VENTILATION ASSEMBLY CONFIGURABLE FOR TOP OPENINGS AND/OR SIDE OPENINGS

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Abstract:
A modular blower combination assembly comprising an interconnection element and a pair of modular blower sub-assemblies associated therewith for exploitation in a ventilation device or system.
VENTILATION ASSEMBLY CONFIGURABLE FOR TOP OPENINGS AND/OR SIDE OPENINGS

[0001] The present invention relates to a ventilation device which comprises a housing means as well as a number of inlet and outlet means, namely fresh air inlet means, exhaust or stale air inlet means, exhaust or stale air outlet means and fresh air outlet means. The present invention in particular relates to a ventilation device comprising an outer frame means (e.g. a housing) and ventilation components mounted to said frame (e.g. within a housing) configured so as to define air paths (e.g. internal air paths) for the exchange of sensible and/or latent heat between exhaust air (e.g. warm and/or moist air) taken from inside a building or enclosure and exterior fresh air (e.g. cool and/or dry air) which is drawn into the building or enclosure. These types of ventilation systems or devices are known.

[0002] It would be advantageous to have available a ventilation unit available with top and/or side ports without having to exploit two totally different platforms. This would allow much more flexibility in terms of its fabrication and installation.

[0003] It would be advantageous to have a ventilation unit which may be designed with airflow and a heat (or energy) transfer core disposed in such a position that with the same frame an air-exchanger may be configured with top ports and/or side ports simply by blocking off the side or top openings as the case may be and by rotating the internal blower(s) which are configured as part of a module that could for example be incremented (i.e. rotated) by 90 degrees.

[0004] It would in particular be advantageous to have an enclosure or housing for a modular blower combination assembly able to be configured so as to be able to be seated in relation to an interconnection element such that air may be expelled from the air outlet thereof in a first direction and as desired in relation to production needs be rotatable so as to be able to be seated in relation to the interconnection element such that air may be expelled from the air outlet thereof in a second direction transverse to the first direction.

[0005] Thus the present invention in accordance with one aspect provides a modular blower combination assembly comprising an interconnection element and a pair of modular blower sub-assemblies associated therewith,

[0006] said interconnection element configured for interconnecting said pair of modular blower sub-assemblies in juxtaposed (e.g. releasable) relationship in a respective first configuration and in a respective second configuration,

[0007] each of said modular blower sub-assemblies comprising blower means and an enclosure disposed about said blower means,

[0008] said blower means having an upstream side and a downstream side,

[0009] said enclosure comprising a pair of opposed faces interconnected by side wall means,

[0010] said enclosure having an axis of rotation relative to said opposed faces,

[0011] one of said opposed faces defining a blower opening in air communication with one side of the blower means, the blower means having an axis of rotation transverse to said one opposed face,
described in relation to a rectangular box-like form, the enclosure may take on a circular form (i.e. circular cross section relative to the axis of rotation of the blower means) in which case the interconnection element is to be modified in order to be able to displace the side wall opening as discussed herein.

[0022] Thus the present invention in accordance with another aspect provides a modular blower combination assembly comprising an interconnection element and a pair of modular blower sub-assemblies associated therewith,

[0023] said interconnection element configured for interconnecting said pair of modular blower sub-assemblies in juxtaposed relationship in a respective first configuration and in a respective second configuration,

[0024] each of said modular blower sub-assemblies comprising blower means and an enclosure disposed about said blower means,

[0025] said blower means having an upstream side and a downstream side,

[0026] said enclosure having a rectangular box-like form and comprising a pair of opposed square broad faces interconnected by a first side wall element and three secondary side wall elements, said enclosure having a central axis of rotation relative to said opposed square broad faces,

[0027] one of said opposed broad faces defining a blower air intake opening in air communication with the upstream side of the blower means, the blower means having an axis of rotation transverse (e.g. perpendicular) to said one opposing face,

[0028] said first side wall element defining a side blower air outlet opening in air communication with the downstream side of the blower means,

[0029] said enclosure being configured to be able to engage said interconnection element in a first configuration whereby said side blower opening is disposed in a first position such that air may pass out of said side blower opening in a first direction and being configured to be able, on rotation of the enclosure 90 degrees about said central axis of rotation of the enclosure, to engage said interconnection element in a second configuration whereby said side blower opening is disposed in a second position such that air may pass out of said side blower opening in a second direction perpendicular to said first direction.

[0030] In accordance with the present invention the axis of rotation of the (blower) enclosure may be coterminous with the axis of rotation of the blower means enclosed therein; alternatively as desired or necessary the axis of rotation of the (blower) enclosure may be offset with respect to the axis of rotation of the blower means enclosed therein. The axis of rotation of the (blower) enclosure may be parallel or as desired or necessary non-parallel to the axis of rotation of the blower means enclosed therein. The axis of rotation of the (blower) enclosure may be considered to be a central axis or a non-central axis depending on the shape of the enclosure. In any event the disposition of these two axii of rotation is to be determined keeping in mind the requirement that the enclosure of a sub-assembly is to be rotatable so as to be able to displace the side wall opening as desired herein.

[0031] The present invention in accordance with a further aspect provides a modular blower assembly for association with an interconnection element configured for interconnecting a pair of modular blower assemblies in juxtaposed relationship in a respective first configuration and in a respective second configuration

[0032] said modular blower sub-assembly comprising blower means and an enclosure disposed about said blower means,

[0033] said blower means having an upstream side and a downstream side,

[0034] said enclosure having a rectangular box-like form and comprising a pair of opposed square broad faces interconnected by a first side wall element and three secondary side wall elements, said enclosure having a central axis of rotation relative to said opposed square broad faces,

[0035] one of said opposed broad faces defining a blower air intake opening in air communication with the upstream side of the blower means, the blower means having an axis of rotation transverse to said one opposed face,

[0036] said first side wall element defining a side blower air outlet opening in air communication with the downstream side of the blower means,

[0037] said enclosure being configured to be able to engage said interconnection element in a first configuration whereby said side blower opening is disposed in a first position such that air may pass out of said side blower opening in a first direction and being configured to be able, on rotation of the enclosure 90 degrees about said central axis of rotation of the enclosure, to engage said interconnection element in a second configuration whereby said side blower opening is disposed in a second position such that air may pass out of said side blower opening in a second direction perpendicular to said first direction.

[0038] The interconnection element may take on any form or configuration keeping in mind the requirement that the enclosure of a sub-assembly is to be rotatable so as to be able to displace the side wall opening as desired. The interconnection element may for example comprise two or more components. The interconnection element may for example form a part of the outer enclosure of the ventilation unit. A modular blower combination assembly in accordance with the present invention may for example comprise an interconnection element which may comprise an elongated element which may have an L-like cross-section so as to have a foot portion and a standing leg portion connected thereto, said foot portion being configured for seating said enclosure by engagement with a secondary side wall element. An interconnection element which may, for example, comprise a shell element as described herein

[0039] In accordance with the present invention a ventilation device or system may incorporate therein modular blower sub-assemblies as described herein. The ventilation unit may for example also comprise a hexagonal shape stacked core such as described in published Can. Pat. Appln. No.2416508 and in U.S. patent application No. 739,412 published under no. 20040226685 the entire contents of both of which are incorporated herein by reference.

[0040] A ventilation unit in accordance with the present invention may have the heat exchanger Core laid on its back
with only a slight angle to achieve enough water drainage. In this case the modular blower combination assembly may provide two blowers to get both exhaust blowers behind the core, i.e. on the air output sides of the core for exhausting air out of the fresh air and stale air sides of the core. Those blower enclosures may be if so desired identical (or different) and may be provided with a tongue and groove pattern for engagement with other elements of the ventilation unit, i.e. so that the enclosures may be rotated during production to achieve either a side or a top port configuration for the final ventilation unit.

In accordance with the present invention ventilator housing means may be provided which may be designed or configured with dual openings on each opposed sides as well as a pair of openings on the top side thereof. Any not-required openings may be blocked with a suitable respective plug, for example, any suitable “swappable” plug may be used to allow air circulation for either a side or a top port configured unit.

Benefits of a ventilation unit of the present invention include convertibility (e.g. at the factory, on the production line) of ventilation unit from top to side port (or vice-versa) while for example being relatively extremely flat (only 12 inches for a 100 Cfm (cubic feet per minutes) unit.

In drawings which illustrate example embodiments of the present invention:

FIG. 1a schematically illustrates a perspective view of an example embodiment of a modular blower combination assembly comprising an interconnection element (comprising an L-shaped element) and a pair of identical modular blower sub-assemblies associated therewith wherein the elements are disposed in a configuration wherein the air outlet openings point upwardly (from the top) in the same direction;

FIG. 1b schematically illustrates a perspective view of the embodiment of the modular blower combination assembly of FIG. 1a reconfigured (i.e. by rotation of the sub-assemblies) such that the interconnection element sets the pair of modular blower sub-assemblies associated therewith such that the air outlet opening point in opposite side directions;

FIG. 2 schematically illustrates a perspective view of the interconnection element of FIGS. 1a and 1b comprising an L-shaped element or member;

FIG. 3a schematically illustrates a perspective view of a modular blower sub-assembly shown in FIGS. 1a and 1b;

FIG. 3b schematically illustrates a front air inlet view of a modular blower sub-assembly shown in FIGS. 1a and 1b;

FIG. 3c schematically illustrates a top air outlet view of a modular blower sub-assembly shown in FIGS. 1a and 1b;

FIG. 3d schematically illustrates a bottom view of a modular blower sub-assembly shown in FIGS. 1a and 1b;

FIG. 3e schematically illustrates a left side view of a modular blower sub-assembly shown in FIGS. 1a and 1b;

FIG. 3f schematically illustrates a right side view of a modular blower sub-assembly shown in FIGS. 1a and 1b;

FIG. 3g schematically illustrates a rear view of a modular blower sub-assembly shown in FIGS. 1a and 1b;

FIG. 4a schematically illustrates an explode perspective view of a modular blower sub-assembly shown in FIGS. 1a and 1b;

FIG. 4b schematically illustrates a detail of the motor assembly of the modular blower sub-assembly shown in FIG. 4a;

FIG. 4c schematically illustrates a further partial perspective front view detail of the motor assembly of the modular blower sub-assembly shown in FIG. 4a;

FIG. 5a schematically illustrates a perspective view from the right side upwardly from below into the interior of an example shell element for housing a heat exchanger core, the shell element having the aspect of a U-shaped member wherein the front U-shaped opening is configured to engage the modular blower sub-assemblies of FIGS. 1a and 1b in tongue and groove fashion;

FIG. 5b schematically illustrates a bottom view of the shell element of FIG. 5a;

FIG. 5c schematically illustrates a front view through the front U-shaped opening of the shell element of FIG. 5a;

FIG. 5d schematically illustrates a left side view of the shell element of FIG. 5a;

FIG. 6 schematically illustrates a rear perspective view from the left side upwardly from below into the interior of an example shell element of FIG. 5a showing wherein the front U-shaped opening engages one of the modular blower sub-assemblies of FIGS. 1a and 1b in tongue and groove fashion, the further modular blower sub-assemblies being shown in the process of being engaged with the shell element;

FIG. 7a schematically illustrates the association of the modular blower sub-assemblies of FIGS. 1a with the shell element to form a top port unit, the L-shaped interconnection element being removed;

FIG. 7b schematically illustrates the association of the modular blower sub-assemblies of FIGS. 1b with the shell element to form either a side port unit, the L-shaped interconnection element being removed;

FIG. 8a schematically illustrates a perspective view from above of an example a ventilation unit of the present invention wherein the modular sub-assemblies define a top port configuration, the ventilation unit including an exterior casing component enclosing the modular blower assembly combination assembly and a modular core combination assembly;

FIG. 8b schematically illustrates a top view of the ventilation unit of FIG. 8a, showing the various top ports (communicating with respective openings) extending from the top of the ventilation unit;

FIG. 8c schematically illustrates a side view of the ventilation unit of FIG. 8a, showing the top ports associated with the modular blower sub-assemblies both in front of the other two ports;
FIG. 8b schematically illustrates a further side view of the ventilation unit of FIG. 8a, showing one top port associated with the modular blower sub-assemblies and one of the other top ports;

FIG. 9a schematically illustrates an exploded view of an example exterior casing configuration for a top port ventilation unit, the L-shaped element being an element of the exterior casing and the exterior casing including a door element to cover the major opening of the shell element;

FIG. 9b schematically illustrates an exploded view of an example exterior casing configuration for a side port ventilation unit, the L-shaped element being an element of the exterior casing and the exterior casing including a door element to cover the major opening of the shell element;

FIG. 10 schematically illustrates an exploded view of an example exterior casing configuration for a top port ventilation unit of FIG. 9 associated with modular blower sub-assemblies in top port configuration in relation to the L-shaped element, a side port configuration of the sub-assemblies also being shown in dotted outline;

FIG. 11 schematically illustrates a perspective view from above of an example top port configured ventilation unit in accordance with the present invention comprising a hexagonal exchanger core, showing air flow in relation to the top ports and with the exterior casing partially cut away to expose the hexagonal exchanger core;

FIG. 12a schematically illustrates a top view of the ventilation unit of FIG. 11 again with a portion of the exterior casing cut away to expose the hexagonal exchanger core, the unit being in a fresh air delivery configuration;

FIG. 12b schematically illustrates a front side view of the ventilation unit of FIG. 11 again with one top port cut away along with a portion of the exterior casing to expose the hexagonal exchanger core, the unit being in a fresh air delivery configuration;

FIGS. 13a and 13b respectively schematically illustrate in enlarged cut away format the disposition of a damper assembly for allowing the input of fresh air into the top port configuration of ventilation unit of FIG. 11 and for the blocking off of fresh air for stale air circulation in an ventilator enclosure through both sides of the exchanger core via a short circuit member;

FIG. 13c schematically illustrates in enlarged cut away format the disposition of a damper assembly for allowing the input of fresh air into the side port configuration of ventilation unit;

FIG. 14 schematically illustrates a perspective view of the shell element shown in FIG. 5a with the shell element rotated 180 degrees about the axis perpendicular to the base side wall element of the shell element;

FIG. 15a schematically illustrates a perspective view from above showing the wide U-shaped opening of a wedge shaped channel member of the present invention for a ventilation unit having side ports;

FIG. 15b schematically illustrates a perspective view from above showing the narrow U-shaped opening of the wedge shaped channel member of FIG. 15a;

FIG. 15c schematically illustrates a perspective view from below of the wedge shaped channel member of FIG. 15a;

FIG. 16 schematically illustrates a perspective view of a shell element of FIG. 14 wherein the wedge shaped channel member of FIG. 15a is disposed in the shell so as to define a stale air path, the stale air path being closed off at the narrow opening by a damper;

FIG. 17 schematically illustrates a perspective view of a shell element and wedge member of FIG. 16 wherein the damper is retracted away from the wedge member so as to close off the fresh air opening of the shell element and expose the narrow opening of the wedge member;

FIG. 18a schematically illustrates a perspective view from above showing the wide U-shaped opening of a further wedge shaped channel member of the present invention for a ventilation unit having top ports;

FIG. 18b schematically illustrates a perspective view from below of the wedge shaped channel member of FIG. 18a showing the narrow U-shaped opening thereof;

FIG. 19 schematically illustrates a perspective view of a shell element of FIG. 14 wherein the wedge shaped channel member of FIG. 18a is disposed in the shell so as to define a stale air path, the stale air path being closed off at the narrow opening by a damper;

FIG. 20 schematically illustrates a perspective view of a shell element and wedge member of FIG. 19 wherein the damper is retracted away from the wedge member so as to close off the fresh air opening of the shell element and expose the narrow opening of the wedge member;

FIG. 21 schematically illustrates a perspective view of a ventilation unit of the present invention with the covering element removed along with the L-shaped interconnection element and one of the modular blower sub-assemblies so as to expose the hexagonal exchanger core;

FIG. 22 schematically illustrates a perspective view of a side interior side of a covering element of the present invention;

FIG. 23a is a schematic illustration of an example fresh air in cycle for a ventilation unit of the present invention showing energy recovery of air from inside an enclosure (i.e. building) by the ventilation unit of the present invention;

FIG. 23b is a schematic illustration of an example stale air return cycle for a ventilation unit of the present invention showing stale air from inside an enclosure (i.e. building) passing through the heat exchanger core back into the enclosure;

FIG. 24 is an illustrative graphic image of an electronics module for association with the L-shaped interconnection means;

FIGS. 25a and 25b are respectively illustrative graphic images of the disposition in exploded view and associated view of an electronics module for association with the L-shaped interconnection means and shell element as well as the with the modular blower sub-assemblies;
[0092] FIG. 26 is an illustrative graphic image of a shell element and modular blower sub-assemblies for a top port configuration showing a plug member used to block off unused side opening of the shell element, exterior casing removed;

[0093] FIG. 27 is an illustrative graphic image of a shell element and modular blower sub-assemblies for a side port configuration showing a plug member used to block off an unused top opening of the shell element, exterior casing removed;

[0094] FIG. 28 is an illustrative graphic image of a shell element and modular blower sub-assemblies with the exterior casing and L-shaped interconnection means removed and showing the unit with an electronics control module for a top port configuration; and

[0095] FIG. 29 is an illustrative graphic image of a shell element and modular blower sub-assemblies with the exterior casing and L-shaped interconnection means removed and showing the unit with an electronics control module for a side port configuration.

[0096] The present invention will be discussed hereinafter in relation to an example modular blower combination assembly comprising an interconnection element and a pair of modular blower sub-assemblies associated therewith, said modular blower sub assemblies being disposed in juxtaposed (e.g. side by side adjacent or spaced apart) relationship, said modular blower sub-assemblies each comprising a pair of opposed broad faces, one of said broad faces defining a blower air intake opening in air communication with a motorized blower means comprising a blower, the axis of rotation of the blower being perpendicular to the said one broad face, said modular blower sub-assemblies each further comprising a pair of narrow side faces disposed parallel to said axis of rotation, one of said narrow side face defining an air outlet opening in air communication with the motorized blower means, said modular blower sub-assemblies each being configured so as to be able to be seated in relation to the interconnection element such that air may be expelled from the air outlet thereof in a first direction and so as to be rotated so as to be seated in relation to the interconnection element such that air may be expelled from the air outlet thereof in a second direction transverse (e.g. perpendicular) to said first direction.

[0097] In accordance with the present invention the modular blower sub-assemblies may be arranged to eject air streams which are parallel and in the same direction, which are in opposite directions, which are parallel and in opposite directions, which are transverse to each other (e.g. perpendicular).

[0098] In the following the same reference designation will be used in the figures to designate common elements.

[0099] Thus FIGS. 1a and 1b illustrate an example embodiment of a modular blower combination assembly comprising an elongated L-shaped interconnection element 2 and a pair of identical modular blower sub-assemblies (designated by the reference numeral 4) associated therewith.

[0100] FIG. 2 illustrates the L-shaped element of FIGS. 1a and 1b.

[0101] FIGS. 3a to 3g illustrate a variety of views of a modular blower sub-assembly of Figure page 1.

[0102] FIGS. 4a illustrates an exploded view of the modular blower sub-assembly of Figure page 3 wherein FIGS. 4b and 4c provide more detailed views of the motor assembly.

[0103] The blower sub-assemblies each comprise a blower enclosure 4 having a rectangular box-like form. The enclosure 5 has a blower means 6 disposed therein. The enclosure 4 also has a pair of opposed broad faces (one of which is designated by the reference numeral 8 in FIGS. 1a and 1b). The broad face 8 defines a blower air inlet opening 10 which is in air communication with the upstream side of the blower means 6. The enclosure 4 has (minor) side wall elements that link the two broad faces 8. Thus the enclosure 5 has a first side wall element 12 defining side blower air outlet opening 14 which is in air communication with the downstream side of the blower means 6. Referring as well to FIGS. 3a to 3g, the enclosure 4 also has secondary side wall elements 14, 16, 18, and 20. The enclosure 4 also has a central axis of rotation 22 relative to the opposed broad faces (e.g. face 8). The blower means 6 has an axis of rotation 22a which is offset (see FIGS. 3c and 3g) from the central axis 22. The axis 22 and the axis 22a when viewed in relation to the plane of the paper on which the broad faces are shown in FIGS. 3b and 3c (i.e. the plane of the paper passing through the peripheral edges of the broad faces) may be viewed or considered as being perpendicular to the broad faces. The broad face 8 may as desired also be provided with a square female groove element 24 that is disposed about the periphery of the broad face 8 for engagement with a shell element described below.

[0104] Referring to FIG. 2, this figure shows an interconnection element which may comprise an elongated L-shaped element 2 having a foot element 28 and a leg element 30 upstanding therefrom.

[0105] The blower sub-assemblies 4 are shown in FIGS. 1a and 1b seated on the foot element 28 in either of two configurations, namely a configuration as shown in FIG. 1a wherein the air outlet openings 14 are each point upwardly in the same direction (i.e. for a ventilation unit having top ports) and as shown in FIG. 1b wherein the air outlet opening point in opposite directions for a unit having side ports). In either case as may be understood the blower intake openings 10 on the major or broad faces do not change position relative to the interior of the ventilation unit. I.e. the difference in disposition of the air outlet openings 14 is due to a 90 degree rotation of the enclosure about the enclosure axis 22. As seen in FIG. 2 the blower sub-assemblies 4 may be seated in unixed fashion to the L-shaped element 2; alternatively as necessary or desired the blower sub-assemblies may be fixed to the element 2 by any suitable means (e.g. by screws through the foot and or leg elements).

[0106] In any case referring back to FIGS. 1a and 1b, the FIG. 1a shows the modular sub assemblies 4 in a top port configuration as described herein; the modular sub assemblies 4 may at this stage however as desired or necessary be rotated (90 degrees) about their respective axis 22 so as to be disposed in a side port configuration as described herein.

[0107] Referring to FIGS. 4a to 4c, a blower sub-assembly 4 may comprise a two part enclosure 4, namely parts 5a and 5b. The blower means may comprise a blower wheel 34 attached (in any suitable manner) by a blower wheel back
plate 38 to the rotatable outer rotor shell part 40 of a motor 42; the motor 42 is fixed (by screws) to the back part 5b of the enclosure 5 by spacer elements 44 which are in turn screwed to the metal support plate 46; the motor 42 being attached to the metal plate 46 by screw-spacer—grommet combinations one of which is indicated generally by the reference numeral 50. The blower sub-assembly may include a C-collar 56 for maintaining the blower wheel in engagement with the motor. A suitable motor may be obtained from IBM-PAPST CANADA INC, Pickering, Ontario, Canada under #IBM-M2E068-BF049-24.

[0108] The modular blower assembly may in turn be associated with a modular core combination assembly so as to form or define the major internal structures of a ventilation device.

[0109] The modular core combination assembly may comprise a shell element 62 (as shown in FIGS. 5a to 5d) having a U-shaped member comprising side wall elements 64 and 66 and base side wall element 68 wherein one side opening thereof is blocked off by a major wall member 70. Thus the shell element 62 has a minor end opening extending transversely from the wall member 70 between the wall elements 64 and 66 elements such that this opening is defined by the side edges 74, 76 and 78. As may be seen the shell element 62 also has a major opening disposed opposite to the major wall member 70 defined by the side edges of the side wall elements 64, 66 and 68 alone; thus the shell element has two U-shaped openings blending together and disposed transverse to each other. The interior of the shell is also provided with an inclined T-shaped projection element 82 which serves to support a hexagonal exchanger core as well as perform a partition role for the separation of air flow through the ventilation unit in conjunction with the core. The T-shaped element 82 (see FIG. 6) is configured to angularly seat a hexagonal shape stacked core (not shown) such as a core as described in Can. Pat. Appln. No. 2416508. In accordance with the present invention the shell element 62 may take on the role of an interconnection element on its own (tongue-groove interconnections—FIG. 6) if a unitary L-shaped element 2 is not used or as in the case of the ventilation unit structure as seen in for example in FIGS. 9a, 9b, be an additional component of the interconnection element, i.e. in addition to an L-shaped element.

[0110] As may be seen from FIGS. 5a, 5b and 5d the shell element is provided with a pair of opposed side openings and a pair of top openings; one top opening is designated with the reference numeral 90 and one side opening is designated with the reference numeral 92.

[0111] In the perspective view of FIG. 5a the smaller U-shaped rectangular side opening is shown as being provided with tongue projection members 74a, 76a and 78a which are spaced apart by a centrally located groove 96, i.e. for engagement with the groove 24 of the enclosure(s) 4.

[0112] As seen in FIG. 6 the tongue projection members 74a, 76a and 78a and the centrally located groove 96 may be configured to mate with corresponding female groove element 24 of the modular blower sub-assemblies 4.

[0113] Referring to FIGS. 7a and 7b these figures illustrate the association of the modular blower sub-assemblies 4 with the shell element 62 to form either a top port unit (FIG. 7a) or a side port unit (FIG. 7b); the L-shaped element being removed. For illustration purposes, the units are shown with port members 110, 112, 114 and 116, port members 110, 112 and 114 being provided with any suitable (known) damper elements. The unused side and top openings of the shell element 62 are blocked off by plug members; some of which are designated by the reference numerals 120, 122 and 124.

[0114] FIGS. 8a to 8d show a ventilation unit with a top port configuration with the above designations for ports associated with inlet and outlet openings; the unit including an exterior casing component enclosing the modular blower combination assembly and the modular core combination assembly. Thus port 110 is for introduction into the unit of fresh air from the outside of a building or room; port 112 is for exhausting stale inside air out of the unit to the outside of the building or room; port 114 is for exhausting from the unit fresh air for delivery to the inside of the building or room; and port 116 is for entry of stale inside air into the unit.

[0115] FIGS. 9a shows an example exterior casing configuration for top port ventilation unit; as may be seen the L-shaped element 2 is an element of the exterior casing; the exterior casing includes a door element or member 130 to cover the major U-shaped opening of the shell element 62, a further covering element 132 to cover the minor U-shaped opening of the shell element and a central casing element 134 to cover the body of the shell element 62. The central casing element 134 is provided with openings 140, 142, 144 and 146 corresponding to the top openings in the shell elements. The interior of the door element 130 is configured to also serve as support for the hexagonal exchanger core as well as to perform a partition role for the separation of air flow through the ventilation unit in conjunction with the T-shaped element 82 and the core (see also FIG. 22, door element 250).

[0116] FIGS. 9b shows an example exterior casing configuration for side port ventilation unit; which except for the central casing element, is the same as the for the top port shown in FIG. 9a. The central casing element 150 is thus provided with side openings corresponding to the used side openings in the shell element 62, two of the side openings are designated with the reference numerals 152 and 154.

[0117] The exterior casing elements are held in place in any suitable manner such as for example by screws

[0118] Figure page 10 shows the example exterior casing configuration for a top port ventilation unit of FIG. 9 associated with modular blower sub-assemblies in top port configuration in relation to the L-shaped element 2; a side port configuration of the sub-assemblies also being shown in dotted outline.

[0119] FIG. 12a schematically illustrates a top view of the ventilation unit of FIG. 11 again with a portion of the exterior casing cut away to expose the hexagonal exchanger core 176, the unit being in a fresh air delivery configuration. The two dark arrows show the separate paths for air movement from the core 176 to respective ports 112 and 114.

[0120] FIG. 12b schematically illustrates a front side view of the ventilation unit of FIG. 11 with one top port 116 (top port 116 being shown in FIG. 12a) cut away along with a portion of the exterior casing to expose the hexagonal exchanger core 176, the unit being in a fresh air delivery
configuration. The two dark arrows show the separate paths for air movement into the core 176 from respective ports 110 and 116.

[0121] As may be seen from FIG. 12, the damper 180 blocks off a stale air by-pass channel so that fresh air may be delivered to the core 176 from port 110.

[0122] FIGS. 13a and 13b show in enlarged format the disposition of the damper 180 for controlling the input of fresh air into the ventilation unit and the blocking off of fresh air for recirculation of enclosure air through both sides of the exchanger core 176, i.e. for a top port arrangement. The ventilation unit is provided with a suitably configured (removable) wedge shaped channel member of U-shaped cross-section which, along with the shell element, defines a stale air path communicating with stale air inside of the ventilation unit. When in the fresh air in configuration the damper 180 blocks an opening of the suitably configured removable wedge shaped channel member so that fresh air follows the arrow 190. When the ventilation unit is in the recirculation air configuration the damper 180 blocks off the port 110 and unblocks the opening defined by the wedge shaped channel member. With the damper 180 so disposed stale air may circulate (arrow 192) through stale air path defined by the wedge shaped channel member through the core 176 back into the enclosure from whence it came.

[0123] FIG. 13c shows in enlarged format the disposition of the damper 180 for controlling the input of fresh air into the ventilation unit through the exchanger core 176, i.e. for a side port arrangement. The side port ventilation unit is provided with a further suitably modified (removable) wedge shaped channel member of U-shaped cross-section which, along with the shell element, defines a stale air path (as mentioned above with respect to FIG. 13a) communicating with stale air inside of the ventilation unit. When in the fresh air in configuration the damper 180 blocks off an opening of the suitably modified (removable) wedge shaped channel member so that fresh air follows the arrow 196. If air recirculation is desired then as in the case for the top port configuration the damper 180 is pulled back to block the opening associated with port 110 to allow for air recirculation through a wedge shaped channel member.

[0124] In accordance with the present invention the wedge shaped channel members may be replaced by any other suitable means for providing a stale air path.

[0125] Referring to FIG. 14, this figure shows a further view of the interior of a shell element as shown in FIG. 5a.

[0126] FIG. 15a schematically illustrates an embodiment of a wedge shaped channel member 200 of the present invention for a ventilation unit having side ports; the wedge member 200 has a wide U-shaped opening. FIG. 15b schematically illustrates a perspective view from above showing the narrow U-shaped opening 204 of the wedge shaped channel member 200 of FIG. 15a. FIG. 15c schematically illustrates a perspective view from below of the wedge shaped channel member 200 of FIG. 15a.

[0127] FIG. 16 schematically illustrates a perspective view of a shell element of FIG. 14 (core removed) wherein the wedge shaped channel member 200 of FIG. 15a is disposed in the shell element 62 so as to define a stale air path closed off at the narrow opening of the wedge shaped channel member 200 by damper 180. FIG. 17 schematically illustrates a perspective view of the shell element (core removed) and wedge member 200 wherein the damper 180 is retracted away from the narrow opening of wedge member 200 so as to close off the fresh air opening of the shell element and expose the narrow opening of the wedge member for recirculation of stale air through the ventilation unit.

[0128] FIG. 18a schematically illustrates a perspective view from above showing the wide U-shaped opening 210 of a further wedge shaped channel member 212 of the present invention for a ventilation unit having top ports. FIG. 18b schematically illustrates a perspective view from below of the wedge shaped channel member 212 of FIG. 18a showing the narrow U-shaped opening 214 thereof.

[0129] FIG. 19 schematically illustrates a perspective view of a shell element of FIG. 14 wherein the wedge shaped channel member 212 of FIG. 18a is disposed in the shell element so as to define (with the shell element 62) a stale air path closed off at a the narrow opening of wedge member 212 by a damper 180. FIG. 20 schematically illustrates a perspective view of a shell element 62 and wedge member 212 of FIG. 19 wherein the damper 180 is retracted away from the wedge member 212 so as to close off the stale air opening of the shell element and expose the narrow opening of the wedge member 212 member for recirculation of stale air through the ventilation unit.

[0130] FIG. 21 schematically illustrates a perspective view of a ventilation unit of the present invention with the covering element removed along with the L-shaped element and one of the modular blower sub-assemblies so as to expose the hexagonal exchanger core 230. The unit is provide with pivot members 234, 234a for pivotal engagement in openings of respective pivot elements 240 and 240a of the door element 250 shown in FIG. 22 (the door element is seen in FIGS. 9a and 9b and is identified by the reference numeral 130).

[0131] FIG. 22 schematically illustrates a perspective view of the interior side of a door element 250 in accordance with the present invention which as shown has a cross-cross patterned structure. The interior side of the door element 250 is configured such that when the exchanger core 230 is in place in the interior of the ventilation unit and resting on the T-shaped projection element 82, the cross-cross patterned structure of the interior of the door element 250 will bear down on the exchanger core pushing it against the projection element 82 so as to effectively divide the interior of the ventilation unit, about the exchanger core, into four spaces; namely a fresh air in space interconnected by the exchanger core with a fresh air out space and a stale air in space interconnected by the exchanger core with a stale air out space, each space being able to communicate with a respect port mentioned herein. A description of such type of interior divisions may be found in U.S. Pat. No. 5,193,610, the entire contents of which is incorporated herein by reference; see also U.S. patent application No. 739,412 published under no. 20040226685, the entire contents of which is also incorporated herein by reference.

[0132] As may be appreciated from the discussion with respect to FIGS. 12a to 22 and in particular the wedge shaped channel members, a wedge channel member provides (in conjunction with a suitably disposed damper) a means for interconnecting the stale air in space with the
fresh air in space so the stale air only may be circulated through the ventilation unit for delivery, for example, back to the enclosure from which the stale air was initially taken.

[0133] FIGS. 23a and 23b respectively schematically illustrate a fresh air in cycle and an interior stale air recirculation (i.e. delivery back) cycle; the damper 180 is shown in both configurations. The damper 180 is illustrated in FIG. 23a as being in a position closing off the narrow opening of the wedge shaped channel member so that fresh air may be drawn into the ventilation unit. The damper 180 is illustrated in FIG. 23b as being in a position closing off the fresh air opening so as to expose the narrow opening of the wedge shaped channel member so that fresh air is blocked from entering the ventilation unit and stale air may circulate back to the enclosure from whence it came.

[0134] FIGS. 24, 25a and 25b illustrate the disposition of an electronics control module 300 for association with the L-shaped element and the shell element as well with the modular blower sub-assemblies; the exchanger core is not shown in FIGS. 25a and 25b. The control module may of course take any desired or necessary form.

[0135] FIGS. 26, 27, 28 and 29 are further illustrations of the shell element and modular blower sub-assemblies for top and side port units of figures with the L-shaped element removed from the FIGS. 28 and 29. These figures also show plug members which are used to block off unused opening of the shell element (see figure page 17 for example). These figures also show the units with electronics control modules 300.

[0136] It is to be born in mind that the ventilation units components described above are given by way of example only and may be modified in any desired fashion in order to exploit the modular blower combination assembly and modular blower sub-assembly of the present invention.

1. A modular blower combination assembly comprising an interconnection element and a pair of modular blower sub-assemblies associated therewith,

s said interconnection element being configured for interconnecting said pair of modular blower sub-assemblies in juxtaposed relationship in a respective first configuration and in a respective second configuration,

each of said modular blower sub-assemblies comprising blower means and an enclosure disposed about said blower means,

s said blower means having an upstream side and a downstream side,

s said enclosure comprising a pair of opposed faces interconnected by side wall means,

s said enclosure having an axis of rotation relative to said opposed faces,

s one of said opposed faces defining a blower opening in air communication with one side of the blower means, the blower means having an axis of rotation transverse to said one opposed face,

s said side wall means defining a side blower opening in air communication with the other side of the blower means,
said enclosure being configured to be able to engage said interconnection element in a first configuration whereby said side blower opening is disposed in a first position such that air may pass through said side blower opening in a first direction and being configured to be able, on rotation of the enclosure about said axis of rotation of the enclosure, to engage said interconnection element in a second configuration whereby said side blower opening is disposed in a second position such that air may pass through said side blower opening in a second direction transverse to said first direction.

2. A modular blower assembly for association with an interconnection element configured for interconnecting a pair of modular blower assemblies in juxtaposed relationship in a respective first configuration and in a respective second configuration, said modular blower assembly comprising blower means and an enclosure disposed about said blower means,

s said blower means having an upstream side and a downstream side,

s said enclosure comprising a pair of opposed faces interconnected by side wall means,

s said enclosure having an axis of rotation relative to said opposed faces,

s one of said opposed faces defining a blower opening in air communication with one side of the blower means, the blower means having an axis of rotation transverse to said one opposed face,

s said side wall means defining a side blower opening in air communication with the other side of the blower means,
said enclosure being configured to be able to engage said interconnection element in a first configuration whereby said side blower opening is disposed in a first position such that air may pass through said side blower opening in a first direction and being configured to be able, on rotation of the enclosure about said axis of rotation of the enclosure, to engage said interconnection element in a second configuration whereby said side blower opening is disposed in a second position such that air may pass through said side blower opening in a second direction transverse to said first direction.

3. A modular blower combination assembly comprising an interconnection element and a pair of modular blower sub-assemblies associated therewith,

s said interconnection element configured for interconnecting said pair of modular blower sub-assemblies in juxtaposed relationship in a respective first configuration and in a respective second configuration,

each of said modular blower sub-assemblies comprising blower means and an enclosure disposed about said blower means,

s said blower means having an upstream side and a downstream side,

s said enclosure comprising a pair of opposed faces interconnected by side wall means,

s said enclosure having an axis of rotation relative to said opposed faces,

s one of said opposed faces defining a blower opening in air communication with one side of the blower means, the blower means having an axis of rotation transverse to said one opposed face,

s said side wall means defining a side blower opening in air communication with the other side of the blower means,
one of said opposed broad faces defining a blower air intake opening in air communication with the upstream side of the blower means, the blower means having an axis of rotation transverse to said one opposed face,
said first side wall element defining a side blower air outlet opening in air communication with the downstream side of the blower means,
said enclosure being configured to be able to engage said interconnection element in a first configuration whereby said side blower opening is disposed in a first position such that air may pass out of said side blower opening in a first direction and being configured to be able, on rotation of the enclosure 90 degrees about said central axis of rotation of the enclosure, to engage said interconnection element in a second configuration whereby said side blower opening is disposed in a second position such that air may pass out of said side blower opening in a second direction perpendicular to said first direction.

4. A modular blower combination assembly as defined in claim 1 wherein the interconnection element comprises an elongated element and has an L-like cross-section having a foot portion and a upstanding leg portion connected thereto, said foot portion being configured for seating said enclosure by engagement with a secondary side wall element.

5. A modular blower assembly for association with an interconnection element configured for interconnecting a pair of modular blower assemblies in juxtaposed relationship in a respective first configuration and in a respective second configuration,
said modular blower sub-assembly comprising blower means and an enclosure disposed about said blower means,
said blower means having an upstream side and a downstream side,
said enclosure having a rectangular box-like form and comprising a pair of opposed square broad faces interconnected by a first side wall element and three secondary side wall elements, said enclosure having a central axis of rotation relative to said opposed square broad faces,
one of said opposed broad faces defining a blower air intake opening in air communication with the upstream side of the blower means, the blower means having an axis of rotation transverse to said one opposed face,
said first side wall element defining a side blower air outlet opening in air communication with the downstream side of the blower means,
said enclosure being configured to be able to engage said interconnection element in a first configuration whereby said side blower opening is disposed in a first position such that air may pass out of said side blower opening in a first direction and being configured to be able, on rotation of the enclosure 90 degrees about said central axis of rotation of the enclosure, to engage said interconnection element in a second configuration whereby said side blower opening is disposed in a second position such that air may pass out of said side blower opening in a second direction perpendicular to said first direction.

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