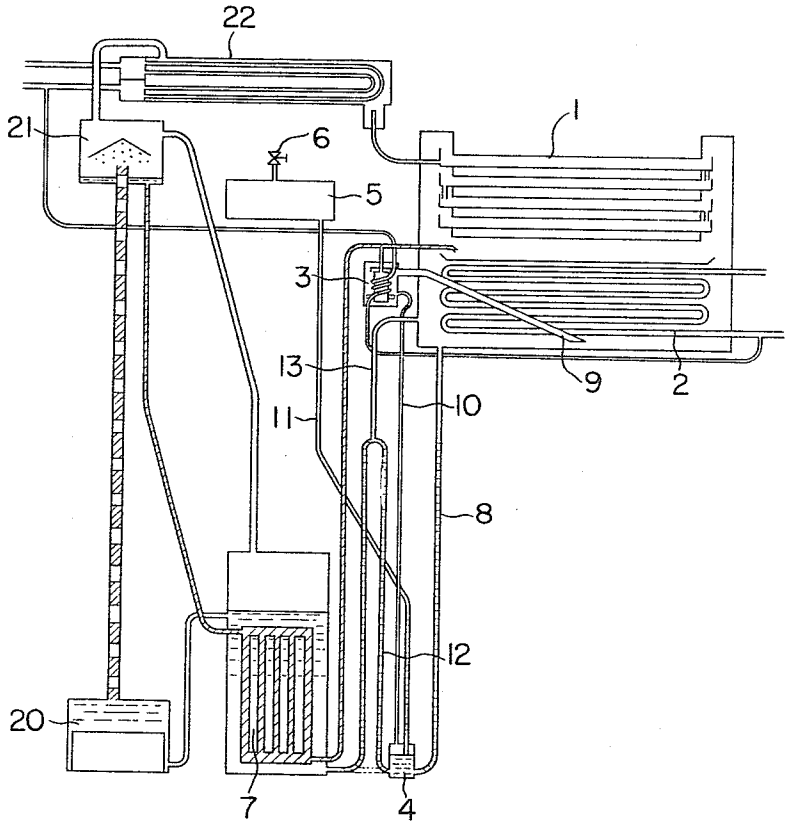
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DEVICE FOR SEPARATING, REMOVING, AND STORING NON-CONDENSABLE GAS IN ABSORPTION-TYPE REFRIGERATORS

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DEVICE FOR SEPARATING, REMOVING, AND STORING NON-CONDENSABLE GAS IN ABSORPTION-TYPE REFRIGERATORS

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This invention relates to refrigeration apparatus of the absorption type wherein water is used as the refrigerant. More particularly, the invention concerns a new device for separating, removing, and storing non-condensable gas in absorption-type refrigerators, said device being of miniature size and being capable of maintaining the interior of the circulation system in a desired vacuum state for a long time.

Ordinarily, an absorption-type refrigerator comprises a generator, a gas-liquid separator, a condenser, an evaporator, an absorber, a heat exchanger, and other parts appropriately interconnected by a piping system, and refrigeration is accomplished therein by the cyclic repetition of a designed circulation of an aqueous solution of lithium bromide in liquid or gaseous state, which solution is sealed in within the sealed interior communicating said various parts.

It is well known that, in a refrigerator of this character, it is desirable that the interior of the sealed system be maintained in a specified vacuum state.

Heretofore, however, it has not been possible to maintain this specified vacuum state constantly because of the introduction into the closed system of gases such as a minute quantity of air infiltrating into the system from the outside, gases generated by corrosion of interior wall surfaces, and gases which the lithium bromide itself contains.

These gases, almost all of which are non-condensable in systems of the instant type, are herein referred to collectively as non-condensable gas. Irrespective of whether the refrigerator is operating or whether it is not operating, this non-condensable gas accumulates at the bottom of the absorber, where the absolute pressure within the refrigerator is the lowest, and causes the pressure within the absorber to rise. As a result, the absorptive capacity of the lithium bromide aqueous solution is greatly lowered, and the refrigeration efficiency is lowered.

In order to eliminate this disadvantage, various means have been proposed, but in all cases such means have caused an inevitable enlargement of the refrigerator itself, whereby they have been unsuitable particularly for ordinary household refrigerators.

It is an object of the present invention to overcome the above described difficulties.

More specifically, it is an object of the invention to provide a miniature device of relatively simple construction for separating, removing, and storing the non-condensable gas in absorption-type refrigerators, which device is capable of maintaining the interior of the circulation system constantly in a specified vacuum state for a long time.

According to the present invention, briefly stated, there is provided, in an absorption refrigerator of the above mentioned type, a device as stated above which comprises a purge pump connected on its suction side to the lower part of the absorber and on its discharge side to the upper part of the separation pot through a thin gas-liquid descent pipe, an inverted U-tube interconnecting the separation pot and the weak solution inlet of the heat exchanger, and a storage chamber for storing non-condensable gas, said chamber having a gas exhaust valve at its upper part and

being connected through a gas separation pipe to the interior of the separation pot at an intermediate level thereof.

The nature, principle, and details of the present invention will be more clearly apparent from the following detailed description with respect to a preferred embodiment of the invention, when taken in conjunction with the accompanying drawing, in which the single figure is a diagrammatic view showing the essential arrangement and composition of an absorption-type refrigerator provided with the device according to the invention.

Referring to the drawing, the absorption-type refrigerator shown therein comprises essentially a generator **20**, a gas-liquid separator **21**, a condenser **22**, an evaporator **1**, an absorber **2**, a separation pot **4**, and heat exchanger **7**, all of which are similar to corresponding parts of a conventional absorption-type refrigerator.

A purge pump **3** is provided in the vicinity of the absorber **2** and above the separation pot **4**, the lower part of the purge pump **3** being communicatively connected to the upper part of the separation pot **4** through a gas-liquid descent pipe **10**, and a suction pipe **9** being provided between the upper part of the purge pump **3** and the lower part of the interior of the absorber **2**, the bottom of which is communicatively connected through a dilute-solution descent pipe **8** to the lower part of the separation pot **4**.

At a relatively high level there is further provided a storage chamber **5** for collecting and storing non-condensable gas, which chamber **5** is provided at its upper part with an exhaust valve **6** and is communicatively connected at its bottom through a gas separation pipe **11** to the separation pot **4**, the lower terminal opening of the separation pipe **11** being disposed at an intermediate level in the separation pot **4**.

An inverted U-shaped tube **12** is provided with its ends connected respectively to the bottom part of the separation pot **4**, on the opposite side from the connection of the pipe **8**, and the bottom part of the heat exchanger **7**. The upper part of this inverted U-tube is communicatively connected through a pipe **13** to the interior of the absorber **2**.

The refrigeration system of the above described arrangement and composition operates in the following manner. At the beginning of the refrigeration operation (description of which is here omitted since it is not directly related to the essential matter of the present invention), non-condensable gas as above mentioned is present in a state of accumulation and stagnation at the lower part of the absorber **2**.

This gas is drawn, together with water vapor, by the suction of the purge pump **3** through the suction pipe **9** and into the purge pump **3**, in which the water vapor is absorbed by concentrated solution, which is thereby weakened. The non-condensable gas is thereby separated as a single, independent gas, and the resulting two distinct phases of gas and liquid descend through the gas-liquid descent pipe **10** and enter the separation pot **4**.

Of these two phases which have thus entered the separation pot **4**, the liquid mixes with the solution already existing therein, and the non-condensable gas accumulates at the upper part of the pot. With the elapse of time, this gas increases in quantity and pressure and forces the solution surface downwardly until it eventually is at the same level as the lower extremity of the gas separation pipe **11**. Then, as the quantity of the non-condensable gas increases further, the gas flows through the pipe **11** and enters the accumulation and storage chamber **5** to accumulate therein. Accordingly, the gas pressure within the storage chamber **5** increases, but the gas so stored remains in a sealed state as long as liquid exists within the pipe **11**.

During this operation, the pressure within the separation

pot 4 is higher than that in the absorber 2 and other parts, but since the pipe 10 is made thin, and, moreover, liquid is continuously flowing downwardly therethrough, there is no possibility of gas rising from the separation pot 4 through the pipe 10.

However, depending on the circumstances of operation, there is the possibility of the gas pressure within the storage chamber 5 rising abnormally, whereby the non-condensable gas flows in reverse direction through the pipe 11, the separation pot 4, and pipe 8 into the absorber 2, and the desired vacuum state cannot be maintained.

According to the present invention, therefore, an inverted U-tube 12 is provided between the separation pot 4 and the heat exchanger 7, whereby, in the piping system relating to the device for separating, removing, and storing non-condensable gas, flow of solution toward the high-pressure side (heat exchanger side) of the absolute pressure within the refrigeration system and resulting marked lowering of the liquid level obtaining during operation are prevented, even when the operation is stopped.

For this reason, even under conditions tending to cause the above mentioned reverse flow, the gas within the storage chamber 5 is sealed by the solution and prevented from undergoing reverse flow. Accordingly, the pressure within the absorber 2 also does not rise, and there is no possibility of the refrigeration efficiency being lowered.

According to conventional practice, the separation pot 4 and the heat exchanger 7 are interconnected by a direct pipe as shown by phantom line. Accordingly, the gas pressure within the pot 4 is transmitted immediately to the heat exchanger side, and the liquid within the pipe 11 also moves, whereby the liquid seal is broken, and the gas within the storage chamber 5 flows through the separation pot 4 and the pipe 8 into the absorber 2.

In contrast, according to the present invention, an inverted U-tube 12 is installed in place of the phantom line pipe, whereby the reverse flow of gas into the absorber is prevented in a simple manner.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention as set forth in the appended claim.

What I claim is:

In a refrigerator of the absorption type including an absorber, a separation pot, a dilute solution descent pipe interconnecting the respective lower parts of the absorber and the separation pot, and a heat exchanger, a device for separating, removing, and storing non-condensable gas comprising: a purge pump communicatively connected on its suction side to the lower part of the absorber and on its discharge side to the upper part of the separation pot through a thin gas-liquid descent pipe; an inverted U-shaped tube interconnecting the liquid outlet of the separation pot and the dilute solution inlet of the heat exchanger, the upper, U-bend part of the inverted U-shaped tube communicating wtih interior of the absorber; and a storage chamber for storing non-condensable gas, said storage chamber having a gas exhaust valve at its upper part and being communicatively connected through a gas separation pipe to the separation pot, said gas separation pipe extending downwardly into the interior of the separation pot and terminating at an intermediate level in the separation pot.

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