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Lazzarato(10) **Pub. No.: US 2007/0180848 A1**(43) **Pub. Date: Aug. 9, 2007**(54) **CONDITIONING DEVICE OF THE FREE
COOLING TYPE****Publication Classification**(51) **Int. Cl.****F25D 17/04** (2006.01)**F25D 17/06** (2006.01)(52) **U.S. Cl. 62/408; 62/426; 62/428; 62/419**

(57)

ABSTRACT

A free cooling conditioning device for climate controlling of an enclosed space comprising, inside a box-like containment body, a first main fan for aspirating air from the enclosed/ outside space, an evaporator, to which the first fan sends aspirated air to introduce it in the enclosed space, a condenser associated with the evaporator, a second fan for air flow over the condenser, a compressor, associated with the condenser and the evaporator to form a refrigeration circuit for aspirated air cooling, a first shutter, upstream of the first fan, for selecting the air stream aspirated by the first fan, from either ambient air, for a direct-cooling conditioning, or external air for free cooling conditioning, and a second shutter for redirecting the air stream in output from the enclosed space either toward the second fan, in the second free cooling mode, or toward the first shutter, at least partly open toward the first fan, for aspiration of ambient air, in the cooling mode.

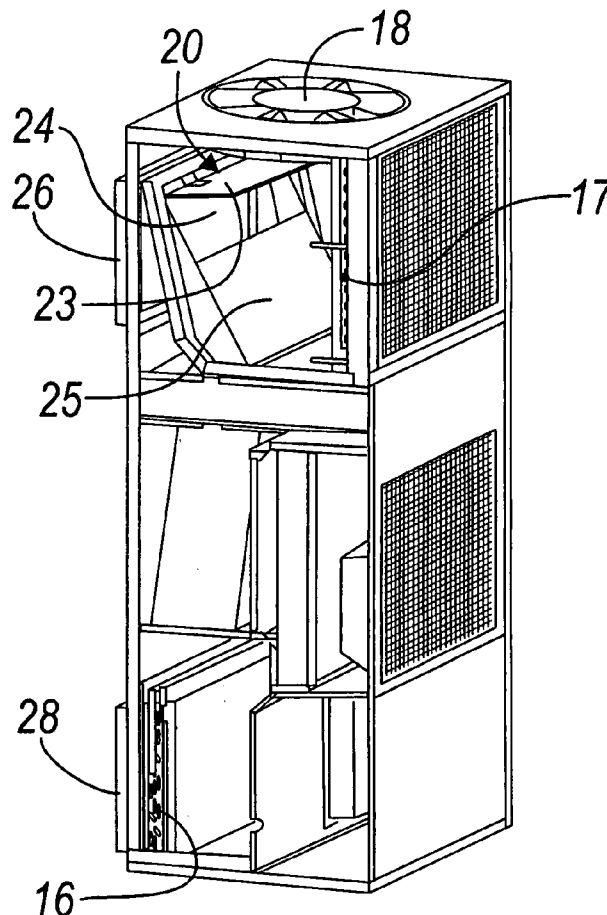
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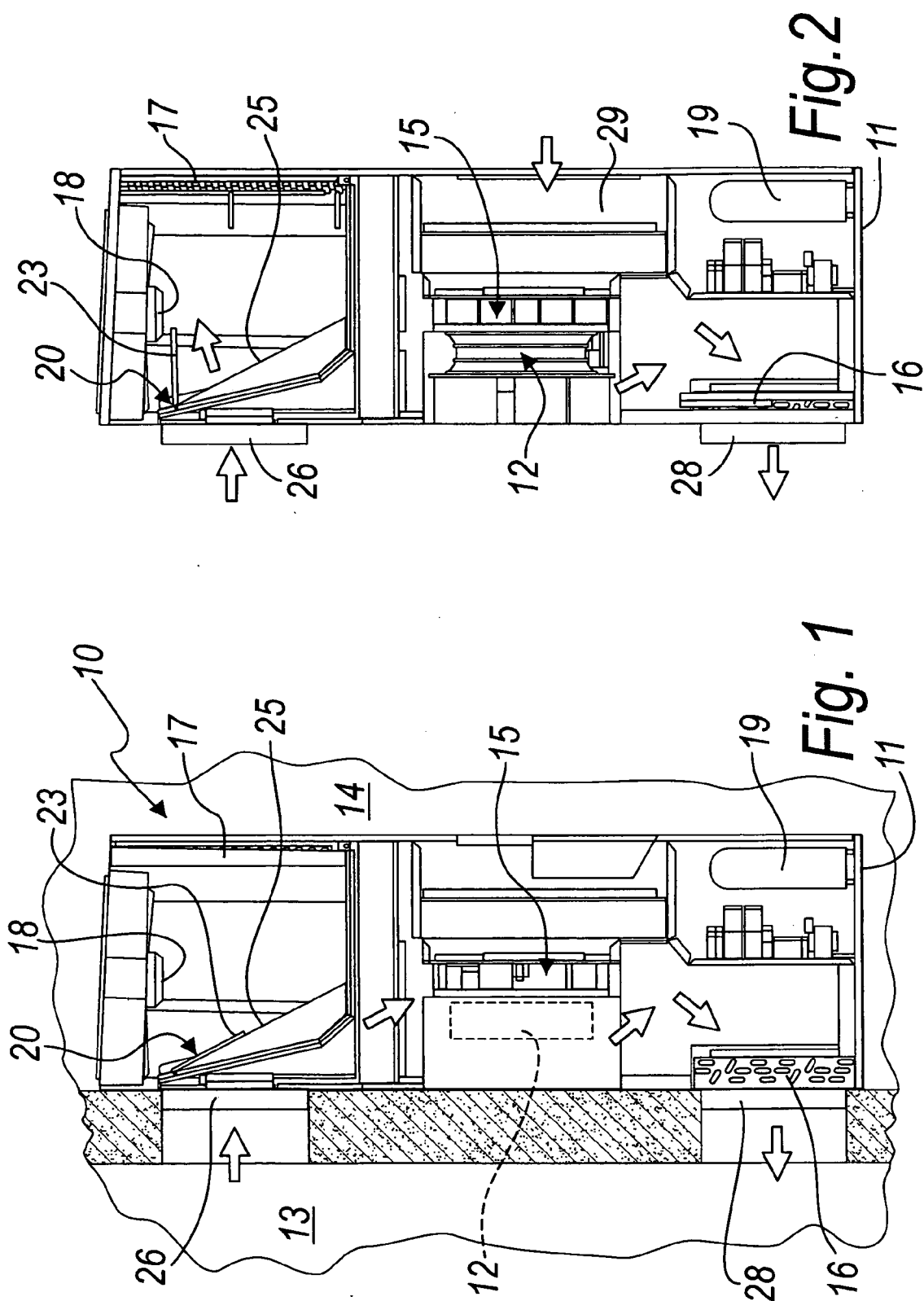
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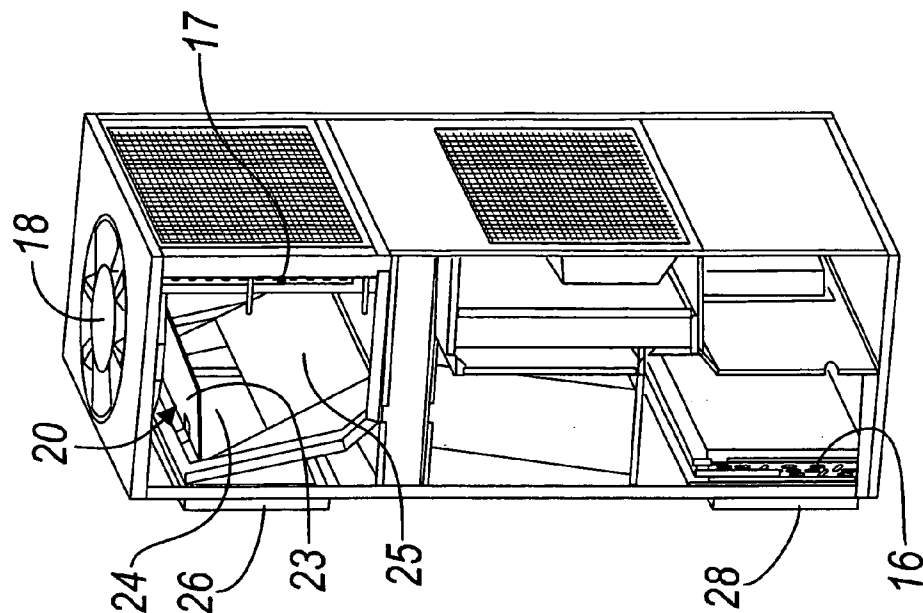


Fig. 4

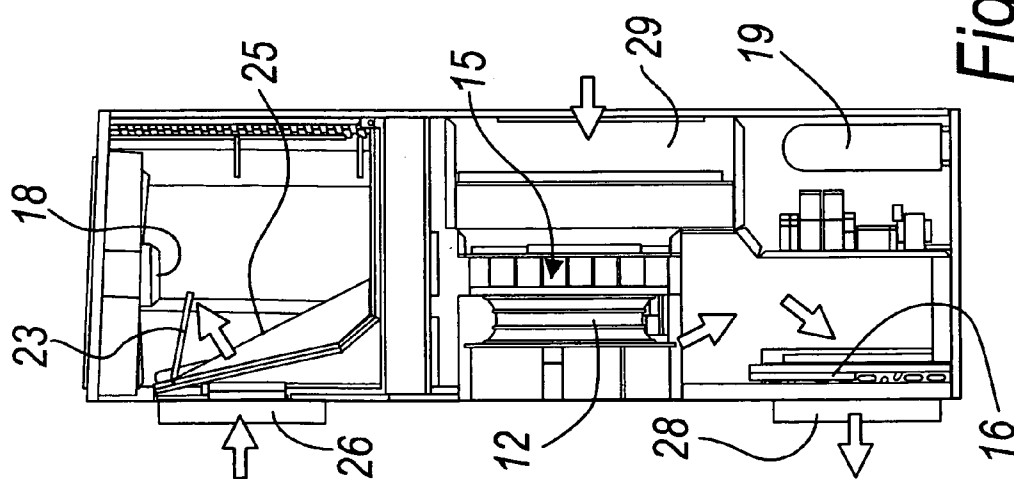


Fig. 3

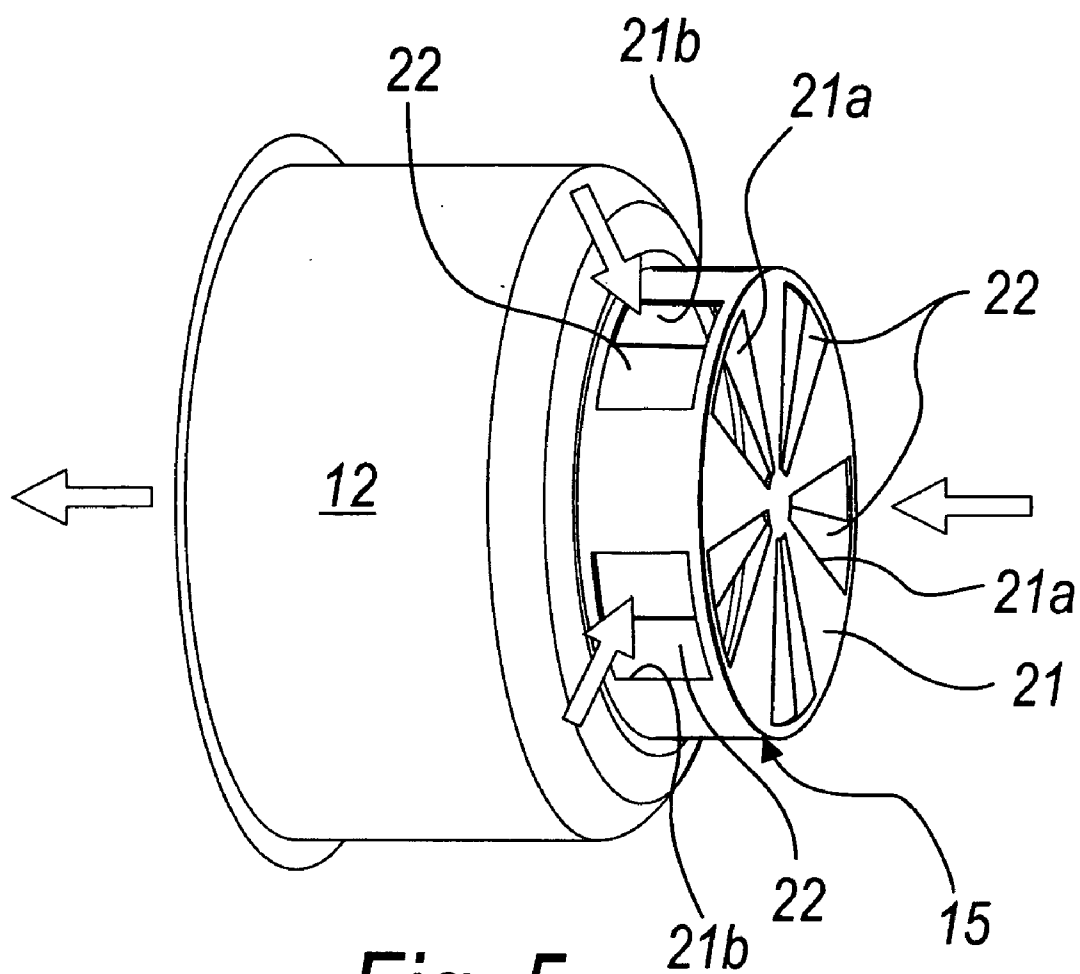


Fig. 5

CONDITIONING DEVICE OF THE FREE COOLING TYPE

[0001] The present invention relates to a conditioning device of the free cooling type.

BACKGROUND OF THE INVENTION

[0002] Air conditioning devices provided with the option known as “free cooling” are currently known in the field of climate control of enclosed spaces ranging from industrial facilities to telephone exchanges to offices to private dwellings and the like.

[0003] The free cooling option is based on the ability of the climate control unit to use, for the conditioning of an enclosed space, air which arrives from outside when said air has an enthalpy value which is higher than that of the air of the internal space.

[0004] Free cooling allows considerable energy saving on the part of the user as well as a healthier management of the air of the internal space, which is replaced appropriately by activating free cooling.

[0005] Known types of free cooling conditioning device are generally installed externally or are wall-mounted with respect to the walls which form the space to be climate-controlled.

[0006] These known conditioning devices are constituted generally by a box-like body which contains:

[0007] a first main fan for aspirating air from the enclosed space or from outside;

[0008] a shutter, arranged upstream of the first fan, for selecting the air stream aspirated by the first fan: ambient air for a first direct-cooling conditioning mode or external air for a second free cooling conditioning mode;

[0009] an evaporator, to which the first fan sends the aspirated air to introduce it in the enclosed space to be climate-controlled;

[0010] a condenser associated with said evaporator;

[0011] a second fan for the flow of air over said condenser;

[0012] a compressor which is associated with the condenser and the evaporator so as to form a refrigeration circuit for cooling the aspirated air.

[0013] In the first conditioning mode, the refrigeration circuit is active, the shutter closes a first port for aspirating air from outside and opens a second port for aspirating air from the enclosed space, forming a first intake channel which connects said second port to the first fan, from which the air reaches the evaporator and from there returns to the space to be climate-controlled.

[0014] At the same time, the second fan also is active and aspirates air from outside in order to send it to the condenser of the refrigeration circuit.

[0015] The transition from this first mode to the second free cooling operating mode occurs by tilting the shutter, which is arranged in a second configuration which is adapted to close the first intake channel between the second port, which is open onto the inside environment, and the first fan, and to open a second channel between a third port, which is open onto the outside, and the first fan, and a third channel between the second port and a fourth port, which also is open onto the outside.

[0016] In this second operating mode, the second fan is off, the refrigeration circuit is inactive, warm air flows from the internal environment outward through the third channel, and the fan aspirates cool air from the outside in order to introduce it into the environment by means of the second channel.

[0017] Although these known conditioning devices are highly appreciated because of the saving on consumption that they can achieve, together with the quality of their climate control, in the free cooling operating mode they typically have a certain slowness in the outflow of warm air inside the enclosed space, due both to the relatively convoluted path that said warm air must follow to arrive outside and because it is pushed outward only by the pressure determined by the inflow of the air from the outside by means of the first fan and by its natural rise.

SUMMARY OF THE INVENTION

[0018] The aim of the present invention is to provide a conditioning device of the free cooling type which is capable of obviating the drawbacks revealed by known types.

[0019] Within this aim, an object of the present invention is to provide a conditioning device which is capable of increasing the efficiency and effectiveness of the free cooling operating mode.

[0020] Another object of the present invention is to provide a conditioning device which is not less compact than known types of device.

[0021] Another object of the present invention is to provide a conditioning device of the free cooling type which can be manufactured cheaply with known systems and technologies.

[0022] This aim and these and other objects, which will become better apparent hereinafter, are achieved by a conditioning device of the free cooling type, which comprises, inside a box-like containment body:

[0023] a first main fan for aspirating air from the enclosed space or from the outside;

[0024] at least one shutter, upstream of the first fan, for selecting the air stream aspirated by the first fan: either ambient air for a first direct-cooling conditioning mode or external air for a second free cooling conditioning mode;

[0025] an evaporator, to which the first fan sends the aspirated air in order to introduce it in the enclosed space to be climate-controlled;

[0026] a condenser associated with said evaporator;

[0027] a second fan for the flow of air over said condenser;

[0028] a compressor, which is associated with the condenser and the evaporator to form a refrigeration circuit for cooling the aspirated air;

[0029] said device being characterized in that it has a first shutter, upstream of the first fan, for selecting the stream of air aspirated by the first fan, either ambient air, for a first direct-cooling conditioning mode, or external air for a second free cooling conditioning mode, and a second shutter, which is adapted to redirect the stream of air in output from the enclosed space either toward said second fan, when the device operates in the second free cooling mode, or toward said first shutter, which is at least partly open toward

the first fan, for the aspiration on the part of said first fan at least partly of ambient air, in the first cooling mode with ambient air recirculation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] Further characteristics and advantages of the invention will become better apparent from the following detailed description of a preferred but not exclusive embodiment thereof, illustrated by way of non-limiting example in the accompanying drawings, wherein:

[0031] FIG. 1 is a schematic sectional side view of a device according to the invention in a first configuration for a first operating mode;

[0032] FIG. 2 is a schematic sectional side view of a device according to the invention in a second configuration for a second operating mode;

[0033] FIG. 3 is a schematic sectional side view of a device according to the invention in the same configuration as in FIG. 2, for a third operating mode;

[0034] FIG. 4 is a perspective view of the device according to the invention in the configuration of FIG. 3;

[0035] FIG. 5 is a schematic perspective view of a detail of a device according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0036] With reference to the figures, a conditioning device of the free cooling type according to the invention is generally designated by the reference numeral 10.

[0037] The conditioning device 10 comprises, within a box-like containment body 11:

[0038] a first main fan 12 for aspirating air from the enclosed space 13 or from the outside 14;

[0039] at least one shutter 15, upstream of the first fan 12, for selecting the air stream aspirated by the first fan 12: either ambient air for a first direct-cooling conditioning mode or external air for a second free cooling conditioning mode;

[0040] an evaporator 16, to which the first fan 12 sends the aspirated air in order to introduce it in the enclosed space 13 to be climate-controlled;

[0041] a condenser 17 associated or operatively connected with the evaporator 16;

[0042] a second fan 18 for passing the flow of air over the condenser 17;

[0043] a compressor 19, which is associated or operatively connected (i.e. connected for controlled, cooperating operation) with the condenser 17 and the evaporator 16 to form a refrigeration circuit for cooling the aspirated air;

[0044] and a second shutter 20, which is adapted to redirect the stream of air in output from the enclosed space 13 either toward the second fan 18, when the device 10 operates in the second free cooling mode, or toward the first shutter 15, which is at least partly open toward the first fan 12, for the aspiration on the part of said first fan at least partly of ambient air, in the first cooling mode with ambient air recirculation.

[0045] The first shutter 15 is of the type with baskets, shown schematically in FIG. 5 and constituted by a first basket 21 and by at least one complementarily shaped second basket 22 inserted within it.

[0046] The first basket 21 opens onto the first fan 12 and is provided with first front ports 21a on its bottom and second lateral ports 21b on its lateral surface.

[0047] The second basket 22, which is internal and is a single one in the embodiment of the invention described here, forms the flow control means of the first shutter 15, by being connected to rotation means for rotation with respect to the first basket 21 and by being contoured so that portions of its bottom and its lateral surface alternately block the first front ports 21a and the second lateral ports 21b; the second basket 22 can be actuated so as to provide selectively one of the following three configurations:

[0048] a first configuration, in which the first ports 21a are closed and the second ports 21b are open;

[0049] a second configuration, in which the first ports 21a are open and the second ports 21b are closed;

[0050] a third configuration, in which the first ports 21a and the second ports 21b are partially open.

[0051] The first configuration allows the operation of the device 10 in the first mode for cooling with ambient air recirculation and active refrigeration circuit.

[0052] The second configuration is designed for the operation of the device 10 in the second free cooling mode, by connecting the outside to the first fan 12.

[0053] The second shutter 20 is provided by a louver 23, which is arranged so as to open/close a corresponding opening 24 which is formed on a redirection wall 25 which is arranged in front of a first port 26 for the outflow of air from the enclosed space 13.

[0054] The redirection wall 25 is inclined so that when the opening 24 is closed the air is redirected toward the first shutter 15 and the first fan 12, as shown by way of example in FIG. 1.

[0055] If the louver 23 is open, the internal air can pass through the opening 24 and flow out through the second fan 18.

[0056] The louver 23 is actuated by electromechanical movement means, not shown for the sake of simplicity, which are actuated by an electronic control unit, which also manages the first shutter 15 and the two fans 12 and 18.

[0057] The device 10 according to the invention is therefore capable of operating in three modes.

[0058] In a first mode, for direct-cooling conditioning, i.e., with the refrigeration circuit active:

[0059] the first shutter 15 is in the first configuration, in which the first ports 21a are closed and the second ports 21b are open (FIG. 1), and the first fan 12 draws air from the enclosed space 13 through the first port 26;

[0060] the second shutter 20 is closed, and the air aspirated by the first port 26 is redirected entirely toward the first fan 12 and from there toward the evaporator 16, from which the cooled air then reaches the enclosed space 13 by means of a second port 28 for emission into the environment;

[0061] the refrigeration circuit is active, and so is the second fan 18, which forces the flow of air from outside to outside over the condenser 17.

[0062] In a second mode for free cooling conditioning, i.e., with the refrigeration circuit off:

[0063] the first shutter 15 is in the second configuration, in which the first ports 21a are open and the second ports 21b are closed, and the first fan 12 aspirates air from the outside 14 through a third port 29, which is open onto the outside;

[0064] the second shutter 20 is open and the air rises from the first port 26 and is redirected entirely toward the second fan 18, which is inactive and by means of which it arrives outside;

[0065] the refrigeration circuit is off, and so is the second fan 18, as mentioned.

[0066] In a third mode for forced free cooling conditioning:

[0067] the first shutter 15 is in the second configuration, in which the first ports 21a are open and the second ports 21b are closed, and the first fan 12 aspirates air from the outside 14 through the third port 29 which is open onto the outside;

[0068] the second shutter 20 is open, and the air rises through the first port 26 toward the second fan 18, which is active and by means of which it is forced outside;

[0069] the refrigeration circuit is off, but the second fan 18 is active.

[0070] This third mode therefore allows to obviate the drawback of known types of device, since thanks to the opening 24 which connects the first port 26 (for the outflow of the air from the enclosed space 13) to the second fan 18, it is able to increase the efficiency and effectiveness of the free cooling operating mode, simply by activating the second fan 18 with the refrigeration circuit off.

[0071] In this third mode, the second fan 18 is adapted to aspirate air from the enclosed space 13, accelerating its replacement.

[0072] This is allowed by the particular structure of the device 10 according to the invention, which differently from known types of device has the port for the outflow of air from the enclosed space, i.e., the first port 26, connected by means of the second shutter 20 to the air passage chamber to which both the condenser 17 and the second fan 18 lead.

[0073] In practice it has been found that the invention thus described solves the problems noted in known types of free cooling conditioning device.

[0074] In particular, the present invention provides a conditioning device which is capable of increasing the efficiency and effectiveness of the free cooling operating mode with respect to known devices.

[0075] Moreover, the present invention provides a conditioning device which is not less compact than known types of device.

[0076] Moreover, the present invention provides a conditioning device of the free cooling type which can be manufactured cheaply with known systems and technologies.

[0077] In practice, the materials employed, so long as they are compatible with the specific use, as well as the dimensions, may be any according to requirements and to the state of the art.

[0078] The disclosures in Italian Utility Model Application No. PD2006U000015 from which this application claims priority are incorporated herein by reference.

What is claimed is:

1. A free cooling conditioning device for climate-controlling of an enclosed space comprising a box-like containment body and therein:

- a first main fan for aspirating air from an enclosed or outside space;
- an evaporator, to which said first fan sends aspirated air in order to introduce the aspirated air in the enclosed space to be climate-controlled;

- a condenser operatively connected with said evaporator;
- a second fan for air flow passing over said condenser;
- a compressor, which is operatively connected with said condenser and said evaporator to form a refrigeration circuit for cooling aspirated air;
- and comprising a first shutter, provided upstream of said first fan, for selecting a stream of air aspirated by said first fan, from either ambient air, for a first direct-cooling conditioning mode, or external air for a second free cooling conditioning mode; and a second shutter, which is adapted to redirect air stream in output from said enclosed space either toward said second fan, when the device operates in the second free cooling mode, or toward said first shutter, which is at least partly open toward said first fan, for aspiration, at least partly, by said first fan of ambient air, in the first direct-cooling mode with ambient air recirculation.

2. The conditioning device of claim 1, wherein said first shutter is a basket shutter, being constituted by a first basket, by at least one complementarily shaped second basket which is inserted inside said first basket and by rotation means, said first basket being open onto the first fan and being provided with first front ports on a bottom thereof and second lateral ports on a lateral surface thereof, said at least one second internal basket being adapted to form flow control means for flow control of the first shutter, being connected to said rotation means for rotating with respect to the first basket and being shaped so as to have bottom and lateral surface portions thereof which alternately block the first front ports and the second lateral ports.

3. The device of claim 2, wherein said first shutter is constituted by two baskets, with a second basket thereof being selectively actuatable so as to be located in a position such as to provide one among the following three configurations:

- a first configuration, in which the first ports are closed and the second ports are open;
 - a second configuration, in which the first ports are open and the second ports are closed;
 - a third configuration, in which the first ports and the second ports are partially open,
- said first configuration allowing operation of the device in the first cooling mode with ambient air recirculation and active refrigeration circuit, said second configuration allowing operation of the device in the second free cooling mode, connecting the outside space to said first fan.

4. The device of claim 2, comprising a first outflow port for outflow of air from the enclosed space and a redirection wall arranged in front of the first port, said second shutter being formed by a louver which is arranged so as to open/close a corresponding opening which is formed in said redirection wall.

5. The device of claim 4, wherein said redirection wall is inclined so that when said opening is closed, air is redirected toward the first shutter and toward the first fan, whereas when the louver is open internal air can pass through said opening toward the outside space through said second fan.

6. The device of claim 5, comprising an electronic control unit and electromechanical movement means, said louver being actuated by said electromechanical movement means, which are actuated by said electronic control unit which also manages said first shutter and said two fans.

7. The device of claim 6, operatable selectively in one of three modes:

- a first direct-cooling conditioning mode;
- a second free cooling conditioning mode;
- a third forced free cooling conditioning mode.

8. The device of claim 7, comprising a second emission port for emission into environment, the refrigeration circuit being active in said first direct-cooling conditioning mode, and the first shutter being in said first configuration, in which the first ports are closed and the second ports are open, and the first fan drawing air from the enclosed space through the first port; the second shutter being closed, and the air aspirated by the first port being redirected entirely toward the first fan and from there toward the evaporator, from which cooled air then is allowed to reach the enclosed space through said second port; the refrigeration circuit being active, and so being the second fan, which forces air flow from the outside space to outside space over said condenser.

9. The device of claim 7, comprising a third port which is open onto the outside, in said second free cooling conditioning mode, with the refrigeration circuit off, the first shutter being in the second configuration, in which the first ports are open and the second ports are closed, and the first

fan aspirates air from the outside space through said third port, the second shutter being open and air rising from the first port and being redirected entirely toward the second fan, which is inactive and to so arrive in the outside space.

10. The device of claim 7, having said third forced free cooling conditioning mode in which:

the first shutter is in the second configuration, in which the first ports are open and the second ports are closed, and the first fan aspirates air from the outside through the third port which is open onto the outside;

the second shutter is open, and the air rises through the first port toward the second fan, which is active and by means of which it is forced outside;

the refrigeration circuit is off.

11. The device of claim 10, wherein said opening is suitable, in said third mode, to connect the first port, for outflow of the air from the enclosed space, to the second fan, whereby an efficiency and effectiveness increase of the free cooling operating mode and of air rate replacement in the enclosed space are achieved.

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