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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

[Continued on next page]

(54) Title: ROOFTOP UNIT

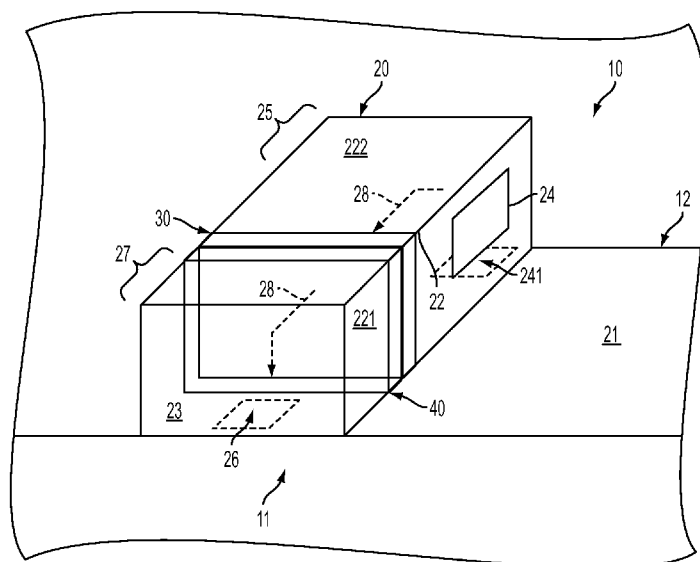


FIG. 1

(57) Abstract: A rooftop air conditioning unit, including an air conditioner to produce conditioned air for a conditioned space within a building, the air conditioner having an evaporator, a compressor operably disposed downstream from the evaporator and a condenser operably interposed between the compressor and the evaporator, the rooftop air conditioning unit including a housing, disposed on a roof of the building to house the evaporator, the compressor and the condenser, the housing being formed to define a pathway from an inlet that is fed by exterior and/or interior air to an outlet leading to the conditioned space and a heat reclaim module disposed within the housing and operably coupled to the air conditioner to be receptive of heat produced in the air conditioner for heat exchange operations.



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ROOFTOP UNIT

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to a rooftop unit and, more particularly, to a rooftop air conditioning unit with heat reclaim capability.

[0002] Most modern buildings, especially large office buildings, hotels and residences, require substantial heating and cooling systems to maintain comfortable living and working conditions in their respective interiors. These systems often include rooftop units that are disposed on rooftops where ready supplies of inlet air can be found and negative issues associated with the noise and exhaust they generate can be mitigated.

[0003] Where the systems are configured to provide air conditioning, heat is generally dumped into the atmosphere. Thus, the energy stored in this heat is lost and wasted and represents a cost of operating the rooftop unit. This cost is particularly noticeable where the building has a heat load requirement and incurs an additional cost in satisfying this requirement while dumping the heat from the air conditioning.

BRIEF DESCRIPTION OF THE INVENTION

[0004] According to one aspect of the invention, a rooftop air conditioning unit, including an air conditioner to produce conditioned air for a conditioned space within a building, the air conditioner having an evaporator, a compressor operably disposed downstream from the evaporator and a condenser operably interposed between the compressor and the evaporator, is provided and includes a housing, disposed on a roof of the building to house the evaporator, the compressor and the condenser, the housing being formed to define a pathway from an inlet that is fed by exterior and/or interior air to an outlet leading to the conditioned space and a heat reclaim module disposed within the housing and operably coupled to the air conditioner to be receptive of heat produced in the air conditioner for heat exchange operations.

[0005] According to another aspect of the invention, a rooftop air conditioning unit is provided and includes a housing, disposed on a roof of a building, defining a pathway from an inlet that is fed by exterior and/or interior air to an outlet leading to a conditioned space within the building, an air conditioner to produce conditioned air to be supplied to the conditioned space, the air conditioner being disposed within the housing and including an evaporator, a compressor operably disposed downstream from the evaporator and a condenser

operably interposed between the compressor and the evaporator and a heat reclaim module disposed within the housing and operably coupled to the air conditioner to be receptive of heat produced in the air conditioner for heat exchange operations.

[0006] According to yet another aspect of the invention, a rooftop air conditioning unit is provided and includes a housing, disposed on a roof of a building, defining a pathway from an inlet that is fed by exterior and/or interior air to an outlet leading to a conditioned space within the building, an air conditioner to produce conditioned air to be supplied to the conditioned space, the air conditioner being disposed within the housing and including an evaporator, a compressor operably disposed downstream from the evaporator and a condenser operably interposed between the compressor and the evaporator and a heat reclaim module disposed within the housing and operably coupled to the air conditioner to be receptive of heated fluid produced in the compressor for heat exchange operations.

[0007] These and other features will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0009] FIG. 1 is a perspective view of a rooftop air conditioning unit;

[0010] FIG. 2 is a schematic view of a fluid supply circuit for use with the rooftop air conditioning unit of FIG. 1; and

[0011] FIGS. 3 and 4 are schematic illustrations of alternate control options for satisfying a building heat load.

[0012] The detailed description explains embodiments of the invention, together with features, by way of example with reference to the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0013] With reference to FIGS. 1 and 2, a rooftop air conditioning unit 10 to provide conditioned air to a conditioned space 11 within a building 12 is provided. The rooftop air conditioning unit 10 includes a housing 20, an air conditioner 30 and a heat reclaim module 40.

[0014] As shown in FIG. 1, the housing 20 is disposed on a roof 21 of the building 12 and includes an elongate body 22 having sidewalls 221 and an upper surface 222, which in concert with the roof 21 enclose an interior 23. Openings 24 and 241 are formed in the sidewalls 221, the upper surface 222 and a lower surface to define an inlet 25 through which exterior air and/or interior or return air enters the interior 23 while a further opening 26 formed through the roof 21 defines an outlet 27 leading to the conditioned space 11. A pathway 28 is thereby defined from the inlet 25 through the interior 23 and to the outlet 27 along which air travels. This air may be blown by atmospheric conditions, an air circulation fan or a mechanical blower.

[0015] As shown in FIGS. 1 and 2, the air conditioner 30 produces conditioned air to be supplied to the conditioned space 11 and is disposed within the housing 20. The air conditioner 30 includes an expansion device 31, which expands a volume of fluid contained within the air conditioner 30, an evaporator 32 operably disposed downstream from the expansion device 31 to execute an evaporation process that cools a supply of air urged by an evaporator fan 33 to flow through the evaporator 32 and toward the conditioned space 11. The air conditioner 30 further includes a compressor 34 and a condenser 35. The compressor 34 is operably disposed downstream from the evaporator 32 to elevate a fluid pressure and a saturation temperature above ambient of a fluid therein such that the fluid may readily reject heat in the condenser 35. The condenser 35 is operably disposed downstream from the compressor 34 and executes a condensing operation by which the heated fluid rejects heat to air urged by a condenser fan 36 to flow through the condenser 35.

[0016] In a conventional rooftop air conditioning unit 10, the heat rejected by the condenser 35 would be lost or dumped to the surrounding atmosphere. In accordance with aspects, however, this heat is reclaimed by the heat reclaim module 40, which is disposed within the housing 20 and operably coupled to the air conditioner 30. In this way, the heat reclaim module 40 is receptive of at least a portion of the heated fluid output from the compressor 34 such that less heat is otherwise rejected by the condenser 35. In alternate embodiments, the heat reclaim module 40 may operate by reclaiming the heat from heated air blown out of the condenser 35 by the condenser fan 36.

[0017] In either case, the heat reclaimed by the heat reclaim module 40 is made available for heat exchange operations (i.e., perimeter heating, pool heating, etc.) in, for example, a refrigerant to water heat exchanger 41, which is fluidly coupled to a fluid supply circuit 42 that is disposed in thermal communication with a heat load of the building 12. As such, the reclaimed heat can be employed to satisfy or at least partially satisfy the heat

requirements of the building 12. This may cancel or at least mitigate the need for additional heat generating equipment for the building 12. Water and/or glycol in some combination thereof may be contained within the fluid supply circuit 42.

[0018] In accordance with embodiments, the air conditioner 30 may further include first piping 50 by which the compressor 34 and the condenser 35 are fluidly coupled with one another and a first valve 51. This first valve 51 may be a condenser modulating valve and is operably disposed along the first piping 50 to modulate an amount of heated fluid permitted to be transported from the compressor 34 to the condenser 35. The heat reclaim module 40 may also further include second piping 52, which is coupled to the first piping 50 at a location that is upstream from the first valve 51. By way of the second piping 52, the first piping 50 and the refrigerant to water heat exchanger 41 may be fluidly coupled. In addition, the heat reclaim module 40 may include a second valve 53 that is operably disposed along the second piping 52 to modulate an amount of heated fluid permitted to be transported from the first piping 51 to the refrigerant to water heat exchanger 41.

[0019] With the configuration described above, the first and second valves 51 and 53 may be operated independently of one another and/or in concert with one another. Thus, the air conditioning unit 30 may be operated to produce conditioned air for the conditioned space 11 with the first valve 51 opened and the second valve 53 opened or closed. With the second valve 53 closed, none of the heated fluid output from the compressor 34 will be diverted to the heat reclaim module 40, which will therefore be non-operative. With the second valve 53 opened, the heat reclaim module 40 operates and reclaims at least some of the heat that would otherwise be rejected from the condenser 35. Still further, the air conditioning unit 30 may be at least partially operated with the first valve 51 closed and the second valve 53 opened. In this way, the condenser 35 can be shut off to save energy and costs and the air conditioner 30 can be operated only for the purpose of producing heat to service the heat load of the building 12.

[0020] With reference to FIGS. 3 and 4, the heat load of the building 12 can be satisfied by further configurations 60 and 70. In configuration 60, as shown in FIG. 3, heated fluid for the fluid supply circuit 42 enters the refrigerant to water heat exchanger 41 in a volume that is modulated by the modulating valve 61 and proceeds toward a boiler or water heater of the fluid supply circuit 42 after being output from the refrigerant to water heat exchanger 41. In the configuration 70, as shown in FIG. 4, the modulating valve 71 is similarly disposed and an additional fluid supply circuit is provided to transport fluid between the fluid supply circuit 42 and the air conditioner 30. In both configurations 60 and 70, the

modulating valves 61 and 71 operate to increase or decrease an amount of fluid available for heat reclaim operations in the heat reclaim module 40.

[0021] While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

CLAIMS:

1. A rooftop air conditioning unit, including an air conditioner to produce conditioned air for a conditioned space within a building, the air conditioner having an evaporator, a compressor operably disposed downstream from the evaporator and a condenser operably interposed between the compressor and the evaporator, the rooftop air conditioning unit comprising:

a housing, disposed on a roof of the building to house the evaporator, the compressor and the condenser, the housing being formed to define a pathway from an inlet that is fed by exterior and/or interior air to an outlet leading to the conditioned space; and

a heat reclaim module disposed within the housing and operably coupled to the air conditioner to be receptive of heat produced in the air conditioner for heat exchange operations.

2. The rooftop air conditioning unit according to claim 1, wherein the heat reclaim module comprises a refrigerant to water heat exchanger.

3. The rooftop air conditioning unit according to claim 2, wherein the refrigerant to water heat exchanger is fluidly coupled to a fluid supply circuit in thermal communication with a heat load of the building.

4. The rooftop air conditioning unit according to claim 3, wherein water and/or glycol is contained within the fluid supply circuit.

5. A rooftop air conditioning unit, comprising:

a housing, disposed on a roof of a building, defining a pathway from an inlet that is fed by exterior and/or interior air to an outlet leading to a conditioned space within the building;

an air conditioner to produce conditioned air to be supplied to the conditioned space, the air conditioner being disposed within the housing and including an evaporator, a compressor operably disposed downstream from the evaporator and a condenser operably interposed between the compressor and the evaporator; and

a heat reclaim module disposed within the housing and operably coupled to the air conditioner to be receptive of heat produced in the air conditioner for heat exchange operations.

6. The rooftop air conditioning unit according to claim 5, wherein the heat reclaim module comprises a refrigerant to water heat exchanger.

7. The rooftop air conditioning unit according to claim 6, wherein the refrigerant to water heat exchanger is fluidly coupled to a fluid supply circuit in thermal communication with a heat load of the building.

8. The rooftop air conditioning unit according to claim 7, wherein water and/or glycol is contained within the fluid supply circuit.

9. The rooftop air conditioning unit according to claim 6, wherein the air conditioner comprises:

first piping by which the compressor and the condenser are fluidly coupled; and

a first valve operably disposed along the first piping to modulate an amount of fluid permitted to be transported from the compressor to the condenser.

10. The rooftop air conditioning unit according to claim 9, wherein the heat reclaim module comprises:

second piping coupled to the first piping upstream from the first valve by which the first piping and the refrigerant to water heat exchanger are fluidly coupled; and

a second valve operably disposed along the second piping to modulate an amount of fluid permitted to be transported from the first piping to the refrigerant to water heat exchanger.

11. The rooftop air conditioning unit according to claim 10, wherein the first and second valves are operated independently.

12. The rooftop air conditioning unit according to claim 10, wherein the first and second valves are operated in concert.

13. A rooftop air conditioning unit, comprising:

a housing, disposed on a roof of a building, defining a pathway from an inlet that is fed by exterior and/or interior air to an outlet leading to a conditioned space within the building;

an air conditioner to produce conditioned air to be supplied to the conditioned space, the air conditioner being disposed within the housing and including an evaporator, a compressor operably disposed downstream from the evaporator and a condenser operably interposed between the compressor and the evaporator; and

a heat reclaim module disposed within the housing and operably coupled to the air conditioner to be receptive of heated fluid produced in the compressor for heat exchange operations.

14. The rooftop air conditioning unit according to claim 13, wherein the heat reclaim module comprises a refrigerant to water heat exchanger.

15. The rooftop air conditioning unit according to claim 14, wherein the refrigerant to water heat exchanger is fluidly coupled to a fluid supply circuit in thermal communication with a heat load of the building.

16. The rooftop air conditioning unit according to claim 15, wherein water and/or glycol is contained within the fluid supply circuit.

17. The rooftop air conditioning unit according to claim 14, wherein the air conditioner comprises:

first piping by which the compressor and the condenser are fluidly coupled; and

a first valve operably disposed along the first piping to modulate an amount of heated fluid permitted to be transported from the compressor to the condenser.

18. The rooftop air conditioning unit according to claim 17, wherein the heat reclaim module comprises:

second piping coupled to the first piping upstream from the first valve by which the first piping and the refrigerant to water heat exchanger are fluidly coupled; and

a second valve operably disposed along the second piping to modulate an amount of heated fluid permitted to be transported from the first piping to the refrigerant to water heat exchanger.

19. The rooftop air conditioning unit according to claim 18, wherein the first and second valves are operated independently.

20. The rooftop air conditioning unit according to claim 18, wherein the first and second valves are operated in concert.

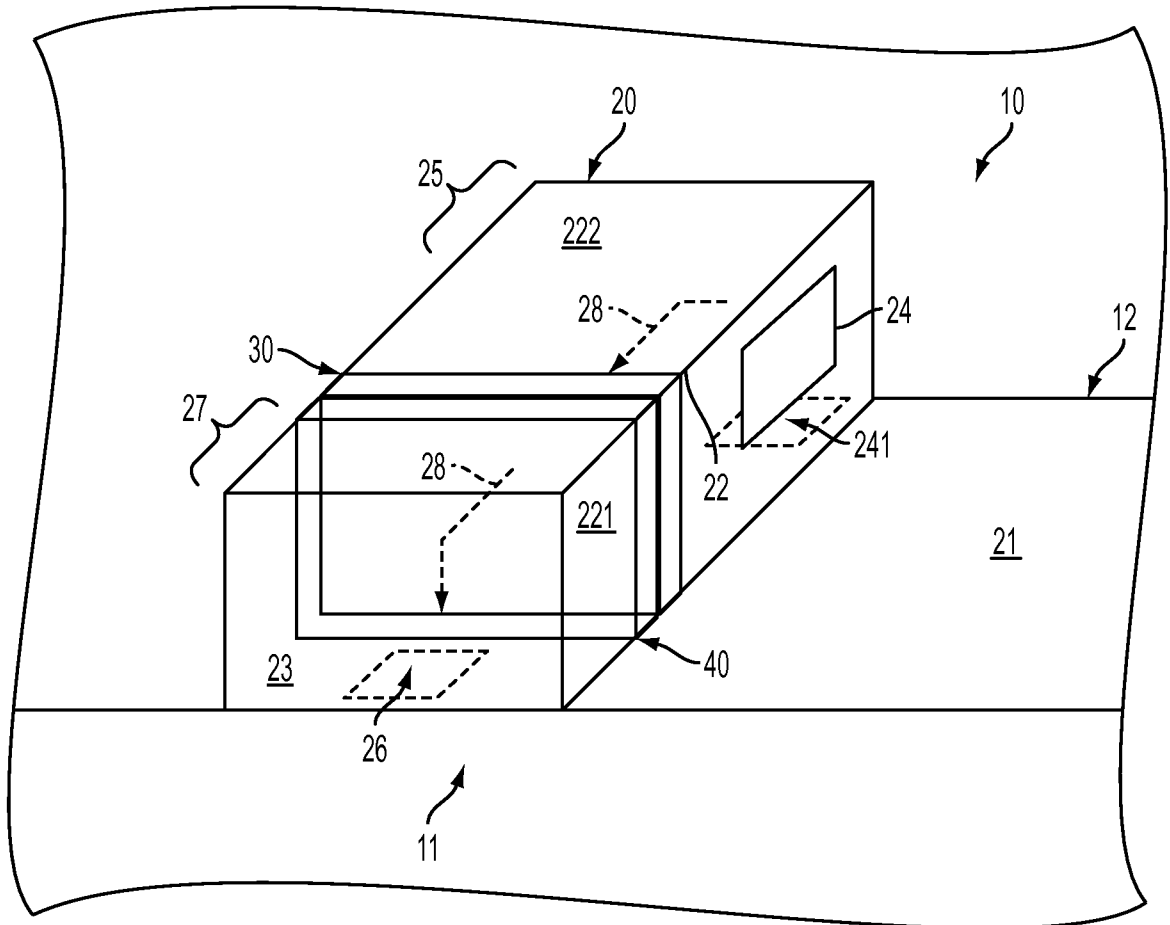


FIG. 1

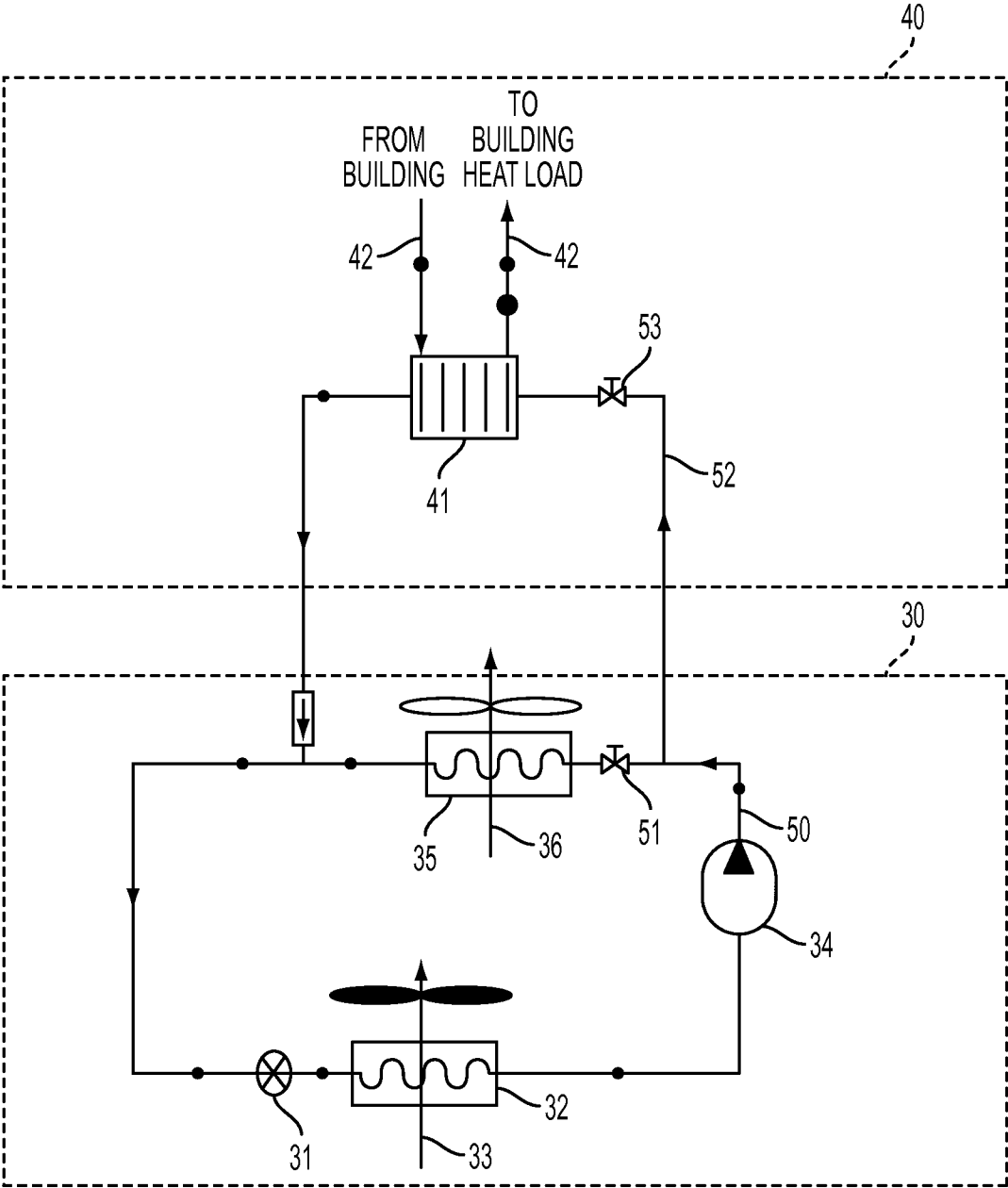


FIG. 2

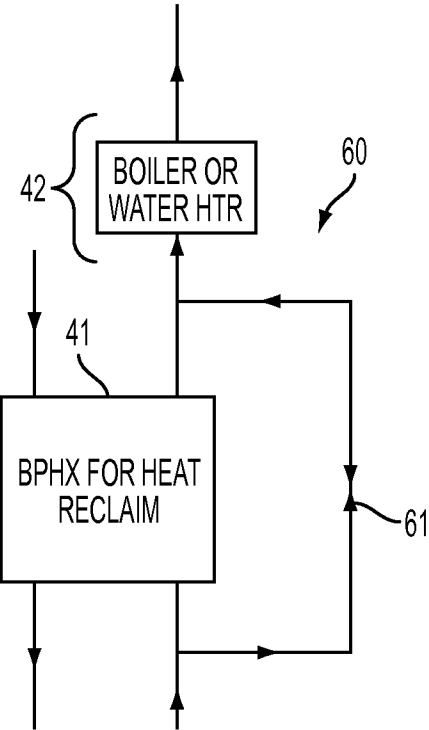


FIG. 3

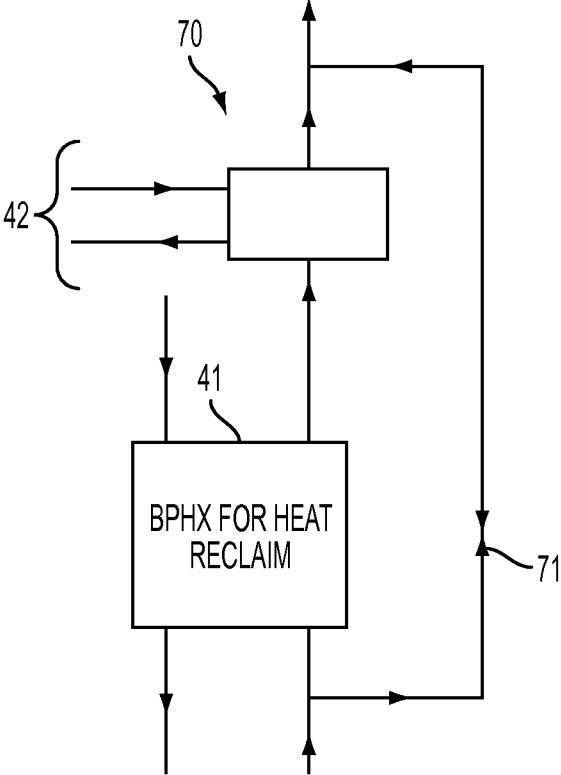


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2012/028167

A. CLASSIFICATION OF SUBJECT MATTER

INV. F24F3/044 F24F5/00 F24F3/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 41 11 319 A1 (SIEMENS AG [DE]) 15 October 1992 (1992-10-15) the whole document	1-20
X	DE 201 01 676 U1 (HANSA VENTILATOREN UND MASCHB [DE]) 29 March 2001 (2001-03-29) page 9, paragraph 2 - page 13, paragraph 2 figures	1,5,13
A	US 5 628 200 A (PENDERGRASS JOSEPH C [US]) 13 May 1997 (1997-05-13) abstract; figures	1
A	US 4 446 703 A (GILBERTSON THOMAS A [US]) 8 May 1984 (1984-05-08) abstract; figures	1



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

30 May 2012

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/028167

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4111319	A1	15-10-1992	NONE
DE 20101676	U1	29-03-2001	NONE
US 5628200	A	13-05-1997	NONE
US 4446703	A	08-05-1984	NONE