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(54) Title: AN AIR-CONDITIONING SYSTEM FOR AN AIRCRAFT CABIN

(57) Abstract: This disclosure relates to an air-conditioning system 100 for an aircraft cabin 102. The system 100 may include an air source 104, and a compressor 114 for compressing the air from the air source 104. A primary heat exchanger 116 may cool the compressed air and transfer heat to a coolant flowing through it. The air may then flow to a secondary heat exchanger 118 where the air is further cooled and the heat is transferred to a coolant flowing through secondary heat exchanger 118. The system 100 may include a turbine 120 for expanding the air flowing out from the secondary heat exchanger 118. system 100 may be such that the coolant flowing within the secondary heat exchanger 118 is the air flowing out from the turbine 120 and the coolant flowing within the primary heat exchanger 116 is the coolant flowing out from the secondary heat exchanger 118.

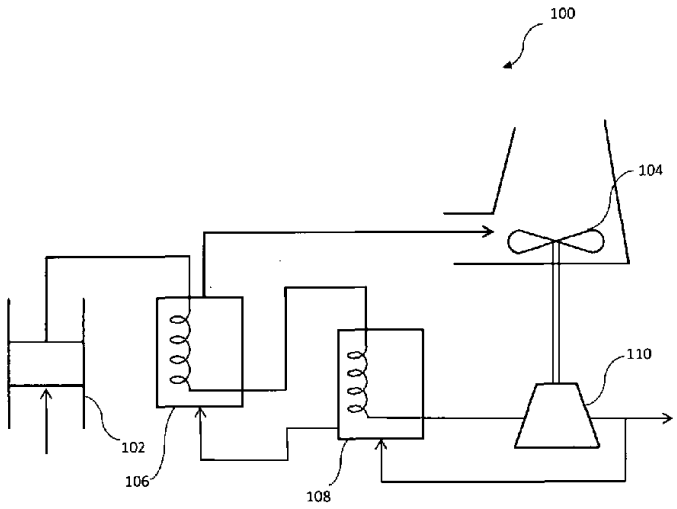

Figure 1

ABSTRACT

An air-conditioning system for an aircraft cabin

This disclosure relates to an air-conditioning system 100 for an aircraft cabin 102. The system 100 may include an air source 104, and a compressor 114 for compressing the air from the air source 104. A primary heat exchanger 116 may cool the compressed air and transfer heat to a coolant flowing through it. The air may then flow to a secondary heat exchanger 118 where the air is further cooled and the heat is transferred to a coolant flowing through secondary heat exchanger 118. The system 100 may include a turbine 120 for expanding the air flowing out from the secondary heat exchanger 118. system 100 may be such that the coolant flowing within the secondary heat exchanger 118 is the air flowing out from the turbine 120 and the coolant flowing within the primary heat exchanger 116 is the coolant flowing out from the secondary heat exchanger 118.

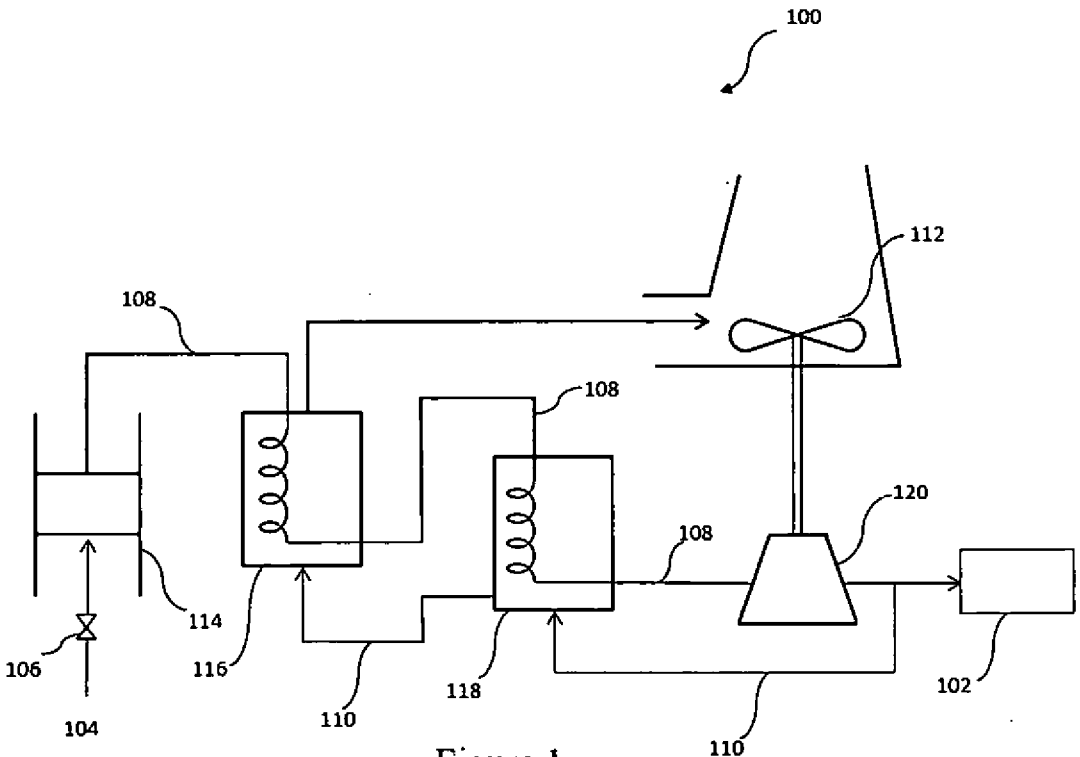

Figure 1

We claim:

1. An air-conditioning system 100 for an aircraft cabin 102, the system comprising:

an air source 104;

a compressor 114 for compressing the air from the air source 104;

a primary heat exchanger 116 for cooling the compressed air and transferring heat of the compressed air to a coolant flowing within the primary heat exchanger 116;

a secondary heat exchanger 118 for cooling the air flowing out from the primary heat exchanger 116 and transferring the heat to a coolant flowing within the secondary heat exchanger 118; and

a turbine 120 for expanding the air flowing from the secondary heat exchanger 118 into the aircraft cabin 102 wherein,

the coolant flowing within the secondary heat exchanger 118 is the air flowing out from the turbine 120 and the coolant flowing within the primary heat exchanger 116 is the coolant flowing out from the secondary heat exchanger 118.

2. The air-conditioning system 100 as claimed in claim 1, wherein the temperature of the air flowing from the turbine 120 into the secondary heat exchanger 118 is less than the temperature of the air flowing from the primary heat exchanger 116 to the secondary heat exchanger 118.

3. The air-conditioning system 100 as claimed in claim 1, wherein the temperature of the coolant flowing out from the secondary heat exchanger 118 is less than the temperature of the compressed air flowing through the primary heat exchanger 116.

4. The air-conditioning system 100 as claimed in claim 1, wherein a passage 108 carrying the air from the turbine 120 into the aircraft cabin 102 includes a bypass passage 110 for air to flow from the turbine 120 to the secondary heat exchanger 118.

5. The air-conditioning system 100 as claimed in claim 1, wherein the turbine 120 includes a direct passage for air to flow from the turbine 120 to the secondary heat exchanger 118.

6. The air-conditioning system 100 as claimed in claim 1, wherein the air source 104 is ambient air exterior to the aircraft.

7. The air-conditioning system 100 as claimed in claim 5, wherein the ambient air is rammed on entering the air-conditioning system 100.

8. The air-conditioning system 100 as claimed in claim 1, wherein the air source 104 is a bleed air from the engine of the aircraft.

9. The air-conditioning system 100 as claimed in claim 1, wherein the air-conditioning system 100 further includes at least one or more valves 106 on the passages 108, 110 of the air-conditioning system 100.

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FIELD OF INVENTION

The invention generally relates to air-conditioning systems and more particularly to an air-conditioning system for cooling an aircraft cabin.

BACKGROUND

An air-conditioning system in an aircraft is basically used to provide a comfortable temperature to the passengers occupying the seats in the aircraft cabin. The temperature in the aircraft cabin may rise due certain factors such as the heat released by the passengers, solar radiation, control devices, air resistance etc. Typically, four types of systems are being used in cooling the cabin climate of the aircraft which include simple air-refrigeration system, bootstrap air-refrigeration system, regenerative air-refrigeration system and reduced ambient air-refrigeration system.

Conventionally, the aircraft air conditioning system provides a cooling effect by intaking a low-pressure air stream through the ram air inlet. This air then undergoes compression followed by cooling in a heat exchanger, using the ram air from outside the aircraft as the cooling medium, and then expanded in a turbine. The result is a considerable reduction in air stream temperature at the turbine exit which permits cooling of the space to which the air is directed. In the conventional systems, the use of ram air as the cooling medium often proves inefficient in cooling the air stream as the ram air is itself normally too warm to bring the temperature down to the required level.

Hence there is a need for an improved air-conditioning system for an aircraft cabin.

SUMMARY OF THE INVENTION

According to an embodiment of the invention, an air-conditioning system for an aircraft cabin is disclosed. The air-conditioning system may include a source of air. The air from the source may undergo compression by a compressor provided in the air-conditioning system. The air-conditioning system may additionally include a primary heat exchanger for cooling the compressed air and transferring the heat of the compressed air to a coolant flowing within the primary heat exchanger. The air flowing out from the primary heat exchanger may be directed to a secondary heat exchanger where the air is further cooled and the heat of the air is transferred to a coolant flowing within the secondary heat exchanger. The air-conditioning system may further include a turbine for expanding the air flowing from the secondary heat exchanger into the aircraft cabin. The arrangement of the air-conditioning system may be such that the coolant flowing within the secondary heat exchanger is the air flowing out from the turbine and the coolant flowing within the primary heat exchanger is the coolant flowing out from the secondary heat exchanger.

BRIEF DESCRIPTION OF DRAWINGS

Other objects, features, and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawing.

Figure 1 illustrates a schematic diagram of an air-conditioning system for an aircraft cabin according to an exemplary embodiment of the invention.

DETAILED DESCRIPTION OF DRAWINGS

The following description with reference to the accompanying drawing is provided to assist in a comprehensive understanding of exemplary embodiments. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skilled in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

Figure 1 illustrates a schematic diagram of an air-conditioning system 100 for an aircraft cabin according to an exemplary embodiment of the invention. The air-conditioning system 100 may use air as a refrigerant in the air-conditioning system 100 and provide a comfortable temperature to the passengers in the aircraft. The air-conditioning system 100 may include a source of air. According to an embodiment, the source of air may be ambient air, external to the aircraft. According to another embodiment, the source of air may be bleed air from an engine of the aircraft. The ambient air, external to the aircraft, may enter the air-conditioning system 100 through an inlet provided on the body of the aircraft. The flow of air through the inlet may increase the pressure and temperature of the air. In other words, the air entering the air-conditioning system 100 through the inlet may get rammed. It may be apparent to a person skilled in the art that the size and shape of the inlet may vary depending on factors such as, but not limited to, cooling required, aircraft size, aircraft speed etc. According to an embodiment, the size of the inlet may be adjustable as per requirement. The air-conditioning system 100 may further include a compressor 102. The compressor 102 may be driven by a motor. The inlet may be connected to a compressor 102 through a duct. The air-conditioning system 100 may include a network of ducts for the air to circulate within the air-conditioning system 100 and

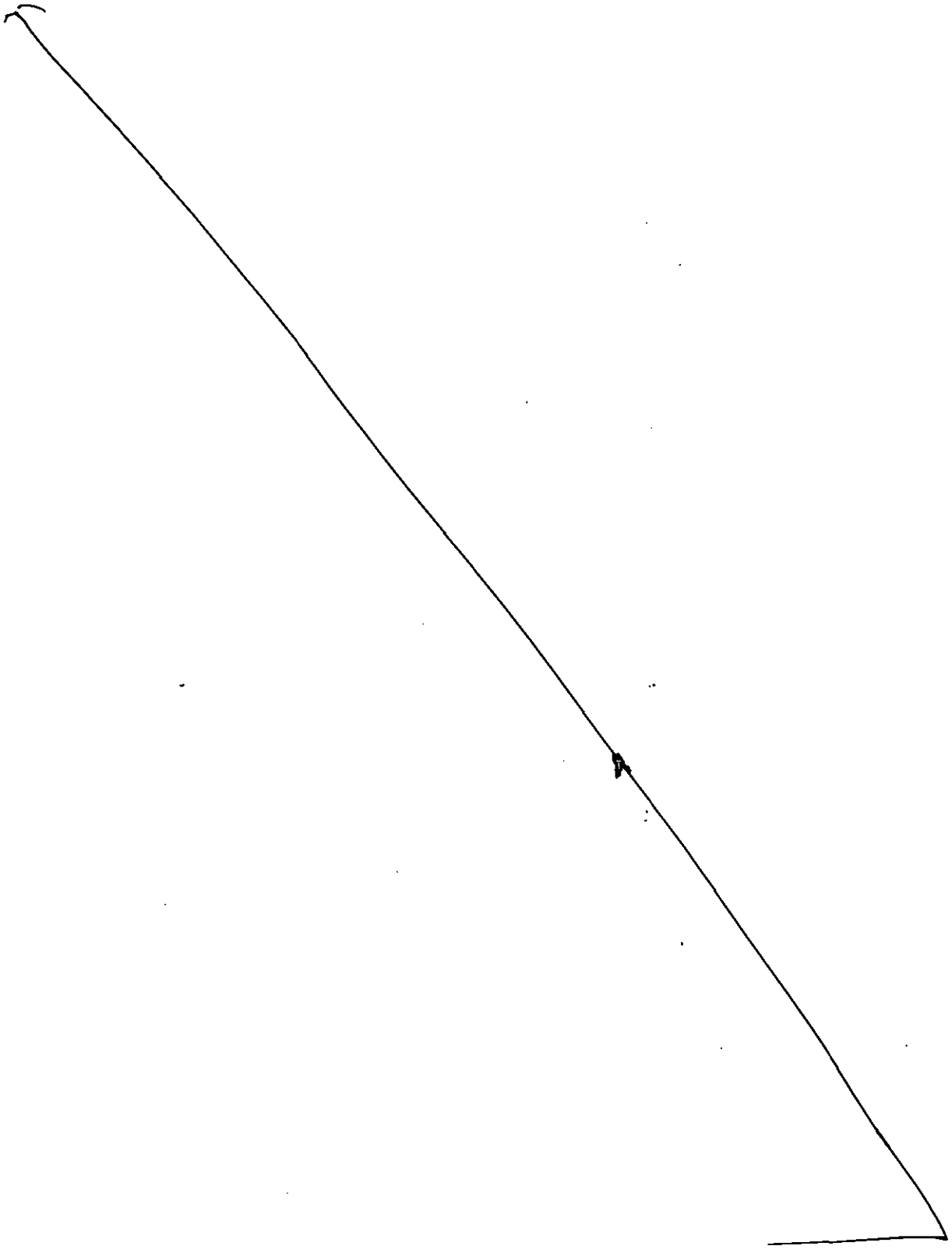
flow from the inlet to the cabin and exhaust fan 104 of the aircraft. The ram air entered through the inlet may then be directed to the compressor 102 through the duct provided between the inlet and the compressor 102, where the air may undergo compression. The air-conditioning system 100 may additionally include a primary heat exchanger 106. After compression of the ram air, the compressed air may be directed to the primary heat exchanger 106. The primary heat exchanger 106 may include two passages wherein the first passage may be for the flow of the air to be cooled and the second passage may be for the flow of a coolant to cool the air flowing through the first passage of the primary heat exchanger 106. The primary heat exchanger 106 may intake and cool the compressed air through the first passage and reduce the temperature of the compressed air by transferring the heat of the air to the coolant flowing through the second passage. The specification of the primary heat exchanger 106 in the air-conditioning system 100 may vary depending on factors such as the aircraft size and the cooling required in the cabin. The air-conditioning system 100 may further include a secondary heat exchanger 108. The secondary heat exchanger 108 may include two passages wherein the first passage may be for the flow of air to be cooled and the second passage may be for the flow of a coolant to cool the air flowing through the first passage of the secondary heat exchanger 108. The cooled air leaving the first passage of the primary heat exchanger 106 may flow to the first passage of the secondary heat exchanger 108 for further cooling and the heat of the air may be transferred to the coolant flowing through the second passage of the secondary heat exchanger 108. The specification of the secondary heat exchanger 108 in the air-conditioning system 100 may vary depending on factors such as the aircraft size and the cooling required in the cabin. The air-conditioning system 100 may further include a turbine 110. The turbine 110 may be provided on the receiving end of the secondary heat exchanger 108. The cooled air from the first passage of the secondary heat exchanger 108 may then flow into a turbine 110 wherein the expansion of the air may occur. The expansion of the air may reduce the temperature of the

air and make it suitable for cooling the aircraft cabin. The turbine 110 may be connected to the cabin of the aircraft through an air flow passage. The air flowing from the turbine 110 to the cabin may provide the cool climate in the aircraft cabin.

According to an embodiment, the passage of air flow from the turbine 110 to the cabin may further include a side passage connected to the second passage of the secondary heat exchanger 108. The side passage may bleed off a part of the expanded air flowing from the turbine 110 to the second passage of the secondary heat exchanger 108. According to another embodiment, the air-conditioning system 100 may include an additional passage directly connecting the turbine 110 and the second passage of the secondary heat exchanger 108. The air flowing through the side passage or the additional passage may be used as the coolant in the secondary heat exchanger 108 and cool the air flowing through the first passage of the secondary heat exchanger 108. The air flowing out from the second passage of the secondary heat exchanger 108 may be directed to the second passage of the primary heat exchanger 106. In other words, the coolant leaving the secondary heat exchanger 108 may be used as the coolant in the primary heat exchanger 106. The coolant leaving the primary heat exchanger 106 then flows out of the air-conditioning system 100 through the exhaust fan 104.

It is understood that the above description is intended to be illustrative, and not restrictive. It is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined in the appended claims. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the

appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein," respectively.



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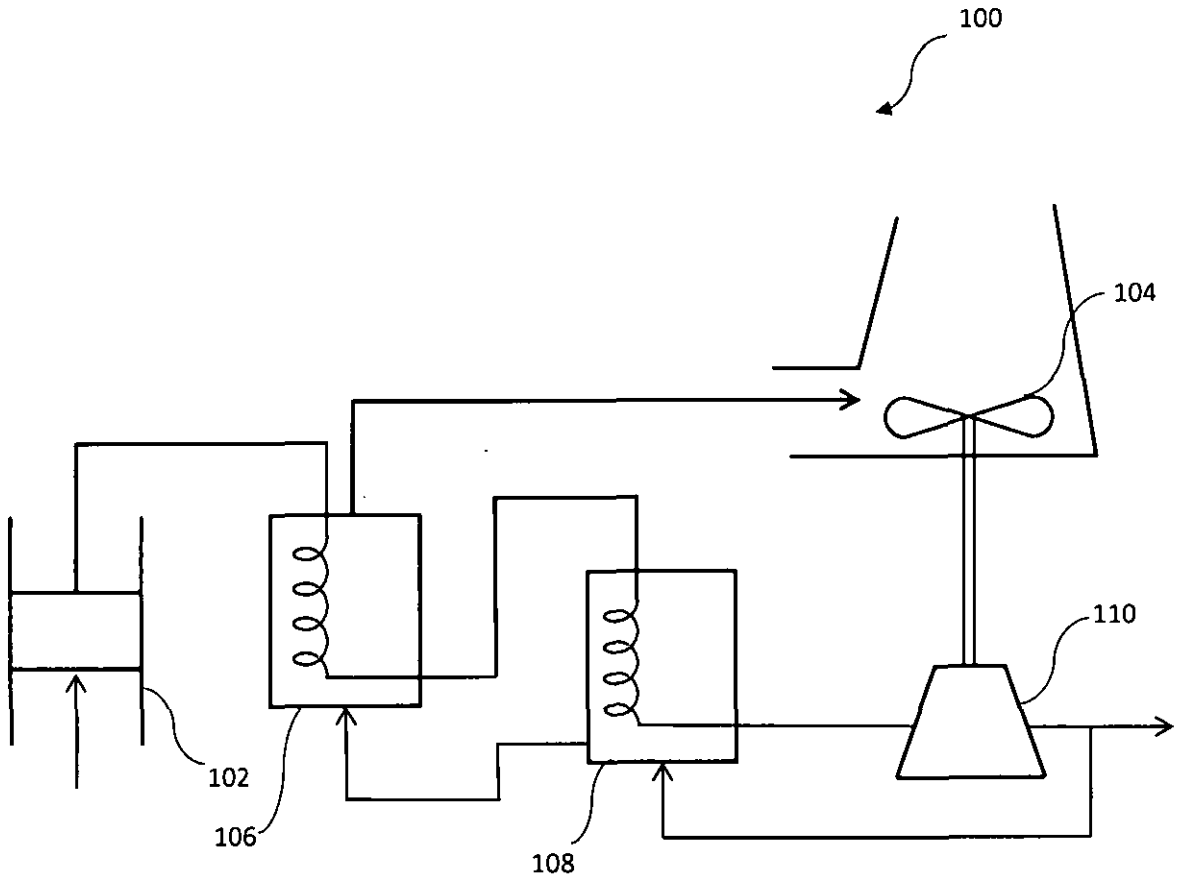

Figure 1

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