

DESCRIPTION

Title of the invention: Capture system of carbon dioxide from a gas containing carbon dioxide

5 The present invention relates to the field of treatment of gases containing carbon dioxide, more specifically to a capture system of carbon dioxide from said gases containing carbon dioxide.

When a source of gas, for example of carbon dioxide containing gas, is running, for example a vehicle such as a floating structure, carbon dioxide containing gases are generated. These carbon dioxide containing gases are generally released into the
10 atmosphere, which leads to environmental damages, in particular because of the carbon dioxide they comprise.

In addition to the environmental impact, this release into the atmosphere is a waste of energy, because carbon dioxide has multiple advantages in various technical domains and can, for example, be used as a coolant.

15 Thus, it can be wise to treat carbon dioxide containing gases from a source of emission to extract carbon dioxide and store it for later use or commercialization. However, a system that makes it possible to capture by desublimation the carbon dioxide from a carbon dioxide containing gas flow consumes a vast amount of energy, because it requires a cooling to very low temperature. State of the art systems are not optimized. That is one
20 of the reasons why they are not used.

The present invention remedies these drawbacks by proposing a system to capture carbon dioxide from a gas containing carbon dioxide, comprising at least a first heat exchanger and a second heat exchanger, wherein each heat exchanger comprises at least a chamber, a first line and a second line that both extend through the chamber, the chamber being
25 so configured that a carbon dioxide containing gas flow flows through it and that it captures by desublimation the carbon dioxide from said carbon dioxide containing gas flow in order to generate a decarbonized gas flow, characterized in that the capture system is configured to make the decarbonized gas flow circulate from either one of the chambers through the first line and/or through the second line of at least one of the heat
30 exchangers.

In the context of the invention, the chamber shall be understood as a zone of thermal transfer between a cold flow and a hot flow. This chamber can be materialized by walls that physically delineate the zone, as pictured in the figures and described below. However, the chamber may also not have walls. In this case, the chamber is a zone of thermal transfer between, on one hand, the carbon dioxide containing gas flow and, on the other hand, the decarbonized gas flow and/or a flow of any refrigerant fluid. A heat exchanger with such a chamber is called a multiframe chamber. Similarly, the case with a pipe with a refrigerant fluid flowing through it, around which there is a ring-shaped space with fins, wherein the carbon dioxide containing gas flow is to circulate through this ring-shaped space, is not beyond the scope of the invention. Thus, a person skilled in the art shall understand that all the line and the ring-shaped space constitute the heat exchanger, thus the chamber is the thermal exchange zone around the line.

The capture system according to the invention aims at capturing the carbon dioxide from the carbon dioxide containing gas flow emitted by a source of emission by desublimation of said carbon dioxide containing gas flow. By desublimizing a carbon dioxide containing gas flow, you get a decarbonized gas flow. According to the invention, this decarbonized gas flow is then used as a cooling means for the at least one heat exchanger of the capture system, in order to implement the desublimation of the carbon dioxide containing gas flow supplied to the at least one heat exchanger.

The first heat exchanger and the second heat exchanger are configured to turn the carbon dioxide containing gas flow that flows into said heat exchangers to a decarbonized gas flow by desublimation of carbon dioxide.

One of the two heat exchangers works in the first operating mode to get the cooling parameters allowing the desublimation of carbon dioxide. The desublimized carbon dioxide solidifies onto the walls and the lines of the heat exchanger in the first operating mode. In order to generate the desublimation when the carbon dioxide containing gas flows through the chamber of one and/or the other one of the heat exchangers, one or several fluids flow through the first line and/or through the second line of one and/or the other heat exchanger in the chamber. At least one of the fluids is the decarbonized gas flow from the chamber of the heat exchanger. This takes part in the cooling of the carbon dioxide containing gas flows thanks to some energy already present in the capture system. Advantageously, another fluid can take part in this cooling. Thus, the decarbonized gas flow can be used as a coolant by flowing to the inlet of at least one of

the two lines of one of the heat exchangers operated according to the first operating mode. The decarbonized gas flow has, for example, a temperature of -120°C between the outlet of the chamber and an inlet of the first line and/or of the second line.

Thus, the system generates a heat exchange between said carbon dioxide containing gas flow and the at least one fluid at low temperature that flows through the at least one line of the heat exchanger, inducing the generation of dry ice, which means solid-state carbon dioxide. When there is generation of dry ice, it is possible to say that the heat exchanger is in “desublimation” mode.

Following the capture of the carbon dioxide as dry ice, the carbon dioxide containing gas flow that circulated through the chamber of the heat exchanger comes out of it decarbonized. The decarbonized gas flow goes out at very low temperature, for example at -120°C .

The decarbonized gas flow from the heat exchanger is then available to feed the first line and/or the second line of another heat exchanger of the capture system according to the invention.

In a second operating mode, a carbon dioxide containing gas flow can circulate through the first and/or the second line of the heat exchanger to warm up said lines and the chamber of the heat exchanger to induce the melting of the dry ice around said lines. In the case of an internal combustion engine, the carbon dioxide containing gas flow flows through the first line and/or the second line can have, for example, an input temperature between the temperature of the combustion gases from the internal combustion engine and -33°C . In case of melting of the dry ice, it is possible to say that the heat exchanger is in “regeneration” mode.

In one embodiment, the capture system is configured so that the carbon dioxide containing gas flow which passes through the chamber during the first operating mode is the same gas flow as the carbon dioxide containing gas flow passing through the first line and/or the second line during the second operating mode. In other words, the capture system is configured so that the carbon dioxide containing gas flow first flows through the first line and/or the second line of at least one of the heat exchangers operated in the second operating mode in order to melt the carbon dioxide which has been captured in the chamber, then this same carbon dioxide containing gas flow also flows through the chamber of at least one of the heat exchangers operated in the first operating mode.

According to another characteristic, a line is configured to channel the decarbonized gas flow to the first line and/or to the second line of each of the heat exchangers.

This is a common line linked to each heat exchanger to bring them the decarbonized gas flow that is a source of cold used for the desublimation operation.

- 5 According to another characteristic, a collector collects the decarbonized gas flow after its circulation through the first line and/or to the second line of each of the heat exchangers.

The decarbonized gas flow removed by the first and/or the second line of the heat exchanger flows on through a collector designed to send said decarbonized gas flow to a
10 heat exchanger and/or to a bypass line of said heat exchanger.

According to another characteristic, a line is configured to channel the decarbonized gas flow from one of the heat exchangers to the first line and/or to the second line of said heat exchanger.

- 15 In this embodiment, the line channels the decarbonized gas flow from one of the two heat exchangers to reinject it to the at least one line of this same heat exchanger. Contrarily to the above-mentioned line that commonly feeds the heat exchangers, the line is proper to each heat exchanger.

According to an option of the invention, the capture system comprises at least one regulation means configured to regulate a temperature of desublimation in each chamber.

- 20 This regulation means works by redirecting a part of the decarbonized gas flow in order to prevent them from flowing through the at least one line of the heat exchanger. This part of the redirected gases is sent to an outlet of the capture system, for example downstream from the lines and upstream from a first thermal exchanger. By monitoring the flowrate of decarbonized gas flow through the line of the heat exchanger, the
25 temperature in the chamber is monitored. The regulation means can notably be used at the beginning of the desublimation phase when the thickness of the dry ice is weak and the heat transfer coefficient is high.

- 30 The regulation means comprise at least a channel that links the decarbonized gas line out of the chamber to a release circuit of the decarbonized gas flow, a flow of decarbonized gas through this channel depending on a measurement means for a temperature in the chamber where the decarbonized gas flow comes from.

The same configuration reproduced on each appliance.

According to another characteristic, at least one management means is configured to monitor the circulation of the decarbonized gas flow through one and/or the other one of the lines of one and/or the other one of the heat exchangers.

- 5 A management means can be, for example, an on-off valve that allows or prevents the circulation of the decarbonized gas flow through one and/or the other one of the lines of the heat exchanger. Thus, it shall be understood that the circulation of the decarbonized gas flow is allowed by the management means when the considered heat exchanger is in the first operating mode.

- 10 Advantageously, the capture system comprises at least one management means per heat exchange.

According to another characteristic, the management means comprises at least a first valve upstream from one and/or the other one of the lines of one and/or the other heat exchanger and/or at least a second valve downstream from one and/or the other of the

- 15 lines of one and/or the other heat exchanger.

The first valve is located upstream from the heat exchanger to monitor the input of the decarbonized gas flow through one and/or the other line. The second valve is located downstream from the heat exchanger to monitor the output of the decarbonized gas flow through one and/or the other line.

- 20 The first valve and the second valve are located on both ends of one of the lines of one and/or the other heat exchanger and can switch between an open position and a closed position to allow or prevent the circulation of the decarbonized gas flow through the considered line, for example the second line of one and/or the other heat exchanger, wherein another fluid flows through the first line.

- 25 According to another characteristic, at least one management device is configured to regulate a circulation of a fluid that **flows through** one and/or the other line of one and/or the other heat exchanger. Such a management device can be, for example, a valve that allows or prevents the circulation of the fluid through one and/or the other line of the heat exchanger.

- 30 The capture system is so configured that this fluid is different from the decarbonized gas flow. For example, it can be liquefied natural gas.

According to another characteristic, the management device comprises at least a third valve upstream from one and/or the other line of one and/or the other of the heat exchangers and/or at least a fourth valve downstream from one and/or the other line of one and/or the other heat exchanger.

- 5 The third valve is located upstream from the heat exchanger to monitor the input of the fluid through either one of the lines.

The fourth valve is located downstream from the heat exchanger to monitor the output of the fluid through either one of the lines.

- 10 The third valve and the fourth valve can switch between an open position and a closed position to allow or prevent the circulation of the fluid through the considered line, for example the first line of either one of the heat exchangers, wherein the decarbonized gas flows through the second line.

- 15 Advantageously, the capture system comprises one management device per heat exchange. Thus, preferably, the capture system comprises one management means and one management device per heat exchange, wherein the management means and the management device each regulate a circulation of a fluid through one of the two lines of one of the heat exchangers. The management means is associated with the decarbonized gas flow while the management device is associated with the fluid, for example liquefied natural gas.

- 20 It shall be understood that the capture system is configured to work with liquefied natural gas, because it is one of the fluids that flow through one of the lines of at least one of the heat exchangers.

- 25 The invention takes advantage of the cooling capacity of a refrigerant fluid, for example liquefied natural gas, to cool down the carbon dioxide containing gas flow, thus to desublimize the carbon dioxide.

- 30 In the case where the capture system is laid out in a floating structure for transport and/or storage of liquefied natural gas or any other entity able to transport or store liquefied natural gas, said gas can be used as a means to sublimize carbon dioxide. The floating structure can comprise at least a transport tank and/or a storage tank for the liquefied natural gas and a means to pump liquefied natural gas from there and to make it circulate to the first line and/or to the second line of at least one of the heat exchangers to take part in the capture of carbon dioxide by desublimation. The liquefied natural gas has, for

example, a temperature of -161°C before flowing through the first line and/or the second line. At last, the case where the floating structure transports and/or stores a liquefied gas different from liquefied natural gas remains in the scope of the invention. In this case, it shall be understood that this liquefied gas can circulate to the first line and/or the second
 5 line of at least one of the heat exchangers to take part in the cooling of the carbon dioxide containing gas flow.

Thus, it shall be understood that the circulation of the fluid, for example of liquefied natural gas, is allowed by the management means when the considered heat exchanger is operated according to the first operating mode.

10 According to another characteristic, at least one monitoring means is configured to monitor the circulation of the carbon dioxide containing gas flow through one and/or the other line of one and/or the other heat exchanger.

A monitoring means can, for example, be a valve that allows or prevents the circulation of the carbon dioxide containing gas flow through one and/or the other line of the heat
 15 exchanger.

Advantageously, the capture system comprises one monitoring means per heat exchange.

According to another characteristic, the monitoring means are at least a fifth valve upstream from one and/or the other line of one and/or the other heat exchanger and/or at least a sixth valve downstream from one and/or the other line of one and/or the other
 20 heat exchanger.

The fifth valve is located upstream from the heat exchanger to monitor the input of the carbon dioxide containing gas flow through one and/or the other line.

The sixth valve is located downstream from the heat exchanger to monitor the output of the carbon dioxide containing gas flow through one and/or the other line.

25 The fifth valve and the sixth valve can switch between an open position and a closed position to allow or prevent the circulation of the carbon dioxide containing gas flow through the considered line, for example the first line of either one of the heat exchangers they are allocated to.

According to another characteristic, at least one monitoring device is configured to
 30 monitor the circulation of the carbon dioxide containing gas flow through the chamber of one and/or the other heat exchanger around one and/or the other of its lines.

A monitoring device can, for example, be a valve that allows or prevents the circulation of the carbon dioxide containing gas flow through either one of the lines of the heat exchanger.

In other words, the monitoring device regulates the circulation of the carbon dioxide containing gas flow through the chamber that goes out as the decarbonized gas flow.

Advantageously, the capture system comprises one monitoring device per heat exchange.

Thus, it shall be understood that the monitoring device allows the circulation of the carbon dioxide containing gas flow when the considered heat exchanger is operated according to the first operating mode.

10 According to another characteristic, the monitoring device comprises at least a seventh valve upstream from the chamber of one and/or the other heat exchanger and/or at least an eighth valve downstream from the chamber of one and/or the other heat exchanger.

The seventh valve is located upstream from the heat exchanger to monitor the input of the carbon dioxide containing gas flow through the chamber of said heat exchanger.

15 The eighth valve is located downstream from the heat exchanger to monitor the output of the carbon dioxide containing gas flow through the chamber of said heat exchanger.

The seventh valve and the eighth valve can switch between an open position and a closed position to allow or prevent the circulation of the carbon dioxide containing gas flow through the chamber of the considered heat exchanger.

20 According to another characteristic, the first thermal exchanger is configured to operate an exchange of heat between the carbon dioxide containing gas flow and the decarbonized gas flow, wherein the first thermal exchanger comprises a first line through which the carbon dioxide containing gas flow flows and a second line through which the decarbonized gas flow flows, said first line being located upstream from the chamber of one and/or the other of the heat exchangers and said second line being located downstream from the chamber.

25 The first thermal exchanger makes it possible to pre-cool the carbon dioxide containing gas flow to a temperature close to the desublimation temperature of carbon dioxide. Thus, the carbon dioxide containing gas flow that flows to the chamber of the heat exchanger in the first operating mode has a low temperature, which facilitates the desublimation process.

The heat exchange in the first thermal exchanger happens between the decarbonized gas flow out of the chamber of one of the heat exchangers operated according to the first operating mode and the carbon dioxide containing gas flow through the second line of the first thermal exchanger coming from the source of emission of carbon dioxide containing gas flows. So, the decarbonized gas flow coming from one and/or the other line of one and/or the other heat exchanger can be used to cool down the carbon dioxide containing gas flow that flows through the first line of the first thermal exchanger. Once again, the invention takes advantage of the frigories in the decarbonized gas flow to pre-cool the carbon dioxide containing gas flows before desublimation in the chamber.

According to another characteristic, a regulation system for a temperature of the first thermal exchanger is configured to cool down the carbon dioxide containing gas flow to a temperature close to the desublimation temperature of carbon dioxide in the carbon dioxide containing gas flow.

The required conditions for desublimation are a temperature between -100°C and -120°C for an operating pressure about 4.5 bar abs.

The desublimation threshold temperature is a temperature that guarantees the absence of desublimation in the first thermal exchanger. For example, this temperature is equal to the desublimation temperature below minus a value between 1°C and 5°C .

According to another characteristic, the regulation system comprises at least a bypass line of the second line of the first heat exchanger, a ninth valve configured to monitor the circulation of the decarbonized gas flow through the bypass line and a detection device of the temperature of the carbon dioxide containing gas flow at an outlet of the first line of said first thermal exchanger.

The monitoring device makes it possible to monitor the temperature of the carbon dioxide containing gas flow in order to monitor the phase change of carbon dioxide, notably by preventing a desublimation of the carbon dioxide when flowing through the first heat exchanger instead of when flowing through the chamber of one of the heat exchangers in the first operating mode.

For example, the first detection device is a temperature probe located in the carbon dioxide containing gas flow.

The ninth valve is configured to allow or prevent the circulation of the decarbonized gas flow through the bypass line in order to prevent a circulation through the second line of

the first thermal exchanger. When the ninth valve allows the flow of decarbonized gas through the bypass line, said decarbonized gas flow does not cool down the carbon dioxide containing gas flow in the first line of the first thermal exchanger.

When the ninth valve prevents the flow of decarbonized gas through the bypass line, said
5 decarbonized gas flows through the first thermal exchanger. As a consequence, the carbon dioxide containing gas flow through the first line of the first thermal exchanger is cooled down by heat exchange with the decarbonized gas flow.

According to another characteristic, the carbon dioxide containing gas flow can come from an internal combustion engine. The engine works thanks to a fuel, and the resulting
10 exhaust gases generate the carbon dioxide containing gas flow. Such a fuel can be the liquefied natural gas stored in the floating structure. In this case, the internal combustion engine and the capture system make up a group.

According to another characteristic, the capture system of carbon dioxide from a carbon dioxide containing gas flow is configured to provide a liquid flow of carbon dioxide.

15 When the carbon dioxide captured as dry ice in the chamber is melted, it is recovered to be collected in liquid state in a storage means, for example a tank or a reservoir.

The scope of the invention also covers a process to desublimize carbon dioxide from a carbon dioxide containing gas flow, by implementing a capture system of carbon dioxide as described herein, where carbon dioxide from a carbon dioxide containing gas flow is
20 first desublimized in a chamber of either one of the heat exchangers, then at least a part of the decarbonized gas flow is sent to one and/or the other line of either one of the heat exchangers.

The scope of the invention also covers a process to regulate the temperature of the carbon dioxide containing gas flow that implements the capture system as described herein,
25 wherein the temperature of the carbon dioxide containing gas flow is regulated, so that this temperature is higher than the threshold desublimation temperature of carbon dioxide by a value between 1°C and 5°C. This regulation is operated by the temperature regulation system of the above-mentioned first heat exchanger.

More precisely, the temperature of the carbon dioxide containing gas flow is measured,
30 for example thanks to the detection device; the measured temperature value of the carbon dioxide containing gas flow is compared to the threshold desublimation temperature of carbon dioxide; the temperature of the carbon dioxide containing gas flow is regulated,

so that this temperature is equal to the threshold desublimation temperature of carbon dioxide plus a value between 1°C and 5°C. This guarantees that desublimation will not start in the first heat exchanger.

Other characteristics, details and advantages of the invention will appear thanks to the following detailed description produced as a guide and non-limitative with a reference to the appended schematic pictures, where:

[Fig. 1] schematically shows a system to capture carbon dioxide from a carbon dioxide containing gas flow according to the invention in a first embodiment;

[Fig. 2] schematically shows the function of the first embodiment of the system to capture carbon dioxide from a carbon dioxide containing gas flow according to the invention of figure 1;

[Fig.3] schematically shows the system to capture carbon dioxide from a carbon dioxide containing gas flow according to the invention of figures 1 and 2 with three heat exchangers;

[Fig. 4] schematically shows a system to capture carbon dioxide from a carbon dioxide containing gas flow according to the invention in a second embodiment;

[Fig. 5] schematically shows the function of the second embodiment of the system to capture carbon dioxide from a carbon dioxide containing gas flow according to the invention of figure 4;

[Fig.6] schematically shows the system to capture carbon dioxide from a carbon dioxide containing gas flow according to the invention of figures 4 and 5 with three heat exchangers;

The characteristics, the variants and the various embodiments of the invention such as described hereabove or hereafter in the detailed description can be associated under various combinations, as far as they are not mutually incompatible or exclusive. You could conceive variants of the invention, which only include a selection of characteristics as described below, apart from the other described characteristics, as far as this selection of characteristics is enough to give a technical advantage and/or to distinguish the invention from the previous state of the art.

The present document uses the words “upstream” and “downstream” to define the relative position of the components. These words are to be considered relatively to the flowing direction of the fluid through these components or through the relevant circuit.

Figure 1 shows a first embodiment of a system 1 to capture carbon dioxide from a carbon dioxide containing gas according to the invention. For example, such a capture system 1 can be integrated in a vehicle, as the outlet of a chimney, a plant, or any other entity that comprises a source of emission 6 of carbon dioxide containing gas. For example, the source of emission 6 can be an internal combustion engine, such as an engine to propel a vehicle or the engine of an electrical generator of said vehicle.

10 When the source of emission 6 is working, it emits carbon dioxide containing gases that contain carbon dioxide. Thus, the capture system 1 is configured to capture the carbon dioxide in a carbon dioxide containing gas flow 2 from the source of emission 6 in order to mitigate the greenhouse effect induced by carbon dioxide when it is released into the atmosphere.

15 In other words, the capture system 1 according to the invention makes it possible to produce a decarbonized gas flow 3 after capture of the carbon dioxide from the carbon dioxide containing gas flow 2. In order to guarantee the capture of the carbon dioxide, the capture system 1 comprises at least two heat exchangers 4, in particular a first heat exchanger 4a and a second heat exchanger 4b.

20 Each heat exchanger 4 comprises a chamber 14 that can be defined, for example, as an internal closed space constituting the considered heat exchanger 4. Each chamber 14 comprises two lines 12 that extend in a volume that is delineated by the chamber 14. More precisely, each chamber in a heat exchanger 4 comprises a first line 12a and a second line 12b through which a fluid can circulate. Thus, a heat exchange can be implemented
25 between the lines 12, where a fluid flows, and the chamber 14.

The heat exchangers 4 have the possibility to be operated according to a first operating mode and a second operating mode.

The first operating mode is called a “desublimation” mode that makes it possible to capture carbon dioxide from the carbon dioxide containing gas flow 2. In this first
30 operating mode, the carbon dioxide containing gas flow 2 flows through the chamber 14 of either one of the heat exchangers 4, so that the carbon dioxide is desublimized. The capture of carbon dioxide by desublimation results in forming dry ice. Thus, dry ice settles

onto the lines 12 and against the walls of the chamber 14 of the heat exchanger 4. This desublimation results from a cooling thanks to a fluid that flows through the lines 12 of the heat exchanger 4. Once the carbon dioxide is in solid state, the carbon dioxide containing gas flow 2 becomes a decarbonized gas flow 3.

- 5 The second embodiment is called a “regeneration” mode that makes it possible to melt the dry ice generated in the lines 12 of the heat exchanger 4 during the implementation of the first operating mode. When the lines 12 of one of the heat exchangers 4 are saturated in dry ice, the heat exchanger 4 switches from the first operating mode to the second operating mode in order to induce the melting of the dry ice and allow a new
10 desublimation/regeneration cycle. The dry ice melts thanks to the input of calories into the carbon dioxide containing gas flow 2 that flows through the lines 12 of the heat exchanger 4. Its temperature is high enough to allow the transformation of dry ice into liquid-state carbon dioxide 52.

- The liquid-state carbon dioxide 52 from one or several heat exchangers 4, 4a, 4b is
15 recovered and brought to a storage means 53 for recycling or reuse. The emptying of the liquid-state carbon dioxide from the at least one chamber 14, 14a, 14b, 14c depends on a drain valve 60.

- Each heat exchanger 4 must periodically switch from the first operating mode to the second operating mode to secure the continuity of the capture of carbon dioxide from
20 the carbon dioxide containing gas flow 2, which is continuously produced by the source of emission 6.

- In order to alternate between the two operating modes, the heat exchangers 4 both comprise at least one management means 42, at least one management device 40, at least one monitoring means 38 and at least one monitoring device 44, which all take part in the
25 management of the circulation of the various fluids through the lines 12 of the heat exchangers 4 according to the operating mode.

- No matter the embodiment of the invention or its variants, there is a regulation means 62, whose role is to control the temperature in at least one of the two chambers 14, 14a, 14b, and advantageously in a unique chamber or in all the chambers in the first operating
30 mode. By controlling the temperature in the chamber 14, it is possible to act on the desublimation that takes place in this chamber 14. To do so, the regulation means 62 comprises at least a channel 63 that links the line 22, in the case of figures 1 to 3, or the

line 54 in the case of figures 4 to 6, to a release circuit 20 of the decarbonized gas flow 3. This channel 63 allows a part of the decarbonized gas flow 3 to bypass the one or several lines 12 of the one or several heat exchangers 4 according to the considered embodiment. Thus, the flowrate through the line can be reduced, which means the supply of cold into the chamber 14 can be adjusted.

The circulation of the decarbonized gas flow 3 through this channel 63 depends on a measurement means 64 for the temperature in at least one of the two chambers 14, 14a, 14b. This measurement means 64 is, for example, a temperature sensor in the chamber 14, or outside of it but immersed in the gas flow. This measurement means 64 acts on a regulation valve 65 located on the channel 63 and that adjusts the flowrate of the decarbonized gas flow 3 through the channel 63.

The management means 42 makes it possible to monitor the circulation of the decarbonized gas flow 3 through one and/or the other of the lines 12 of the heat exchangers 4. Thus, the management means 42 comprises a first valve 42a and a second valve 42b, the first valve 42a being located upstream from the heat exchanger 4 while the second valve 42b is downstream from heat exchanger 4. The management means 42 can be an on-off valve or a variable opening device.

The management device 40 makes it possible to monitor the circulation of the liquefied natural gas 30 through one and/or the other of the lines 12 of the heat exchangers 4. Thus, the management device 40 comprises a third valve 40a and a fourth valve 40b, the third valve 40a being located upstream from the heat exchanger 4 while the fourth valve 40b is downstream from heat exchanger 4. The management device 40 can be an on-off device or a variable opening device.

The liquefied natural gas 30 constitutes a cooling source for the heat exchanger 4 to take part in the desublimation when said heat exchanger 4 is in the first operating mode.

Thus, it shall be understood that the first valve 42a, the second valve 42b, the third valve 40a and the fourth valve 40b are open to allow the circulation of the coolants when the considered heat exchanger 4 is in the first operating mode, i.e. the decarbonized gas flow 3 and the liquefied natural gas 30, through the lines 12 of the heat exchanger 4 in order to reach a temperature favorable to desublimation.

The monitoring means 38 makes it possible to monitor the circulation of the carbon dioxide containing gas flow 2 through one and/or the other of the lines 12 of the heat

exchangers 4. Thus, the monitoring means 38 comprises a fifth valve 38a and a sixth valve 38b, the fifth valve 38a being located upstream from the heat exchanger 4 while the sixth valve 38b is downstream from heat exchanger 4. The monitoring means 38 can be an on-off device or a variable opening device.

- 5 Advantageously, as pictured on figure 1, each monitoring means 38 comprises two fifth valves 38a and two sixth valves 38b, which means a fifth valve 38a and a sixth valve 38b upstream and downstream from each of the lines 12 of the considered heat exchanger 4.

Thus, it shall be understood that the fifth valves 38a and the sixth valves 38b are open to allow the circulation of the carbon dioxide containing gas flow 2 through the lines 12 of
 10 the heat exchanger 4 when the considered heat exchanger 4 is in the second operating mode in order to take part in the melting of the dry ice in said heat exchanger 4.

The monitoring device 44 makes it possible to monitor the circulation of the carbon dioxide containing gas flow 2 through the chamber 14 of the heat exchangers 4. Thus, the monitoring device 44 comprises a seventh valve 44a and an eighth valve 44b, the seventh
 15 valve 44a being located upstream from the heat exchanger 4 while the eighth valve 44b is downstream from heat exchanger 4. The monitoring device 44 can be an on-off device or a variable opening device.

Thus, it shall be understood that when the heat exchanger 4 is in the first operation mode, the seventh valves 44a and the eighth valves 44b are open to allow the circulation of the
 20 carbon dioxide containing gas flow 2 through the chamber 14 of the heat exchanger 4 in order to capture the carbon dioxide from said flow.

The capture system 1 further comprises a first thermal exchanger 16 and a second thermal exchanger 10, each of them being configured to operate an exchange of heat between the carbon dioxide containing gas flow 2 and the decarbonized gas flow 3. It can be
 25 considered that this first thermal exchanger 16 and this second thermal exchanger 10 are part of both the supply circuit 8 and the release circuit 20.

The decarbonized gas flow 3 out of the first heat exchanger 4 has a low temperature because of the implementation of the first operating mode. Contrarily to the decarbonized gas flow 3, the carbon dioxide containing gas flow 2 has a high temperature because it
 30 comes from the source of emission 6.

Thus, the decarbonized gas flow 3 is able to cool down the carbon dioxide containing gas flow 2. To do so, the first thermal exchanger 16 and the second thermal exchanger 10 feature each a first line 16a, 10a and a second line 16b, 10b.

The carbon dioxide containing gas 2 flows through the first line 16a of the first thermal exchanger 16 and the decarbonized gas 3 flows through the second line 16b. Similarly, the decarbonized gas 3 flows through the first line 10a of the second thermal exchanger 10 and the carbon dioxide containing gas flow 2 flows through the second line 10b. Thus, the first thermal exchanger 16 and the second thermal exchanger 10 both make it possible to implement an exchange of heat between two above-mentioned flows in order to decrease the temperature of the carbon dioxide containing gas flow 2.

The capture system 1 can further comprise a third thermal exchanger 18, which, contrarily to the first and the second thermal exchangers, operates an exchange of heat between the carbon dioxide containing gas flow 2 and the liquefied natural gas 30.

The liquefied natural gas 30 is stored in a tank 34 at low temperature, which means less than -161°C at atmospheric pressure. Thus, the liquefied natural gas 30 is able to cool down the carbon dioxide containing gas flow 2. To do so, the third thermal exchanger 18 features a first line 18a and a second line 18b.

The carbon dioxide containing gas flow 2 flows through the first line 18a of the third heat exchanger 18 and the liquefied natural gas 30 flows through the second line 18b. Thus, the third heat exchanger 18 makes it possible to exchange heat between the two above-mentioned flows.

Figure 2 corresponds to the circulation of the various above-mentioned fluids through the capture system 1 according to the first embodiment.

In the figures 2 and 3, the thick plain lines are where the carbon dioxide containing gas flow 2 flows, the thin plain lines are where the decarbonized gas 3 flows, the mixed lines are where liquefied natural gas flows, the long dotted lines correspond to a flow of liquid carbon dioxide, and the short dotted lines correspond to pipes where there is no circulation of any fluid in the considered operating mode.

In the figure 2, the second heat exchanger 4b works in the first operating mode. In other words, the capture of the carbon dioxide by desublimation of the carbon dioxide containing gas flow 2 is happening in the second heat exchanger 4b, more precisely in the chamber 14b.

At the same time, the first heat exchanger 4a is in the second operating mode. In other words, the melting of the dry ice resulting from the desublimation of the carbon dioxide containing gas flow 2 happens in the first heat exchanger 4a, more precisely in the chamber 14a, when the first heat exchanger 4a has been used in the first operating mode.

- 5 In order to secure the circulation of the carbon dioxide containing gas flow 2 to the heat exchanger 4b for desublimation, the capture system 1 features a supply circuit 8. This first supply system comprises a main line 8a and a secondary line 8b. The main line 8a first carries the carbon dioxide containing gas flow 2 to the second thermal exchanger 10, where it is pre-cooled thanks to the heat exchange with the decarbonized gas 3 that flows
10 through the second line 10b of the second thermal exchanger 10.

Out of the second thermal exchanger 10, the supply circuit 8 carries the carbon dioxide containing gas flow 2 to the lines 12 of the first heat exchanger 4a.

- The monitoring means 38 allow the circulation of the carbon dioxide containing gas flow 2 through one or the two lines 12 of the first heat exchanger 4a by maintaining the fifth
15 valves 38a and the sixth valves 38b open. The circulation of the carbon dioxide containing gas flow 2 through the lines 12 makes it possible to bring heat to the chamber 14a of the first heat exchanger 4a, which melts the dry ice in said first heat exchanger 4a. The temperature of the carbon dioxide containing gas flow decreases by yielding heat to the dry ice and goes out of the lines 12a and 12b colder than when it went in.

- 20 Out of the lines 12 of the first heat exchanger 4a, the carbon dioxide containing gas flow 2 flows through the first thermal exchanger 16, where it is cooled once again thanks to the heat exchange with the decarbonized gas 3 that flows through the second line 16b of the first thermal exchanger 16.

- Out of the first thermal exchanger 16, the carbon dioxide containing gas flow 2 keeps on
25 flowing through the supply circuit 8 to the second heat exchanger 4b.

- The monitoring device 44 allows the circulation of the carbon dioxide containing gas flow 2 through the chamber 14b of the second heat exchanger 4b by maintaining the seventh valve 44a and the eighth valves 44b open. The circulation of the carbon dioxide containing gas flow 2 through the second chamber 14b makes it possible to circulate this carbon
30 dioxide containing gas flow 2 to desublimize the carbon dioxide.

Thus, the carbon dioxide containing gas flow 2 into the second chamber 14b is pre-cooled in three steps: through the thermal exchanger 10, then through at least one of the lines of

the heat exchanger 4a, and finally through the first thermal exchanger 16. The carbon dioxide containing gas flow 2 is additionally pre-cooled by the second thermal exchanger 10.

After this pre-cooling, this carbon dioxide containing gas flow 2 is cooled because of the decarbonized gas flow 3, on one hand, and of the liquid natural gas flow 30, on the other hand, through the lines 12 of the second heat exchanger 4b. That is here that the carbon dioxide in this carbon dioxide containing gas flow 2 is desublimized.

The capture of the carbon dioxide in the carbon dioxide containing gas flow 2 generates the decarbonized gas flow 3. The decarbonized gas flow 3 is circulated by a release circuit 20.

The release circuit 20 comprises at least the line 22 configured to channel the decarbonized gas flow 3 out of at least one of the chambers 14 of at least one of the heat exchangers 4 in the first operating mode to at least one of the lines 12 of at least one of the heat exchangers 4 in the first operating mode. It is interesting to distribute this way the decarbonized gas flow 3 from the heat exchangers 4, because it constitutes a cooling source useful for the desublimation.

The line 22 sends the decarbonized gas flow 3 from the second chamber 14b of the second heat exchanger 4b to the second line 12b of the second heat exchanger 4b.

A part of the decarbonized gas flow 3 can also be sent directly to the first thermal exchanger 16 without passing through the at least one heat exchanger 14. The flowrate through the line 12 is thus reduced. The measurement means 64 monitors the flowrate of the decarbonized gas flow 3 through the line 12. This monitoring is a function of the temperature in the chamber 14.

The management means 42 allows the circulation of the decarbonized gas flow 3 through only one of the two lines 12 of the second heat exchanger 4b by maintaining the first valve 42a and the second valve 42b open. The decarbonized gas flow 3 through the second line 12b makes it possible to cool the chamber 14b of the second heat exchanger 4b, thus taking part in the desublimation.

Out of the second line 12b of the second heat exchanger 4b, the decarbonized gas flow 3 is collected in a collector 24. The collector 24 can take part in the release circuit 20. The collector 24 collects the decarbonized gas flow 3 from the second line 12b of the second heat exchanger 4b. The collector 24 makes notably possible to circulate the decarbonized

gas flow 3 to the second line 16b of the first thermal exchanger 16 to cool down the carbon dioxide containing gas flow 2 through the first line 16a of the first thermal exchanger 16, as mentioned above.

Out of the first thermal exchanger 16, the decarbonized gas flow 3 keeps on flowing to
 5 the second thermal exchanger 10 to cool down the carbon dioxide containing gas flow 2 through the second line 10b of the second thermal exchanger 10. Then, the decarbonized gas 3 flows out of the capture system 1.

The capture system 1 further comprises a third supply circuit 28 where a flow of liquefied natural gas 30 circulates. The liquefied natural gas 30 stored in the tank 34 is sucked by a
 10 pump 32 located, for example, in said tank. Thus, the liquefied natural gas 30 is removed from the tank 34 to reach the heat exchanger 4 when at least one of said heat exchangers is in the first operating mode. The flowrate of this liquefied natural gas 30 is monitored by a monitoring valve 61 on the third supply circuit 28 between an outlet of the pump 32 and upstream from the line 12 of the heat exchanger 14, for example by connection of
 15 the inlet of the fourth valve 40b.

It shall be understood that the liquefied natural gas 30 constitutes a cooling source that takes part in the desublimation to capture the carbon dioxide from the carbon dioxide containing gas flow 2.

The management device 40 allows the circulation of the liquefied natural gas 30 through
 20 only one of the lines 12 of the second heat exchanger 4b by maintaining the third valve 40a and the fourth valve 40b open. The flow of liquefied natural gas 30 through the first line 12a of the second heat exchanger 4b brings a cooling source different from the decarbonized gas flow 3 to take part in the desublimation of the carbon dioxide contained in the carbon dioxide containing gas flow 2, which constitutes an additional cooling source
 25 that makes it possible to reduce the cold that has to be carried by the LNG, in other word by the external source.

This way, the carbon dioxide containing gas flow 2 that reaches the second chamber 14b is cooled because of the decarbonized gas flow 3 and of the liquid natural gas flow 30 through the lines 12 of the second heat exchanger 4b, hence cooling the chamber 14b.

30 Out of the first line 12a of the second heat exchanger 4b, the liquefied natural gas 30 is sent to the third heat exchanger 18.

It shall be understood that the third heat exchanger 18 comprises both a first line 18a that is part of the first supply circuit 8, precisely of the secondary line 8b, and a second line 18b that is part of the third supply circuit 28. Thus, the third heat exchanger 18 is configured to lower the temperature of the carbon dioxide containing gas flow 2 through the first line 18a by heat exchange with the liquefied natural gas 30 that flows through the second line 18b of the third heat exchanger 18.

It shall be understood that the three thermal exchangers 10, 16 and 18 are configured to pre-cool the carbon dioxide containing gas flow 2 down to a temperature close to a threshold desublimation temperature before the entry of said flow into the heat exchanger 4 in the first operating mode. By threshold temperature, it shall be understood such a temperature that the desublimation of carbon dioxide cannot happen.

Downstream from the third thermal exchanger 18, the secondary line 8b joins the main line 8a downstream from the first thermal exchanger 16 and upstream from the heat exchangers 4. Thus, the carbon dioxide containing gas flow 2 that flows through each of the lines 8a, 8b are gathered at an identical or substantially identical temperature. At the outlet of the third thermal exchanger 18, the liquefied natural gas flow 30 is vaporized and flows to a receiving means 35.

In order to adjust the temperature of the carbon dioxide containing gas flow 2 through the first thermal exchanger 16, the capture system 1 comprises a regulation system 46 and at least one detection device 48 for the temperature of the carbon dioxide containing gas flow 2 through the first line 16a of the first thermal exchanger 16. The regulation system 46 comprises a bypass line 26 and a ninth valve 50. The ninth valve 50 is located on the bypass line 26. Furthermore, the ninth valve 50 is configured to monitor the decarbonized gas flow 3 through the bypass line 26 from the second line 12b of the second heat exchanger 4b. The detection device 48 is connected to the regulation system 46 since the information from the detection device 48 is used to monitor a cross section in the ninth valve 50. The detection system 48 measures the temperature of the carbon dioxide containing gas flow 2 downstream from the first thermal exchanger 16. When the temperature of the carbon dioxide containing gas flow 2 after flowing through the thermal heat exchanger 16, as measured by the detection device 48, is higher than a threshold desublimation temperature, the regulation system 46 allows the circulation of the decarbonized gas flow 3 through the second line 16b of the first thermal exchanger 16 via the ninth valve 50. Thus, the cross-section in the ninth valve 50 is at least partly closed to

force the decarbonized gas flow 3 through the first thermal exchanger 16. Thus, the heat exchange between the carbon dioxide containing gas flow 2, in other words, the gas that flows through the first line 16a of the first thermal exchanger 16, and the decarbonized gas flow 3, in other words the gas that flows through the second line 16b of the first thermal exchanger 16, makes it possible to cool down the carbon dioxide containing gas flow 2 to reduce its temperature to a value slightly higher than the desublimation temperature of carbon dioxide at the pressure considered for the system.

The detection device 48 of the temperature is, for example, a temperature sensor or probe. Inversely, when the temperature of the carbon dioxide containing gas flow 2, as measured downstream from the first thermal exchanger 16 by the detection device 48 is lower than the threshold desublimation temperature, the regulation system 46 restricts the circulation of the decarbonized gas flow 3 through the second line 16b of the first thermal exchanger 16. To do so, the ninth valve 50 opens to allow the decarbonized gas flow 3 through the bypass line 26. Thus, the decarbonized carbon dioxide containing gas flow 3 bypasses the first thermal exchanger 16, which prevents a desublimation in the first thermal exchanger 16 while it is wanted in the internal volume of the chamber 14 of the considered heat exchanger 4.

The regulation system 46 takes part in the cooling of the carbon dioxide containing gas flow 2 that flows through the first supply circuit 8 to prevent its desublimation in the first thermal exchanger 16.

Figure 3 shows a variant of the first embodiment of the capture system 1 according to the invention. Relatively to what was described about the previous figures, the variant is different in that there is a third additional heat exchanger 4c that is identical to the configuration of the second heat exchanger 4b, which means that the heat exchanger 4c works in the first operating mode.

The third heat exchanger 4c also comprises a first line 12a and a second line 12b located in a chamber 14c of this third heat exchanger and connected to the line 22, where the decarbonized gas 3 flows. Here, this line 22 is common to the three heat exchangers, in that it channels the decarbonized gas flow 3 toward each of these three heat exchangers. Thus, the decarbonized gas flows 3 from the second heat exchanger 4b and from the third heat exchanger 4c are channeled by the line 22 to the second line 12b of the third heat exchanger 4c and to the second line 12b of the second heat exchanger 4b.

Since all these structural and functional elements, except those of the third heat exchanger 4c, are identical to what was described above, it shall be referred to the description of the figure 2 about the items common to the first embodiment and to its variant.

In the variant of the first embodiment, the capture process of the carbon dioxide is so configured that there are always two heat exchangers 4 in the first operating mode, which means two heat exchangers 4 that capture carbon dioxide in their respective chamber 14. In figure 3, the first heat exchanger 4a is in the second operating mode while the second heat exchanger 4b and the third heat exchanger 4c are in the first operating mode. Having two heat exchangers 4 in the first operating mode makes it possible to treat a bigger flowrate of the carbon dioxide containing gas flow 2, which makes the capture system 1 more effective.

Figure 4 represents a second embodiment of the carbon dioxide capture system 1 according to the invention. Relatively to what was described for the previous figures, the second embodiment is different because there is no line 22, its role relatively to it being substituted by a line 54.

In this second embodiment, the first heat exchanger 4a comprises a first line 54a and the second heat exchanger 4b comprises a second line 54b.

The line 54 starts downstream from the chamber 14 of the heat exchanger 4 and is then connected to the second line 12b that extends through said chamber 14. This way, each heat exchanger 4 can receive only the decarbonized gas flow 3 it produced itself. This configuration allows operations at different temperatures, if needed, at the outlet of each heat exchanger 4. This configuration also allows to prevent interferences between the two appliances working in the first operating mode (in desublimation mode).

Figure 5 corresponds to the circulation of the various above-mentioned flows and fluids through the capture system 1 according to the second embodiment.

When the second heat exchanger 4b is in the first operating mode, the first line 54a channels the decarbonized gas flow 3 coming exclusively from the second chamber 14b in association with the second heat exchanger 4b to the second line 12b of said heat exchanger.

When the first heat exchanger 4a is in the second operating mode, the second line 54b does not channel the decarbonized gas flow 3 coming from the first chamber 14a respectively in association with the first heat exchanger 4a. The eighth valve 44b of the

monitoring device 44 prevents the circulation of the decarbonized gas flow 3 in order to prevent any disturbance to the operation of the second operating mode.

Since all these structural and functional elements are identical to what was described above, it shall be referred to the description of the figure 2 about the items common to
5 the first embodiment and to the second embodiment.

Figure 6 shows a variant of the second embodiment. Relatively to what was described about the previous figures, the variant is different in that there is a third additional heat exchanger 4c in desublimation mode, that is identical to the configuration of the second heat exchanger 4b. The third heat exchanger 4c also comprises a third line 54c that
10 channels the decarbonized gas flow 3 exclusively coming from said heat exchanger 4c to exclusively reinject said decarbonized gas flow 3 into said heat exchanger 4c.

When the third heat exchanger 4c is in the first operating mode, the third line 54c channels the decarbonized gas flow 3 coming from the third chamber 14c constitutive of the third heat exchanger 4c to the second line 12b of said heat exchanger.

15 Since all these structural and functional elements, except the third heat exchanger 4c, are identical to what was described above, it shall be referred to the description of the figures 3 and 5 about the items common to this variant and to the second embodiment.

As for the variant of the first embodiment pictured in figure 3, the first heat exchanger 4a is in the second operating mode while the second heat exchanger 4b and the third heat
20 exchanger 4c are in the first operating mode. Having two heat exchangers 4 in the first operating mode makes it possible to treat a bigger flowrate of the carbon dioxide containing gas flow 2, which makes the capture system 1 able to treat higher gas flowrates for smoother transitions from the first to the second operating mode and inversely.

The scope of the invention also covers a process of desublimation of carbon dioxide from
25 a carbon dioxide containing gas flow 2 implementing the capture system of carbon dioxide 1 from the carbon dioxide containing gas flow 2 as previously described.

In a first step, the carbon dioxide in the carbon dioxide containing gas flow 2 is desublimized thanks to either one of the heat exchangers 4b, 4c in order to retain the carbon dioxide from the carbon dioxide containing gas flow 2.

30 In a second step, at least a part of the decarbonized gas flow 3 is sent to one and/or the other of the lines 12a, 12b of one and/or the other heat exchanger 4b, 4c when it is or

they are operated in desublimation mode. This step of return of the decarbonized gas flow 3 aims at bringing the heat exchangers 4b, 4c a cold source useful for the desublimation.

5 The invention also aims at a process to regulate the temperature of the carbon dioxide containing gas flow 2 that implements the capture system 1 of carbon dioxide from the carbon dioxide containing gas flow, where the temperature of the carbon dioxide containing gas flow 2 is regulated, so that this temperature is higher than the threshold desublimation temperature of carbon dioxide, whose value is between 1°C and 5°C.

10 This way, the temperature of the carbon dioxide containing gas flow 2 is measured out of the first line 16a of the first thermal exchanger 16. This measured temperature is measured against a threshold desublimation temperature of carbon dioxide at a preset pressure.

15 In the case where the temperature of the carbon dioxide containing gas flow 2, as measured by the regulation system 46, is lower than the threshold desublimation temperature, the regulation process comprises a step of increase of the flowrate of the carbon dioxide containing gas flow 2 thanks to the regulation system 46. To do so, the ninth valve 50 is at least partly opened so that the decarbonized gas flow 3 bypasses the first thermal exchanger 16.

20 In the case where the temperature the carbon dioxide containing gas flow 2, as measured by the regulation system 46, is higher than the threshold desublimation temperature, the regulation process comprises a step of decrease of the temperature of the carbon dioxide containing gas flow 2 thanks to the regulation system 46. To do so, the ninth valve 50 is at least partly closed so that the decarbonized gas flow 3 passes through the first thermal exchanger 16 and does not or does little pass through the bypass line 26. This step is completed until the temperature of the carbon dioxide containing gas flow 2, as measured
25 by the regulation system 46, is equal to the threshold desublimation temperature increased by an offset value between 1°C and 5°C.

30 The invention as described hereabove reaches its goal, i.e. offer an optimized solution to desublimize at an industrial scale a large quantity of carbon dioxide from carbon dioxide containing gas flow, and then to tap the thermal energy of this decarbonized gas flow 3 in a heat exchanger 4 in desublimation mode. Applied to carbon dioxide, such a solution makes it possible to reduce the greenhouse effect.

The present invention cannot be limited to the means and configurations described and illustrated here and must also include any equivalent means and configuration and any technically effective combination of such means.

CLAIMS

1. A capture system (1) of carbon dioxide from a gas containing carbon dioxide, comprising at least a first heat exchanger (4a) and a second heat exchanger (4b), wherein each heat exchanger (4, 4a, 4b) comprises at least a chamber (14, 14a, 14b), a first line
5 (12a) and a second line (12b) that both extend through the chamber (14, 14a, 14b), the chamber (14, 14a, 14b) being so configured that a carbon dioxide containing gas flow (2) flows through it and that it captures by desublimation the carbon dioxide from said carbon dioxide containing gas flow (2) in order to generate a decarbonized gas flow (3), characterized in that the capture system (1) is configured to make the decarbonized gas
10 flow (3) circulate from either one of the chambers (14, 14a, 14b) through the first line (12a) and/or through the second line (12b) of at least one of the two heat exchangers (4, 4a, 4b).
2. A capture system (1) according to claim 1, comprising a line (22) configured to channel the decarbonized gas flow (3) to the first line (12a) and/or to the second line
15 (12b) of each of the heat exchangers (4, 4a, 4b).
3. A capture system (1) according to any one of claims 1 to 2, comprising a collector (24) that collects the decarbonized gas flow (3) after flowing through the first line (12a) and/or through the second line (12b) of each of the heat exchangers (4, 4a, 4b).
- 20 4. A capture system (1) according to claim 1, comprising a line (54) configured to channel the decarbonized gas flow (3) from one of the heat exchangers (4, 4a, 4b) to the first line (12a) and/or to the second line (12b) exclusively of said heat exchanger (4, 4a, 4b).
5. A capture system (1) according to any one of claims 1 to 4, comprising at least
25 one regulation means (62) configured to regulate the temperature of desublimation in at least one of the chambers (14, 14a, 14b).
6. A capture system (1) according to claim 5 in combination with claim 2 or 4, wherein the regulation means (62) comprises at least a channel (63) that links the line (22) or the line (54) to an release circuit (20) of the decarbonized gas flow (3), a flow of
30 decarbonized gas (3) through this channel (63) depending on a measurement means (64) for the temperature in at least one of the two chambers (14, 14a, 14b).

7. A capture system (1) according to any one of the claims 1 to 6, comprising at least one management means (42) configured to monitor the circulation of the decarbonized gas flow (3) through one and/or the other line (12a, 12b) of one and/or the other one heat exchanger (4, 4a, 4b).
- 5 8. A capture system (1) according to claim 7, wherein the management means (42) comprises at least a first valve (42a) upstream from one and/or the other line (4a, 4b) of one and/or the other heat exchanger (4, 4a, 4b) and/or at least a second valve (42b) downstream from one and/or the other line (12a, 12b) of one and/or the other heat exchanger (4, 4a, 4b).
- 10 9. A capture system (1) according to any one of the claims 1 to 8, comprising at least one management device (40) configured to regulate the circulation of a fluid (30) that flows through either one of lines (12a, 12b) of one and/or the other heat exchanger (4, 4a, 4b).
- 15 10. A capture system (1) according to claim 9, wherein the management device (40) comprises at least a third valve (40a) upstream from either one of the lines (12a, 12b) of one and/or the other heat exchanger (4, 4a, 4b) and/or at least a fourth valve (40b) downstream from either one of the lines (12a, 12b) of one and/or the other heat exchanger (4, 4a, 4b).
- 20 11. A capture system (1) according to claims 9 or 10, configured to work with a refrigerant fluid, for example liquefied natural gas (30), wherein this is one of the fluids that flow through one of the lines (12a, 12b) of at least one of the heat exchangers (4, 4a, 4b).
- 25 12. A capture system (1) according to any one of the claims 1 to 11, comprising at least one monitoring means (38) configured to monitor the circulation of the carbon containing gas flow (2) through one and/or the other line (12a, 12b) of one and/or the other heat exchanger (4, 4a, 4b).
- 30 13. A capture system (1) according to claim 12, wherein the monitoring means (38) is at least a fifth valve (38a) upstream from one and/or the other line (12a, 12b) of one and/or the other heat exchanger (4, 4a, 4b) and/or at least a sixth valve (38b) downstream from one and/or the other line (12a, 12b) of one and/or the other heat exchanger (4, 4a, 4b).

- 14.** A capture system (1) according to any one of the claims 1 to 13, comprising at least one monitoring device (44) configured to regulate the circulation of the carbon containing gas flow (2) through the chamber (14, 14a, 14b) of one and/or the other heat exchanger (4, 4a, 4b) around one and/or the other of its lines (12a, 12b).
- 5 **15.** A capture system (1) according to claim 14, wherein the monitoring device (44) comprises at least a seventh valve (44a) upstream from the chamber (14, 14a, 14b) of one and/or the other heat exchanger (4, 4a, 4b) and/or at least a eighth valve (44b) downstream from the chamber (14, 14a, 14b) of one and/or the other heat exchangers (4, 4a, 4b).
- 10 **16.** A capture system (1) according to any one of the claims 1 to 15, comprising a first thermal exchanger (16) configured to operate an exchange of heat between the carbon dioxide containing gas flow (2) and the decarbonized gas flow (3), wherein the first thermal exchanger (16) comprises a first line (16a) through which the carbon dioxide containing gas flow (2) flows and a second line (16b) through which the
- 15 decarbonized gas flow flows (3), said first line (16a) being located upstream from the chamber (14, 14a, 14b) of one and/or the other heat exchanger (4, 4a, 4b) and said second line (16b) being located downstream from said chamber (14, 14a, 14b).
- 17.** A capture system (1) according to claim 16, comprising a regulation system (46) of a temperature of the first thermal exchanger (16), configured to cool down the
- 20 carbon dioxide containing gas flow (2) to a threshold desublimation temperature of carbon dioxide in the carbon dioxide containing gas flow (2).
- 18.** A capture system (1) according to claim 17, wherein the regulation system (46) comprises at least a bypass line (26) of the second line (16b) of the first thermal exchanger (16), a ninth valve (50) configured to monitor the circulation of the
- 25 decarbonized gas flow (3) through the bypass line (26), and a detection means (48) of the temperature of the carbon dioxide containing gas (2) at an outlet of the first line (16a) of said first thermal exchanger (16).
- 19.** A capture system (1) according to any one of claims 1 to 18, configured to provide a liquid flow (52) of carbon dioxide.
- 30 **20.** A method of desublimation of carbon dioxide from a carbon dioxide containing gas flow (2) implementing a capture system (1) according to claim 1, wherein:

- the carbon dioxide in the carbon dioxide containing gas flow (2) in the chamber (14, 14a, 14b) of either one of the heat exchangers (4, 4a, 4b) is desublimized;
- at least a part of the decarbonized gas flow (3) is sent to one and/or the other of the lines (12a, 12b) of either one of the heat exchangers (4, 4a, 4b).

5 **21.** A method to regulate a temperature of the carbon dioxide containing gas flow (2) that implements the capture system (1) according to claims 17 or 18, wherein the temperature of the carbon dioxide containing gas flow (2) is regulated, so that this temperature is higher than a threshold desublimation temperature of carbon dioxide, whose value is between 1°C and 5°C.