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(54) Benævnelse: **Fluid supply system**

(56) Fremdragne publikationer:
DE 3240343 A1
JP 63105354 A
AU 2015200017 B1
JP 074677 A

(57) Sammendrag:
The invention relates to a fluid supply system comprising a district hot fluid supply line (2), a district fluid return line (3), a district cold fluid supply line (4), at least one local hot fluid line (9, 10), at least one heat exchanger (5, 6) and a hot fluid pump (21). The at least one heat exchanger (5, 6) comprises a primary side (11) that is connected at a primary inlet (13) to the district hot fluid supply line (2) and at a primary outlet to the district fluid return line (3). The at least one heat exchanger (5, 6) comprises a secondary side (12) that is connected at a secondary inlet (16) to the district cold fluid supply line (4) and at a secondary outlet (17) to the local hot fluid line (9, 10). The at least one local hot fluid line (9, 10) is connected to at least one local fluid tapping unit (7, 8) to supply heated fluid from the secondary outlet (17) of the connected heat exchanger (5, 6). The hot fluid pump (21) is activated if a need for hot fluid is detected. Task of the invention is to provide a simplified and less expensive fluid supply system for multiple consumers. The above task is solved in that each heat exchanger (5, 6) is connected at its respective primary inlet (13) to the district hot fluid supply line (2), at its respective primary outlet (14) to the district fluid return line (3), at its respective secondary inlet (16) to the district cold fluid supply line (4) and at its respective secondary outlet (17) each to a different local hot fluid line (9, 10), wherein the hot fluid pump (21) is arranged in the district hot fluid supply line (2) providing hot fluid to all connected heat exchanger (5, 6) and wherein the hot fluid pump (21) is activated if fluid is tapped at anyone of the local fluid tapping units (7, 8).

Fortsættes ...

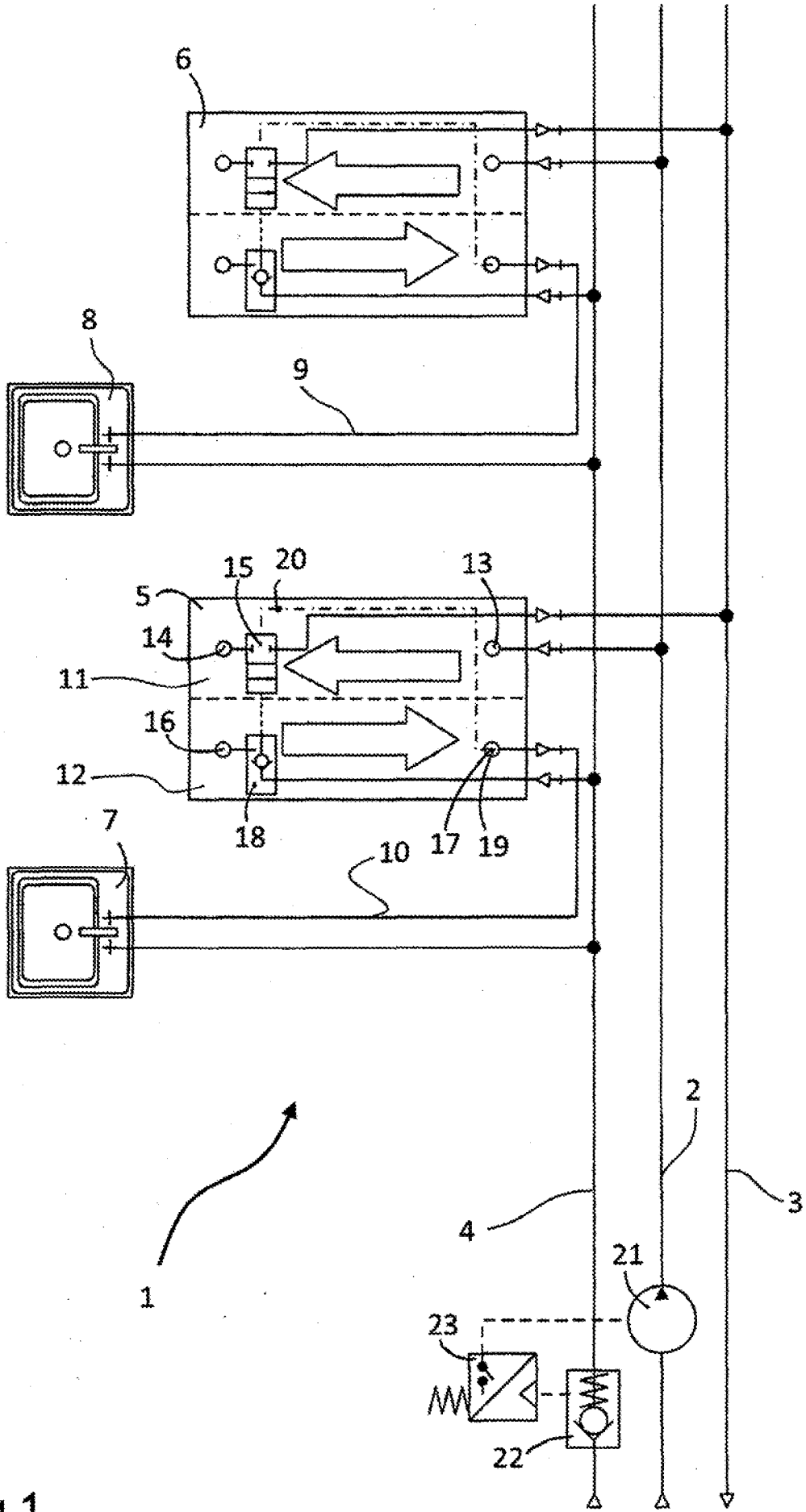

Fig.1

Fluid supply system

The invention relates to a fluid supply system comprising a district hot fluid supply line, a district fluid return line, a district cold fluid supply line, at least one local hot fluid line, at least one heat exchanger and a hot fluid pump, wherein at least one heat exchanger comprises a primary side that is connected at a primary inlet to the district hot fluid supply line and at a primary outlet to the district fluid return line, and wherein the at least one heat exchanger comprises a secondary side that is connected at a secondary inlet to the district cold fluid supply line and at a secondary outlet to the local hot fluid line, and wherein the at least one local hot fluid line is connected to at least one local fluid tapping unit to supply heated fluid from the secondary outlet of the connected heat exchanger, and wherein the hot fluid pump is activated if a need for hot fluid is detected.

For the scope of this application the fluid may be water in particular in the local hot fluid line and the district cold fluid line or in all fluid lines. For the district hot fluid line and the district fluid return line the fluid may alternatively be water steam, decalcified water or a suitable alternative.

A water supply system of the above kind is for example known from EP 1 342 957 A1. Therein the hot water pump is arranged downstream of the secondary outlet of the heat exchanger in the local hot water line. A flow

sensor in the hot water line detects if hot water is dispensed at a local water tapping unit connected to the local hot water line.

This solution is advantageous for a single consumer (e.g. a single house connected to a district hot water supply line remote from other connected consumers). However, in case multiple consumers in close vicinity (e.g. in a development area) are to be connected to the district hot water supply line the above solution is relatively expensive and complicated.

The task of the present invention is therefore to provide a fluid supply system that simplifies installation and maintenance.

According to the present invention the above task is solved in that each heat exchanger is connected at its respective primary inlet to the district hot fluid supply line, at its respective primary outlet to the district fluid return line, at its respective secondary inlet to the district cold fluid supply line and at its respective secondary outlet each to a corresponding local hot fluid line, wherein the hot fluid pump is arranged in the district hot fluid supply line providing hot fluid to all connected heat exchangers, and wherein the hot fluid pump is activated if fluid is tapped at one of the local fluid tapping units.

With this solution each heat exchanger can, for example, be associated with an apartment in a multi-apartment building or with a single household building. Only one hot fluid pump is necessary to supply one or more heat exchangers which simplifies installation and maintenance and consequently reduces costs. Furthermore, adding an additional consumer to an existing fluid supply system is simplified in particular since no additional pump is required. Furthermore, the solution reduces energy loss due to heat dissipation, reduces the time necessary to reach the desired temperature of the fluid at the local fluid tapping units and reduces the risk of bacteria (e.g. legionella) spreading in the system.

The at least one local fluid tapping unit may also be connected to the district cold fluid supply line.

In an embodiment the fluid is water. Consequently, the fluid supply system may be a water supply system. The district hot fluid supply line may be a district hot water supply line. The district fluid return line may be a district water return line. The district cold fluid supply line may be a district cold water supply line. The at least one local hot fluid line may be at least one local hot water line. The hot fluid pump may be a hot water pump.

In an embodiment the fluid supply system comprises two or more heat exchangers, wherein each heat exchanger is connected at its respective secondary outlet to a different local hot fluid line.

A main sensor may be arranged in the district cold fluid supply line to detect if fluid is tapped at one of the local fluid tapping units. If the main sensor detects that fluid is tapped in one of the local fluid tapping units it may then provide a signal to a control unit. The control unit may then send a activation signal to the hot fluid pump. The main sensor may also send the activation signal directly to the hot fluid pump.

In an embodiment of the invention the fluid supply system comprises a main check valve that is arranged in the district cold fluid supply line, wherein the sensor detects the opening of the main check valve, and wherein the main check valve is normally closed and opens if the fluid pressure downstream the main check valve drops in response to fluid being tapped at one of the connected local fluid tapping units. This solution is relatively simple since the main check valve may be purely pressure controlled without the need of an actuator. The main sensor may in this embodiment be connected to the main check valve to detect if the main check valve is in an open position. If the

main sensor detects a change in opening position of the main check valve will then communicate this to the control unit which may in turn start the hot fluid pump. Alternatively, the main sensor may directly signal the hot fluid pump to activate.

A local check valve may be arranged at the secondary side of each heat exchanger, wherein the local check valve is normally closed and opens if the fluid pressure at the corresponding secondary outlet drops in response to fluid being tapped at at least one connected local fluid tapping unit. The local check valve may be purely pressure controlled. This embodiment has the advantage that in principle no connection of the local check valve to the control unit is necessary.

In an embodiment at least one local check valve is arranged at a secondary inlet.

In an embodiment the local check valve only opens in response to fluid being drawn from the local hot fluid line. In this embodiment the local hot fluid line leading to the connected local fluid tapping units is kept separate from the connection of the local fluid tapping unit to the district cold fluid supply line to avoid a pressure drop at the secondary side which may lead to an opening of the local check valve.

In an embodiment a restrictor valve is arranged at the primary side of each heat exchanger to allow or restrict a flow of hot fluid through the primary side of the heat exchanger. This way, it is ensured that the primary side of an inactive heat exchanger is not heated up if a different heat exchanger of the fluid supply system is being activated.

In an embodiment at least one restrictor valve is arranged at the primary outlet.

In an embodiment at least one local check valve is mechanically connected to the restrictor valve arranged at the same heat exchanger. The mechanical connection may be facilitated by a pin translating a change in valve position of the local check valve to a change in valve position of the restrictor valve in the same heat exchanger. The pin may be connected to both valve elements of the local check valve and the restrictor valve. This embodiment has the advantage that both the local check valve and the restrictor valve may be purely pressure controlled which reduces costs of the individual heat exchanger unit.

In an embodiment the restrictor valve is automatically opened if the connected local check valve opens. A simple way to facilitate this functionality is to mechanically connect the restrictor valve to the at least one local check valve in the same heat exchanger. Alternatively, the restrictor valve may be actuated by an actuator to be opened when it is detected that the local check valve has opened.

In an embodiment at least one restrictor valve is a thermostatic valve comprising a thermostatic actuator to control the flow of hot fluid through the primary side of the heat exchanger. This embodiment has the advantage that the flow of hot fluid through the primary side of the heat exchanger can be more exactly regulated. This is advantageous, for example, if the heat exchanger supplies a multitude of connected local fluid tapping units. In this case, the amount of flow of hot fluid through the heat exchanger can be limited, for example, if only one of a plurality of connected local fluid tapping units requires hot fluid. The thermostatic valve in this case can be controlled by the control unit. The control unit here may be a local control unit associated with the heat exchanger (i.e. with the connected consumer).

In an embodiment at least one secondary sensor is arranged at the secondary side of the at least one heat exchanger to detect the flow of fluid towards the local hot fluid line. The amount of flow detected by the secondary sensor can then be provided to the control unit. Based on the detected flow by the secondary sensor the control unit can then send a control signal to the restrictor valve. Preferably, the secondary sensor is arranged at the secondary outlet.

In an embodiment the control unit limits the opening degree of the restrictor valve according to the amount of flow detected by the secondary sensor in the same heat exchanger.

A preferred embodiment of the invention is now described with reference to the figure wherein:

Fig. 1 shows a fluid supply system according to a preferred embodiment of the invention.

Fig. 1 shows a fluid supply system 1 comprising a district hot fluid supply line 2, a district fluid return line 3 and a district cold fluid supply line 4. The fluid supply system 1 furthermore comprises in this case two heat exchangers 5, 6. Each heat exchanger 5, 6 may be associated, for example, with an apartment in a multi-apartment building or with a single household building each. The fluid supply system 1 may also comprise a multitude of heat exchangers 5, 6.

Each heat exchanger 5, 6 provides at least one local fluid tapping unit 7, 8. Each heat exchanger 5, 6 may however supply a multitude of local fluid tapping units 7, 8. The local fluid tapping units 7, 8 are connected to their respective heat exchanger 5, 6 via a local hot fluid line 9, 10. Each heat exchanger 5, 6 comprises a primary side 11 and a secondary side 12. The

primary side 11 is connected to the district hot fluid supply line 2 at a primary inlet 13. The hot fluid from the district hot fluid supply line 2 flows through the primary side 11 until it exits a primary outlet 14. At the primary side 11 the heat exchanger 5 furthermore comprises a restrictor valve 15 which is in this embodiment arranged downstream of the primary outlet 14.

At the secondary side 12 of the heat exchanger 5, 6 cold fluid from the district cold fluid supply line 4 enters through a secondary inlet 16. When the heat exchanger 5, 6 is active the cold fluid flowing through the secondary side 12 is heated up by the hot fluid flowing through the primary side 11. The heated up fluid at the secondary side 12 then exits at a secondary outlet 17. The secondary outlet 17 is connected to the local hot fluid line 9, 10.

At the secondary side 12 of the heat exchanger 5 furthermore a local check valve 18 is arranged. The local check valve 18 is normally closed an opens if the fluid pressure at the secondary outlet 17 drops in response to fluid being tapped at the connected local fluid tapping unit 7. The local check valve 18 can be connected mechanically to the restrictor valve 15 such that if the local check valve 18 opens the restrictor valve will also be opened.

Alternatively, the restrictor valve 15 can be a thermostatic valve comprising a thermostatic actuator to control the flow of hot fluid through the primary side 11 of the heat exchanger 5. In this case the fluid supply system 1 advantageously comprises a secondary sensor 19 to detect the amount of flow through the secondary side 12. The secondary sensor 19 is here depicted as being located at the secondary outlet 17. A signal from the secondary sensor 19 can then be provided to the thermostatic actuator 20 to change the opening degree of the restrictor valve 15 to control the amount of flow of hot fluid through the primary side 11. The signal may also be provided to a local or central control unit which may control the restrictor valve(s) 15 and/or the hot fluid pump described below.

The fluid supply system 1 comprises a hot fluid pump 21 which is arranged in the district hot fluid supply line 2. If no fluid is being tapped from the local fluid tapping units 7, 8 the hot fluid pump 21 will be inactive. In the district cold fluid supply line 4 a main check valve 22 is arranged. The main check valve 22 opens in response to a drop in pressure downstream of the main check valve 22 due to fluid being drawn from one of the connected local fluid tapping units 7, 8.

Furthermore, the fluid supply system 1 comprises a sensor 23 which detects a change in valve position of the main check valve 22. When such a change to an open valve position of the main check valve 22 is detected by the sensor 23 an activation signal is sent to the hot fluid pump 21. This activation signal may be send by a central control unit. At the same time in the heat exchanger 5, 6 connected to the local fluid tapping unit 7, 8 that has been activated the local check valve 18 will also change the valve position and similarly the restrictor valve 15 in the same heat exchanger 5, 6. Thereby, the heating up of cold fluid flowing through the secondary side 12 by the hot fluid flowing through the primary side 11 will be facilitated such that hot fluid can be supplied through the local hot fluid line 9, 10 connected to the active local fluid tapping unit 7, 8.

The fluid in the above described embodiment may be water, decalcified water, water steam or a suitable alternative fluid. The district hot fluid supply line and the district fluid return line may use a different fluid than the other fluid lines since the district hot fluid supply line and the district fluid return line may form a closed circuit.

Claims

1. Fluid supply system (1) comprising a district hot fluid supply line (2), a district fluid return line (3), a district cold fluid supply line (4), at least one local hot fluid line (9, 10), at least one heat exchanger (5, 6) and a hot fluid pump (21), wherein the at least one heat exchanger (5, 6) comprises a primary side (11) that is connected at a primary inlet (13) to the district hot fluid supply line (2) and at a primary outlet to the district fluid return line (3), and wherein the at least one heat exchanger (5, 6) comprises a secondary side (12) that is connected at a secondary inlet (16) to the district cold fluid supply line (4) and at a secondary outlet (17) to the local hot fluid line (9, 10), and wherein the at least one local hot fluid line (9, 10) is connected to at least one local fluid tapping unit (7, 8) to supply heated fluid from the secondary outlet (17) of the connected heat exchanger (5, 6), and and wherein the hot fluid pump (21) is activated if a need for hot fluid is detected, characterized in that each heat exchanger (5, 6) is connected at its respective primary inlet (13) to the district hot fluid supply line (2), at its respective primary outlet (14) to the district fluid return line (3), at its respective secondary inlet (16) to the district cold

fluid supply line (4) and at its respective secondary outlet (17) each to a corresponding local hot fluid line (9, 10), wherein the hot fluid pump (21) is arranged in the district hot fluid supply line (2) providing hot fluid to all connected heat exchangers (5, 6), and wherein the hot fluid pump (21) is activated if fluid is tapped at one of the fluid tapping units (7, 8).

2. Fluid supply system (1) according to claim 1, characterized in that the fluid is water.

3. Fluid supply system (1) according to claim 1 or 2, characterized in that the fluid supply system (1) comprises two or more heat exchangers (5, 6), wherein each heat exchanger (5, 6) is connected at the respective secondary outlet to a different local hot fluid line (9, 10).

4. Fluid supply system (1) according to any of claims 1 to 3, characterized in that a main sensor (23) is arranged in the district cold fluid supply line (4) to detect if fluid is tapped at one of the fluid tapping units (7, 8).

5. Fluid supply system (1) according to claim 4, characterized in that the fluid supply system (1) comprises a main check valve (22) that is arranged in the district cold fluid supply line (4), wherein the main sensor (23) detects the opening of the main check valve (22), and wherein the main check valve (22) is normally closed and opens if the fluid pressure downstream the main check valve (22) drops in response to fluid being tapped at one of the connected local fluid tapping units (7, 8).

6. Fluid supply system (1) according to any of claim 1 to 5, characterized in that a local check valve (18) is arranged at the secondary side (12) of each heat exchanger (5, 6), wherein the local check valve (18) is normally closed and opens if the fluid pressure at the corresponding secondary outlet (12) drops in response to water being tapped at at least one connected local fluid tapping unit (7, 8).

7. Fluid supply system (1) according to claim 6, characterized in that at least one local check valve (18) is arranged at a secondary inlet (16).

8. Fluid supply system (1) according to claim 6 or 7, characterized in that the local check valve (18) only opens in response to fluid being drawn from the connected local hot fluid line (9, 10).

9. Fluid supply system (1) according to any of claims 1 to 8, characterized in that a restrictor valve (15) is arranged at the primary side (11) of each heat exchanger (5, 6) to allow or restrict a flow of hot fluid through the primary side (11) of the heat exchanger (5, 6).

10. Fluid supply system (1) according to claim 9, characterized in that at least one restrictor valve (15) is arranged at the primary outlet (14).

11. Fluid supply system (1) according to claim 9 or 10, characterized in that at least one local check valve (18) is mechanically connected to the restrictor valve (15) arranged in the same heat exchanger (5, 6).

12. Fluid supply system (1) according to any of claims 9 to 11, characterized in that the restrictor valve (15) is automatically opened if the connected local check valve (18) opens.

13. Fluid supply system (1) according to any of claims 9 to 12, characterized in that at least one restrictor valve (15) is a thermostatic valve comprising a thermostatic actuator (20) to control the flow of hot fluid through the primary side (11) of the heat exchanger (5, 6).

14. Fluid supply system (1) according to any of claims 1 to 13, characterized in that at least one secondary sensor (19) is arranged at the secondary side (12) of the at least one heat exchanger (5, 6) to detect the flow of fluid towards the local hot fluid line (9, 10).

15. Fluid supply system (1) according to claim 14, characterized in that the opening degree of the restrictor valve (15) is limited according to the amount of flow detected by the secondary sensor (19) in the same heat exchanger (5, 6).

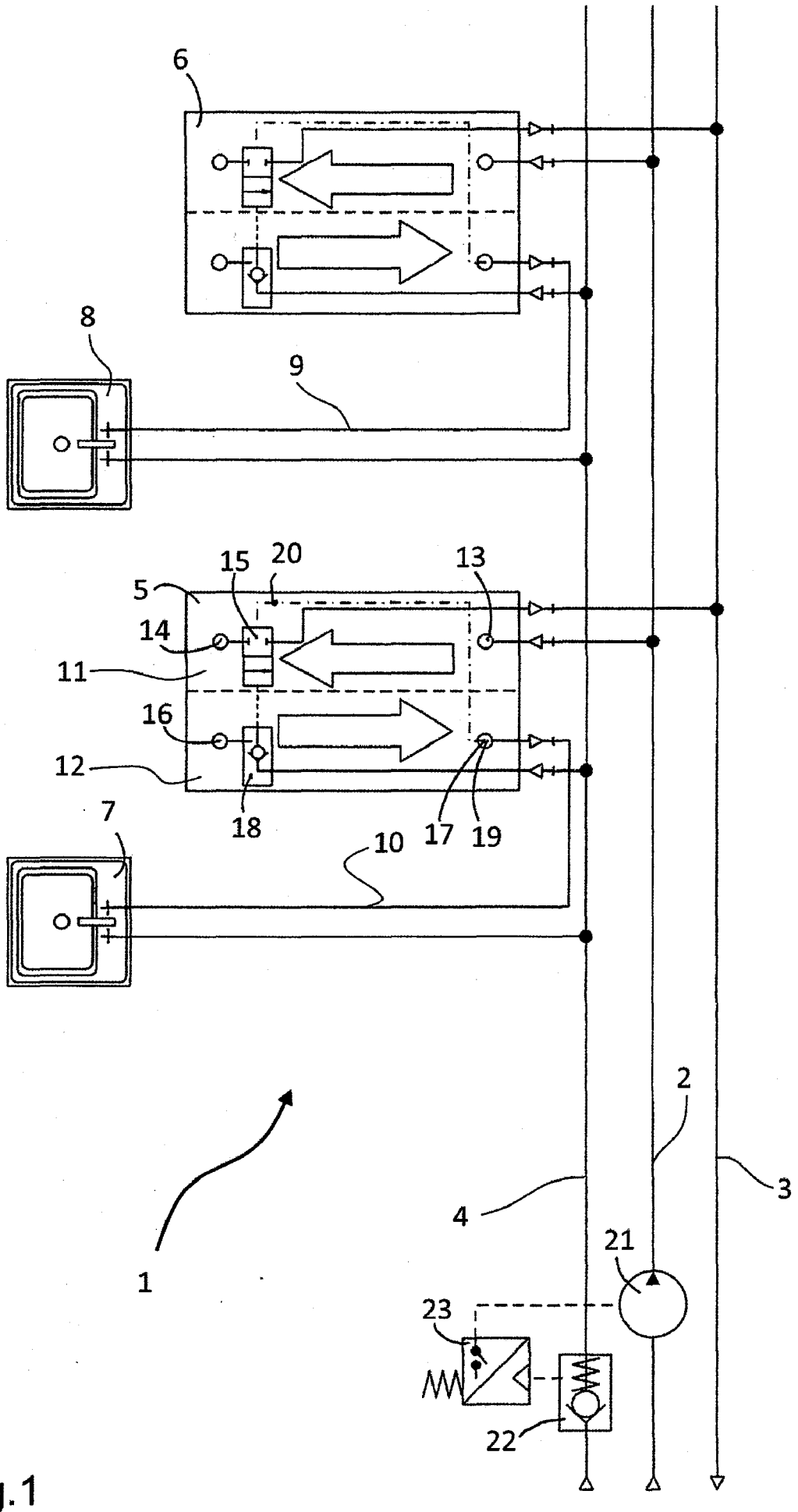

Fig.1

DANISH PATENT AND TRADEMARK OFFICE

SEARCH REPORT - PATENT	Application No. PA 2016 00529

1. ☐ Certain claims were found unsearchable (See Box No. I).

2. ☐ Unity of invention is lacking prior to search (See Box No. II).

A. CLASSIFICATION OF SUBJECT MATTER

F 24 D 17/00 (2006.01)

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&CPC: F24D

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

DK, NO, SE, FI: IPC-classes as above.

Electronic database consulted during the search (name of database and, where practicable, search terms used)

EPODOC, WPI, FULL TEXT: ENGLISH, GERMAN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant for claim No.
X; Y; A	DE 3240343 A1 (STRELOW et al.) 03 May 1984. See pages 3-6, Fig. 4 and Fig. 5.	1-3; 4; 5-15
X	JPS 63105354 A (AGENCY IND SCIENCE TECHN) 10 May 1988. See English abstract and figure.	1-3

☒ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:	"P" Document published prior to the filing date but later than the priority date claimed.
"A" Document defining the general state of the art which is not considered to be of particular relevance.	"T" Document not in conflict with the application but cited to understand the principle or theory underlying the invention.
"D" Document cited in the application.	"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.
"E" Earlier application or patent but published on or after the filing date.	"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.
"L" Document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified).	"&" Document member of the same patent family.
"O" Document referring to an oral disclosure, use, exhibition or other means.	

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15 March 2017

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SEARCH REPORT - PATENT		Application No. PA 2016 00529
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant for claim No.
Y	AU 2015200017 B1 (RINNAI KK) 03 December 2015. See especially abstract, page 6, lines 15- 25, Fig. 1 and Fig. 2	4
A	JPH 074677 A (MARUYAMA NOBORU) 10 January 1995. See English abstract, Fig 1 and Fig. 8.	1

SEARCH REPORT - PATENT	Application No. PA 2016 00529

Box No. I Observations where certain claims were found unsearchable

This search report has not been established in respect of certain claims for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched, namely:

2. ☐ Claims Nos.:
because they relate to parts of the patent application that do not comply with the prescribed requirements to such an extent that no meaningful search can be carried out, specifically:

3. ☐ Claims Nos.:
because of other matters.

Box No. II Observations where unity of invention is lacking prior to the search

The Danish Patent and Trademark Office found multiple inventions in this patent application, as follows:

SEARCH REPORT - PATENT	Application No. PA 2016 00529

SUPPLEMENTAL BOX

Continuation of Box [.]