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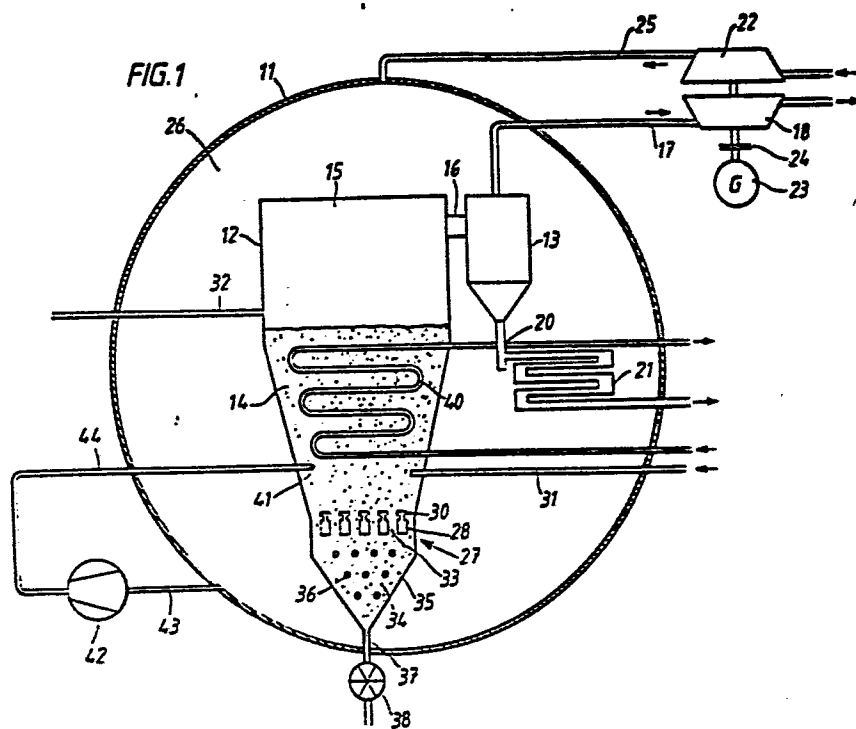
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(54) **Combustion method and power plant.**

(57) Method of improving the utilization of a sulphur absorbing material in a power plant for the combustion of a sulphur-containing fuel in a fluidized bed (14) of particulate material containing sulphur absorbent. According to the invention unconsumed absorbent in the interior part of the particles of the bed material is exposed by blowing gas into the bed (14) through special grinding nozzles (41) at a higher velocity than combustion air through the fluidizing nozzles (30). The gas pressure shall be so high that powerful gas jets are produced so that bed material particles are accelerated to a high velocity and, upon collision with other particles, are disintegrated. In a power plant for carrying out the method the grinding nozzles (41) are located at the lower part of the combustion chamber (12), preferably between its bottom (27) and a tube bundle (40) in the combustion chamber (12).



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Method of improving the utilization of a sulphur absorbing material in a power plant and a power plant for carrying out the method

The invention relates to a method of improving the utilization of a sulphur absorbing material in a power plant according to the precharacterising part of claim 1. The invention also relates to a power plant for carrying out the method.

The invention is primarily intended for such a plant where the combustion takes place at a pressure exceeding the atmospheric pressure, that is, a so-called PFBC plant. The fluidized bed consists of a particulate material, which at least partly consists of a sulphur absorbent. Provisions are made for removing consumed sulphur absorbent from the bed.

In prior art power plants with combustion of sulphur-containing coal in a combustion chamber with a fluidized bed, lime or dolomite is used as bed material and sulphur absorbent. During combustion of the fuel in the bed, combustion gases will make intimate contact with the bed material and react with the sulphur in the fuel while forming gypsum, CaSO_4 . The reaction takes place on the surface of the particles and in pores emanating from this surface. Gradually, a shell of gypsum is formed around a core of unconsumed absorbent material, which renders the contact between combustion gases and absorbent difficult or impossi-

ble. This means that not all the absorbent will be utilized and that bed material containing non-utilized absorbent will be left, which must be removed from the combustion chamber. This means that the absorbent consumption considerably exceeds the amount which is theoretically needed to remove the sulphur from the fuel. This also involves increased costs for procuring and depositing consumed bed material. This prior art is disclosed in more detail in US-A-4 421 036.

The object of the invention is to develop a method and a power plant for carrying out the method of the above-mentioned kind with a considerably increased utilization of the sulphur absorbing material.

To achieve this aim the invention suggests a method according to the introductory part of Claim 1, which is characterized by the features of the characterizing part of Claim 1.

Further developments of the method are characterized by the features of the Claims 2 to 4.

A power plant for carrying out the method according to the invention is characterized by the features of Claim 5.

Further developments of this power plant are characterized by the features of the Claims 6 to 9.

According to the invention, the particles in the bed material, which may have a size of between about 0.5 and 6 mm, are disintegrated by blowing a gas at a high velocity into the bed through special grinding nozzles. This blowing in of gas will cause the bed particles to collide with each other at a great velocity and to be disintegrated to a certain extent, so that unconsumed sulphur absorbent present in the interior part of the particles is exposed and, upon contact with combustion gases, absorbs sulphur. Ground-down bed ma-

- terial leaving the bed together with the combustion gases, are separated in gas cleaners and removed. The grinding is suitably regulated so that the same amount of bed material is ground down as is supplied to the bed. In this way, the
- 5 bed depth can be kept at the desired level in the case of constant power output from the plant. The grinding nozzles should be located in the lower part of the combustion chamber, below the region containing cooling tubes. The reasons for this are, on the one hand, to eliminate erosion on the
- 10 cooling tubes and, on the other hand, to extend the dwell time of the small particles formed in the bed as long as possible before they leave the combustion chamber carried away by the combustion gases.
- 15 Gas jets from two or more nozzles may suitably be directed such that they intersect or converge with each other, resulting in particles colliding with each other at a high velocity. The grinding capacity is thereby strengthened. The gas may consist of compressed air which is utilized for the
- 20 combustion of the fuel, or of oxygen-poor gas which completely or partially consists of combustion gases. Combustion air or combustion gases leaving the gas turbine or the waste heat boiler can be utilized. In those cases where the use of air tends to give too high a local bed tempera-
- 25 ture with an ensuing harmful formation of slag, oxygen-poor gas is used. The gas is compressed to such a pressure that a gas velocity which is necessary for the grinding is obtained at the nozzle orifice.
- 30 In a plant, the combustion chamber comprises at least one but suitably a plurality of grinding nozzles for disintegrating absorbent material particles. The nozzles may be located such that the gas jets intersect each other or converge with each other. The gas may consist of air or oxygen-
- 35 poor combustion gas. In a PFBC plant with a combustion chamber which is enclosed within a pressure vessel and sur-

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rounded by compressed combustion air, part of this combustion air may be further compressed in a booster compressor and be supplied to the grinding nozzles.

5 The invention will now be described in greater detail with reference to the accompanying drawings showing - by way of example - in

0 Figure 1 schematically a PFBC power plant according to the invention,

Figure 2 a horizontal section of a combustion chamber exhibiting a possible location of grinding nozzles.

5 In the figures, 11 designates a pressure vessel, 12 a combustion chamber and 13 a cleaner of cyclone type enclosed within the pressure vessel 11. Only one cyclone is shown, but in reality there is a cleaning plant with a plurality of parallel-connected groups each group consisting of a number of series-connected cyclones. Fuel is burnt in a fluidized
0 bed 14 in the combustion chamber 12. The bed 14 consists of a particulate sulphur absorbing material, such as limestone or dolomite. The main part of this material usually has a grain size of between 0.5 and 5.0 mm. The combustion gases are collected in the freeboard 15 and flow through the conduit 16 to the cleaner 13, where dust is separated, and from
5 the cleaner 13 via the conduit 17 to a turbine 18 and from there, for example, to a waste gas boiler (not shown). Separated dust is fed out from the cleaner 13 through the conduit 20 and the pressure reducing feeding-out device and
0 cooler 21 to a receiving container (not shown). The turbine 18 drives a compressor 22 and a generator 23 via a coupling 24, the generator 23 feeding out energy onto an electricity supply network. The generator 23 can also be utilized as a
5 starter motor.

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Through the conduit 25 the inner space 26 of the pressure vessel 11 surrounding the combustion chamber 12 and the cleaner 13 is supplied with compressed air. The pressure may amount to 2 MPa or more. The combustion chamber 12 is provided with a bottom 27 consisting of elongated air distribution chambers 28 with air nozzles 30. Through these the bed 14 is supplied with air for fluidization and for combustion of supplied fuel. Fuel is supplied to the bed 14 through a conduit 31 from a fuel storage (not shown). The combustion chamber 12 accommodates fuel nozzles (not shown), which are evenly distributed, suitably one nozzle per m^2 of bottom area. Fresh bed material is supplied to the bed 14 through the conduit 32 from a bed material storage (not shown). Between the air distribution chambers 28 there are gaps 33, through which bed material from the bed may fall down into the space 34 in the discharge cone 35 for bed material at the lower part of the combustion chamber 12. This space 34 accommodates cooling tubes 36 for cooling the bed material before it is fed out through the conduit 37 and the feeding-out device 38. In the combustion chamber 12 there is a tube bundle 40, in which water is heated or steam is generated.

At least one grinding nozzle 41 is provided in the combustion chamber 12, opening out into the bed 14 of the combustion chamber 12 below the tube bundle 40. Through this nozzle 41, gas with a considerably higher pressure than in the bed 14 is blown into the bed 14. The gas velocity at the orifice of the one nozzle or more nozzles 41 is high, the gas jet accelerating bed particles to a high velocity. These bed particles on collision with other bed particles are fractured to smaller particles, thus bringing about a grinding effect. This causes unconsumed sulphur absorbent to become exposed, and on its way up through the bed 14 this absorbent will absorb sulphur upon contact with the combustion gases. Bed material which is disintegrated to a small dimen-

sion, below about 0.5 mm, will leave the bed together with the flue gases.

Grain size and dwell time in the bed 14 are important parameters for the absorption of sulphur. For utilizing the bed material it is important that crushed and exposed unused absorbing material has such a small size that a rapid and complete reaction is obtained between absorbent and sulphur during the time during which the material is present in the bed 14. It is, therefore, desirable for absorbent particles to be ground down to the greatest possible fineness so as to obtain a large contact surface in relation to the volume. Grinding to about 50 micrometers is desirable for obtaining an approximately complete utilization.

In a PFBC plant with a combustion chamber 12 operating at a high pressure and being placed within a pressure vessel, gas for the grinding nozzles 41 may be provided from the pressurized air in space 26 of the pressure vessel 11 which air is compressed to a higher pressure in a booster compressor 42, which is located outside the pressure vessel 11 and is connected to the inner space 26 of the pressure vessel by means of a conduit 43 and to the one or more nozzles 41. It may be suitable to place a plurality of nozzles 41 in a combustion chamber 12 so that the gas jets from the grinding nozzles 41 converge with each other, causing particles to collide with great force thus bringing about a powerful grinding effect. As is shown in Figure 2, four nozzles 41, for example, may be placed in one horizontal plane so that the air jets from the nozzles 41 intersect each other and, within a limited volume, rotate and grind down bed particles to a small size, thus obtaining a large absorption surface of unconsumed absorbent.

C L A I M S

1. Method of improving the utilization of a sulphur absorb-
ing material in a power plant for the combustion of a sul-
phur-containing fuel in a fluidized bed (14) of particulate
material containing sulphur absorbent by exposing unconsumed
5 absorbent in the interior part of the absorbent particles,
c h a r a c t e r i z e d in that grinding of absorbent
particles is accomplished in the bed (14) by blowing gas
into the bed (14) through special grinding nozzles (41) at a
higher velocity than combustion air through fluidization
10 nozzles (30).
2. Method according to claim 1, c h a r a c t e r i z e d
in that the grinding of the absorbent particles takes place
by blowing in the grinding gas through nozzles (41) in an
15 area in the bed (14) which is not provided with cooling
tubes (40).
3. Method according to claim 1 or 2, c h a r a c t e r i z e d
e d in that gas jets from two or more nozzles (41) are di-
20 rected so as to intersect each other or converge with each
other.
4. Method according to any of the preceding claims, c h a -
r a c t e r i z e d in that gas jets are directed so as to
25 obtain a controlled circulation of bed material within the
bed (14).
5. Power plant for carrying out the method according to any
of the preceding claims comprising a combustion chamber (12)
30 formed with a bottom (27) with nozzles (30) for the supply
of air to a fluidizable bed (14) consisting at least partly
of particulate sulphur-absorbing material for the combustion
of fuel supplied to the bed (14), comprising supply conduits
(31, 32) for the supply of fuel and bed material to the bed
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(14), and comprising a compressor (22) for supplying the combustion chamber (12) with air for fluidization of the bed (14) and combustion of the fuel, c h a r a c t e r i z e d in that the combustion chamber (12) comprises at least one
5 separate grinding nozzle (41), opening out into the the bed (14), for disintegrating bed material particles.

6. Power plant according to claim 5, c h a r a c t e r i z -
e d in that at least two grinding nozzles (41) are located
10 such that gas jets from these nozzles (41) intersect each other or converge with each other.

7. Power plant according to claim 5 or 6, c h a r a c -
t e r i z e d in that it comprises a compressor (42) which
15 supplies the grinding nozzles (41) with compressed, oxygen-poor gas or air with a higher pressure than the air for fluidization of the bed (14) and combustion of the fuel.

8. Power plant according to any of claims 5 to 7, c h a r
20 a c t e r i z e d in that the combustion chamber (12) is enclosed within a pressure vessel (11) and the combustion takes place at a pressure exceeding the atmospheric pressure.

9. Power plant according to claim 8, c h a r a c t e r i z -
25 e d in that the pressure exceeds twice the atmospheric pressure.

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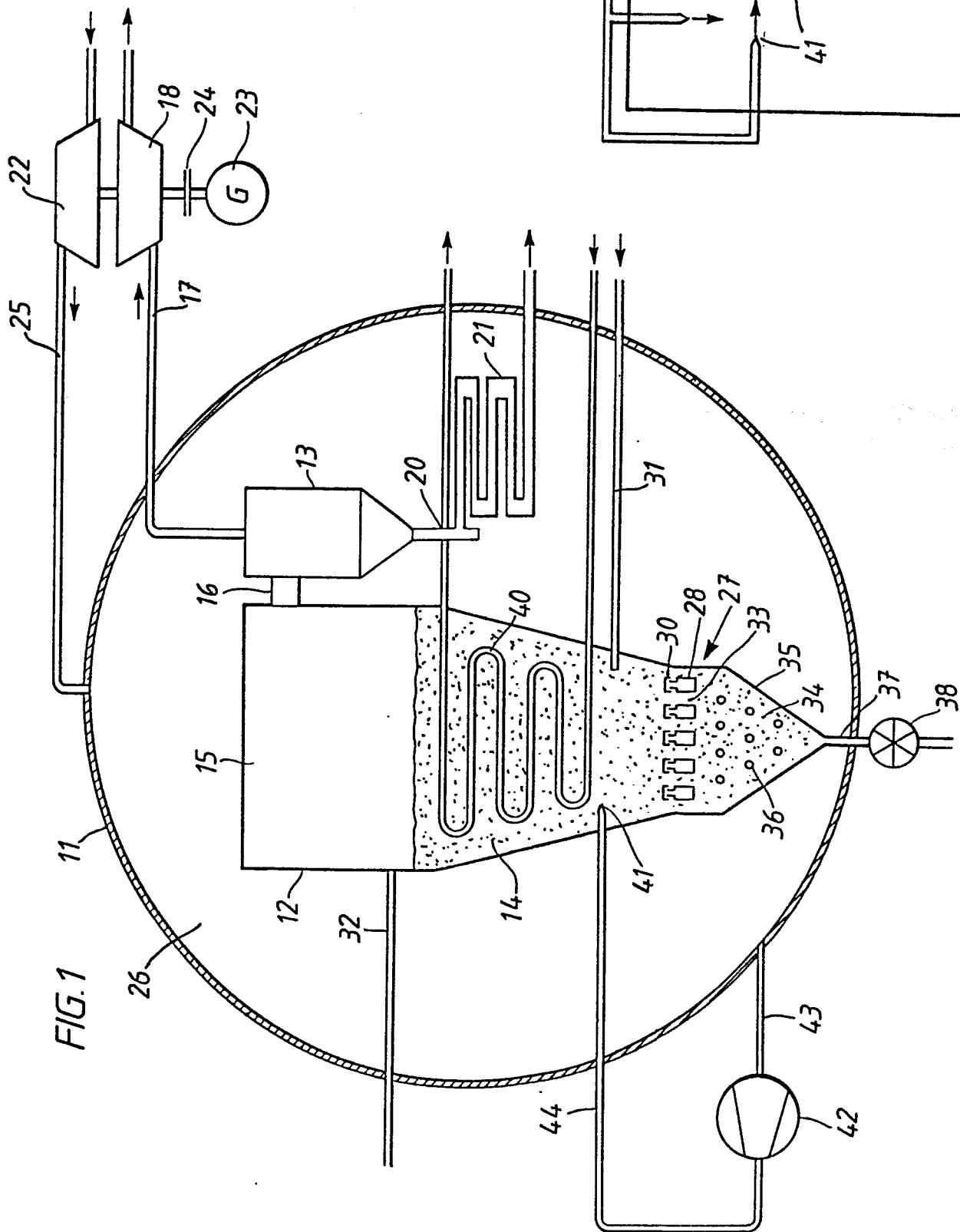
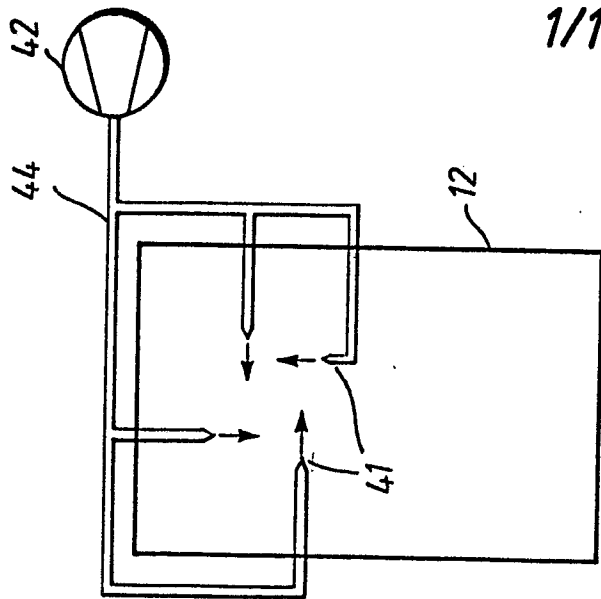


FIG. 2





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
A	SE-B 434 087 (STAL-LAVAL TURBIN AB)	1-9	F 23 C 11/02
A	US-A-4 279 207 (WORMSER)	1-9	
A	PATENT ABSTRACTS OF JAPAN, vol. 8, no. 94 (M 293); & JP-A-59-7810 (MITSUBISHI JUKOGYO K.K.) 17-01-1984	1-9	
A	US-A-4 159 000 (IWASAKI et al)	1-9	
A	US-A-4 060 041 (SOWARDS)	1-9	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			F 23 C
The present search report has been drawn up for all claims			
Place of search STOCKHOLM		Date of completion of the search 10-3-1987	Examiner VÄNGBORG A.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			