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(54) **METHODS AND APPARATUS FOR UNIVERSAL TRANSITION**

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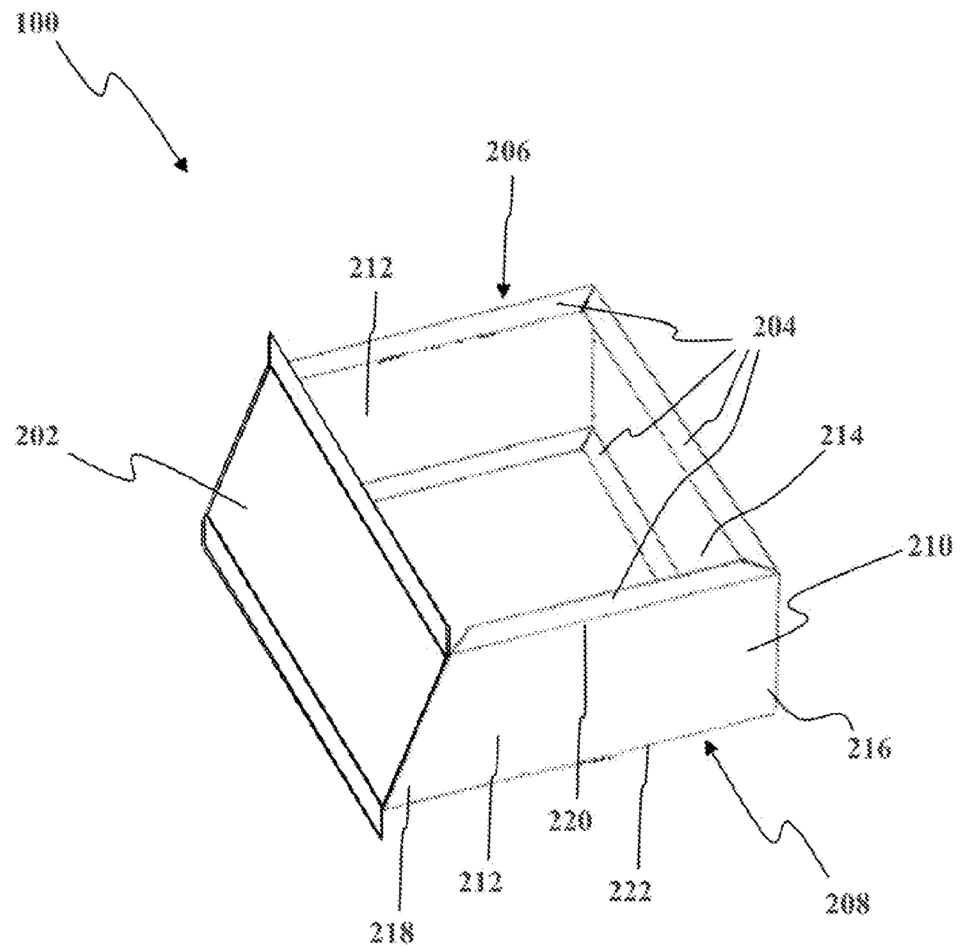
(57) **ABSTRACT**

Methods and apparatus for a universal transition according to various aspects of the present invention comprise a duct that is configured to be located between two heat exchanging devices and provide an improved airflow transition. The system may comprise one or more wall sections configured to provide an increasing or decreasing cross-sectional area in the direction of the airflow to facilitate a more gradual transition between an exhaust vent of one heat exchanging device and an intake vent of a second heat exchanging device. The system may also comprise a removable access panel that allows the intake and exhaust vents to be cleaned and/or serviced without having to physically decouple the heat exchanging devices from each other.



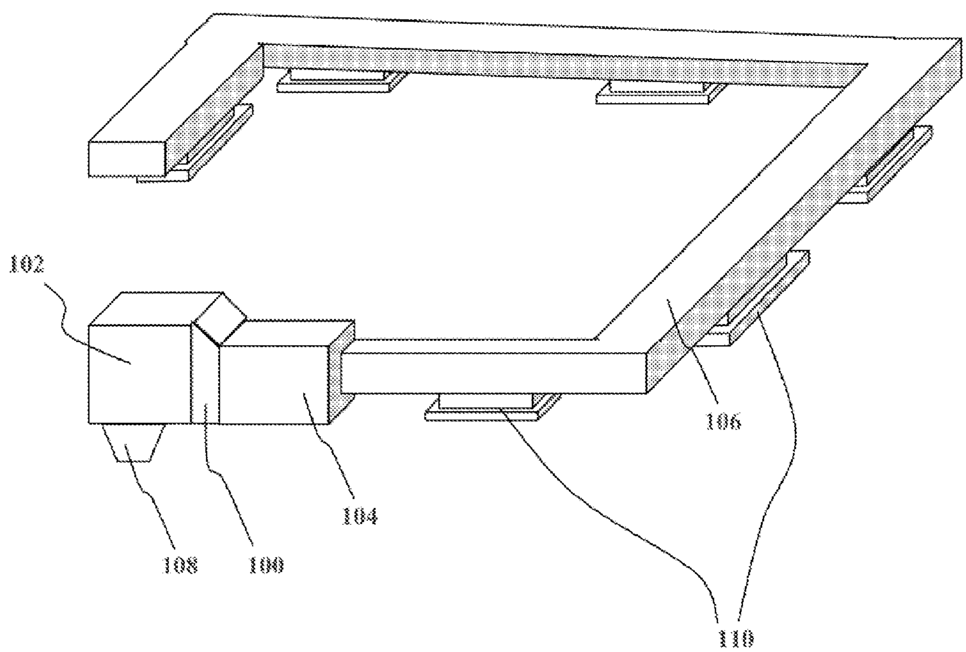


FIGURE 1

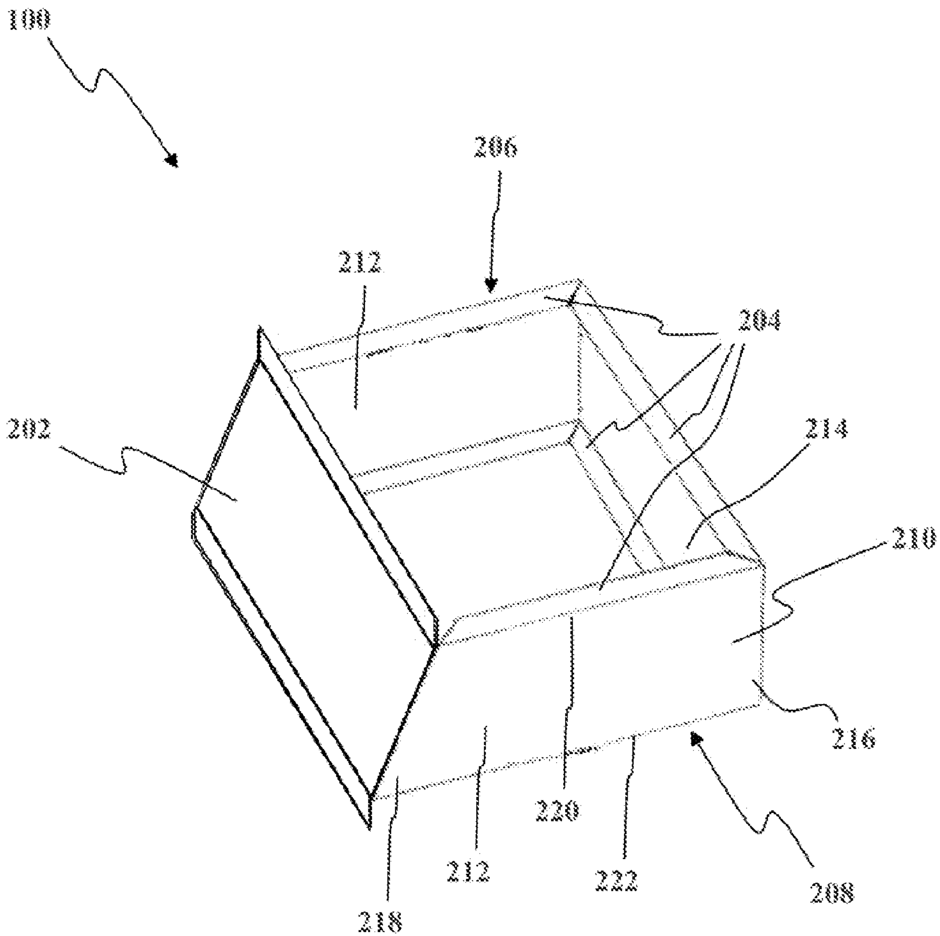


FIGURE 2

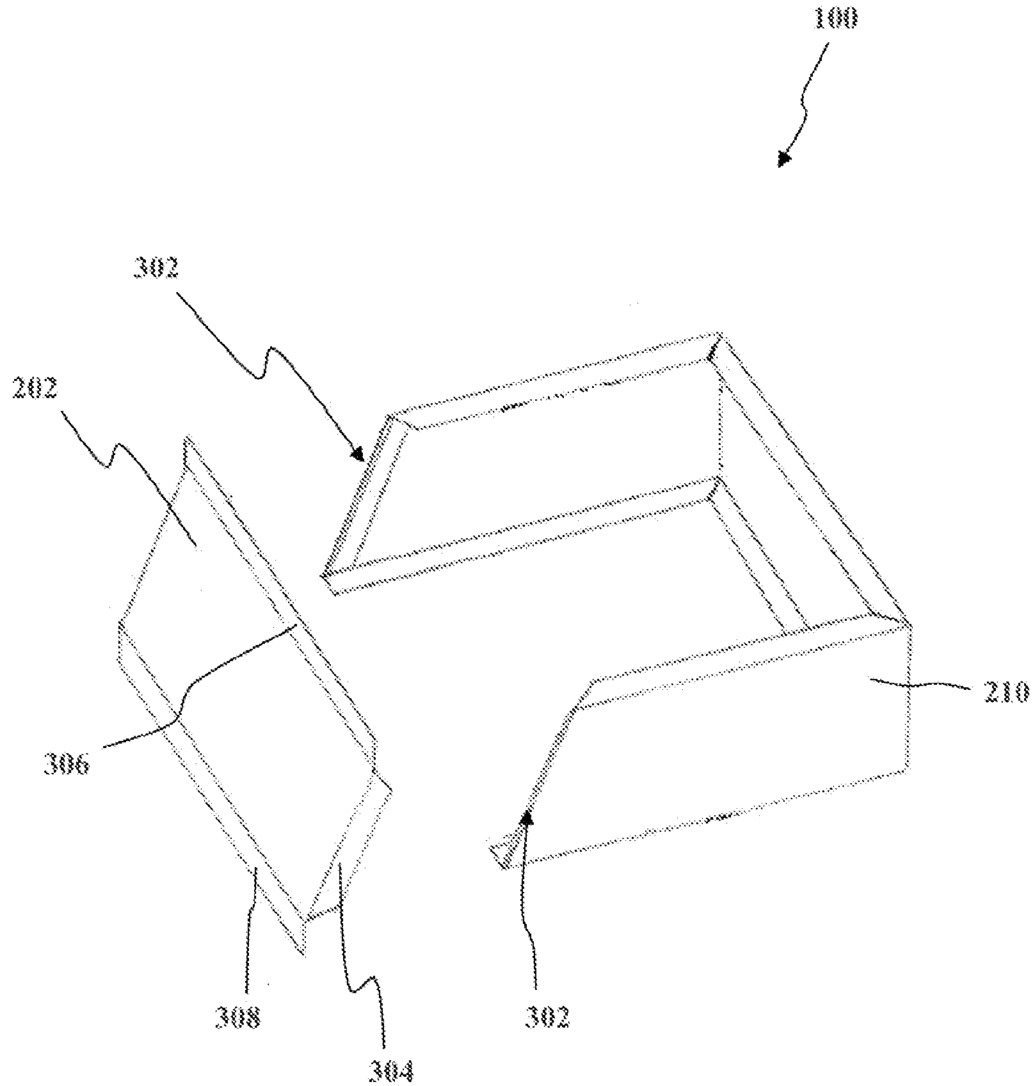


FIGURE 3

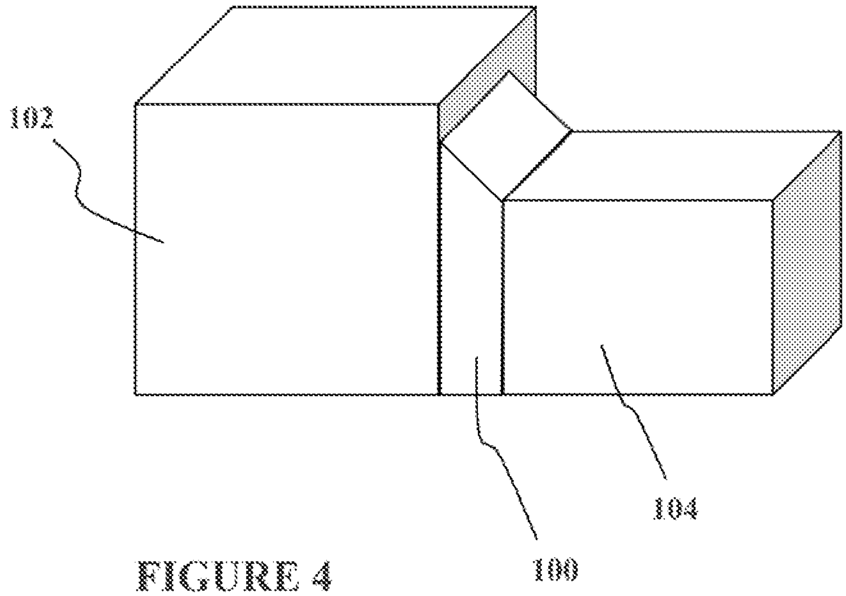


FIGURE 4

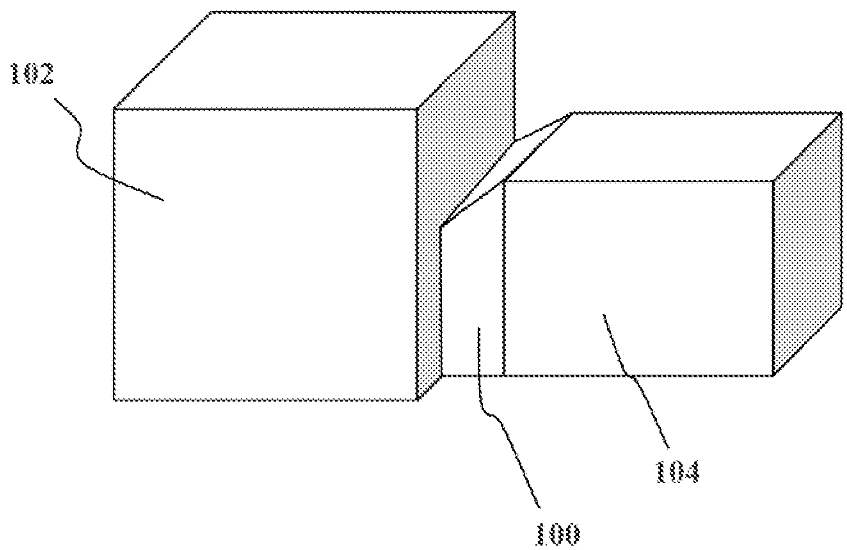


FIGURE 5

METHODS AND APPARATUS FOR UNIVERSAL TRANSITION

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 61/726,671, Nov. 15, 2012, and incorporates the disclosure of the application by reference.

BACKGROUND OF INVENTION

[0002] Residential and commercial air handling systems are often made up of several components linked together to form a heating and air conditioning ventilation system (HVAC). Often, components are designed to work together to improve efficiency the overall system. For example, components such as furnace and an air handling unit are often coupled together so that an airflow exhausted by one component may be received by the other and subsequently heated or cooled. However, there is no universal standard with respect to the size and thane of intake and exhaust vents on different components and as a result when two components are coupled together there may be a mismatch between the exhaust and intake vents. This mismatch may create sudden obstructions to the airflow and may reduce system efficiency and/or lead to system failure.

SUMMARY OF THE INVENTION

[0003] Methods and apparatus for a universal transition according to various aspects of the present invention comprise a duct that is configured to be located between two heat exchanging devices and provide an improved airflow transition. The system may comprise one or more wall sections configured to provide an increasing or decreasing cross-sectional area in the direction of the airflow to facilitate a more gradual transition between an exhaust vent of one heat exchanging device and an intake vent of a second heat exchanging device. The system may also comprise a removable access panel that allows the intake and exhaust vents to be cleaned and/or serviced without having to physically decouple the heat exchanging devices from each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] A more complete understanding of the present invention may be derived by referring to the detailed description when considered M connection with the following illustrative figures. In the following figures, like reference numbers refer to similar elements and steps throughout the figures.

[0005] FIG. **1** representatively illustrates a transition duct coupled between a first and second heat exchanger unit of a forced air system in accordance with an exemplary embodiment of the present invention;

[0006] FIG. **2** representatively illustrates the transition duct in accordance with an exemplary embodiment of the present invention;

[0007] FIG. **3** representatively illustrates the transition duct with an access panel removed in accordance with an exemplary embodiment of the present invention;

[0008] FIG. **4** representatively illustrates a transition duct having a decreasing cross-sectional area in as flow direction in accordance with an exemplary embodiment of the present invention; and

[0009] FIG. **5** representatively illustrates a transition duct having an increasing cross-sectional area in the flow direction in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0010] The present invention may be described in terms of functional block components and various processing steps. Such functional blocks may be realized by any number of components configured to perform the specified functions and achieve the various results. For example, the present invention may employ various types of materials, sealants, fasteners, and the like, which may carry out a variety of functions. In addition, the present invention may be practiced in conjunction with any number of systems such as commercial and/or residential heating and cooling systems and the system described is merely one exemplary application for the invention. Further, the present invention may employ any number of conventional techniques for coupling duct work, facilitating air flow, and heating and/or cooling air.

[0011] Methods and apparatus for universal transition according to various aspects of the present invention may operate in conjunction with any suitable ventilation system and/or forced air heating and cooling system. Various representative implementations of the present invention may be applied to any duct transition and/or air return system.

[0012] Referring now to FIG. **1**, in an exemplary embodiment of the present invention, a universal transition may comprise a transition duct **100** configured to be coupled between a first heat exchanger **102** and second heat exchanger **104** of a heating, ventilation, and air conditioning system such as a forced air system. The forced air system may further comprise a ducting system **106**, a plurality of air registers **110**, and a return vent **108**. The ducting system **106** may be configured to route an air flow of conditioned air from the second heat exchanger **104** throughout an area such as a house or a building. The air registers **110** may be configured to deliver a portion of the air flow to specific locations within the area and the return vent **108** may provide a location to collect air from the area and route it to the first heat exchanger **102** where it may be heated and/or cooled by the first heat exchanger **102** and second heat exchanger **104** before proceeding to the ducting system **106**.

[0013] The first heat exchanger **102** may comprise any system for heating or cooling an air flow such as a furnace. The second heat exchanger **104** may comprise a second system for heating and/or cooling the mass of air flow such as an air handling unit having an internal heat exchanging coil linked to a compressor. The first heat exchanger **102** may comprise an intake vent for receiving the air flow from the return vent and an exhaust vent suitably configured to allow the air flow to exit the first heat exchanger **102**. The second heat exchanger **104** may comprise an intake vent for receiving the air flow from the first heat exchanger **102** and an exhaust vent coupled to the ducting system **106**.

[0014] The intake and exhaust vents of the first and second heat exchangers **102**, **104** may comprise any shape or size depending upon various factors such as manufacturer design, installed operating position, or a desired mass flow of air. For example, in one embodiment, the first heat exchanger **102** may have a substantially rectangular exhaust vent having an approximate area of approximately three and one-haft square feet and the second heat exchanger **104** may have a substantially rectangular intake vent having an approximate area of approximately three square feet. In as second embodiment, the first heat exchanger **102** may have an exhaust vent with a smaller area than that of the intake vent of the second heat exchanger **104**.

[0015] The first and second heat exchangers **102**, **104** may be linked together by the transition duct **100** to provide an airflow path between the two heat exchangers with a gradual change in cross-sectional area along as length of the transition duct **100**. The transition duct **100** may comprise any suitable system or device configured to align the airflow between the first heat exchanger **102** and the second heat exchanger **104**. The transition duct **100** may be configured to reduce an amount of airflow obstruction and/or sudden change in the cross-sectional area to the airflow path that may occur as a result of a mismatch between the area of the exhaust vent of the first heat exchanger **102** and the area of the intake vent of the second heat exchanger **104** to reduce losses in total system efficiency.

[0016] Referring now to FIG. **2**, the transition duct **100** may comprise a section of ductwork having a varying cross-sectional area along its length that is configured to provide a more gradual change in cross-sectional flow area as compared to an installation where the first heat exchanger **102** and the second heat exchanger **104** are directly coupled together causing an immediate obstruction and/or change to the airflow path between the first heat exchanger **102** and the second heat exchanger **104**. The transition duct **100** may comprise any suitable materials such as metal, plastic, or composite. For example, in one embodiment, the transition duct **100** may comprise 26 gauge G/90 sheet metal.

[0017] The transition duct **100** may comprise one or more wall elements coupled together to form a duct with a first cross-sectional area at a first end **208** of the duct and the second cross-sectional area at a second end **206** of the duct, wherein the second cross-sectional area is different than that of the first cross-sectional area. The cross sectional area between the two ends of the duct may result from any suitable configuration between the plurality of wall elements.

[0018] In an alternative embodiment, the transition duct **100** may be formed from one or more pieces of sheet metal bent, cast, molded, or otherwise formed into a desired shape. For example, referring again to FIG. **2**, in one embodiment, the transition duct **100** may comprise a first wall element section **210** and a second wall element section **202**. The second wall element section **202** may comprise a substantially rectangular wall element that is configured to be coupled to the first wall element section **210**. The first wall element section **210** may comprise two opposing wall elements **212** and a connecting wall element **214** formed from a single piece of sheet metal bent to form three sides of the transition duct **100**.

[0019] The two opposing wall elements **212** may comprise any suitable shape or size and may be arranged in any suitable orientation. For example, in one embodiment, the two opposing wall elements **212** may be oriented parallel to each other and separated by a distance of between twelve and twenty-four inches. The two opposing wall elements **212** may each comprise a substantially trapezoidal shape with a squared first end **216** and an angled second end **218** such that a top edge **220** and a bottom edge **222** of each opposing wall element **212** have different lengths. For example, in one embodiment, the bottom edge **222** may comprise a length of between eighteen inches and twenty-six inches and the top edge **220** may comprise a length of between fifteen inches and twenty-three inches.

[0020] The connecting wall element **214** may also comprise any suitable shape or size and may be arranged in any suitable orientation. For example, in one embodiment, the connecting wall element **214** may comprise a substantially rectangular shape and extend perpendicularly between the squared first end **216** of each opposing wall element **212** to form a right angle between each opposing wall element **212** and the connecting wall element **214**. In a second embodiment, the connecting wall element **214** may extend away from each opposing wall element **212** at an angle such that the squared first end **216** of each opposing wall element **212** is offset.

[0021] The second wall element section **202** may extend between the angled second ends **218** of the opposing wall elements **212** such that the second wall element section **202** slopes along the length of the duct from the first end **208** to the second end **206**. As a result, the transition duct **100** may comprise a substantially rectangular cross-sectional area along the length of the transition duct **100** that varies from the first end **208** to the second end **206**. The rate of change of the cross-sectional area may be determined according to any suitable criteria such as the size and/or shape of the respective exhaust and intake vents of the first and second heat exchangers **102**, **104**. For example, referring now to FIGS. **4** and **5**, in one embodiment, the transition duct **100** may comprise a decreasing cross-sectional area between the first heat exchanger **102** and the second heat exchanger **104**. In a second embodiment, the transition duct **100** may comprise an increasing cross-sectional area between the first heat exchanger **102** and the second heat exchanger **104**.

[0022] The second wall element section **202** may further be configured to be removably connected to the first wall element section **210**. The second wall element section **202** may be suitably configured to provide access to an interior region of the transition duct **100** and/or provide access to an interior of at least one of the first and second heat exchangers **102**, **104** when the transition duct **102** is installed between the first and second heat exchangers **102**, **104**. For example, in one embodiment, the second wall element section **202** may be configured to be selectively coupled to the first wall element section **210** thus forming a removable panel. The removable panel may be selectively coupled to the first wall element section **210** by any suitable method such as by mechanical fasteners, adhesives, tabs, notches, and/or compression fit. For example, referring now to FIG. **3**, in one embodiment, the second wall element section **202** may comprise at least one tab **304** that is suitably configured to slidably mate to a receiving pocket **302** disposed along at least one of the angled second ends **218** of the opposing wall elements **212**.

[0023] The transition duct **100** may be configured to couple to the first and second heat exchangers **102**, **104** by any suitable method. For example, referring again to FIGS. **2** and **3**, the transition duct **100** may comprise one or more flanges **204** disposed along an edge of each of the two opposing wall elements **212** and/or the connecting wall element **214**. Each flange **204** ma be configured to contact the respective heat exchanger to provide a connection point for a fastener such as a screw. In a second embodiment, the flanges **204** may be configured to be crimped to a portion of the first and second heat exchangers **102**, **104** such as the intake and exhaust vents to form a coupling.

[0024] The second wall clement section **202** may also comprise one or more flanges suitably configured to engage the intake and exhaust vents of the first and second heat exchangers **102**, **104**. For example, a first flange **306** disposed along the second end **206** may be bent towards art exterior surface of the second wall element section **202** by and angle of between forty and sixty degrees relative to the exterior surface of the second wall element section **202**. A second flange **308** may be disposed along the first end **208** and may be bent away from the exterior surface of the second wall element section **202** by and angle of between forty and sixty degrees relative to the exterior surface of the second wall element section **202**. The angle that each flange is bent may be determined according to any suitable criteria such as the change in cross-section area between the first end **208** and the second end **206** or the size of the intake and/or exhaust vents.

[0025] The transition duct **100** may further comprise insulation along one or more sidewalls to reduce heat transfer between an interior of the transition duct **100** and the surrounding environment. For example, insulation may be affixed to the interior surfaces of the transition duct **100**. In a second embodiment, the entire transition duct **100** may be enclosed within an insulation device.

[0026] The particular implementations shown and described are illustrative of the invention and its best mode and are not intended to otherwise limit the scope of the present invention in any way. Indeed, for the sake of brevity, conventional manufacturing, connection, preparation, and other functional aspects of the system may not be described in detail. Furthermore, the connecting lines shown in the various figures are intended to represent exemplary functional relationships and/or steps between the various elements. Many alternative or additional functional relationships or physical connections may be present in a practical system.

[0027] In the foregoing specification, the invention has been described with reference to specific exemplary embodiments. Various modifications and changes may be made, however, without departing from the scope of the present invention as set forth in the claims. The specification and figures are illustrative, rather than restrictive, and modifications are intended to be included within the scope of the present invention. Accordingly, the scope of the invention should be determined by the claims and their legal equivalents rather than by merely the examples described.

[0028] For example, the steps recited in any method or process claims may be executed in any order and are not limited to the specific order presented in the claims. Additionally, the components and/or elements recited in any apparatus claims may be assembled or otherwise operationally configured in a variety of permutations and are accordingly not limited to the specific configuration recited in the claims.

[0029] Benefits, other advantages and solutions to problems have been described above with regard to particular embodiments; however, any benefit, advantage, solution to problem or any element that may cause any particular benefit, advantage or solution to occur or to become more pronounced are not to be construed as critical, required or essential features or components of any or all the claims.

[0030] As used herein, the terms "comprise", "comprises", "comprising", "having", "including", "includes" or any variation thereof, are intended to reference a non-exclusive inclusion, such that a process, method, article, composition or apparatus that comprises a list of elements does not include only those elements recited, but may also include other elements not expressly listed or inherent to such process, method, article, composition or apparatus. Other combinations and/or modifications of the above-described structures, arrangements, applications, proportions, elements, materials or components used in the practice of the present invention, in addition to those not specifically recited, may be varied or otherwise particularly adapted to specific environments, manufacturing specifications, design parameters or other operating requirements without departing from the general principles of the same.

1. A transition duct for coupling a first heat exchanger unit to a second heat exchanger unit, comprising:
- a first duct wall, comprising:
  - an intake end and an exhaust end;
  - a pair of opposing parallel wall elements, wherein each opposing parallel wall element comprises:
    - a square end portion; and
    - an angled end portion forming an angle between the intake end and the exhaust end;
  - a connecting wall element extending between the square end portions of the pair of opposing parallel wall elements; and
- a second duct wall selectively connected to the angled end portions of the pair of opposing parallel wall elements.

2. A transition duct according to claim **1**, wherein the connecting wall element extends perpendicularly between the square end portions of the pair of opposing parallel wall elements and the second duct wall to form a duct having a substantially rectangular cross-sectional area that varies from the intake end to the exhaust end.

3. A transition duct according to claim **1**, wherein each of the opposing parallel wall elements further comprises:
- a first flange extending away from an interior surface of the parallel wall element, wherein the first flange is configured to be positioned proximate to an exhaust vent of the first heat exchanger unit to couple the intake end to the first heat exchanger unit; and
- a second flange extending away from the interior surface of the parallel wall element, wherein the second flange is configured to be positioned proximate to an intake vent of the second heat exchanger unit to couple the exhaust end to the second heat exchanger unit.

4. A transition duct according to claim **1**, wherein the second duct wall comprises a substantially rectangular wall section.

5. A transition duct according to claim **4**, wherein the second duct wall further comprises a pair of opposing side tabs extending away from an interior surface of the second duct wall, wherein the pair of opposing side tabs are configured to slideably engage the angled end portions of the pair of opposing parallel wall elements.

6. A transition duct according to claim **5**, wherein each angled end portion of the pair of opposing parallel wall elements further comprises a receiving pocket configured to receive one of the opposing side tabs of the second duct wall.

7. A transition duct according to claim **5**, wherein the second duct wall further comprises:
- a first flange bent towards an exterior surface of the second duct wall; and
- a second flange bent away from the exterior surface of the second duct wall.

8. A transition duct according to claim **1**, further comprising a layer of insulation affixed to an internal surface of: the first duct wall and the second duct wall.

9. A transition duct according to claim 1, further comprising an insulation device substantially enclosing an external surface of: the first duct wall and the second duct wall.

10. A transition duct having a intake end and an exhaust end for coupling a first heat exchanger unit to a second heat exchanger unit, comprising:

a first wall section including a first end and a second end;

a pair of opposing trapezoidal wall sections extending, perpendicularly away from the first and second ends of the first wall section, wherein each trapezoidal wall section comprises:

a square can portion engaging the first wall section; and

an angled end portion positioned distal from the first wall section;

a top edge extending between the square end portion and the angled end portion; and

a bottom edge extending between the square end portion and the angled end portion, wherein the top edge and the bottom edge comprise different lengths; and

a second wall section coupled to the angled end portions of the pair of opposing wall sections to form a duct having a substantially rectangular cross-sectional area that varies from the intake end to the exhaust end.

11. A transition duct according to claim 10, wherein:

the top edge of the opposing trapezoidal wall sections comprises a flange configured to be positioned adjacent to an exhaust vent of the first heat exchanger unit; and

the bottom edge of the opposing trapezoidal wall sections comprises a flange configured to be positioned adjacent to an intake vent of the second heat exchanger unit.

12. A transition duct according to claim 10, wherein the second wall section is configured to be selectively removable from the angled end portions of the pair of opposing trapezoidal wall sections.

13. A transition duct according to claim 10, wherein the second wall section comprises a substantially rectangular wall section.

14. A transition duct according to claim 13, wherein the second wall section further comprises:

a pair of opposing side tabs bent about ninety degrees away from an exterior surface of the second wall section, wherein the pair of opposing side tabs are configured to slideably engage the angled end portions of the pair of opposing trapezoidal all sections;

a top flange bent towards the exterior surface of the second wall section; and

a bottom flange bent away from the exterior surface of the second wall section.

15. A transition duct according to claim 14, wherein the angled end portion of each opposing trapezoidal all section comprises a pocket configured to receive one of the opposing side tabs of the second wall section.

16. A transition duct according to claim 10, further comprising, a layer of insulation affixed to an internal surface of: the first wail section, the pair of opposing trapezoidal wall sections, and the second wall section.

17. A transition duct according to claim 10, further comprising an insulation device substantially enclosing an external surface of: the first wall section, the pair of opposing trapezoidal wall sections, and the second wall section.

18. A method of forming a transition between a first and second heat exchanger unit, comprising:

providing a first wall section including an intake end and an exhaust end, wherein the first wall section comprises:

a pair of opposing trapezoidal wall sections, wherein each trapezoidal wail section comprises:

a square end portion engaging the first wall section and extending perpendicularly away therefrom; and

an angled end portion positioned distal from the first wall section;

a top edge extending between the square end portion and the angled end portion; and

a bottom edge extending between the square end portion and the angled end portion, wherein the top edge and the bottom edge comprise different lengths; and

a connecting wall section extending between the square end portions of the pair of opposing trapezoidal wall sections; and

coupling a second wall section to the angled end portions of the pair of opposing wall sections to forma duct having a substantially rectangular cross-sectional area that varies from the intake end to the exhaust end.

19. A method of forming a transition between a first and second heat exchanger unit according to claim 18, further comprising:

forming a first flange along the top edge of the opposing trapezoidal wall sections;

forming a second flange along the bottom edge of the opposing trapezoidal wall sections;

securing the first flange to an area adjacent to an exhaust vent of the first heat exchanger unit; and

securing the second flange an area adjacent to an intake vent of the second heat exchanger unit.

20. A method of forming a transition between a first and second heat exchanger unit according to claim 18, wherein coupling the second wall section to the angled end portions comprises slideably engaging a pair of opposing side tabs bent about ninety degrees away from an exterior surface of the second wall section with a receiving pocket disposed along the angled end portions of the pair of opposing trapezoidal wall sections.

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