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(54) Heat exchanging system for exhaust gas of heat engine.

(57) A heat exchanging system for exhaust gas of heat engine wherein heat recovery is carried out by way of a mixture which is obtained by adding liquid phase water to compressed air or gas including air as the main part thereof which is used as combustion supporting gas, working medium gas, or the like, or gaseous fuel, if it is required, in case such gaseous fuel is used as fuel, or by contacting the former with the latter, said heat exchanging system being characterized in that said mixture comprises compressed gas mixture or compressed air mixture, or mixture of liquid phase water and the gas mixture or the air mixture which is obtained by compressing air, gas including air as the main part thereof or gaseous fuel in the presence of liquid phase water.

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HEAT EXCHANGING SYSTEM FOR EXHAUST GAS OF HEAT ENGINE

The present invention relates to an improvement of a novel method of heat recovery or novel heat exchanging system for exhaust gas of a heat engine wherein heat recovery is carried out by way of mixture which is obtained by adding liquid phase water to compressed air or gas including air as the main part thereof which is used as combustion supporting gas or working medium gas or the like, or gaseous fuel, if it is required, in case that such gaseous fuel is used as fuel, or by contacting the former with the latter, which is disclosed by Japanese Patent Serial No. 78808/80 et al. More particularly, the present invention relates to a novel heat exchanging system including the above-mentioned constitution characterized in that heat recovery is carried out by way of a compressed mixture which comprises gas mixture, compressed air mixture or mixture of liquid phase water and the gas mixture or air mixture and is obtained by compressing the air, gas including air as the main part thereof or the gaseous fuel in the presence of liquid phase water.

In the heat exchanging system wherein heat recovery is carried out by way of mixture which is obtained by adding liquid phase water to compressed air or compressed gas including air as the main part thereof which is used as combustion supporting gas or working medium or the like, or gaseous fuel, if it is required, in case that such gaseous fuel is used as fuel (this is referred to hereafter as "a water injection cycle"), heat recovery is conducted by way of the mixture in which transformation of water from liquid phase to gas

phase is performed under existence of air or gas including air as the main part thereof or under co-existence of air and compressed gaseous fuel, if it is required, in case such gaseous fuel is used as fuel. This results in great improvement in effectiveness of heat recovery, decrease in the amount of compressed gas to be required, and high temperature of the work producing cycle, which in turn brings great improvement in thermal efficiency and output ratio with various advantages.

Meanwhile, the increase of humidity of compressed gas or compressed air of the water injection cycle is generally performed by contacting liquid phase water from which heat recovery is conducted, if it is required, with intermediate compressed gas or intermediate compressed gaseous fuel, or with finally compressed gas or gaseous fuel discharged from the multi-step gas compressor each step of which is connected in series.

However, this method includes one big disadvantage in that it needs a great amount of work for compression due to the separate actuation for compression and increase of humidity, individually.

The object of the present invention is to provide a novel and improved heat exchanging system without the above-mentioned conventional disadvantages.

A further object of the present invention is to provide a novel and improved heat exchanging system having high thermal efficiency.

The present invention accomplishes the above-mentioned objects by using a heat exchanging system for exhaust gas of heat engine wherein heat recovery is carried out by way of a mixture which is obtained by adding liquid phase water to compressed air or gas including air as the main part thereof which is used as combustion gas, working medium gas, or the like, or gaseous fuel, if it is required, in case such gaseous fuel is used as fuel, or by contacting the former with the latter, said heat exchanging system being characterized in that said mixture comprises a compressed gas mixture or compressed air mixture, or a mixture of liquid phase water and the gas mixture or the air mixture which is obtained by

compressing air, gas including air as the main part thereof or gaseous fuel in the presence of liquid phase water.

Briefly, the present invention is performed by introducing water into the compressor so as not to obstruct the compressing operation. There are several methods for accomplishing the above. In one method compression is carried out while injecting water into absorption gas of the compressor or intermediate discharged gas at each intermediate-step of compressor, if it is required. In another method, in a constant delivery compressor, water or a sealing composition including water as the main part thereof, is used as sealing medium instead of sealing oil, water lost through vaporization being replaced by a corresponding amount of water. In another method absorption gas including mist is compressed.

In the mixture of the compressed air/steam or the compressed gaseous fuel/steam, or further the mixture of liquid phase water and the mixture of the compressed gas/steam or the mixture of compressed gaseous fuel/steam which is obtained by the present method, the so-called PV-value is smaller than that of the conventional system wherein compression and increase of humidity are carried out individually while the temperature after compression falls due to vaporization of water and the number of moles of compressed gas is increased. This results in decrease in compression work and fall of discharged gas temperature after compression.

Thus, the compressed mixture which is obtained by the present method is available for the heat exchanging system advantageously and it brings a great improvement in thermal efficiency.

As described above, the heat exchanging system in accordance with the present invention is significantly superior from the viewpoint of the decrease of compressing work and the improvement in effectiveness of heat recovery and brings about a big improvement in the heat efficiency of the heat engine.

CLAIMS

1. A heat exchanging system for recovering heat from the exhaust gas of a heat engine wherein heat recovery is carried out using as heat exchange medium a mixture comprising a gas and vaporised water characterised in that said mixture is obtained by compressing said gas in the presence of liquid phase water.

2. A heat exchanging system for exhaust gas of heat engine wherein heat recovery is carried out using as heat exchange medium a mixture which is obtained by adding liquid phase water to compressed air or gas including air as the main part thereof which is used as combustion supporting gas, working medium gas, or the like, or gaseous fuel, if it is required, in case such gaseous fuel is used as fuel, or by contacting the former with the latter, said heat exchanging system being characterized in that said mixture comprises compressed gas mixture or compressed air mixture, or mixture of liquid phase water and the gas mixture or the air mixture which is obtained by compressing air, gas including air as the main part thereof or gaseous fuel in the presence of liquid phase water.

3. A heat exchanging system for exhaust gas of heat engine wherein heat recovery is carried out using as heat exchange medium a mixture which is obtained by adding liquid phase water to compressed air or gas including air as the main part thereof which is used as combustion supporting gas, working medium gas, or the like, or gaseous fuel, if it is required, in case such gaseous fuel is used as fuel, or by contacting the former with the latter, said heat exchanging system being characterized in that said mixture comprises (1) a compressed gas mixture, (2) a compressed air mixture, (3) a mixture of liquid phase water and said gas mixture or (4) a mixture of liquid phase water and said air mixture, and said mixture is obtained by compressing air, gas including air as the main part thereof or gaseous fuel in the presence of liquid phase water.

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X,Y	GB - A - 687 480 (RATEAU) * page 2, lines 3-34; figures *	1,2,3
Y	DE - A - 2 005 656 (METALLGESELLSCHAFT) * page 7, lines 27-32; page 8, page 9, lines 1-12; figure 1 *	1,2,3
A	DE - C - 414 133 (ESCHER)	

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

F 01 K 21/04
F 02 C 3/30
F 02 G 5/02

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

F 01 K
F 02 C
F 02 G
F 04 D

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

☒ The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	01-03-1982	VAN GHEEL

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