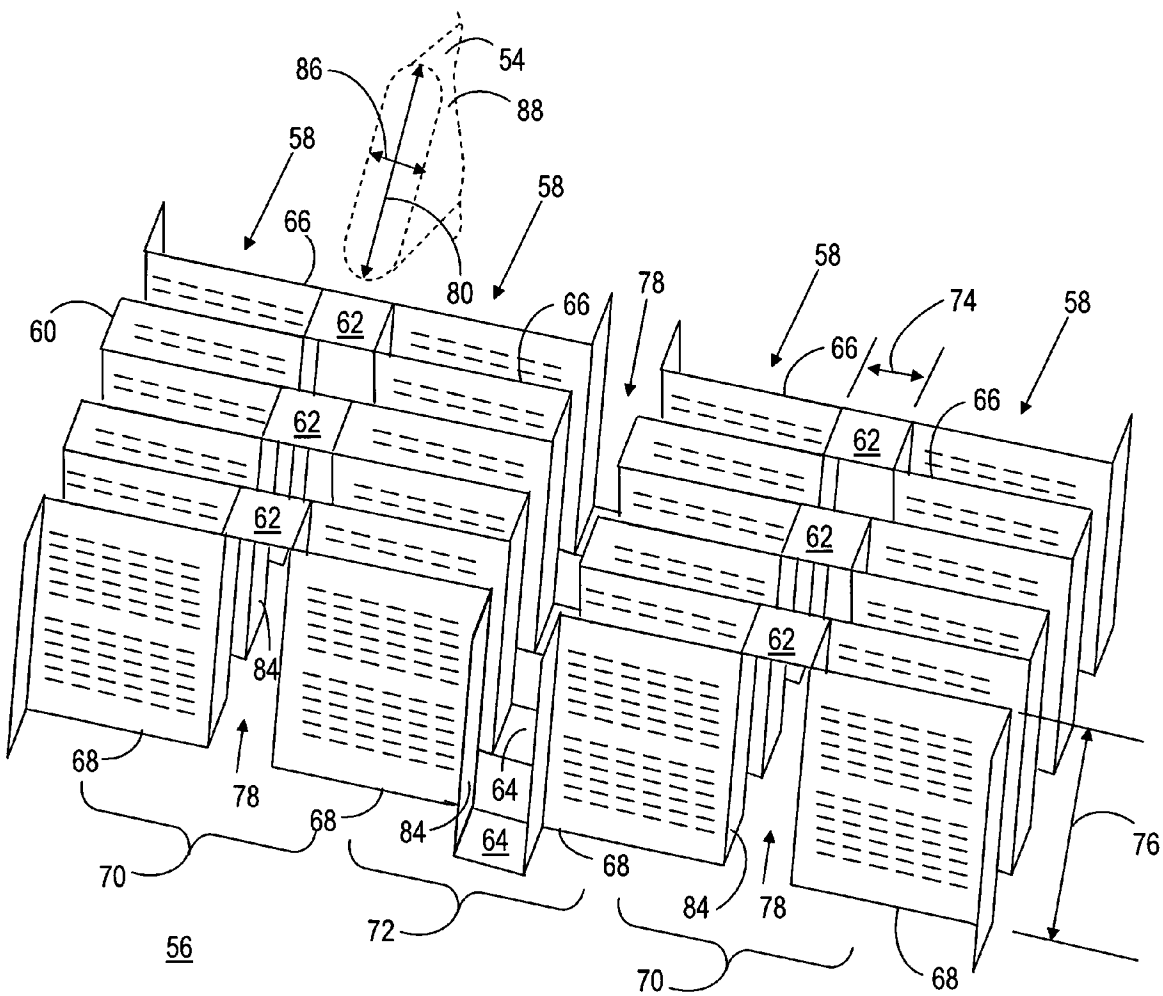
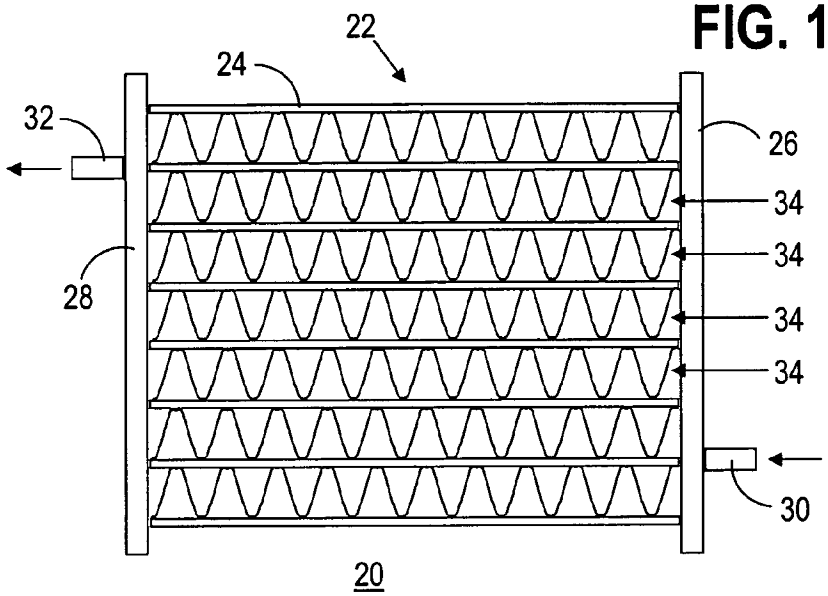
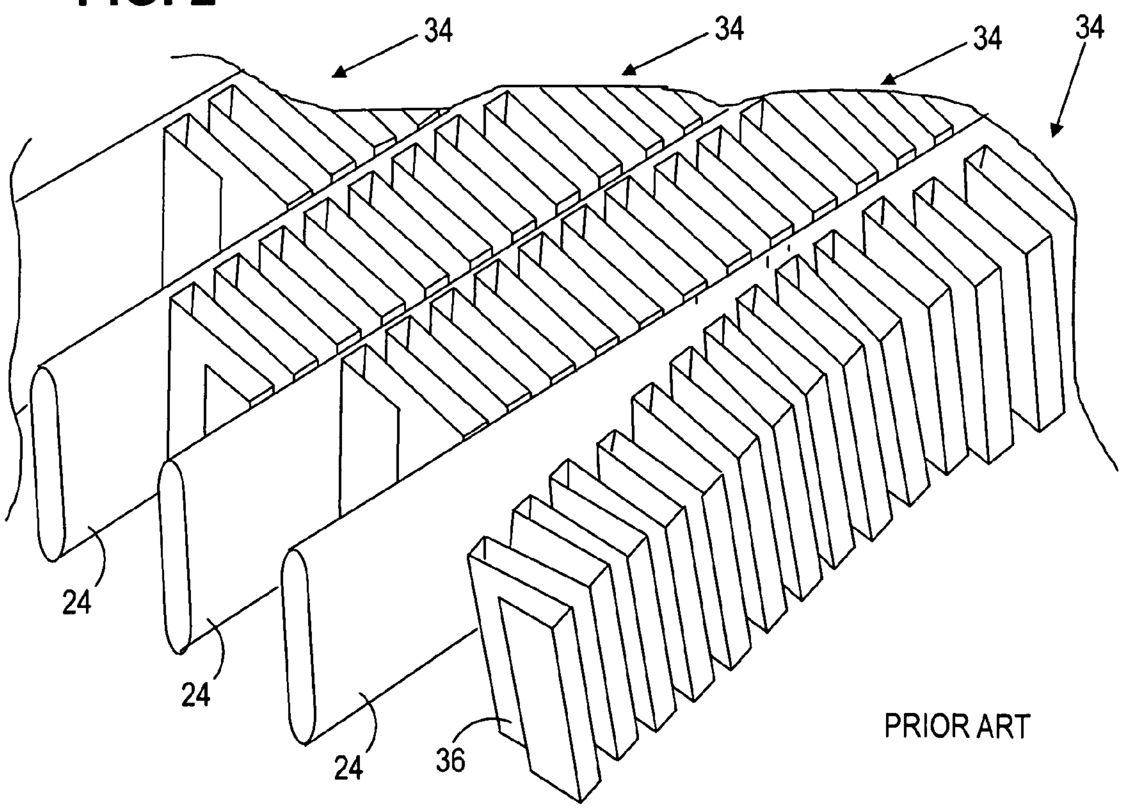


FIG. 1



PRIOR ART

FIG. 2



PRIOR ART

FIG. 3

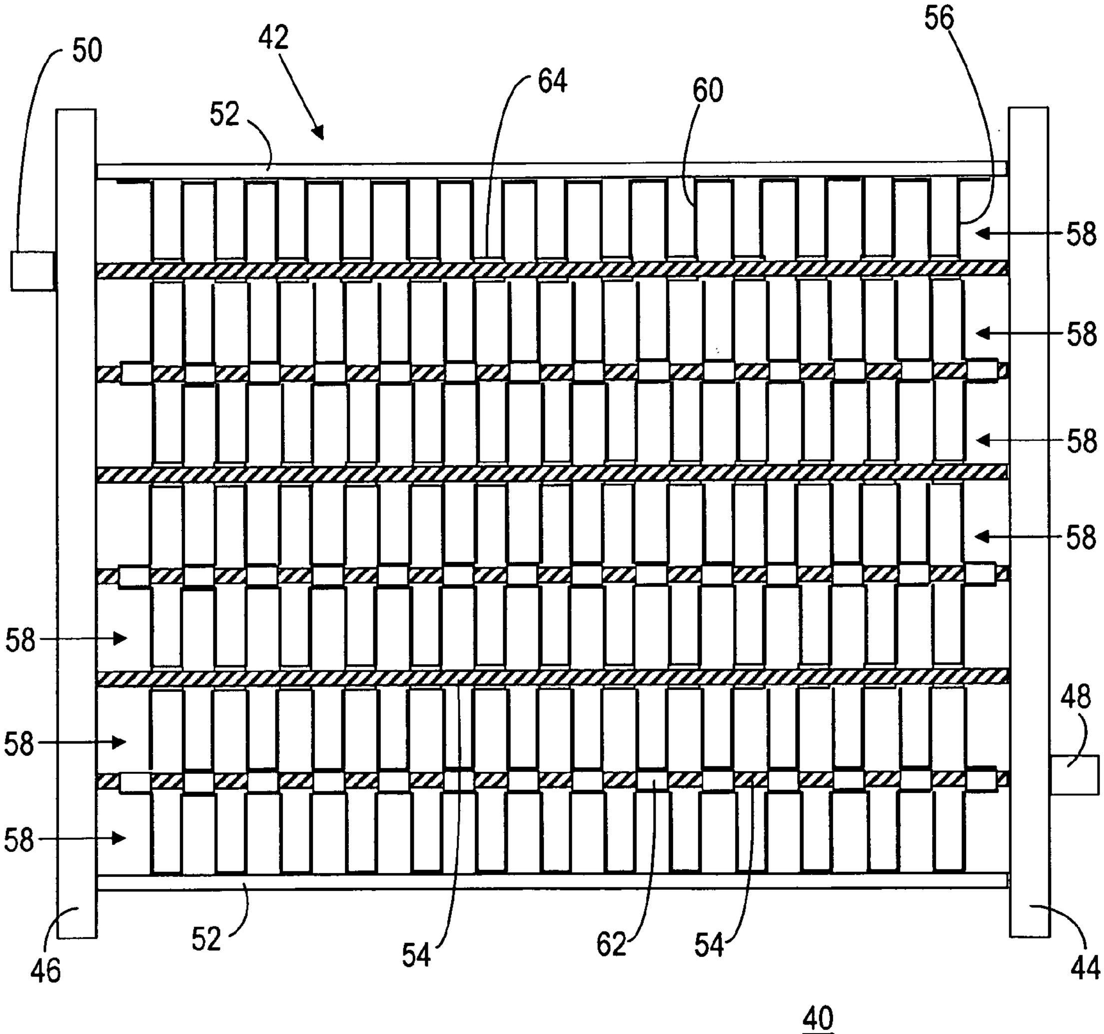


FIG. 4

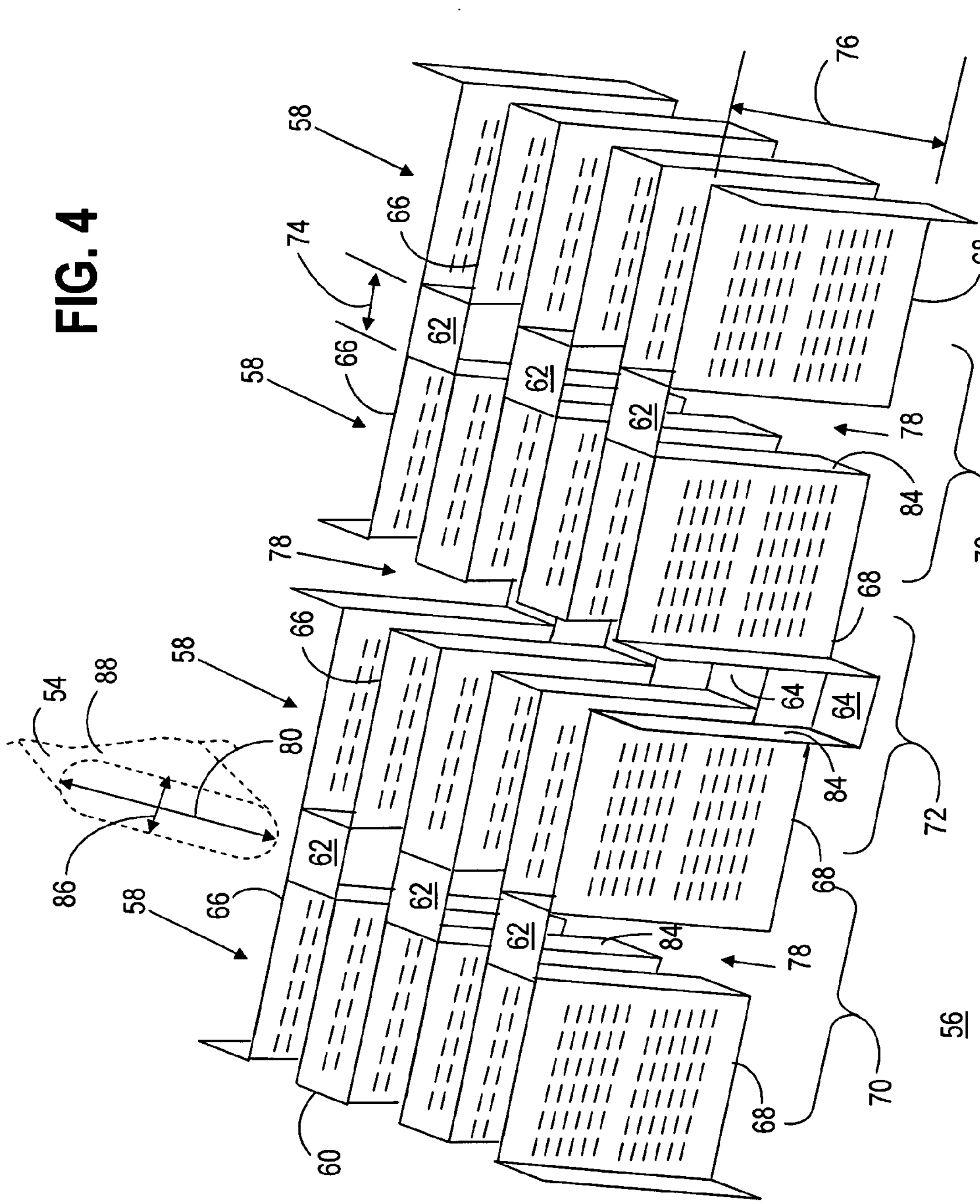
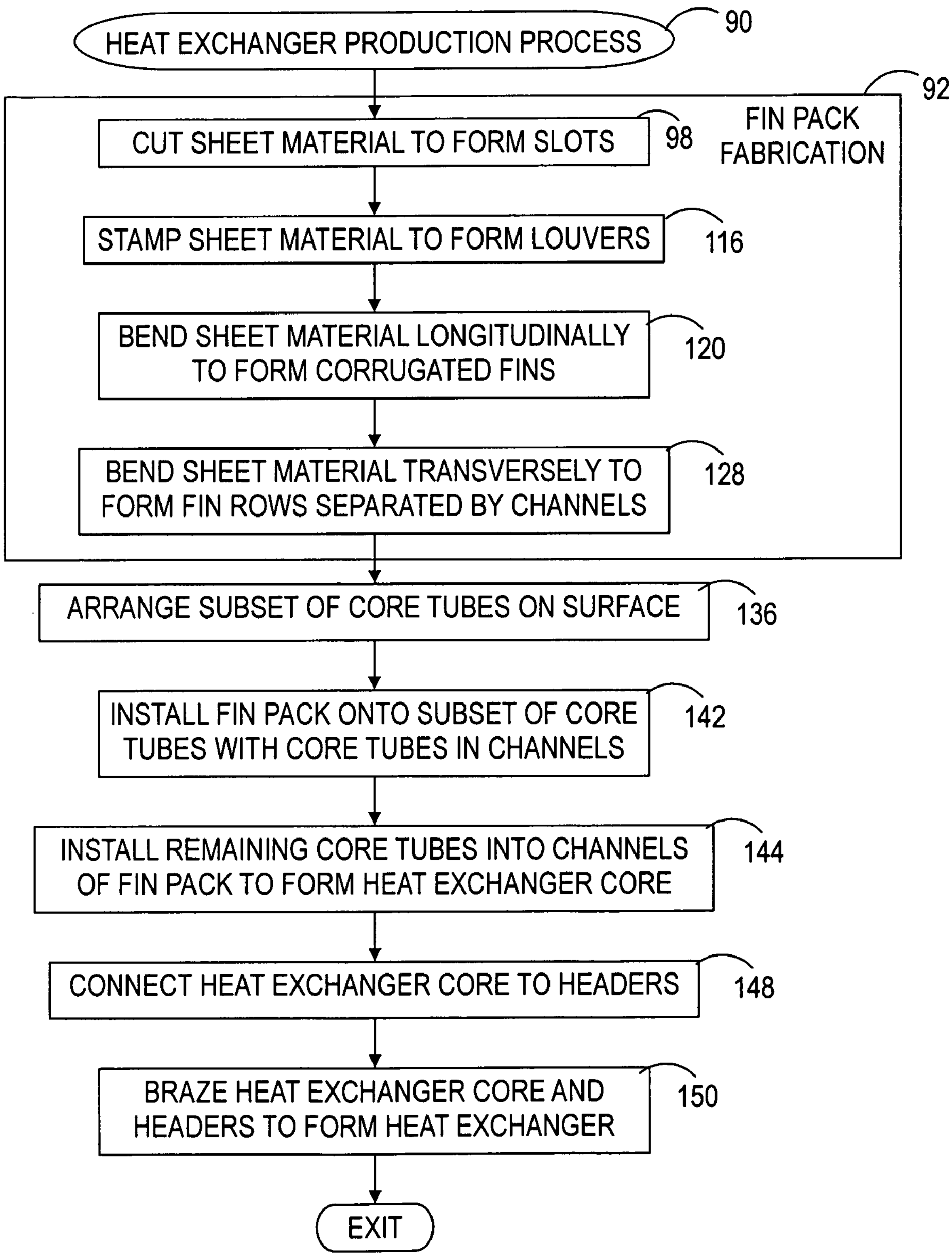


FIG. 5



HEAT EXCHANGER PRODUCTION PROCESS
90
92
FIN PACK FABRICATION
CUT SHEET MATERIAL TO FORM SLOTS
98
STAMP SHEET MATERIAL TO FORM LOUVERS
116
BEND SHEET MATERIAL LONGITUDINALLY TO FORM CORRUGATED FINS
120
BEND SHEET MATERIAL TRANSVERSELY TO FORM FIN ROWS SEPARATED BY CHANNELS
128
ARRANGE SUBSET OF CORE TUBES ON SURFACE
136
INSTALL FIN PACK ONTO SUBSET OF CORE TUBES WITH CORE TUBES IN CHANNELS
142
INSTALL REMAINING CORE TUBES INTO CHANNELS OF FIN PACK TO FORM HEAT EXCHANGER CORE
144
CONNECT HEAT EXCHANGER CORE TO HEADERS
148
BRAZE HEAT EXCHANGER CORE AND HEADERS TO FORM HEAT EXCHANGER
150
EXIT

FIG. 6

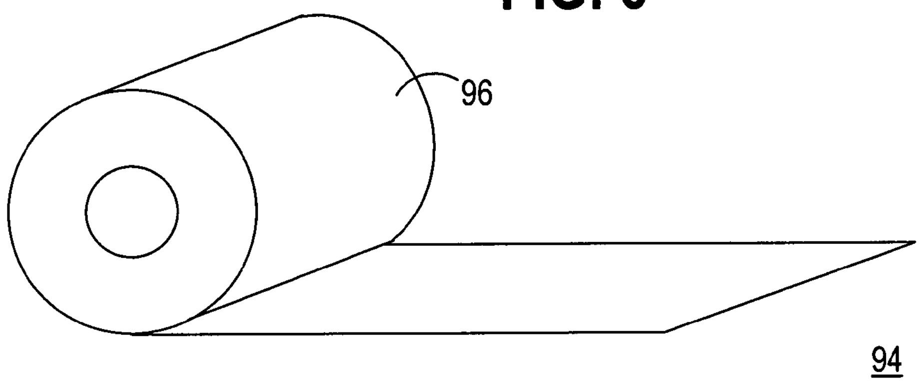


FIG. 7

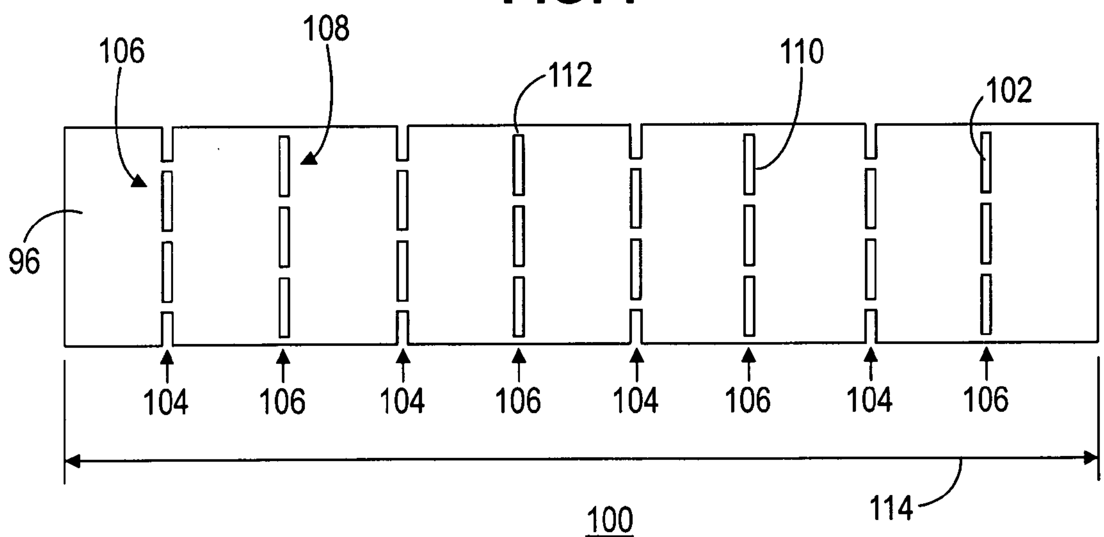


FIG. 8

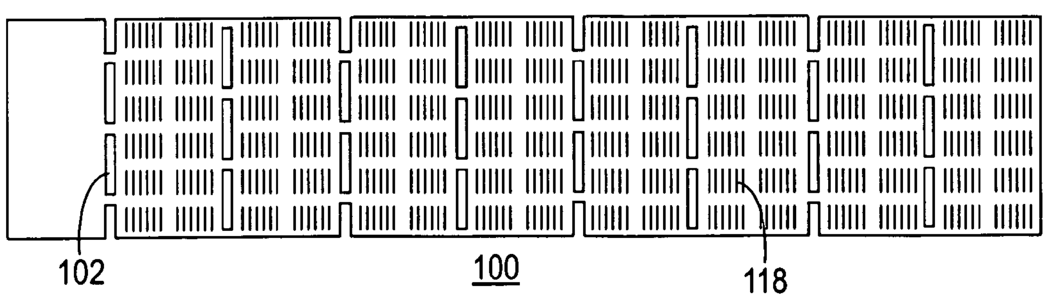


FIG. 9

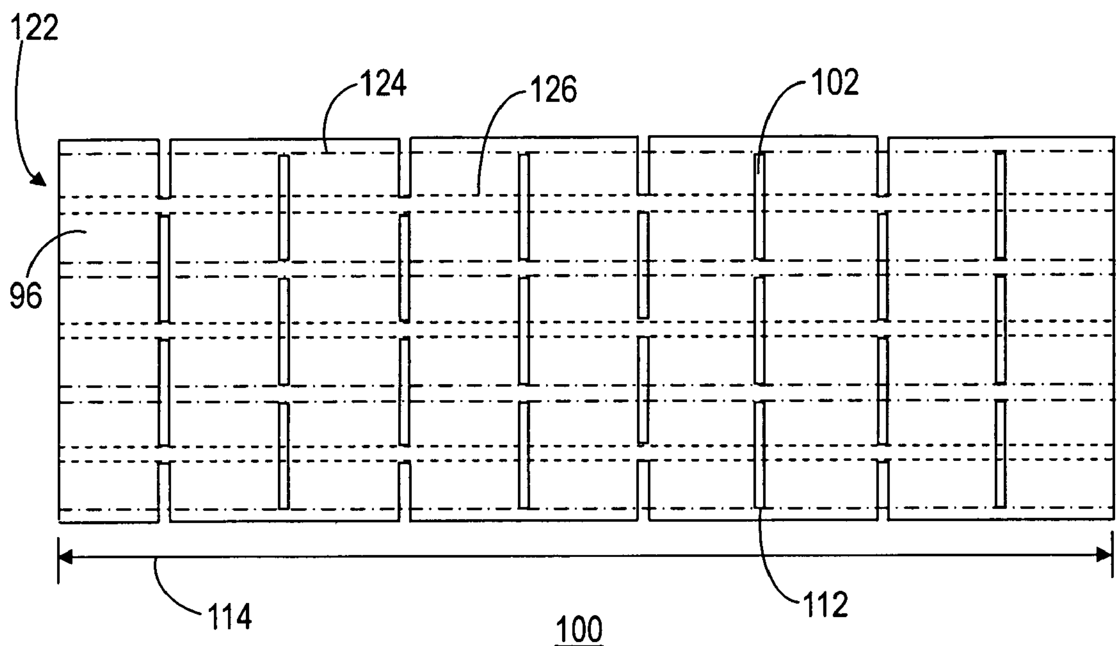


FIG. 10

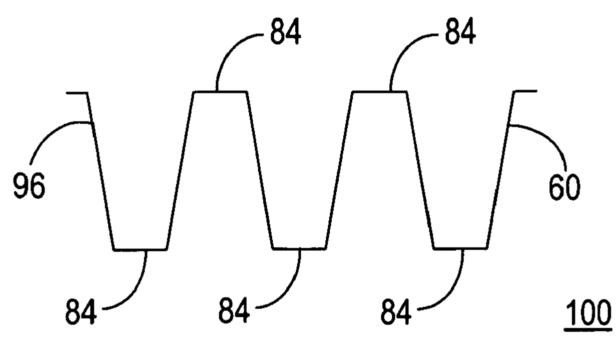


FIG. 11

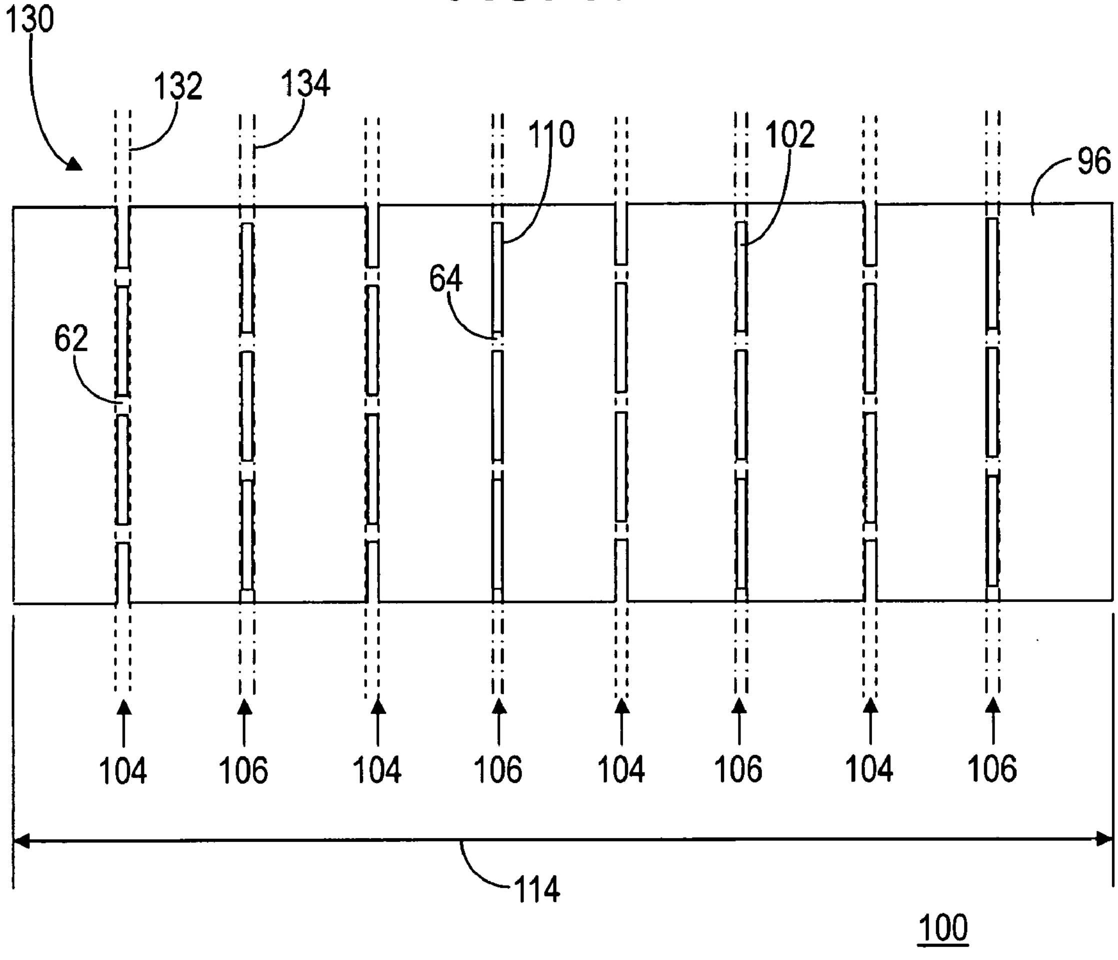

130
132
134
110
102
96
64
62
104
106
104
106
104
106
104
106
114
100

FIG. 12

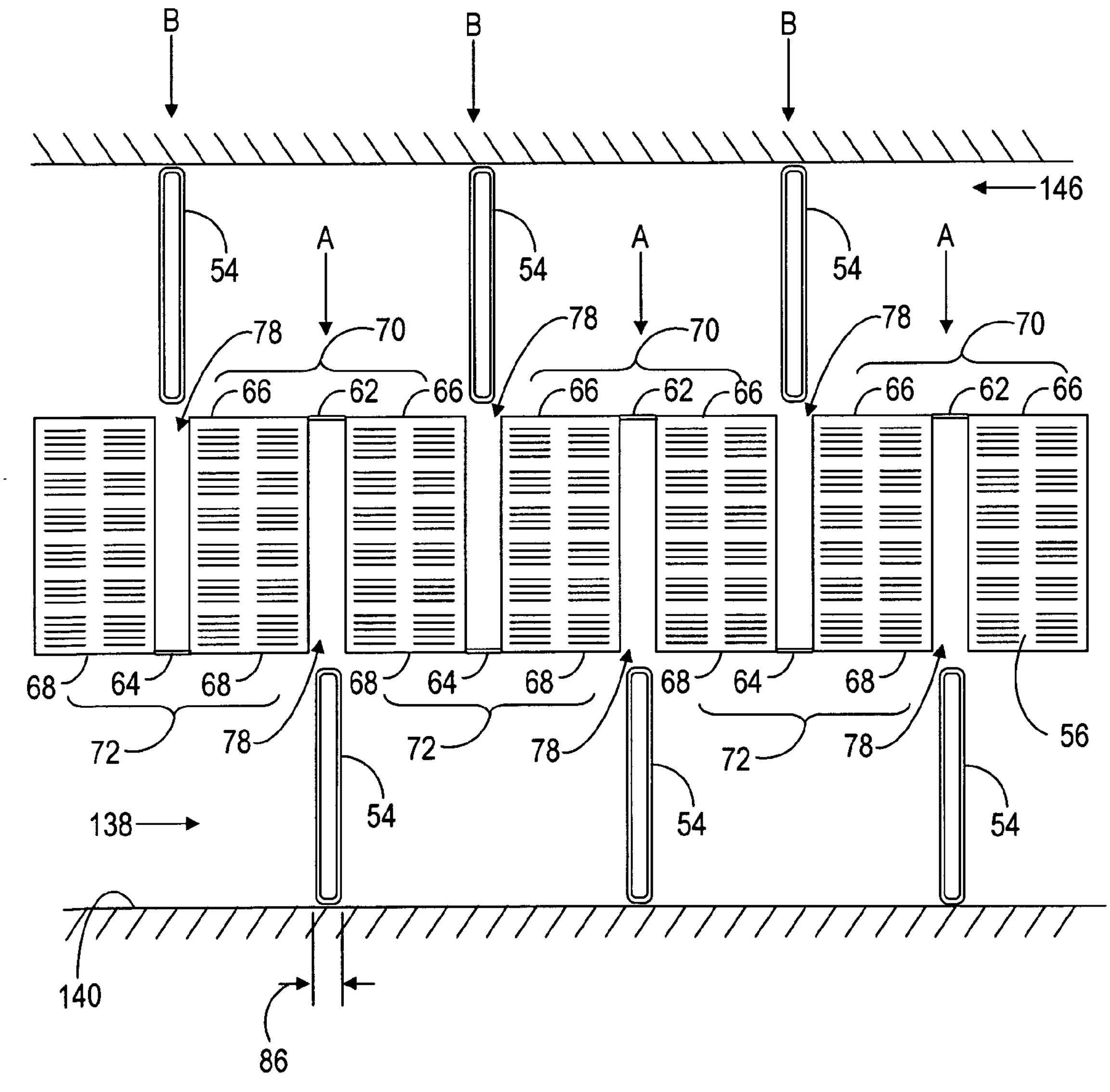
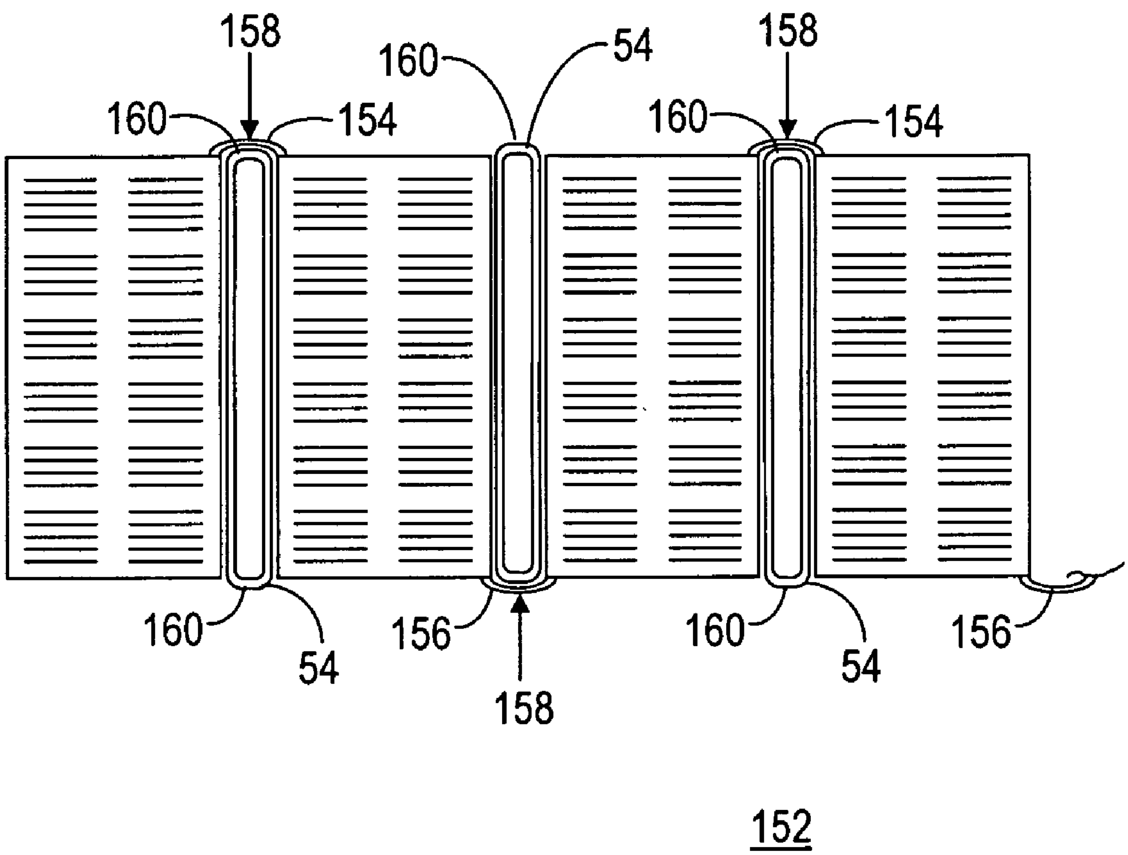

B
B
B
146
54
54
54
A
A
A
78
70
78
70
78
70
66
62
66
66
62
66
66
62
66
68
64
68
68
64
68
68
64
68
72
78
72
78
72
78
56
138
54
54
54
140
86

FIG. 13



FIN PACK, HEAT EXCHANGER, AND METHOD OF PRODUCING SAME

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to the field of heat exchangers. More specifically, the present invention relates to a fin pack having multiple rows of interconnected fins and a method for producing a heat exchanger having such a fin pack.

BACKGROUND OF THE INVENTION

[0002] A heat exchanger is a device which transfers the heat of one substance to another, for example, from a warm or hot surface to a cold or cooler one. Heat exchangers are widely used in industrial processing plants, power plants, air conditioning, vehicles, and the like as evaporators, condensers, and radiators. In a simple form, a heat exchanger includes one or more passages through which a fluid flows while exchanging heat with the environment surrounding the passages.

[0003] One typical heat exchanger entails a tube-and-fin type design that includes a number of fluid filled tubes thermally communicating with fins. The fins enhance the ability of the heat exchanger to transfer heat from the fluid in the tubes to the environment, or vice versa. Design variations include the manner in which the fluid passage is constructed and the type of fin used. For example, the passage may be composed of a number of discrete parallel tubes, joined, typically by brazing, to and between a pair of headers. The fins may be provided in the form of panels having apertures through which the tubes are inserted, or in the form of fin rows that can be positioned between adjacent pairs of tubes.

[0004] Referring to FIGS. **1-2**, FIG. **1** shows a front view of an exemplary prior art tube-and-fin type heat exchanger **20** and FIG. **2** shows a partial perspective view of an exemplary prior art heat exchanger core **22** of heat exchanger **20**. Heat exchanger core **22** includes a number of discrete parallel flat core tubes **24** coupled between first and second headers **26** and **28**, respectively. Inlet and outlet tubes **30** and **32**, respectively, are connected to first and second headers **26** and **28**, for the passage of a fluid, such as a refrigerant.

[0005] Discrete fin rows **34** are positioned between adjacent pairs of core tubes **24**. Each of fin rows **34** is manufactured separately and installed individually between core tubes **24**. The separate manufacturing and individual installation increases cycle time and reduces manufacturing efficiency.

[0006] Conventionally, a heat exchanger, such as heat exchanger **20**, is manufactured by joining tubes **24**, fin rows **34**, and headers **26** and **28**, and other associated components using a brazing operation. Unfortunately, the discrete fin rows **34** can “drop” away from core tubes **24** during the braze cycle. This “drop” is shown in FIG. **2**, in which a first row **36** of fin rows **34** is shown as sagging and partially detached from one of core tubes **24** following brazing. In addition, fin rows **34** can be misaligned during assembly causing a short fin-to-header condition (as shown in FIG. **2**), fin pitches can be inconsistent, fin rows can lean, and fins can be gapped or separated from core tubes **24**.

[0007] All of these problems can lead to adverse consequences in terms of both performance and appearance of a heat exchanger. Thus, what is needed is an improved fin row design and improvements in methodology for joining the core tubes and fins of a heat exchanger.

SUMMARY OF THE INVENTION

[0008] Accordingly, it is an advantage of the present invention that a fin pack for a heat exchanger is provided that includes multiple rows of interconnected fins.

[0009] It is another advantage of the present invention that a fin pack and production method are provided that enable concurrent installation of multiple fin rows with core tubes of a heat exchanger.

[0010] Another advantage of the present invention is that a fin pack and heat exchanger production method are provided that result in improved appearance of a heat exchanger, a reduction in dropped and misaligned fins, and a reduction in defective parts.

[0011] Yet another advantage of the present invention is that a fin pack and heat exchanger production method are provided that yield efficient manufacture process time.

[0012] The above and other advantages of the present invention are carried out in one form by a fin pack for a heat exchanger. The fin pack includes a first row of fins and a second row of fins adjacent to and arranged substantially parallel with the first row of fins. A tabular portion extends between and interconnects the first and second row of fins. The tabular portion defines a channel between the first and second row of fins configured for insertion of a core tube of the heat exchanger.

[0013] The above and other advantages of the present invention are carried out in another form by a method of assembling a heat exchanger. The method calls for forming a fin pack having multiple rows of fins, wherein adjacent pairs of the multiple rows of fins are interconnected by tabular portions, the tabular portions defining channels between each of the rows of fins. One each of multiple core tubes are inserted in each of the channels to form a heat exchanger core. Opposing ends of the core tubes of the heat exchanger core are connected to first and second headers, and the heat exchanger core with the first and second headers is brazed to form the heat exchanger.

[0014] The above and other advantages of the present invention are carried out in yet another form by a heat exchanger. The heat exchanger includes a first header, a second header, and multiple flat core tubes arranged spaced apart from one another and connected between the first and second headers. The heat exchanger further includes a fin pack having multiple rows of fins and multiple tabular portions such that pairs of adjacent ones of said multiple rows are interconnected by the tabular portions. The tabular portions define channels between each of the rows of fins, the core tubes are seated in the channels, and one each of the rows of fins is disposed between pairs of the core tubes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A more complete understanding of the present invention may be derived by referring to the detailed description and claims when considered in connection with the Figures, wherein like reference numbers refer to similar items throughout the Figures, and:

[0016] FIG. **1** shows a front view of an exemplary prior art tube-and-fin type heat exchanger;

[0017] FIG. **2** shows a partial perspective view of an exemplary prior art heat exchanger core of the heat exchanger of FIG. **1**;

[0018] FIG. **3** shows a front view of a heat exchanger in accordance with an embodiment of the present invention;

[0019] FIG. **4** shows a perspective view of a fin pack for the heat exchanger in accordance with the present invention;

[0020] FIG. **5** shows a flowchart of a heat exchanger production process in accordance with another embodiment of the present invention;

[0021] FIG. **6** shows a perspective view of a coil of sheet material utilized in connection with fabrication of a fin pack of the heat exchanger of FIG. **3**;

[0022] FIG. **7** shows a top view of a portion of the sheet material pierced to form slots;

[0023] FIG. **8** shows a top view of the sheet material of FIG. **7** with louvers stamped thereon;

[0024] FIG. **9** shows a top view of the sheet material with a first fold pattern superimposed thereon;

[0025] FIG. **10** shows an end view of the folded sheet material;

[0026] FIG. **11** shows a top view of the sheet material with a second fold pattern superimposed thereon;

[0027] FIG. **12** shows a front schematic view of core tubes of the heat exchanger being installed in the fin pack; and

[0028] FIG. **13** shows a partial front schematic view of core tubes of the heat exchanger installed in a fin pack in accordance with another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] FIG. **3** shows a front view of a heat exchanger **40** in accordance with an embodiment of the present invention. Heat exchanger **40** includes a heat exchanger core **42** disposed between first and second headers **44** and **46**, respectively. Inlet and outlet tubes **48** and **50**, respectively, are connected to first and second headers **44** and **46**, for the passage of a fluid, such as a refrigerant. Side plates **52** span between first and second headers **44** and **46**, respectively, to form an upper and lower boundary of heat exchanger core **42**.

[0030] Heat exchanger core **42** includes a number of discrete parallel flat core tubes **54** coupled between first and second headers **44** and **46**. In accordance with the present invention, heat exchanger core **42** further includes a fin pack **56** having multiple substantially parallel rows **58** of fins **60**, with each of rows **58** being corrugated and having a continuous series of fins **60**. Adjacent rows **58** of fins **60** are interconnected with first tabular portions **62** shown overlying core tubes **54** and alternating with adjacent rows **58** of fins **60** that are interconnected with second tabular portions **64**, shown underlying core tubes **54**. Rows **58** are interconnected by first and second tabular portions **62** and **64**, respectively, to form a single fin pack **56** of multiple rows **58** of fins **60**, as opposed to the discrete fin rows **34** (FIG. **1**) of the prior art. As will be discussed in greater detail below, the inclusion of fin pack **56** that includes multiple rows **58** of fins **60** allows for the concurrent installation of multiple rows **58** of fins **60** with multiple core tubes **54**, thereby significantly reducing cycle time, increasing manufacturing efficiency, and producing a more consistent product with less manufacturing defects.

[0031] It should be noted that core tubes **54** are not typically provided in an actual heat exchanger with cross-hatched markings. Rather, core tubes **54** are shown in FIG. **3** with cross-hatching to more clearly distinguish tubes **54** from first and second tabular portions **62** and **64** that overlie and underlie tubes **54**.

[0032] FIG. **4** shows a perspective view of a fin pack **56** for heat exchanger **40** (FIG. **3**) in accordance with the present invention. Fin pack **56** is shown with several less rows **58**, fins **60**, first tabular portions **62**, and second tabular portions **64** for simplicity of illustration. However, it should be understood that fin pack **56** can have as few as two rows **58** of fins **60**, or any number of rows **58** and fins **60** desired for producing heat exchanger core **42** (FIG. **3**). In addition, heat exchanger core **42** may be formed from a single fin pack **56**, or from several smaller fin packs **56**.

[0033] Each of fins **60** within rows **58** exhibits an upper edge **66** and a lower edge **68**. First pairs **70** of rows **58** are interconnected by first tabular portion **62** at upper edge **66** of each of fins **60**. Second pairs **72** (of which only one is shown) of rows **58** are interconnected by second tabular portion **64** at lower edge **68** of each of fins **60**. Second pairs **72** of rows **58** alternate with first pairs **70** of rows **58** so that first tabular portions **62** located at upper edge **66** likewise alternate with second tabular portions **64** at lower edge **68**.

[0034] A length **74** of each of first and second tabular portions **62** and **64**, respectively, and a height **76** of fins **60** defines channels **78** between each of rows **58** of fins **60**. In a preferred embodiment, height **76** of fins **60** is substantially equivalent to a height **80** of core tubes **54** (one shown in ghost form). Channels **78** extend along an entire length of rows **58**. In addition, each of fins **60** includes a substantially flat contact portion **84** that forms an inner wall of one of channels **78**. In accordance with the present invention, one each of core tubes **54** is inserted into and largely fills one each of channels **78**. In particular, the width of each of channels **78**, defined by length **74** of first and second tabular portions **62** and **64** is approximately equivalent to a width **86** of each of core tubes **54**, so that flat contact portion **84** of fins **60** abuts an external peripheral wall **88** of each of core tubes **54**. This abutment of flat contact portion **84** with wall **88** of each of core tubes **54** can enhance heat transfer efficiency between core tubes **54** and fin pack **56**.

[0035] Fin pack **56** that includes multiple rows **58** of fins **60** interconnected by first and second tabular portions **62** and **64** yields a rigid and consistent structure, both in appearance and performance. This structure is coupled with core tubes **54**, subsequently attached to headers **44** and **46**, and can then be brazed as a single unit. Accordingly, improvements are achieved in terms of greater efficiency in manufacture process time and in a reduction in the amount of defective parts and their commensurate waste.

[0036] FIG. **5** shows a flowchart of a heat exchanger production process **90** in accordance with another embodiment of the present invention. Process **90** provides generalized methodology of the operations involved in the manufacture of heat exchanger **40** having fin pack **56**. In addition, process **90** includes a fin pack fabrication subprocess **92** detailing the operations involved in the manufacture of fin pack **56**. The operations described in process **90** may take place in a single manufacturing facility in a serial operation. Alternatively, fin pack fabrication subprocess **92** may occur in a separate facility for producing fin packs **56**. Those fin packs **56** may then be assembled into heat exchangers **40** in an assembly facility. Those skilled in the art will recognize that there are other conventional operations pertaining to the manufacture and assembly of heat exchanger **40**. These conventional operations are not described herein for brevity.

[0037] Heat exchanger production process **90** begins with fin pack fabrication subprocess **92**. Referring to FIG. **6**, FIG. **6** shows a perspective view of a coil **94** of sheet material **96** utilized in connection with fabrication of fin pack **56** (FIG. **4**) of heat exchanger **40** (FIG. **3**). Sheet material **96** may be any of a number of materials that are conventionally used to form sheet metal, such as, aluminum, brass, copper, cold rolled steel, mild steel, tin, nickel, titanium, and the like. More particularly, sheet material **96** is formed from those conventional sheet metals that are typically utilized to form fins for heat exchangers.

[0038] Referring back to FIG. **5**, at an operation **98** of fin pack fabrication method section **92**, coil **94** is passed through the appropriate machinery used for unrolling and cutting coil **94** into the appropriate size and shape to produce fin pack **56**. In addition, slots are cut into cut sheet material.

[0039] Referring now to FIG. **7** in connection with operation **98**, FIG. **7** shows a top view of a portion **100** of sheet material **96** cut or pierced to form slots **102**. Slots **102** may be formed utilizing conventional sheet metal fabrication equipment such as a punch or a laser. Slots **102** are formed into rows **104** having a first slot pattern **106** alternating with rows **106** having a second slot pattern **108**. Each of slots **102** exhibits a base **110** and a side **112**, and rows **104** and **106** of slots **102** are arranged with each side **112** parallel to a longitudinal dimension **114** of portion **100** of sheet material **96**.

[0040] With reference back to FIG. **5**, following operation **98** of fin pack fabrication subprocess **92**, an operation **116** may be performed. At operation **100**, sheet material **96** may optionally be stamped to form louvers. Referring now to FIG. **8** in connection with operation **116**, FIG. **8** shows a top view of portion **100** of sheet material **96** with louvers **118** stamped thereon. Heat exchangers, such as heat exchanger **40** (FIG. **3**), with louvered fins **60** (FIG. **3**) are used widely in the automotive air-conditioning industry. The dominant thermal resistance in compact heat exchangers occurs on the airside, and fins are used to reduce this thermal resistance and improve overall performance of the heat exchanger. Louvers **118** on fins **60** create interrupted surfaces to generate complex airflow patterns that can increase the performance of the heat exchanger.

[0041] Referring back to FIG. **5**, following operation **116** of fin pack fabrication subprocess **92**, an operation **120** may be performed. At operation **120**, the sheet material is bent longitudinally to form corrugated fins **60** (FIG. **4**) of fin pack **56** (FIG. **4**).

[0042] Referring to FIGS. **9-10** in connection with operation **120**, FIG. **9** shows a top view of portion **100** of sheet material **96** with a first fold pattern **122** superimposed thereon, and FIG. **10** shows an end view of the folded portion **100** of sheet material **96**. Portion **100** of sheet material **96** is shown without louvers **118** (FIG. **8**) for clarity of illustration.

[0043] First fold pattern **122** includes first fold lines **124** having a dash-dot pattern and second fold lines **126** having a dash pattern, as shown in FIG. **9**. Sheet material **96** is bent parallel to longitudinal dimension **114** at each of sides **112** of slots **102**. Accordingly, first and second fold lines **124** and **126** are aligned and co-located with sides **112** of slots **102**.

[0044] It should be noted that sheet material **96** is not actually provided with first and second fold lines **124** and **126**. Rather, lines **124** and **126** are shown in FIG. **9** to clearly demarcate locations at which sheet material **96** is to be folded and to distinguish a direction of the fold. In this example, first fold lines **124** represent those folds of sheet material **96** that are directed "downwardly," i.e., into the drawing page. Second fold lines **126** represent those folds of sheet material **96** that are directed "upwardly," i.e., out of the drawing page.

[0045] With the exception of the two outermost first fold lines **124**, each of the fold lines occur in alternating pairs of first fold lines **124** and second fold lines **126**. Bending portion **100** of sheet material **96** in accordance with first fold pattern **122** yields the continuous series of corrugated fins **60** having flat contact portions **84** that form an inner wall of one of channels **78** (FIG. **4**) of fin pack **56** (FIG. **4**).

[0046] Returning to FIG. **5**, following the bending operation of operation **120**, fin pack fabrication subprocess **92** continues with an operation **128**. At operation **128**, sheet material **96** is subsequently bent transversely to form interconnected rows **58** (FIG. **4**) of fins **60** (FIG. **4**) separated by channels **78** (FIG. **4**).

[0047] With reference to FIG. **11** in connection with operation **128**, FIG. **11** shows a top view of sheet material **96** with a second fold pattern **130** superimposed thereon. It should be noted that FIG. **11** shows portion **100** of sheet material **96** in its flat state, without having first been folded as shown in FIG. **10**, in order to clearly distinguish second fold pattern **130**. However, in actual practice, sheet material **96** will have first been folded longitudinally in accordance with first fold pattern **122** (FIG. **9**), followed by being folded transversely in accordance with second fold pattern **130**.

[0048] Second fold pattern **130** includes third fold lines **132** having a dash pattern and fourth fold lines **134** having a dash-dot pattern. Sheet material **96** is bent transversely, i.e., perpendicular to longitudinal dimension **114** at each of bases **110** of slots **102**. Accordingly, third and fourth fold lines **132** and **134** are aligned and co-located with bases **110** of slots **102**.

[0049] Again, sheet material **96** need not be provided with third and fourth fold lines **132** and **134**. Rather, lines **132** and **134** are shown in FIG. **12** to clearly demarcate locations at which sheet material **96** is to be folded and to distinguish a direction of the fold. In this example, third fold lines **132** can represent those folds of sheet material **96** that are directed "downwardly," i.e., into the drawing page. Fourth fold lines **134** can represent those folds of sheet material **96** that are directed "upwardly," i.e., out of the drawing page.

[0050] Each of the fold lines occur in alternating pairs of third fold lines **132** and fourth fold lines **134**. Bending portion **100** of sheet material **96** in accordance with second fold pattern **130**, after sheet material **96** has first been bent in accordance with first fold pattern **122** (FIG. **9**) yields the multiple rows **58** (FIG. **4**) of fins **60** interconnected by first and second tabular portions **62** and **64**, respectively. More specifically, first tabular portions **62** are formed between slots **102** of rows **104** and second tabular portions **64** are formed between slots **102** of rows **106**.

[0051] Returning to FIG. **5**, following the bending operation of operation **128**, fabrication of fin pack **56** is complete and fin pack **56** has the appearance of that shown in FIG. **4**. Those skilled in the art will recognize that other conventional work processes may be performed such as cleaning and degreasing, applying flux or braze paste, and the like to actually finalize the fabrication of fin pack **56**.

[0052] Following manufacture of fin pack **56** through the execution of fin pack fabrication subprocess **92**, heat exchanger production process **90** continues with a number of operations that describe an efficient process for the assembly of heat exchanger **40** utilizing fin pack **56**. Process **90** continues with an operation **136**. At operation **136**, a subset of core tubes **54** are arranged on a surface.

[0053] Referring to FIGS. **5** and **12**, FIG. **12** shows a front schematic view of core tubes **54** of heat exchanger **40** (FIG. **3**) being installed in fin pack **56**. FIG. **12** is not intended to be a realistic portrait of the assembly of core tubes **54** with fin pack **56**. Rather, FIG. **12** enables visualization of the concurrent installation of multiple core tubes **54** with fin pack **56**. As shown, a subset **138** of, e.g., approximately half, of core tubes **54** utilized with fin pack **56** are arranged on a surface **140**. More specifically, core tubes **54** are placed on an edge with a lower side, or width **86**, facing surface **140**. Surface **140** need not be a substantially flat surface, but may include holding structures and/or placement structures for temporarily retaining core tubes **54** in position.

[0054] With continued reference to FIGS. **5** and **12**, following operation **136**, an operation **142** is performed. At operation **142**, fin pack **56** is installed onto subset **138** of core tubes **54** by seating core tubes into those of channels **78** in which first tabular portions **62** are positioned along upper edge **66** between pairs **70** of rows **58** of fins **60**. In other words, fin pack **56** is lowered onto subset **138** of core tubes **54**, as represented by downwardly directed arrows, labeled "A."

[0055] Next, an operation **144** is performed. At operation **144**, a remaining subset **146** of core tubes **54** is inserted into remaining channels **78** having second tabular portion **64** along lower edge **68** between pairs **72** of rows **58** of fins **60** to form heat exchanger core **42** (FIG. **3**). Subset **146** of core tubes **54** may be held on edge by a pick and place system, or manipulator, that can hold multiple core tubes **54** and install those multiple core tubes **54** at the same time. In effect, subset **146** of core tubes **54** is lowered onto fin pack **56**, as represented by downwardly directed arrows, labeled "B."

[0056] In the instance in which fin pack **56** includes only two rows **58** of fins **60**, both of operations **142** and **144** need not occur. Rather, all core tubes **54** may be installed at one time, with either one or more two row fin packs **56** being lowered onto all of the required core tubes **58** or all of core tubes **54** being lowered onto the one or more two row fin packs **56**.

[0057] Referring back to FIG. **5**, following operation **144**, an operation **148** is performed. At operation **148**, heat exchanger core **42** is connected to first and second headers **44** and **46**, respectively (FIG. **3**). The alternating connecting tab structure of first and second tabular portions **62** and **64** enables fin pack **56** to lock with core tubes **54** during assembly, thereby eliminating the possibility of dropped fins and providing for better control of fin edges. The connection of heat exchanger core **42** with headers **44** and **46** further locks fin pack and core tubes **54** together resulting in a rigid structure that is subsequently brazed at an operation **150** of process **90**. Following operation **150**, process **90** exits.

[0058] FIG. **13** shows a partial front schematic view of core tubes **54** of heat exchanger **40** (FIG. **3**) installed in a fin pack **152** in accordance with another embodiment of the present invention. Fin pack **152** is similar to fin pack **56** and includes multiple rows of a continuous series of corrugated fins **60**. Adjacent rows of fins **60** are interconnected along upper edges **66** by first tabular portions **154** alternating with adjacent rows of fins **60** that are interconnected along lower edges **68** by second tabular portions **156** to form a single fin pack **152** of multiple rows of fins.

[0059] In accordance with the embodiment shown in FIG. **13**, first and second tabular portions **154** and **156** exhibit an outwardly arcuate, or arched, shape **158**. Arcuate shape **158** of tabular portions **154** and **156** corresponds with a shape of core tubes **54**. That is, each of core tubes **54** has rounded sides **160** extending in a widthwise direction. Methodology to produce arcuate shape **158** of first and second tabular portions **154** and **156** entails, for example, bending, rolling, or stretching sheet material **96** (FIG. **6**) in the course of executing fin pack fabrication subprocess **92** (FIG. **5**).

[0060] Arcuate shape **158** of tabular portions **154** and **156** enables tabular portions **154** and **156** to wrap around sides **160** of core tubes **54** so that closer contact is made between core tubes **54** and tabular portions **154** and **156**. This closer contact can result in greater rigidity of the heat exchanger core, in enhanced heat transfer efficiency, and facilitate laminar flow of air around rounded sides **160** of core tubes **52** and tabular portions **154** and **156**.

[0061] In summary, the present invention teaches of a fin pack that includes multiple rows of continuous corrugated fins interconnected by tabular portions. The multiple rows of fins are spaced apart by channels in which core tubes of a heat exchanger can be inserted. A production method yields the fabrication of a fin pack having multiple interconnected rows of fins using one coil of sheet material. The production method further enables the concurrent installation of multiple core tubes into the channels between the multiple rows of fins to form a heat exchanger core. The fin pack of the present invention results in improved appearance of a heat exchanger, a reduction in dropped and misaligned fins, and a reduction in defective parts and waste relative to prior art designs. In addition, the production methodology enables concurrent installation of multiple fin rows with core tubes of a heat exchanger resulting in an improved appearance of the heat exchanger and cost savings in terms of a more efficient manufacture process time.

[0062] Although the preferred embodiments of the invention have been illustrated and described in detail, it will be readily apparent to those skilled in the art that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

What is claimed is:

1. A fin pack for a heat exchanger comprising:

a first row of fins;

a second row of said fins adjacent to and arranged substantially parallel with said first row of said fins; and

a tabular portion extending between and interconnecting said first and second row of fins, said tabular portion defining a channel between said first and second row of fins configured for insertion of a core tube of said heat exchanger.

2. A fin pack as claimed in claim **1** wherein each of said first and second rows of said fins is corrugated having a continuous series of said fins.

3. A fin pack as claimed in claim **2** wherein said core tube is a flat tube, and each of said fins of said first and second rows exhibits a substantially flat contact portion configured to abut an external peripheral wall of said flat tube along a height of said external peripheral wall.

4. A fin pack as claimed in claim **1** wherein said core tube is a flat tube exhibiting a width, and said tabular portion exhibits a length that is approximately equivalent to said width.

5. A fin pack as claimed in claim **1** wherein said core tube is a flat tube exhibiting rounded sides extending in a widthwise direction, and said tabular portion exhibits an outwardly arcuate shape configured to correspond with said rounded sides of said flat tube.

6. A fin pack as claimed in claim **1** wherein said tabular portion is a first tabular portion, and said fin pack further comprise:
- a third row of fins adjacent to and arranged substantially parallel with said second row of fins; and
- a second tabular portion extending between and interconnecting said second and third row of fins, said second tabular portion defining a second channel between said second and third row of fins configured for insertion of a second core tube of said heat exchanger.

7. A fin pack as claimed in claim **6** wherein:
- said first tabular portion interconnects said first and second rows of fins along an upper edge of each of said first and second rows of said fins; and
- said second tabular portion interconnects said second and third rows of fins along a lowed edge of each of said second and third rows of said fins.

8. A fin pack as claimed in claim **1** further comprising:
- multiple rows of said fins, said first and second rows being a pair of said multiple rows;
- first tabular portions interconnecting an upper edge of first pairs of said rows of said fins, said tabular portion being one of said first tabular portions; and
- second tabular portions interconnecting a lower edge of second pairs of said rows of said fins, said second pairs of said rows alternating with said first pairs of said rows.

9. A method of producing a heat exchanger comprising:
- forming a fin pack having multiple rows of fins, wherein adjacent pairs of said multiple rows of said fins are interconnected by tabular portions along an edge of said fins, said tabular portions defining channels between each of said rows of said fins;
- inserting one each of multiple core tubes in each of said channels to form a heat exchanger core;
- connecting opposing ends of said core tubes of said heat exchanger core to first and second headers; and
- brazing said heat exchanger core with said first and second headers to form said heat exchanger.

10. A method as claimed in claim **9** wherein said forming operation comprises:
- forming first ones of said tabular portions interconnecting an upper edge of first pairs of said rows of said fins; and
- forming second ones of said tabular portions interconnecting a lower edge of second pairs of said rows of said fins, said second pairs of said rows alternating with said first pairs of said rows.

11. A method as claimed in claim **10** wherein said forming said first and second ones of said tabular portions comprises shaping each of said tabular portions to have an outwardly arcuate shape.

12. A method as claimed in claim **9** wherein said forming operation comprises:
- forming rows of slots in sheet material, each of said slots exhibiting a base and a side, said rows of said slots being arranged with said side parallel to a longitudinal dimension of said sheet material;
- bending said sheet material parallel to said longitudinal dimension at said side of each of said slots to form corrugations for said rows of fins; and
- bending said sheet material perpendicular to said longitudinal dimension at said base of each of said slots to form said rows of fins, such that said sheet material located between said sides of adjacent slots forms one of said tabular portions.

13. A method as claimed in claim **12** further comprising:
- stamping louvers in said sheet material prior to said bending operations.

14. A method as claimed in claim **9** wherein said core tubes are flat tubes having external walls exhibiting a height and a width, and said inserting operation comprises:
- arranging a subset of said core tubes with said a side of each of said subset of said core tubes seated on a surface;
- installing said fin pack onto said portion of said core tubes by seating said core tubes in those of said channels in which said tabular portions are positioned along said upper edge of said rows of said fins; and
- inserting a remaining subset of said core tubes into remaining ones of said channels, said remaining channels having said tabular portion positioned along said lower edge of said rows of said fins.

15. A heat exchanger comprising:
- a first header;
- a second header;
- multiple flat core tubes arranged spaced apart from one another and connected between said first and second headers; and
- a fin pack having multiple rows of fins and multiple tabular portions such that pairs of adjacent ones of said multiple rows are interconnected by said tabular portions, said tabular portions defining channels between each of said rows of fins, said core tubes being seated in said channels and one each of said rows of fins being disposed between pairs of said core tubes.

16. A heat exchanger as claimed in claim **15** wherein each of said rows of said fins is corrugated having a continuous series of said fins.

17. A heat exchanger as claimed in claim **15** wherein each of said fins exhibits a substantially flat contact portion abutting a corresponding one of said core tubes along said height of said external wall.

18. A heat exchanger as claimed in claim **15** wherein:
- said core tubes are flat tubes, each of said flat tubes having rounded sides extending in a widthwise direction; and
- each of said tabular portions exhibits an outwardly arcuate shape corresponding with said rounded sides of said each flat tube.

19. A heat exchanger as claimed in claim **15** wherein tabular portions of said fin pack comprise:
- first tabular portions interconnecting an upper edge of first pairs of said rows of said fins; and
- second tabular portions interconnecting a lower edge of second pairs of said rows of said fins, said second pairs of said rows alternating with said first pairs of said rows.

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