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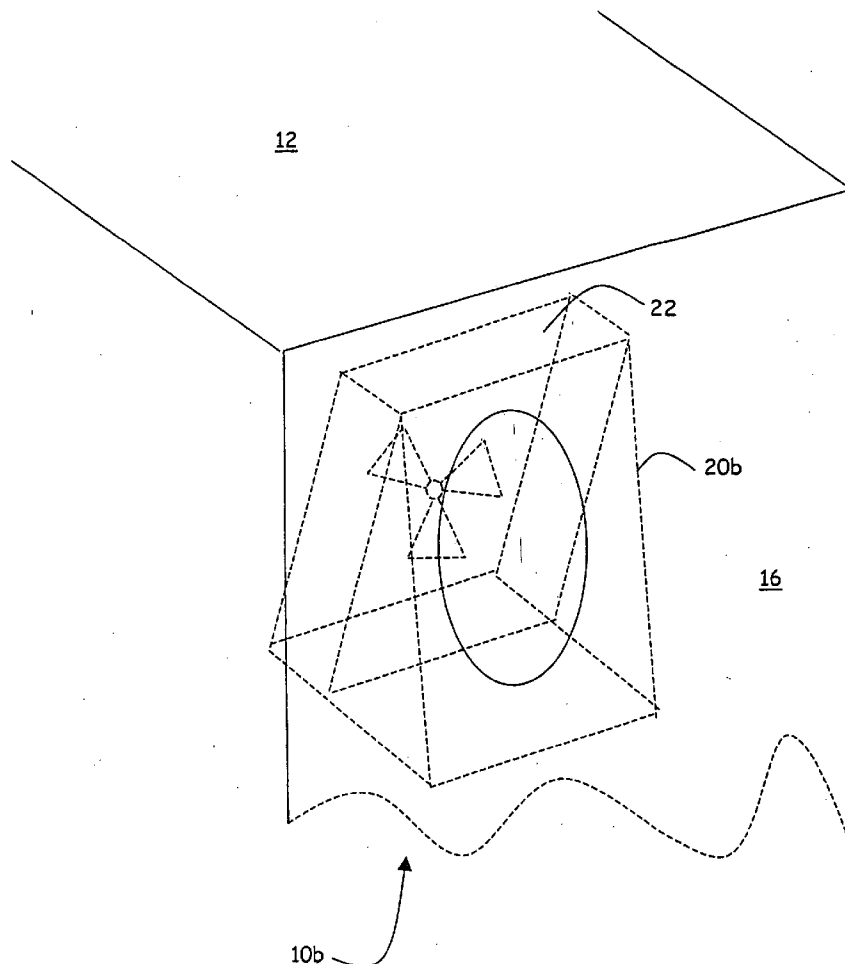
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(57) **ABSTRACT**

A vent for a computer enclosure is envisioned. The vent system has a fan, operable to draw a flow of air from within the enclosure and direct it out through an outlet vent disposed in a wall of the enclosure. The outlet vent is made of an outlet path. The outlet path is defined by a first and a second side member. The first and second side members are attached to the enclosure and form an environmental seal. The outlet vent also has an outlet face oriented at a first angle relative to the wall. A plurality of slats are rotatably coupled to the outlet face. The plurality of slats maintain a first position when the fan is not operating. When the fan goes into an operational mode and produces an airflow, the plurality of slats swing radially outward to a second position. The plurality of slats return to the first position when the airflow is not present. The angle of the slats in the first position is nearer to parallel to the first angle than when in the second position.



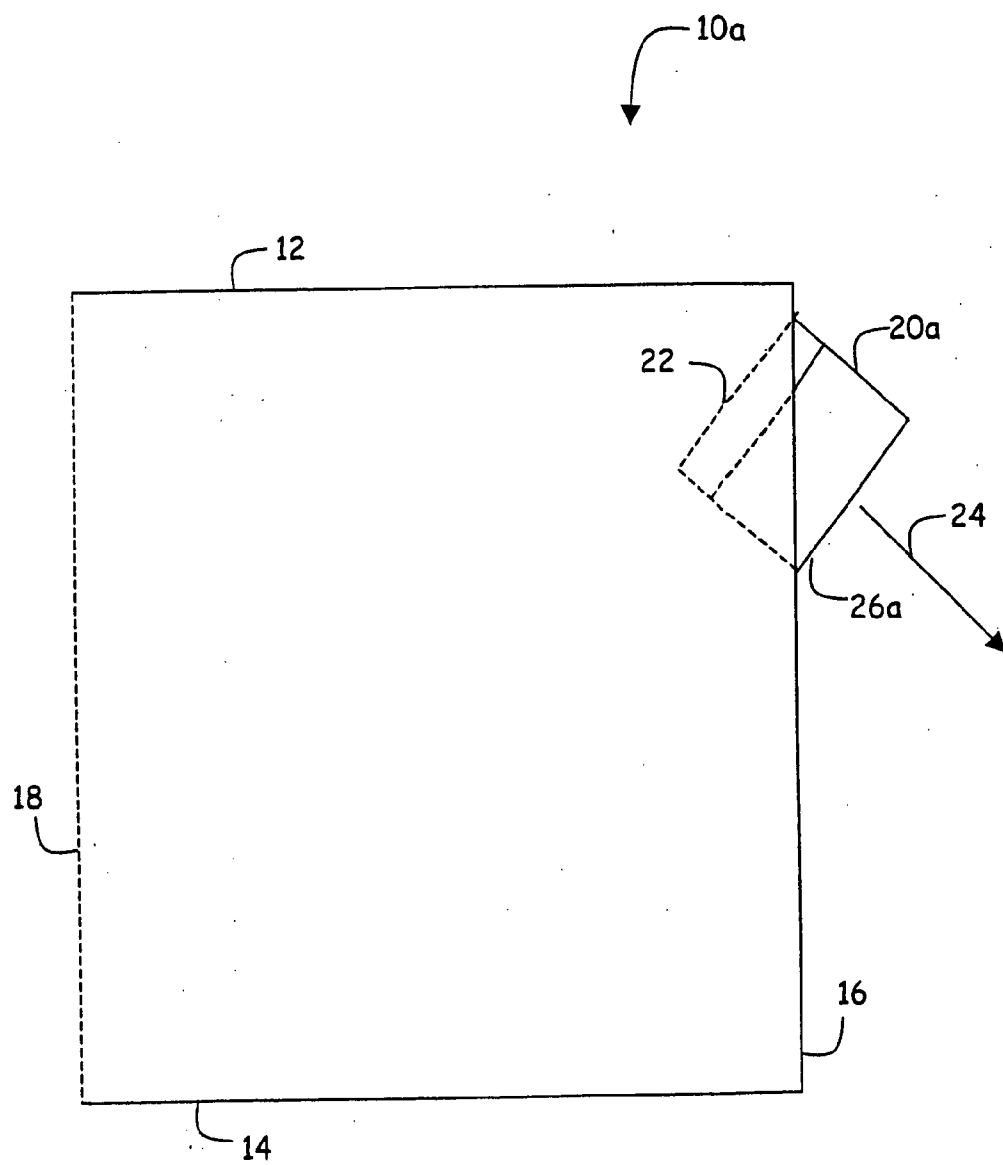


Figure 1

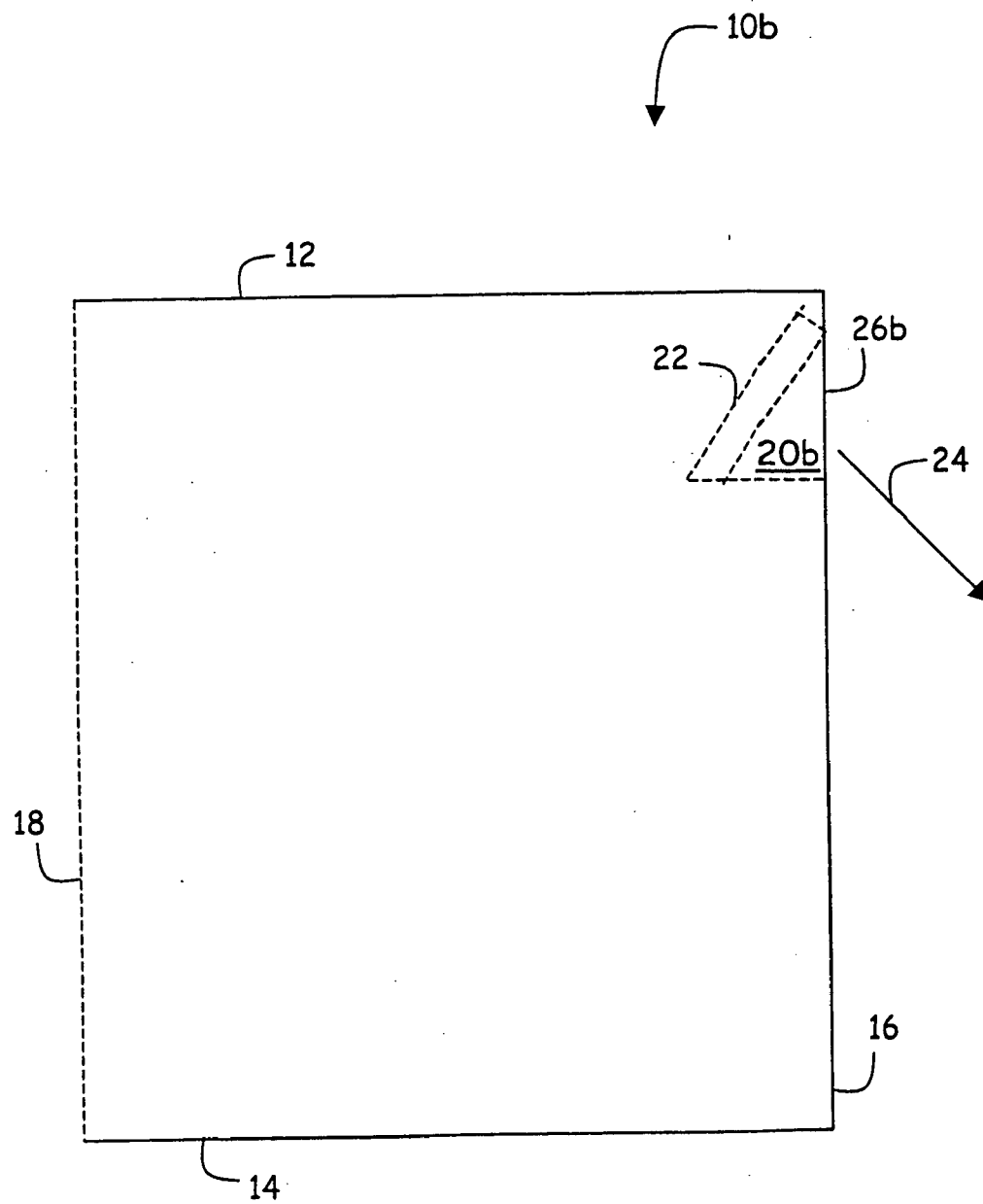


Figure 2

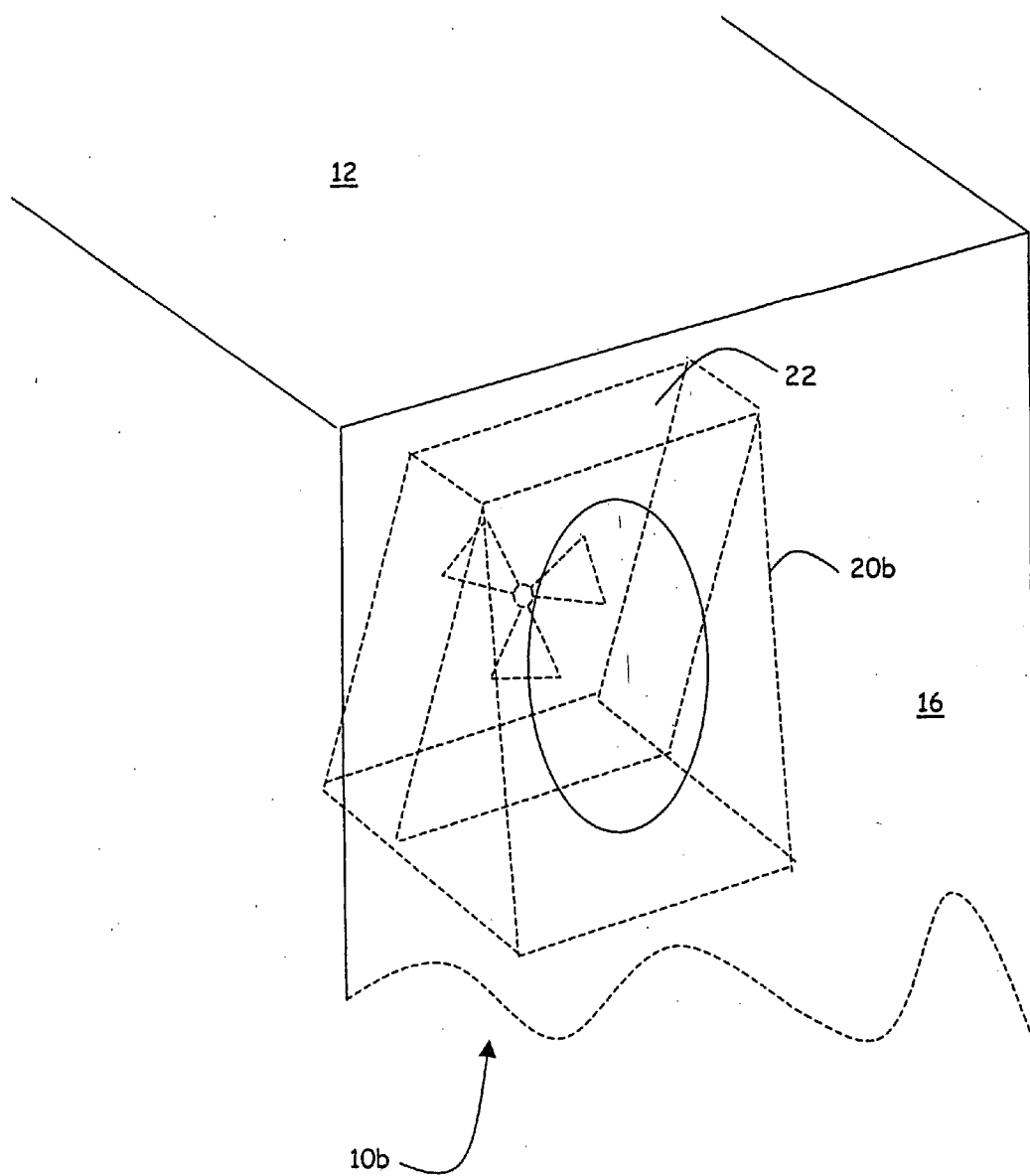


Figure 3

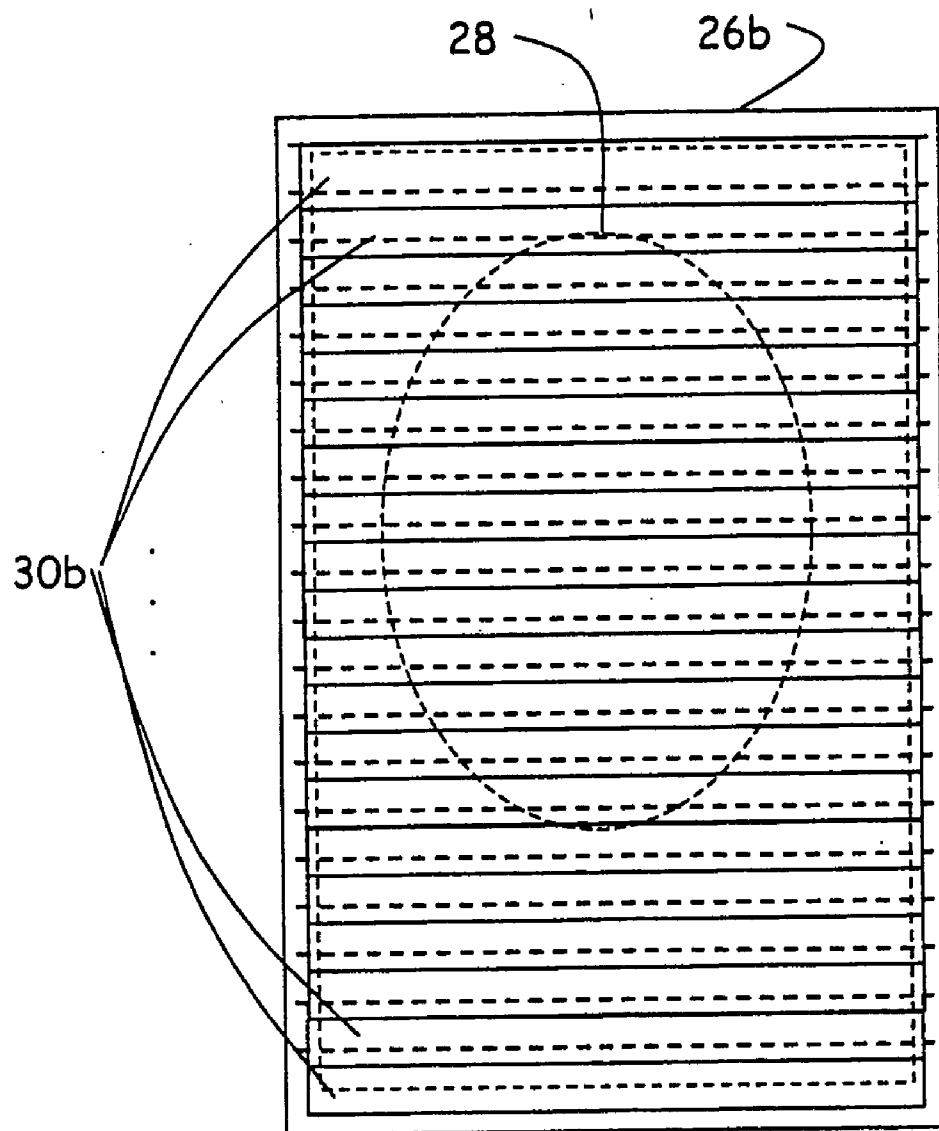


Figure 4

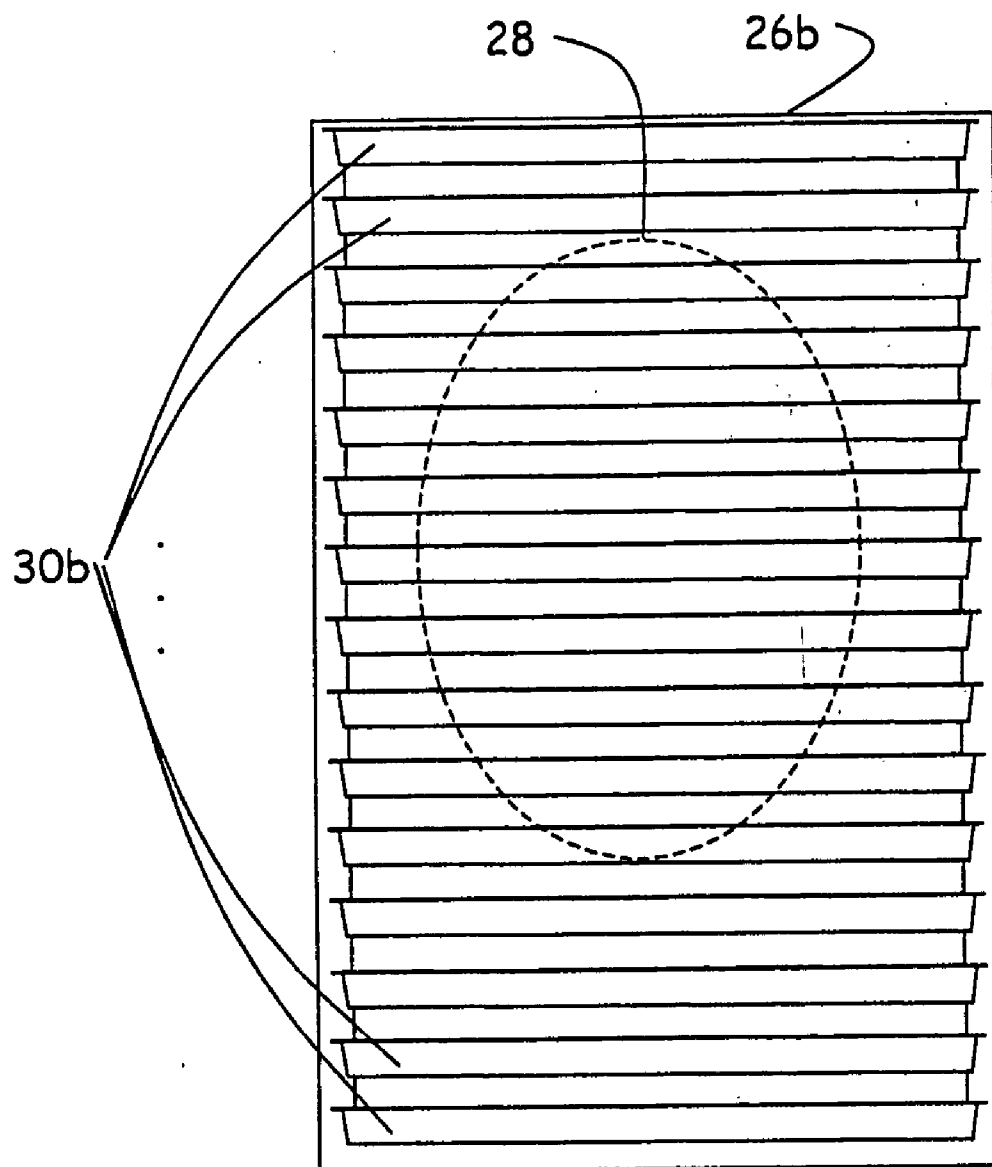


Figure 5

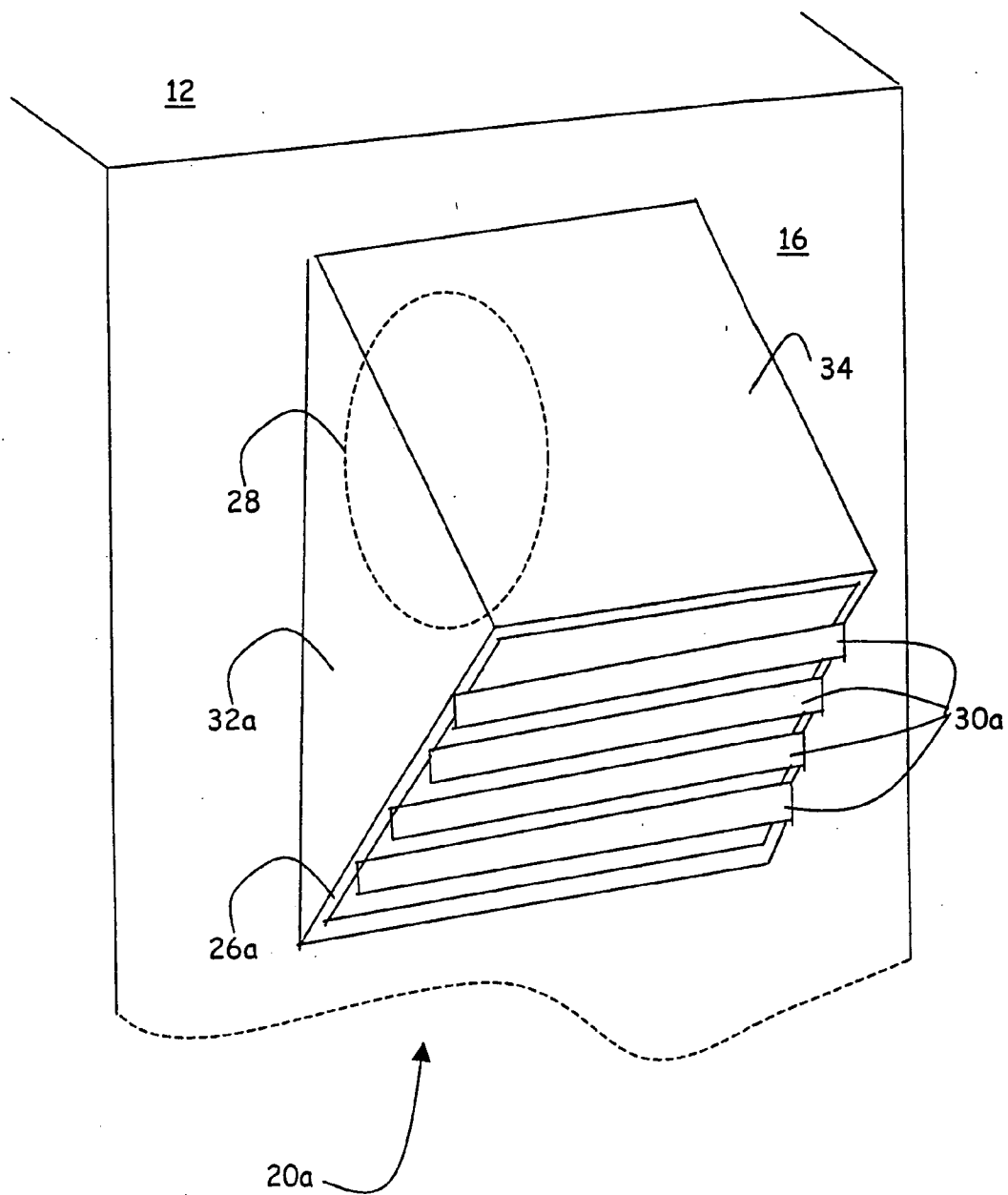


Figure 6

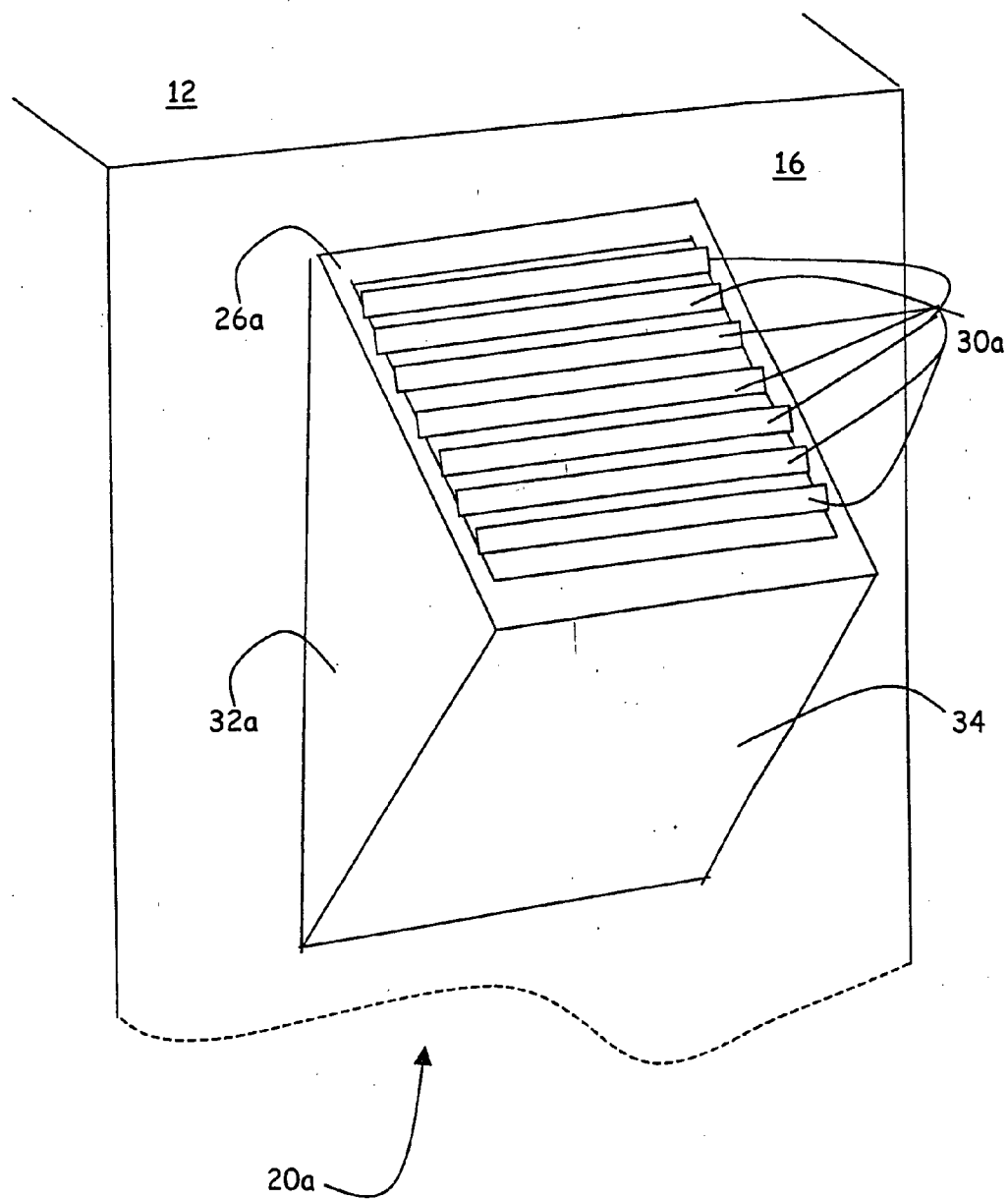


Figure 7

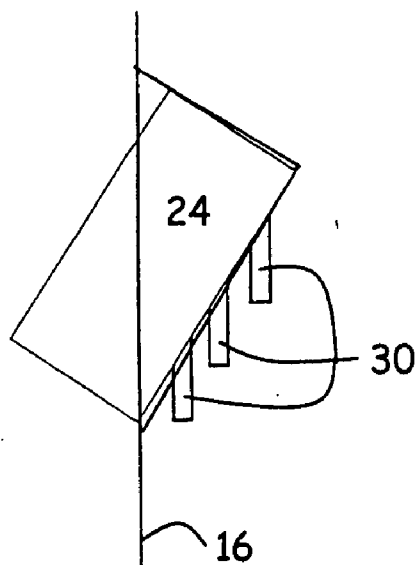


Figure 8a

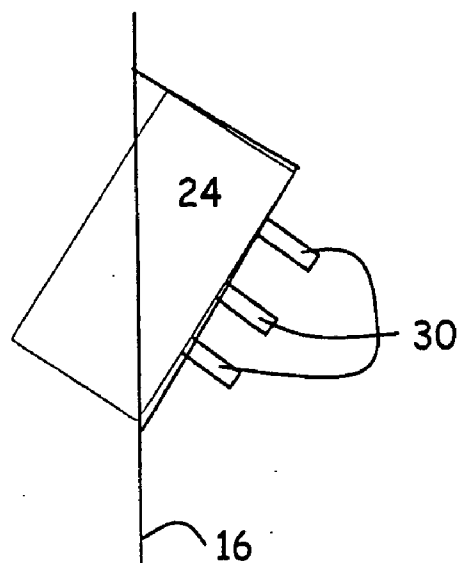


Figure 8b

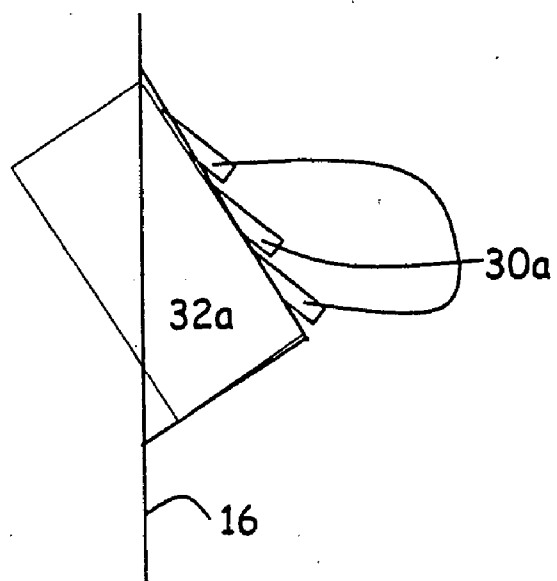


Figure 9a

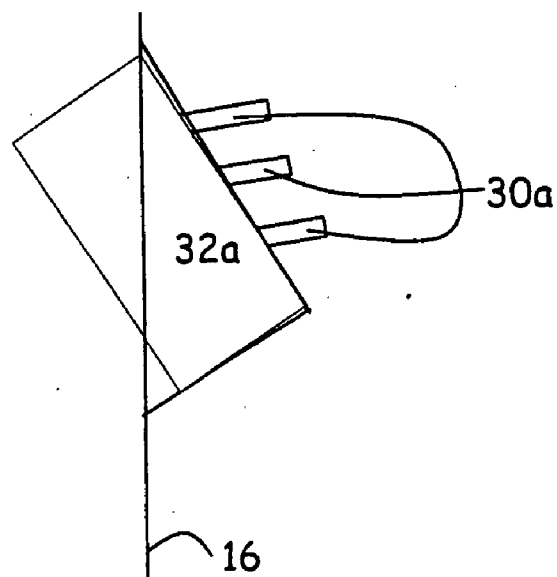


Figure 9b

SYSTEM AND METHOD FOR VENTING AIR FROM A COMPUTER CASING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 10/429,161, filed May 2, 2003. Related patents include U.S. Pat. Nos. 6,702,665 and 6,951,513, which issued from applications filed the same day as the above-mentioned application.

FIELD OF THE INVENTION

[0002] The invention is directed towards a venting system for a computer enclosure. More specifically, the invention is directed towards venting system that dynamically allows and/or restricts the outflow path of air for venting system.

BACKGROUND

[0003] Many computer systems have venting systems to allow a fan or other environmental mechanism to output heated air to an external environment. Typically, a fan will draw air across electronic components found within the enclosure for the computer system. The heated electronic components transfer heat to the air as an airflow passes across the electronic components. A fan or other environmental outlet mechanism draws the heated air to an aperture or vent disposed in the enclosure. The fan then directs the heated air through the vent into the external environment. All the while, the same outflow produces an inflow of cooler air into the casing, and the process is repeated. Some systems contain dynamic thermal regulation systems. When a sensor detects increased thermal parameters in the internal environment of the enclosure, the operational speed of the fan may be increased. Conversely, when a sensor detects decreased thermal parameters in the internal environment of the enclosure, the operational speed of the fan may be decreased.

[0004] In many systems, the vent is a grated structure disposed across the aperture in the wall of the enclosure. During periods with an increased outflow, the heated air may be obstructed by such a fixed structure. The totality of the heated air may not be able to be expelled through the vent, leading to inefficient heat transfer in the case.

[0005] In these same systems, the periods of low flow may also lead to decreased heat transfer. This might occur, as the pressure of the outflow does not completely block the now-expelled heated air from reentering the enclosure. Again, this may lead to inefficient heat transfer in the case.

BRIEF DESCRIPTION

[0006] A vent for a computer enclosure is envisioned. The vent system has a fan, operable to draw a flow of air from within the enclosure and direct it out through an outlet vent disposed in a wall of the enclosure. The outlet vent is made of an outlet path. The outlet path is defined by a first and a second side member. The first and second side members are attached to the enclosure and form an environmental seal. The outlet vent also has an outlet face oriented at a first angle relative to the wall. A plurality of slats are rotatably coupled to the outlet face. The plurality of slats maintain a first position when the fan is not operating. When the fan goes into an operational mode and produces an airflow, the

plurality of slats swing radially outward to a second position. The plurality of slats return to the first position when the airflow is not present. The angle of the slats in the first position is nearer to parallel to the first angle than when in the second position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The accompanying drawings, which are incorporated into and constitute a part of this specification, illustrate one or more embodiments of the present invention and, together with the detailed description, serve to explain the principles and implementations of the invention.

[0008] In the drawings:

[0009] FIG. 1 is a cross-sectional diagram of a computer enclosure and a venting system for such in enclosure, in accordance with the invention.

[0010] FIG. 2 is a cross-sectional diagram of another embodiment of the computer enclosure and a venting system for such an enclosure, in accordance with the invention.

[0011] FIG. 3 is a perspective diagram detailing an embodiment of the fan and vent assembly of FIG. 2 in accordance with the invention.

[0012] FIG. 4 is a perspective diagram of the back of the vent assembly during rest and used in conjunction with the enclosure of FIG. 2, in accordance with the invention.

[0013] FIG. 5 is a perspective diagram of the back of the vent assembly during a time that the fan is operating and used in conjunction with the enclosure of FIG. 2, in accordance with the invention.

[0014] FIG. 6 is a perspective view of the vent as depicted in FIG. 1, in accordance with the invention.

[0015] FIG. 7 is a perspective view of an alternative orientation of the vent of FIG. 1, in accordance with the invention.

[0016] FIGS. 8a and 8b are side views of the vent apparatus of FIG. 6 during rest and during operation of the fan, respectively, in accordance with the invention.

[0017] FIGS. 9a and 9b are side views of the vent system of FIG. 7 during rest and during operation of the fan, respectively, in accordance with the invention.

DETAILED DESCRIPTION

[0018] Embodiments of a system and method for venting air from a computer casing are described herein in the context of an enclosure for the storage and operation of electronic components having increased airflow characteristics. Those of ordinary skill in the art will realize that the following detailed description of the present invention is illustrative only and is not intended to be in any way limiting. Other embodiments of the present invention will readily suggest themselves to such skilled persons having the benefit of this disclosure. Reference will now be made in detail to implementations of the present invention as illustrated in the accompanying drawings. The same reference indicators will be used throughout the drawings and the following detailed description to refer to the same or like parts.

[0019] In the interest of clarity, not all of the routine features of the implementations described herein are shown and described. It will, of course, be appreciated that in the development of any such actual implementation, numerous implementation-specific decisions must be made in order to achieve the developer's specific goals, such as compliance with application- and business-related constraints, and that these specific goals will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking of engineering for those of ordinary skill in the art having the benefit of this disclosure. In accordance with the present invention, the components or structures may be implemented using various types of items.

[0020] FIG. 1 is a cross-sectional diagram of a computer enclosure and a venting system for such an enclosure, in accordance with the invention. A computer enclosure 10 has housing defined by an upper wall 12 and a bottom wall 14. The upper wall 12 and the bottom wall 14 are attached to a rear wall 16. Also present, but not shown, the upper wall 12, the bottom wall 14, and the rear wall 16 are attached to two side walls. In some enclosures, a front wall 18 is present. However, in some "rack mount" computer units, the front wall 18 may not be present. Electronic components are disposed within the housing defined by the two side walls, the upper wall 12, the bottom wall 14, the rear wall 16, and the optional front wall 18. Within the housing, the electronic components are protected from damage due from the external environment.

[0021] The two side walls, the upper wall 12, the bottom wall 14, the rear wall 16, and the optional front wall 18 all impede the flow of air from the environment external to the housing into the housing, thus contributing to heat buildup in the housing. To alleviate the thermal problems associated with the housing, intake openings disposed in the walls. These openings, acting in coordination with a vent and with an environmental flow mechanism, such as a fan, provide a flow of cooler air from the external environment through the housing 10a and across the electronic components contained therein.

[0022] Disposed on the rear wall 16 is a vent 20. In practice, a fan, or other environmental flow mechanism, is used to direct an airflow through the enclosure 10a of the computer system. This airflow is expelled from the enclosure 10a through the vent 20. A fan 22 directionally vents the airflow at an angle away from perpendicular to the rear wall 16.

[0023] In the embodiment depicted in FIG. 1, the outlet airflow is depicted by an arrow 24. The outflow 24 is vented through a face 26a of the vent 20a. In this manner, the outflow 24 is directed downwards and outwards from the enclosure 10a for the computer system.

[0024] FIG. 2 is a cross-sectional diagram of another embodiment of the computer enclosure and a venting system for such an enclosure, in accordance with the invention. The same structural features of the vent are present, but embedded within the construction of the enclosure 10b. In the embodiment depicted in FIG. 2, an arrow 24 again depicts the outlet airflow from the enclosure 10b. The outflow 24 is vented through a vented face 26b of the vent 20b. Again, the outflow 24 is directed downwards and outwards from the

enclosure 10b for the computer system. It should be noted that the structures depicted in all the Figures may be interior to the enclosures, exterior to the enclosures, or partially interior and partially exterior in nature.

[0025] Typically, the environmental flow mechanism 22 may be a fan. However, other flow mechanisms are known to those skilled in the art, and this disclosure should be read as to include them as well. Such art may include such mechanisms as pumps, blowers, or any mechanism operable to produce an environmental flow from within the enclosure to the exterior environment. Further, the vent assembly and fan may be placed on any exterior wall, and the inclusion of them on the rear wall should be for illustrative purposes. Additionally, only one fan and vent assemblies are shown in FIG. 1 and in FIG. 2. It should be noted that any number of these fans and/or vents may be contemplated in the scope of this disclosure, as well as the placement of the fans and/or vents on or about differing walls.

[0026] FIG. 3 is a perspective diagram detailing an embodiment of the fan and vent assembly of FIG. 2 in accordance with the invention. This diagram illustrates and highlights the relationship of the directional nature of the fan 22 with respect to the back wall 16. This diagram is provided without showing any structures covering the face of the vent 20b, as that relationship is diagramed and explained in succeeding portions of this disclosure.

[0027] FIG. 4 is a perspective diagram of the back of the vent assembly during rest and used in conjunction with the enclosure of FIG. 2, in accordance with the invention. Covering the face 26b of FIGS. 2 and 3 are slat structures 30b. The slats 30b are made of roughly rectangular structures that fit over the opening disposed in the wall of the enclosure. The rectangular portions block or impede a flow of air into or out of the enclosure 10b. The rectangular portions of the slats 30b rest in a first position in a steady state with no force being applied on them.

[0028] The slats 30b are attached to the vent face 26b. The slats 30b are attached in a rotatable manner, allowing the slats 30b to rotate away from the rear wall 16 when a force is applied from the direction of the interior of the enclosure 10b. Thus, when such a force is applied, the rectangular portions of the slats 30b rotate to a second position that is more perpendicular to the plane of the rear wall 16 than as when the force is not present. When such a force is removed, the slats 30b rotate back to their rest position, with the rectangular portions of the slats 30b returning to the first position, that being at an angle more parallel to the rear wall 16 than the second position.

[0029] When the fan is engaged, an output flow of air is directed from the interior of the enclosure 10b through an environmental opening 28. The combination of the action of the fan and the vent 20b direct the airflow downwards and across the face of the slats 30b. As such, the resulting outflow creates a force against the hanging slats 30b, causing them to lift upwards and outwards in a radial manner.

[0030] With increased outflows from the interior of the enclosure 10b through the environmental opening 28, the force directed on the slats 30b correspondingly increases. This increased force results in the slats 30b lifting higher and more outward than they would be under a decreased flow. As the outflow increases, the slats 30b move out of the way and

create less of an impediment to the outflow of air. Accordingly, increased outflows do not result in a “backwash” effect, wherein the outflow is forced back into the enclosure.

[0031] With decreased outflows, the slats **30b** lower. The lower position of the rectangular portions of the slats **30b** decrease the area available for expelled air to reenter the enclosure **10b** after it has been expelled. Accordingly, decreased outflows do not result in a “reentry” effect, wherein the outflow can reenter the enclosure **10b** under a decreased outflow.

[0032] It should be noted that the assembly of FIGS. 2 and 3 direct the airflow in a downwards direction. One skilled in the art will recognize that a differing orientation of outflow may be obtained in the upwards direction with little experimentation, and this disclosure should be read as including the upwards orientation herein.

[0033] FIG. 5 is a perspective diagram of the back of the vent during a time that the fan is operating and used in conjunction with the enclosure of FIG. 2, in accordance with the invention. The airflow produced by the fan is, in this case, directed downwards. The airflow impinges on the rectangular portion of the slats **30b**. The resulting force lifts them away from the rear wall **16**, as depicted in FIG. 5.

[0034] FIG. 6 is a perspective view of the vent as depicted in FIG. 1, in accordance with the invention. The vent **20a** has a first support member **32a** which is attached to the enclosure **10a** for the computing system. Not shown, a corresponding second support member is located opposite the first support member **32a**. The first support member **32a** and the second support member (not shown), together with a structural member **34** form an outlet path for the venting of air out of the enclosure **10a** for the computer system.

[0035] Shown in dashed lines, the vent **28** or other environmental opening is disposed in the rear wall **16** of the enclosure **10a** for the computer system. From the fan, an airflow from the interior of the enclosure **10a** for computer system is directed out of the environmental opening **28**. The airflow emanating from the environmental opening **28** is redirected by the solid support member **32a**, the second support member (not shown), and the structural member **34** in a specified direction. In this case, the three members form an outlet path directed downwards. Of course, the members **32a** and **34** need not end at the rear wall **16**. They may continue into the interior of the enclosure **10a** for the computer system, as denoted in FIG. 1, in part or in whole.

[0036] The bottom edge **26a** of the outlet vent assembly **20a** has a plurality of slats **30a** coupled to it. Again, the slats **30a** are rotatably coupled, allowing the slats **30a** to swing outwards upwards in response to any airflow emanating from the enclosure **10a** for the computer system.

[0037] When the fan is engaged, an output flow of air is directed from the environmental opening **28**. The combination of the structural member **34**, the support member **32a**, and the other support member (not shown) direct the airflow downwards and across the face of the slats **30a**. As such, the resulting outflow creates a force against the hanging slats **30a**. This force causes the slats **30a** to lift upwards and outwards in a radial manner.

[0038] Like that described above, with increased outflows from the environmental opening **28**, the force directed on the

slats **30a** correspondingly increases. This increased force from the outflow results in the slats **30a** lifting higher and more outward than they would be under a decreased flow. As the outflow increases, the slats **30a** move out of the way and create less of an impediment to the outflow of air. Accordingly, increased outflows do not result in a “backwash” effect, wherein the outflow is forced back into the enclosure **10a** of the computer system.

[0039] Again, with decreased outflows, the slats **30a** lower and decrease the area available for expelled air to reenter. Accordingly, decreased outflows do not result in a “reentry” effect, wherein the outflow can reenter the enclosure **10a** of the computer system under a decreased outflow.

[0040] The bottom face **26a** of the outlet vent is disposed at an angle relative to the wall of the enclosure **10a** to which it is disposed on. The slats **30a** coupled to the bottom face **26a** assume a rest position when the fan is not operating. In the rest position, the rectangular portion of the slats **30** are oriented in an approximately vertical manner due to gravity.

[0041] As described above, during operation of the fan, the slats **30a** swing outwards from the vent face **26a** to assume a second position. The rectangular portions of the slats **30a** are oriented during operation of the fan at an angle nearer the perpendicular to the vent face **26a** than they assume during the rest position. Accordingly, the orientation of the slats **30a** move between being in the rest position and that of full operation based upon the level of flows emanating from the environmental opening **28**.

[0042] In an alternative embodiment, the vent face **26a** to which the slats **30a** are attached may be directed upwards. In this case, the air flow emanating out of the enclosure **10a** for the computer system is directed upwards, instead of downwards.

[0043] FIG. 7 is a perspective view of an alternative orientation of the vent of FIG. 1, in accordance with the invention. Many of the same features of the embodiment of FIG. 6 are present, with the airflow being directed upwards instead of downwards. In this embodiment, the support member **32a** and the other support (not shown) are substantially the same as that depicted in FIG. 2. In FIG. 7, the structural member **34** is located on the downward face of the venting structure. The slats **30a** are arranged on the upper face of the venting structure, allowing an upwards flow of air out of the enclosure **10a** of the computer system.

[0044] In the embodiment depicted in FIG. 7, the rest position of the slats **30a** is at an angle substantially parallel to the angle that the upper face **26a** is in relation to the rear wall **16** of the enclosure **10a** for the computer system. In this case, the slats **30a** lay substantially flat. In one embodiment, they may lie one on top of another. Accordingly, the rest position of the slats **30a** in the embodiment of FIG. 7 strongly inhibits passage of an external environment through the slats **30a** and into the enclosure **10a** of the computer system.

[0045] Again, during times when the fan is operating, the outflows from the environmental opening **28** impinge against the surface of the slats **30a**, causing them to raise upwards and allowing an escape path for the outgoing air flows. During the time that the fan is operating, the position in which the slats **30a** enjoy is dictated by the amount of outcoming airflow from the enclosure **10a** of the computer

system. Typically during fan operation, the slats **30a** will be at an angle closer to the perpendicular to the upper face than when at the rest position.

[0046] FIGS. **8a** and **8b** are side views of the vent apparatus of FIG. **6** during rest and during operation of the fan, respectively, in accordance with the invention. In both FIGS. **8a**, the environmental opening (not shown in FIGS. **8a** and **8b**) is disposed through the rear wall **16**.

[0047] During periods of time characterized by no airflow from the interior of the enclosure, such as that depicted in FIG. **8a**, the slats **30a** are disposed at an angle relative to that of the bottom edge of the support member **24a**. In this case, the slats **30a** hang freely with the force of gravity. It should be noted however that the angle at which the slats **30a** rest relative to the support member **32a** may be altered through the use of springs or mechanical devices.

[0048] FIG. **8b** is the side view of the same vent of FIG. **8a** during a period of operation. During operation, airflow from the interior of the enclosure is expelled through the environmental opening disposed in the back wall **16**. This airflow impinges upon the slats **30a**. The force created by the outflow rotatably moves the slats **30a** into a second position, as shown in FIG. **8b**.

[0049] FIGS. **9a** and **9b** are side views of the vent system of FIG. **7** during rest and during operation of the fan, respectively, in accordance with the invention. In FIG. **9a**, the fan or other flow mechanism is not operating. No airflow is directed from the interior of the enclosure through the environmental opening disposed in the wall. Accordingly, the slats **30a** assume a position substantially equal to the edge of the vent structure. However, in FIG. **9b**, the fan or flow mechanism is operational and producing an airflow from the interior of the enclosure out through the environmental opening. The force of the airflow directed through environmental opening impinges upon the slats **30a**. The force of the outflow on the slats **30a** tends to move them in a rotational manner as depicted in FIG. **9b**.

[0050] It should be noted that the slats **30** are depicted with faces having a rectangular construction. Other shapes of faces are known in the art, and should be considered as part of this disclosure.

[0051] Thus, a system and method for venting air from a computer casing is described and illustrated. Those skilled in the art will recognize that many modifications and variations of the present invention are possible without departing from the invention. Of course, the various features depicted in each of the figures and the accompanying text may be combined together. Accordingly, it should be clearly understood that the present invention is not intended to be limited by the particular features specifically described and illustrated in the drawings, but the concept of the present invention is to be measured by the scope of the appended claims. It should be understood that various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention as described by the appended claims that follow.

[0052] While embodiments and applications of this invention have been shown and described, it would be apparent to those skilled in the art having the benefit of this disclosure that many more modifications than mentioned above are possible without departing from the inventive concepts

herein. The invention, therefore, is not to be restricted except in the spirit of the appended claims.

1. A computer enclosure comprising:

a housing comprising opposed side walls, opposed upper and bottom walls, and opposed vertical front and rear walls;

electronic components disposed within the housing;

an outlet vent structure disposed at the rear wall near said upper wall, comprising an outlet face, said outlet face oriented at a angle downward and outward relative to the rear wall;

a fan, operable to draw a flow of air from within the housing and direct it non-perpendicularly relative to the rear wall out through the outlet face;

said outlet face comprising a plurality of slats rotatably coupled to said outlet face, said plurality of slats being in a first position when said fan is not operational, said plurality of slats operable to swing radially from the first position when said fan produces an airflow in said outlet vent, said plurality of slats returning due to gravity to the first position when the airflow is not present.

2. The computer enclosure of claim 1, wherein the computer enclosure comprises a plurality of the outlet vent structures, each with a said outlet face, and a plurality of the fans, each said fan operable to draw air from within the housing and direct it non-perpendicularly relative to the rear wall through a respective said outlet face of a respective said outlet vent structure.

3. The computer enclosure of claim 1 wherein the outlet vent structure is disposed on the exterior of the rear wall.

4. The computer enclosure of claim 1 wherein the outlet vent structure is disposed at least in part in the interior of the enclosure.

5. The computer enclosure of claim 1 wherein the outlet vent structure is disposed within the enclosure.

6. A computer enclosure for containing electronic modules, the enclosure comprising:

a housing comprising a plurality of walls, including an upper, a lower, a rear wall, and a plurality of side walls, the housing enclosing the electronic modules;

a fan, operable to draw a flow of air from within the housing and direct it non-perpendicularly relative to the rear wall out through an outlet vent structure disposed about the rear wall;

said outlet vent comprising an outlet path defined by a first and second side member, attached to said one of said plurality of walls, an outlet face, attached to said side members, said outlet face oriented at a first angle non-perpendicular to the wall, and a plurality of slats, rotatably coupled to said outlet face.

7. The computer enclosure of claim 6 wherein the rear wall is vertical and the first angle is directed downwards and outwards.

8. The computer enclosure of claim 6 wherein the rear wall is vertical and the first angle is directed upwards and outwards.

9. The computer enclosure of claim 6 wherein said outlet vent is disposed on the exterior of the rear wall.

10. The computer enclosure of claim 6 wherein said outlet vent is disposed at least in part in the interior of the housing.

11. The computer enclosure of claim 6 wherein said outlet vent is disposed within the housing.

12. A computer enclosure comprising:

a housing comprising a plurality of walls and enclosing electronic components of a computer;

a fan, disposed within the housing, operable to draw an airflow from within the enclosure and direct it outward through an adjacent outlet vent structure disposed about an upper portion of a rear wall of the enclosure;

said outlet vent structure comprising an outlet face oriented at an oblique angle relative to the rear wall of the enclosure;

said outlet vent structure comprising a plurality of slats at said outlet face, said plurality of slats being in a substantially closed position when said fan is not operating, said plurality of slats operable to swing radially to an open position due to the airflow when the fan is operating, and said plurality of slats returning by gravity to said substantially closed position when the airflow is not present.

13. The computer enclosure of claim 12 wherein airflow out the outlet face is obliquely downwards and outwards.

14. The computer enclosure of claim 12 wherein airflow out the outlet face is obliquely upwards and outwards.

* * * * *