(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2019 (16.05.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/093946 A1

(51) International Patent Classification:
F24F 12/00 (2006.01) *F28D 7/10* (2006.01)

(21) International Application Number:
PCT/SE2018/051125

(22) International Filing Date:
05 November 2018 (05.11.2018)

(25) Filing Language: Swedish

(26) Publication Language: English

(30) Priority Data:
1751402-7 10 November 2017 (10.11.2017) SE

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

WO 2019/093946 A1

(54) **Title:** AIR HEAT EXCHANGING SYSTEM FOR NATURAL VENTILATION HOUSES

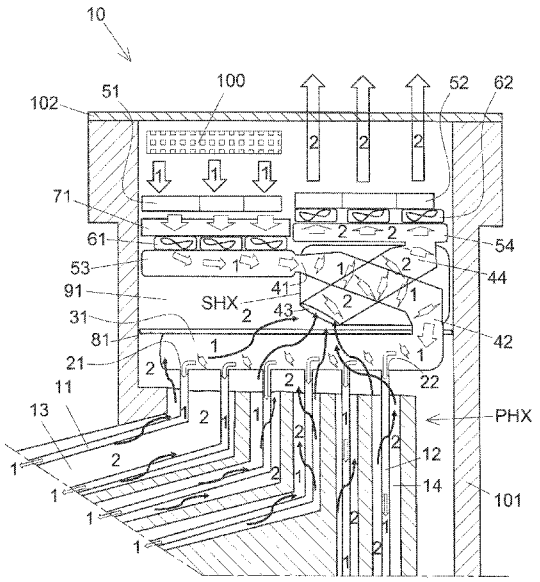

Fig 1

(57) **Abstract:** Air heat exchanging system (10), for instance for installation in an older natural ventilation house, the system comprising at least two supply air ducts (11, 12) each one of which provided with a respective inlet (21, 22), each supply air duct (11, 12) being situated either inside an exhaust-air duct (13) common to at least two supply air ducts (11, 12) and/or inside an exhaust-air duct (14) separate for each supply air duct (11, 12). The inlet (21, 22) of each supply air duct (11, 12) is connected to a common supply air distributor (31), which in turn is connected to an outlet (42) for supply air (1) in a secondary heat exchanger (SHX). Furthermore, the secondary heat exchanger (SHX) is provided with an inlet (41) for supply air (1) and with an inlet (43) and an outlet (44) for exhaust air (2). In the secondary heat exchanger (SHX), supply air (1) is heated by exhaust air (2) which is led out from the system through exhaust air devices (52).

AIR HEAT EXCHANGING SYSTEM FOR NATURAL VENTILATION HOUSES

Technical Field

The present invention relates to tubular counterflow air heat exchangers which are placed in air ducts in natural ventilation houses.

Background of the Invention

In existing buildings, there is a desire to save energy by taking advantage of heat/energy of the exhaust air to raise the temperature of the supply air. This has previously been provided by the fact that the exhaust air heat has been recovered by plate or rotary heat exchanger assemblies standing in an attic, fan room, or another arranged installation site. In this connection, new supply air ducts have been constructed through the building in new shafts, which is expensive and occupies valuable area.

By SE patent application 1450352, a heat exchanger of tube type is previously known, where supply air is led into apartments or flats through a central duct and where exhaust air from the apartments is led out through a concentrically situated outer duct. Such a construction works excellently as long as the tubular heat exchanger has sufficient length for the heat exchange to get the time required at moderate air flows.

However, this air change is in many cases inadequate, wherein the energy losses will be unnecessary large.

In case of new construction, heat exchangers are often installed to utilize heated exhaust air for heating cool/cold supply air in order to decrease the energy losses.

The problems of these previously known heat exchangers are that they are not suitable for retrofitted ventilation air change in housing where a high efficiency as regards the temperature in the air change is desirable and where the inner tube should be oriented in relation to an outer tube or duct.

The Object of the Invention

The object of the invention is to solve these problems by providing an air heat exchanging system in the form of tubular ducts placed in surrounding ducts,

for instance in a way where an inner tube is fitted in an outer tube, and which air heat exchanging system has a relatively high efficiency.

The object is further that the system is formed to be possible to be installed in existing duct systems on natural ventilation buildings or in blocks of flats.

The object is to be able to, in a simple way, retrofit such a heat exchanger system in a building.

The object is further to be able to retrofit such heat exchanger systems inside existing exhaust-air ducts in order not to occupy installation space from attic storeys, storerooms, and cellarages.

The object is to utilize the accumulated energy/temperature in an existing building and ventilating system to equalize cold and warm temperature peaks in the apartments by affecting the supply air temperature through stored temperatures in the chimney of the building and in the framework of the building independently of cold or warm outdoor temperature.

The object is to be able to retrofit such heat exchanger systems in historical and protected buildings of cultural interest without installing bulky equipment and ugly-making tube installations. Such a retrofit affords a possibility of being able to recover old cultural buildings without causing extensive reconstructions.

The object is to be able to give a natural fire protection to buildings by installation inside existing fire cells and duct systems without the installation of complicated and expensive fire equipment.

The object is to be able to give buildings, which takes in polluted cold air through valves at windows in facades facing a street, up to 3 times cleaner, preheated supply air which is taken in above the roof ridge to where air pollution with particles from the exhaust fumes, brakes, and tyres of a vehicle does not reach.

The object is to offer older buildings increased comfort and increased standard using heated supply air which partly is independent of the outer temperature of the air.

The object is to offer older buildings continuous oxygen feed independently of outer temperature.

The object is to be able to present the above advantages by installation inside the original ventilating system of the building.

In addition, in such a system, the object is to be able to, in a simple way, dismount filters and fan units for cleaning and maintenance.

Summary of the Invention

By the present invention, as the same appears in the independent claims, the above-mentioned objects are met wherein said disadvantages have been eliminated. Suitable embodiments of the invention are defined in the dependent claims.

The invention concerns an air heat exchanging system having a primary heat exchanger which recovers heat of the exhaust air from primarily the exhaust air of kitchen, bathroom, and water closet. Upon cooking, extra recovery is afforded when hot fumes of cooking are pressed out through the kitchen fan and heat exchange takes place in a primary heat exchanger of supply air heat. Upon shower activity, extra recovery is afforded when hot water steam is sucked out through the shower valve and heat exchange of supply air heat takes place. Heat recovery is also provided to the apartment by preheated supply air, which, not the least during the winter half, decreases cost of heating and penetration of cold air into the dwelling. In addition, the system according to the invention comprises a secondary heat exchanger which exchanges heat from the total flow from exhaust air to supply air.

More specifically, the invention concerns an air heat exchanging system, for instance for installation in an older natural ventilation house, the system comprising at least two supply air ducts each one of which provided with a respective inlet. Each supply air duct is situated either inside an exhaust-air duct common to at least two supply air ducts and/or inside an exhaust-air duct separate for each supply air duct in the form of a primary heat exchanger, the inlet of each supply air duct being connected to a common supply air distributor, which in turn is connected to an outlet for supply air in a secondary heat exchanger. The secondary heat exchanger is furthermore provided with an inlet for supply air and with an inlet and an outlet for exhaust air. In the secondary heat exchanger, supply air is flowing, in the form of cold outdoor air in to the system, through supply air devices in the form of an outdoor air grille, outdoor air being heated by exhaust air,

in the form of heated indoor air, which is led out from the system through exhaust air devices. The entire secondary heat exchanger is placed in an air volume to which a plurality of exhaust-air ducts of the primary heat exchanger are connected. By such a construction, means of easy access is provided for cleaning and replacement of supply air filters and exhaust air filters by opening a door to the air volume.

In one embodiment of the invention, at least one supply air fan is placed adjacent to said supply air devices/outdoor air grille. This also contributes to an easy handling upon service and maintenance of the fan.

In one embodiment of the invention, at least one exhaust air fan is placed adjacent to said exhaust air devices and/or secondary heat exchanger. Correspondingly, also this contributes to an easy handling upon service and maintenance of the fan.

In one embodiment of the invention, at least two supply air devices are connected to a common supply air collector, which in turn is connected to the inlet of the secondary heat exchanger for supply air. The supply air collector provides a possibility of connecting a plurality of supply air ducts to the same inlet of the secondary heat exchanger.

In one embodiment of the invention, at least two exhaust air devices are connected to a common exhaust air diffuser, which in turn is connected to the outlet of the preheat exchanger for exhaust air. This provides means of varied discharge of exhaust air.

In one embodiment of the invention, the supply air collector and/or the exhaust air diffuser are/is formed with a rectangular cross-section in a vertical plane and are/is horizontally oriented in the system. Such a design and orientation means that the parts thereof of the system can be placed in the mentioned air volume for a compact mounting.

In one embodiment of the invention, all supply air ducts are vertically oriented in an area adjacent to the inlet of the respective duct and the surrounding exhaust-air ducts in said area are also vertically oriented. The orientation means that the system can be installed in existing chimneys for ventilation where the ventilation ducts in the upper part of the chimneys are vertical but a number of which further down in the building deviate from this orientation.

In one embodiment of the invention, said supply air distributor is horizontally oriented in the system. This orientation entails that a number of vertically oriented supply air ducts easily can be connected.

In one embodiment of the invention, said secondary heat exchanger is formed as a cross-type heat exchanger. By this choice of heat exchanger type, an air space is obtained having a defined air volume between the inlet and outlet of the heat exchanger by these being placed on one hand at the top and on the other hand at the bottom in the air volume, which is advantageous to mounting in a chimney having ventilation ducts. A further advantage of this design of air heat exchanging system is that the exhaust air inlet of the secondary heat exchanger is situated in the air volume without being connected to any air duct, which gives a simple installation and an advantageous placing and fitting of an exhaust air filter. Furthermore, the air volume constitutes an existing air volume in an existing duct system.

In one embodiment of the invention, a supply air filter is mounted adjacent to said supply air device/outside grille or supply air fan.

In one embodiment of the invention, an exhaust air filter is mounted between said supply air distributor and said secondary heat exchanger. This location of the filter means that the filter is placed in and can be horizontally oriented in the air volume and cover the horizontal cross-section of the entire air volume.

In one embodiment of the invention, said exhaust-air ducts mouth in an exhaust air volume in which the supply air distributor is mounted and that the exhaust air inlet of the secondary heat exchanger also is situated in said exhaust air volume. This exhaust air volume corresponds to the above mentioned air volume.

In one embodiment of the invention, also the secondary heat exchanger, the supply air collector, and the exhaust air diffuser are situated in said exhaust air volume. This gives a compact installation of the system, for instance in an existing chimney space.

In one embodiment of the invention, the exhaust air volume is limited by a system housing, which is provided with an openable lid. As indicated previously, this constitutes a simple way to offer access to the system for service and maintenance. Preferably, the door is provided with horizontally placed hinges. The

door may in addition be provided with a plurality of part doors for specific access to parts of the system.

In one embodiment of the primary air heat exchanger, an inner tube is cylindrically shaped and fitted in an outer tube, which also is cylindrically shaped and furthermore, the inner tube is placed in a distanced position by means of spacer devices in relation to the outer tube. In previously indicated embodiments, the tubes may have different cross-sections, for instance rectangular, quadratic, or oval. Also a mixture of cross-sections between the inner tube and the outer tube is feasible, for instance a cylindrical inner tube in an outer tube having a rectangular cross-section. For instance, the length Li of the inner tube and the length Ly of the outer tube are equal and that $50My \leq Li \leq 200My$. In case of an outer tube of 125 mm, this implies a length of the heat exchanger between 6,25 m to 25 m. The tubes/ducts have a length of usually 7–25 m. The outer tube may be an existing ventilation duct or be a separate extra tube.

An advantageous installation of the system is that the supply air is taken in horizontally in the duct system and that the exhaust air is discharged vertically from the duct system adjacent to the upper end of the duct system. This installation means that the risk of supply air contaminated by exhaust air is eliminated.

Brief Description of the Drawings

Now, the invention will be described in more detail, references being made in connection with the accompanying drawing figure. The drawing figure is only schematically made to illustrate the invention in the clearest way.

Figure 1 schematically shows a section through an air heat exchanging system according to an embodiment within the scope of the invention.

Description of the Invention

Figure 1 shows an air heat exchanging system 10 fitted in a system housing 101 in the form of a chimney for ventilation. The air heat exchanging system 10 is provided with a number of supply air ducts 11, 12 each one of which is provided with a respective inlet 21, 22. The figure shows six supply air ducts but the number may naturally vary depending on type of installation. The figure shows

a supply air duct 11 situated inside an exhaust-air duct 13 common to two supply air ducts 11. The figure also shows that a supply air duct 12 is mounted inside a separate exhaust-air duct 14. The entire arrangement of supply air ducts 11, 12 and exhaust-air ducts 13, 14 constitute a primary heat exchanger PHX.

Furthermore, the inlet 21, 22 of each supply air duct 11, 12 is connected to a common supply air distributor 31, which is closed but which is connected via an inlet to an outlet 42 for supply air 1 to a secondary heat exchanger SHX. Said secondary heat exchanger SHX is furthermore provided with an inlet 41 for supply air 1 and with an inlet 43 and an outlet 44 for exhaust air 2. To the secondary heat exchanger SHX, supply air 1 is flowing, in the form of cold outdoor air in to the system, through supply air devices 51. The supply air 1 is heated by exhaust air 2, in the form of heated indoor air, which is led out from the system through exhaust air devices 52. In the figure, the supply air is indicated by the numeral "1" while the exhaust air is indicated by the numeral "2" and are placed in the respective air flow. Generally seen, the arrows in the figure indicate the flow directions for the air through the system.

For the supply air flow into the system, three supply air fans 61 are placed adjacent to a respective supply air device 51. In the figure, the supply air devices 51 are shown integrated in a supply air unit but they may alternatively be separated and placed at a distance from each other. The number is adapted according to the supply air flow that is desired.

Correspondingly, three exhaust air fans 62 are placed on the exhaust air side adjacent to three exhaust air devices 52. Also these may be separated so that each exhaust air fan distributes air out through a separate exhaust air device. The arrows of the figure indicate that the exhaust air 2 flows vertically out from the system while the supply air 1 is supplied horizontally to the system from a lateral air-intake 100. This means that dirty exhaust air cannot be resupplied directly into the system.

The figure shows that the three supply air devices 51 are connected to a common supply air collector 53, which in turn is connected to the inlet 41 of the secondary heat exchanger SHX for supply air 1. The supply air collector 53 is oriented horizontally in the system housing 101 with a smaller vertical extension than a horizontal extension. By this orientation, an exhaust air volume 91 is provided below the supply air collector 53. Between the supply air devices 51 and

the supply air collector 53, a supply air filter 71 is mounted. The same supply air filter may, for instance, be adapted to minimize/eliminate that pollen, particles, etc. pass the filter. The exhaust-air ducts 13, 14 ends in the exhaust air volume 91 in which the supply air distributor 31 is mounted. The exhaust air inlet 43 of the secondary heat exchanger SHX is also situated in the exhaust air volume 91. Furthermore, also the secondary heat exchanger SHX, the supply air collector 53, and the exhaust air diffuser 54 are situated in the exhaust air volume 91.

Also the supply air distributor 31 is oriented horizontally in the system housing 101 with a smaller vertical extension than a horizontal extension. By this orientation, a limitation of the exhaust air volume 91 is provided between the supply air collector 53 and the supply air distributor 31.

Thus, the supply air collector 53 and/or the exhaust air diffuser 54 are/is formed with a rectangular cross-section in a vertical plane and are/is horizontally oriented in the system.

For the supply air 1, the secondary heat exchanger SHX is connected with the inlet 41 thereof to the supply air collector 53 and with the outlet 42 thereof to the supply air distributor 31. Through the secondary heat exchanger SHX, exhaust air 2 is flowing in through the inlet 43 and out through the outlet 44. The inlet 43 consists of a free opening in the heat exchanger so that exhaust air in the entire air volume 91 could flow into the heat exchanger. By the fact that the secondary heat exchanger SHX is formed as a cross-type heat exchanger, the mentioned air volume is obtained because the supply air connections 41, 42 of the cross-type heat exchanger are situated at a vertical distance from each other and the fact that the exhaust air connections 43, 44 of the cross-type heat exchanger also are situated at a vertical distance from each other.

By the fact that all supply air ducts 11, 12 are vertically oriented in an area adjacent to the inlet 21, 22 of the respective duct and that the surrounding exhaust-air ducts 13, 14 in said area also are vertically oriented, this arrangement can define the primary heat exchanger PHX.

An exhaust air filter 81 is mounted between the supply air distributor 31 and the secondary heat exchanger SHX so as to, as far as possible, eliminate discharge of contaminated particles and substances. The exhaust air filter 81 is horizontally oriented in the air volume and connects against the limiting walls of the air volume which are the vertical walls of the system housing 101. This

mounting of the exhaust air filter means that the collected volume of exhaust air from the primary heat exchanger PHX will pass the filter.

The primary heat exchanger PHX is formed with an inner cylindrical tube situated either inside an outer, preferably cylindrical, tube or inside an outer duct in a distanced position by means of spacer devices. The spacer devices aim at holding the inner tube at a distance from the outer tube/duct to obtain an optimum heat transfer between the two tubes and thereby an optimum heat exchange.

The entire air heat exchanging system 10, including the exhaust air volume 91, is contained in the system housing 101, which is provided with an openable lid 102. By this lid, service and filter change can simply be carried out.

CLAIMS

1. Air heat exchanging system (10), for instance for installation in an older natural ventilation house, the system comprising at least two supply air ducts (11, 12) each one of which provided with a respective inlet (21, 22), that each supply air duct (11, 12) is situated inside an exhaust-air duct (13) common to at least two supply air ducts (11, 12) and/or inside an exhaust-air duct (14) separate for each supply air duct (11, 12) in the form of a primary heat exchanger (PHX), the inlet (21, 22) of each supply air duct (11, 12) being connected to a common supply air distributor (31), which in turn is connected to an outlet (42) for supply air (1) in a secondary heat exchanger (SHX), which furthermore is provided with an inlet (41) for supply air (1) and with an inlet (43) and an outlet (44) for exhaust air (2), in which secondary heat exchanger (SHX) supply air (1), in the form of cold outdoor air, inflowing to the system, through a supply air device (51) placed in the upper part of a system housing (101) passes the secondary heat exchanger (SHX) in which the supply air (1) is heated by outflowing exhaust air (2), in the form of heated indoor air, which is led out from the system through an exhaust air device (52) placed in the upper part of a system housing (101), **characterized in** that said exhaust-air ducts (13, 14) mouth in an exhaust air volume (91) in which the supply air distributor (31) is mounted, and that the exhaust air inlet (43) of the secondary heat exchanger (SHX) also is situated in said exhaust air volume (91).

2. Air heat exchanging system according to claim 1, **characterized in** that at least one supply air fan (61) is placed adjacent to said supply air device (51).

3. Air heat exchanging system according to any one of claims 1–2, **characterized in** that at least one exhaust air fan (62) is placed adjacent to said exhaust air device (52).

4. Air heat exchanging system according to any one of claims 1–3, **characterized in** that at least two supply air devices (51) are connected to a common supply air collector (53), which in turn is connected to the inlet (41) of the secondary heat exchanger (SHX) for supply air (1).

5. Air heat exchanging system according to claim 4, **characterized in** that the supply air collector (53) is formed with a rectangular cross-section in a vertical plane and is horizontally oriented in the system.

6. Air heat exchanging system according to any one of claims 1–5, **characterized in** that at least two exhaust air devices (52) are connected to a common exhaust air diffuser (54), which in turn is connected to the outlet (44) of the secondary heat exchanger for exhaust air (2).

7. Air heat exchanging system according to claim 6, **characterized in** that the exhaust air diffuser (54) is formed with a rectangular cross-section in a vertical plane and is horizontally oriented in the system.

8. Air heat exchanging system according to any one of claims 1–7, **characterized in** that all supply air ducts (11, 12) are vertically oriented in an area adjacent to the inlet (21, 22) of the respective duct and that the surrounding exhaust-air ducts (13, 14) in said area also are vertically oriented.

9. Air heat exchanging system according to any one of claims 1–8, **characterized in** that said supply air distributor (31) is horizontally oriented in the system.

10. Air heat exchanging system according to any one of claims 1–9, **characterized in** that said secondary heat exchanger (SHX) is formed as a cross-type heat exchanger.

11. Air heat exchanging system according to any one of claims 1–10, **characterized in** that a supply air filter (71) is mounted adjacent to said supply air device (51).

12. Air heat exchanging system according to any one of claims 1–11, **characterized in** that an exhaust air filter (81) is mounted between said supply air distributor (31) and said secondary heat exchanger (SHX).

13. Air heat exchanging system according to claim 1, **characterized in** that also the secondary heat exchanger (SHX), a supply air collector (53), and an exhaust air diffuser (54) are situated in said exhaust air volume (91).

14. Air heat exchanging system according to any one of claims 1 or 13, **characterized in** that the exhaust air volume (91) is limited by a system housing (101), which is provided with an openable lid (102).

15. Air heat exchanging system according to any one of claims 1–14, **characterized in** that said primary heat exchanger (PHX) is formed with an inner cylindrical tube situated either inside an outer, preferably cylindrical, tube or inside an outer duct in a distanced position by means of spacer devices.

16. Air heat exchanging system according to any one of claims 1–15, **characterized in** that the exhaust air devices (52) are arranged in such a way that the exhaust air (2) flows vertically out from the system while the supply air (1) is supplied horizontally to the system from a lateral air-intake 100.

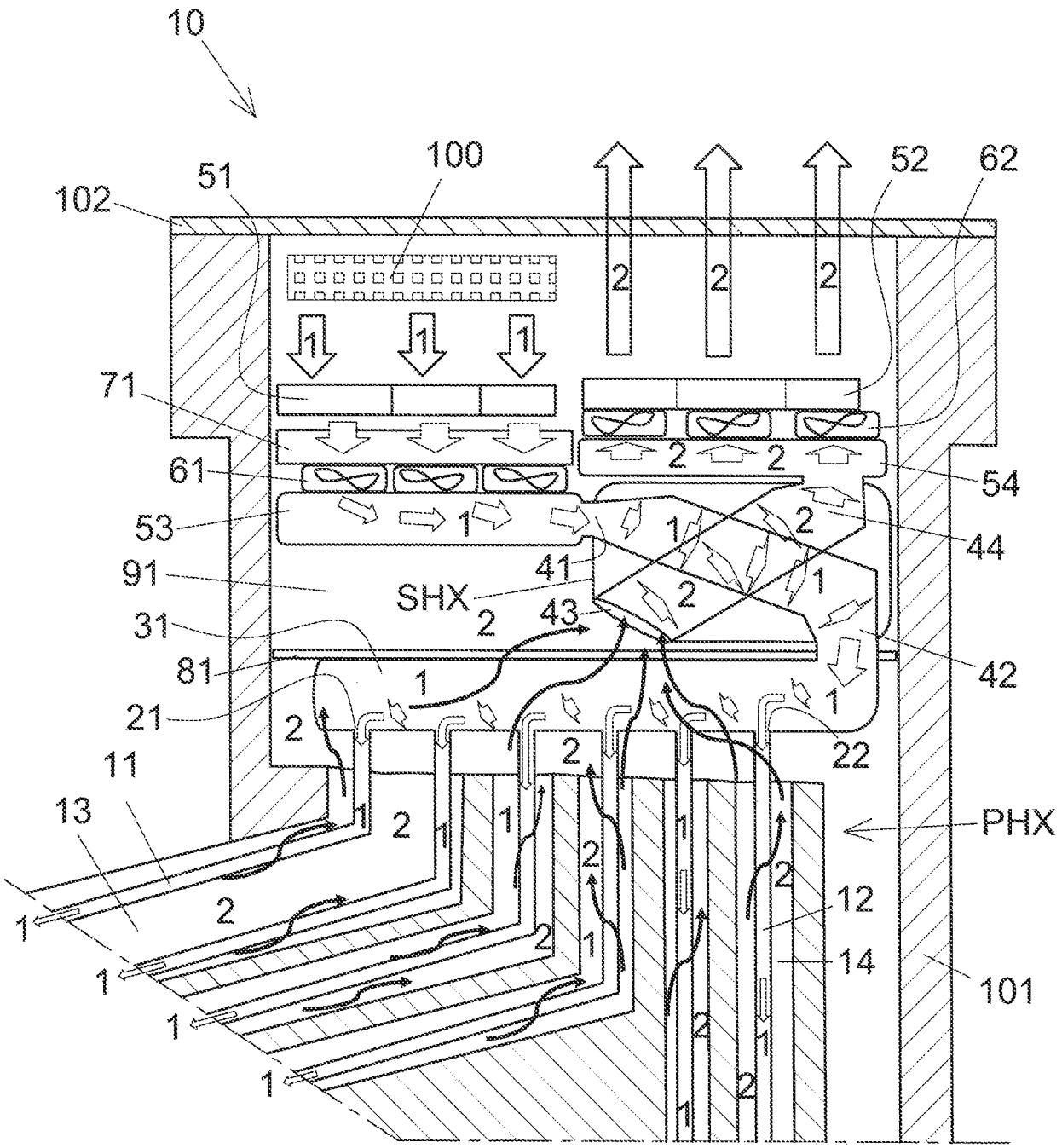
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Fig 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2018/051125

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: F24F, F28D

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 4134305 A1 (DREHER EDUARD), 22 April 1993 (1993-04-22); abstract; column 3, line 68 - column 4, line 69; column 5, line 14 - line 32; figures; claims 1,3-5,8-10 --	1-16
A	FR 2944340 A1 (IOSIS CONCEPT), 15 October 2010 (2010-10-15); abstract; paragraphs [0024], [0031], [0035]-[0038], [0047]; figures; claims 1,9 --	1-16
A	EP 1184627 A1 (GASTEC NV), 6 March 2002 (2002-03-06); abstract; figure 1 --	1-16

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
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Date of the actual completion of the international search	Date of mailing of the international search report
16-01-2019	17-01-2019

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2018/051125

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 3640347 A1 (SCHOENHAMMER JOHANN), 9 June 1988 (1988-06-09); abstract; figures --	1-16
A	US 20110223848 A1 (LIPINSKI THOMAS), 15 September 2011 (2011-09-15); abstract; paragraphs [0024], [0047]; figures --	1-16
A	US 4993484 A (NEUZIL JACK E), 19 February 1991 (1991-02-19); abstract; column 2, line 29 - line 68; figures --	1-16
A	EP 2792961 A1 (HUSLER PETER), 22 October 2014 (2014-10-22); abstract; figures; claim 1 -- --------	1-16

International application No.
PCT/SE2018/051125

Continuation of: second sheet

International Patent Classification (IPC)

F24F 12/00 (2006.01)
F28D 7/10 (2006.01)

DE	4134305	A1	22/04/1993	NONE			
FR	2944340	A1	15/10/2010	NONE			
EP	1184627	A1	06/03/2002	NL	1016063	C2	01/03/2002
DE	3640347	A1	09/06/1988	NONE			
US	20110223848	A1	15/09/2011	EP	2369254	A3	21/11/2012
				GB	2474529	B	21/09/2011
				US	9151512	B2	06/10/2015
US	4993484	A	19/02/1991	NONE			
EP	2792961	A1	22/10/2014	NONE			