

FORM 1

596505

SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

Siemens Aktiengesellschaft, incorporated in the Federal Republic of Germany, of Wittelsbacher Platz 2, 8000 Muenchen, FEDERAL REPUBLIC OF GERMANY, hereby apply for the grant of a standard patent for an invention entitled:

Combined Gas and Steam Turbine Power Plant

which is described in the accompanying complete specification.

Details of basic application(s):-

Basic Applic. No: Country:

P3709469.6

FEDERAL REPUBLIC OF GERMANY

Application Date:

23 March 1987

The address for service is:-

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DATED this SEVENTEENTH day of MARCH 1988

Siemens Aktiengesellschaft

By:

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS
OUR REF: 51381
S&F CODE: 61890

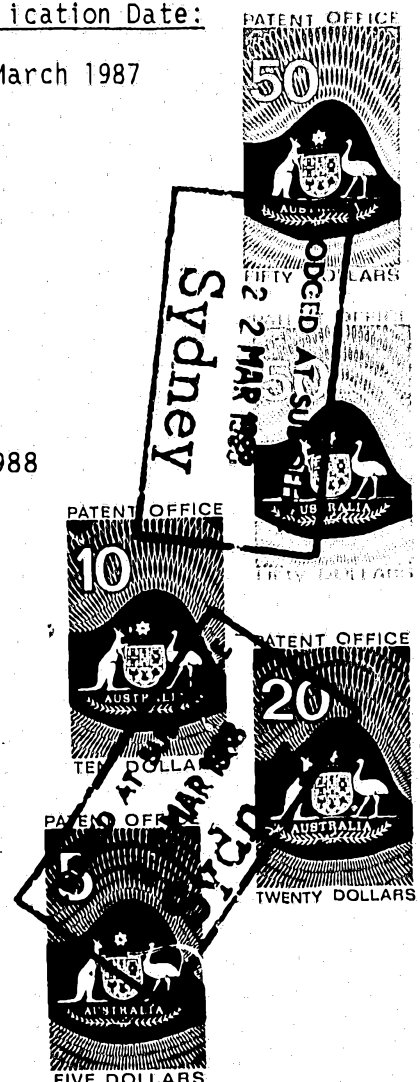
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22 MAR 1988

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DECLARATION IN SUPPORT OF A
CONVENTION APPLICATION FOR A PATENTAUSTRALIA
CONVENTION
STANDARD
& PETTY PATENT
DECLARATIONIn support of the Convention Application made for a
patent for an invention entitled:

Title of Invention Combined Gas and Steam Turbine Power Plant

I/We John Gordon Hinde

Full name(s) and
address(es) of
Declarant(s)Care of Spruson & Ferguson
St Martins Tower, 31 Market Street,
Sydney, New South Wales, Australia

do solemnly and sincerely declare as follows:-

Full name(s) of
Applicant(s)

1. ~~I am/We are the applicant(s) for the patent~~
(or, in the case of an application by a body corporate)
1. I am/~~We are~~ authorised by

Siemens Aktiengesellschaft

the applicant(s) for the patent to make this declaration on
its/~~their~~ behalf.

2. The basic application(s) as defined by Section 141 of the
Act was/~~were~~ made

Basic Country(ies)

in Federal Republic of Germany

Priority Date(s)

on 23 March 1987

Basic Applicant(s)

by Kraftwerk Union AG

Full name(s) and
address(es) of
inventor(s)

3. ~~I am/We are the actual inventor(s) of the invention referred
to in the basic application(s)~~
(or where a person other than the inventor is the applicant)

3.

of JUERGEN KARG
Seuffertstr. 16, 8500 Nuernberg 70,
(Staatsangehoerigkeit,)
Federal Republic of Germany (respectively)

is/~~are~~ the actual inventor(s) of the invention and the facts upon
which the applicant(s) is/~~are~~ entitled to make the application are
as follows:

Set out how Applicant(s)
derive title from actual
inventor(s) e.g. The
Applicant(s) is/~~are~~ the
assignee(s) of the
invention from the
inventor(s)

The said applicant is the assignee of Kraftwerk
Union AG who is the assignee of the actual
inventor.

4. The basic application(s) referred to in paragraph 2 of this
Declaration was/~~were~~ the first application(s) made in a Convention
country in respect of the invention(s) the subject of the application.

Declared at Sydney this 17th day of March 1988

Signature of Declarant(s)

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COMBINED GAS AND STEAM TURBINE POWER PLANT
- international Patent Classification(s)
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- (30) Priority Data
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JUERGEN KARG
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SPRUSON & FERGUSON
- (56) Prior Art Documents
US 4150953
US 4092825
- (57) Claim

1. A combined gas and steam turbine power plant comprising an upstream coal gasifier and a gas-cooling and gas-cleaning plant downstream of the coal gasifier, the plant further comprising (a) means whereby the tar fraction obtained during the gas-cooling and gas-cleaning can be recycled to the coal gasifier for the purpose of being cracked, gasified and partial burnt therein, and (b) means whereby the naphtha and oil fractions thus obtained can be used as additional fuel for the gas turbine.

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FORM 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

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Complete Specification Lodged:
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Name and Address
of Applicant:

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Complete Specification for the invention entitled:

Combined Gas and Steam Turbine Power Plant

The following statement is a full description of this invention, including the best method of performing it known to me/us

ABSTRACT

COMBINED GAS AND STEAM TURBINE POWER PLANT

In a combined gas and steam turbine power plant having an upstream coal gasifier and a gas-cooling and gas-cleaning plant downstream of the coal gasifier, the naphtha and oil fractions obtained should be extracted in such a way as to obtain energy in the most efficient way. The invention provides that the tar fractions obtained during gas-cooling and gas-cleaning be recycled to the coal gasifier and that the naphtha and oil fractions obtained be used as additional gas turbine fuel. Furthermore, the naphtha and oil fractions may be introduced into a store and, according to requirements, be fed to the combustion chamber of the gas turbine. The invention is particularly suited to coal power plants.

COMBINED GAS AND STEAM TURBINE POWER PLANT

The invention relates to a combined gas and steam turbine power plant having an upstream coal gasifier and a gas-cooling and gas-cleaning plant downstream of the coal gasifier.

Combined gas and steam turbine power plants having upstream coal gasifiers are known. In such combined gas and steam turbine power plants, the coal is converted in the coal gasifier by the use of an oxygen/steam or air/steam mixture as a gasification means. The crude gas produced is cooled, if necessary after being quenched, in heat exchangers with simultaneous steam generation, and the cooled crude gas is subjected to gas cleaning. Particles of dust and ash, as well as sulphur compounds, are removed from the crude gas in the course of the gas cleaning. The cleaned gas, also called pure gas, is usually reheated and fed to a gas turbine.

Fixed bed coal gasifiers are distinguished from other gasification systems in that, depending on the process, a very large proportion of the coal energy in the form of chemically bonded energy is contained in the fuel gas produced and only a relatively small proportion of the energy is converted into latent heat. Because of the lower gasification temperature compared to other gasification systems, tars, oils and naphtha are obtained which condense in the gas-cooling and gas-cleaning plant. There are known methods wherein the tar fractions obtained, as well as oils and naphtha, are recycled to the gasifier to be cracked, gasified and partly burnt therein in order to contribute to an increase in the yield of crude gas.

A method is also known wherein the oil and naphtha fractions obtained are sold as products or are supplied for a separate use. The combustible condensates can, for example, be used for undergrate firing of process

steam generators.

However all of these known processes, in the case of a combined gas and steam turbine power plant, result in the chemical energy of the naphtha and oil fractions in the gas turbine only being able to be partly used or being not used at all. Based on the energy of the coal, all these processes represent energetic and exergonic sources of loss, which restrict the overall attainable efficiency.

The underlying object of the present invention, therefore, is to increase the overall efficiency of the conversion of coal into electrical energy, in a combined gas and steam turbine power plant having an upstream coal gasifier.

According to the present invention, there is provided a combined gas and steam turbine power plant comprising an upstream coal gasifier and a gas-cooling and gas-cleaning plant downstream of the coal gasifier, the plant further comprising (a) means whereby the tar fraction obtained during the gas-cooling and gas-cleaning can be recycled to the coal gasifier for the purpose of being cracked, gasified and partial burnt therein, and (b) means whereby the naphtha and oil fractions thus obtained can be used as additional fuel for the gas turbine.

Preferably, the plant comprises means whereby the naphtha and oil fractions continuously obtained can be continually mixed with the cleaned and reheated fuel gas. In this case, the plant preferably comprises means whereby the naphtha and oil fractions obtained can be heated to the approximate temperature of the fuel gas before being mixed with the cleaned fuel gas.

Preferably, the plant comprises means whereby the naphtha and oil fractions condensed-out can be introduced into a store and according to requirements fed to a combustion chamber of the gas turbine. In

this case, the plant preferably comprises means whereby the naphtha and oil fractions can be injected directly into the combustion chamber of the gas turbine as liquid fuel. Alternatively, the plant preferably
5 comprises means whereby the naphtha and oil portions, following prior vaporization, can be mixed with the fuel gas of the gas turbine.

In another preferred embodiment, the plant comprises means whereby the continuously obtained
10 naphtha and oil fractions can be continually injected directly into the combustion chamber of the gas turbine.

Preferably the coal gasified is a fixed bed coal gasifier.

15 The invention is particularly suited to coal power plants.

Thus according to the invention, the tar fractions obtained during gas-cooling and gas-cleaning are recycled to the coal gasifier for the purpose of
20 cracking, gasifying or partial combustion, and the naphtha and oil fractions obtained are used as additional gas turbine fuel. By this measure, the full heat value of the naphtha and oil fractions for the generation of electrical energy is obtained without
25 further loss with regard to gas generation. The overall efficiency of the combined gas and steam turbine power plant having the upstream coal gasifier is clearly improved by this process compared to other known systems.

30 In an advantageous embodiment of the invention, the naphtha and oil fractions, continuously obtained, can be continually mixed with the cleaned and reheated fuel gas. This has the result that the heat value of the fuel gas is raised and in this way the chemically
35 bonded energy delivered to the gas turbine is increased.

In a particularly advantageous embodiment of the invention, the naphtha and oil fractions condensed-out can be introduced into a store and, according to requirements, led to the combustion chamber of the gas turbine. Thus, the naphtha and oil fractions can be held back in the case of a part-load and then used in the event of a full-load, an over-load or a sudden load increase. A more flexible reaction to fluctuations in the load can thus be achieved than was possible by reversal of the coal gasifier and of the air-separation plant upstream thereof. Moreover the naphtha and oil fractions in the store can be used for starting the turbine instead of the auxiliary fuels otherwise required.

Further details of the invention are illustrated by the exemplary embodiment represented in the Figure, which shows a schematic representation of a combined gas and steam turbine power plant according to the invention having an upstream fixed bed coal gasifier.

The combined gas and steam turbine power plant 1 shown in the drawing consists of a gas turbine power plant 2 and a steam turbine power plant 8. In the gas turbine power plant, there are located a gas turbine 3 and associated air compressor 4 and generator 5 and a combustion chamber 7 upstream of the gas turbine 3 and attached to a fresh air line 6 of the air compressor 4. In the steam turbine power plant 8, there are located a waste heat steam generator 10 attached to a waste gas line 9 of the gas turbine power plant 2, a flue 11 downstream on the waste gas side, and a steam turbine 12 and associated generator 13 and condenser 14.

In the Figure, a coal gasifier 15 is also shown, in the present embodiment a fixed bed gasifier 15, and gas-cooling and gas-cleaning plant 16 is located downstream of the coal gasifier 15. The gas-cooling and gas-cleaning plant 16 is attached to the combustion

chamber 7 of the gas turbine power plant 2 by a pure gas line 17. Moreover, a waste water treatment plant 18 and an oil and naphtha store 19 are associated with the gas-cooling and gas-cleaning plant 16.

5 When the combined gas and steam turbine power
plant 1 with the upstream coal gasifier 15 is in
operation, steam 27 and coal by way of the fuel line 20
(either separately or, in some cases, together) and
oxygen 21 as gasification means from an air-separation
10 plant (not shown) are delivered to the coal gasifier
15. The crude gas obtained by the gasification is
delivered to the gas-cooling and gas-cleaning plant 16.
The slag obtained by the gasification is removed
separately by way of an outlet line 22. In the gas-
15 cooling and gas-cleaning plant 16, on the crude gas
side, downstream of the coal gasifier, the gas is
separated from the dust, ash, sulphur, tar, oil and
naphtha fractions thereof and delivered as pure gas by
way of the pure gas line 17 to the combustion chamber 7
20 of the combined gas and steam turbine power plant 1.
It is burnt in the combustion chamber by the use of
compressed fresh air from the air compressor 4. The
hot waste gas of the gas turbine 3 is extracted in a
known way in the waste heat boiler 10 for the
25 generation of steam for use in the steam turbine 12 of
the steam turbine power plant 8.

 The tar fraction obtained by the gas-cooling and
gas-cleaning are recycled by way of a return line 23
to the gasifier 15. They are then cracked, gasified
30 and partly burned, the resulting products being
accordingly present in the crude gas issuing from the
coal gasifier 15. In the illustrated embodiment, the
oil and naphtha fractions condensed-out during the gas-
cooling are delivered to an oil and naphtha store 19 by
35 way of a separate line 24. The fuel collecting in the
oil and naphtha store 19 can be delivered to the

combustion chamber 7 of the gas turbine 3 for starting the gas turbine 3 or as an additional fuel when the gas turbine 3 is operating under full load. Even in the case of sudden increases in load, the performance of the gas and steam turbine power plant 1 can be raised relatively quickly by use of the fuel from the store 19. Auxiliary fuels such as natural gas and oil, which are in some cases required for starting the gas and steam turbine power plant, are thus not required.

The supply of oil and naphtha fractions as liquid fuel, to the combustion chamber 7 of the gas turbine 3 can be effected by way of an auxiliary line 25. In this case, oil and naphtha are injected directly into the combustion chamber 7. It is also possible, however, to heat these oil and naphtha fractions by use of a separate heat exchanger 26, shown by dotted lines, and to add these fractions as a gas to the pure gas flowing into the combustion chamber 7 of the gas turbine 3.

A particular advantage of this arrangement is that a larger proportion of chemically bonded fuel energy, in relation to the coal energy used, can be fed to the combustion chamber 7 of the gas turbine 3, than in the case of all other known processes. By the reduction of the energy loss achieved in this way and the thermodynamically advantageous increase in the performance of the gas turbine, a clear improvement in the overall efficiency is achieved. This is particularly so in the case of fixed bed coal gasifiers.

~~CLAIMS~~ The claims defining the invention are as follows:

1. A combined gas and steam turbine power plant comprising an upstream coal gasifier and a gas-cooling and gas-cleaning plant downstream of the coal gasifier,
5 the plant further comprising (a) means whereby the tar fraction obtained during the gas-cooling and gas-cleaning can be recycled to the coal gasifier for the purpose of being cracked, gasified and partial burnt therein, and (b) means whereby the naphtha and oil
10 fractions thus obtained can be used as additional fuel for the gas turbine.

2. A plant according to Claim 1, comprising means whereby the naphtha and oil fractions continuously obtained can be continually mixed with the
15 cleaned and reheated fuel gas.

3. A plant according to Claim 1, comprising means whereby the naphtha and oil fractions condensed-out can be introduced into a store and according to requirements fed to a combustion chamber of the gas
20 turbine.

4. A plant according to Claim 3, comprising means whereby the naphtha and oil fractions can be injected directly into the combustion chamber of the gas turbine as liquid fuel.

5. A plant according to Claim 3, comprising means whereby the naphtha and oil portions, following prior vaporization, can be mixed with the fuel gas of the gas turbine.

6. A plant according to Claim 2, comprising
30 means whereby the naphtha and oil fractions obtained can be heated to the approximate temperature of the fuel gas before being mixed with the cleaned fuel gas.

7. A plant according to Claim 1, comprising means whereby the continuously obtained naphtha and oil
35 fractions can be continually injected directly into the combustion chamber of the gas turbine.

8. A plant according to any of Claims 1 to 7,
wherein the coal gasifier is a fixed bed coal gasifier.

9. A plant according to Claim 1, substantially
as hereinbefore described with reference to, and as
5 shown in, the drawing.

DATED this SEVENTEENTH day of MARCH 1988

Siemens Aktiengesellschaft

Patent Attorneys for the Applicant
SPRUSON & FERGUSON

