



EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.09.2018 Bulletin 2018/39

(51) Int Cl.:
F01K 23/06 (2006.01)

(21) Application number: **18159955.6**

(22) Date of filing: **05.03.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **23.03.2017 JP 2017057649**

(71) Applicants:
• **Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.)**
Kobe-shi, Hyogo, 651-8585 (JP)
• **Asahi Shipping Co. Ltd.**
Tokyo 105-0003 (JP)
• **Tsuneishi Shipbuilding Co., Ltd.**
Hiroshima 720-0394 (JP)

• **Miura Co., Ltd.**
Matsuyama-shi, Ehime 799-2696 (JP)

(72) Inventors:
• **ADACHI, Shigeto**
Takasago-shi,, Hyogo 676-8670 (JP)
• **FUJII, Tetsuro**
Minato-ku,, Tokyo 105-0003 (JP)
• **ARAHIRA, Kazuya**
Minato-ku,, Tokyo 105-0003 (JP)
• **YAMAMOTO, Hiroyuki**
Fukuyama-shi,, Hiroshima 720-0394 (JP)
• **ISHIDA, Tomoaki**
Fukuyama-shi,, Hiroshima 720-0394 (JP)

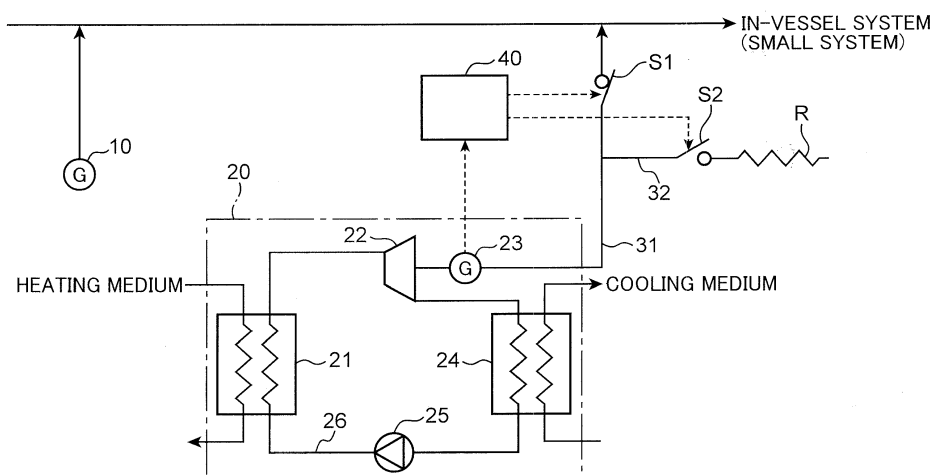
(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

(54) **POWER GENERATION SYSTEM**

(57) A power generation system comprises a diesel generator, a binary generating equipment including an evaporator, an expander, a binary generator, a condenser, and a pump, a connection line connecting an output of the binary generator to an output of the diesel gener-

ator, a connection switch disposed on the connection line, and a controller, wherein the controller, upon receipt of an abnormal signal indicating an abnormal output of the binary generator, opens the connection switch.

FIG.1



Description

Background of the Invention

Field of the Invention

[0001] The present invention relates to a power generation system.

Background Art

[0002] Conventionally, there are known power generation systems comprising a diesel generator, and a binary generating equipment including a binary generator. For example, Japanese Unexamined Patent Publication No. 2013-92144 (hereinafter, referred to as "Patent Document 1") discloses a power generation system comprising a generator (diesel generator) for generating power using a diesel engine as a driving source, and a power generation cycle for generating power using a binary cycle (heat engine). The power generation cycle includes an evaporator for evaporating a working medium, an expander for expanding the working medium flowing from the evaporator, a binary generator connected to the expander, a condenser for condensing the working medium flowing from the expander, and a pump for feeding the working medium flowing from the condenser to the evaporator.

[0003] In such a power generation system as shown in Patent Document 1, there is a case where an output of the binary generator is connected to an output system of the diesel generator. In this case, there is a possibility that the output system (voltage) of the diesel generator may fluctuate when an abnormal output of the binary generator occurs.

Summary of the Invention

[0004] An object of the present invention is to provide a power generation system capable of suppressing instability of an output system of a diesel generator when an abnormal output of a binary generator occurs.

[0005] A power generation system according to an aspect of the present invention comprises: a diesel generator; a binary generating equipment including an evaporator for evaporating a working medium, an expander for expanding the working medium flowing from the evaporator, a binary generator connected to the expander, a condenser for condensing the working medium flowing from the expander, and a pump for feeding the working medium flowing from the condenser to the evaporator; a connection line connecting an output of the binary generator to an output of the diesel generator; a connection switch disposed on the connection line; and a controller, wherein the controller, upon receipt of an abnormal signal indicating an abnormal output of the binary generator, opens the connection switch.

[0006] These and other objects, features and advantages

of the present invention will become more apparent upon reading the following detailed description along with the accompanying drawings.

Brief Description of the Drawings

[0007] FIG. 1 is a schematic diagram of a configuration of a power generation system according to an embodiment of the present invention.

Detailed Description of the Preferred Embodiments of the Invention

[0008] A power generation system according to an embodiment of the present invention will be described with reference to FIG. 1.

[0009] As shown in FIG. 1, the present power generation system comprises a diesel generator 10, a binary generating equipment 20 including a binary generator 23, a connection line 31, a connection switch S1, a branch line 32, a branch switch S2, a resistor R, and a controller 40. The power generation system is mounted on a vessel.

[0010] The diesel generator 10 includes an output connected to an in-vessel system. In other words, the diesel generator 10 supplies electric power to a load disposed in the vessel. In the present embodiment, a rated power of the diesel generator 10 is equal to or less than 1000kW.

[0011] The binary generating equipment 20 includes an evaporator 21, an expander 22, the binary generator 23, a condenser 24, a pump 25, and a circulation flow channel 26 connecting the evaporator 21, the expander 22, the condenser 24, and the pump 25 in this order.

[0012] The evaporator 21 performs heat exchange between a working medium and a heating medium (such as vapor generated in the vessel) to thereby evaporate the working medium.

[0013] The expander 22 is disposed on a portion of the circulation flow channel 26 that is downstream of the evaporator 21. The expander 22 expands the working medium in the form of gas flowing from the evaporator 21. In the present embodiment, a positive displacement screw expander is used as the expander 22, which includes a rotor rotationally driven by expansion energy of the gaseous working medium.

[0014] The binary generator 23 is connected to the expander 22. Specifically, the binary generator 23 includes a rotary shaft (not shown) connected to the rotor, a mover secured to the rotary shaft, and a stator arranged around the mover. The rated power of the binary generator 23 is smaller than a rated power of the diesel generator. For example, the rated power of the binary generator 23 is 100kW.

[0015] The condenser 24 is disposed on a portion of the circulation flow channel 26 that is downstream of the expander 22. The condenser 24 performs heat exchange between the working medium flowing from the expander 22 and a cooling medium (such as seawater) to thereby condense the working medium.

[0016] The pump 25 is disposed on a portion (a portion between the condenser 24 and the evaporator 21) of the circulation flow channel 26 that is downstream of the condenser 24. The pump 25 feeds the working medium in the form of liquid flowing from the condenser 24 to the evaporator 21 at a predetermined pressure.

[0017] The connection line 31 connects an output of the binary generator 23 to the output of the diesel generator 10. In other words, both an output of the diesel generator 10 and an output of the binary generator 23 are supplied to the load disposed in the vessel.

[0018] The connection switch S1 is disposed on the connection line 31. The connection switch S1 permits or inhibits merging of the output of the binary generator 23 into the output of the diesel generator 10.

[0019] The branch line 32 branches from the connection line 31. The branch switch S2 and the resistor R are disposed on the branch line 32. The branch switch S2 permits input of or cut off the output of the binary generator 23 to the resistor R. As shown in FIG. 1, when the binary generating equipment 20 operates normally, the connection switch S1 is closed and the branch switch S2 is open.

[0020] The controller 40, upon receipt of an abnormal signal indicating an abnormal output of the binary generator 23, opens the connection switch S1 and closes the branch switch S2. In the present embodiment, the controller 40 further stops the binary generator 23 upon the receipt of the abnormal signal.

[0021] The abnormal signal is transmitted to the controller 40 when the rotary shaft of the binary generator 23 rotates at an excessive speed, when the temperature of the binary generator 23 exceeds a reference value, and when a converter of the binary generator 23 detects an excessive voltage or an excessive current, for example.

[0022] As described above, in the present power generation system, the connection switch S1 disposed on the connection line 31 is opened (i.e. the connection line 31 is cut off) when an abnormal output of the binary generator 23 occurs. This makes it possible to suppress instability of an output system of the diesel generator 10 when an abnormal output of the binary generator 23 occurs.

[0023] Further, the controller 40, upon receipt of the abnormal signal, opens the connection switch S1 and closes the branch switch S2. Consequently, power generated by the binary generator 23 when an abnormal output of the binary generator 23 occurs is effectively consumed at the resistor R connected to the branch line 32, without reaching an output line of the diesel generator 10.

[0024] Further, the controller 40 stops the binary generator 23 upon the receipt of the abnormal signal, which makes it possible to gradually reduce power generated by the binary generator 23 during a period after the receipt of the abnormal signal by the controller 40 and before the stop of the binary generator 23. This makes it possible to prevent an increase in size of the resistor R.

[0025] The embodiment described above is now summarized.

[0026] A power generation system according to the present embodiment comprises: a diesel generator; a binary generating equipment including an evaporator for evaporating a working medium, an expander for expanding the working medium flowing from the evaporator, a binary generator connected to the expander, a condenser for condensing the working medium flowing from the expander, and a pump for feeding the working medium flowing from the condenser to the evaporator; a connection line connecting an output of the binary generator to an output of the diesel generator; a connection switch disposed on the connection line; and a controller, wherein the controller, upon receipt of an abnormal signal indicating an abnormal output of the binary generator, opens the connection switch.

[0027] In the present power generation system, the connection switch disposed on the connection line is opened (i.e. the connection line is cut off) when an abnormal output of the binary generator occurs. This makes it possible to suppress instability of an output system of the diesel generator when an abnormal output of the binary generator occurs.

[0028] In the above-described power generation system, it is preferred to further comprise: a branch line branching from the connection line; a branch switch disposed on the branch line; and a resistor connected to the branch line, and that the controller, upon the receipt of the abnormal signal, opens the connection switch and closes the branch switch.

[0029] This configuration allows power generated by the binary generator when an abnormal output of the binary generator occurs, to be effectively consumed at the resistor connected to the branch line, without reaching an output line of the diesel generator.

[0030] Further, it is preferred that the controller, upon the receipt of the abnormal signal, opens the connection switch, closes the branch switch, and stops the binary generator.

[0031] This configuration makes it possible, when an abnormal output of the binary generator occurs, to gradually reduce the output of the binary generator. This makes it possible to prevent an increase in size of the resistor.

[0032] Further, in the above-described power generation system, it is preferred that the output of the diesel generator and the output of the binary generator are connected to a load disposed in a vessel, that a rated power of the diesel generator is equal to or less than 1000kW, and that a rated power of the binary generator is smaller than the rated power of the diesel generator.

[0033] This configuration makes it possible, even in the system (small system mounted in the vessel) in which the rated power of the diesel generator is equal to or less than 1000kW, to effectively suppress instability of the output system of the diesel generator when an abnormal output of the binary generator occurs.

[0034] A power generation system comprises a diesel generator, a binary generating equipment including an evaporator, an expander, a binary generator, a condenser, and a pump, a connection line connecting an output of the binary generator to an output of the diesel generator, a connection switch disposed on the connection line, and a controller, wherein the controller, upon receipt of an abnormal signal indicating an abnormal output of the binary generator, opens the connection switch.

5

10

the output of the diesel generator and the output of the binary generator are connected to a load disposed in a vessel;
a rated power of the diesel generator is equal to or less than 1000kW; and
a rated power of the binary generator is smaller than the rated power of the diesel generator.

Claims

1. A power generation system, comprising:

15

a diesel generator;
a binary generating equipment including

an evaporator for evaporating a working medium,

20

an expander for expanding the working medium flowing from the evaporator,

a binary generator connected to the expander,

a condenser for condensing the working medium flowing from the expander, and

25

a pump for feeding the working medium flowing from the condenser to the evaporator;

30

a connection line connecting an output of the binary generator to an output of the diesel generator;

a connection switch disposed on the connection line; and

35

a controller, wherein

the controller, upon receipt of an abnormal signal indicating an abnormal output of the binary generator, opens the connection switch.

40

2. The power generation system according to claim 1, further comprising:

a branch line branching from the connection line;
a branch switch disposed on the branch line; and
a resistor connected to the branch line, wherein the controller, upon the receipt of the abnormal signal, opens the connection switch and closes the branch switch.

45

50

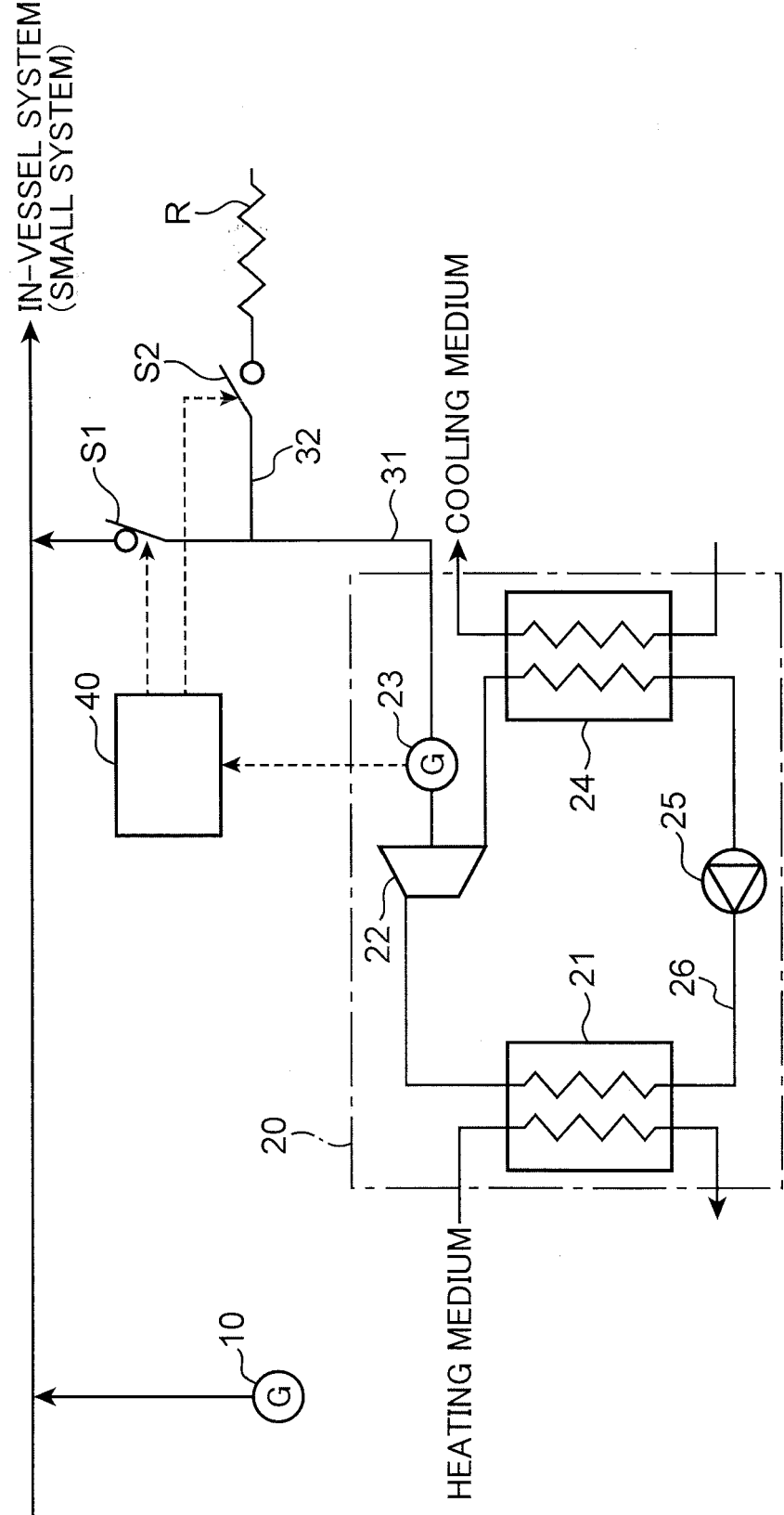
3. The power generation system according to claim 2, wherein

the controller, upon the receipt of the abnormal signal, opens the connection switch, closes the branch switch, and stops the binary generator.

55

4. The power generation system according to any one of claims 1 to 3, wherein:

FIG.1



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2013092144 A [0002]