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(54) **ROOFTOP AIR RECIRCULATION DEVICE**

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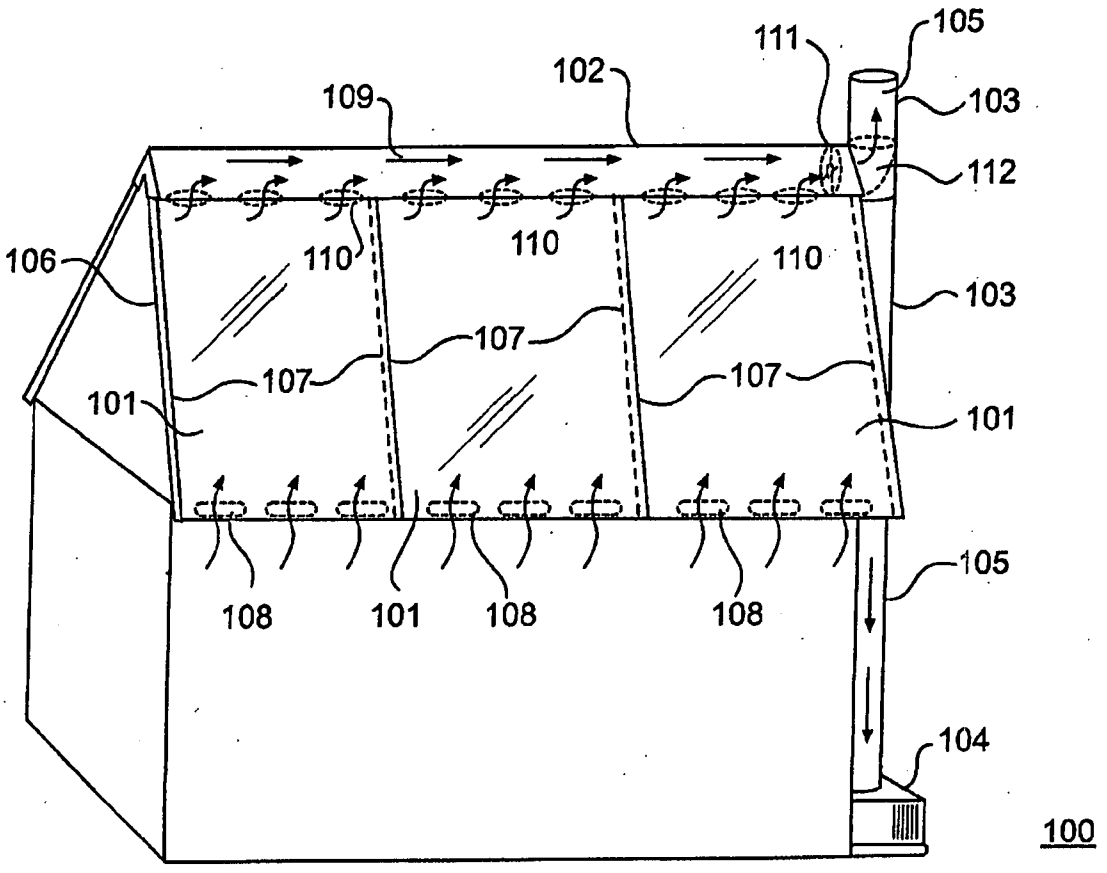
(57) **ABSTRACT**

A rooftop device and method for collection of heated air for recirculation and/or ventilation. The rooftop device supplements cooling of roof structures and supplements building heat systems. A roof cap including an air passage is connected to air outlets disposed within the roof structure of a building and to air passages formed by panels mounted over the surface of a building's roof. The roof cap is connected to a vent which either exhausts air to the atmosphere and/or recirculates air to a building air handling system. Air flow within the device is enhanced by a fan disposed within the device.



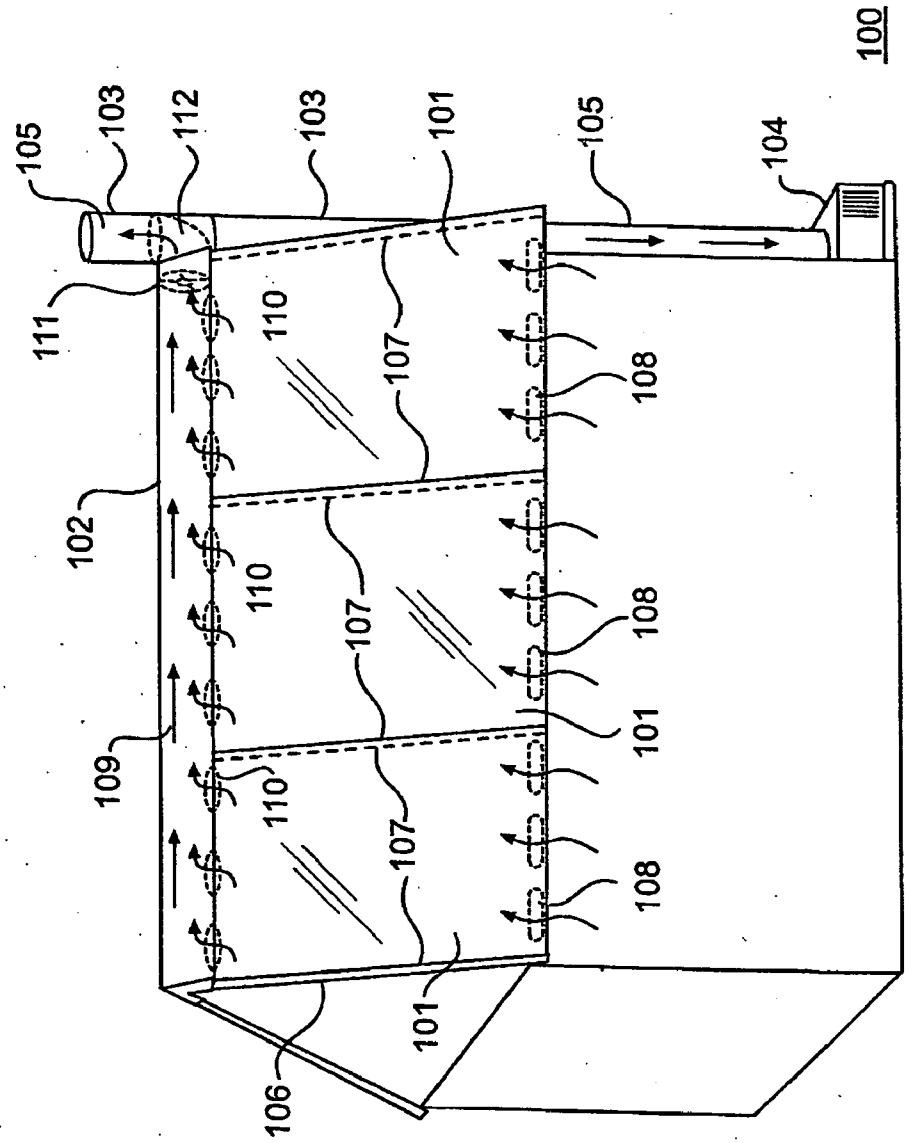

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FIG. 1

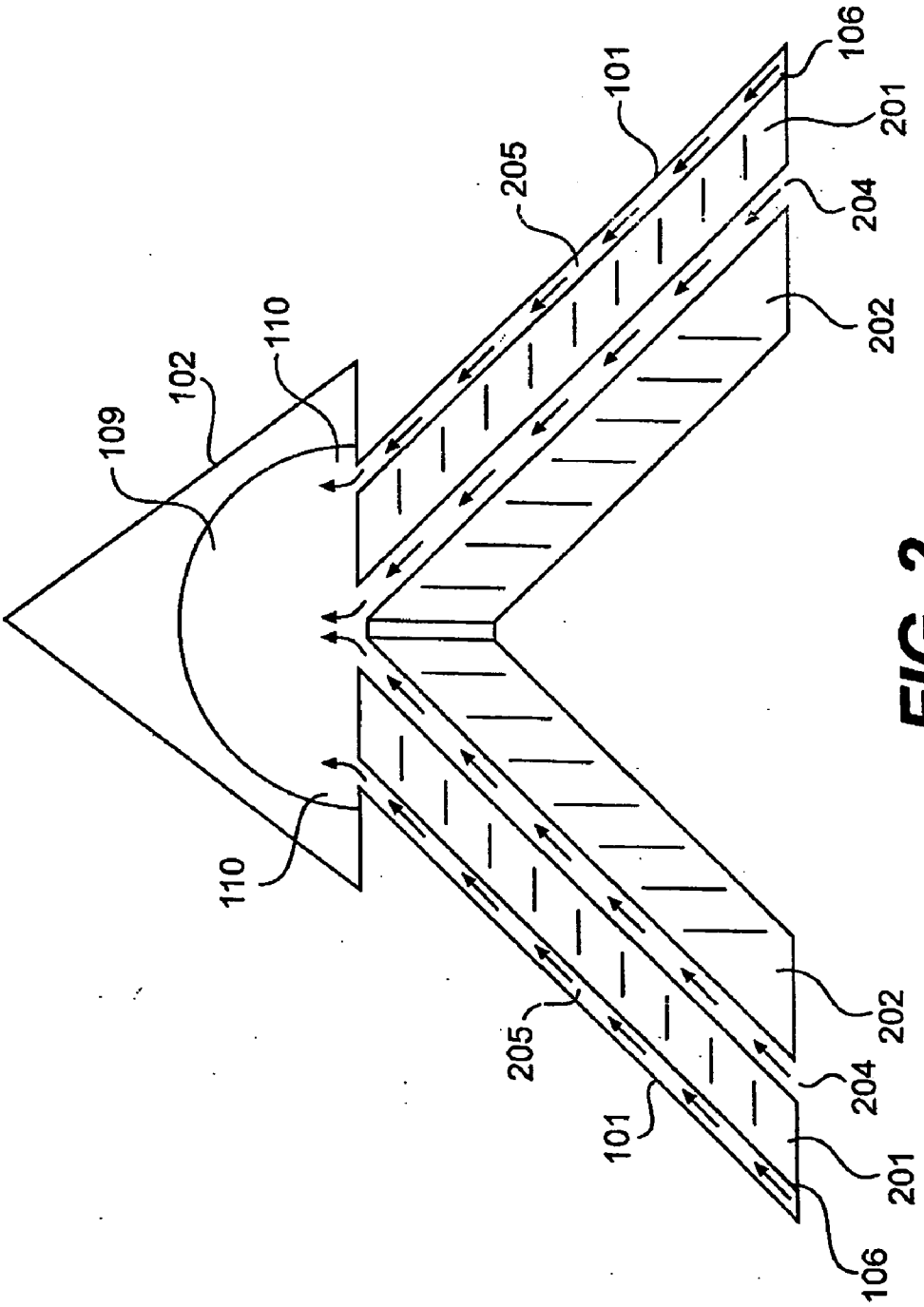


FIG. 2

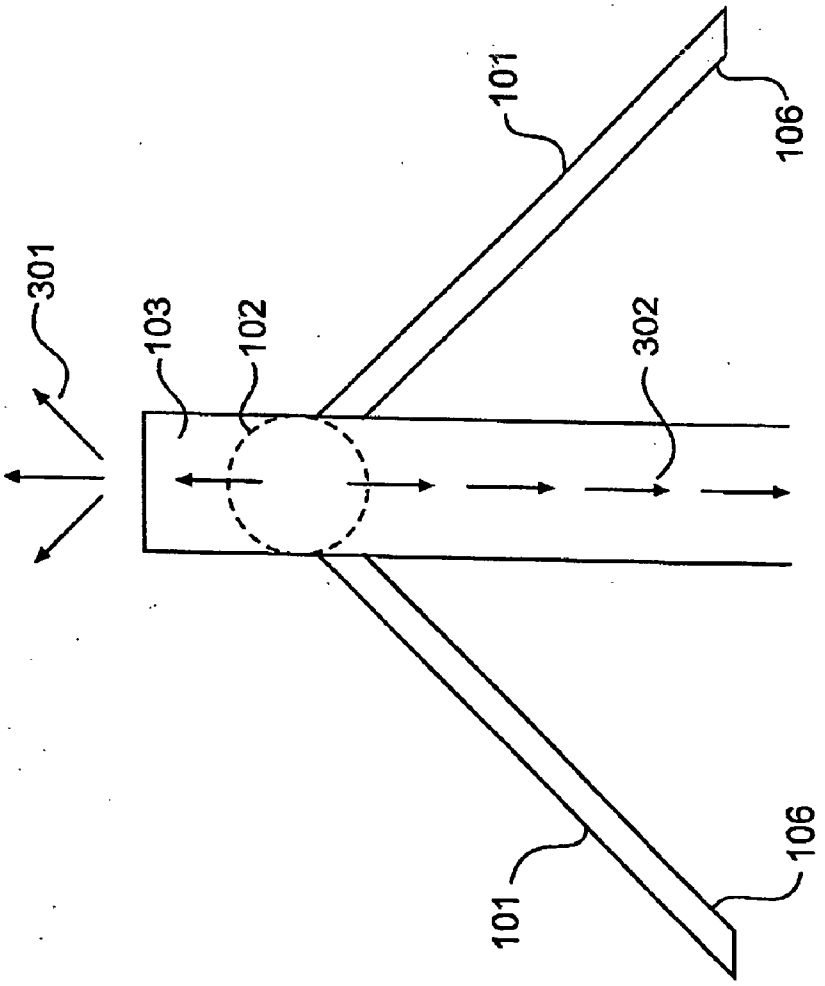


FIG. 3

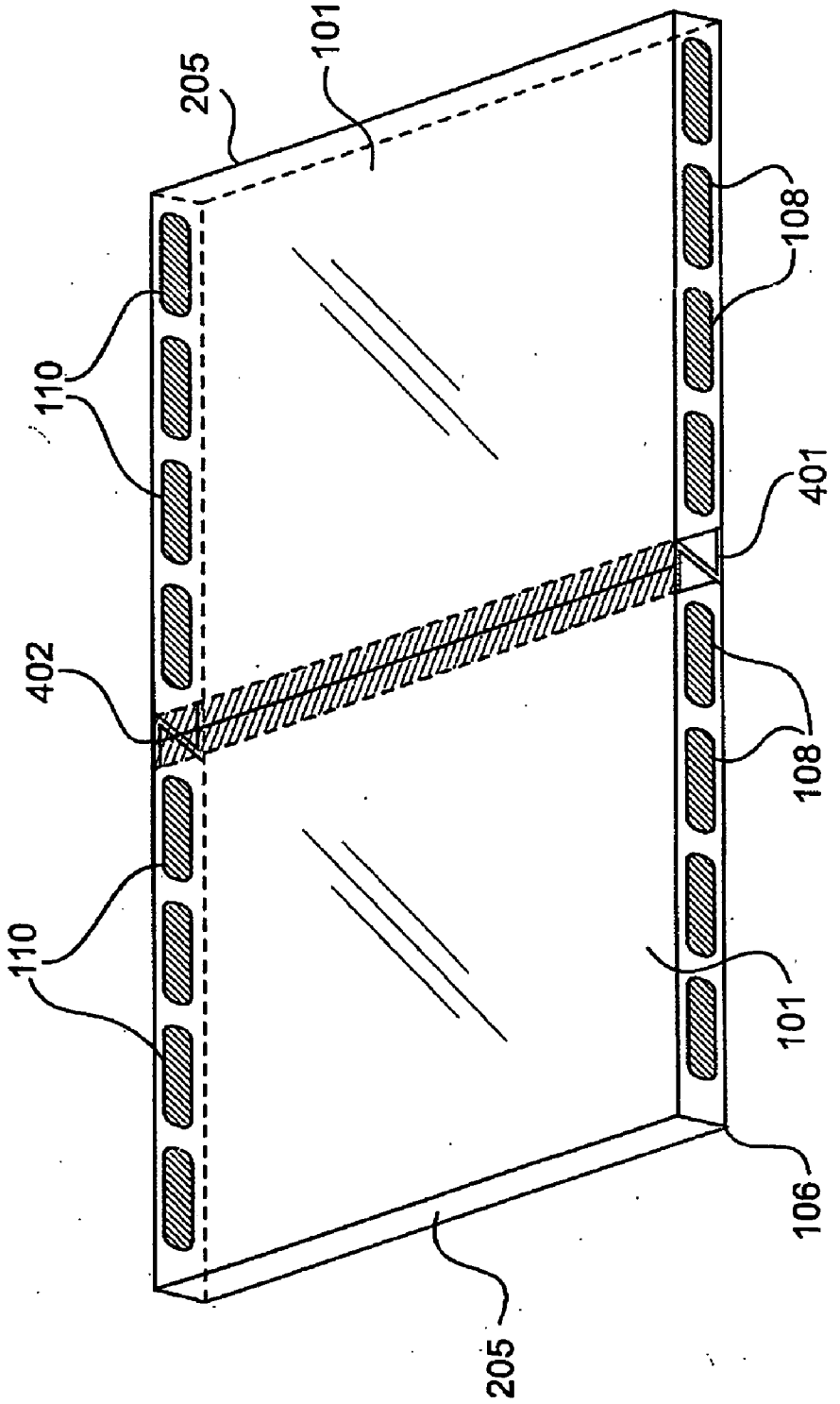


FIG. 4

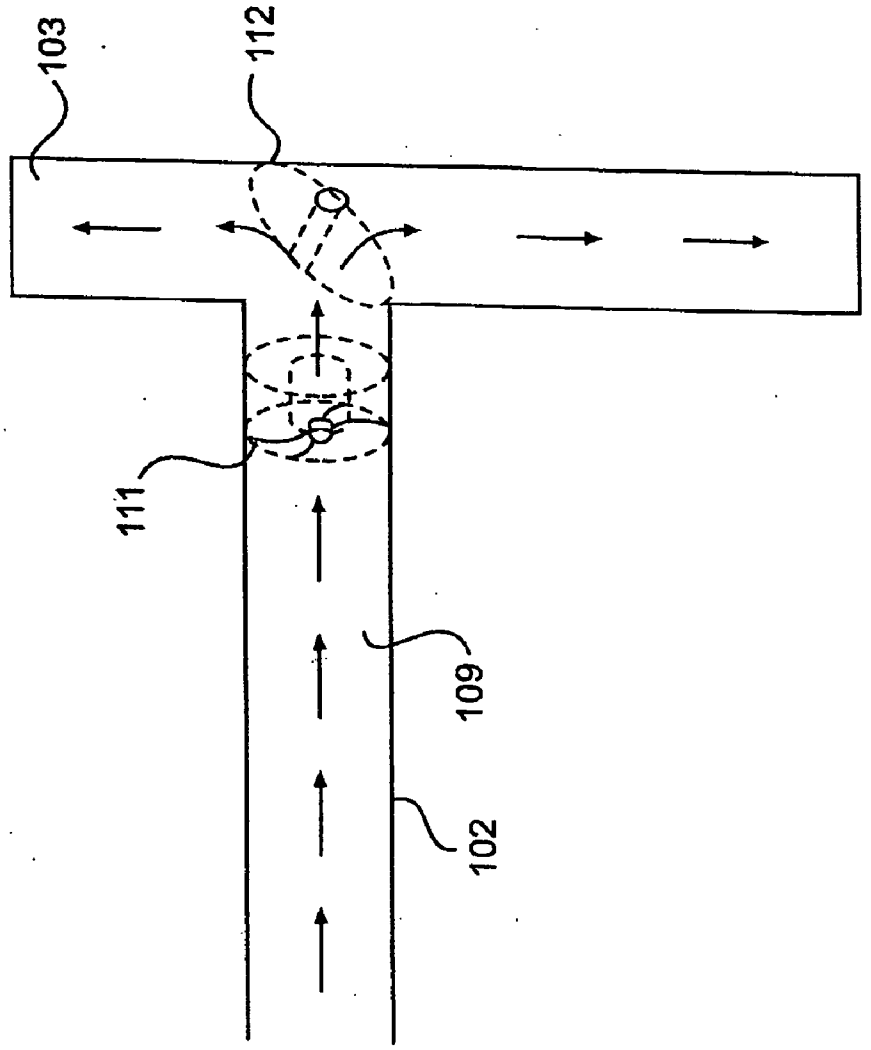


FIG. 5

# ROOFTOP AIR RECIRCULATION DEVICE

**[0001]** This Application claims the benefit of Provisional Application No. 60/943,076, filed on Jun. 11, 2007.

## BACKGROUND OF THE INVENTION

**[0002]** 1. Field of the Invention

**[0003]** This invention relates to the recirculation and ventilation of roof top heated air in residential and commercial buildings. The present invention may be utilized in both pre-existing buildings as well as incorporated into new construction. In general, the present invention provides means to capture and control heat generated within a structure, and more specifically the heated air that collects underneath a roof due to natural processes and/or the heated air that collects underneath a roof due to design features incorporated into a building's structure.

**[0004]** Heated air within a building rises; a natural result of this convective flow causes heated air to collect at or near the underside of the peak of the structure. Adding to the temperature rise under the roof structure is the effect of sunlight on a roof. In particular, sunlight on the surface of a roof, and in particular on roof shingles, causes an increase in the temperature of the air underneath the roof surface. This accumulation of additional heat, in addition to being of waste of available energy, causes degradation of the structure of a roof and increases the rate of deterioration of roof shingles.

**[0005]** A partial solution to this collected heat problem is the addition of an attic vent or a roof peak vent to a structure. Venting of the air adjacent to the underside of a roof helps to reduce the temperature of the roof structure itself. Modern buildings incorporate a further design feature: air spaces located within the structure of the roof, under the shingles and sheathing and above the insulation layer. This design feature, however, relies upon unassisted convective flow, and is intended to vent any such heated air to the atmosphere. Generally, such a design works in conjunction with a roof cap for the purpose of venting the heated air outside of the structure. And, while the roof cap vent and air spaces under the shingles and sheathing of a roof provide cooling means for the roof, heat is constantly being generated on the surface of a roof. Therefore, except for unassisted natural mechanisms that remove heat from the surface of a roof, the present designs rely upon heat removal mechanisms several layers removed from a significant source of the heat sought to be removed. Heat resident for any period of time under the sheathing and shingles has a greater opportunity for movement into the remainder of the structure.

**[0006]** Overall, this means that present designs have two major flaws. First, they are inherently inefficient and rely upon purely passive mechanisms for heat transfer and cooling of the affected roof structure. Second, the present designs waste significant heat energy that may be recaptured and utilized within the structure itself, reducing overall heat loss within the structure. What is needed is a method of enhancing the cooling of a roof structure while providing the option of simultaneously supplementing a building's heating system.

**[0007]** It therefore an object of the present invention to reduce the amount of heat that normally collects in, under and above roof structures and that contributes to the deterioration of roof shingles and may be conveyed through the insulation into the interior of the building structure. It is a further object of the present invention to provide an efficient manner by which to supplement the heating system of a building. It is yet another object of the present invention to provide a device that comprises an air capture and circulation system wherein a roof cap structure, vent, heated air collecting panels, and circulation devices are used in combination to prevent heated air rising from the eaves to the ridge during winter months from escaping into the atmosphere, and to channel that heated air from the ridge area to the primary heat source where it is either blown into the supply duct directly into the building structure or into the primary heat source's air intake.

**[0008]** 2. Description of the Prior Art

**[0009]** Various methods have been used both to ventilate the area beneath roof structures, and to recirculate the air beneath roof structures through air circulation systems. These methods have been primarily intended to prevent the accumulation of heated air in the attic area during summer months and to employ the attic heat in the winter to improve the heating efficiency of buildings. Typically these methods involve air circulation systems wherein devices, such as fans and blowers, are intended to supplement and/or assist the passive heat transfer that occurs as a result of building design. Such methods are generally configured to draw warm air from the attic area into the atmosphere during the summer months and, alternatively, from the lower part of the interior of a building structure to the upper portion thereof during the winter months. The methods employed are varied, and include the use of combinations of air ducts, valves, and blowers, such as the air duct assembly taught in U.S. Pat. No. 3,463,391 (Air Duct Assembly Particularly For A Stable or The Like) (the '391 Patent) to Haegens.

**[0010]** The '391 Patent teaches an air duct assembly, particularly for use in stables and similar building structures, that works to stabilize and maintain the interior temperature of the buildings, namely by replenishing air into the buildings and removing warm air therefrom and, alternatively, by recirculating warm air in the stable. The air duct assembly of the '391 Patent extends through the roof and allows the influx of outside air into the structure and the outflow of warm air from inside the structure to the outside. While this patent utilizes a fan mechanism and valves to control the flow of air as in the current invention, the '391 Patent has duct openings located in the center of the structure ('391 Patent, column 2 lines 17-21) to draw in heated air. More importantly, that heated air is not recirculated as in the current invention, but is vented to the outside of the structure ('391 Patent, column 4, lines 2-3).

**[0011]** Another such method, U.S. Pat. No. 3,653,316 (Industrial Building Design) (the '316 Patent) teaches an industrial building utilizing an interior powerplant exhaust stack in combination with air blowers and ducting, as a means to heat air for the building. The '316 design allows for recirculation of heated air, but requires that the overall design of the building house the recirculation and heating systems within the center stack of the building, described as a circular dome structure with a central support column. As distinguished from the current invention, the '316 Patent does not address the type of heating and cooling efficiency problem addressed in the current invention.

**[0012]** U.S. Pat. No. 5,031,514 (Apparatus and Method For Controlling The Mixing of Atmospheric Air From A Building) (the '514 Patent) teaches "an apparatus for controlling the mixing of atmospheric air with return air from a building." The '514 invention consists of an external housing unit that is secured to a roof and includes baffles and dampers to mix atmospheric air with return air from a building. However, the

device is specifically designed to re-mix return air from return air ducting and is unsuited to the heating/ventilation problem addressed by the current invention. U. S. Pat. No. 6,147,295 (Sunlight Energy Conversion Apparatus, and Air Circulation System) (the '295 Patent) teaches a means to maintain the temperature of a solar energy conversion panel within a high enough range to allow continued operation of the solar panels. The '295 invention utilizes ducting to provide an air-flow space underneath the roof of a structure; however, the air flow from the building is used to warm the solar panels mounted on the roof of the structure, and warm air (during summer operation) is then vented outside of the structure. Cool air is drawn in from the outside during winter operation, is heated and then supplied to the building structure ('295 Patent, column 4, lines 64-67). Neither the '514 Patent nor the '295 Patent utilizes the heated air recirculation means as set forth in the current invention.

**[0013]** Finally, U.S. Pat. No. 3,683,785 (Roof Construction Providing Air Flow From Eave To Ridge) (the '785 Patent), teaches a roof ventilation system to allow air flow on the underside of the roof. The stated object of the design is to remove the thermal gradient between the surface of the roof and the underside of the roof to prevent ice buildup from water runoff. While the '785 invention makes use of air flow under the roof structure, it does not make use of the warm air to recirculate back to the lower portions of the building. The invention does serve, however, to help remove accumulated warm air in the attic ('785 Patent, column 4, lines 43-47), but does not recirculate any of that accumulated warm air.

**[0014]** The current invention is an improvement over the prior art in that it provides a new means by which heated air that accumulates in the roof structure of buildings is captured within a roof cap structure and then circulated into the primary heating cycle of a building structure during winter months, thereby increasing the efficiency of the heat system. The present invention assists and enhances the passive air flow that results from building designs. In another embodiment, the present invention also provides heat collecting panels to be used during winter months to increase the amount of heated air available to direct into the primary heating system of the building structure. As an added benefit, during the summer months the current invention permits the discharge of heated air that rises to the crown from the roof area to the outside. The current invention does not require a particular building design and conveniently may be secured atop an existing roof cap, utilized to replace an existing roof cap altogether, or used in new construction.

**[0015]** It is an object of the present invention to provide means to reduce heat losses in a structure to the atmosphere.

**[0016]** It is a further object of the present invention of recirculating recaptured heated air that otherwise would be a loss to the heating system for a structure.

**[0017]** It is yet a further object of the present invention to provide a means to supplement the heating system of a structure through the capture of air at the surface of a roof heated by solar energy.

**[0018]** It is yet a further object of the present invention to provide a means to reduce heat damage to roof structures.

**[0019]** It will be understood by those skilled in the art that the invention as disclosed below is merely illustrative and that there are other embodiments that are not described herein that still fall within the scope and intent of the present invention. In particular, it will be obvious to one skilled in the art that the method of pushing air through the roof cap structure may be accomplished using a variety of air circulation devices. Further, the method of controlling the direction of the heated air, whether to send the heated air into the ambient environment or to direct it back into the heating system of the building, can be accomplished in a multitude of ways. The method of using a pneumatic valve that may be electronically controlled by a person or by an automatic temperature control system is disclosed herein as the means to accomplish this task but should not be deemed as a limit on the scope of the present invention.

## SUMMARY OF THE PRESENT INVENTION

**[0020]** The present invention relates to a rooftop device designed to recirculate heated air and to direct the same into the primary heating cycle of a residential or commercial building. In a first embodiment, the rooftop device disclosed herein is utilized in conjunction with conventional roof construction of buildings, and comprises (i) a roof cap structure that either is placed on top of an existing roof cap, utilized to replace an existing roof cap, or built into new construction and (ii) circulation devices and air flow direction control devices that allow for the capture of heated air that is generated or collects under the roof structure of a building, and the subsequent movement of the heated air to accomplish either venting of the heated air to the atmosphere or circulating the captured air into the heating system of the structure. The present invention, through such design, provides a method to carry captured heated air to the primary heat source of the building structure during winter months and/or to discharge heated air to the atmosphere during the summer months.

**[0021]** In another embodiment, the present invention further comprises substantially transparent panels that are affixed to the roof surface and secured thereto, the transparent panels creating air passages between the panels and the surface of a roof. The air passages communicate with a roof cap.

**[0022]** In another embodiment, the transparent panels incorporate openings distal to the peak of the roof of a structure.

## DESCRIPTION OF THE DRAWINGS

**[0023]** FIG. **1** is a view of a building incorporating the present invention.

**[0024]** FIG. **2** is an end view cross section illustrating the roof cap and air circulation patterns of the present invention.

**[0025]** FIG. **3** is an end view cross section of the vent and air circulation of the present invention.

**[0026]** FIG. **4** is an isometric view of the roof panels and air circulation of the present invention.

**[0027]** FIG. **5** is a detailed view of fan, valve assembly and air circulation of the roof cap and vent of the present invention.

## DESCRIPTION OF A PREFERRED EMBODIMENT

**[0028]** Referring now to FIG. **1** and FIG. **2**, both illustrate air flow direction by arrows. FIG. **1** is a side view of a structure **100** is shown incorporating the present invention. The panels **101** are located above the surface of the roof **106**. The panels **101** and the surface of the roof **106** form air passages **205** wherein air is trapped, heated and circulated to the roof cap **102**. It will be understood by those skilled in the art that, while numerous materials may be utilized for the panels **101**, such as glass or plastic, it is preferred that lightweight trans-

parent materials, such as Plexiglas® and the like, form the basis of the panels **101**. FIG. **1** illustrates three panels **101** stretching across one side of the roof **106** of a typical house, but it will be understood that the number and size of panels **101** may vary depending upon the size and shape of the roof **106** surface of a structure **100**, and such variations in the size and shape of the panels **101** will not result in deviation from the invention as described herein.

**[0029]** Air within the space between the panels **101** and the surface of the roof **106** increases in temperature as a result of sunlight striking the roof **106**. As the panels **101** heat up, the air within heats up and rises towards the top ridge of the roof **106**. The panels **101** create passages **205** between the surface of the roof **106** and the underside of the panels **101**; the noted heated air collects within these passages **205**. The passages **205** created by the panels **101** and the roof **106** surface communicate with the air passage **109** within the roof cap **102** through inlet means **110** in the roof cap **102**. The inlet means may comprise openings, baffled or controlled openings, and the like. The panels **101** further comprise openings **108** distal to the peak of the roof **106**. Natural convective flow causes the heated air to flow into the roof cap **102**. A fan **111** located within the roof cap **102** assists the air flow from the passages **205**. The roof cap **102** further communicates with the air spaces **204** located under the roof **106**. The air spaces **204** are designed in new construction to be located between the roof **106** sheathing **201** and the insulation layer **202**.

**[0030]** The fan **111** causes heated air to be drawn through the air passage **109** within the roof cap **102** in the direction of the fan **111**, and thereafter into a vent **103**. The vent **103** comprises a air passage **105** and valve **112**. The valve **112** located within the vent **103** may be positioned to vent **103** heated air to the atmosphere (as shown in FIG. **1**), positioned to direct heated air back into the building **100** air handling system **104**, or may be positioned in such a manner that the heated air directed to the vent **103** is partially vented and partially redirected into the building **100** air handling system **104**. It will be understood by those skilled in the art that the valve **112** may be adjusted by means well known in the art to a intermediate position allowing control over the volume of air flow in either direction within the vent **103**.

**[0031]** The present invention is described as installed onto existing structures or incorporated into new construction wherein the air under the roof **106** is intended to be vented at the peak of the structure **100**. It will be understood by those skilled in the art, however, that heat generated within a structure **100** may be vented at various points on the structure **100** and, consequently, the present invention may capture that heated air at the point of venting of the structure **100** without deviating from the scope and intent of the present invention. For example, the point of venting could be located at some specific point below the peak of the roof **106**, and such vent **103** outlet may be located in such a manner as to vent **103** heated air directly into the passage **205** between the roof **106** and the panels **101**.

**[0032]** FIG. **3** illustrates a cross section view of the vent **103** portion of the present invention. The rooftop air recirculation device will enable the heated air to be released through the vent **103** in warmer months or, alternatively, recirculate the heated air to the intake of the building heating system in the colder months. The arrows on FIG. **3** show flow paths of heated air, with air either vented to the atmosphere **301**, directed **302** to the structure's air handling system **104**, or a combination thereof.

**[0033]** FIG. **4** illustrates a rooftop assembly incorporating two panels **101** joined at a centerline **402**. The rooftop assembly is supported by braces **401**. The braces **401** are preferentially "Z" shaped when viewed on end, and support the panels **101** at both joint areas (represented by the centerline **402** in FIG. **4**) and the ends of the rooftop assembly. Each panel **101** forms a closed structure **100** with the roof **106**, with the exception of openings **108** at the end distal to the roof **106** peak, and inlet means **110** proximal to the roof **106** peak. The resulting structure **100** forms a passage **205** between the panels **101** and the roof **106**. Air within the passage **205** is warmer than external ambient air as a result of heated air collecting under the roof **106** as well as sunlight on the surface of the panels **101**.

**[0034]** Referring now to FIG. **5**, heated air flows to the vent **103** as a result of natural convection, the flow of air caused by the fan **111**, or a combination of the two. The valve **112** may be rotated about a horizontal axis **501** such that air may be either vented up to the atmosphere or down to the building's air handling system **104**.

What is claimed is:

**1**. A rooftop device, said rooftop device comprising:
- a roof cap defining one or more air passages;
- openings in said roof cap located proximally to and communicating with air passages incorporated into a roof structure; and
- outlet means located at the distal end of said roof cap.

**2**. The rooftop device of claim **1** wherein said roof cap is mounted on the peak of said roof structure.

**3**. The rooftop device of claim **1** wherein said roof cap is mounted on a flat portion of said roof structure.

**4**. The rooftop device of claim **1**, further comprising a plurality of substantially transparent panels mounted on the surface of said roof structure, said panels further comprising support structures defining passages for air flow wherein said passages communicate with said inlet means of said rooftop device.

**5**. The rooftop device of claim **1** further comprising one or more generally vertical ducts at one or both outer ends of said roof cap, the generally vertical ducts having connecting means to said outlet means of said roof cap.

**6**. The rooftop device of claim **5** further comprising one or more air exhaust outlets.

**7**. The rooftop device of claim **6** wherein at least one of said one or more exhaust outlets opens to the atmosphere.

**8**. The rooftop device of claim **6** wherein at least one of said one or more exhaust outlets communicates with a building's air handling system.

**9**. The rooftop device of claim **1** wherein said rooftop device further comprises a fan disposed within said air passages and said fan is positioned to cause air to be moved from said roof cap air passages to said outlet means.

**10**. The rooftop device of claim **9** wherein said fan is disposed within said outlet means.

**11**. The rooftop device of claim **9** wherein said fan is reversible.

**12**. The rooftop device of claim **5** wherein said one or more generally vertical ducts at one or both outer ends of said roof cap further comprises a valve for selecting the direction of exhaust air flow from said roof cap one of one or more exhaust outlets.

**13**. The rooftop device of claim **5** wherein said air passages further comprise air intakes distal to the roof peak.

**14**. The rooftop device of claim **1** wherein said air passage communicates with outlets to vent heated air from under a roof structure.

**15**. A method of collecting and redirecting heated air from the roof of building, comprising capturing air within a roof cap and redirecting said captured air to a vertical vent.

**16**. The method of claim **15**, wherein air directed to the vertical vent is redirected to one or more exhaust outlets, and wherein those exhaust outlets either direct the air flow to the exterior of the structure or direct the air into an air handling system for the building.

**17**. The method of claim **16**, wherein heated air is captured from passages contained within the structure of the said roof.

**18**. A method of heating and collecting air on the surface of a roof of a structure, comprising allowing air to be heated by ambient sunlight, wherein said air is disposed within passages between the surface of a roof and substantially transparent panels disposed upon supports connected to the panels and the surface of the roof.

**19**. The method of claim **18**, wherein the air heated by ambient sunlight is allowed to rise within the passages between the surface of the roof and the substantially transparent panels and thence into a roof cap.

**20**. The method of claim **19**, wherein said heated air is forcibly moved within the said passages and the said roof cap by means of a fan disposed within said roof cap.

**21**. The method of claim **18**, wherein said roof cap contains one or more air passages that are connected to a vertical vent, and wherein said vertical vent allows said heated air to be selectively exhausted to either the atmosphere or into the air handling system of a structure.

**22**. The method of claim **20**, wherein said heated air is selectively exhausted to either the atmosphere or into the air handling system of a structure by means of a valve disposed within said vertical vent.

* * * * *