

PATENT SPECIFICATION

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(54) PLANT FOR PRODUCING ELECTRIC POWER AND DESALINATED WATER

(71) We, SNAMPROGETTI S.P.A., an Italian company, of Corso Venezia 16, Milan, Italy, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the production of electric power and desalinated water.

According to the present invention, there is provided a plant for the concurrent production of electric power and desalinated water, the plant comprising a gas turbo-alternator connected to a low-pressure steam generator, and a desalination installation for heating water to be desalinated, the arrangement of the plant being such that, in use, exhaust gas discharged from the gas turbine is fed to the steam generator to produce steam which is fed to the desalination installation.

In the plant of the present invention, a back-pressure turbine (i.e. a turbine in which all the steam is withdrawn at an intermediate point at a superatmospheric pressure, for use elsewhere) or a bleed-steam, condensation-type turbine (i.e. a turbine in which only part of the steam is withdrawn at superatmospheric pressure at an intermediate point, the remainder continuing its expansion in the turbine until becoming condensed) may be incorporated for producing additional electric power. Such a turbine is fed by superheated steam under a high pressure, which is produced at the expense of part of the heat recovered from the exhaust gases discharged from the gas turbine. If it is desired to increase the production of both electric power and desalinated water, the exhaust gas discharged from the gas turbine may be further heated by means of a burner inserted downstream of the gas turbine and upstream of the inlet for the exhaust gas in the steam generator.

The plant according to the present inven-

tion, compared with a conventional system which produces electric power and desalinated water with a thermoelectric power station with a steam turbine of the back-pressure type, has the advantage that, for a given output of desalinated water, the production of electric power can exceed by more than three times that of the conventional system and the specific consumption of primary power (calories per Kwh) can be lower.

The advantage of improved production of electric power, for a given output of desalinated water, remains when a comparison is made with thermoelectric power stations which employ bleed-steam, condensation-type turbines.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing in which Figures 1 and 2 represent schematically two different plants according to the present invention.

Referring to Figure 1, there is shown a pipe 1 for conveying air to a filter 2 and on to a gas turbine plant formed by a compressor 3, a combustion chamber 4 (to which fuel may be fed in a pipe 14) and a turbine 5 coupled to an electricity generator 6. A pipe 11 for discharged exhaust gas leads from the turbine 5 to a casing 7 which contains a low-pressure steam generator 8 and optionally a generator 9 of high pressure steam (both generators being fed by preheated water 10).

The casing 7 is provided with a discharge pipe 12 leading to an exhaust 13, for discharging the exhaust gas after having yielded to the steam generator(s) the heat contained by the gas.

Also present is a pipe 15 for conveying steam, produced in the low-pressure generator 8 (generally at a pressure of from 5 to 15 atmospheres absolute), to a desalinator

16, where it is used for heating the water to be desalinated. Steam coming from the optional high-pressure generator 9 (generally at a pressure of from 30 to 70 atmospheres absolute) is fed to a bleed-steam, condensation-type turbine 17 (which could be replaced by a back-pressure turbine, in which the bleed steam is sent to the desalinator 16 through a pipe 18, with condensation taking place in a condenser 19.

Figure 2 illustrates a modification of the plant shown in Figure 1. Identical components are indicated by identical reference numerals. The plant of Figure 2 is provided in pipe 11 with an auxiliary burner 20 connected to a fuel supply line 24 and a blower 21. Such an auxiliary burner permits the production of desalinated water and possibly of electric power, even when the gas turbine plant 3, 4, 5 is inoperative.

In addition, when the gas turbine plant is in action, it permits an increase in the production of electric power and concurrently of desalinated water by further heating the exhaust gas discharged from the gas turbine plant 3, 4, 5.

WHAT WE CLAIM IS:—

1. A plant for the concurrent production of electric power and desalinated water, the plant comprising a gas turbo-alternator connected to a low-pressure steam generator, and a desalination installation for heating water to be desalinated, the arrangement of the plant being such that, in use, exhaust gas discharged from the gas turbine is fed to the steam generator to produce steam which is fed to the desalination installation.

2. A plant according to claim 1, which

also includes (a) a high-pressure steam generator and (b) a back-pressure turbine or a bleed-steam, condensation-type turbine, the arrangement of the plant being such that, in use, part of the heat contained in the exhaust gas discharged from the gas turbine is used for the production of high-pressure steam which feeds the back-pressure turbine or bleed-steam, condensation-type turbine, and the steam from the turbine is fed to the desalination installation.

3. A plant according to claim 2, which also includes a burner disposed downstream of the gas turbine and upstream of the steam generator, whereby the production of electric power and/or of steam for the desalination can be increased by further heating the exhaust gases discharged from the gas turbine in the burner.

4. A plant substantially as hereinbefore described with reference to, and as illustrated in, Figure 1 or Figure 2 of the accompanying drawing.

5. A method of concurrently producing electric power and desalinated water, whenever effected in a plant according to any preceding claim.

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16, where it is used for heating the water to be desalinated. Steam coming from the optional high-pressure generator 9 (generally at a pressure of from 30 to 70 atmospheres absolute) is fed to a bleed-steam, condensation-type turbine 17 (which could be replaced by a back-pressure turbine, in which the bleed steam is sent to the desalinator 16 through a pipe 18, with condensation taking place in a condenser 19.

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WHAT WE CLAIM IS:—

1. A plant for the concurrent production of electric power and desalinated water, the plant comprising a gas turbo-alternator connected to a low-pressure steam generator, and a desalination installation for heating water to be desalinated, the arrangement of the plant being such that, in use, exhaust gas discharged from the gas turbine is fed to the steam generator to produce steam which is fed to the desalination installation.

2. A plant according to claim 1, which

also includes (a) a high-pressure steam generator and (b) a back-pressure turbine or a bleed-steam, condensation-type turbine, the arrangement of the plant being such that, in use, part of the heat contained in the exhaust gas discharged from the gas turbine is used for the production of high-pressure steam which feeds the back-pressure turbine or bleed-steam, condensation-type turbine, and the steam from the turbine is fed to the desalination installation.

3. A plant according to claim 2, which also includes a burner disposed downstream of the gas turbine and upstream of the steam generator, whereby the production of electric power and/or of steam for the desalination can be increased by further heating the exhaust gases discharged from the gas turbine in the burner.

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