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Datasheet for the decision of 6 February 2013

Case Number: T 2449/09 - 3.3.05

Application Number: 03797775.8

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IPC: B01D 53/50, B01D 53/83, B01F 13/02

Language of the proceedings: EN

Title of invention:
Method and device for separating gaseous pollutants from hot process gases by absorption and a mixer for moistening particulate dust

Applicant:
Alstom Technology Ltd.

Opponent:
-

Headword:
Saturation temperature/ALSTOM

Relevant legal provisions:
EPC Art. 54(1)(2), 56, 84, 123(2)

Keyword:
"Novelty (main and first auxiliary requests): no"
"Inventive step (second auxiliary request): yes - evidence for an improvement"

Decisions cited:
-

Catchword:
-

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Case Number: T 2449/09 - 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 6 February 2013

Appellant: (Applicant)
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 11 August 2009 refusing European patent application No. 03797775.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: G. Raths
Members: J.-M. Schwaller
C. Vallet

Summary of Facts and Submissions

I. This appeal lies from the decision of the examining division refusing European patent application No. 03 797 775.8.

II. Independent claims 1 and 16 at the basis of the decision read as follows:

"1. A method of separating gaseous pollutants, such as sulphur dioxide, from hot process gases, such as flue gases, in which method the process gases are passed through a contact reactor (22; 322), in which a particulate absorbent material reactive with the gaseous pollutants is introduced in a moistened state into the process gases in order to convert the gaseous pollutants into separable dust, after which the process gases are passed through a dust separator (10), in which dust is separated from the process gases and from which the cleaned process gases are discharged, characterised in that a circulating part of the dust separated in the dust separator (10) is cooled in a first step by being brought into direct contact with a cooling fluid, the cooled dust is mixed in a second step with a gas containing water vapour, said gas having a saturation temperature with regard to water vapour that is higher than the temperature of the cooled dust, and the dust moistened by condensation of the water vapour is introduced as absorbent material into the contact reactor (22; 322) to be mixed with the process gases."

"16. A device for separating gaseous pollutants, such as sulphur dioxide, from hot process gases, such as flue gases, said device having a contact reactor (22; 322), through which the process gases are intended to be passed and which has means (24, 40; 124; 224; 324; 340) for introducing a particulate absorbent material in a moistened state, which is reactive with the gaseous pollutants, into the process gases for the purpose of converting the gaseous pollutants into separable dust, and a dust separator (10) which is adapted to separate the dust from the process gases and discharge the cleaned process gases, characterised in that the device has a cooling zone (68; 168; 268; 368) for cooling at least a circulating part of the dust separated in the dust separator (10), means (62, 64; 162, 164, 166; 218, 262, 264; 318) for supplying a cooling fluid to the cooling zone (68; 168; 268; 368) for cooling the dust by direct contact between the fluid and the dust, means (52; 152; 330) for feeding the cooled dust to a moistening zone (80; 180; 280; 380), means (70; 170; 270; 370) for supplying a gas containing water vapour and having a saturation temperature with regard to water vapour which is higher than the temperature of the cooled dust, to the cooled dust in order to moisten this by condensation of water vapour, and means (40; 340) for feeding the moistened dust to the contact reactor (22; 322)."

III. Among the documents considered in the examination proceedings, the following are of relevance for the present decision:

D1: WO 97/37747 A1

D2: WO 88/04196 A1

D3: US 4 795 619

D4: US 6 209 921 B1

IV. The contested decision can be summarised as follows:

It was unclear (Article 84 EPC) for the examining division how a theoretical thermophysical value, like the saturation temperature of a gas, could be compared with the temperature of a solid, like the absorbent dust.

The subject-matter of claim 1 was obvious from the content of document D1 - which represented the closest state of the art - when taken in combination with the teaching of document D2. D1 did not disclose the addition to the absorbent material of a gas comprising steam, but the addition of air through inlet 25 in the second part of the mixer, which air implicitly comprised a certain amount of water vapour. The combustion gases, which were added to the absorbent through stream P2, also comprised water vapour as a hydrocarbon combustion reaction product. The technical problem could be formulated in the provision of how to modify the method of D1 in order to not evaporate too much of the moisture from the absorbent wetted in the first zone whilst avoiding the absorbent to stick together. The skilled person would derive the solution from document D2 (page 8, line 1 and Figure 2) which taught that steam was supplied to the adsorbent by the passage 23 in the mixer 22. The above solution was also derivable from documents D3 (claim 1) and D4 (claim 12)

which disclosed the addition of water vapour to the absorbent.

Claim 16 lacked novelty over the apparatus known from D1, which disclosed the same structural apparatus features.

V. With its grounds of appeal dated 11 December 2009, the appellant filed a new document:

A1: "*Das h,x-Diagramm, Aufbau und Anwendung*", Building Technologies, Siemens Schweiz AG.

It also submitted three sets of claims as a main request and as auxiliary requests 1 and 2, respectively, with the claims of the first auxiliary request being identical to those on which the contested decision was based.

Independent claims 1 and 16 of the main request were distinguished from the claims in point II. above by the **omission of the feature** "*with regard to water vapour*".

In the second auxiliary request, the apparatus claims were deleted and independent claim 1 read as follows (in bold the difference to claim 1 of auxiliary request 1, i.e. to claim 1 in point II. above):

"1. A method of separating gaseous pollutants, such as sulphur dioxide, from hot process gases, such as flue gases, in which method the process gases are passed through a contact reactor (22; 322), in which a particulate absorbent material reactive with the gaseous pollutants is introduced in a moistened state

into the process gases in order to convert the gaseous pollutants into separable dust, after which the process gases are passed through a dust separator (10), in which dust is separated from the process gases and from which the cleaned process gases are discharged, characterised in that a circulating part of the dust separated in the dust separator (10) is cooled in a first step by being brought into direct contact with a cooling fluid, the cooled dust is mixed in a second step with a gas containing water vapour, said gas having a saturation temperature with regard to water vapour that is higher than the temperature of the cooled dust, ***such that water vapour will condense on the dust****, and the dust moistened by condensation of the water vapour is introduced as absorbent material into the contact reactor (22; 322) to be mixed with the process gases.*

VI. In a communication dated 20 September 2012, the board expressed its preliminary opinion that claim 1 of the main request contravened Article 84 EPC because it was unclear towards which gas the saturation temperature of the "gas containing water vapour" was to be measured.

The board further held the subject-matter according to the device claim 16 of the main request to lack novelty over document D1.

Concerning the first and second auxiliary requests, the board - in accordance with the passages at page 5, lines 11 to 18; page 9, lines 34 to 36; page 10, lines 13 to 16 of the description - held the following features essential to solve the problem with which the application was concerned:

(1) water vapour has to condense on the cooled dust particles;

(2) the residence time in the cooling zone is at least 2 s;

(3) the residence time in the moistening zone is at least 2 s.

Since independent claim 1 of these requests did not contain these features, the application did not meet the requirements of Article 84 EPC taken in combination with Rule 43(1) and (3) EPC that any independent claim must contain all the technical features essential to the definition of the invention.

VII. With the letter dated 18 January 2013, the appellant filed three new requests replacing the previous ones.

The **new main request** comprises two independent claims: claims 1 and 13 which correspond *mutatis mutandis* to the claims 1 and 16 at the basis of the contested (see point II. above).

The **new first auxiliary request** also comprises two independent claims which read as follows (in bold the differences to the claims of the main request):

"1. A method of separating gaseous pollutants, such as sulphur dioxide, from hot process gases, such as flue gases, in which method the process gases are passed through a contact reactor (22; 322), in which a particulate absorbent material reactive with the

gaseous pollutants is introduced in a moistened state into the process gases in order to convert the gaseous pollutants into separable dust, after which the process gases are passed through a dust separator (10), in which dust is separated from the process gases and from which the cleaned process gases are discharged, characterised in that a circulating part of the dust separated in the dust separator (10) is cooled in a first step by being brought into direct contact with a cooling fluid, ***wherein the residence time in the cooling zone is at least 2 s,*** *the cooled dust is mixed in a second step with a gas containing water vapour, said gas having a saturation temperature with regard to water vapour that is higher than the temperature of the cooled dust,* ***such that water vapour will condense on the dust, wherein the residence time in the moistening zone is at least 2 s,*** *and the dust moistened by condensation of the water vapour is introduced as absorbent material into the contact reactor (22; 322) to be mixed with the process gases.*

13. A device for separating gaseous pollutants, such as sulphur dioxide, from hot process gases, such as flue gases, said device having a contact reactor (22; 322), through which the process gases are intended to be passed and which has means (24, 40; 124; 224; 324; 340) for introducing a particulate absorbent material in a moistened state, which is reactive with the gaseous pollutants, into the process gases for the purpose of converting the gaseous pollutants into separable dust, and a dust separator (10) which is adapted to separate the dust from the process gases and discharge the cleaned process gases, characterised in that the device has a cooling zone (68; 168; 268; 368)

for cooling at least a circulating part of the dust separated in the dust separator (10), means (62, 64; 162, 164, 166; 218, 262, 264; 318) for supplying a cooling fluid to the cooling zone (68; 168; 268; 368) for cooling the dust by direct contact between the fluid and the dust, ***wherein the residence time in the cooling zone is at least 2 s****, means (52; 152; 330) for feeding the cooled dust to a moistening zone (80; 180; 280; 380), means (70; 170; 270; 370) for supplying a gas containing water vapour and having a saturation temperature with regard to water vapour which is higher than the temperature of the cooled dust, to the cooled dust in order to moisten this by condensation of water vapour,* ***wherein the residence time in the moistening zone is at least 2 s*** *and means (40; 340) for feeding the moistened dust to the contact reactor (22; 322)."*

The **new second auxiliary request** consists of only process claims, with an independent claim 1 corresponding to claim 1 of the new first auxiliary request (see just above) and dependent claims 2 to 12 as specific embodiments thereof.

VIII. The appellant requested that the contested decision be set aside and that a patent be granted on the basis of one of the sets of claims filed on 18 January 2013 as a main request and as auxiliary requests 1 and 2, respectively. The appellant further requested oral proceedings in the event the board would consider not setting aside the contested decision.

Reasons for the Decision

1. Preliminary remark

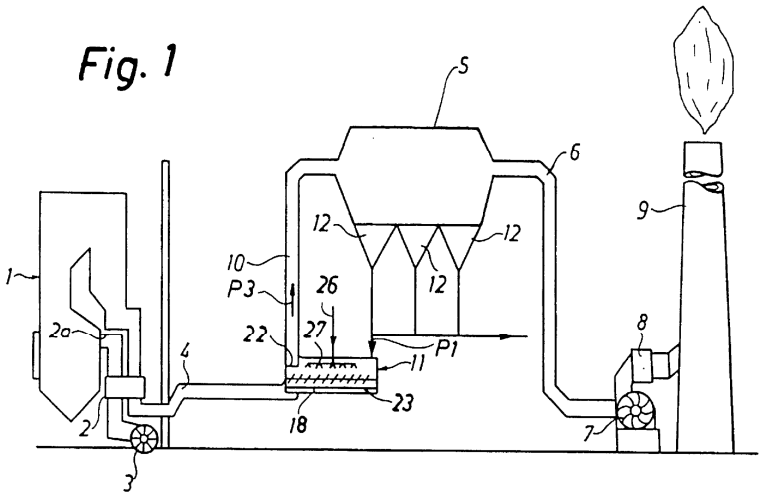
It is to be observed that the request for holding oral proceedings was linked to the condition that the contested decision were not set aside by the board. This being not the case, a decision can be taken without oral proceedings to be held.

2. Main request - Novelty

In the board's view, the subject-matter of claim 13 of this request - which corresponds to claim 16 of the set of claims on which the decision was based (see item II. above) - lacks novelty over the disclosure of document D1 in the following respects.

2.1 D1, claim 1, describes a device arranged in a substantially vertical flue gas duct (10), in which flue gases containing gaseous pollutants are to be conducted upwards, for discharging and distributing in the flue gas duct a particulate absorbent material which is reactive with the gaseous pollutants in the flue gases and which, during cleaning of the flue gases, is to be introduced into these gases in moistened state in order to convert the gaseous pollutants to separable dust, the device comprising at least one distributing plate (35) extending obliquely downwards in said flue gas duct (10) and adapted to receive on its upper side moistened absorbent material. The claimed device is illustrated in Figures 1, 2 and 4 reproduced hereinafter:

Fig. 1



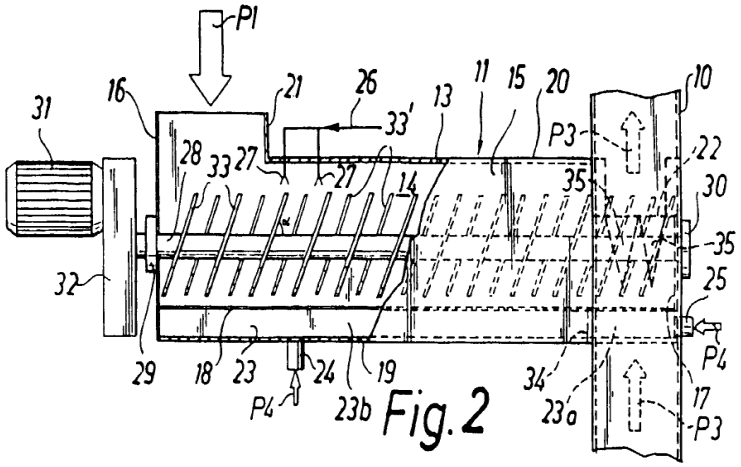


Fig. 2

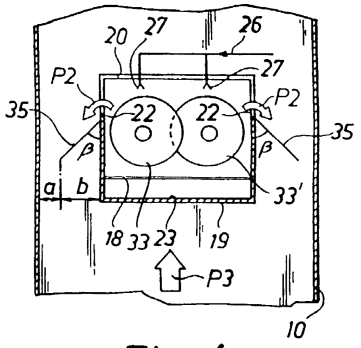


Fig. 4

In the board's view, the structural means of the device defined in claim 13 of the main request can be read in the following means of the device illustrated in the above Figures:

– the "*contact reactor through which the process gases are intended to be passed*" corresponds to the space between the duct (10) and the box materialised by the bottom (19) and top (20); see also arrow P3 which shows the flow of the flue gas containing the gaseous pollutants

– the "*means for introducing a particulate absorbent material in a moistened state, which is reactive with the gaseous pollutants, into the process gases for the purpose of converting the gaseous pollutants into separable dust*" corresponds to the distributing plates (35); see also the arrow P2 which shows the flow of the adsorbent;

– *the "dust separator (10) adapted to separate the dust from the process gases and discharge the cleaned process gases"* corresponds to the dust separator (5) which recycles into the mixer/discharging unit (11) the dust particles collected in the hoppers (12);

– *the "cooling zone for cooling at least a circulating part of the dust separated in the dust separator"* can be read in the upstream part of the mixer/ discharging unit (11);

– *the "means for supplying a cooling fluid to the cooling zone for cooling the dust by direct contact between the fluid and the dust"* can be seen in the air inlet (24);

– *the "means for feeding the cooled dust to a moistening zone"* corresponds to the horizontal

shafts (28, 28') on which are mounted the discs (33, 33'), the rotation of which pushes the cooled dust in direction of the moistening zone (located below the nozzles (27) and downstream the "cooling zone");

– the "*means for supplying a gas containing water vapour and having a saturation temperature with regard to water vapour which is higher than the temperature of the cooled dust, to the cooled dust in order to moisten this by condensation of water vapour*", are to be seen in the water-supply line (26) and the plurality of nozzles (27) which moisten the dust/adsorbent particles;

– the "*means for feeding the moistened dust to the contact reactor*" are to be seen in the combination of horizontal shafts (28, 28'), discs (33, 33') and distributing plates (35).

2.2 The appellant argued that the above device was not suitable for moistening a cooled dust, because the hot flue gas would heat the dust present above the front part chamber 23a; thus heating would prevent the dust to be moistened, since the dust would be quickly heated to a temperature above that at which moistening could occur.

2.3 The board cannot accept this argument because in the device according to document D1 the moistening happens - as explained in point 2.1 - in the zone located below the nozzles 27. As further explained in D1, page 5, lines 3 to 5, the nozzles extend along the container 13 and so moistening also happens in the zone located above the front part chamber 23a.

2.4 In the board's view, the device known from document D1 possesses all the structural means specified in claim 13 of the main request. The device is further plainly suitable - without any constructional change - for carrying out the different process steps or functions defined in claim 1 at issue. In particular, by controlling the fluid flow through the fluid supply means (24), (25) and (27), the temperature of the dust can be controlled so as to moisten it *"by condensation of water vapour"*, as defined in claim 13 at issue.

2.5 From the above considerations, it follows that claim 13 of this request is no longer novel in the light of document D1 and does therefore not meet the requirements of Article 54(1) and (2) EPC.

3. First auxiliary request - Novelty

Claim 13 of this request differs from claim 13 of the main request in that the **residence time in both the cooling zone and moistening zone** has now been specified to be **at least 2 s** in either zone.

The board observes that claim 13 at issue, although being directed to a device, has been restricted with process features which do not render novel the now claimed device over the one disclosed in D1, because a single variation of the rotation speed of the horizontal shafts (28, 28') in the device of document D1 renders it plainly suitable - without any constructional change - for meeting the residence time requirements and thus carrying out the additional process step claimed. It follows - for the same reasons

as those indicated for claim 13 of the main request - that claim 13 of the first auxiliary request also lacks novelty under Article 54(1) and (2) EPC.

4. Second auxiliary request

4.1 Allowability of the amendments

The claims of this request have a basis as follows in the application as filed, published as WO 2004/026443 A1:

- Claim 1 results from the combination of claim 1 with the passages at page 5, lines 9 to 13; page 9, lines 34 to 36; page 10, lines 13 to 16 and page 11, lines 1 to 3 of the application as filed;

- Dependent claims 2 to 12, which are directed to specific embodiments of independent claim 1, have a basis in the corresponding dependent claims 2 to 12, respectively, of the application as filed.

It follows that the amended claims of this request meet the requirements of Article 123(2) EPC.

4.2 Article 84 EPC

4.2.1 The board cannot accept the arguments of the examining division that it was unclear how the saturation temperature of a gas could be compared with the temperature of a solid, like the absorbent dust. As established in document A1, section 2.2.5 (page 10), and Fig. 2.6 (dew point temperatures), it is clear that bringing a gas having a certain water vapour saturation

temperature into contact with objects having a temperature which is lower than the saturation temperature of the gas will result in condensation of water vapor on those objects, just as it is disclosed in the present application. Furthermore, as established in document A1, paragraph 2.2.9, it is clear for the skilled person how the saturation temperature of a gas can be measured. The conditions of any gas-vapor mixture can be measured, e.g. by means of a psychrometer, and the conditions measured can be plotted in a h,x-diagram (for example a so-called Mollier diagram), such as the one disclosed in Fig. 2.10 of A1. Furthermore, as described hereinbefore with reference to section 2.2.5 of A1, from a plotted point in a h,x-diagram it is possible to find the saturation temperature, such as disclosed in Fig. 2.6 of A1.

In summary, the saturation temperature is indeed a well-established physical feature of a gas containing water vapour and it can be accurately measured with the help of a psychrometer and a h,x-diagram. Hence, to a skilled person it is clear that a saturation temperature exists for each gas containing water vapor, and that such a saturation temperature can be compared to a temperature of a solid object, such as cooled dust.

It follows that the clarity remarks in the contested decision are not acceptable, and the claims on file thus meet the clarity requirements of Article 84 EPC.

4.2.2 The application as filed states at page 9, lines 34 to 36 that "*residence times in the cooling zone of less than 2 s yield insufficient cooling of the particles in the dust*" and at page 10, lines 13 to 16 that

"*residence times in the moistening zone of less than 2 s yield uneven and insufficient condensation of water vapour on the particles of dust*". The minimal requirements as regards the residence time in both the cooling and the moistening zone having been inserted into the claimed subject-matter, the board is satisfied that claim 1 at issue now recites all the features essential to the definition of the invention and so also satisfies the requirements of support by the description as required by Article 84 EPC.

4.3 Novelty

The board is satisfied that the claimed subject-matter is novel over the known prior art documents, in particular over document D1 which does not disclose in particular that the cooled dust is mixed with a gas having a saturation temperature with regard to water vapour that is higher than the temperature of the cooled dust.

4.4 Inventive step

By applying the problem-solution approach, the board comes to the conclusion that the claims on file meet the requirements of Article 56 EPC.

4.4.1 The invention relates to a method of separating gaseous pollutants, in particular sulphur dioxide, from hot process gases by passing them through a contact reactor in which a particulate absorbent material reactive with the pollutants is introduced in a moistened state into the process gases in order to convert the pollutants into separable dust, after which the process gases are

passed through a dust separator, in which dust is separated from the process gases and from which the cleaned process gases are discharged.

4.4.2 As to the starting point for assessing inventive step, the board agrees with the examining division that document D1 represents the closest state of the art and thus, the starting point for assessing inventive step. D1 discloses a similar process for removing gaseous pollutants, in particular sulphur dioxide, from hot process gases; for the details see points 2.1 to 2.3 above.

4.4.3 As to the technical problem to be solved, the appellant explained (page 5 of the letter dated 18 January 2013) that it consisted in the provision of a process for removing gaseous pollutants from hot process gases having an improved efficiency.

4.4.4 As a solution to this problem, the invention proposes the method of separating gaseous pollutants according to claim 1 at issue, which is in particular characterised in that:

(a) the residence time in the cooling zone is at least 2 s,

(b) the cooled dust is mixed with a gas containing water vapour and having a saturation temperature with regard to water vapour that is higher than the temperature of the cooled dust,

(c) the residence time in the moistening zone is at least 2 s.

4.4.5 As to the question whether the problem as established by the appellant has been successfully solved by the

proposed solution, the board observes from examples 1, 2 and 3 that the efficiency of separating SO_2 is greatly increased in the case where the gas supplied to the moistening zone has a saturation temperature (86°C) higher than the temperature (about 70°C) of the cooled dust (Example 1; efficiency 84%) in comparison with the cases (examples 2 and 3; efficiency 60% and 61%, respectively) where said gas had a saturation temperature (12°C) below the temperature (about 63°C) of the cooled dust.

4.4.6 As to the question whether the solution as proposed in claim 1 at issue was obvious in view of the cited prior art, the board observes that none of the known state of the art documents suggests that an improvement in terms of sulphur dioxide removal might be obtained by controlling the saturation temperature so that the latter be higher than the temperature of the cooled dust. It follows that the skilled person faced with the problem of improving the removal efficiency of sulphur dioxide does not find any incentive in the prior art to implement the solution defined in claim 1 at issue for solving the problem identified in point 4.4.3.

The board therefore concludes that the subject-matter of claim 1 at issue - and by the same token that of dependent claims 2 to 12, which include all the features of claim 1 - is not obvious for the skilled person in the light of the disclosure of document D1, even when taken in combination with the other documents cited in the examination proceedings.

5. In summary, it follows from the above that the claims of the second auxiliary request meet the requirements of the EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the claims according to the second auxiliary request filed with letter dated 18 January 2013, the Figures 1 to 5 as originally filed and a description to be adapted.

The Registrar: The Chairman:

C. Vodz G. Raths