DESCRIPTION

AIR CONDITIONER

TECHNICAL FIELD

[0001] The present invention relates to an air conditioner for controlling temperature and humidity.

BACKGROUND ART

[0002] There is a known two-stage compression type refrigerator that controls overheating of the discharged gas from a high stage-side thereof (see Patent Literature 1).

Also, there is a known air conditioner that increases energy efficiency while ensuring safety (see Patent Literature 2) or carries out a multi-stage compressing operation to increase operational efficiency in both cooling and heating operations (see Patent Literature 3).

CITATION LIST

Patent Literature

[0003] Patent Literature 1 Japanese Patent Application Laid-open No. 2007-255864 (see the claims and Fig. 1)

Patent Literature 2 Japanese Patent Application Laid-open No. 2006-029744 (see the claims and Figs. 1 to 3)

Patent Literature 3 Japanese Patent Application Laid-open No. 2010-112618 (see the claims and Figs. 1 to 3)

SUMMARY OF INVENTION

Technical Problem

[0004] When conditioning the air in a relatively large space

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SUMMARY OF INVENTION

Technical Problem

[0004] When conditioning the air in a relatively large space

CLAIMS

1. An air conditioner comprising:

an air supply duct for supplying conditioning target air including at least indoor air and optionally outdoor air of a building to be air-conditioned into the interior of the building;

a high stage-side cooler provided in the air supply duct for mainly eliminating sensible heat of the conditioning target air;

a low stage-side cooler provided downstream of the high stage-side cooler in the air supply duct for mainly eliminating latent heat of the conditioning target air whose heat load has been partly eliminated by the high stage-side cooler; and

an indoor cooler for mainly eliminating latent heat of the indoor air.

2. The air conditioner according to claim 1, comprising:

a first heat recovery unit provided upstream of the high stage-side cooler in the air supply duct; and

a second heat recovery unit provided between the high stage-side cooler and the low stage-side cooler in the air supply duct.

3. The air conditioner according to claim 1 or 2, comprising an indoor air intake fan provided at an inlet of the air supply duct for taking the indoor air into the air supply duct.

4. The air conditioner according to claim 3, wherein the air conditioner comprises a first inter-refrigerant heat

exchanger for exchanging heat between a primary refrigerant and a secondary refrigerant, the secondary refrigerant circulating in a secondary refrigerant circulation pathway and being supplied to the high stage-side cooler, the low stage-side cooler, and the indoor air cooler for absorbing sensible heat and latent heat of the conditioning target air and sensible heat of the indoor air, the primary refrigerant circulating in a primary refrigerant circulation pathway for cooling the secondary refrigerant, the secondary refrigerant pathway and the primary refrigerant pathway being physically separated from each other.

5. The air conditioner according to claim 4, wherein

the first inter-refrigerant heat exchanger is provided outside of the building,

the secondary refrigerant includes two mutually different kinds of refrigerants, one of which is used in the high stage-side cooler and the low stage-side cooler, and the other of which is used in the indoor air cooler,

the refrigerant used in the indoor air cooler is safer than the refrigerant used in the high stage-side cooler and the low stage-side cooler, and

the air conditioner comprises a second inter-refrigerant heat exchanger provided outside of the building for exchanging heat between the refrigerant used in the high stage-side cooler and the low stage-side cooler and the refrigerant used in the indoor air cooler.

6. The air conditioner according to claim 4 or 5, wherein

the primary refrigerant is ammonia, which has an excellent

quality as a refrigerant, and

the secondary refrigerant is water or brine, which is safer in comparison with other kinds of refrigerants.

7. The air conditioner according to claim 4 or 5, wherein

the primary refrigerant is chlorofluorocarbon, ammonia, water, carbon dioxide, or hydrocarbon, and

the secondary refrigerant is carbon dioxide.

8. The air conditioner according to any one of claims 1 to 7, wherein

a high stage-side compressor connected to the high stage-side cooler and a low stage-side compressor connected to the low stage-side cooler are turbo refrigerators having a variable speed control feature.

[Claim 1]

An air conditioner comprising:

an air supply duct for supplying conditioning target air including at least indoor air and optionally outdoor air of a building to be air-conditioned into the interior of the building;

an indoor air cooler for mainly eliminating sensible heat of the indoor air; and

a two-stage compression and two-stage expansion-type refrigerator that at least includes

a high stage-side cooler for mainly eliminating sensible heat of the conditioning target air,

a low stage-side cooler for mainly eliminating latent heat of the conditioning target air whose heat load has been partly eliminated by the high stage-side cooler,

a high stage-side compressor whose capacity is controlled while being connected to the high stage-side cooler,

a low stage-side compressor whose capacity is controlled while being connected to the low stage-side cooler,

an intermediate liquid receiver for stably carrying out two-stage compression and two-stage expansion while being connected to the high stage-side compressor and the low stage-side compressor, and

a low pressure liquid receiver for recovering refrigerant returned from the low stage-side cooler, the refrigerant including a mixture of liquid and gas, separating the gas from the refrigerant, and delivering only the gas back to the low stage-side compressor,

wherein the high stage-side cooler for mainly eliminating sensible heat of the conditioning target air is provided in the air supply duct,

the low stage-side cooler for mainly eliminating latent heat of the conditioning target air whose heat load has been partly eliminated by the high stage-side cooler is provided downstream of the high stage-side cooler in accordance with the flow of the conditioning target air in the air supply duct,

the indoor cooler for mainly eliminating sensible heat of the indoor air is provided in the interior of the building as an evaporator connected to the high stage-side of the two-stage compression and two-stage expansion-type

refrigerator, and

an indoor air intake fan is provided at an inlet of the air supply duct for taking the indoor air into the air supply duct while adjusting the amount of the indoor air in supply.

[Claim 2]

The air conditioner according to claim 1, comprising:

a first heat recovery unit provided upstream of the high stage-side cooler in the air supply duct; and

a second heat recovery unit provided between the high stage-side cooler and the low stage-side cooler in the air supply duct.

[Claim 3]

The air conditioner according to claim 1 or 2, wherein the air conditioner comprises a first inter-refrigerant heat exchanger for exchanging heat between a primary refrigerant and a secondary refrigerant, the secondary refrigerant circulating in a secondary refrigerant circulation pathway and being supplied to the high stage-side cooler, the low stage-side cooler, and the indoor air cooler for absorbing sensible heat and latent heat of the conditioning target air and sensible heat of the indoor air, the primary refrigerant circulating in a primary refrigerant circulation pathway for cooling the secondary refrigerant, the secondary refrigerant pathway and the primary refrigerant pathway being physically separated from each other.

[Claim 4]

The air conditioner according to claim 3, wherein

the first inter-refrigerant heat exchanger is provided outside of the building,

the secondary refrigerant includes two mutually different kinds of refrigerants, one of which is used in the high stage-side cooler and the low stage-side cooler, and the other of which is used in the indoor air cooler,

the refrigerant used in the indoor air cooler is safer than the refrigerant used in the high stage-side cooler and the low stage-side cooler, and

the air conditioner comprises a second inter-refrigerant heat exchanger provided outside of the building

for exchanging heat between the refrigerant used in the high stage-side cooler and the low stage-side cooler and the refrigerant used in the indoor air cooler.

[Claim 5]

The air conditioner according to claim 3 or 4, wherein

the primary refrigerant is ammonia, which has an excellent quality as a refrigerant, and

the secondary refrigerant is water or brine, which is safer in comparison with other kinds of refrigerants.

[Claim 6]

The air conditioner according to claim 3 or 4, wherein

the primary refrigerant is chlorofluorocarbon, ammonia, water, carbon dioxide, or hydrocarbon, and

the secondary refrigerant is carbon dioxide.

[Claim 7]

The air conditioner according to any one of claims 1 to 6, wherein

the high stage-side compressor is a turbo refrigerator that is connected to the high stage-side cooler and that has a variable speed control feature, and

the low stage-side compressor is a turbo refrigerator that is connected to the low stage-side cooler and that has a variable speed control feature.

[Claim 8]

The air conditioner according to any one of claims 1 to 7, wherein

the capacity of the high stage-side compressor and the low stage-side compressor is controlled by an inverter.

[Claim 9]

The air conditioner according to any one of claims 1 to 8, wherein

the two-stage compression and two-stage expansion-type refrigerator further includes an evaporative condenser that has a large ventilation area for enabling effective operation of a high-capacity fan while being connected to the high stage-side compressor.

[Claim 10]

An air conditioner comprising:

an air supply duct for supplying conditioning target air including at least indoor air and optionally outdoor air of a building to be air-conditioned into the interior of the building;

a high stage-side cooler provided in the air supply duct for mainly eliminating sensible heat of the conditioning target air;

a low stage-side cooler provided downstream of the high stage-side cooler in the air supply duct for mainly eliminating latent heat of the conditioning target air whose heat load has been partly eliminated by the high stage-side cooler;

an indoor cooler for mainly eliminating sensible heat of the indoor air;

a first heat recovery unit provided upstream of the high stage-side cooler in the air supply duct; and

a second heat recovery unit provided between the high stage-side cooler and the low stage-side cooler in the air supply duct.