



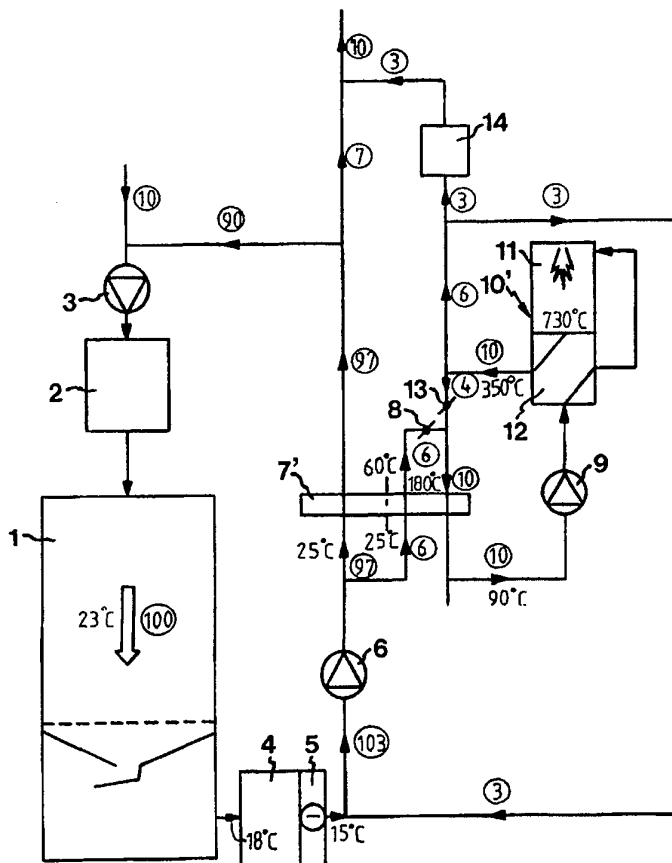
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/SE94/00643 (22) International Filing Date: 29 June 1994 (29.06.94) (30) Priority Data: 9302329-9 6 July 1993 (06.07.93) SE (71) Applicant (for all designated States except US): ABB FLÄKT AB [SE/SE]; Sickla Allé 13, S-131 34 Nacka (SE). (72) Inventors; and (75) Inventors/Applicants (for US only): PERSSON, Anders [SE/SE]; Pär Lagerkvists väg 7C, S-352 43 Växjö (SE). ENEROTH, Jan-Mats [SE/SE]; Röjningsvägen 8, S-352 51 Växjö (SE). (74) Agent: AWAPATENT AB; P.O. Box 5117, S-200 71 Malmö (SE).		(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published With international search report. In English translation (filed in Swedish).	

(54) Title: METHOD FOR CLEANING A GAS FLOW

(57) Abstract

In the cleaning of a humid gas flow containing gaseous impurities, the gas flow is dehumidified by cooling. The cooled gas flow is reheated and then conducted through a device (7') for the adsorption of gaseous impurities. A desorption-gas flow is heated so as to form a hot-gas flow, which is conducted through the adsorption device (7') in order to clean the latter. The contaminated hot-gas flow is conducted to a combustion device (10') in order to be burnt. Hot combustion gases are removed from the combustion device (10') in order to take part in at least one of the heating processes by being introduced into and mixed with the cooled gas flow and the desorption-gas flow.



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METHOD FOR CLEANING A GAS FLOW

This invention relates to a method for cleaning a humid gas flow containing gaseous impurities, such as an exhaust-air flow containing volatile solvents and originating from a spray booth in a painting plant, in which
5 method the gas flow is dehumidified by cooling, the cooled gas flow is reheated to subsequently be conducted through a device for the adsorption of gaseous impurities, a desorption-gas flow is heated to form a hot-gas flow, which is conducted through the adsorption device in
10 order to clean the latter and entrain impurities accumulated therein, the contaminated hot-gas flow is conducted to a combustion device in order to be burnt, and hot combustion gases are removed from the combustion device in order to take part in at least one of the heating processes.
15

The above method is used in a painting plant for cleaning an exhaust-air flow containing paint particles and volatile solvents and originating from a spray booth in the plant. In this prior-art method, the gas flow is
20 conducted through a dust separator, where particulate impurities are separated from the gas flow, which is cooled when leaving the dust separator. Part of the gas flow leaving the dust separator is conducted, as cooling-gas flow, through the adsorption device in order to cool
25 those parts of this device that have been heated by the hot-gas flow, whereupon the cooling-gas flow is used as desorption-gas flow. Hot combustion gases from the combustion device are conducted through a heat exchanger in order there to emit heat to the desorption-gas flow,
30 which also is conducted through the heat exchanger. Further, a heat exchanger is used for reheating the cooled gas flow leaving the dust separator.

The object of the present invention is to provide a cleaning method in which the energy consumption is lower

and there is less need of heat exchangers than in the above prior-art method, and which thus is less expensive to implement than the prior-art method.

According to the invention, this object is attained
5 by a method which is of the type stated by way of introduction and is characterised in that hot combustion gases from the combustion device are introduced into and mixed with the cooled gas flow and the desorption-gas flow.

It will be appreciated that the two heat exchangers
10 required for implementing the above prior-art method can be dispensed with when utilising the method according to the invention. The cooling-gas flow, which in the prior-art method is dimensioned to serve as hot-gas flow as well and thus is unnecessarily large, may, if used in
15 a corresponding fashion when implementing the method according to the invention, be advantageously reduced to merely fulfil the cooling function, hot combustion gases being supplied to the desorption-gas flow so as to form the hot-gas flow.

20 The invention will now be described in more detail with reference to the accompanying drawings, in which

Fig. 1 schematically illustrates a plant which is intended for implementing the inventive method and in which use is made of an incinerator with a recuperative
25 heat exchanger; and

Fig. 2 schematically illustrates a plant which is intended for implementing the inventive method and in which use is made of an incinerator with a regenerative heat exchanger.

30 In Figs 1 and 2, the encircled numerals at the different flow arrows indicate a flow value for the respective flows, this flow value bearing a relation to the air flow which prevails in a spray booth and whose flow value has been set at 100. The temperature of the respective
35 flows is also indicated at some flow arrows.

Both the plant illustrated in Fig. 1 and that illustrated in Fig. 2 are used for cleaning the exhaust-air

flow containing paint particles, volatile solvents and water vapour that leaves a spray booth 1 in a plant for painting vehicle bodies. Via an air conditioner 2, an air flow is blown into the spray booth 1 by means of a fan 3.

5 The major part (about 90%) of the air blown into the spray booth 1 is air that is circulated in the system in a manner to be described in more detail below, whereas the remainder (about 10%) is taken from the surrounding atmosphere. The air is conditioned in the air conditioner

10 2 in such a manner that an air flow having a temperature of about 23°C and a relative humidity of about 60% is obtained in the spray booth 1.

The air flow leaving the spray booth 1 and having a temperature of about 18°C is conducted through a dust

15 separator 4, such as a wet electrostatic precipitator, where particulate impurities, such as paint particles, are separated from the air flow. When leaving the dust separator 4, the air flow is dehumidified by cooling in a cooler 5.

20 The cooled air flow leaving the cooler 5 is, as will be described in more detail below, supplemented with an additional flow with which it is conducted, by means of a fan 6, through a device 7' (Fig. 1) or 7" (Fig. 2) for the adsorption of gaseous impurities, such as volatile

25 solvents. The adsorption device 7' or 7", which is of known design, consists of a rotor composed of a plurality of segment-shaped adsorption elements containing a suitable adsorbing agent, which is zeolite in the rotor 7' shown in Fig. 1 and active carbon in the rotor 7"

30 shown in Fig. 2. US-A-5,057,128, for instance, discloses a rotor of this type.

The flow path through the rotor 7' or 7" is, by means of fixed channel walls (not shown), divided into three sectors, namely a gas-cleaning sector, which covers

35 most of the circular cross-sectional area of the rotor and through which is conducted the main part of the gas flow to be cleaned, and two minor sectors, of which one

is a cooling sector through which a minor part of the gas flow to be cleaned is conducted in order to cool the adsorption elements, and the other is a desorption sector through which a hot-gas flow is conducted in order to
5 clean the rotor and entrain impurities accumulated therein. The cooling-air flow is regulated by means of a register 8. The rotor 7' or 7" rotates during use, so that the portion thereof situated opposite to the gas-cleaning sector of the flow path is gradually inserted
10 into the desorption sector of the flow path so as to be cleaned, and then inserted into the cooling sector of the flow path in order to be cooled.

The major part of the cleaned gas flow leaving the adsorption device or the rotor 7' or 7" is, as mentioned
15 above, recycled to the air intake of the fan 3, whereas the remainder of the gas flow is discharged into the surrounding atmosphere.

The hot-gas flow, which has a high solvent concentration when leaving the adsorption device 7' or 7", is
20 conducted to a combustion device 10' or 10" by means of a fan 9.

In the Example illustrated in Fig. 1, the combustion device 10' is an incinerator of the type described in e.g. DE-A1-30 41 269 and DE-A1-30 43 286 and has a combustion chamber 11 and a recuperative heat exchanger 12
25 through which the heavily contaminated hot-gas flow is introduced into the combustion chamber 11. The combustion gases from the combustion chamber 11 are removed through the heat exchanger 12, where they emit heat to preheat
30 the hot-gas flow, so that their temperature is reduced from about 730°C to about 350°C.

A part (about 40%) of the thus-cooled combustion gases is conducted, via a flow-regulating register 13, to the desorption sector there to be mixed with the cooling-air flow from the adsorption device 7' and form, together
35 therewith, the hot-gas flow. The cooling-air flow leaving the adsorption device 7' has a temperature of about 60°C

and is mixed with combustion gases having a temperature of about 350°C in such proportions (6:4) that the hot-gas flow obtains a temperature of about 180°C. When leaving the adsorption device 7', the hot-gas flow has a temperature of about 90°C.

A part (about 30%) of the combustion gases cooled in the heat exchanger 12 forms the above-mentioned additional flow and is conducted to the outlet of the cooler 5 to be mixed with the cooled air flow leaving this device. The cooled air flow leaving the cooler 5 has a temperature of about 15°C and is mixed with combustion gases having a temperature of about 350°C in such proportions (100:3) that a gas flow having a temperature of about 25°C is obtained.

The remainder (about 30%) of the combustion gases cooled in the heat exchanger 12 is conducted through a heat-recovery device 14 before being let out into the surrounding atmosphere.

The plant illustrated in Fig. 2 differs from that illustrated in Fig. 1 in that active carbon, and not zeolite, is used in the adsorption device, as mentioned above, and in that an incinerator with a regenerative heat exchanger, and not a recuperative heat exchanger, is used as combustion device. The incinerator employed is of the type described in e.g. SE-A-8403330-7 and SE-A-8802791-7.

The hot-gas flow, which has a high solvent concentration when leaving the adsorption device 7", is conducted to the combustion device 10", i.e. the regenerative incinerator, where combustion takes place. The combustion gases removed from the combustion device 10" have a temperature of about 206°C. A part (about 45%) of the combustion gases is conducted, via a register 13, to the desorption sector there to be mixed with the cooling-air flow from the adsorption device 7" and form therewith the hot-gas flow. The cooling-air flow leaving the adsorption device 7" has a temperature of about 50°C

and is mixed with combustion gases having a temperature of about 206°C in such proportions (5.5:4.5) that the hot-gas flow obtains a temperature of about 120°C. When leaving the adsorption device 7", the hot-gas flow has a temperature of about 70°C. The remainder (about 55%) of the combustion gases is conducted to the outlet of the cooler 5 to be mixed with the cooled air flow leaving this device. This air flow, which has a temperature of about 15°C as in the plant illustrated in Fig. 1, is mixed with combustion gases having a temperature of about 206°C in such proportions (100:5.5) that a gas flow having a temperature of about 25°C is obtained. In the plant illustrated in Fig. 2, the energy contained in the combustion gases is utilised to the full, for which reason there is no need of any special heat-recovery device.

CLAIMS

1. A method for cleaning a humid gas flow containing
5 gaseous impurities, such as an exhaust-air flow contain-
ing volatile solvents and originating from a spray booth
(1) in a painting plant, in which method the gas flow is
dehumidified by cooling, the cooled gas flow is reheated
to subsequently be conducted through a device (7'; 7")
10 for the adsorption of gaseous impurities, a desorption-
gas flow is heated to form a hot-gas flow, which is
conducted through the adsorption device (7'; 7") in order
to clean the latter and entrain impurities accumulated
therein, the contaminated hot-gas flow is conducted to a
15 combustion device (10'; 10") in order to be burnt, and
hot combustion gases are removed from the combustion
device (10'; 10") in order to take part in at least one
of the heating processes, c h a r a c t e r i s e d i n
that hot combustion gases from the combustion device
20 (10', 10") are introduced into and mixed with the cooled
gas flow and the desorption-gas flow.

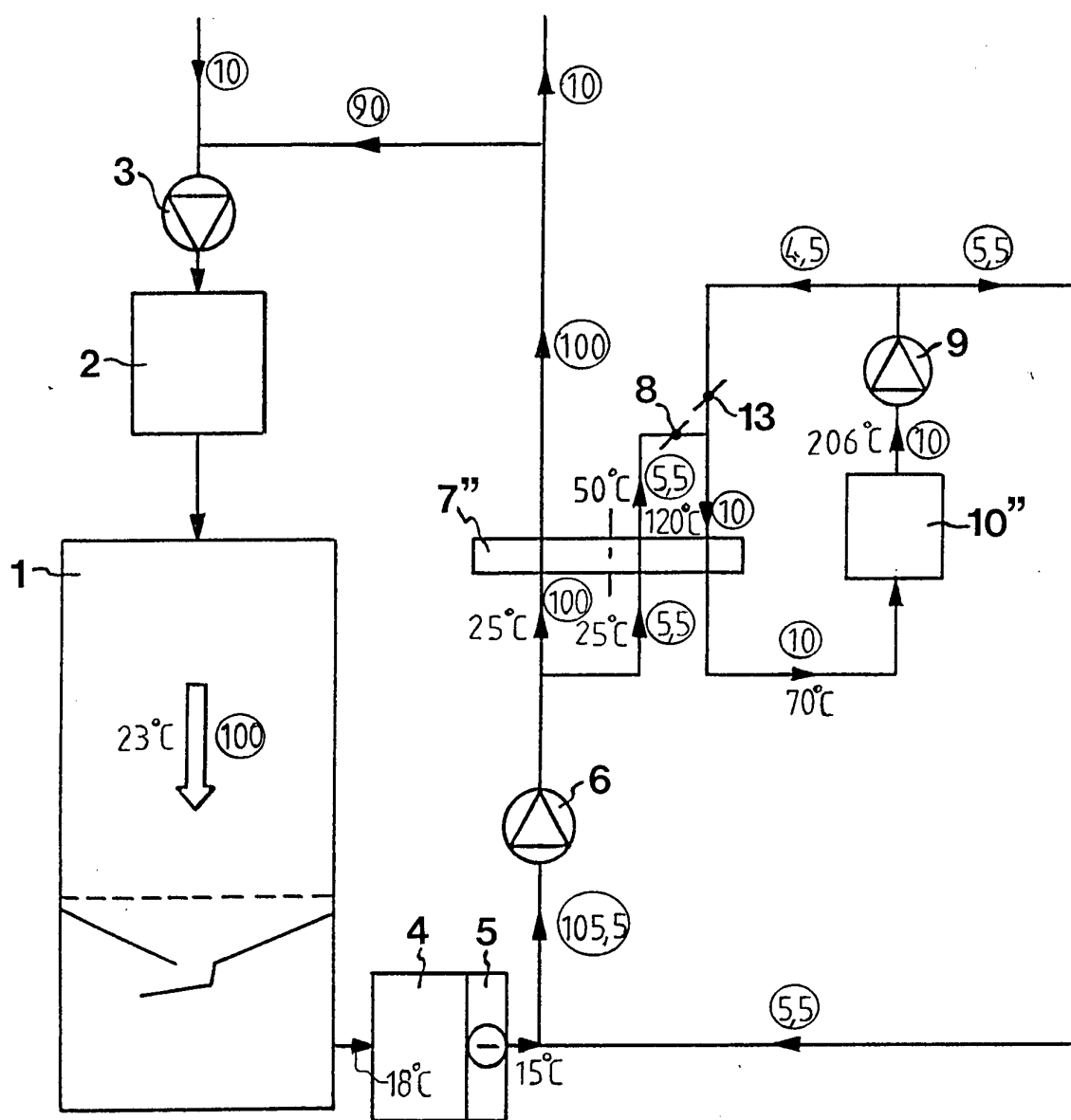
2. A method as set forth in claim 1, in which part
of the gas flow leaving the adsorption device (7'; 7") is
used as desorption-gas flow, c h a r a c t e r i s e d
25 in that the hot-gas flow is formed by supplying hot com-
bustion gases from the combustion device (10'; 10") to
the desorption-gas flow.

3. A method as set forth in claim 1, in which part
of the cooled and subsequently reheated gas flow is con-
ducted through the adsorption device (7'; 7") as a cool-
30 ing-gas flow for cooling those parts of the adsorption
device that have been heated by the hot-gas flow, where-
upon the cooling-gas flow is used as desorption-gas flow,
c h a r a c t e r i s e d i n that the hot-gas flow is
35 formed by supplying hot combustion gases from the com-
bustion device (10'; 10") to the desorption-gas flow.

4. A method as set forth in claim 2 or 3,
c h a r a c t e r i s e d in that hot combustion gases
from the combustion device (10'; 10") are supplied to
the cooled gas flow before this is conducted through
5 the adsorption device (7'; 7").

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FIG. 2



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 94/00643

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6: B01D 53/02, B01D 53/06, B01D 53/72, F23G 7/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6: B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SE, B, 467238 (RÅDIA KOMMANDITBOLAG), 22 June 1992 (22.06.92), page 5, line 20 - line 33, figure 3 --	1-4
P,X	SE, A, 9201424 (MUNTERS ZEOL AB), 7 November 1993 (07.11.93), figures 1,2, claims 1-2 --	1-4
A	SE, B, 461808 (FLÄKT AB), 26 March 1990 (26.03.90) -- -----	1-4

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE-B- 467238	22/06/92	DE-D- 69009187 EP-A,B- 0479864 EP-A- 0556192 SE-A- 9000386 WO-A- 9302771	00/00/00 15/04/92 25/08/93 03/08/91 18/02/93
SE-A- 9201424	07/11/93	NONE	
SE-B- 461808	26/03/90	EP-A- 0354197 JP-A- 2082013 SE-A- 8802791	07/02/90 22/03/90 03/02/90