

(19)



(11)

**EP 4 542 137 A2**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**23.04.2025 Bulletin 2025/17**

(51) International Patent Classification (IPC):  
**F25B 13/00 (2006.01)**

(21) Application number: **24202709.2**

(52) Cooperative Patent Classification (CPC):  
**F25B 13/00**

(22) Date of filing: **25.09.2024**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA**  
Designated Validation States:  
**GE KH MA MD TN**

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(30) Priority: **28.09.2023 CN 202311279662**

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(54) **MULTI-SPLIT AIR CONDITIONER OUTDOOR UNIT, INSTALLATION METHOD, AND AIR CONDITIONING SYSTEM**

(57) There is provided a multi-split air conditioner outdoor unit, an installation method of the multi-split air conditioner outdoor unit, and an air conditioning system. By adding a manifold and a switching device at a specific position, or adding a manifold and a valve at a specific position, the multi-split air conditioner outdoor unit can be

used commonly in three-pipe and two-pipe air conditioning systems, and a problem of needing to design and produce two or more different multi-split air conditioner outdoor units to be respectively applied to a three-pipe multi-split air conditioning system and a two-pipe multi-split air conditioning system is solved.

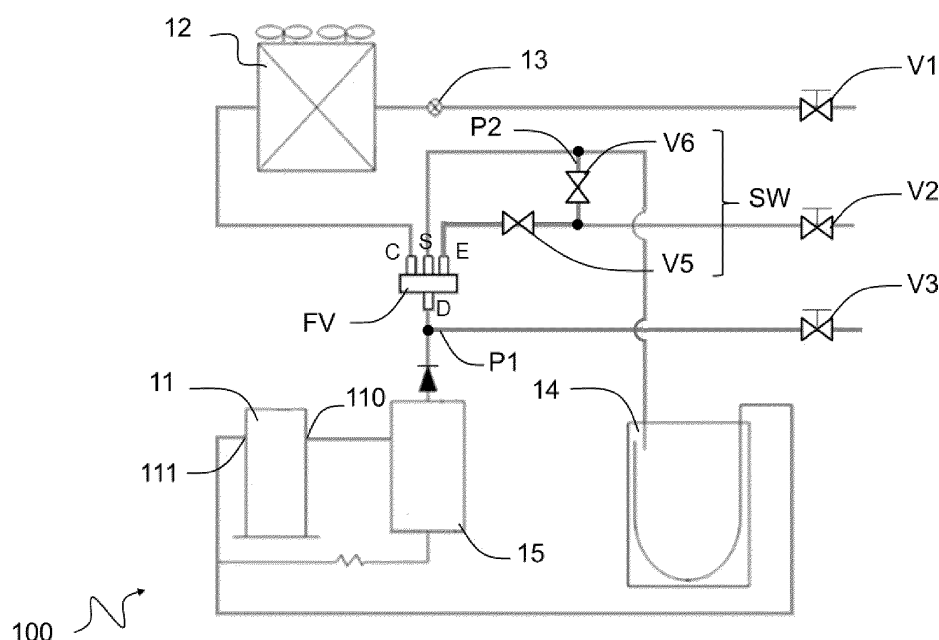


FIG. 1

## Description

### Technical Field

[0001] The present invention relates to the field of air conditioners, and particularly relates to a multi-split air conditioner outdoor unit, an installation method, and an air conditioning system.

### Background Art

[0002] A three-pipe heat recovery multi-split air conditioning system is a multi-split air conditioning system in which three refrigerant pipes are used to connect an outdoor unit and an indoor unit. Specifically, in addition to a liquid pipe and an air pipe used in a standard multi-split system, a high-pressure air pipe is added as the refrigerant pipe, so that it is possible to achieve a function of simultaneously cooling and heating by the indoor unit in the same system, to achieve a purpose of more accurate temperature and humidity control, and to achieve dehumidification without cooling.

[0003] The outdoor unit of the three-pipe heat recovery multi-split air conditioning system usually has a connection method, part selection, copper pipe connection, and the like that are different from those of a two-pipe standard multi-split system. Therefore, manufacturers need to design and produce a three-pipe outdoor unit and a two-pipe outdoor unit different from each other, which are used according to different application modes of multi-split air conditioning systems and cannot be interchanged.

### Summary of the Invention

[0004] The present invention aims to provide a multi-split air conditioner outdoor unit, an installation method for the multi-split air conditioner outdoor unit, and an air conditioning system, so that the multi-split air conditioner outdoor unit can be used commonly in three-pipe and two-pipe multi-split air conditioning systems, and a problem of needing to design and produce two or more different multi-split air conditioner outdoor units to be respectively applied to the three-pipe multi-split air conditioning system and the two-pipe multi-split air conditioning system is solved.

[0005] A first aspect provides a multi-split air conditioner outdoor unit, including: a compressor; an outdoor heat exchanger; an outdoor expansion valve; a four-way valve; a first valve; and a second valve. The four-way valve includes a first port, a second port, a third port, and a fourth port, the first port is connected to a discharge port of the compressor, the second port is connected to the outdoor heat exchanger, the outdoor expansion valve, and the first valve in sequence, and the third port is connected to a suction port of the compressor. The four-way valve is capable of being switched to connect the first port to the second port and connect the third port

to the fourth port, or switched to connect the first port to the fourth port and connect the second port to the third port. The multi-split air conditioner outdoor unit further includes: a first manifold; a second manifold; a third valve; and a switching device. The first manifold is connected between the discharge port of the compressor and the first port, the third valve is disposed in the first manifold, the second manifold is connected between the suction port of the compressor and the third port, and the switching device is connected to the second manifold, the fourth port, and the second valve, and capable of being switched between a first switching state and a second switching state. In the first switching state, the switching device connects the fourth port to the second valve, and in the second switching state, the switching device connects the second manifold to the second valve.

[0006] Optionally, the switching device includes a fifth valve and a sixth valve, two ends of the fifth valve are respectively connected to the fourth port and the second valve, one end of the sixth valve is connected to the second manifold, and the other end is connected between the fifth valve and the second valve.

[0007] Optionally, the fifth valve and the sixth valve are both ball valves.

[0008] Optionally, the switching device is a three-way valve, and three ports of the three-way valve are respectively connected to the second manifold, the fourth port, and the second valve.

[0009] Optionally, the multi-split air conditioner outdoor unit further includes a control unit, and the control unit is capable of switching the switching device to the first switching state when the multi-split air conditioner outdoor unit is applied to a two-pipe air conditioning system, and switching the switching device to the second switching state when the multi-split air conditioner outdoor unit is applied to a three-pipe air conditioning system. The fifth valve and the sixth valve may be electric ball valves or other types of electric valves.

[0010] Optionally, the first valve, the second valve, and the third valve are all stop valves.

[0011] Optionally, the multi-split air conditioner outdoor unit further includes:

a vapor-liquid separator connected between the third port and the suction port of the compressor; and an oil separator connected between the first port and the discharge port of the compressor.

[0012] A second aspect provides an installation method, which is used for installing any one of the multi-split air conditioner outdoor units according to the first aspect to form an air conditioning system, the installation method including:

performing connection to a refrigerant pipeline of an indoor unit using pipelines where the first valve and the second valve are located and switching the switching device to the first switching state when

the air conditioning system to be installed is a two-pipe air conditioning system; and performing connection to a refrigerant pipeline of an indoor unit using pipelines where the first valve, the second valve, and the third valve are located and switching the switching device to the second switching state when the air conditioning system to be installed is a three-pipe air conditioning system.

**[0013]** A third aspect provides an air conditioning system, including any one of the multi-split air conditioner outdoor units according to the first aspect; and an indoor unit, in which the air conditioning system is a two-pipe air conditioning system, the multi-split air conditioner outdoor unit is connected to a refrigerant pipeline of the indoor unit using pipelines where the first valve and the second valve are located, and the switching device is switched to the first switching state, or the air conditioning system is a three-pipe air conditioning system, the multi-split air conditioner outdoor unit is connected to a refrigerant pipeline of the indoor unit using pipelines where the first valve, the second valve, and the third valve are located, and the switching device is switched to the second switching state.

**[0014]** A fourth aspect provides a multi-split air conditioner outdoor unit, including: a compressor; an outdoor heat exchanger; an outdoor expansion valve; a four-way valve; a first valve; and a second valve. The four-way valve includes a first port, a second port, a third port, and a fourth port, the first port is connected to a discharge port of the compressor, the second port is connected to the outdoor heat exchanger, the outdoor expansion valve, and the first valve in sequence, the third port is connected to a suction port of the compressor, and the fourth port is connected to the second valve. The four-way valve is capable of being switched to connect the first port to the second port and connect the third port to the fourth port, or switched to connect the first port to the fourth port and connect the second port to the third port. The multi-split air conditioner outdoor unit further includes: a first manifold; a third valve; a third manifold; and a fourth valve. The first manifold is connected between the discharge port of the compressor and the first port, the third valve is disposed in the first manifold, the third manifold is connected between the suction port of the compressor and the third port, and the fourth valve is disposed in the third manifold.

**[0015]** Optionally, the first valve, the second valve, the third valve, and the fourth valve are all stop valves.

**[0016]** Optionally, the multi-split air conditioner outdoor unit further includes: a vapor-liquid separator; and an oil separator. The vapor-liquid separator is connected between the third port and the suction port of the compressor, and the oil separator is connected between the first port and the discharge port of the compressor.

**[0017]** A fifth aspect provides an installation method, which is used for installing any one of the multi-split air conditioner outdoor units according to the fourth aspect to form an air conditioning system, the installation method

including: performing connection to a refrigerant pipeline of an indoor unit using pipelines where the first valve and the second valve are located when the air conditioning system to be installed is a two-pipe air conditioning system; and performing connection to a refrigerant pipeline of an indoor unit using pipelines where the first valve, the third valve, and the fourth valve are located when the air conditioning system to be installed is a three-pipe air conditioning system.

**[0018]** A sixth aspect provides an air conditioning system, including: any one of the multi-split air conditioner outdoor units according to the fourth aspect; and an indoor unit. The air conditioning system is a two-pipe air conditioning system, and the multi-split air conditioner outdoor unit is connected to a refrigerant pipeline of the indoor unit using pipelines where the first valve and the second valve are located, or the air conditioning system is a three-pipe air conditioning system, and the multi-split air conditioner outdoor unit is connected to a refrigerant pipeline of the indoor unit using pipelines where the first valve, the third valve, and the fourth valve are located.

## Descriptions of the Drawings

**[0019]**

FIG. 1 is a schematic structural diagram of a multi-split air conditioner outdoor unit;

FIG. 2 is a schematic structural diagram of the multi-split air conditioner outdoor unit of FIG. 1, which automatically controls a switching state of a switching device by using a control unit;

FIG. 3 is a schematic structural diagram of the multi-split air conditioner outdoor unit of FIG. 1, which uses a three-way valve as the switching device;

FIG. 4 is a system schematic diagram of a two-pipe air conditioning system formed by connecting the multi-split air conditioner outdoor unit of FIG. 1 to indoor units;

FIG. 5 is a schematic diagram of a refrigerant flow path when the two-pipe air conditioning system of FIG. 4 is operated in a cooling mode;

FIG. 6 is a schematic diagram of a refrigerant flow path when the two-pipe air conditioning system of FIG. 4 is operated in a heating mode;

FIG. 7 is a system schematic diagram of a three-pipe air conditioning system formed by connecting the multi-split air conditioner outdoor unit of FIG. 1 to indoor units;

FIG. 8 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system of FIG. 7 is operated in a pure cooling mode;

FIG. 9 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system of FIG. 7 is operated in a pure heating mode;

FIG. 10 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system of FIG. 7 is operated in a main cooling mode;

FIG. 11 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system of FIG. 7 is operated in a main heating mode;

FIG. 12 is a schematic structural diagram of another multi-split air conditioner outdoor unit;

FIG. 13 is a system schematic diagram of a two-pipe air conditioning system formed by connecting the multi-split air conditioner outdoor unit of FIG. 12 to indoor units;

FIG. 14 is a system schematic diagram of a three-pipe air conditioning system formed by connecting the multi-split air conditioner outdoor unit of FIG. 12 to indoor units;

FIG. 15 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system of FIG. 14 is operated in a pure cooling mode;

FIG. 16 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system of FIG. 14 is operated in a pure heating mode;

FIG. 17 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system of FIG. 14 is operated in a main cooling mode; and

FIG. 18 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system of FIG. 14 is operated in a main heating mode.

#### [0020] List of Reference Numerals:

100 multi-split air conditioner outdoor unit, 11 compressor, 110 discharge port, 111 suction port, 12 outdoor heat exchanger, 13 outdoor expansion valve, 14 vapor-liquid separator, 15 oil separator, 16 control unit, 200 indoor unit, 21 indoor heat exchanger, 22 indoor expansion valve, FV four-way valve, D first port, C second port, S third port, E fourth port, SW switching device, V1 first valve, V2 second valve, V3 third valve, V4 fourth valve, V5 fifth valve, V6 sixth valve, V7 seventh valve, V8 eighth valve, P1 first manifold, P2 second manifold, and P3 third manifold.

#### Detailed Description

[0021] A detailed description of one or more embodiments of the present invention are presented herein by way of exemplification and not limitation with reference to the Figures.

[First Embodiment]

<Multi-Split Air Conditioner Outdoor Unit 100>

[0022] FIG. 1 is a schematic structural diagram of a multi-split air conditioner outdoor unit 100 according to a first embodiment. Referring to FIG. 1, the multi-split air conditioner outdoor unit 100 according to the present embodiment includes a compressor 11, an outdoor heat exchanger 12, an outdoor expansion valve 13, a four-way valve FV, a first valve V1, and a second valve V2. The four-way valve FV includes a first port D, a second port C,

a third port S, and a fourth port E. The first port D is connected to a discharge port 110 of the compressor 11, the second port C is connected to the outdoor heat exchanger 12, the outdoor expansion valve 13, and the first valve V1 in sequence, and the third port S is connected to a suction port 111 (via a vapor-liquid separator 14) of the compressor 11. The four-way valve FV can be switched to connect the first port D to the second port C, and connect the third port S to the fourth port E at the same time, or switched to connect the first port D to the fourth port E, and connect the second port C to the third port S at the same time.

[0023] In addition, the multi-split air conditioner outdoor unit 100 further includes a first manifold P1, a second manifold P2, a third valve V3, and a switching device SW. The first manifold P1 is connected between the discharge port 110 of the compressor 11 and the first port D, and the third valve V3 is disposed in the first manifold P1. The second manifold P2 is connected between the suction port 111 of the compressor 11 and the third port S, specifically between an inlet of the vapor-liquid separator 14 and the third port S.

[0024] The switching device SW is connected to the second manifold P2, the fourth port E, and the second valve V2, and can be switched between a first switching state and a second switching state. In the first switching state, the switching device SW connects the fourth port E to the second valve V2, and in the second switching state, the switching device SW connects the second manifold P2 to the second valve V2.

[0025] Specifically, in the embodiment shown in FIG. 1, the switching device SW is a combination of a fifth valve V5 and a sixth valve V6. Two ends of the fifth valve V5 are respectively connected to the fourth port E and the second valve V2. One end of the sixth valve V6 is connected to the second manifold P2, and the other end is connected between the fifth valve V5 and the second valve V2.

[0026] In the present embodiment, the first switching state refers to a state in which the fifth valve V5 is opened and the sixth valve V6 is closed. In this state, bypass connection between the second manifold P2 and an air pipe is cut off, and the fourth port E of the four-way valve FV and the second valve V2 are connected via the air pipe. The third valve V3 is also closed. At this time, a connection method of the multi-split air conditioner outdoor unit 100 is basically the same as that of a common two-pipe outdoor unit, and pipelines where the first valve V1 and the second valve V2 are located may be used for connection to indoor units 200 to form a two-pipe air conditioning system.

[0027] In the present embodiment, the second switching state refers to a state in which the fifth valve V5 is closed and the sixth valve V6 is opened. The third valve V3 is opened. At this time, the multi-split air conditioner outdoor unit 100 can be used as a three-pipe outdoor unit, and pipelines where the first valve V1, the second valve V2, and the third valve V3 are located are used for the

connection to the indoor units 200 to form a three-pipe air conditioning system. The pipeline where the third valve V3 is located is a high-pressure air pipe.

**[0028]** By switching the switching device SW between the first switching state and the second switching state, the multi-split air conditioner outdoor unit 100 according to the present embodiment can be used commonly in the two-pipe air conditioning system and the three-pipe air conditioning system, and the same multi-split air conditioner outdoor unit 100 can be used to adapt to form the two-pipe air conditioning system or the three-pipe air conditioning system, thereby reducing types of multi-split air conditioner outdoor units 100 that need to be designed and produced, and further reducing costs. In addition, the multi-split air conditioner outdoor unit 100 according to the present embodiment can also be obtained based on a simple modification of an existing model, and specifically, can be obtained by adding a manifold and a switching device SW based on a two-pipe outdoor unit or a three-pipe outdoor unit, thereby improving utilization efficiency of the existing model. In summary, the multi-split air conditioner outdoor unit 100 according to the present embodiment can improve commonality of the two-pipe and three-pipe air conditioning systems by using a simple device change.

**[0029]** In the present embodiment, the first valve V1, the second valve V2, and the third valve V3 are all stop valves. Taking cooling as an example, the pipeline where the first valve V1 is located is a liquid pipe, the pipeline where the second valve V2 is located is the air pipe, and the pipeline where the third valve V3 is located is the high-pressure air pipe.

**[0030]** In some embodiments, the fifth valve V5 and the sixth valve V6 may be ball valves, and a user or an installer may manually switch closing and opening states of the ball valves to switch the multi-split air conditioner outdoor unit 100 to be adapted to the two-pipe air conditioning system or the three-pipe air conditioning system.

**[0031]** Referring to FIG. 2, the present embodiment also provides the multi-split air conditioner outdoor unit 100 which uses a control unit 16 to automatically control the switching state of the switching device SW. Specifically, the multi-split air conditioner outdoor unit 100 according to the present embodiment includes the control unit 16. The control unit 16 is in communication connection with the fifth valve V5 and the sixth valve V6, and the fifth valve V5 and the sixth valve V6 are solenoid valves. The control unit 16 can electrically switch closing and opening states of the fifth valve V5 and the sixth valve V6 to switch the multi-split air conditioner outdoor unit 100 to be adapted to the two-pipe air conditioning system or the three-pipe air conditioning system.

**[0032]** In some embodiments, the control unit 16 can switch the switching states of the fifth valve V5 and the sixth valve V6 according to a type of an air conditioning system that needs to be formed or is formed by the multi-split air conditioner outdoor unit 100, so as to adapt to the

two-pipe and three-pipe air conditioning systems more conveniently and intelligently.

**[0033]** Referring to FIG. 3, the present embodiment also provides the multi-split air conditioner outdoor unit 100 which uses a three-way valve as the switching device SW. Specifically, three ports of the three-way valve are respectively connected to the second manifold P2, the fourth port E of the four-way valve FV, and the second valve V2. The three-way valve may connect the second manifold P2 to the second valve V2, or may connect the fourth port E of the four-way valve FV to the second valve V2. Those skilled in the art can understand that in the above embodiment, the combination of the fifth valve V5 and the sixth valve V6 and the two structures of the three-way valve are merely exemplary, and in other embodiments, other suitable types of valves or combinations of valves may also be used, which will not be repeated here.

#### <Two-Pipe Air Conditioning System>

**[0034]** FIG. 4 is a system schematic diagram of a two-pipe air conditioning system formed by connecting the multi-split air conditioner outdoor unit 100 according to the present embodiment to the indoor units 200. Referring to FIG. 4, one multi-split air conditioner outdoor unit 100 may be connected to a plurality of indoor units 200, and for convenience of display, a flow path switching structure of the indoor unit 200 is not shown in the figure. The indoor unit 200 includes at least an indoor expansion valve 22 and an indoor heat exchanger 21 connected in series.

**[0035]** The two-pipe air conditioning system has at least two operating modes, that is, a cooling mode and a heating mode. In the cooling mode or the heating mode, the fifth valve V5 is opened, and the sixth valve V6 is closed.

**[0036]** FIG. 5 is a schematic diagram of a refrigerant flow path when the two-pipe air conditioning system is operated in the cooling mode in the present embodiment. Referring to FIG. 5, in the four-way valve FV, the first port D and the second port C are connected, and the third port S and the fourth port E are connected.

**[0037]** After being discharged from the discharge port 110 of the compressor 11, a high-temperature and high-pressure liquid refrigerant (indicated by solid arrows, the same below) passes through the oil separator 15, the first port D and the second port C of the four-way valve FV, the outdoor heat exchanger 12, and the outdoor expansion valve 13 in sequence, is converted into a medium-temperature and medium-pressure refrigerant (indicated by hollow arrows, the same below), and enters the indoor unit 200 through the first valve V1. Then, the medium-temperature and medium-pressure refrigerant passes through the indoor expansion valve 22 and the indoor heat exchanger 21, and is converted into a low-temperature and low-pressure gaseous refrigerant (indicated by straight lines with an arrow, the same below). The gaseous refrigerant flows back to the multi-split air condi-

tioner outdoor unit 100 through the second valve V2, passes through the fifth valve V5, the fourth port E and the third port S of the four-way valve FV, and the vapor-liquid separator 14 in sequence, and flows back to the suction port 111 of the compressor 11 to complete a circulation of a refrigerant flow.

**[0038]** FIG. 6 is a schematic diagram of a refrigerant flow path when the two-pipe air conditioning system is operated in the heating mode in the present embodiment. Referring to FIG. 6, in the four-way valve FV, the first port D and the fourth port E are connected, and the second port C and the third port S are connected.

**[0039]** After being discharged from the discharge port 110 of the compressor 11, a high-temperature and high-pressure liquid refrigerant passes through the oil separator 15, the first port D and the fourth port E of the four-way valve FV, the fifth valve V5, and the second valve V2 in sequence to enter the indoor unit 200, and is converted into a medium-temperature and medium-pressure refrigerant after passing through the indoor heat exchanger 21 and the indoor expansion valve 22. Then, the medium-temperature and medium-pressure refrigerant flows back to the multi-split air conditioner outdoor unit 100 through the first valve V1, and is converted into a low-temperature and low-pressure gaseous refrigerant after passing through the outdoor expansion valve 13 and the outdoor heat exchanger 12. After passing through the second port C and the third port S of the four-way valve FV and the vapor-liquid separator 14, the gaseous refrigerant flows back to the suction port 111 of the compressor 11 to complete a circulation of a refrigerant flow.

#### <Three-Pipe Air Conditioning System>

**[0040]** FIG. 7 is a system schematic diagram of a three-pipe air conditioning system formed by connecting the multi-split air conditioner outdoor unit 100 according to the present embodiment to the indoor units 200. Referring to FIG. 7, one multi-split air conditioner outdoor unit 100 may be connected to a plurality of indoor units 200 via a pipeline system including a valve box. The indoor unit 200 includes at least the indoor expansion valve 22 and the indoor heat exchanger 21 connected in series. In addition, the pipeline system by which the indoor unit 200 is connected to the outdoor unit 100 further includes at least a seventh valve V7 and an eighth valve V8. One end of the seventh valve V7 is connected to the pipeline where the second valve V2 is located, and the other end is connected to the indoor heat exchanger 21. One end of the eighth valve V8 is connected to the pipeline where the third valve V3 is located, and the other end is connected to the indoor heat exchanger 21. Pipelines where the seventh valve V7 and the eighth valve V8 are located are connected in parallel.

**[0041]** The three-pipe air conditioning system has at least four modes, that is, a pure cooling mode, a pure heating mode, a main cooling mode, and a main heating mode. The pure cooling mode is a mode in which all

indoor units 200 in operation are in a cooling working condition. The pure heating mode is a mode in which all indoor units 200 in operation are in a heating working condition. The main cooling mode is a mode in which most (which may be a quantity or a total power) indoor units 200 in operation are in a cooling working condition, and a few indoor units 200 in operation are in a heating working condition. The main heating mode is a mode in which most indoor units 200 in operation are in a heating working condition, and a few indoor units 200 in operation are in a cooling working condition. In other embodiments, other modes such as a dehumidification mode and a dehumidification and non-cooling mode may also be included, and a structure of the indoor unit 200, a pipe connection method, a control method, and the like may be set as needed, which will not be repeated here. In the above modes, the fifth valve V5 is closed, and the sixth valve V6 is opened.

**[0042]** FIG. 8 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system is operated in the pure cooling mode in the present embodiment. At the time of operating in the pure cooling mode, the seventh valve V7 of the indoor unit 200 that needs a cooling operation is opened, and the eighth valves V8 are all closed. Referring to FIG. 8, in the four-way valve FV, the first port D and the second port C are connected, and the third port S and the fourth port E are connected.

**[0043]** A high-temperature and high-pressure liquid refrigerant is discharged from the discharge port 110 of the compressor 11, passes through the oil separator 15, the first port D of the four-way valve FV, the outdoor heat exchanger 12, and the outdoor expansion valve 13 in sequence and becomes a medium-temperature and medium-pressure refrigerant, and then flows into the indoor unit 200 through the first valve V1. Then, the medium-temperature and medium-pressure refrigerant passes through the indoor expansion valve 22 and the indoor heat exchanger 21 in sequence and becomes a low-temperature and low-pressure gaseous refrigerant, and returns to the outdoor unit through the seventh valve V7 and the pipeline where the second valve V2 is located. The gaseous refrigerant further passes through the sixth valve V6, the second manifold P2, and the vapor-liquid separator 14, and returns to the suction port 111 of the compressor 11 to complete a circulation of the refrigerant flow.

**[0044]** FIG. 9 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system is operated in the pure heating mode in the present embodiment. At the time of operating in the pure heating mode, the seventh valve V7 of the indoor unit 200 that needs a heating operation is opened, and the eighth valves V8 are all closed. Referring to FIG. 9, in the four-way valve FV, the first port D and the fourth port E are connected, and the second port C and the third port S are connected.

**[0045]** A high-temperature and high-pressure liquid refrigerant is discharged from the discharge port 110 of the compressor 11, passes through the oil separator 15,

and flows into the indoor unit 200 through the pipeline where the second valve V2 is located. Then, the refrigerant passes through the seventh valve V7, the indoor heat exchanger 21, and the indoor expansion valve 22 in sequence and becomes a medium-temperature and medium-pressure refrigerant, and returns to the multi-split air conditioner outdoor unit 100 through the pipeline where the first valve V1 is located. The medium-temperature and medium-pressure refrigerant passes through the outdoor expansion valve 13 and the outdoor heat exchanger 12 and becomes a low-temperature and low-pressure gaseous refrigerant, and passes through the second port C and the third port S of the four-way valve FV and the vapor-liquid separator 14 in sequence, and then returns to the suction port 111 of the compressor 11 to complete a circulation of the refrigerant flow.

**[0046]** FIG. 10 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system is operated in the main cooling mode in the present embodiment. At the time of operating in the main cooling mode, the third valve V3 is opened, the seventh valve V7 of the indoor unit 200 (two indoor units 200 on a right side of FIG. 10) that needs a cooling operation is opened and the eighth valve V8 is closed, and the eighth valve V8 of the indoor unit 200 (one indoor unit 200 on a left side of FIG. 10) that needs a heating operation is opened and the seventh valve V7 is closed. Referring to FIG. 10, in the four-way valve FV, the first port D and the second port C are connected, and the third port S and the fourth port E are connected.

**[0047]** A high-temperature and high-pressure liquid refrigerant is discharged from the discharge port 110 of the compressor 11, and is divided into two paths at the first manifold P1 after passing through the oil separator 15.

**[0048]** The high-temperature and high-pressure liquid refrigerant of a first path passes through the first port D of the four-way valve FV, the outdoor heat exchanger 12, and the outdoor expansion valve 13 in sequence and becomes a medium-temperature and medium-pressure refrigerant, and then flows into the indoor unit 200 through the first valve V1. Then, the medium-temperature and medium-pressure refrigerant passes through the indoor expansion valve 22 and the indoor heat exchanger 21 in sequence and becomes a low-temperature and low-pressure gaseous refrigerant, and returns to the multi-split air conditioner outdoor unit 100 through the seventh valve V7 and the pipeline where the second valve V2 is located. The gaseous refrigerant further passes through the sixth valve V6, the second manifold P2, and the vapor-liquid separator 14, and returns to the suction port 111 of the compressor 11 to complete a circulation of the refrigerant flow.

**[0049]** The high-temperature and high-pressure liquid refrigerant of a second path flows into the indoor unit 200 through the pipeline where the third valve V3 is located. The high-temperature and high-pressure liquid refrigerant of the second path passes through the eighth valve

V8, the indoor heat exchanger 21, and the indoor expansion valve 22 and becomes a medium-temperature and medium-pressure refrigerant, and merges with the medium-temperature and medium-pressure refrigerant of the first path flowing into the indoor unit 200 from the first valve V1, and enters the refrigerant circulation of the first path.

**[0050]** FIG. 11 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system is operated in the main heating mode in the present embodiment. At the time of operating in the main heating mode, the third valve V3 is opened, the seventh valve V7 of the indoor unit 200 (one indoor unit 200 on a left side of FIG. 11) that needs a cooling operation is opened and the eighth valve V8 is closed, and the eighth valve V8 of the indoor unit 200 (two indoor units 200 on a right side of FIG. 11) that needs a heating operation is opened and the seventh valve V7 is closed. Referring to FIG. 11, in the four-way valve FV, the first port D and the fourth port E are connected, and the second port C and the third port S are connected.

**[0051]** A high-temperature and high-pressure liquid refrigerant is discharged from the discharge port 110 of the compressor 11, passes through the oil separator 15, the first manifold P1, and the pipeline where the third valve V3 is located, and flows into the indoor unit 200. Then, the high-temperature and high-pressure liquid refrigerant passes through the eighth valve V8, the indoor heat exchanger 21, and the indoor expansion valve 22 of the indoor unit 200 that needs a heating operation in sequence and becomes a medium-temperature and medium-pressure refrigerant.

**[0052]** The medium-temperature and medium-pressure refrigerant is divided into two paths. The medium-temperature and medium-pressure refrigerant of a first path directly flows back to the multi-split air conditioner outdoor unit 100 through the pipeline where the first valve V1 is located, passes through the outdoor expansion valve 13 and the outdoor heat exchanger 12, and becomes a low-temperature and low-pressure gaseous refrigerant. After passing through the second port C and the third port S of the four-way valve FV and the vapor-liquid separator 14, the gaseous refrigerant flows back to the suction port 111 of the compressor 11 to complete a circulation of the refrigerant flow.

**[0053]** The medium-temperature and medium-pressure refrigerant of a second path flows to the indoor unit 200 that needs a cooling operation, passes through the indoor expansion valve 22 and the indoor heat exchanger 21, and becomes a low-temperature and low-pressure gaseous refrigerant. The gaseous refrigerant flows back to the multi-split air conditioner outdoor unit 100 through the seventh valve V7 and the pipeline where the second valve V2 is located. Then, the gaseous refrigerant passes through the sixth valve V6 and the second manifold P2, merges with the low-temperature and low-pressure gaseous refrigerant of the first path, and flows back to the suction port 111 of the compressor 11 through the vapor-

liquid separator 14 to complete the circulation of the refrigerant flow.

**[0054]** It should be noted that the above description is merely an exemplary description of the operation mode of the multi-split air conditioner outdoor unit 100 of the first embodiment, and by adjusting the structure of the indoor unit 200, the pipe connection method, and the like, those skilled in the art can completely change or increase operation modes that can be used, which will not be repeated.

**[0055]** Through the above method, the multi-split air conditioner outdoor unit 100 according to the present embodiment may be combined with the indoor unit 200 to form a two-pipe air conditioning system, or may be combined with the indoor unit 200 and the valve box to form a three-pipe air conditioning system, which has better commonality. Manufacturers only need to design and produce one multi-split air conditioner outdoor unit 100 to adapt to two air conditioning systems, which effectively reduces costs of design, production, and the like.

[Second Embodiment]

<Multi-Split Air Conditioner Outdoor Unit 100>

**[0056]** FIG. 12 is a schematic structural diagram of the multi-split air conditioner outdoor unit 100 according to a second embodiment. Referring to FIG. 12, the multi-split air conditioner outdoor unit 100 according to the second embodiment includes the compressor 11, the outdoor heat exchanger 12, the outdoor expansion valve 13, the four-way valve FV, the first valve V1, and the second valve V2. The four-way valve FV includes the first port D, the second port C, the third port S, and the fourth port E. The first port D is connected to the discharge port 110 of the compressor 11, the second port C is connected to the outdoor heat exchanger 12, the outdoor expansion valve 13, and the first valve V1 in sequence, the third port S is connected to the suction port 111 of the compressor 11, and the fourth port E is connected to the second valve V2. The four-way valve FV can be switched to connect the first port D to the second port C and connect the third port S to the fourth port E, or switched to connect the first port D to the fourth port E and connect the second port C to the third port S.

**[0057]** The multi-split air conditioner outdoor unit 100 further includes the first manifold P1, a third manifold P3, the third valve V3, and a fourth valve V4. The first manifold P1 is connected between the discharge port 110 of the compressor 11 and the first port D, and the third valve V3 is disposed in the first manifold P1. The third manifold P3 is connected between the suction port 111 of the compressor 11 and the third port S, and the fourth valve V4 is disposed in the third manifold P3.

**[0058]** The multi-split air conditioner outdoor unit 100 according to the second embodiment includes at least four refrigerant ports located on a shell surface or outside

of the multi-split air conditioner outdoor unit 100, that is, refrigerant ports of pipelines where the first valve V1, the second valve V2, the third valve V3 and the fourth valve V4 are located respectively. The multi-split air conditioner outdoor unit 100 may be connected to the indoor unit 200 by using two or three of the refrigerant ports, thereby forming a two-pipe air conditioning system and a three-pipe air conditioning system.

**[0059]** Specifically, by connecting with the indoor unit 200 using the refrigerant ports of the pipelines where the first valve V1 and the second valve V2 are located, a two-pipe air conditioning system can be formed, and by connecting with the indoor unit 200 and the pipeline system including the valve box using the refrigerant ports of the pipelines where the first valve V1, the third valve V3, and the fourth valve V4 are located, a three-pipe air conditioning system can be formed. That is, the multi-split air conditioner outdoor unit 100 according to the second embodiment may form an air conditioning system by selecting a suitable refrigerant port from the four refrigerant ports to connect the indoor unit 200, and thus is common to the two-pipe air conditioning system and the three-pipe air conditioning system, thereby reducing types of multi-split air conditioner outdoor units 100 that need to be designed and produced, and reducing costs.

**[0060]** In addition, the multi-split air conditioner outdoor unit 100 according to the present embodiment can also be obtained based on a simple modification of an existing model, and specifically, can be obtained by adding a manifold and a valve based on a two-pipe outdoor unit or a three-pipe outdoor unit, thereby improving utilization efficiency of the existing model. In summary, the multi-split air conditioner outdoor unit 100 according to the present embodiment can improve commonality of the two-pipe and three-pipe air conditioning systems by using a simple device change.

**[0061]** In the present embodiment, the first valve V1, the second valve V2, the third valve V3, and the fourth valve V4 are all stop valves. Taking cooling as an example, the pipeline where the first valve V1 is located is a liquid pipe, the pipeline where the second valve V2 is located is an air pipe of a two-pipe air conditioning system, the pipeline where the third valve V3 is located is a high-pressure air pipe of a three-pipe air conditioning system, and the pipeline where the fourth valve V4 is located is an air pipe of the three-pipe air conditioning system.

<Two-Pipe Air Conditioning System>

**[0062]** FIG. 13 is a system schematic diagram of a two-pipe air conditioning system formed by connecting the multi-split air conditioner outdoor unit 100 according to the second embodiment to the indoor units 200. Referring to FIG. 13, the first valve V1 and the second valve V2 are opened, and the third valve V3 and the fourth valve V4 are closed. At the time of cooling, in the four-way valve FV, the first port D and the second port C are connected,



and the third port S and the fourth port E are connected. At the time of heating, in the four-way valve FV, the first port D and the fourth port E are connected, and the second port C and the third port S are connected.

**[0063]** A refrigerant flow path may refer to the refrigerant flow paths in FIG. 5 and FIG. 6 in the first embodiment, which will not be repeated here.

#### <Three-Pipe Air Conditioning System>

**[0064]** FIG. 14 is a system schematic diagram of a three-pipe air conditioning system formed by connecting the multi-split air conditioner outdoor unit 100 according to the second embodiment to the indoor units 200. Referring to FIG. 14, the indoor unit 200 includes at least the indoor expansion valve 22 and the indoor heat exchanger 21 connected in series. In addition, the pipeline system by which the indoor unit 200 is connected to the outdoor unit 100 further includes at least the seventh valve V7 and the eighth valve V8. One end of the seventh valve V7 is connected to the pipeline where the fourth valve V4 is located, and the other end is connected to the indoor heat exchanger 21. One end of the eighth valve V8 is connected to the pipeline where the third valve V3 is located, and the other end is connected to the indoor heat exchanger 21. Pipelines where the seventh valve V7 and the eighth valve V8 are located are connected in parallel.

**[0065]** The three-pipe air conditioning system has at least four modes, that is, a pure cooling mode, a pure heating mode, a main cooling mode, and a main heating mode. In other embodiments, other modes such as a dehumidification mode and a dehumidification and non-cooling mode may also be included, and a structure of the indoor unit 200, a pipe connection method, a control method, and the like may be set as needed, which will not be repeated here.

**[0066]** FIG. 15 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system is operated in the pure cooling mode in the second embodiment. At the time of operating in the pure cooling mode, both the second valve V2 and the third valve V3 are closed, the seventh valve V7 of the indoor unit 200 that needs a cooling operation is opened, and the eighth valves V8 are all closed. Referring to FIG. 15, in the four-way valve FV, the first port D and the second port C are connected, and the third port S and the fourth port E are connected. A refrigerant flow path in the pure cooling mode is shown in FIG. 15, which will not be repeated here.

**[0067]** FIG. 16 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system is operated in the pure heating mode in the second embodiment. At the time of operating in the pure heating mode, the second valve V2 and the fourth valve V4 are closed, the eighth valve V8 of the indoor unit 200 that needs a heating operation is opened, and the seventh valves V7 are all closed. Referring to FIG. 16, in the four-way valve FV, the first port D and the fourth port E are connected,

and the second port C and the third port S are connected. A refrigerant flow path in the pure heating mode is shown in FIG. 16, which will not be repeated here.

**[0068]** FIG. 17 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system is operated in the main cooling mode in the second embodiment. At the time of operating in the main cooling mode, the first valve V1, the third valve V3, and the fourth valve V4 are all opened, the seventh valve V7 of the indoor unit 200 (two indoor units 200 on a right side of FIG. 17) that needs a cooling operation is opened and the eighth valve V8 is closed, and the eighth valve V8 of the indoor unit 200 (one indoor unit 200 on a left side of FIG. 17) that needs a heating operation is opened and the seventh valve V7 is closed. Referring to FIG. 17, in the four-way valve FV, the first port D and the second port C are connected, and the third port S and the fourth port E are connected. A refrigerant flow path in the main cooling mode is shown in FIG. 17, which will not be repeated here.

**[0069]** FIG. 18 is a schematic diagram of a refrigerant flow when the three-pipe air conditioning system is operated in the main heating mode in the second embodiment. At the time of operating in the main heating mode, the first valve V1, the third valve V3, and the fourth valve V4 are all opened, the seventh valve V7 of the indoor unit 200 (one indoor unit 200 on a left side of FIG. 18) that needs a cooling operation is opened and the eighth valve V8 is closed, and the eighth valve V8 of the indoor unit 200 (two indoor units 200 on a right side of FIG. 18) that needs a heating operation is opened and the seventh valve V7 is closed. Referring to FIG. 18, in the four-way valve FV, the first port D and the fourth port E are connected, and the second port C and the third port S are connected. A refrigerant flow path in the main heating mode is shown in FIG. 18, which will not be repeated here.

**[0070]** Through the above method, the multi-split air conditioner outdoor unit 100 according to the present embodiment may be combined with the indoor unit 200 by using the pipelines where the first valve V1 and the second valve V2 are located, so as to form a two-pipe air conditioning system, or may be combined with the indoor unit 200 and the valve box by using the pipelines where the first valve V1, the third valve V3, and the fourth valve V4 are located, so as to form a three-pipe air conditioning system, which has better commonality. Manufacturers only need to design and produce one multi-split air conditioner outdoor unit 100 to adapt to two air conditioning systems, which effectively reduces costs of design, production, and the like.

**[0071]** It should be noted that, for convenience of illustration, a connection pipeline between the multi-split air conditioner outdoor unit 100 and the indoor unit 200 is simplified in the Figures. An actual connection pipeline may include many different forms, and may include other components (not shown), such as a valve box and a valve.

**[0072]** The above embodiments are merely described embodiments of the present invention and are not intended to limit the scope of the present invention as defined by the appended claims. In addition, any modifications, equivalent substitutions, improvements, and the like may be made without departing from the scope of the present invention as defined by the appended claims.

## Claims

1. A multi-split air conditioner outdoor unit, comprising: a compressor; an outdoor heat exchanger; an outdoor expansion valve; a four-way valve; a first valve; and a second valve, wherein

the four-way valve includes a first port, a second port, a third port, and a fourth port, the first port is connected to a discharge port of the compressor, the second port is connected to the outdoor heat exchanger, the outdoor expansion valve, and the first valve in sequence, and the third port is connected to a suction port of the compressor, the four-way valve is capable of being switched to connect the first port to the second port and connect the third port to the fourth port, or switched to connect the first port to the fourth port and connect the second port to the third port, the multi-split air conditioner outdoor unit further comprises:

a first manifold connected between the discharge port of the compressor and the first port;  
a third valve disposed in the first manifold;  
a second manifold connected between the suction port of the compressor and the third port; and  
a switching device connected to the second manifold, the fourth port, and the second valve, and capable of being switched between a first switching state and a second switching state,  
in the first switching state, the switching device connects the fourth port to the second valve, and  
in the second switching state, the switching device connects the second manifold to the second valve.

2. The multi-split air conditioner outdoor unit according to claim 1, wherein the switching device includes a fifth valve and a sixth valve, two ends of the fifth valve are respectively connected to the fourth port and the second valve, one end of the sixth valve is connected to the second manifold, and the other end is connected between the fifth valve and the second valve.

3. The multi-split air conditioner outdoor unit according to claim 2, wherein the fifth valve and the sixth valve are both ball valves.

4. The multi-split air conditioner outdoor unit according to claim 1, wherein the switching device is a three-way valve, and three ports of the three-way valve are respectively connected to the second manifold, the fourth port, and the second valve.

5. The multi-split air conditioner outdoor unit according to claim 1, further comprising:  
a control unit, wherein the control unit is capable of

switching the switching device to the first switching state when the multi-split air conditioner outdoor unit is applied to a two-pipe air conditioning system, and  
switching the switching device to the second switching state when the multi-split air conditioner outdoor unit is applied to a three-pipe air conditioning system.

6. The multi-split air conditioner outdoor unit according to claim 1, wherein the first valve, the second valve, and the third valve are all stop valves.

7. The multi-split air conditioner outdoor unit according to claim 1, further comprising:

a vapor-liquid separator connected between the third port and the suction port of the compressor; and  
an oil separator connected between the first port and the discharge port of the compressor.

8. An installation method, which is used for installing the multi-split air conditioner outdoor unit according to any one of claims 1 to 7 to form an air conditioning system, the installation method comprising:

performing connection to a refrigerant pipeline of an indoor unit using pipelines where the first valve and the second valve are located and switching the switching device to the first switching state when the air conditioning system to be installed is a two-pipe air conditioning system; and  
performing connection to a refrigerant pipeline of an indoor unit using pipelines where the first valve, the second valve, and the third valve are located and switching the switching device to the second switching state when the air conditioning system to be installed is a three-pipe air conditioning system.

9. An air conditioning system, comprising: the multi-split air conditioner outdoor unit according to any one

of claims 1 to 7; and an indoor unit, wherein

the air conditioning system is a two-pipe air conditioning system, the multi-split air conditioner outdoor unit is connected to a refrigerant pipeline of the indoor unit using pipelines where the first valve and the second valve are located, and the switching device is switched to the first switching state, or  
the air conditioning system is a three-pipe air conditioning system, the multi-split air conditioner outdoor unit is connected to a refrigerant pipeline of the indoor unit using pipelines where the first valve, the second valve, and the third valve are located, and the switching device is switched to the second switching state.

- 10.** A multi-split air conditioner outdoor unit, comprising: a compressor; an outdoor heat exchanger; an outdoor expansion valve; a four-way valve; a first valve; and a second valve, wherein

the four-way valve includes a first port, a second port, a third port, and a fourth port, the first port is connected to a discharge port of the compressor,  
the second port is connected to the outdoor heat exchanger, the outdoor expansion valve, and the first valve in sequence,  
the third port is connected to a suction port of the compressor,  
the fourth port is connected to the second valve, the four-way valve is capable of being switched to connect the first port to the second port and connect the third port to the fourth port, or switched to connect the first port to the fourth port and connect the second port to the third port, and  
the multi-split air conditioner outdoor unit further comprises:

a first manifold connected between the discharge port of the compressor and the first port;  
a third valve disposed in the first manifold;  
a third manifold connected between the suction port of the compressor and the third port; and  
a fourth valve disposed in the third manifold.

- 11.** The multi-split air conditioner outdoor unit according to claim 10, wherein the first valve, the second valve, the third valve, and the fourth valve are all stop valves.

- 12.** The multi-split air conditioner outdoor unit according to claim 10, further comprising:

a vapor-liquid separator connected between the third port and the suction port of the compressor; and  
an oil separator connected between the first port and the discharge port of the compressor.

- 13.** An installation method, which is used for installing the multi-split air conditioner outdoor unit according to any one of claims 10 to 12 to form an air conditioning system, the installation method comprising:

performing connection to a refrigerant pipeline of an indoor unit using pipelines where the first valve and the second valve are located when the air conditioning system to be installed is a two-pipe air conditioning system; and  
performing connection to a refrigerant pipeline of an indoor unit using pipelines where the first valve, the third valve, and the fourth valve are located when the air conditioning system to be installed is a three-pipe air conditioning system.

- 14.** An air conditioning system, comprising: the multi-split air conditioner outdoor unit according to any one of claims 10 to 12; and an indoor unit, wherein

the air conditioning system is a two-pipe air conditioning system, and the multi-split air conditioner outdoor unit is connected to a refrigerant pipeline of the indoor unit using pipelines where the first valve and the second valve are located, or  
the air conditioning system is a three-pipe air conditioning system, and the multi-split air conditioner outdoor unit is connected to a refrigerant pipeline of the indoor unit using pipelines where the first valve, the third valve, and the fourth valve are located.

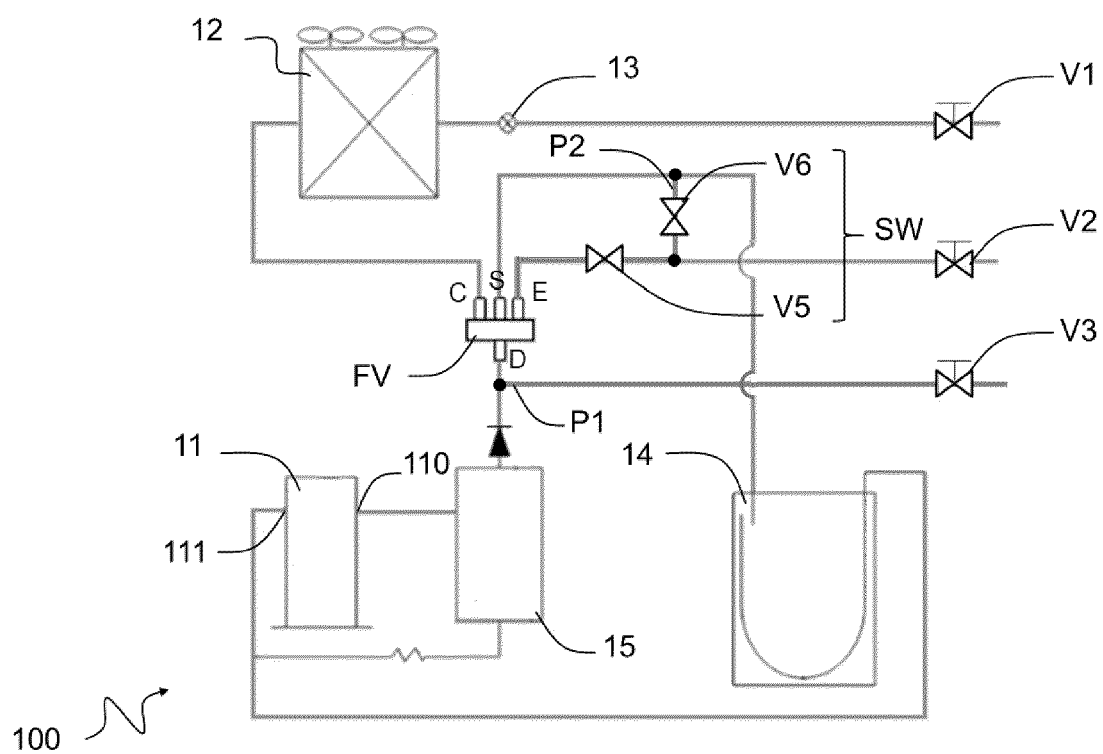


FIG. 1

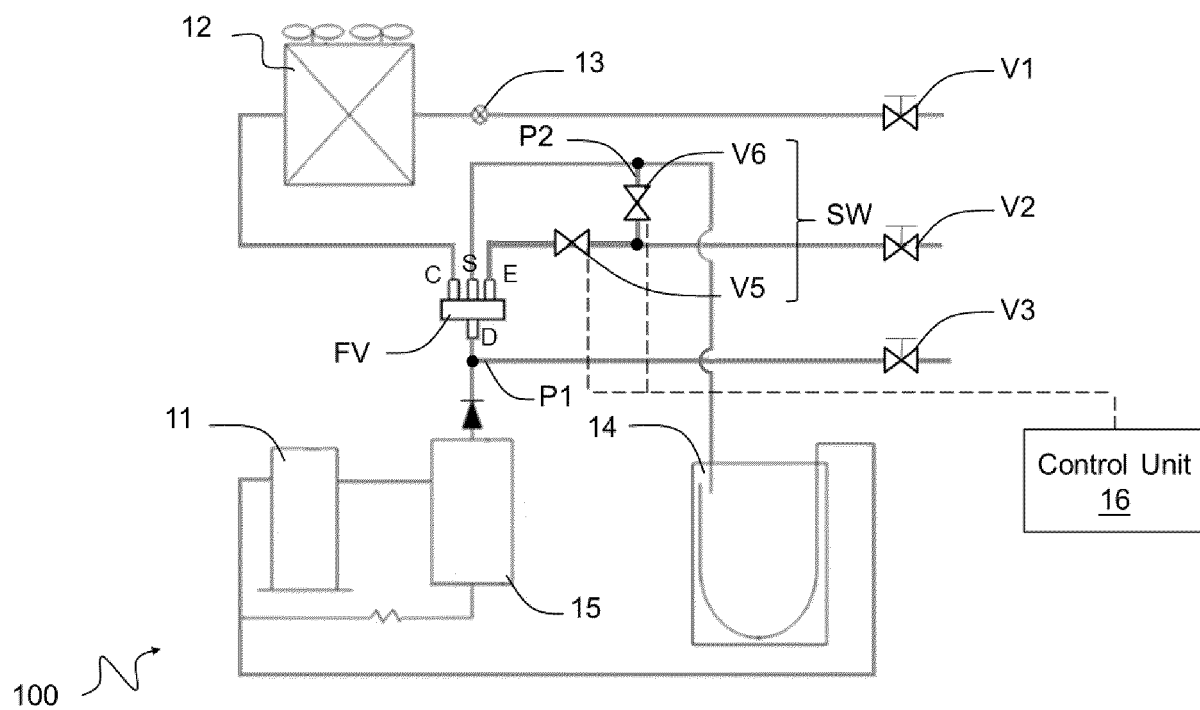


FIG. 2

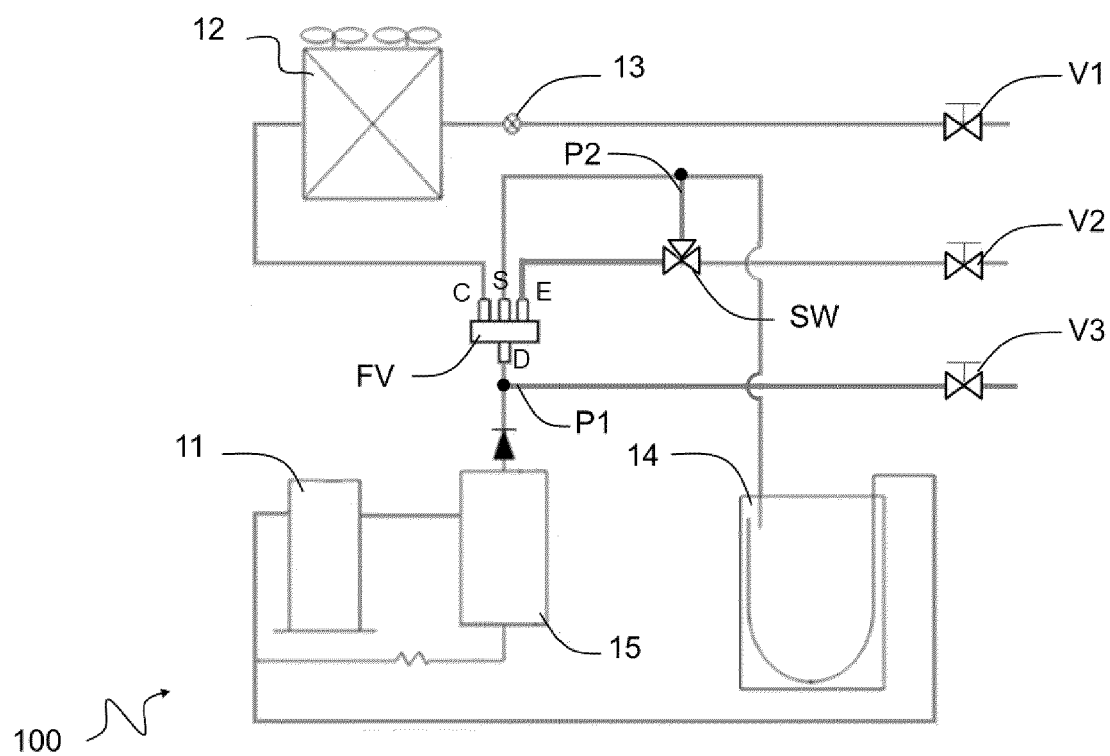


FIG. 3

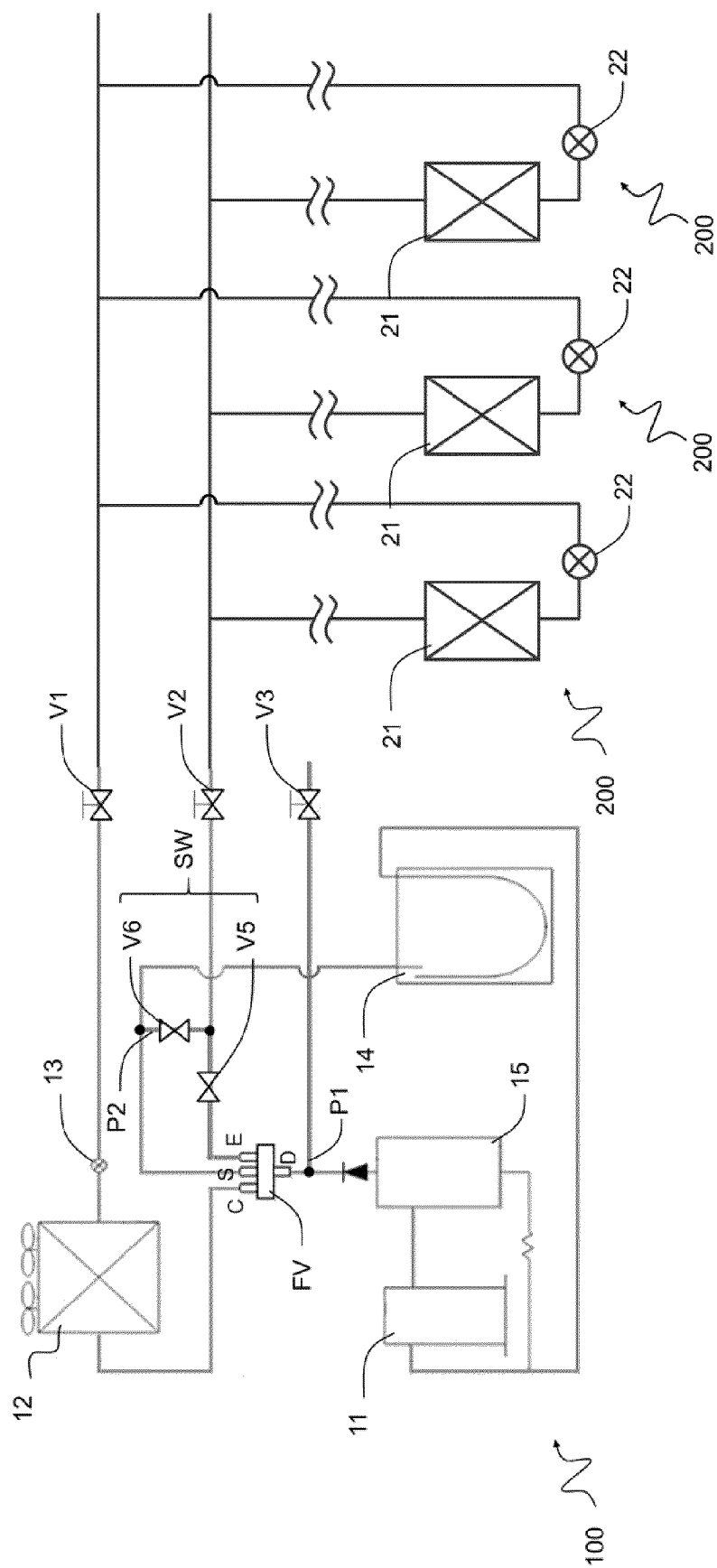


FIG. 4

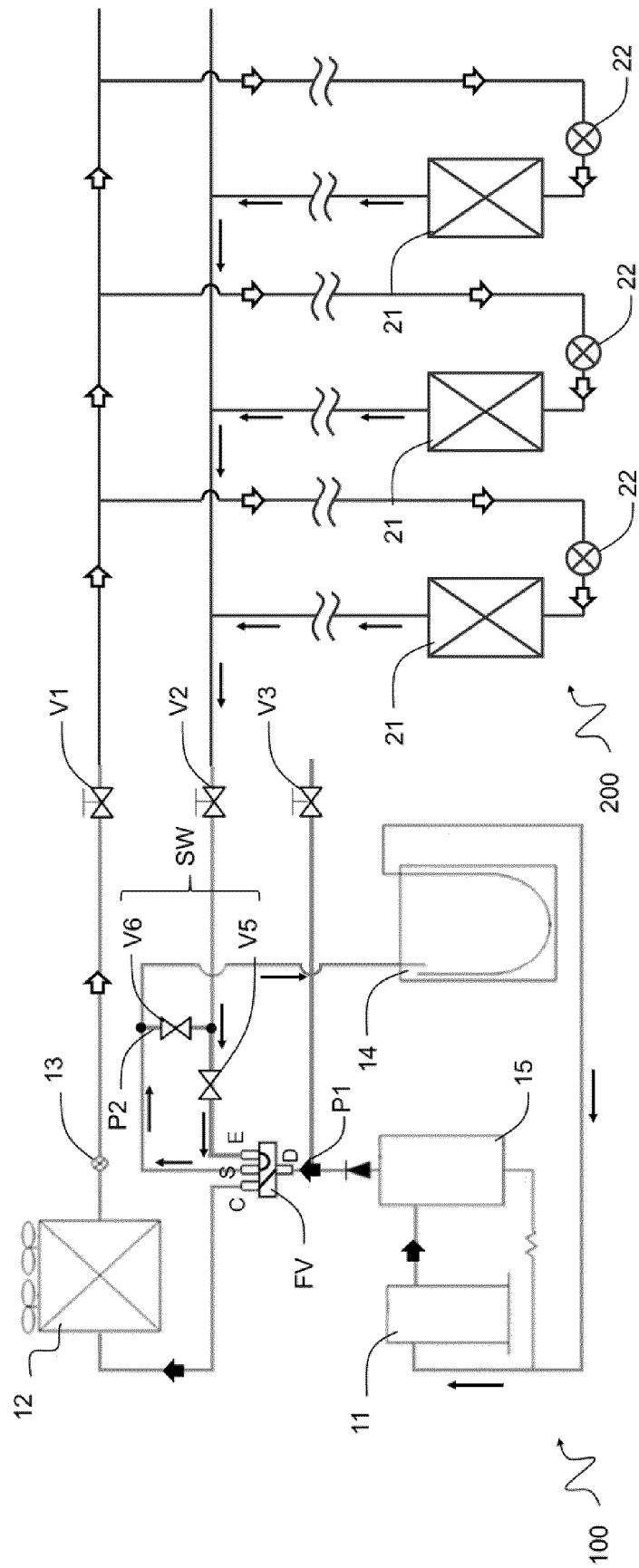


FIG. 5

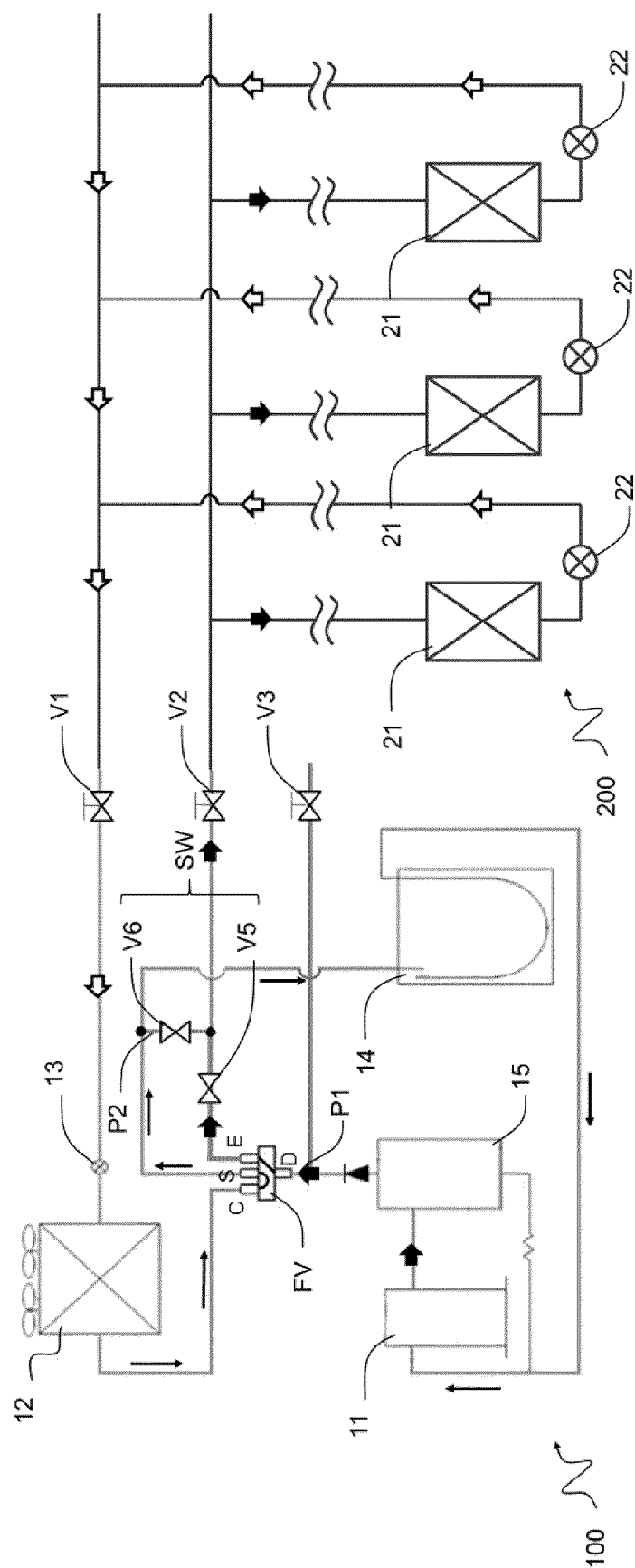


FIG. 6



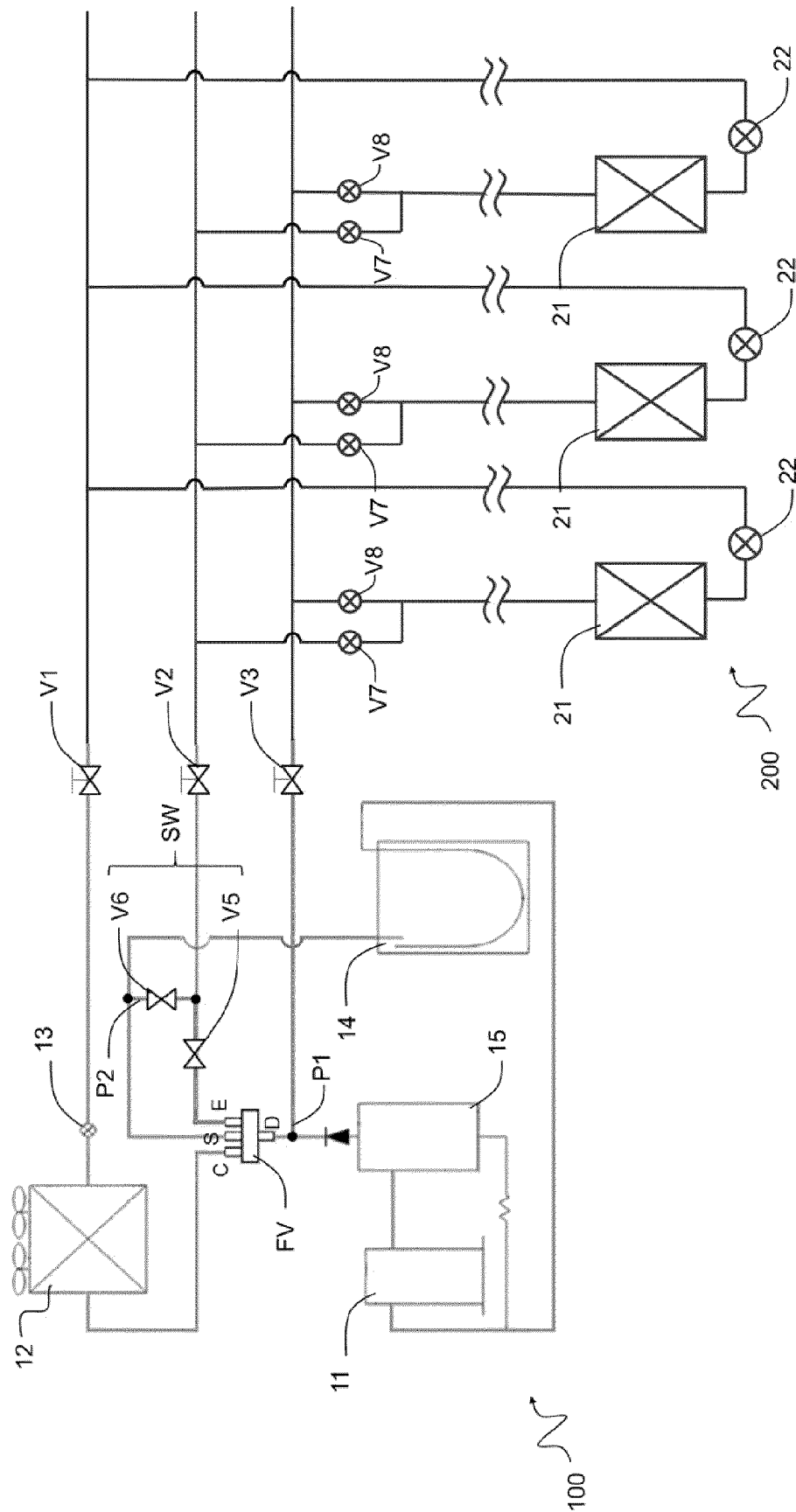


FIG. 7

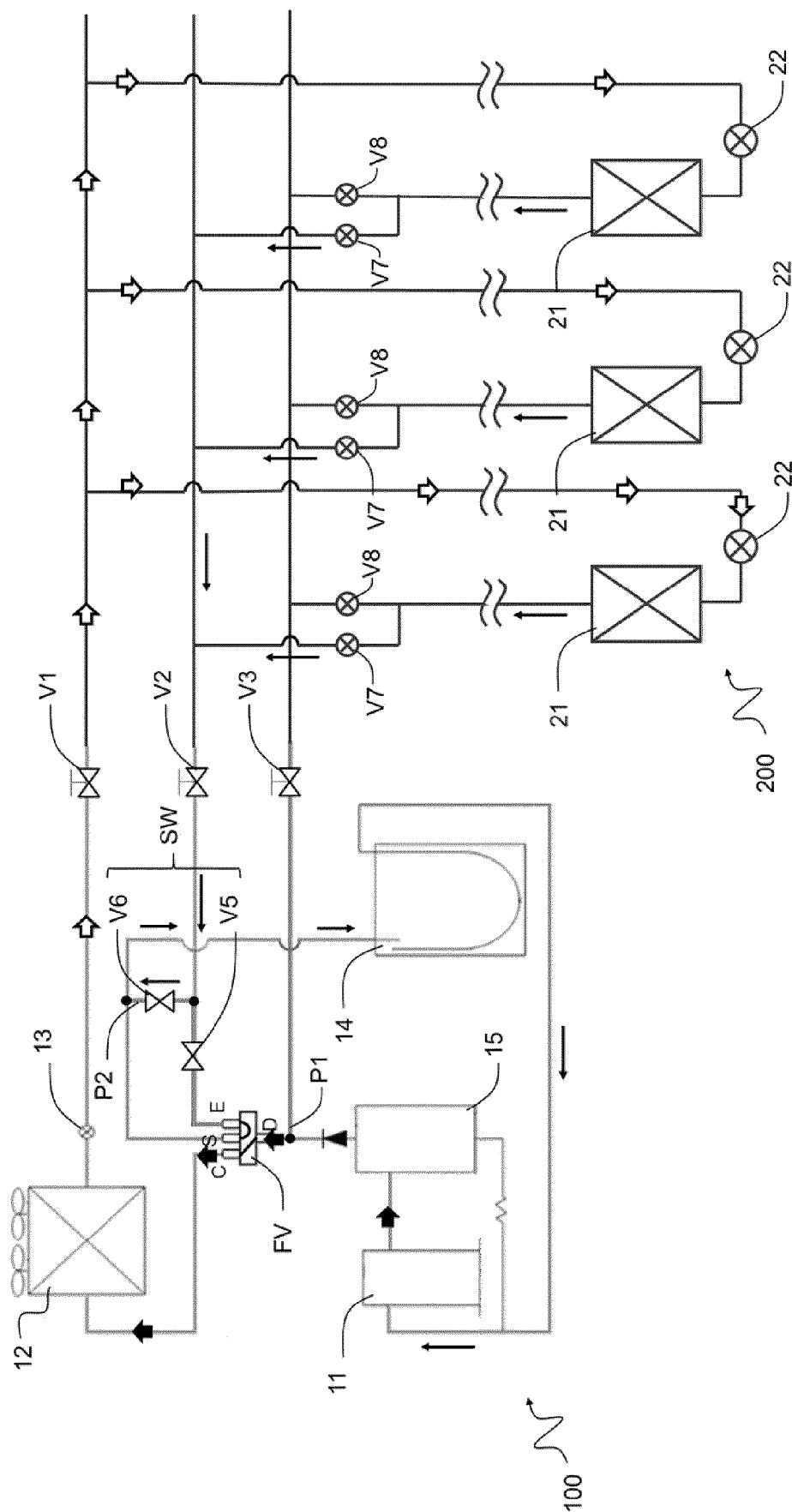


FIG. 8

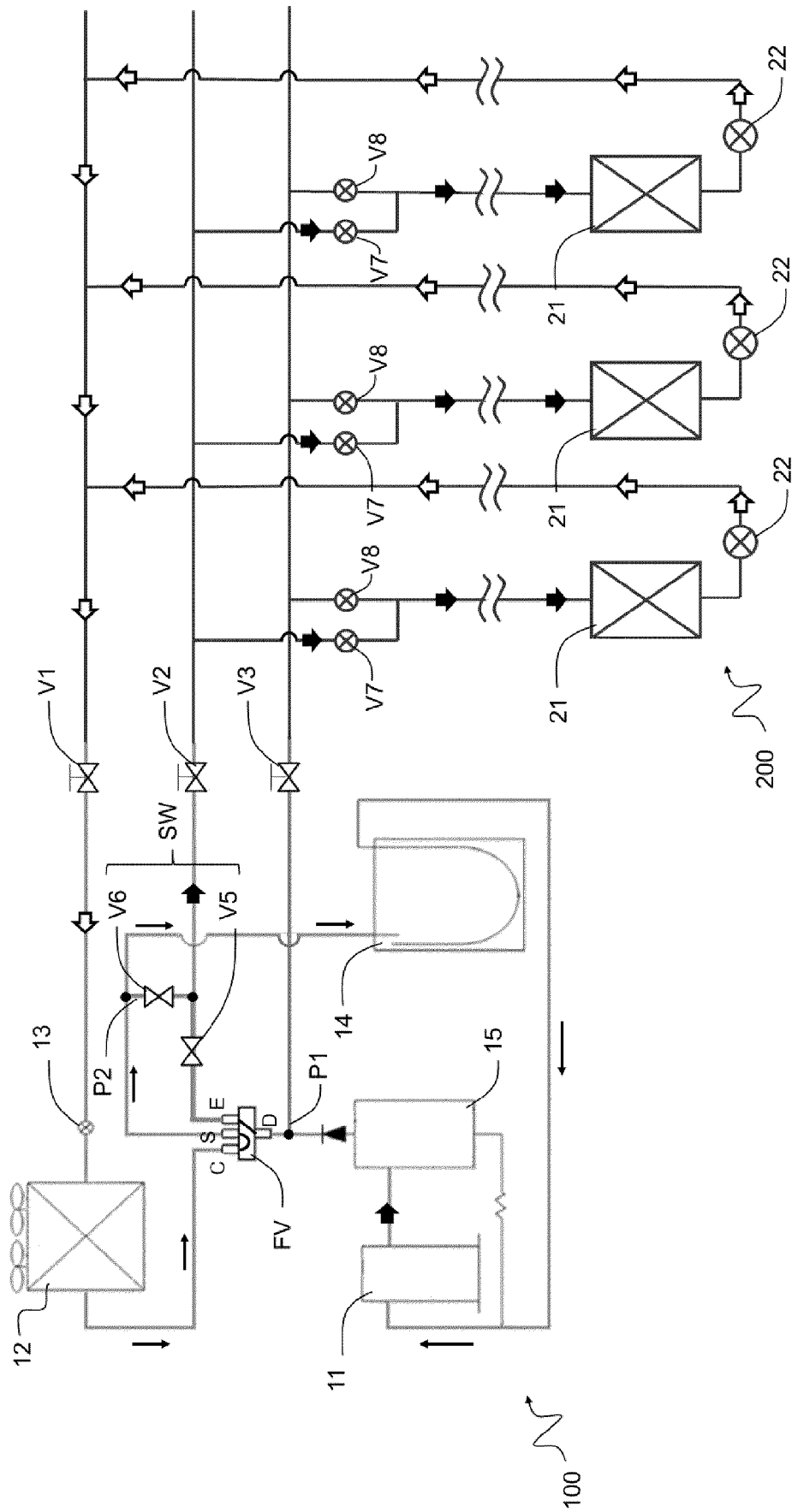


FIG. 9

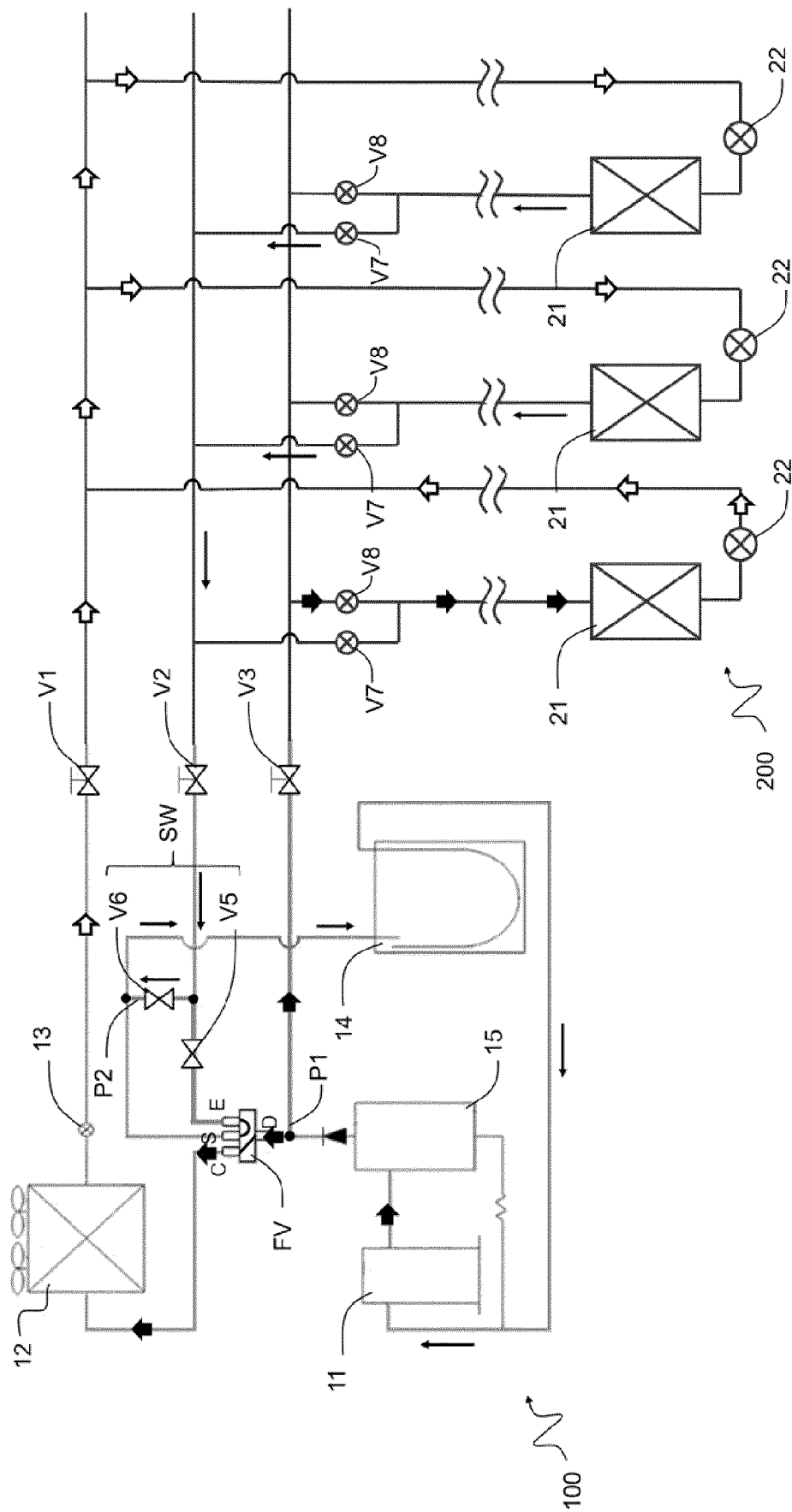


FIG. 10

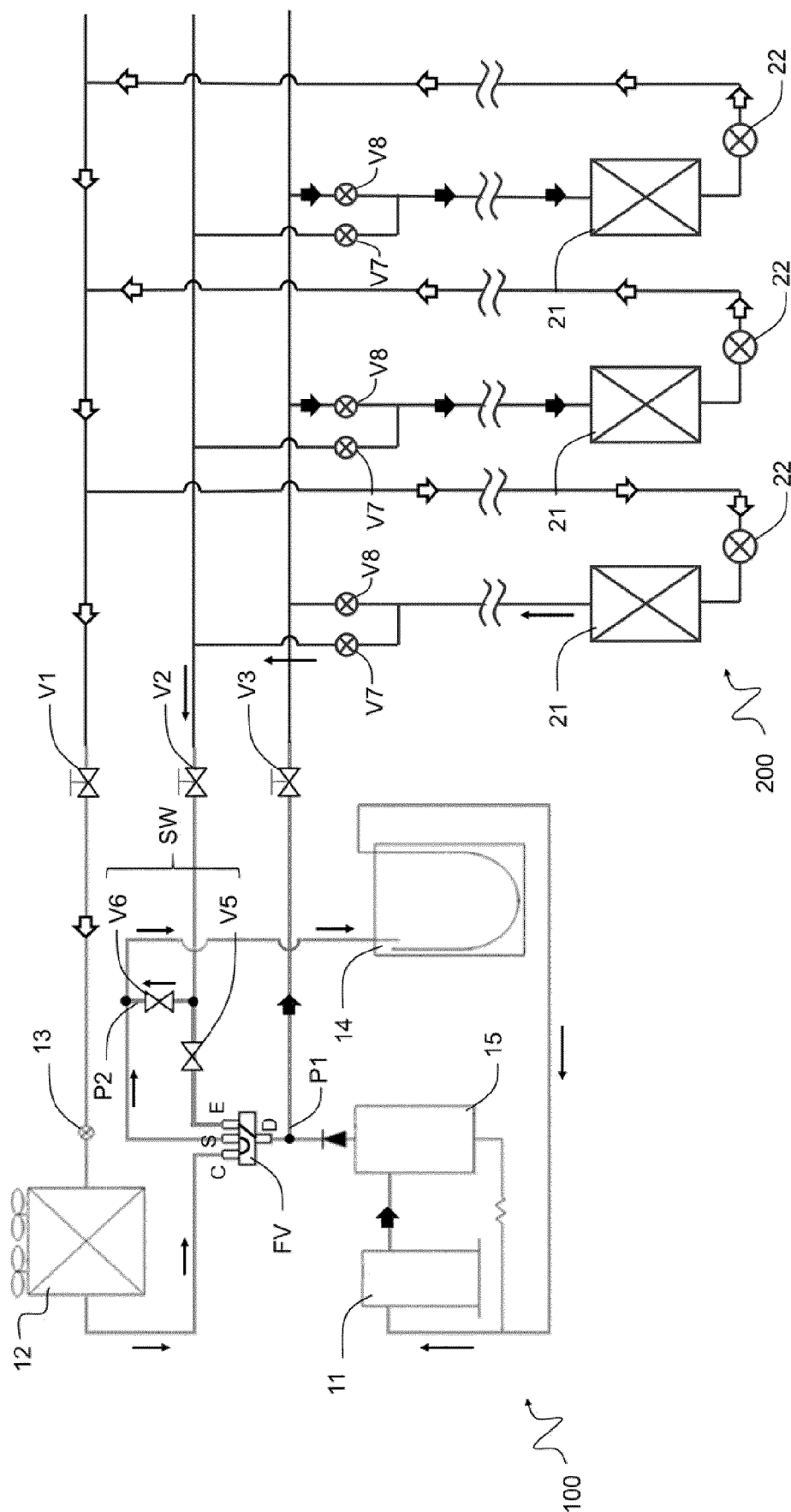


FIG. 11

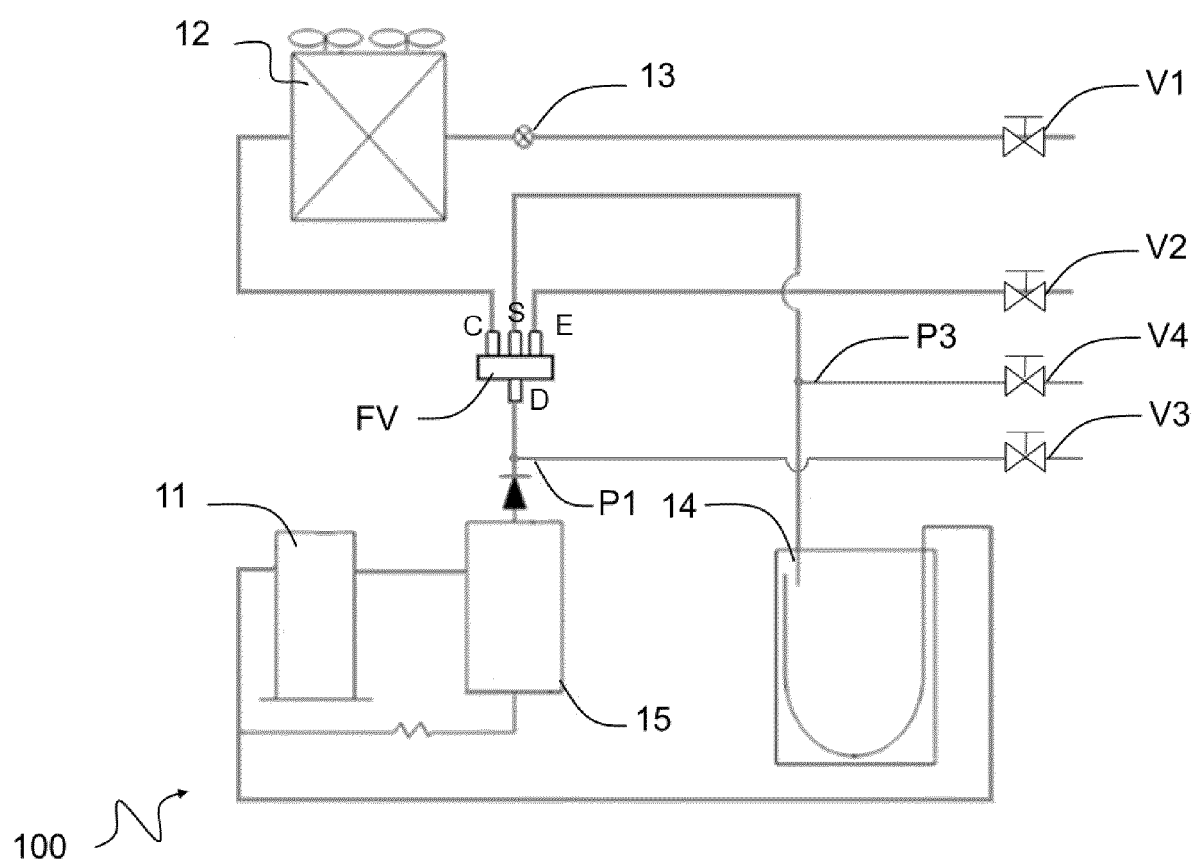


FIG. 12

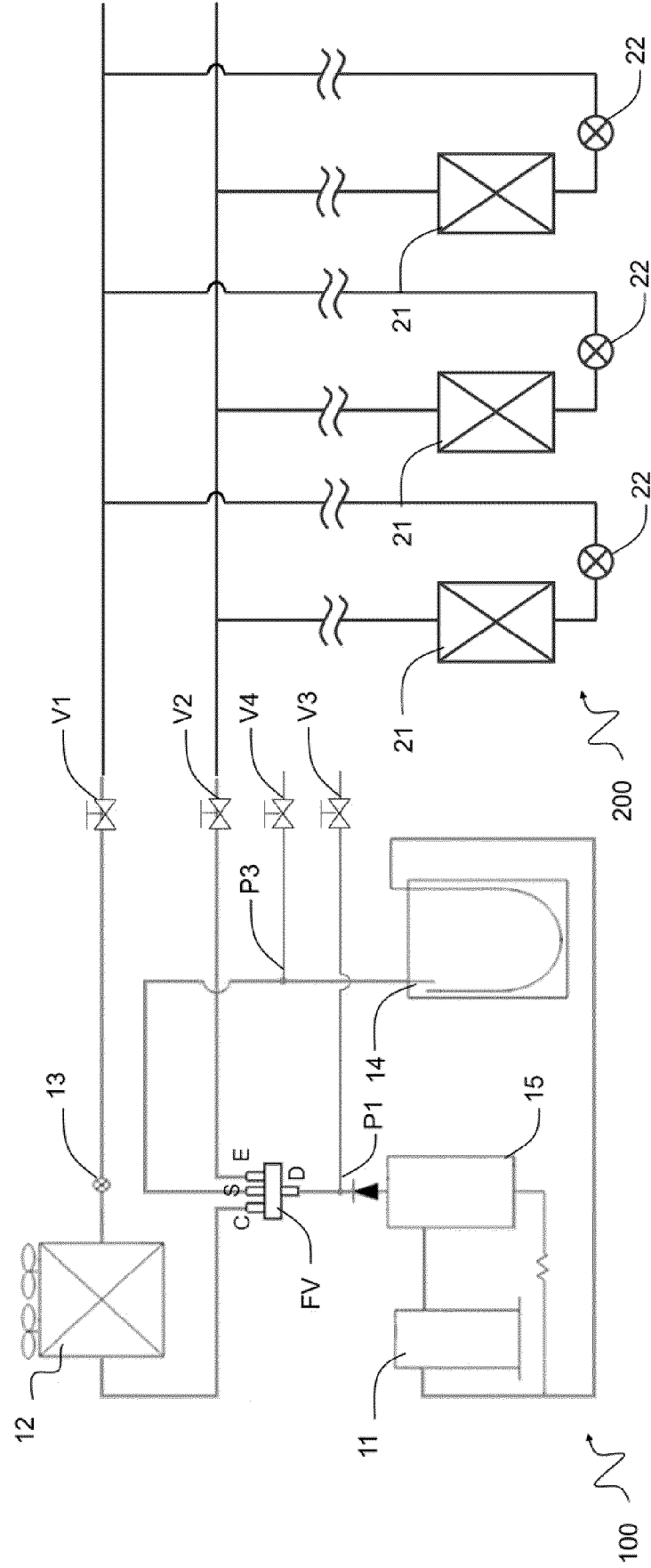


FIG. 13

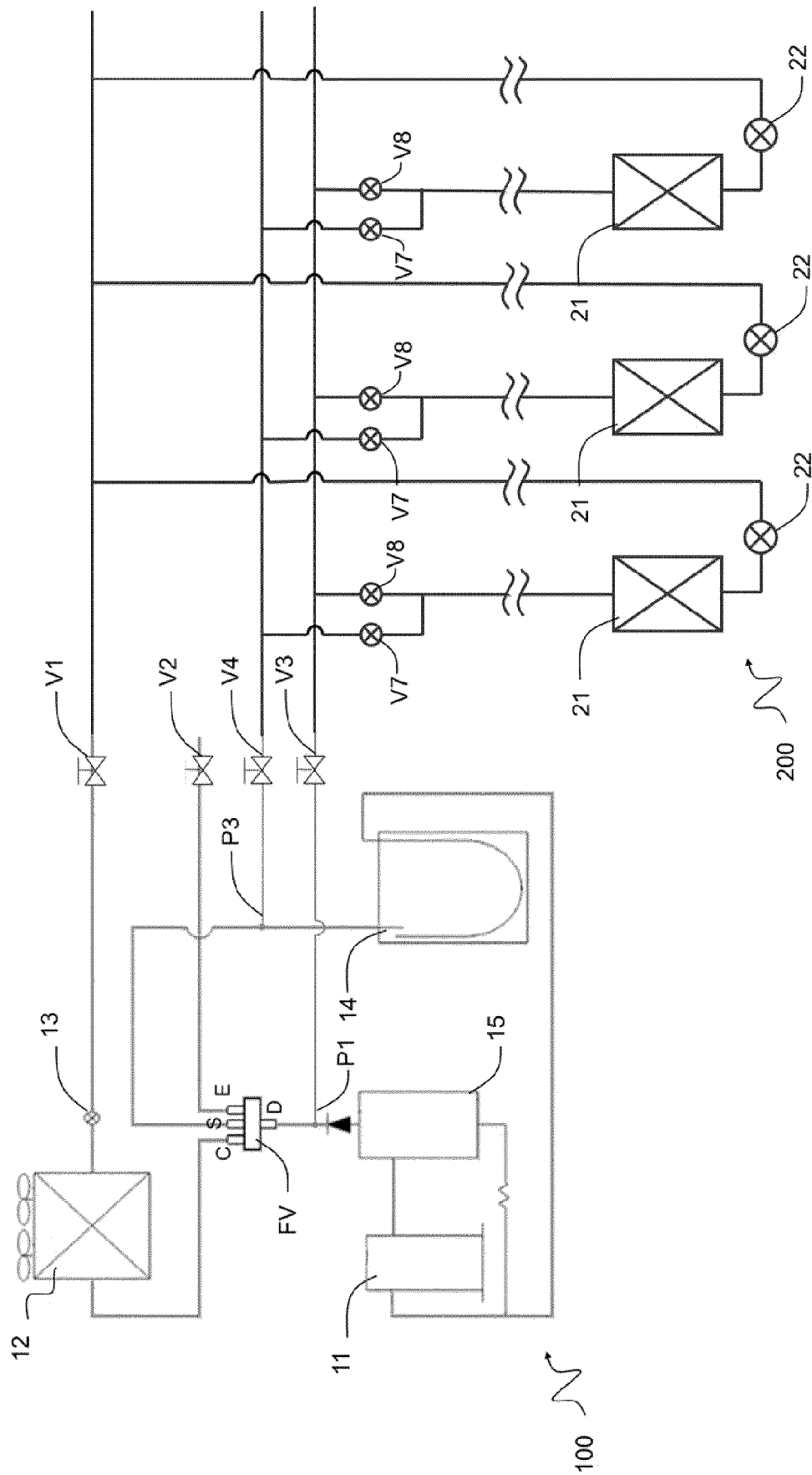


FIG. 14



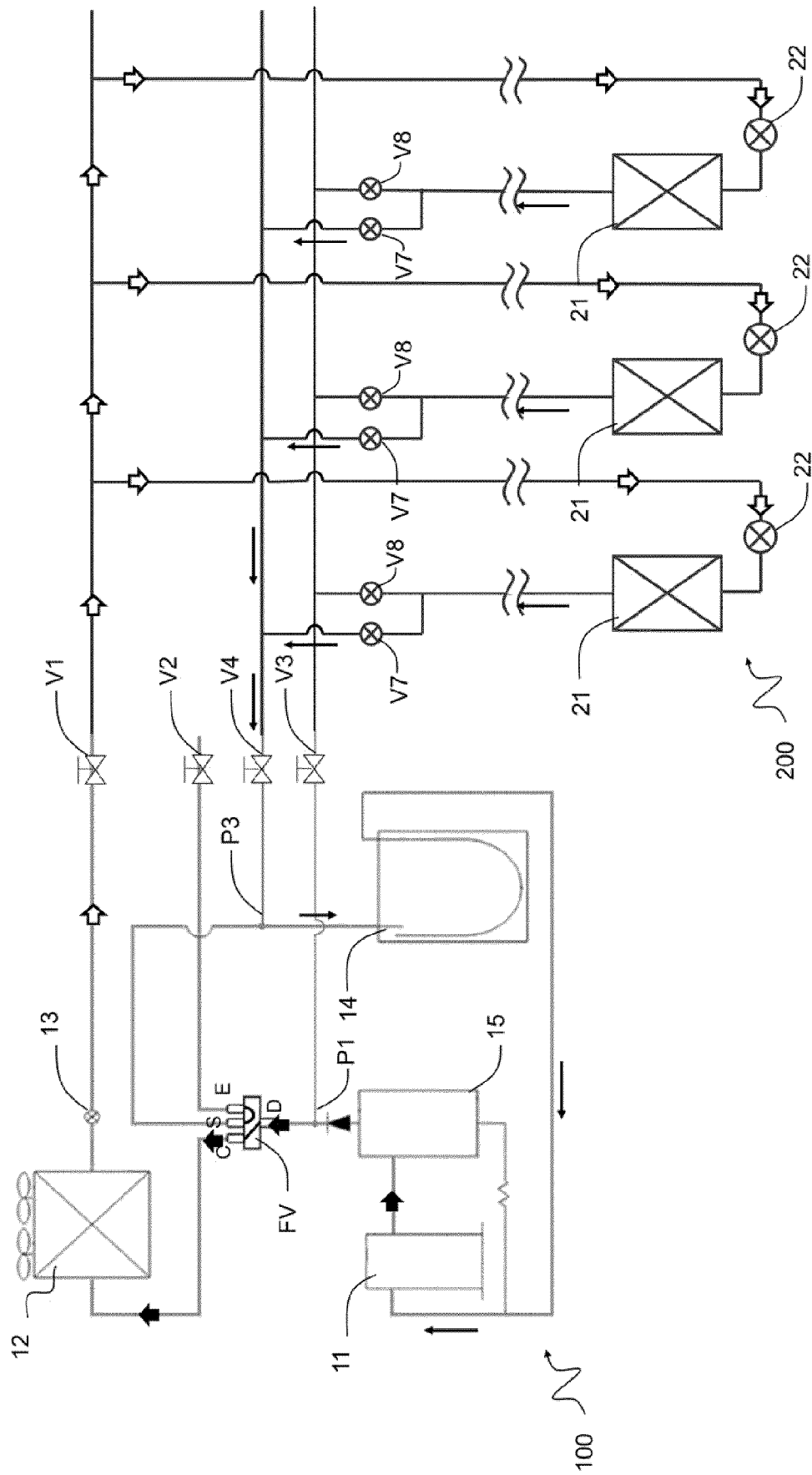


FIG. 15

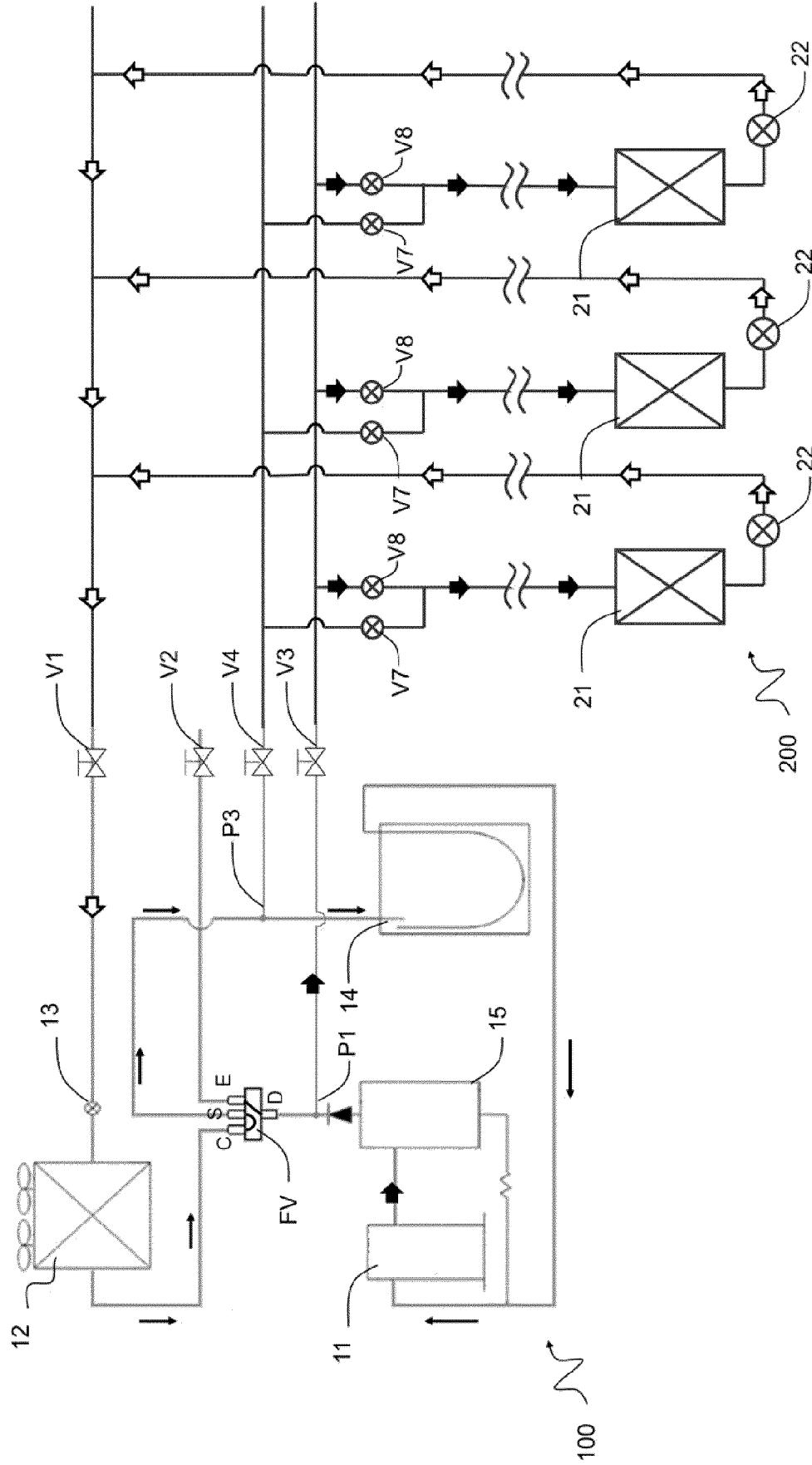


FIG. 16

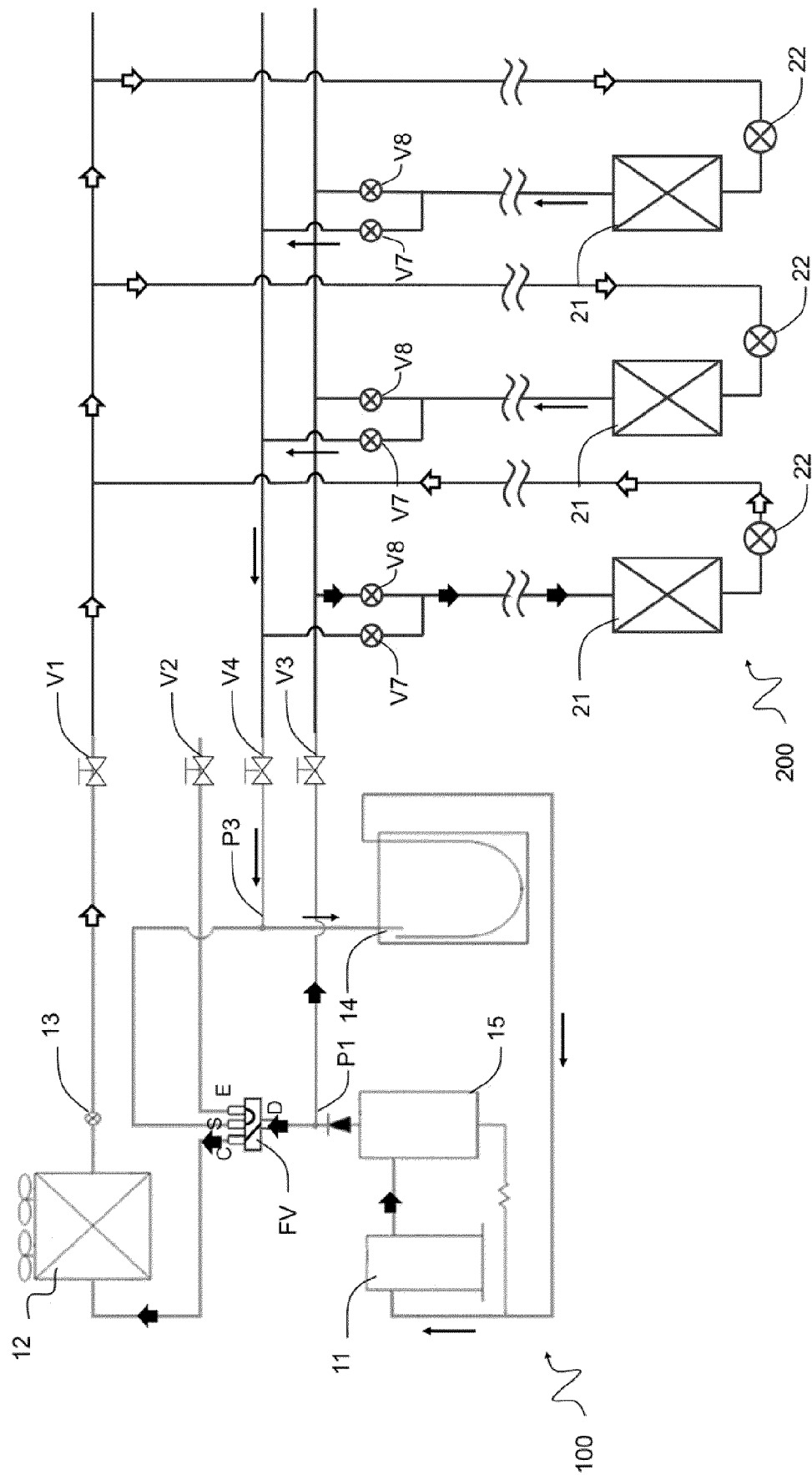


FIG. 17

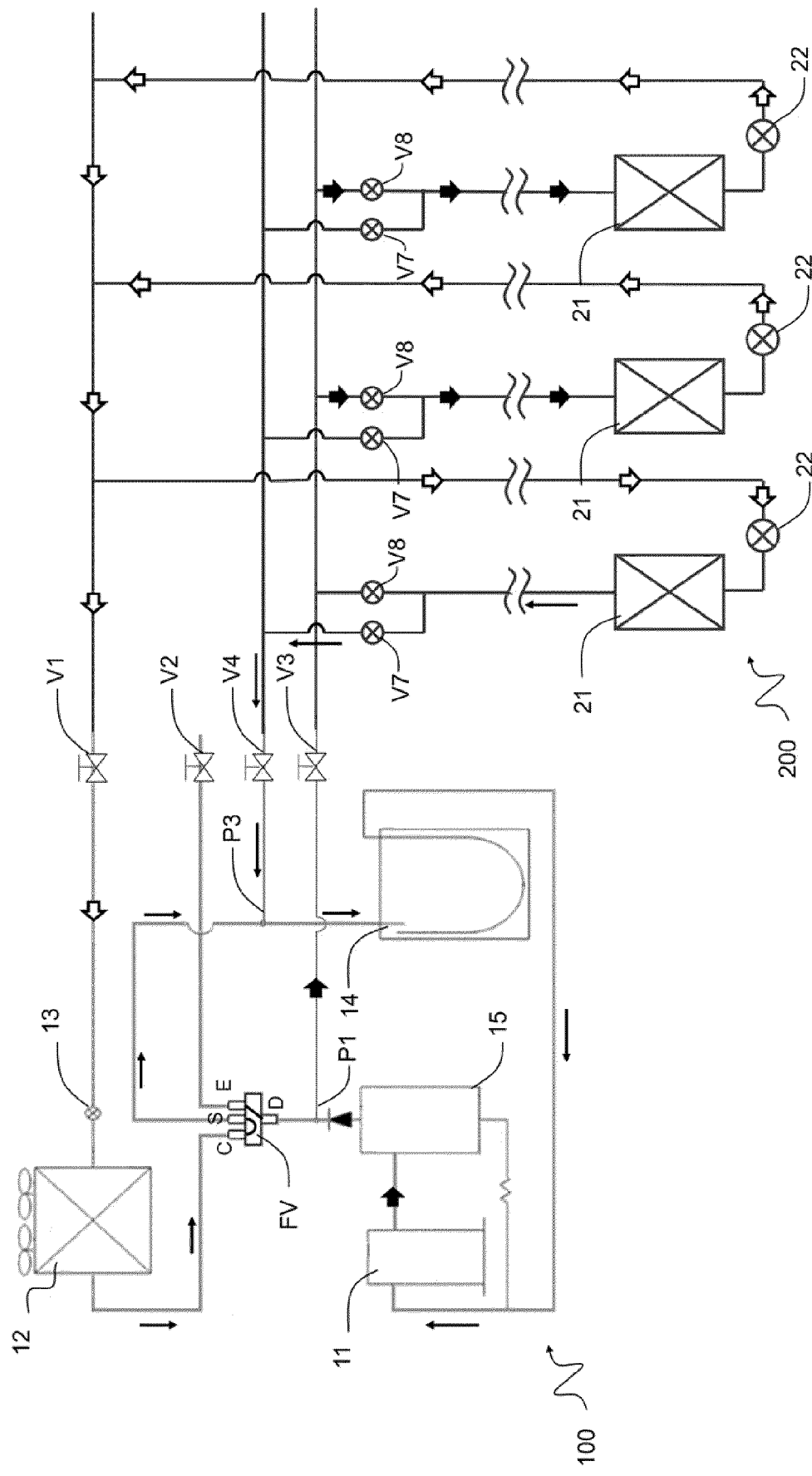


FIG. 18