US010385779B2

(12) United States Patent
Kippel et al.

(10) Patent No.: US 10,385,779 B2
(45) Date of Patent: Aug. 20, 2019

(54) **SYSTEM FOR COOLING EXHAUST GAS WITH ABSORPTION CHILLER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 444 days.

(21) Appl. No.: **15/176,132**

(22) Filed: **Jun. 7, 2016**

(65) **Prior Publication Data**

US 2017/0350320 A1 Dec. 7, 2017

(51) **Int. Cl.**

F01N 3/20	(2006.01)
F01D 25/12	(2006.01)
F02C 7/18	(2006.01)

(52) **U.S. Cl.**

CPC ***F02C 7/185*** (2013.01); ***F01D 25/12*** (2013.01); ***F01N 3/2066*** (2013.01); *F01N 2240/02* (2013.01); *F01N 2240/22* (2013.01); *F01N 2270/02* (2013.01); *F01N 2560/06* (2013.01); *F01N 2590/10* (2013.01); *F01N 2610/02* (2013.01); *Y02T 10/24* (2013.01)

(58) **Field of Classification Search**

CPC F02C 7/12; F02C 7/141; F02C 6/18; F05D 2270/08; F05D 2270/082; F01N 3/2066; F01N 3/0205; F01N 3/05

See application file for complete search history.

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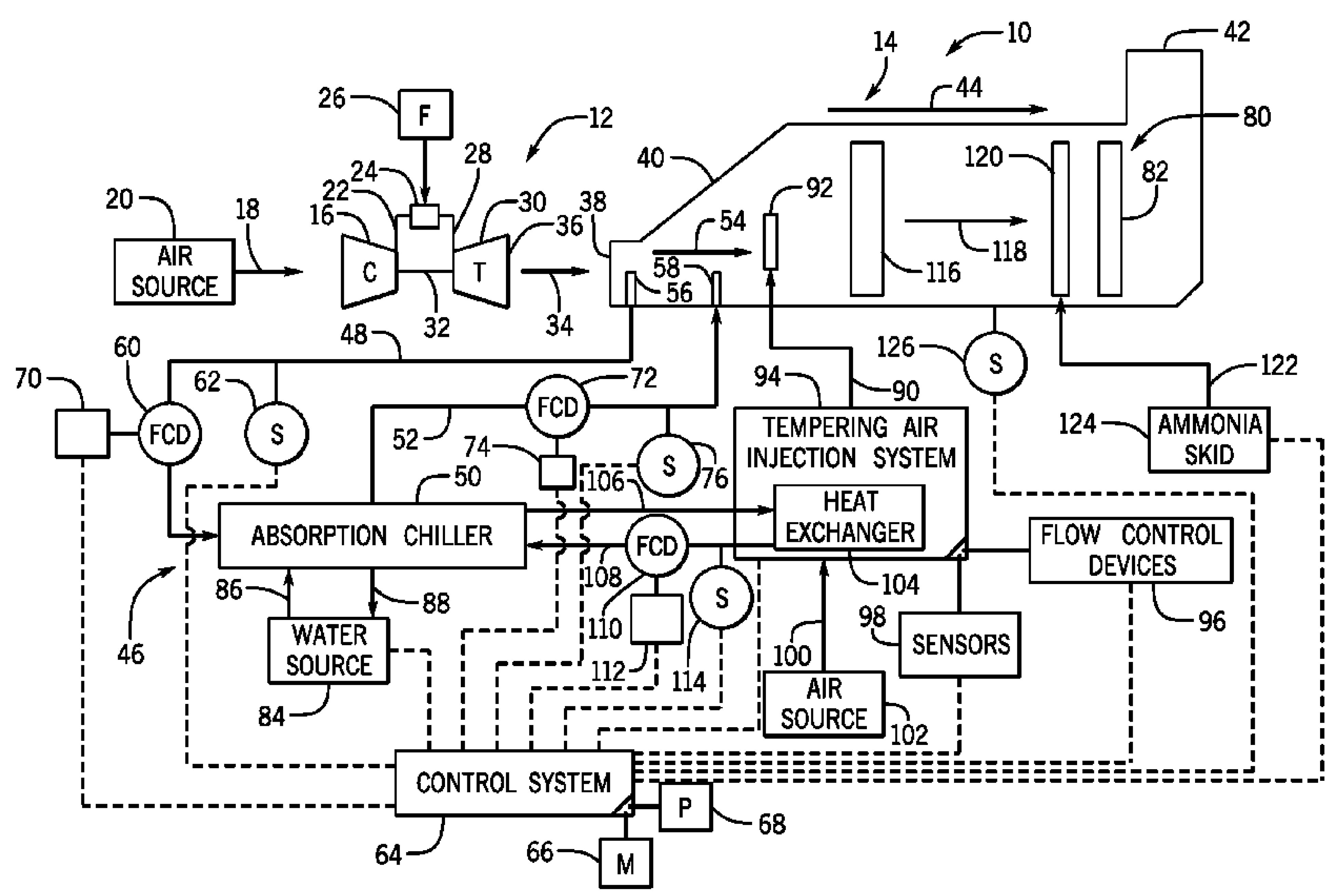
(57) **ABSTRACT**

A gas turbine system includes a gas turbine engine configured to combust a fuel and produce an exhaust gas. An exhaust duct assembly is coupled to the gas turbine engine and is configured to receive the exhaust gas. An absorption chiller is fluidly coupled to the exhaust duct assembly and is configured to receive a take-off stream of the exhaust gas. The absorption chiller is configured to use the take-off stream to drive at least a portion of an absorption cooling process to generate a cooled take-off stream of exhaust gas. The exhaust duct assembly is configured to receive the cooled take-off stream of exhaust gas from the absorption chiller and to mix the cooled take-off stream with exhaust gas present within the exhaust duct assembly to cool the exhaust gas.

20 Claims, 5 Drawing Sheets



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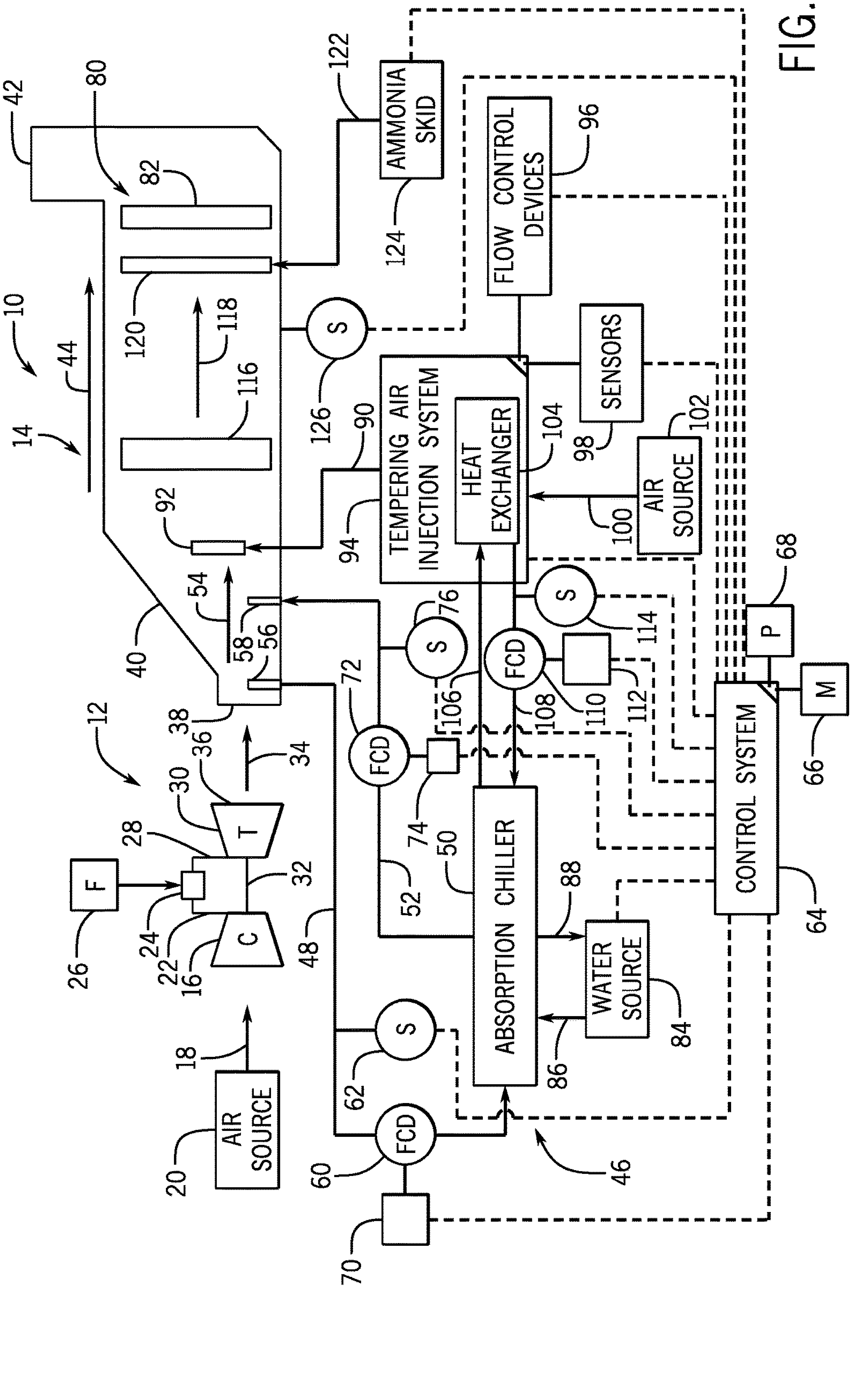
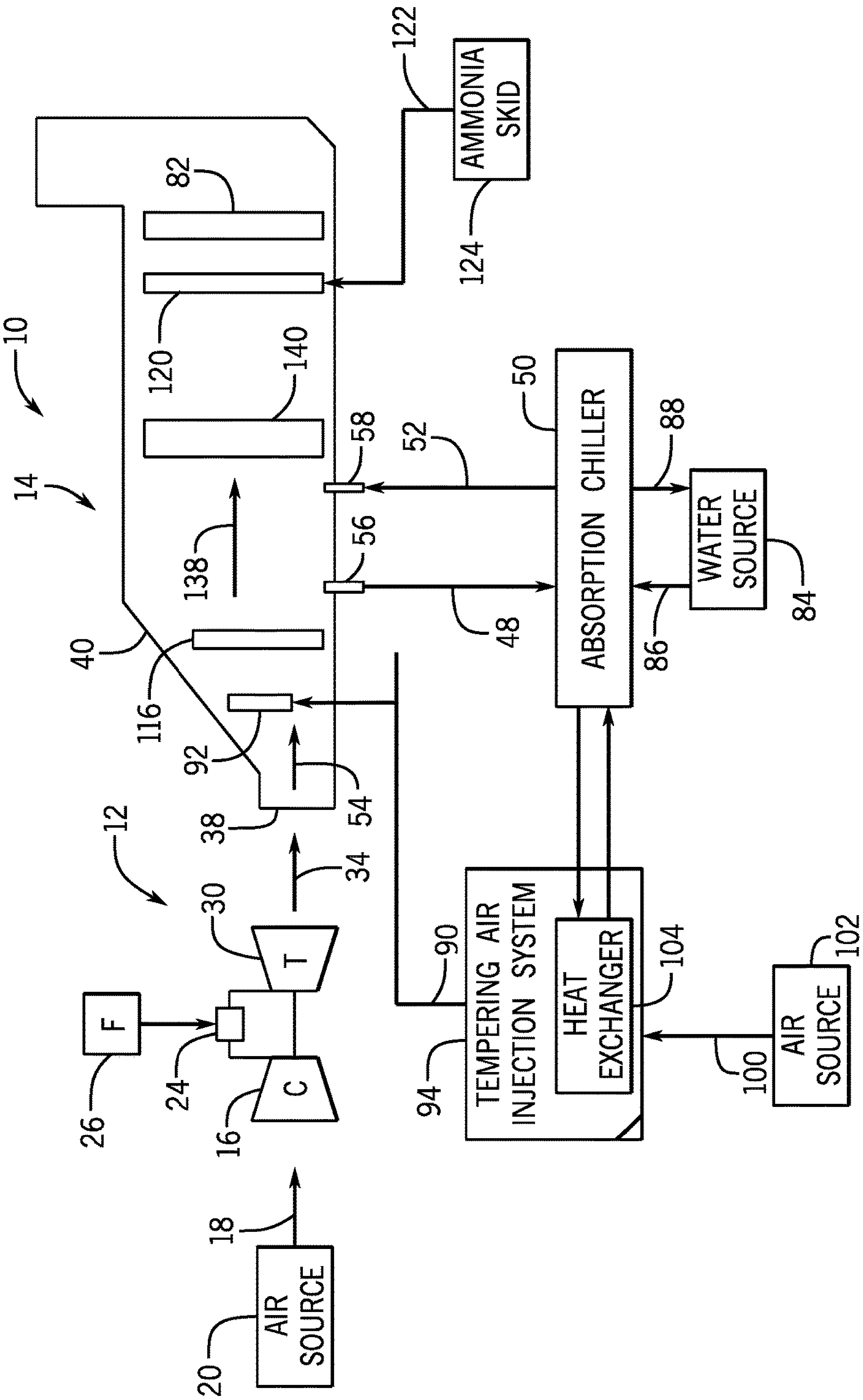
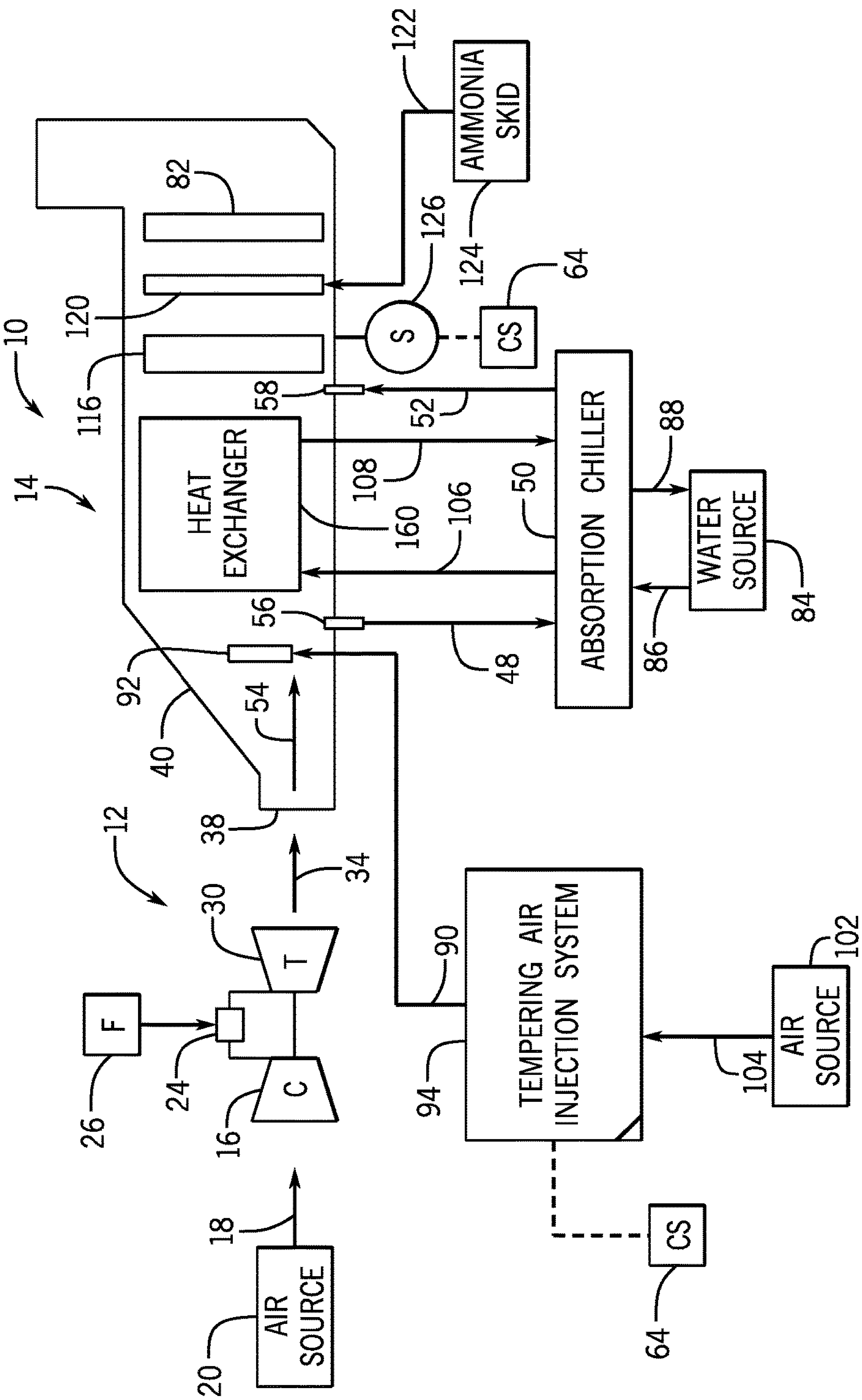

AIR SOURCE
F
C
T
AMMONIA SKID
FLOW CONTROL DEVICES
SENSORS
TEMPERING AIR INJECTION SYSTEM
HEAT EXCHANGER
AIR SOURCE
ABSORPTION CHILLER
WATER SOURCE
CONTROL SYSTEM
P
M
FCD
S

FIG. 1



AMMONIA SKID
ABSORPTION CHILLER
WATER SOURCE
TEMPERING AIR INJECTION SYSTEM
HEAT EXCHANGER
AIR SOURCE
AIR SOURCE
F
T
C
10
12
14
16
18
20
24
26
30
34
38
40
48
50
52
54
56
58
82
84
86
88
90
92
94
100
102
104
116
120
122
124
138
140

FIG. 2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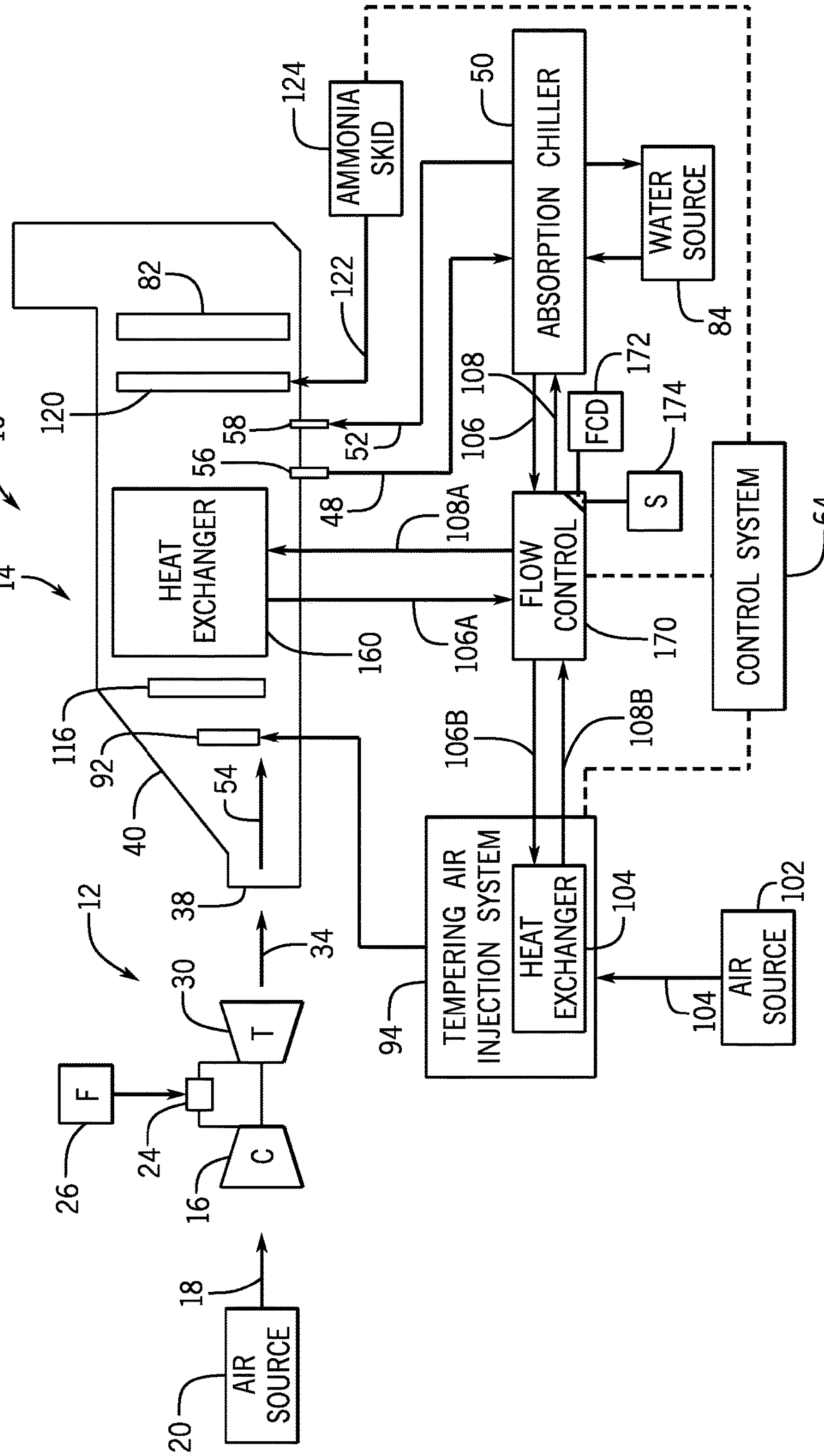
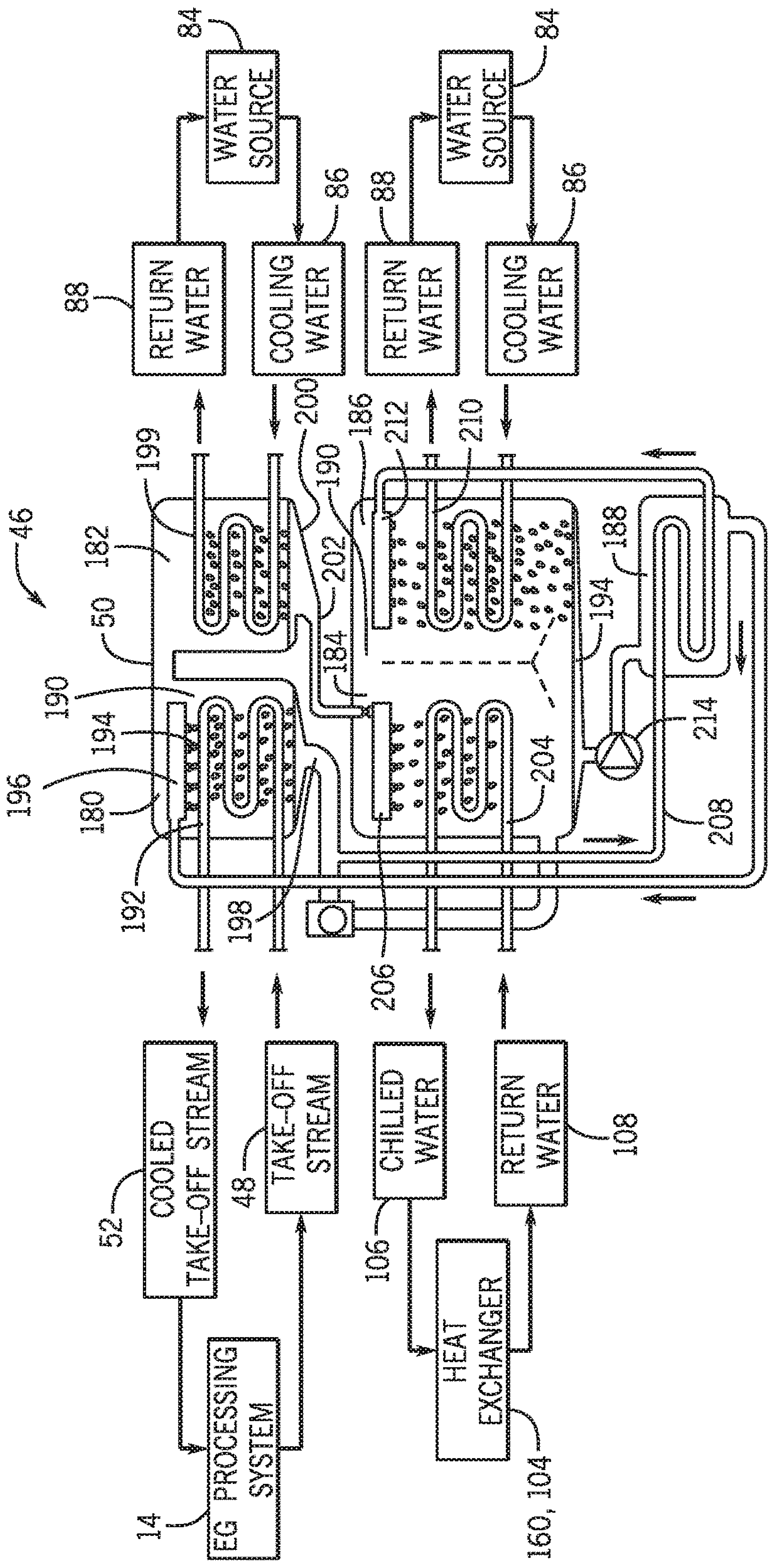
12
14
AMMONIA SKID
122
124
126
82
120
116
64
S
CS
58
52
HEAT EXCHANGER
108
160
106
50
ABSORPTION CHILLER
88
WATER SOURCE
84
86
56
48
92
54
40
38
34
30
T
C
F
26
24
16
90
TEMPERING AIR INJECTION SYSTEM
94
AIR SOURCE
102
104
18
20
CS
64

FIG. 3



AMMONIA SKID
124
ABSORPTION CHILLER
50
WATER SOURCE
84
82
122
120
10
58
52
56
48
106
108
172
FCD
174
S
HEAT EXCHANGER
14
108A
FLOW CONTROL
CONTROL SYSTEM
64
106A
160
170
116
92
54
40
106B
108B
TEMPERING AIR INJECTION SYSTEM
HEAT EXCHANGER
104
38
12
34
30
T
94
AIR SOURCE
102
F
24
C
26
16
18
AIR SOURCE
20

FIG. 4



WATER SOURCE
RETURN WATER
COOLING WATER
WATER SOURCE
RETURN WATER
COOLING WATER
COOLED TAKE-OFF STREAM
TAKE-OFF STREAM
CHILLED WATER
RETURN WATER
EG PROCESSING SYSTEM
HEAT EXCHANGER
84
84
86
86
88
88
46
50
182
199
200
190
186
212
210
202
184
188
194
190
194
196
180
192
198
204
214
208
206
52
48
106
108
14
160, 104

FIG. 5

SYSTEM FOR COOLING EXHAUST GAS WITH ABSORPTION CHILLER

BACKGROUND OF THE INVENTION

The subject matter disclosed herein relates to turbine systems and, more specifically, to systems and methods for injecting cooling air into exhaust gas flow(s) produced by turbine systems.

Gas turbine systems typically include at least one gas turbine engine having a compressor, a combustor, and a turbine. The combustor is configured to combust a mixture of fuel and compressed air to generate hot combustion gases, which, in turn, drive blades of the turbine. Exhaust gas produced by the gas turbine engine may include certain byproducts, such as nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon oxides (CO_x), and unburned hydrocarbons.

BRIEF DESCRIPTION OF THE INVENTION

In one embodiment, a gas turbine system includes a gas turbine engine configured to combust a fuel and produce an exhaust gas. An exhaust duct assembly is fluidly coupled to the gas turbine engine and is configured to receive the exhaust gas from the gas turbine engine. An absorption chiller is fluidly coupled to the exhaust duct assembly and is configured to receive a take-off stream of exhaust gas from the exhaust duct assembly via an exhaust take-off path. The absorption chiller is configured to use the take-off stream of exhaust gas to drive at least a portion of an absorption cooling process to generate a cooled take-off stream of exhaust gas. The exhaust duct assembly is configured to receive the cooled take-off stream of exhaust gas from the absorption chiller via a cooled take-off path and to mix the cooled take-off stream of exhaust gas with exhaust gas present within the exhaust duct assembly to cool the exhaust gas.

In another embodiment, a system includes an exhaust duct assembly fluidly configured to receive exhaust gas from a gas turbine engine and an absorption chiller fluidly coupled to the exhaust duct assembly and configured to receive a take-off stream of exhaust gas from the exhaust duct assembly via an exhaust take-off path. The absorption chiller is configured to use the take-off stream of exhaust gas to drive at least a portion of an absorption cooling process to generate a cooled take-off stream of exhaust gas. The system also includes a heat exchanger fluidly coupled to the absorption chiller via a chilled fluid path configured to flow a stream of chilled fluid from the absorption chiller to the heat exchanger. The heat exchanger is positioned within the exhaust duct assembly or is part of a tempering air injection system configured to provide tempering air to the exhaust duct assembly.

In a further embodiment, a gas turbine system is provided. The system includes a gas turbine engine configured to combust a fuel and produce an exhaust gas; an exhaust duct assembly fluidly coupled to the gas turbine engine and configured to receive the exhaust gas from the gas turbine engine. The exhaust duct assembly is configured to flow the exhaust gas along an exhaust gas path from an inlet to an outlet. The system also includes a selective catalytic reduction (SCR) system having an SCR catalyst positioned within the exhaust duct assembly and an ammonia injection grid positioned within the exhaust duct assembly upstream of the SCR catalyst. The ammonia injection grid is configured to inject ammonia into the exhaust gas path and the SCR catalyst is configured to reduce an amount of NO_x present within the exhaust gas. An absorption chiller is fluidly coupled to the exhaust duct assembly and configured to receive a take-off stream of exhaust gas from the exhaust duct assembly via an exhaust take-off path. The absorption chiller is configured to use the take-off stream of exhaust gas to drive at least a portion of an absorption cooling process to generate a cooled take-off stream of exhaust gas. The exhaust duct assembly is configured to receive the cooled take-off stream of exhaust gas from the absorption chiller via a cooled take-off path and to mix the cooled take-off stream of exhaust gas with exhaust gas along the exhaust flow path to cool the exhaust gas. The system further includes a control system configured to control cooling of the exhaust gas along the exhaust gas path such that a temperature of the exhaust gas, upon encountering the SCR catalyst, is within a predetermined temperature range that is appropriate for the SCR catalyst to reduce the amount of NO_x present within the exhaust gas.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

FIG. **1** is a schematic side view of an embodiment of a simple cycle gas turbine system having an exhaust processing system that utilizes an absorption chiller driven by an exhaust gas take-off stream to simultaneously cool exhaust gas generated by the system and to produce cooled tempering air for further cooling of the exhaust gas, in accordance with an aspect of the present disclosure;

FIG. **2** is a schematic side view of another embodiment of the simple cycle gas turbine system of FIG. **1** in which the exhaust gas take-off stream is downstream of a tempering air injection grid, in accordance with an aspect of the present disclosure;

FIG. **3** is a schematic side view of an embodiment of a simple cycle gas turbine system having an exhaust processing system that utilizes an absorption chiller driven by an exhaust gas take-off stream to simultaneously cool exhaust gas generated by the system and to direct a chilled fluid stream to an exhaust gas heat exchanger for further cooling of the exhaust gas, in accordance with an aspect of the present disclosure;

FIG. **4** is a schematic side view of an embodiment of a simple cycle gas turbine system combining the cooling features of the systems of FIGS. **1** and **3**, in accordance with an aspect of the present disclosure; and

FIG. **5** is a block diagram of the manner in which the absorption chiller utilizes the exhaust gas take-off stream of FIGS. **1-4** to generate a chilled fluid for use in a heat exchanger, in accordance with an aspect of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

One or more specific embodiments of the present invention will be described below. In an effort to provide a concise description of these embodiments, all features of an actual implementation may not be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

When introducing elements of various embodiments of the present invention, the articles "a," "an," "the," and "said" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements.

As set forth above, gas turbine engines may produce a number of products of combustion. These products may include nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon oxides (CO_x), and unburned hydrocarbons. Generally, reducing the relative concentration of these products within an exhaust gas may include reacting such products with other reactants in the presence of a catalyst. The reaction between NO_x and a reductant such as ammonia (NH_3), for example, may occur within an exhaust duct assembly in the presence of a selective catalytic reduction (SCR) system. The catalyst lowers the activation energy of a reaction between the NO_x and ammonia to produce nitrogen gas (N_2) and water (H_2O), thereby reducing the amount of NO_x in the exhaust gas before the exhaust gas is released from the gas turbine system. Such catalyst systems may be referred to as "DeNO$_x$" systems.

SCR systems may be used in a variety of different gas turbine systems, which range from relatively small-scale systems (e.g., aero-derivative systems) to larger, heavy-duty gas turbine systems. Small-scale systems produce exhaust gases having a relatively low temperature, while heavy-duty gas turbine systems produce exhaust gases with much higher temperatures. While exhaust gases from small scale systems (e.g., aero-derivative systems) have a temperature range that is generally amenable to the SCR process, the temperature of exhaust gases produced by heavy-duty systems is often much higher than acceptable operating ranges for the SCR process (e.g., temperatures suitable to maintain stability of the SCR catalyst). For example, in accordance with an embodiment of the present disclosure, the isotherm temperature of exhaust gases produced by a heavy-duty gas turbine engine may be greater than about 1000° F. (e.g., about 540° C.), such as between about 1100° F. and about 1300° F. (e.g., about 590° C. and about 705° C.), while an acceptable operating range of a "hot" SCR system (an SCR system having a relatively higher operating temperature range compared to other SCR systems) may be between about 800° F. and about 900° F. (e.g., about 425° C. and about 485° C.).

To reduce a temperature of these hot exhaust gases to the acceptable operating range for the SCR system, the exhaust gases may be mixed with tempering air to transfer heat from the exhaust gas to the tempering air and thereby cool the exhaust gas. Generally, the amount of tempering air therefore largely determines the amount of heat removed from the exhaust gas.

It is now recognized that the amount of tempering air used to reduce exhaust gas temperature generated in heavy-duty systems is much larger than amounts used in other systems. For example, a flow rate of tempering air suitable to cool the exhaust gas in heavy-duty gas turbine systems to an appropriate temperature for the SCR system may represent between about 20% and about 50%, such as about 30%, of the exhaust flow rate. This type of cooling can represent a significant energy input to cool the exhaust gas, which reduces plant efficiency. Additionally, introducing a flow of tempering air into the exhaust gas means that the resulting mixture should be homogenized using, for example, features that encourage turbulent flow. Accordingly, it is also now recognized that it may be desirable to reduce or altogether eliminate the need for tempering air in heavy-duty gas turbine systems (e.g., simple-cycle systems). Furthermore, it is also recognized that the heat from the exhaust gas generated by a gas turbine engine in such a system may be used to drive certain cooling features of the system, such as an absorption chiller.

In accordance with aspects of the present disclosure, the absorption chiller may utilize the exhaust gas heat to drive a cooling process that includes heat exchange between the exhaust gas and a medium in the absorption chiller. The exhaust gas used for this heat exchange may be a portion of the total exhaust gas generated by the gas turbine engine, and may be extracted from an exhaust duct assembly or similar feature of the system. This heat exchange causes the exhaust gas (the portion that is extracted) to be cooled. The cooled exhaust gas may be re-introduced to the exhaust path to facilitate cooling of the overall exhaust gas flow in the exhaust path.

Additionally, in certain embodiments of the present disclosure, the cooling process driven by this heat exchange may be used to generate a cooled or chilled heat exchange medium. The cooled heat exchange medium may be used, for example, to cool tempering air used in a tempering air system, and/or to provide additional cooling of the exhaust gas present within the exhaust path of the system.

While the present disclosure may be applicable to a number of different gas turbine systems, the embodiments described herein may be particularly useful in simple cycle heavy-duty gas turbine systems that produce relatively high temperature exhaust gases (e.g., greater than 1000° F., about 540° C.). One example of a system having a configuration in accordance with certain aspects of the present disclosure is depicted in FIG. **1**, which is a side elevational view of an embodiment of a simple cycle heavy-duty gas turbine system **10**. More particularly, the simple cycle gas turbine system **10** of FIG. **1** includes a gas turbine engine **12** fluidly coupled to an exhaust processing system **14** utilizing the exhaust extraction and absorption chiller features of the present disclosure.

As illustrated, the gas turbine engine **12** includes a compressor **16** having intake features configured to intake air **18** from an air source **20**. By way of non-limiting example, the air source **20** may include various components configured to intake and pre-treat (e.g., filter and silence) air taken in from the ambient environment. During operation, the compressor **16** intakes the air **18**, and compresses the air to produce a compressed air feed **22** provided to a combustor section **24** of the gas turbine engine **12**. In the combustor section **24**, which includes one or more turbine combustors, the compressed air feed **22** is used for combustion of a fuel **26** (from a fuel source such as a pipeline or fluid storage vessel) to produce hot combustion gases **28**. The hot combustion gases **28** generally include products of combustion such as carbon oxides as well as sulfur and nitrogen oxide species. In certain embodiments, combustion parameters such as fuel-to-air ratio, fuel and air volume, and so forth, may control temperatures in the combustor section **24** and the relative amounts of the gas species generated by combustion.

To extract work from the hot combustion gases **28**, the gas turbine engine **12** includes a turbine **30**, which includes a plurality of turbine stages having turbine blades attached to rotating wheels. The wheels are attached to a shaft **32** mechanically coupling the turbine **30** to the compressor **16**, and in certain embodiments to an additional load such as an electrical generator. The turbine **30** is configured to receive the hot combustion gases **28** and includes a shroud that flows the hot combustion gases **28** over the turbine blades. The turbine blades and associated turbine wheels are driven into rotation by the hot combustion gases, which in turn cause the shaft **32** to rotate. Compression stages in the compressor **16**, which are mechanically coupled to the shaft **32**, are driven by this rotation.

The turbine **30** is configured to discharge the combustion gases from which work has been extracted as an exhaust gas **34**. More specifically, an outlet **36** of the turbine **30** is fluidly coupled to an inlet **38** of the exhaust processing system **14** (e.g., the inlet of an exhaust duct assembly **40**). The exhaust duct assembly **40** may include a single duct, or a combination of ducts that are coupled to one another fluidly and physically. As a more specific example, the exhaust duct assembly **40** may include several sections, such as a transition section and an exhaust duct section. During operation, the exhaust processing system **14** receives and processes the exhaust gas **34** (e.g., for cooling, to reduce certain combustion products) before the exhaust gas **34** is directed out of the system **10** (e.g., via stack **42**).

In accordance with present embodiments, the exhaust processing system **14** may also include features located externally relative to the exhaust duct assembly **40**, the features being configured to facilitate cooling of the stream of exhaust gas **34** as it passes through the exhaust duct assembly **40** in a downstream direction **44**. More specifically, the exhaust processing system **14** may include an absorption cooling system **46** configured to receive a take-off stream **48** of the exhaust gas **34** and to cool the take-off stream **48** using an absorption chiller **50** to produce a cooled take-off stream **52**. The cooled take-off stream **52** may be re-introduced into an exhaust flow path **54** of the exhaust gas **34** through the exhaust duct assembly **40**.

To allow for removal and re-introduction of the exhaust gas **34**, the exhaust duct assembly **40** may include an absorption cooling inlet **56** and an absorption cooling outlet **58**, which may each include one or more openings in a wall of the exhaust duct assembly **40**. In the illustrated embodiment, the absorption cooling inlet **56** includes a tap-in located upstream of a tap-in of the absorption cooling outlet **58**.

The absorption cooling inlet **56** leads to (is fluidly coupled to) a conduit configured to flow the take-off stream **48** to the absorption chiller **50**. The conduit may represent all or a portion of a take-off flow path. One or more take-off flow control devices **60** (e.g., valves, pumps, fans, blowers) and one or more take-off sensors **62** (e.g., thermocouples, thermistors, pressure transducers, flow meters) may be positioned along the take-off flow path extending between the absorption cooling inlet **56** and the absorption chiller **50** for controlling the amount and/or flow characteristics of the take-off stream **48**. For example, a control system **64** of the gas turbine system **10** may include instructions stored on a local memory **66** and executable by a processor **68** to control a flow of the take-off stream **48**. The control system **64** may be communicatively coupled to an actuator **70** of the one or more take-off flow control devices **60** and to the one or more take-off sensors **62**. Such communication allows the control system **64** to send control signals as appropriate to the actuator **70** to adjust operation of the one or more take-off flow control devices **60** based at least in part on feedback signals provided by the one or more take-off sensors **62**.

Generally, the control system **64** is configured to monitor parameters of the exhaust gas **34**, such as composition (e.g., levels of CO_x, SO_x, NO_x, and so forth), temperature, pressure, and so on. The control system **64** may also monitor aspects relating to the ambient environment (e.g., the temperature of ambient air, the humidity of the ambient air), and/or aspects relating to the gas turbine engine **12**, such as the loading of the gas turbine engine **12**. The loading of the gas turbine engine **12** may affect the composition and temperature of the exhaust gas **34**, as higher loading of the engine **12** may be associated with higher combustion temperatures. The control system **64** may control various parameters of the exhaust processing system **14** based on these monitored parameters. For example, the control system **64** may control cooling of the exhaust gas **34** based on any one or a combination of the parameters listed above. More specific control aspects are described in further detail below.

In certain embodiments, the take-off stream **48** may be directed to and through the absorption chiller **50** using the take-off flow control devices **60**, which may not provide sufficient motive force for returning the cooled take-off stream **52** to the exhaust duct assembly **40**. Additional or alternative control of the cooled take-off stream **52** may be enabled by one or more return flow control devices **72** and their associated actuators **74**, which may be communicatively coupled to the control system **64**. Exhaust gas return sensors **76** (e.g., thermocouples, thermistors, pressure transducers, flow meters) may be positioned along the exhaust gas return path (e.g., a cooled take-off stream flow path) extending between the absorption chiller **50** and the absorption cooling outlet **58** of the exhaust duct assembly **40**, and may be communicatively coupled to the control system **64** to enable the control system **64** to monitor aspects of the cooled take-off stream **52**.

In this example arrangement, the control system **64** may flow the take-off stream **48** through the absorption chiller **50** using only the take-off flow control devices **60**, only the return flow control devices **72**, or a combination of these. The manner in which these flows are controlled may depend on, for example, the level of cooling for the exhaust gas **34** that is required for suitable treatment at a selective catalytic reduction (SCR) system **80** of the exhaust processing system **14** (more particularly, a catalyst **82** of the SCR system **80**). Indeed, the control system **64** may control a number of different flows based on such cooling requirements.

As one example, in the illustrated embodiment, the control system **64** is communicatively coupled to a water source **84**, which supplies one or more flows of cooling water **86** to the absorption chiller **50** and receives one or more flows of return water **88**. The water source **84** may represent a single source of water (e.g., a single tank or other source of water such as boiler feed water, or water from a cooling tower), or may represent a plurality of sources of water (e.g., a plurality of tanks or similar sources of water). As described in further detail below, the one or more flows of cooling water **86** may function to condense refrigerant water present within the absorption chiller **50**, and may remove heat of dissolution generated from an absorption process occurring within the absorption chiller **50**. The flows of cooling water **86** may be controlled, for example, based on the rate at which the refrigerant water needs to be condensed and the amount of thermal energy generated during the absorption process.

In accordance with present embodiments, the control system **64** may also control a flow of tempering air **90** into a tempering air injection grid **92** positioned within the exhaust duct assembly **40** to control cooling of the exhaust gas **34**. The tempering air **90** is provided by a tempering air injection system **94**, which may include one or more tempering air flow control devices **96** and one or more sensors **98** (e.g., thermocouples, thermistors, pressure transducers, flow meters) configured to allow control of the intake and distribution of air **100** from an air source **102**. Specifically, the control system **64** may control the flow of the air **100** into the tempering air injection system **94**, and through one or more flow paths configured to allow treatment and/or cooling of the air **100** before injection into the exhaust duct assembly **40**.

In the illustrated embodiment, the tempering air injection system **94** includes a heat exchanger **104** configured to receive a flow of chilled water **106** (or other chilled medium) from the absorption chiller **50**. The flow of chilled water **106** may be generated via evaporative cooling within the absorption chiller **50**. In certain embodiments, the flow of chilled water **106** may include additives that facilitate heat exchange and depress the freezing point of the water. By way of non-limiting example, the flow of chilled water **106** may include salt and/or glycol additives such as ethylene glycol. The heat exchanger **104** is configured to enable the air **100** to be cooled via heat exchange with the flow of chilled water **106**, thereby generating the tempering air **90** and a return water flow **108** that is directed back to the absorption chiller **50**. The control system **64** may control the flows **106**, **108** using one or more chilled water flow control devices **110** (and their associated actuators **112**) and one or more chilled water sensors **114** (e.g., thermocouples, thermistors, pressure transducers, flow meters) positioned along a flow path of either or both of the flows **106**, **108**.

The amount of tempering air **90** injected into the exhaust flow path **54** may depend on the amount of cooling provided by the absorption chiller **50**, as well as the cooling requirements of the SCR system **80** and the temperature of the exhaust gas **34**. In certain embodiments, the control system **64** may monitor loading of the heavy-duty gas turbine engine **12**, and may adjust an amount of the tempering air **90** used to cool the exhaust gas **34** in response to detecting a change in the loading of the heavy-duty gas turbine engine **12**. In still further embodiments, the control system **64** may be configured to monitor a parameter of the exhaust gas **34** within the exhaust duct assembly **40**, and may adjust an amount of the tempering air **90** used to cool the exhaust gas **34** in response to detecting a change in the monitored parameter of the exhaust gas **34**.

Upon injection, the tempering air **90** mixes and undergoes heat exchange with the exhaust gas **34**, which may be facilitated by features positioned within the exhaust duct assembly **40** (e.g., one or more turbulators **116**). A resulting cooled exhaust gas flow **118** is directed through an ammonia injection grid **120**, which is configured to inject ammonia **122** provided from an ammonia skid **124**. At least a portion of the ammonia skid **124** (e.g., flow control devices) may be controlled by the control system **64**. The ammonia **122**, when mixed with the cooled exhaust stream **118** in the presence of the SCR catalyst **82**, acts as a reducing agent that reduces the NO_x species in the exhaust gas into nitrogen gas and water. The amount of the ammonia **122** (and/or other reducing agent) provided via the grid **120** may largely depend on the amount of cooled exhaust gas **118** to be treated by the SCR catalyst **82**, as well as levels of NO_x present within the exhaust gas. This information may be provided by one or more exhaust gas sensors **126** (e.g., lambda sensors, CO sensors, NO_x sensors, temperature sensors) positioned at various positions along the exhaust duct assembly **40**. Indeed, the one or more exhaust gas sensors **126** may be used to provide both feed forward and feed back information to the control system **64** for the control of the various flows intended to cool and treat the exhaust gas **34**.

Again, as set forth above, it is now recognized that the exhaust gas **34** may be utilized as the heating fluid that drives the generator portion of an absorption chiller. In accordance with the present disclosure, the take-off location of the take-off stream **48** and the re-introduction location of the cooled take-off stream **52** may vary across different embodiments. Generally, in FIG. **1**, the take-off stream **48** is taken off at the absorption cooling inlet **56** at a location between the inlet **38** of the duct **40** and the tempering air injection grid **92** (i.e., upstream of the tempering air injection grid **92**). Additionally, the cooled take-off stream **52** is injected via the absorption cooling outlet **58** upstream of the tempering air injection grid **92**. Such a configuration may be desirable to facilitate mixing and cooling of the tempering air **90**, the cooled take-off stream **52**, and the bulk exhaust gas **34** using the turbulators **116**, and to utilize exhaust gas **34** having a higher temperature relative to exhaust gas that has been cooled using the tempering air **90** and/or cooled by heat transfer to various physical features of the exhaust processing system **14**. However, in other embodiments, it may be desirable for the take-off stream **48** to be taken off downstream of the tempering air injection grid **92**, such as downstream of the turbulators **116**.

FIG. **2** depicts an example of such an embodiment. Certain features of the system **10** of FIG. **1** are not reproduced in FIG. **2** for clarity, but it should be noted that those components, such as the various flow control devices, sensors, and the control system **64**, are also present. The embodiment of the system **10** in FIG. **2** has the absorption cooling inlet **56** and the absorption cooling outlet **58** positioned downstream of the tempering air injection grid **92**. Accordingly, in this embodiment, the take-off stream **48** may include a mixture of the tempering air **90** and the exhaust gas **34**. The turbulators **116** may be positioned upstream of the absorption cooling inlet **56** so that the take-off stream **52** has a substantially homogenous distribution of the tempering air **90** and the exhaust gas **34** (e.g., due to the introduction of turbulent flow). The mixture of the tempering air **90** and the exhaust gas **34** may be considered a tempered exhaust gas flow **138**, and the take-off stream **48** may essentially include this mixture.

The system **10** may also include an additional set of turbulators **140** positioned downstream of the absorption cooling outlet **58** and upstream of the ammonia injection grid **120**. The configuration of FIG. **2** may therefore introduce the cooled take-off stream **52** back into the exhaust gas path **54** at a position where the cooled take-off stream **52** may be mixed with the tempered exhaust gas flow **138** and subsequently passed through the additional turbulators **140**. The additional turbulators **140** may encourage turbulent flow in the mixture of the cooled take-off stream **52** and the tempered exhaust gas flow **138**, which facilitates mixing and heat exchange.

As shown, the additional turbulators **140** may be positioned upstream of the ammonia injection grid **120**. However, in other embodiments, the additional turbulators **140** may be positioned downstream of the ammonia injection grid **120** but upstream of the SCR catalyst **82** to encourage mixing of and heat exchange between the cooled take-off stream **52**, the tempered exhaust gas flow **138**, and the ammonia **122** before arriving at the SCR catalyst **82**.

As in the system **10** of FIG. **1**, the system **10** of FIG. **2** utilizes the heat exchanger **104** to cool intake air **100** and generate the tempering air **90** using the flow of chilled water **106**. However, in certain embodiments and as shown in FIG.

3, the system **10** direct the flow of chilled water **106** to an exhaust gas heat exchanger **160** positioned within the exhaust gas path **54** to cool the exhaust gas **34** (or the tempered exhaust gas **138**). In this embodiment, the control system **64** may utilize a reduced amount of the tempering air **90** to cool the exhaust gas **34** and, indeed, in certain situations may altogether eliminate the use of the tempering air **90**. For example, the control system **64** may control cooling of the exhaust gas **34** primarily by controlling heat exchange via the exhaust gas heat exchanger **160**, and while maintaining the tempering air injection system **94** in an off, standby, or reduced throughput operating state. While the exhaust gas heat exchanger **160** is depicted as being positioned downstream of the tempering air injection grid **92** along the exhaust flow path **54**, the present disclosure is not limited to this configuration. For example, in certain embodiments, the respective positions of the tempering air injection grid **92** and the exhaust gas heat exchanger **160** may be reversed such that the exhaust gas heat exchanger **160** is positioned upstream of the tempering air injection grid **92**.

It is now recognized that reducing the amount of tempering air **90** utilized for cooling the exhaust gas **34** may be desirable to facilitate maintenance of the exhaust gas **34** in a homogenous state (e.g., to reduce or eliminate pockets of tempering air or other gaseous species). In addition, it is now recognized that the use of the exhaust gas **34** to drive the absorption cooling process within the absorption chiller **50** both cools the exhaust gas **34** and reduces reliance on outside power sources for cooling. For example, it is now recognized that the coefficient of performance (COP) for cooling the exhaust gas **34** (the amount of cooling of the exhaust gas that is achieved relative to the amount of work input to the system) may be increased by reducing reliance on tempering air **90** to cool the exhaust gas **34**, and instead cooling the exhaust gas **34** utilizing the exhaust gas heat exchanger **160** and the absorption chiller **50**. That is, cooling using the exhaust gas heat exchanger **160** and the absorption chiller **50** may be more efficient than cooling using the tempering air injection system **94** (using the tempering air injection system **94** without absorption chiller integration).

Thus, in accordance with present embodiments, the system **10** of the present disclosure may utilize reduced amounts of tempering air **90** relative to typical systems. As one example, in certain heavy duty simple cycle gas turbine systems (not aero-derivative systems) producing exhaust isotherm temperatures of 1240° F. (about 670° C.), to reach the 800-900° F. (about 430-480° C.) temperature for the SCR catalyst **82**, the tempering air **90** may represent a flow volume that is equal to about 30% of the exhaust flow volume. This corresponds to about 2% temperature reduction of the exhaust gas **34** for every 1% of equal flow volume of tempering air. It may be possible to reduce or altogether eliminate the need for tempering air using the exhaust gas heat exchanger **160** and absorption chiller **50** configuration of the present disclosure. For example, in an embodiment of a simple cycle heavy duty gas turbine system of the present disclosure, the temperature of the exhaust gas **34** may be reduced by between 2.5% and 5% for every 1% of equal tempering air flow volume. In certain embodiments, this may correspond to a temperature drop from an isotherm temperature of the exhaust gas **34** of about 1240° F. to a range of about 800° F. to about 900° F. using a flow volume of tempering air that is equal to no more than 20%, no more than 10%, or no more than 5% of the exhaust gas flow volume.

More generally, the exhaust processing system **14** of the simple cycle heavy-duty gas turbine system **10** may be configured to receive the exhaust gas **34** at an initial isotherm temperature that is higher than an acceptable temperature for treatment at the SCR catalyst **82**. The cooling features of the exhaust processing system **14** of the present disclosure are configured to cool the exhaust gas **34** to a temperature that is within an appropriate range for treatment at the SCR catalyst **82**. This cooling may be achieved using tempering air that is equal to between 1% and 20% of the exhaust flow volume.

To achieve this level of cooling using reduced tempering air flows, the exhaust gas heat exchanger **160** may include one or more structures having an appropriate thickness, material construction, and surface area that enables heat exchange between the exhaust gas **34** and the flow of chilled water **106**. For example, the exhaust gas heat exchanger **160** may include heat exchange coils positioned directly in the exhaust gas path **54**, a plurality of shell- and tube heat exchangers configured to pass the exhaust gas **34** through a series of tubes (e.g., a grid of parallel tubes), or any other appropriate configuration. The flow of chilled water **106** may be provided in a sufficient amount (e.g., at a sufficient flow rate) and at a sufficient temperature to cool the exhaust gas **34** by a predetermined amount.

Generally, the control system **64** may control cooling of the exhaust gas **34** via the exhaust gas heat exchanger **160** by controlling parameters of the flow of chilled water **106** through the exhaust gas heat exchanger **160**. Such control may be performed using the flow control device **110** (see FIG. **1**). For instance, the control system **64** may adjust the circulation rate of the flow of chilled water **106** through the exhaust gas heat exchanger **160**. Controlling the mass flow of the chilled water through the heat exchanger **160** and the absorption chiller **50** also affects the residence time of the water within the heat exchanger **160** and the absorption chiller **50**, and allows for monitoring and control of the temperature difference between the flow of chilled water **106** and the return water **108**. Accordingly, in certain embodiments, the system **10** may include sensors **114** disposed along the respective flow paths of both of the chilled water **106** and the return water **108**. The temperature difference between the chilled water **106** and the return water **108** may be indicative of heat exchange efficiency and the flow and temperature parameters of the exhaust gas **34**.

In certain embodiments, the circulation rate may also be adjusted based at least in part on various feed forward and/or feedback information obtained from sensors **98** (see FIG. **1**) within the tempering air injection system **94**, sensors **62** and **76** (see FIG. **1**) positioned along the flow paths of the take-off stream **48** and the cooled take-off stream **52**, respectively, one or more of the exhaust gas sensors **126**, or any combination thereof. For example, the control system **64** may adjust the circulation rate of the flow of chilled water **106** based on a feed forward input including a temperature of the exhaust gas **34** obtained upstream of the heat exchanger **160** (e.g., between the inlet **38** of the exhaust duct assembly **40** and the tempering air injection grid **92**). Additionally or alternatively, the control system **64** may adjust the circulation rate of the flow of chilled water **106** based on a feedback input including a temperature of the exhaust gas **34** obtained downstream of the exhaust gas heat exchanger **160** (e.g., between the exhaust gas heat exchanger **160** and the SCR catalyst **82**).

As set forth above, it is now recognized that the thermal energy contained in the take-off stream **48** may be used to drive the absorption cooling process within the absorption cooler **50** (specifically, the generator section). Accordingly, the flow of chilled water **106** may also be controlled based on the temperature of the take-off stream **48**, which in turn corresponds to the rate at which certain processes occur within the absorption chiller **50**. These processes affect the rate at which the chilled water **106** may be generated, or the rate at which the return water **108** may be chilled to produce the flow of chilled water **106**.

It should be noted that these control parameters are not limited to the configuration of the system **10** of FIG. **3**. Rather, the flow of the chilled water **106** to the heat exchanger **104** in the tempering air injection system **94**, as in the system **10** of FIGS. **1** and **2**, may be controlled based on these and/or similar parameters. Indeed, as shown in FIG. **4**, certain embodiments of the system **10** may include both the heat exchanger **104** in the tempering air injection system **94** and the exhaust gas heat exchanger **160**, and both may be configured to receive a flow of the chilled water **106**. As noted above with respect to FIG. **3**, while the exhaust gas heat exchanger **160** is depicted in FIG. **4** as being positioned downstream of the tempering air injection grid **92** along the exhaust flow path **54**, the present disclosure is not limited to this configuration. In certain embodiments, the respective positions of the tempering air injection grid **92** and the exhaust gas heat exchanger **160** may be reversed such that the exhaust gas heat exchanger **160** is positioned upstream of the tempering air injection grid **92**.

In such embodiments, a flow control system **170** having one or more flow control devices **172** (e.g., valves, pumps, blowers, fans), one or more sensors **174** (e.g., thermocouples, flow meters, pressure transducers), and/or one or more flow distribution devices (e.g., a flow distribution header) may function to split the flow of the chilled water **106** between the heat exchangers **104**, **160** as appropriate. The flow control system **170**, and in particular the flow control devices **172** and the sensors **174**, are in communication with the control system **64**. The flow control system **170** is intended to represent a collection of flow control devices, flow distribution devices, actuators, sensors, and so forth, appropriately positioned along one or more flow paths to collectively carry the flow of chilled water **106** and the return water **108** to and from the absorption chiller **50**.

The control system **64** may control a split between a first flow of the chilled water **106**A from the absorption chiller **50** to the exhaust gas heat exchanger **160** and a second flow of the chilled water **106**B from the absorption chiller **50** to the heat exchanger **104** in the tempering air injection system **94**. Specifically, the flow of chilled water **106** may first flow from the absorption chiller **50** to one or more features of the flow control system **170**, such as a flow distribution header. The flow control system **170** may then, via control by the control system **64**, cause the flow to be split into a first amount of the chilled water **106** sent to the exhaust gas heat exchanger **160** (as first chilled water **106**A) and a second amount of the chilled water **106** sent to the heat exchanger **104** (as second chilled water **106**B). The split may be controlled such that the ratio of flow volume or mass flow of the first flow of chilled water **106**A to second flow of chilled water **106**B may be controlled in the range of 100:0 to 0:100. For example, the ratio may be between 100:0 and 50:50 first flow of chilled water **106**A to second flow of chilled water **106**B, or vice-versa, depending on cooling requirements and the particular configuration of the system **10**. In one embodiment, none of the chilled water **106** is sent to the heat exchanger **104** of the tempering air injection system **94**. In this embodiment, no tempering air **90** may be provided for cooling the exhaust gas **34**. That is, the exhaust gas **34** may be cooled using only heat exchange features other than the tempering air injection system **94**.

A number of factors may control the split of the chilled water **106**. As one example, the amount of chilled water **106** flowed to the exhaust gas heat exchanger **160** relative to the chilled water **106** flowed to the tempering air injection system **94** may be based on the measured effect of cooling the exhaust gas **34** using only the exhaust gas heat exchanger **160** versus using a combination of the exhaust gas heat exchanger **160** and the tempering air **90**. As noted above, the amount of tempering air **90** utilized for cooling may depend on various parameters of the system **10**, such as gas turbine loading, exhaust gas throughput, exhaust gas temperature, exhaust gas pressure, exhaust gas composition, and so forth. Accordingly, the control system **64** may control the split of the chilled water **106** based on loading of the heavy-duty gas turbine engine **12**, based on ambient air conditions, based on a sensed temperature of exhaust gas **34** within the exhaust duct assembly, or any combination thereof.

Indeed, in accordance with present embodiments, utilizing less tempering air **90** may be desirable to enhance homogeneity of the exhaust gas **34**. In other words, using less tempering air may be desirable to help ensure more homogenous exhaust gas **34** (e.g., a more even distribution of the exhaust gas constituents, taken along a cross-section of the exhaust gas flow **54**). Reducing reliance on tempering air cooling may also enhance the efficiency of the system **10**.

Again, in accordance with embodiments of the present disclosure, a stream of take-off exhaust gas may be used to drive an absorption chiller to simultaneously cool the take-off stream and generate a chilled stream that is capable of being used for further heat exchange. An example of the manner in which the exhaust processing system **14** may be integrated with the absorption chiller **50** is depicted in FIG. **5**, which is a schematic view of an embodiment of the absorption cooling system **46**.

Generally, the absorption chiller **50** utilized in embodiments of the present disclosure will include various regions where some form of heat exchange occurs. In the embodiment of FIG. **5**, the absorption chiller **50** is a single effect absorption chiller that utilizes a single generator section. However, in other embodiments, the absorption chiller **50** may be a double effect absorption chiller having two generator sections.

More specifically, the illustrated absorption chiller **50** includes a generator section **180**, a condenser section **182** fluidly coupled to the generator section **180**, an evaporator section **184** fluidly coupled to the condenser section **182**, and an absorption section **186** fluidly coupled to the evaporator section **184**. A chiller heat exchange section **188** is fluidly coupled to the generator section **180** and to the absorption section **186**. The chiller heat exchange section **188** facilitates heat exchange between the output streams of both sections to generate input streams for the other respective section.

In the embodiment of FIG. **5**, the absorption chiller **50** utilizes water as a refrigerant, and the water refrigerant undergoes a refrigeration cycle within the absorption chiller **50** to cool at least one fluid stream. Refrigerant vapor **190** generally permeates every section of the absorption chiller **50**. Starting with the generator section **180**, as shown, the generator section **180** includes a generator heat exchanger **192** configured to receive the take-off stream **48** and place the take-off stream **48** in a heat exchange relationship with a dilute absorber solution **194**. In the illustrated embodiment, the generator heat exchanger **192** includes a plurality of heat exchange coils, and the dilute absorber solution **194** is dispersed over the generator heat exchanger **192** using a dilute absorber solution injector **196**. However, in other embodiments, other configurations for heat exchange between the dilute absorber solution **194** and the generator heat exchanger **192** may be utilized. In accordance with present embodiments, the dilute absorber solution **194** is a dilute aqueous (water-based) solution of a hygroscopic material (e.g., lithium bromide).

This dispersal results in thermal energy transfer from the take-off stream **48** to the dilute absorber solution **194**, which causes water within the dilute absorber solution **194** to evaporate and causes the cooled take-off stream **52** to be generated. Again, the cooled take-off stream **52** may, itself, be utilized to directly cool the exhaust gas **34** within the exhaust processing system **14** (e.g., by re-introduction into the exhaust gas **34** still within the exhaust path **54**). The water evaporation within the generator section **180** generates a concentrated absorber solution **198** and the refrigerant vapor **190**. The process involving the concentrated absorber solution **198** is described in further detail below. The refrigerant vapor **190**, which is water in its vapor state within the generator section **180**, moves to an area of lower pressure within the condenser section **182**.

The condenser section **182** includes a condenser heat exchanger **199**, which is configured to receive the cooling water **86** from the water source **84** and place the cooling water **86** in a heat exchange relationship with the refrigerant vapor **190**. At the temperature and pressure within the condenser section **182**, some of the refrigerant vapor **190** condenses to form refrigerant liquid **200**. The pressure and temperature gradient between the generator section **180** and the condenser section **182** also facilitates evaporation of water from the dilute absorber solution **194** and movement of the refrigerant vapor **190** toward the condenser section **182**.

The refrigerant liquid **200** flows through a fluid connection **202** coupling the condenser section **182** and the evaporator section **184**. The condenser section **182**, in its most general sense, includes features that facilitate evaporation of the refrigerant liquid **200** to cause evaporative cooling. In the illustrated embodiment, the evaporator section **184** includes an evaporator heat exchanger **204**, which is configured to receive the return water **108** and place the return water **108** in a heat exchange relationship with the refrigerant liquid **200**. The refrigerant liquid **200** may be dispersed over the evaporator heat exchanger **204** using, for example, a refrigerant liquid injector **206**.

More specifically, as the refrigerant liquid **200** contacts a surface of the evaporator heat exchanger **204**, the refrigerant liquid **200** may evaporate off this surface. Accordingly, not only does heat exchange occur between the refrigerant liquid **200** and the return water **108** within the evaporator heat exchanger **204**, but the evaporation of the refrigerant liquid **200** also removes additional thermal energy (e.g., the heat of vaporization) from the return water **108**. This evaporative cooling of the return water **108** generates the chilled water **106**. Again, the chilled water **106** may be provided to the exhaust gas heat exchanger **160** to reduce or eliminate the use of tempering air to cool the exhaust gas **34**. Additionally or alternatively, the chilled water **106** may be provided to the heat exchanger **104** in the tempering air injection system **94** to facilitate generation of the tempering air **90**.

Returning now to the concentrated absorber solution **198** produced within the generator section **180**, as shown, the solution **198** is passed via a fluid conduit **208** through the chiller heat exchange section **188** and to the absorber section **186**. The absorber section **186** includes an absorber heat exchanger **210**, which is configured to receive the cooling water **86** from the water source **84**. The absorber heat exchanger **210** places the cooling water **86** in a heat exchange relationship with the refrigerant vapor **190**, as well as with the concentrated absorber solution **198**, which is dispersed using a concentrated absorber solution injector **212**. The strong affinity of the hygroscopic material in the concentrated absorber solution **198** for water, in combination with the cooled surface of the absorber heat exchanger **210**, encourages the refrigerant vapor **190** to be drawn into the concentrated absorber solution **198**. This causes the dilute absorber solution **194** to be formed, and also creates a vacuum effect between the evaporator section **184** and the absorber section **186** to facilitate the refrigeration cycle.

To further facilitate the refrigeration cycle and motivation of the absorber solutions through the absorption chiller **50**, a solution pump **214** may be positioned at a fluid outlet **216** (a dilute absorber solution outlet) of the absorber section **186**. As the solution pump **214** draws the dilute absorber solution **194** out of the absorber section **186**, the solution pump **214** further encourages continuation of the refrigeration cycle of the refrigerant water by, for instance, maintaining the level of refrigerant liquid **202** within the absorber section **186** at a relatively low level. The solution pump **214** is configured to pump the dilute absorber solution **194** through the chiller heat exchange section **188**, where it undergoes heat exchange with the concentrated absorber solution **198**. The solution pump **214**, as illustrated, motivates the dilute absorber solution **194** toward the generator section **180**, and the absorption cooling cycle continues as described.

In other embodiments, the absorption chiller **50** may have specific configurations in regard to the exact manner in which the refrigerant vapor **190** and the refrigerant liquid **202** are generated and passed through the absorption chiller **50** that are different than those presented herein. However, present embodiments encompass any appropriate configuration in which the take-off stream **48** of exhaust gas is utilized to impart sufficient thermal energy to generate the refrigerant liquid **190** from the dilute absorber solution **194**. In addition, present embodiments encompass any appropriate configuration where, in combination with utilizing the take-off stream **48** as set forth above, the chilled water **106** (or other chilled fluid) is utilized for heat exchange with exhaust gas within the exhaust processing system **14** and/or is utilized for heat exchange with air for use as tempering air within the exhaust processing system **14**.

Technical effects of the invention include the use of thermal energy contained within exhaust gas generated by a gas turbine engine to drive an absorption cooling process that is in turn used to cool the exhaust gas. Using the exhaust gas in this manner may increase the efficiency of simple cycle heavy-duty gas turbine engines by reducing or eliminating their reliance on tempering air for exhaust cooling. For example, the coefficient of performance (COP) for cooling the exhaust gas (the amount of cooling of the exhaust gas that is achieved relative to the amount of work input to the system) may be increased by reducing reliance on tempering air to cool the exhaust gas, and instead cooling the exhaust gas utilizing an exhaust gas heat exchanger and an absorption chiller. Cooling using the exhaust gas heat exchanger and the absorption chiller may be more efficient than cooling using a tempering air injection system.

This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

The invention claimed is:

1. A gas turbine system, comprising: a gas turbine engine configured to combust a fuel and produce an exhaust gas; an exhaust duct assembly fluidly coupled to the gas turbine engine and configured to receive the exhaust gas from the gas turbine engine;

an absorption chiller fluidly coupled to the exhaust duct assembly and configured to receive a take-off stream of exhaust gas from the exhaust duct assembly via an exhaust take-off path, wherein the absorption chiller is configured to use the take-off stream of exhaust gas to drive at least a portion of an absorption cooling process to generate a cooled take-off stream of exhaust gas; and

wherein the exhaust duct assembly is configured to receive the cooled take-off stream of exhaust gas from the absorption chiller via a cooled take-off path and to mix the cooled take-off stream of exhaust gas with exhaust gas present within the exhaust duct assembly to cool the exhaust gas, and

a heat exchanger disposed within a tempering air injection system fluidly coupled to the exhaust duct assembly, wherein the heat exchanger is configured to receive a chilled fluid from the absorption chiller via a chilled fluid path and to direct a return fluid generated from the chilled fluid to the absorption chiller via a return fluid path, wherein the chilled fluid path extends from a chilled fluid outlet of the absorption chiller to a chilled fluid inlet of the heat exchanger, and the return fluid path extends from a return fluid outlet of the heat exchanger to a return fluid inlet of the absorption chiller, and wherein the chilled fluid path and the return fluid path are fluidly coupled.

2. The gas turbine system of claim **1**, wherein the exhaust duct assembly comprises an absorption cooling inlet and an absorption cooling outlet, wherein the exhaust take-off path extends from the absorption cooling inlet to the absorption chiller, and wherein the cooled take-off path extends from the absorption chiller to the absorption cooling outlet.

3. The gas turbine system of claim **2**, wherein the absorption chiller comprises a generator section having a generator heat exchanger, wherein the generator heat exchanger is configured to place the take-off stream of exhaust gas in heat exchange with a dilute absorber solution to produce the cooled take-off stream of exhaust gas and a concentrated absorber solution.

4. The gas turbine system of claim **1**, comprising a selective catalytic reduction (SCR) catalyst disposed within the exhaust duct assembly and configured to reduce NO_x present within the exhaust gas.

5. The gas turbine system of claim **4**, comprising an ammonia skid having a source of ammonia and one or more flow paths configured to direct ammonia to an ammonia injection grid positioned within the exhaust duct assembly upstream of the SCR catalyst.

6. The gas turbine system of claim **1**, wherein the tempering air injection system is configured to inject tempering air generated via heat exchange between the chilled fluid and air into an exhaust gas flow path of the exhaust duct assembly to cool the exhaust gas.

7. The gas turbine system of claim **6**, wherein the tempering air injection system is configured to inject the tempering air via a tempering air injection grid positioned along the exhaust gas flow path.

8. The gas turbine system of claim **7**, wherein the tempering air injection grid is positioned upstream of a selective catalytic reduction (SCR) catalyst configured to reduce NO_x present within the exhaust gas.

9. The gas turbine system of claim **6**, comprising a control system communicatively coupled to one or more flow control devices of the tempering air injection system and to one or more sensors configured to enable the control system to monitor a parameter of the exhaust gas within the exhaust duct assembly, wherein the control system is configured to adjust an amount of the tempering air used to cool the exhaust gas in response to detecting a change in the monitored parameter of the exhaust gas.

10. The gas turbine system of claim **6**, comprising a control system communicatively coupled to one or more flow control devices of the tempering air injection system, wherein the control system is configured to monitor loading of the gas turbine engine, and to adjust an amount of the tempering air used to cool the exhaust gas in response to detecting a change in the loading of the gas turbine engine or ambient air conditions.

11. The gas turbine system of claim **2**, comprising a tempering air injection grid disposed within the exhaust duct assembly, wherein the absorption cooling inlet and the absorption cooling outlet are disposed upstream of the tempering air injection grid.

12. A system, comprising:

an exhaust duct assembly configured to receive exhaust gas from a gas turbine engine;

an absorption chiller fluidly coupled to the exhaust duct assembly and configured to receive a take-off stream of exhaust gas from the exhaust duct assembly via an exhaust take-off path, wherein the absorption chiller is configured to use the take-off stream of exhaust gas to drive at least a portion of an absorption cooling process to generate a cooled take-off stream of exhaust gas; and

a tempering air injection system fluidly coupled to the exhaust duct assembly and configured to provide tempering air to the exhaust duct assembly, wherein the tempering air injection system comprises a heat exchanger fluidly coupled to the absorption chiller, wherein the absorption chiller is configured to flow a stream of chilled fluid to the heat exchanger via a chilled fluid path extending between a chilled fluid outlet of the heat exchanger and a chilled fluid inlet of the absorption chiller, and wherein the heat exchanger is configured to direct a return fluid flow generated from the chilled fluid to the absorption chiller via a return flow path extending between a return fluid outlet of the heat exchanger and a return fluid inlet of the absorption chiller, wherein the chilled fluid path and the return fluid path are fluidly coupled.

13. The system of claim **12**, wherein the absorption chiller comprises a generator section having a generator heat exchanger, wherein the generator heat exchanger is fluidly coupled to the exhaust duct assembly by a take-off flow path such that the generator heat exchanger is configured to receive the take-off stream of exhaust gas and place the take-off stream of exhaust gas in heat exchange with a dilute absorber solution to produce the cooled take-off stream of exhaust gas and a concentrated absorber solution.

14. The system of claim **12**, comprising a flow control system positioned along the chilled fluid path and configured to split the stream of chilled fluid between the heat exchanger and an exhaust gas heat exchanger positioned within the exhaust duct assembly.

15. The system of claim **14**, comprising a control system communicatively coupled to at least a portion of the flow control system, wherein the control system is configured to control the split of the stream of chilled fluid to control an amount of the stream of chilled fluid provided to the heat exchanger versus an amount of the stream of chilled fluid provided to the exhaust gas heat exchanger.

16. The system of claim **15**, wherein the control system is configured to control the split based on loading of the gas turbine engine, based on ambient air conditions, based on a sensed temperature of exhaust gas within the exhaust duct assembly, or any combination thereof.

17. The gas turbine system of claim **12**, comprising a cooled take-off path extending between the absorption chiller and an absorption cooling outlet disposed along the exhaust duct assembly, wherein the cooled take-of path is fluidly coupled to the exhaust take-off path, wherein the exhaust take-off path extends between an absorption cooling inlet and the absorption chiller, and wherein the absorption cooling inlet and the absorption cooling outlet are disposed adjacent to an upstream end of the exhaust duct assembly.

18. A gas turbine system, comprising:

a gas turbine engine configured to combust a fuel and produce an exhaust gas;

an exhaust duct assembly fluidly coupled to the gas turbine engine and configured to receive the exhaust gas from the gas turbine engine, wherein the exhaust duct assembly is configured to flow the exhaust gas along an exhaust gas path from an inlet to an outlet;

a selective catalytic reduction (SCR) system having an SCR catalyst positioned within the exhaust duct assembly and an ammonia injection grid positioned within the exhaust duct assembly upstream of the SCR catalyst, wherein the ammonia injection grid is configured to inject ammonia into the exhaust gas path and the SCR catalyst is configured to reduce an amount of NOx present within the exhaust gas;

an absorption chiller fluidly coupled to the exhaust duct assembly and configured to receive a take-off stream of exhaust gas from the exhaust duct assembly via an exhaust take-off path, wherein the absorption chiller is configured to use the take-off stream of exhaust gas to drive at least a portion of an absorption cooling process to generate a cooled take-off stream of exhaust gas, wherein the exhaust duct assembly is configured to receive the cooled take-off stream of exhaust gas from the absorption chiller via a cooled take-off path and to mix the cooled take-off stream of exhaust gas with exhaust gas along the exhaust gas path to cool the exhaust gas;

a tempering air injection system fluidly coupled to the exhaust duct assembly and the absorption chiller and comprising a heat exchanger configured to receive a chilled fluid from the absorption chiller and to cool a stream of air within the tempering air injection system via heat exchange with the chilled fluid to generate a tempering air and a return fluid;

a chilled fluid path extending from a chilled fluid outlet of the absorption chiller to a chilled fluid inlet of the heat exchanger, wherein the chilled fluid path is configured to direct the chilled fluid from the absorption chiller to the heat exchanger;

a return fluid path fluidly coupled to the chilled fluid path and extending from a return fluid outlet of the heat exchanger and a return fluid inlet of the absorption chiller, wherein the return fluid path is configured to direct the return fluid from the heat exchanger to the absorption chiller, and wherein the chilled fluid path and the return fluid path are fluidly coupled; and

a control system configured to control cooling of the exhaust gas along the exhaust gas path such that a temperature of the exhaust gas, upon encountering the SCR catalyst, is within a predetermined temperature range that is appropriate for the SCR catalyst to reduce the amount of NOx present within the exhaust gas.

19. The gas turbine system of claim **18**, wherein the tempering air injection system is configured to provide the tempering air to the exhaust duct assembly, and wherein the control system is configured to control cooling of the exhaust gas by controlling at least a flow of the stream of chilled fluid to the heat exchanger and to control a flow of the take-off stream to the absorption chiller.

20. The gas turbine system of claim **18**, wherein the exhaust take-off path extends from an absorption cooling inlet disposed along the exhaust duct assembly to the absorption chiller, and the cooled take-off path extends from the absorption chiller to an absorption cooling outlet disposed along the exhaust duct assembly, wherein the exhaust take-off path and the cooled take-off path are fluidly coupled, and wherein the absorption cooling inlet and the absorption cooling outlet are disposed between the tempering air injection system and the ammonia injection grid.

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