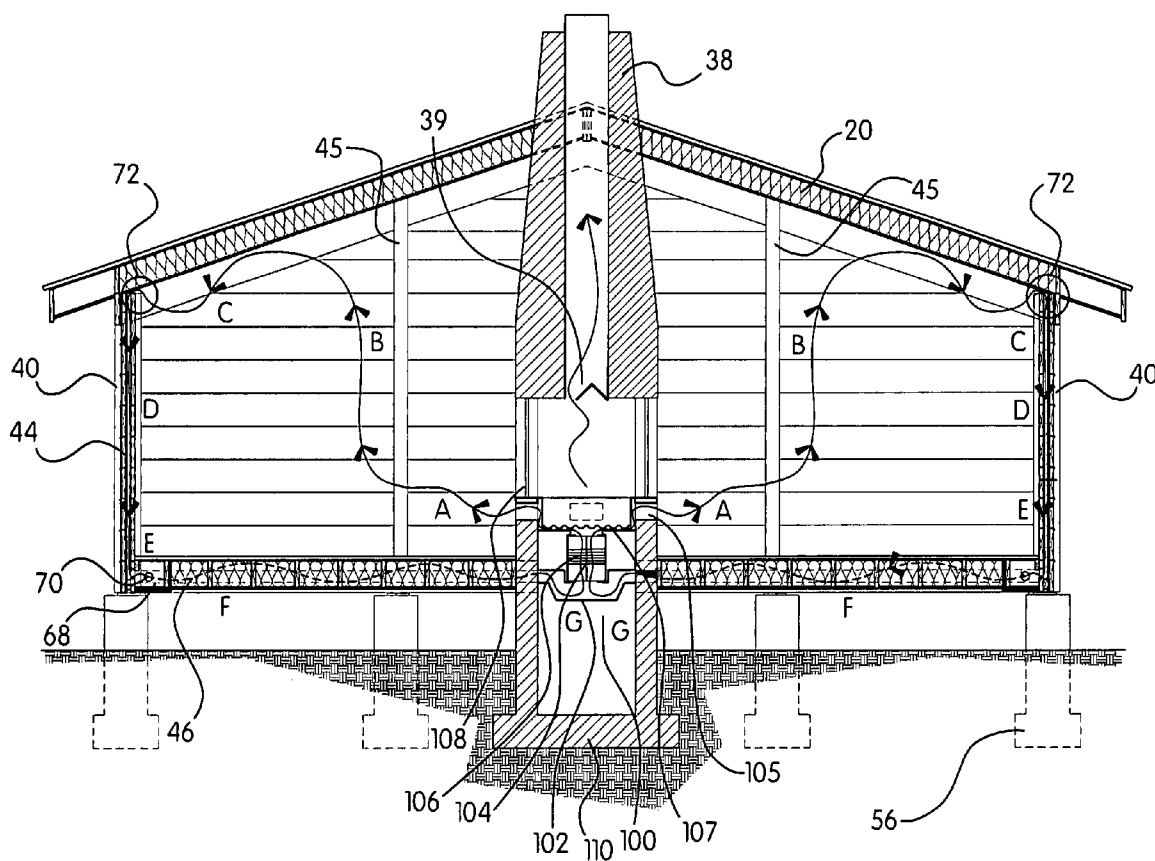




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(19) **United States**(12) **Patent Application Publication**
Needham(10) **Pub. No.: US 2009/0242653 A1**(43) **Pub. Date: Oct. 1, 2009**(54) **ENVIROMENTALLY DISTINCTIVE CABIN
DESIGN AND INTEGRATED RECOVERY
SYSTEM**(76) Inventor: **Robert M. Needham**, Pittsburgh,
PA (US)Correspondence Address:
MEYER UNKOVIC & SCOTT LLP
535 Smithfield Street, Suite 1300
Pittsburgh, PA 15222-2315 (US)(21) Appl. No.: **12/383,375**(22) Filed: **Mar. 24, 2009****Related U.S. Application Data**(60) Provisional application No. 61/070,992, filed on Mar.
27, 2008.**Publication Classification**(51) **Int. Cl.**
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F24B 1/188 (2006.01)
F24F 7/007 (2006.01)
F24J 2/00 (2006.01)
(52) **U.S. Cl. 237/50; 126/516; 454/233; 126/569**
(57) **ABSTRACT**

An integrated air flow induction system for heating a building is provided, the system comprising a centrally located fireplace hearth assembly and wall and floor beam sections defining hollow channels therethrough. The hollow channels are configured to return air back to the fireplace. The fireplace comprises a fire box, the fire box configured to retain a fire therein and further configured to receive returned air from the hollow channels, such that the returned air is heated. A plenum, located below the fire box, is configured to receive the returned air from the hollow channels. A fan, located between the fire box and the plenum, is configured to direct the returned air received by the plenum through the fire box, such that the air is heated by the fire box and dispersed throughout the building.



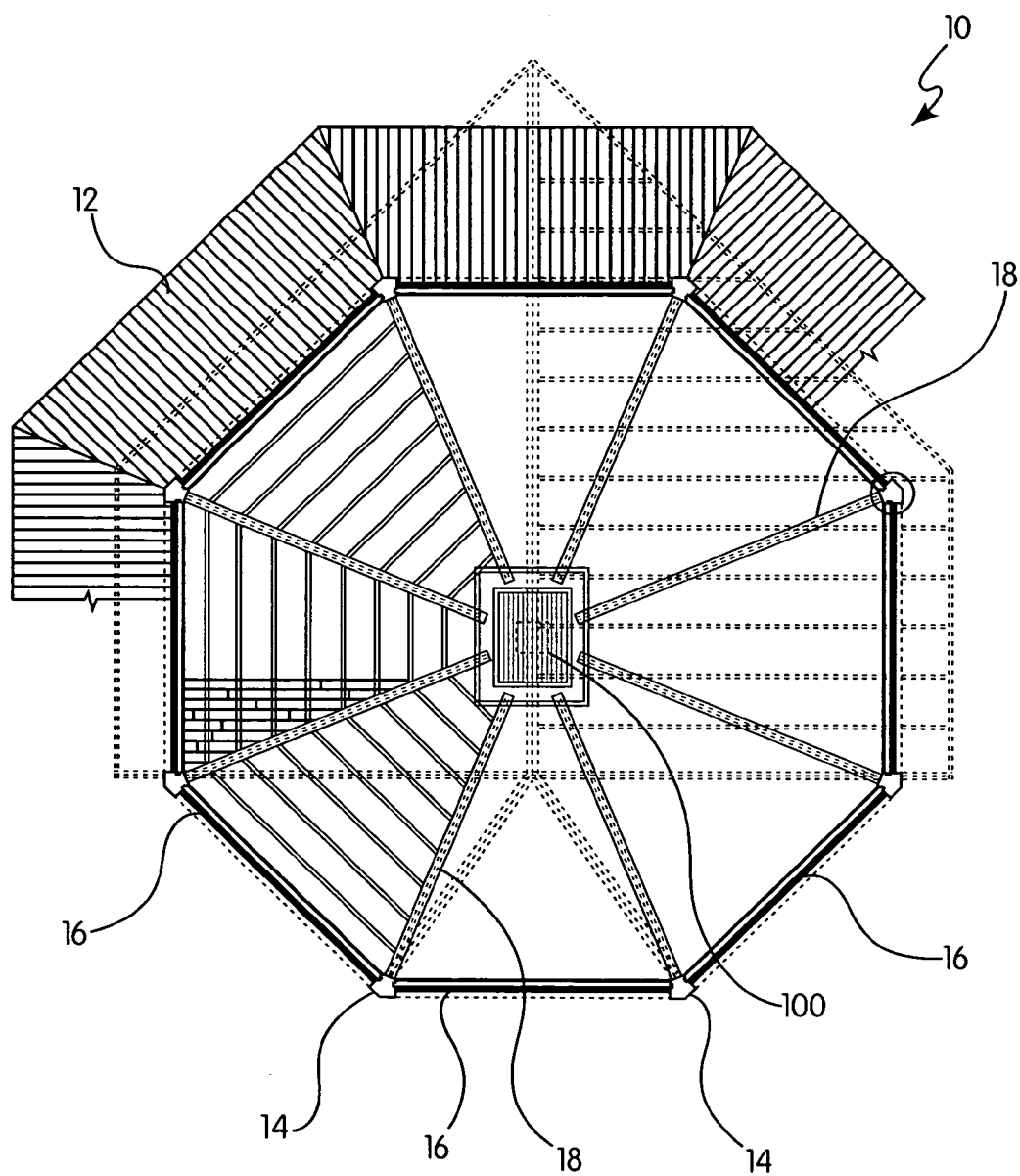


FIG. 1A

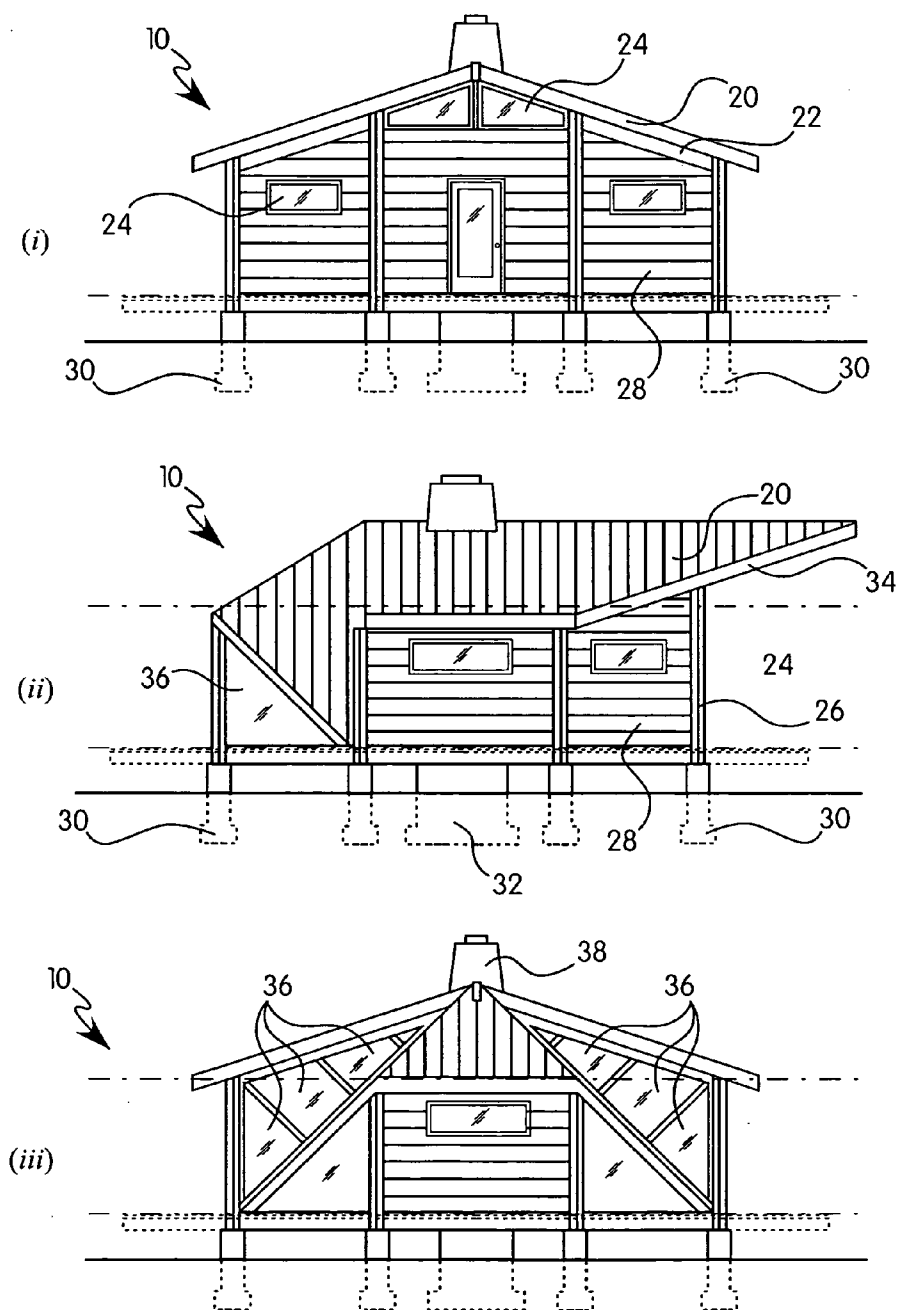


FIG. 1B

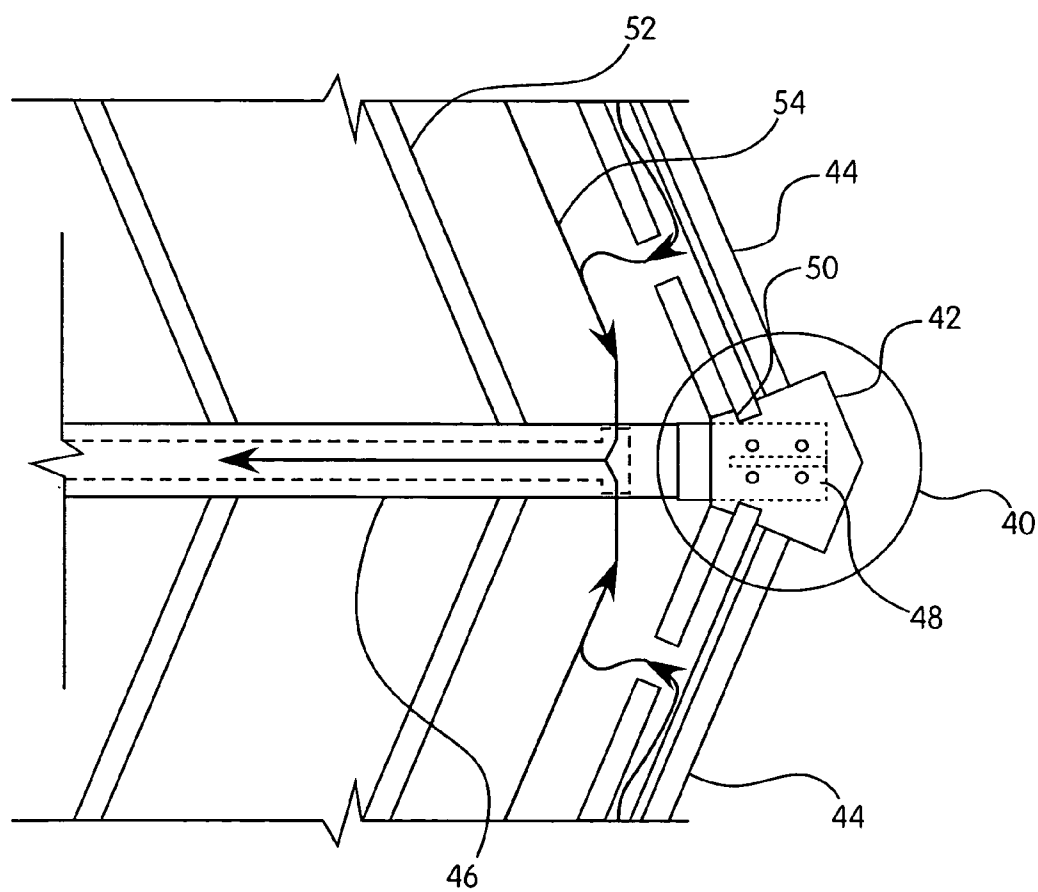


FIG. 2A

FIG. 2B

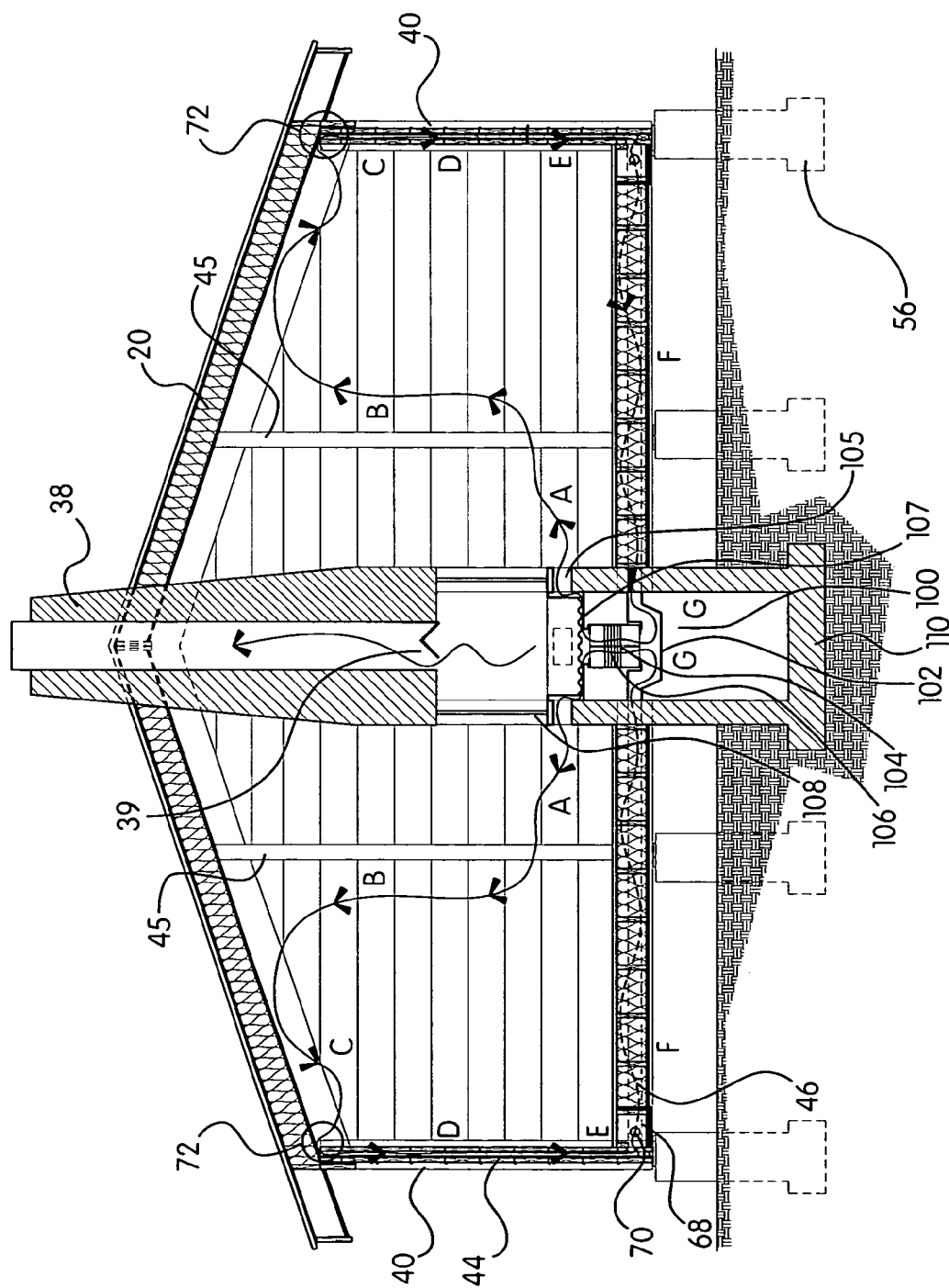


FIG. 2C

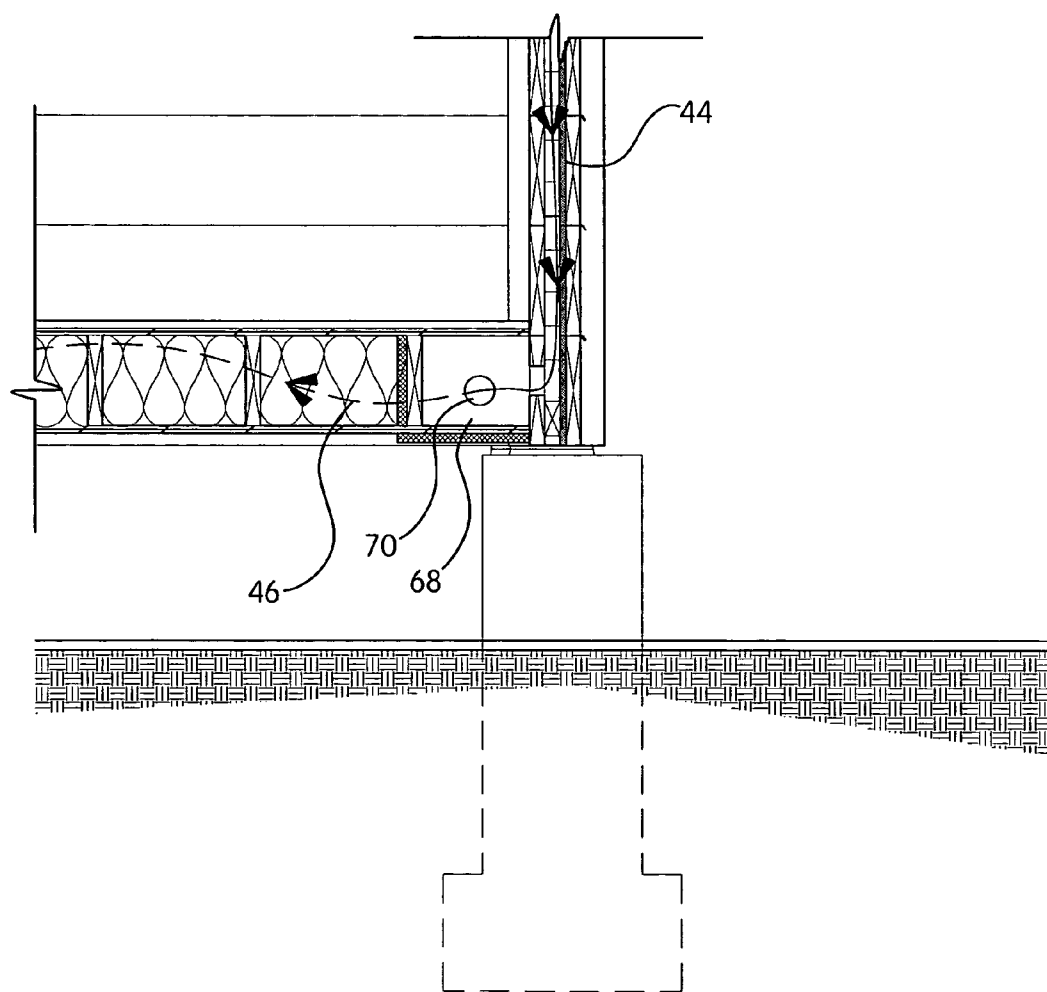


FIG. 2D

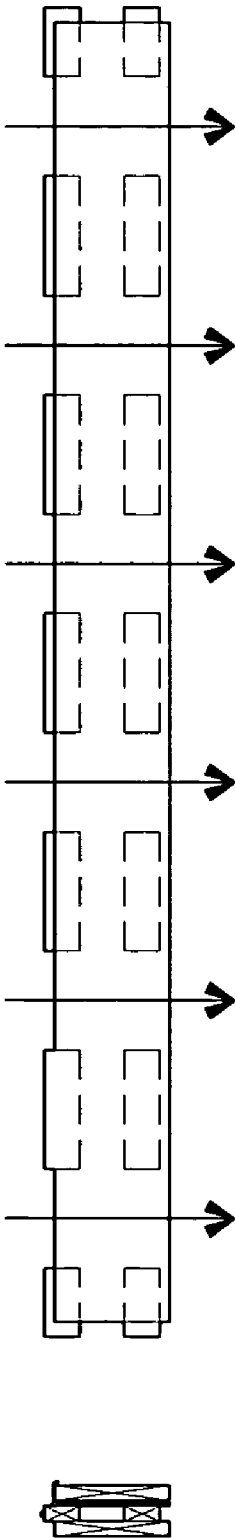


FIG. 3A

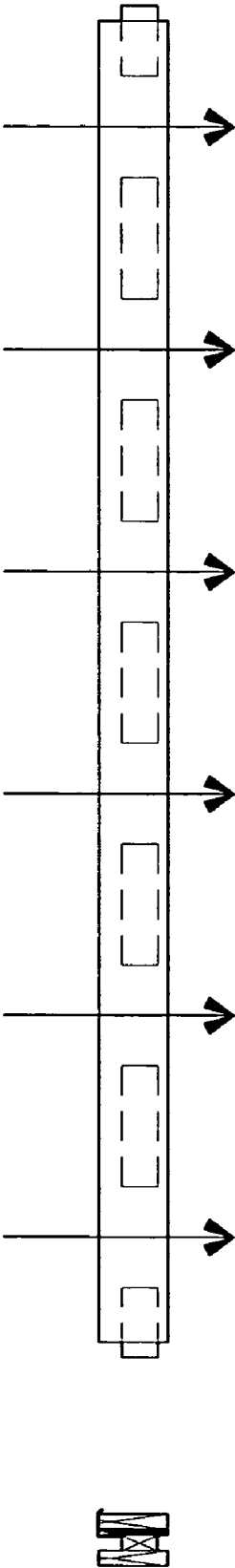


FIG. 3B

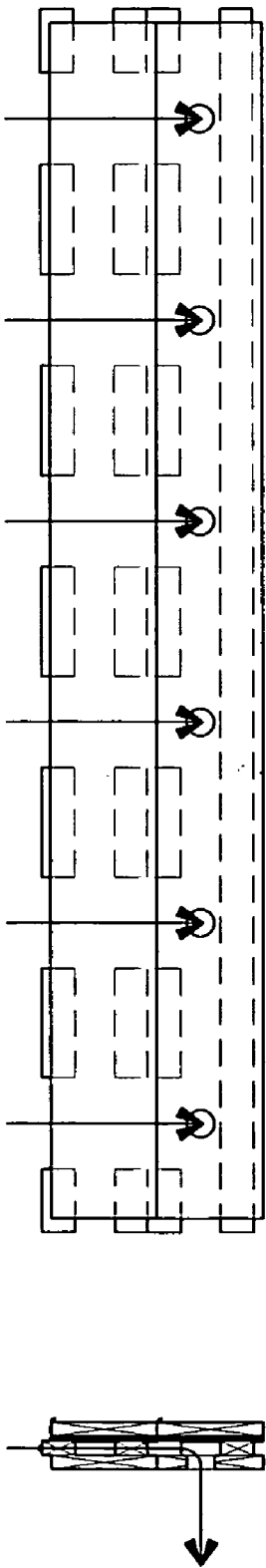


FIG. 3C

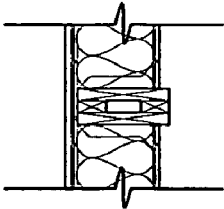


FIG. 3D

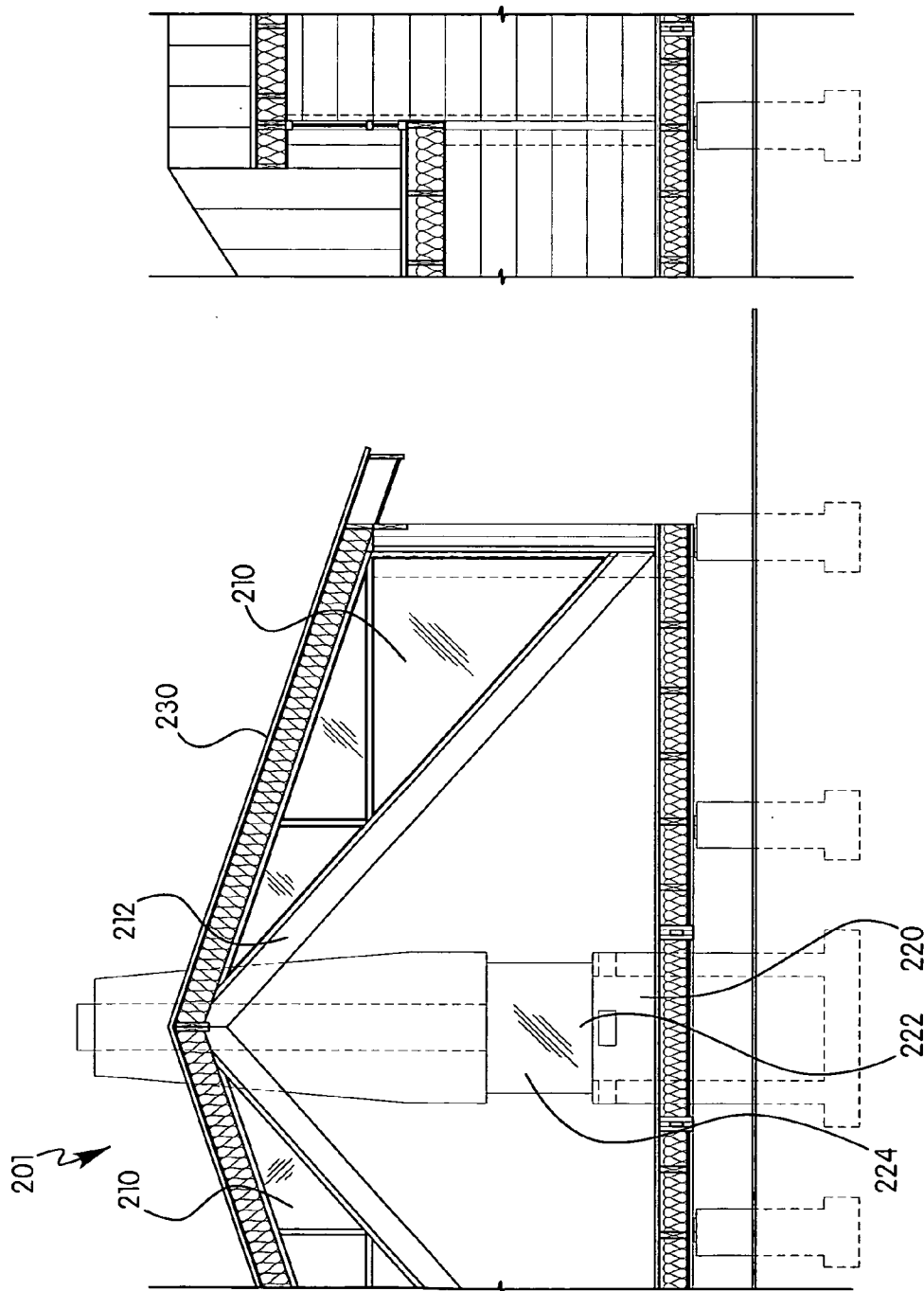


FIG. 4A

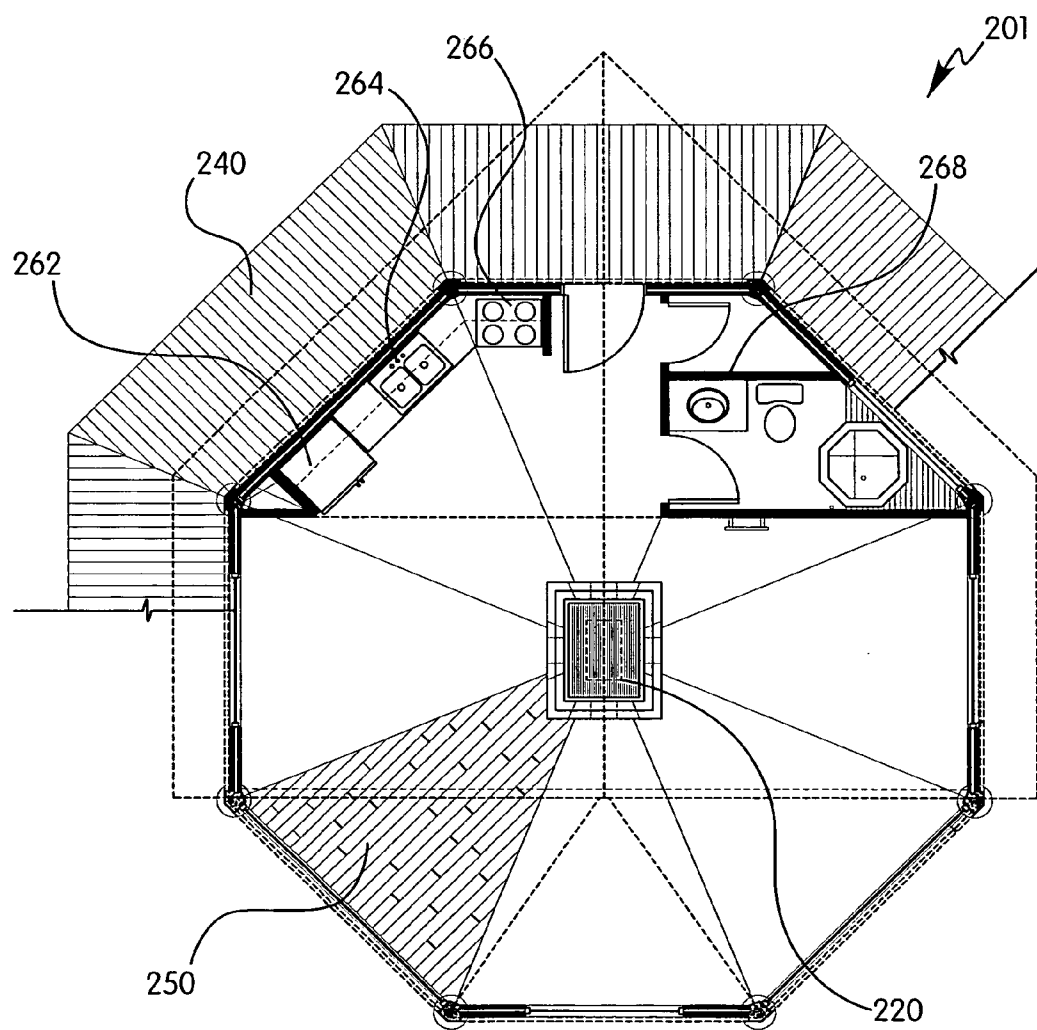


FIG. 4B

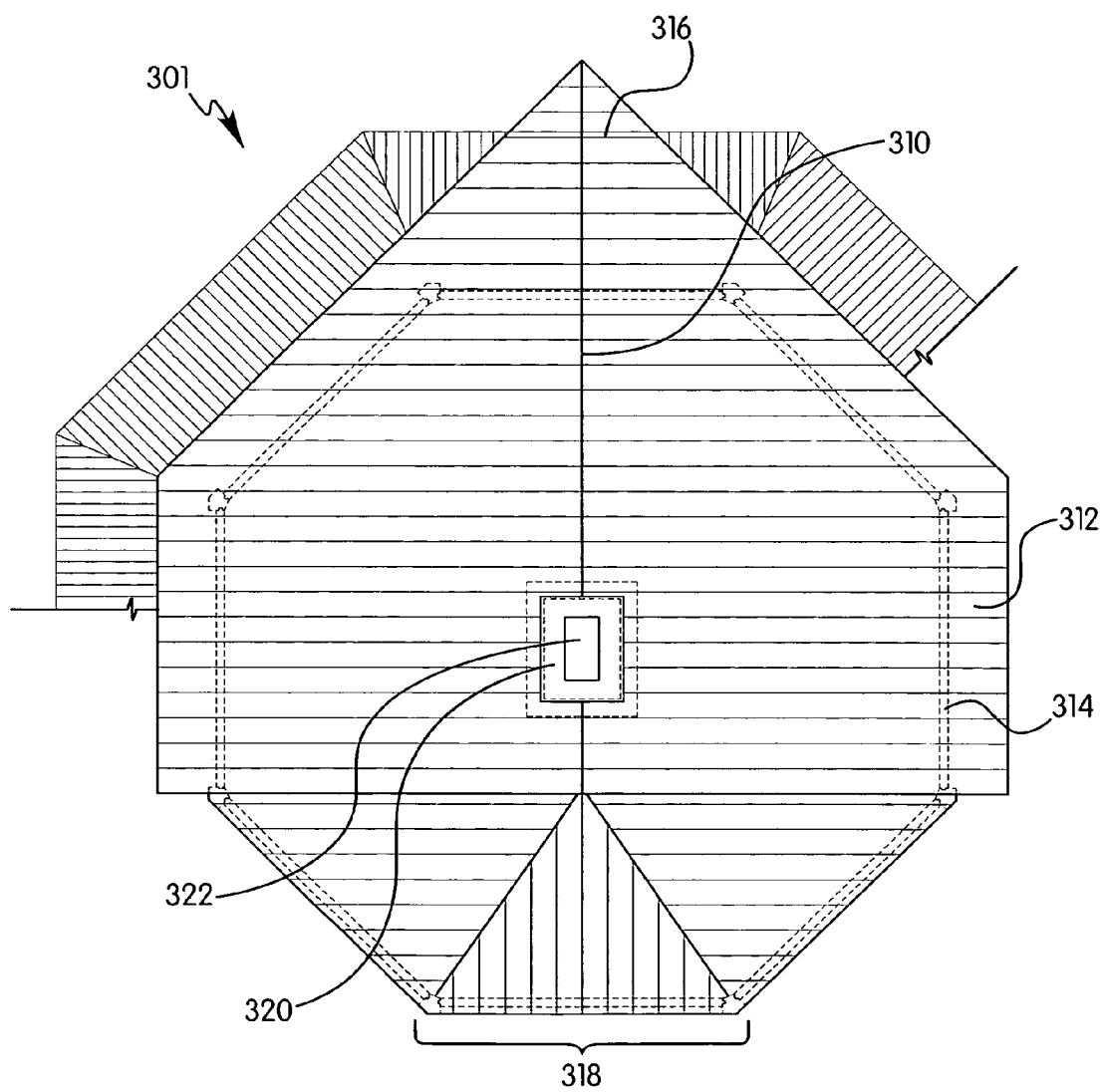


FIG. 4C

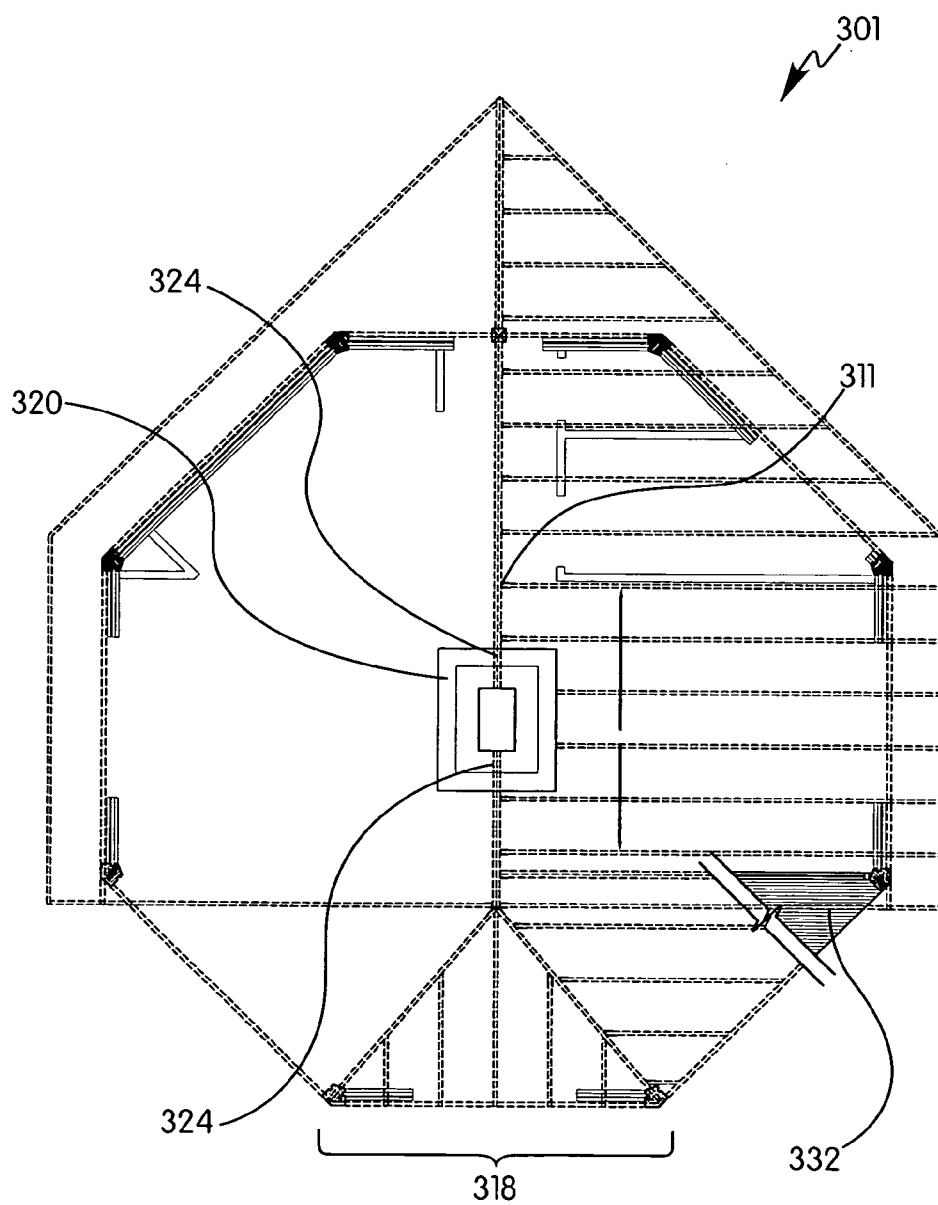


FIG. 4D

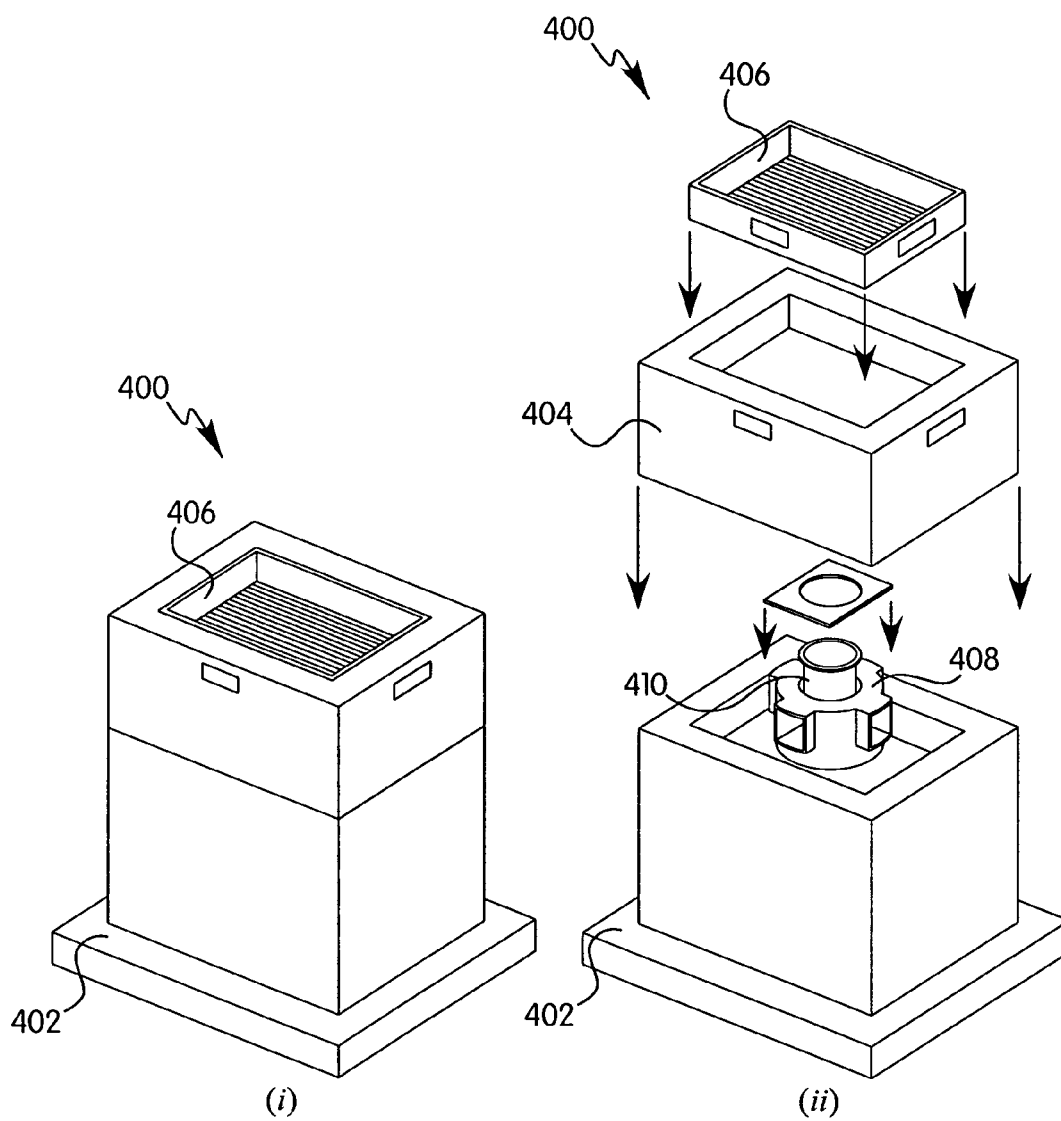


FIG. 5

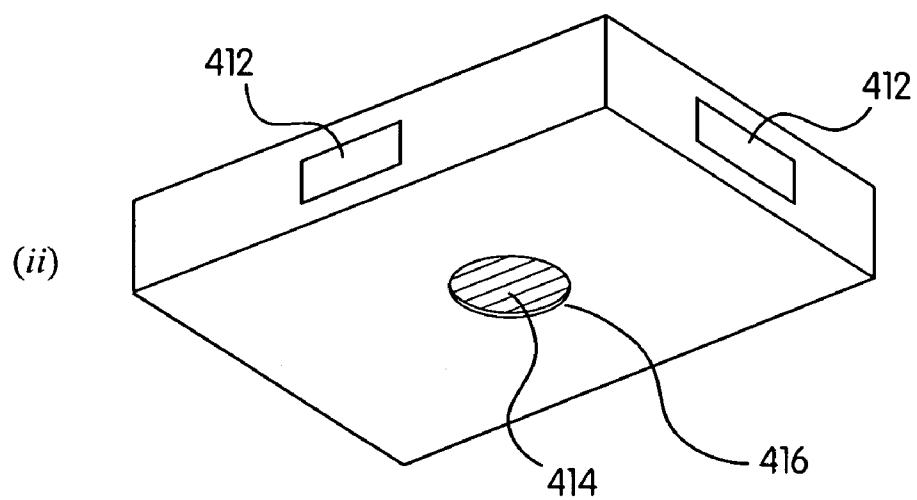
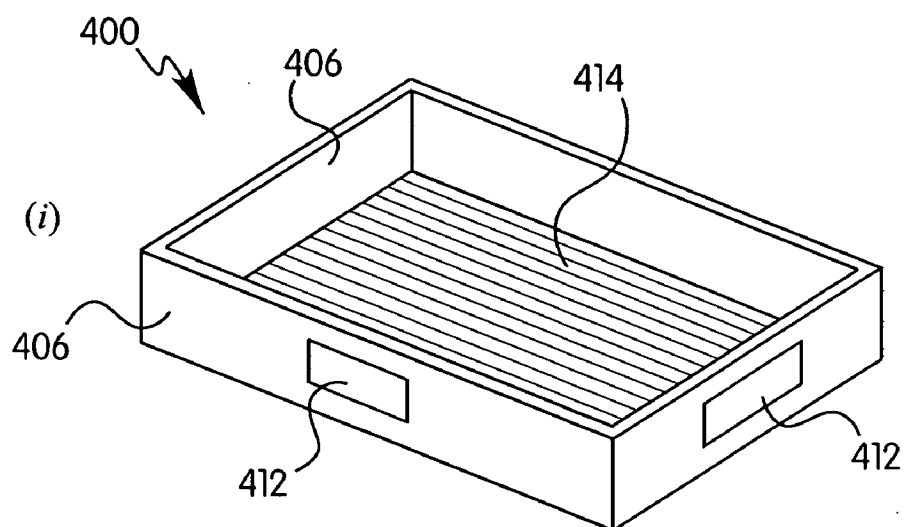


FIG. 6

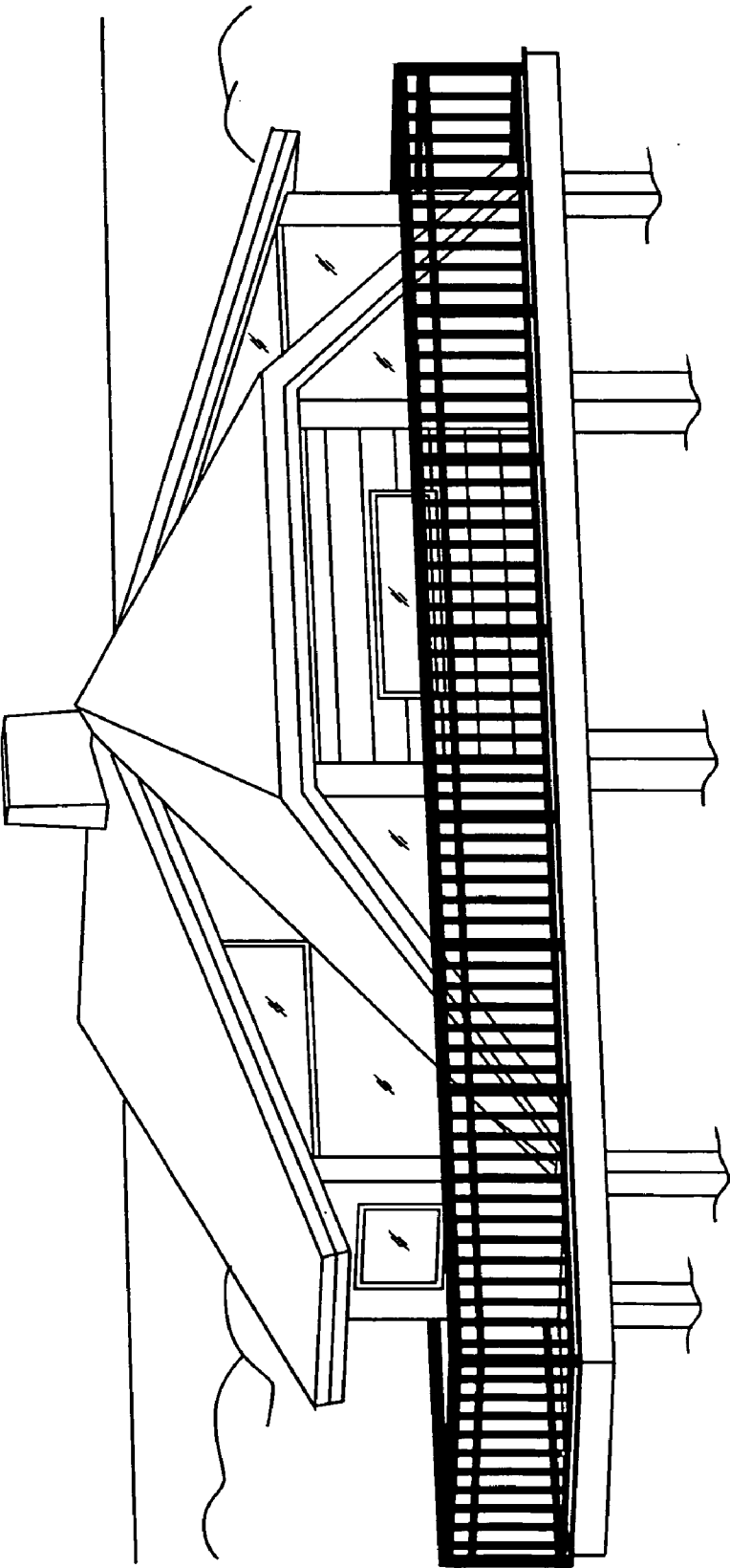


FIG. 7

ENVIROMENTALLY DISTINCTIVE CABIN DESIGN AND INTEGRATED RECOVERY SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 61/070,992, filed on Mar. 27, 2008.

FIELD OF THE INVENTION

[0002] This invention is generally related to a novel cabin design and centralized renewable energy recirculation/recovery system.

BACKGROUND OF THE INVENTION

[0003] Conventional heat recovery systems typically involve gas fired forced air and/or boiler heat sink technology. The present invention improves on these conventional heat recovery systems by providing an integrated air flow induction system that continually recirculates ambient and passive solar air through a combination of hollow-core wall and floor beam sections via a centrally located wood burning open hearth fireplace insert to heat the structure.

[0004] The present invention is also a departure from the conventional use of panelized wall sections used in the building industry today. While the panelized wall is a relatively common wall system in most climatic conditions, it is susceptible to damage in instances of high winds and/or water-laden weather conditions. This invention offers an “architecturally green” alternative to the traditional panelized system while at the same time incorporating “high impact resistant” design features to the overall structure characteristic of solid timber construction in thwarting hurricane type airborne debris damage.

[0005] Consistent with the author’s long standing appreciation for timber framing technology coupled with a desire to provide the occupant(s) with “campfire under a roof” atmosphere, the archetypical cabin design emerged.

SUMMARY OF THE INVENTION

[0006] An objective of the present invention is to provide an improved living space heat recovery system within a novel cabin design scheme. The invention has three primary components.

[0007] First, the invention, in a preferred embodiment, may employ an innovative low profile, polyhedron canopy roof design rising up from a modified octagonal floor plan comprising the main cabin design envelope. A combination of fixed and articulating triangular skylights allow for passive solar heating during the winter months and open air ventilation and cooling in the summer.

[0008] Second, the invention includes a centrally located 360 degree open hearth heating system.

[0009] Third, the invention provides an air induction and heat recovery system that recycles ambient air through ventilated or hollow core wall and floor beam sections, and then

via induction back through a dampening air plenum under the hearth fire box insert to redistribute return air into the living space.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIGS. 1A and 1B disclose a building and elevations plan of one embodiment of the present invention;

[0011] FIGS. 2A, 2B, 2C and 2D disclose a sectional detail of one embodiment of the present invention;

[0012] FIGS. 3A, 3B, 3C and 3D disclose a wall panel detail of the present invention;

[0013] FIGS. 4A, 4B, 4C and 4D show sectional plans of one embodiment of the present invention;

[0014] FIG. 5 shows perspective views of the hearth system of the present invention and system components;

[0015] FIG. 6 shows perspective views of the fire box insert within the hearth system of the present invention; and

[0016] FIG. 7 shows perspective views of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The invention will now be described in detail in relation to a preferred embodiment and implementation thereof which is exemplary in nature and descriptively specific as disclosed. As is customary, it will be understood that no limitation of the scope of the invention is thereby intended. The invention encompasses such alterations and further modifications in the illustrated apparatus, and such further applications of the principles of the invention illustrated herein, as would normally occur to persons skilled in the art to which the invention relates.

[0018] With reference now to FIGS. 1A and 1B, building elevation plans of one embodiment of the present disclosure are shown. FIG. 1A shows an aerial view of a building structure **10** having a central, open hearth system **100** designed to receive returned air from the building **10**, re-heat the returned air and circulate the re-heated returned air back through the building **10**. The embodiment of FIG. 1A further shows an octagonal building structure **10** including a deck **12** surrounding the perimeter of the structure **10**. Each of the eight joints **14** of the octagonal structure **10** is configured to secure two of the wall panel systems **16** together, thereby supporting the structure **10**. Furthermore, at the base, or floor, of each joint **14** is a hollow core floor beam system **18** extending inwardly from its corresponding joint **14** toward the centrally located open hearth assembly **100**.

[0019] The arrows of FIG. 2C illustrate the flow of air through the building **10**. The heated air flows from the hearth system **100**, propelled via a variable speed fan **106**, disposed within the hearth system **100**, through the building **10** and returns through the hollow wall panels **42** and hollow floor beams **46** of the structure **10**. The returned air eventually reaches the plenum **102** of the hearth system **10**, thereby allowing the air to be re-heated and re-circulated by the fan **106**. The operation of the hearth assembly **100** as well as the heat recovery system will be described in more detail below.

[0020] FIG. 1B shows elevation plans of one embodiment of the building structure **10** of FIG. 1A wherein illustration (i) shows a front elevation plan, illustration (ii) shows a side elevation plan, and illustration (iii) shows a rear elevation plan. Illustration (i) shows the building structure **10** including an metal fascia roof **20** supported by roof framing supports

22. In this embodiment, the roof 20 is a low profile, polyhedron canopy roof. The roof 20 may also be downward sloping, as shown, as can be insulated.

[0021] The windows 24 shown in illustration (i) and (ii) are exemplary, and the placement and shape of such windows 24 may be configured in accordance with one's preferences. The solid wood columns 26 shown correspond to the joint locations between the wall panels 28. Each of the solid wood columns 26 is secured to a reinforced concrete pier 30 to stabilize and anchor the building 10 in case of inclement weather. Similarly, the centrally located hearth system 100 is supported by a concrete 32. This footer 32 can be a pre-cast concrete faulted footer.

[0022] Illustration (ii) of FIG. 1B shows one embodiment in which the roof 20 includes an overhang 34 over the entryway and sides to the building. Illustration (iii) further shows the downward sloping roof at the rear portion of the building as well as a combination of fixed and articulating triangular skylights 36, which are incorporated into the rear of the building 10. These fixed and articulating triangular skylights 36 are advantageous in that they allow for passive solar heating during the winter months and open air ventilation in the summer months.

[0023] As mentioned above, the roof 20 and building 10 may be supported by solid wood columns 26 incorporated into the perimeter of the building 10. For example, in the octagonal structure shown in FIG. 1A, eight solid wood columns 26 would support the roof 20 and building 10, one of the eight solid wood columns 26 being disposed at each of the eight joints 14 which join the panels 16, thereby forming the octagonal structure 10.

[0024] In exemplary embodiments of the building structure 10 shown in illustrations (i)-(iii), the chimney 38 may be a stone chimney 38. The roof 20 may be a standing seam metal roof and a deck 12 surrounding the perimeter of the structure may also be included. Furthermore, the structure 10 may be supported by reinforced concrete piers 30, or other similar support mechanisms.

[0025] With reference now to FIGS. 2A-2D, FIG. 2A shows an enlarged, detailed view of one of the joints 40 in the octagonal building structure of FIGS. 1A and 1B, at the base of one of the solid wood columns 42. As mentioned, the solid wood columns 42 join two of the hollow core wall panel units 44 at each of the joint locations 40. Each solid wood column 42 is also joined to a hollow core floor beam 46 at the base, or floor, of the structure. A steel knife plate 48 may be configured to secure the wood columns 42 to the floor beams 46. Slots 50 in the wood columns 42 are configured to engage the wall panels 44, securing them therein, as shown in FIG. 2A. Wood columns 42 are laminated in one embodiment of the invention. Floor support beams 52 are positioned at the base of the structure 10, throughout the structure 10, to reinforce and stabilize the floor of the structure 10. These support beams 52 are connected at one end to one of the hollow core floor beams 46 and at a second end to another hollow core floor beam 46, providing a frame-like structure upon which sheathing (preferably insulated) and wood flooring, or similar flooring used in the art, may be installed. Furthermore, an additional sheathing is disposed below the frame-like structure mentioned above. This external sheathing may be made from exterior-grade plywood or other suitable material. The space defined between the support beams 52, hollow core floor beams 46, installed flooring, and exterior sheathing is the joist space 54. The importance of this space 54 will become more

apparent below. As will be described in more detail below, ambient air within the building enters the hollow wall panels 44 and is returned through the joist space 54 and hollow floor beams 46 to the plenum.

[0026] The hollow core wall panels 44 may include insulation materials designed to help increase the R-value of the panels, thereby helping to prevent internal heat loss during colder months. The wall panels 44 may further include wiring chases and ventilation channels, to achieve maximum flexibility.

[0027] FIG. 2B shows an enlarged, detailed view of one of the solid wood columns 42 interfacing with a reinforced concrete pier 56 supporting the structure and further illustrates the floor structure, allowing for air to return to the plenum. A steel base plate 58 is provided in connection with each joint, each steel base plate 58 configured to carry the column 42 and floor beams 46 and secure the columns 42 to the reinforced concrete piers 56. Anchor bolts 60 are used to secure the steel base plates 58 to the concrete piers 56, thereby maintain the integrity of the structure. The slots 50 located on either side of the solid wood columns 42 accept and retain the wall panels 44 therein.

[0028] In the embodiment shown in FIG. 2B, a plywood sheath 62 is laid on the frame created by the hollow core floor beams and support beams. On top of the plywood sheath 62 is finished flooring 64, preferably made of wood. This plywood sheath 62 and the exterior grade plywood sheath 66 disposed on the underside of the frame effectively seal the frame and joist space 68 from the outside air as well as from the air inside the building 10.

[0029] As mentioned above, the floor beams 46 extending from the joints to the central hearth system have a hollow core, allowing air to flow from the wall panels back to the central hearth system. Furthermore, an aperture 70, located near the joint, is defined within each of the floor beams 46. These apertures 70 are configured to allow air, which is disposed within the joist space 68, to pass from the joist space 68 into the floor beam 46. Thus, ambient air within the joist space 68 may enter the hollow core of the floor beams 46 and return to the plenum (not shown), where it is forced through the fire box by the variable speed fan, reheated, and re-distributed throughout the building 10.

[0030] FIG. 2C shows a cross-sectional view of the building 10 in accordance with one embodiment of the present disclosure. At either end of the building 10, one of the joints 40 is shown whereby the wood columns 44 are shown anchored into the concrete piers 56. Additionally, exposed interior columns 45 within the building structure 10 show the interior facia of columns 44 of building 10. Furthermore, the 360 open hearth system 100 is at least partially enclosed via heat resistant glass enclosure 108 including an access door 108. Apertures 105 in the hearth system 100 adjacent to the fire box 107 allow for heated air to escape the firebox insert 107 and circulate throughout the building 10. Furthermore, openings 72 located at the top of each hollow core wall panels 44 allow ambient air to enter the hollow core wall panels and eventually return to the plenum 102. It should be noted that the openings 72 located at the top of the hollow core wall panels are open to the interior of the building only. The interior of the building is sealed off from the outside, to ensure that heated air does not escape the building and also to make sure that cooler air does not enter the building.

[0031] In the embodiment shown in FIG. 2C, the hearth assembly 100 and chimney 38 are shown centrally disposed

within the building structure 10. A concrete fireplace foundation 110 and footing 110 are located beneath the hearth system 100 and chimney 38, to support the hearth system 100 and chimney 38.

[0032] With continued reference to FIG. 2C, the ambient heat recovery system of the present disclosure will be described in detail, where the arrows indicate the flow of air throughout the building. The centrally located hearth system 100 is secured within a concrete fireplace foundation 110 and extending upwardly through the roof 20 of the building 10 is a chimney 38 with a flue 39 defined therein. The fireplace portion of the hearth system 100 includes a fire box 107. The fire box 107 is configured to retain a fire therein and further configured to receive returned air from the plenum 102. The plenum 102 is located below the fire box 107 and is configured to receive the returned air from the hollow core floor beams 46. A fan 106 is located between the fire box 107 and the plenum 102. The fan 106 is configured to direct the returned air received by the plenum 102 through the fire box 107, such that the air is heated by the fire within fire box 107 and dispersed throughout the building 10. Once the air is heated by the fire contained within the fire box 107, the air escapes through apertures 105 and is evenly distributed throughout the building, due to the 360 degree, central location of the hearth assembly 100. The smoke from the fire exits the building through the flue 39 in the chimney 38.

[0033] When a wood-burning or other suitable fire is started in the fire box 107, heated air exits the fire box 107 through apertures 105, thereby heating the building 10. Fan 106, which may be a variable speed fan, helps distribute the heated air evenly throughout the entire building 10. As shown by letter A, the heated air is exiting the hearth assembly and entering the living space. The heated air continues to travel, as indicated by the path of arrows at location B. Eventually, the heated air, which emanated from the centrally located hearth system 100 reaches the furthest parts of the building 10, noted as at location C, which is around the perimeter walls of the building 10. As the heated air travels along the above described path, from A to C, for example, it mixes with cooler air, thereby increasing the temperature of the building 10. This ambient air will reach the openings 72 located at the top of wall panels 44 and enter the hollow core of the wall panel units 44. The air travels down the hollow core of the wall panel 44 as shown by the arrow segment D. When the air reaches the base of the wall panels 44, at location E, it enters the floor joist space 68 via a opening located beneath the sheathing and flooring. Once located in the floor joist distribution space 68, the air may flow into the hollow core floor beams 46 through apertures 70. The hollow core floor beams 46 lead from the outer perimeter of the building 10 to the centrally located hearth assembly 100, where they are in fluid communication with the plenum 102, thereby allowing the ambient air to return to the plenum 102, for example, via path F. It is preferred that the plenum 102 is a steel plenum 102, however it is also envisioned that other suitable materials may be used.

[0034] Once the ambient air is returned to the steel plenum 102, as described above, it is transferred, at location G, via the variable speed fan 106 back through the fire box 107, where the air is re-heated. The variable speed fan 106 also assists in forcing the re-heated air back through the openings 105 in the hearth assembly 100, as shown by arrow segment A, and thus the ambient heat recovery system just described repeats itself. As can be appreciated by one skilled in the art, the above-

mentioned process continues indefinitely, heating the building and returning previously heated air, until the fire or heat source is no longer burning.

[0035] FIG. 2D shows an enhanced view of the wall and floor details which provide for the return of air to the centrally disposed hearth assembly. As shown, the air flows through the hollow core wall panels 44, where it eventually enters the distribution space 68, through a small opening at the base of the wall panels 44. The air then flows from the distribution space 68, through the aperture 70 and into the hollow core floor beams 46, where it is then returned to the hearth assembly via the hollow core floor beams 46.

[0036] Now referencing FIGS. 3A-D, the uniquely designed wall panels and floor beams of the present invention are illustrated. FIG. 3A shows an elevation view of the typical hollow core wall panel unit in accordance with the present disclosure, while FIG. 3B is an elevation view of the cap of the hollow core wall panel. FIG. 3C is an elevation view of the base of the hollow core wall panel and FIG. 3D is an elevation view of the hollow core floor beam in accordance with the present disclosure.

[0037] FIG. 4A shows a cross-sectional view from the back of a building structure 201 according to one embodiment of the present disclosure, showing the skylights 210, centralized hearth assembly 220 and showing the roof structure 230 in more detail. In the embodiment of FIG. 4A, the hearth 222 is partially surrounded by a heat resistant glass casing 224. Alternatively, the hearth 222 may be surrounded by any fire screen known in the art.

[0038] The skylights 210 may be made from any sufficient material allowing solar heat to pass through, for passive heating of the building 201 and/or may be insulated to prevent heat loss during the colder months. The skylights 210 may be fixed window skylights or articulating window skylights. The windows 210 are supported by solid wood beam truss 212 extending diagonally from the base of the structure 201 to the top portion of the structure 201, thereby creating the triangular truss shape.

[0039] FIG. 4B shows a potential floor plan in accordance with the building structure 201 and hearth assembly 220 of the present disclosure. The octagonal-shaped building 201 includes a centrally located hearth assembly 220 and may further include a wood, or other suitable material deck 240 at least partially surrounding the octagonal structure. Wood flooring 250 may be installed, preferably running perpendicular to the floor framing, as shown.

[0040] The floor plan shown in FIG. 4B including a refrigerator 262, sink 264, range-top stove 266 and bathroom 268 are exemplary and it is contemplated that any desired layout may be used in conjunction with the present disclosure. Furthermore, although a one-floor plan is shown, it is within the scope of the present disclosure that a multiple floor or lost-style floor plan may also be used, as long as the hearth assembly 220 is centrally located.

[0041] FIG. 4C shows an aerial view of the roof structure 301, in accordance with the present disclosure wherein the roof 301 generally slopes downwardly from the central ridge 310. The centrally located chimney 320 and flue 322 also extend from the roof 301, centered on the central ridge 310. A portion of the roof 312 extends beyond the octagonal frame 314 of the building and an accentuated overhang 316 may be provided over the front of the building structure, as shown. The roof 301 further includes the partially-detached rear por-

tion **318** consisting of three roof panels sloping downwardly as well. This embodiment of the roof is also illustrated in FIG. 7, discussed below.

[0042] FIG. 4D is a detailed aerial view of the roof structure **301** showing the incorporation of the chimney **320** into the roof **301** as well as the partially-detached rear portion **318** of the roof **301**, allowing for the installation of skylight windows and/or passive solar paneling (not shown). Framing members **332** are included surrounding the triangular skylight truss sections. The masonry making up the chimney **320** defines a pocket **324** therein for accepting the central ridge beam **311**.

[0043] With reference to FIG. 5, an open hearth assembly **400** in accordance with the present disclosure is shown. Illustrations (i) and (ii) of FIG. 5 shows the base of the hearth assembly **402**, including a plenum **408**, and designed to receive returned air from a building, through openings in the hearth **404**. The fire box insert **406** is disposed above the plenum **408** and configured to retain a burning fire (i.e. via wood, coal, etc.) or similar heat producing mechanism therein.

[0044] Illustration (ii) is an exploded view of illustration (i) and shows a fan **410**, which may be a variable speed fan, disposed within the plenum **408** and configured to force the air returned through the plenum up through the fire box insert **406** thereby heating the air within the building. The variable speed fan **410** also assists to direct the heated air throughout the cabin structure.

[0045] Illustration (iii) further shows fire box insert **406** positioned above the variable speed fan **410** and plenum assembly **408**, in accordance with the present disclosure.

[0046] The fan **410** and plenum **408** may be designed for relatively maintenance free operation. Furthermore, the open hearth assembly **400** may be configured such that it is easily accessible from inside the cabin structure, allowing a user to easily empty ash from the fire box insert **406** and/or manually control the fire. Such a design is advantageous in that operation of the hearth system **400** and provides efficient and relatively user-friendly operation.

[0047] FIG. 6 shows a more detailed view of the fire box insert **406** in accordance with the present disclosure. As shown in illustration (i) of FIG. 6, the fire box **406** may be rectangular in shape and may include a ribbed/corrugated base section **414**, thereby allowing uniform heat transfer to the surfaces within the fire box insert chamber. Illustration (i) further shows specifically designed openings **412** in the fire box insert **406**, allowing reheated air to return to the living space within the cabin structure.

[0048] Illustration (ii) is a contrasted view of the fire box insert **406**, allowing a more clear view of its configuration including side wall openings **412**, and a base opening **416**, which may be circular in configuration, and that allows forced air to enter the firebox insert chamber from below.

[0049] Referring now to FIG. 7, external perspective view of a completed cabin structure, designed to incorporate the above-mentioned open-hearth system and embodiments of the present disclosure are shown, including a chimney **510** leading from the hearth system, a roof structure **520** in accordance with the present disclosure, and triangular windows **530** as discussed above.

What is claimed is:

1. A fireplace system for a building comprising:
 - a fire box assembly, the fire box configured to retain a fire therein and further configured to receive returned air there through, such that the returned air is heated;
 - a plenum located below the fire box, the plenum configured to receive the returned air from the building;
 - a fan located between the fire box and the plenum, the fan configured to direct the returned air received by the plenum through the fire box, such that the air is heated by the fire box and dispersed throughout the building; and
 - wall and floor beam sections defining hollow channels therethrough, the hollow channels configured to return air back to the fireplace.
2. The fireplace system of claim 1, further comprising a fire screen, wherein the fire screen helps to contain the fire within the fire box.
3. The fireplace system of claim 1, wherein the fan is a variable speed fan such that the variable speed fan produces an even distribution of heated air throughout the building.
4. The fireplace system of claim 1, wherein the firebox is a lift-out firebox, thereby providing for portable ash removal.
5. An integrated air flow induction system for heating a building comprising:
 - a centrally located fireplace; wall and floor beam sections defining hollow channels therethrough, the hollow channels configured to return air back to the fireplace.
6. The integrated air flow induction system of claim 5, wherein the fireplace comprises:
 - a fire box, the fire box configured to retain a fire therein and further configured to receive returned air from the hollow channels defined within the wall and floor beam sections, such that the returned air is heated;
 - a plenum located below the fire box, the plenum configured to receive the returned air from the wall and floor beam sections; and
 - a fan located between the fire box and the plenum, the fan configured to direct the returned air received by the plenum through the fire box, such that the air is heated by the fire box and dispersed throughout the building.
7. The integrated air flow induction system of claim 6, wherein the fireplace further comprises a fire screen, wherein the fire screen helps to contain the fire within the fire box.
8. The integrated air flow induction system of claim 6, wherein the fan is a variable speed fan such that the variable speed fan produces an even distribution of heated air throughout the building.
9. The fireplace system of claim 5, wherein the firebox is a lift-out firebox, thereby providing for portable ash removal.
10. The integrated air flow induction system of claim 5, further comprising passive solar panels, wherein the passive solar panels allow sunlight to heat the air within the building.
11. The integrated air flow induction system of claim 5, wherein insulation lines the hollow channels defined within the wall and floor beam sections.
12. The integrated air flow induction system of claim 5, wherein the wall and floor beam sections further comprises wiring chases therein.
13. The integrated air flow induction system of claim 5, wherein the building comprises a low profile canopy roof structure.
14. The integrated air flow induction system of claim 13, wherein the low profile canopy roof structure comprises a polyhedron multi-faceted canopy roof.