(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 505 426 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
**28.02.1996 Bulletin 1996/09**

(21) Application number: **91900972.0**

(22) Date of filing: **10.12.1990**

(51) Int. Cl.$^{6}$: **B03C 3/01**

(86) International application number: **PCT/SE90/00817**

(87) International publication number: **WO 91/08837**
**(27.06.1991 Gazette 1991/14)**

# (54) METHOD FOR REDUCING THE RISK OF BACK-CORONA IN AN ELECTROSTATIC PRECIPITATOR

VERFAHREN ZUR VERMEIDUNG DES RÜCKSPRÜHENS IN EINEM ELEKTROABSCHEIDER

PROCEDE DE REDUCTION DES RISQUES DE DECHARGES EN RETOUR A EFFET DE COURONNE DANS DES FILTRES ELECTROSTATIQUES

(84) Designated Contracting States:
**AT BE CH DE DK ES FR GB GR IT LI LU NL SE**

(30) Priority: **11.12.1989 SE 8904154**

(43) Date of publication of application:
**30.09.1992 Bulletin 1992/40**

(73) Proprietor: **ABB FLÄKT AB**
**S-131 34 Nacka (SE)**

(72) Inventor: **PORLE, Kjell**
**S-352 42 Växjö (SE)**

(74) Representative: **Andersson, Per-Olof et al**
**S-200 71 Malmö (SE)**

(56) References cited:
**US-A- 3 512 340**
**US-A- 4 533 364**



EP 0 505 426 B1

Printed by Rank Xerox (UK) Business Services
2.9.9/3.4

## Description

The invention concerns a method for reducing the risk of back-corona in an electrostatic precipitator to which hot dust-containing gases are conducted via a gas supply duct and through which the gases are conducted for dust separation, wherein the gas temperature is reduced and the gas humidity increased by the addition to the gases, before these are conducted through the precipitator, of water which evaporates in the gases.

Usually, electrostatic precipitators are made up of a plurality of successive precipitator units through which dust-containing gases are conducted for cleaning. Each of these units has an inner chamber which is divided into a plurality of parallel gas passages by means of a plurality of juxtaposed vertical curtains of earthed steel plates forming the collecting electrodes of the unit. A plurality of vertical wires, to which a negative voltage is applied, are arranged in each gas passage and form the discharge electrodes of each unit. Owing to corona discharges at the discharge electrodes, the gases are ionised in the electric field in the gas passages. The negative ions are attracted by the collecting electrodes and, when moving towards these, collide with dust particles in the gases, thereby charging the particles which are separated from the gases by being attracted by the nearest collecting electrode, where they deposit and build up a layer of dust.

Generally, dust separation efficiency increases with the voltage between the electrodes. The voltage should, however, not be too high, since that may cause flashovers between the electrodes. Too high a current per unit area towards the collecting electrode may entail that the dust layer is charged faster than it is discharged towards the collecting electrode. Then, this charging of the dust layer leads to sparkings in the layer proper, what is generally referred to as back-corona, and dust is flung back into the gases, thereby impairing the dust separation efficiency. Further, the risk of back-corona increases with the resistivity of the dust.

To reduce the risk of back-corona, especially in the separation of dust of high resistivity, while maintaining such a current supply to the discharge electrodes that evenly distributed corona discharges occur at these electrodes, the discharge electrodes are now usually supplied with current pulses. Each precipitator unit has a separately controllable current and/or voltage supplying circuit with associated control equipment, such that the current and/or voltage supply to each unit can be separately controlled. Thus, the current supply to the discharge electrodes of each unit is separately adjusted in such a manner that maximum dust separation efficiency is obtained.

Another method for reducing the risk of back-corona consists in adding water to lower the temperature of the hot gases and increase their humidity, thereby reducing the resistivity of the dust. Such cooling of the hot gases by direct evaporation of water is usually carried out in a conditioning tower through which the gases are conducted before being conveyed to the electrostatic precipitator. Such towers are very large, since all the water injected therein must be evaporated before the gases leave.

US-A-3,512,340 discloses a method in which dust particles and liquid are introduced separately at different locations into the gas supply duct. First, the dust particles are introduced, which are rapidly heated by the hot gases, and then the liquid is injected into the gas supply duct to be evaporated by heat exchange with the heated dust particles. The water is injected directly into the gas supply duct. In practice, it has been found that some of the water reaches the wall of the duct before it has been evaporated. In this manner, the wall is wetted, which in turn results in dust particles adhering to the wall as a deposit, which is a major problem. This problem has not been solved in a satisfactory manner, although this was one of the primary aims of the invention according to the US patent specification. Such a direct injection of water could apparently only be carried out with the aid of large conditioning towers.

In other prior art methods for reducing the risk of back-corona in an electrostatic precipitator, anhydrous sulphur trioxide gas (see US-A-7 533 364), a phosphoric acid component, ammonia or sodium are added to the gases before these are conducted through the precipitator. These prior art methods are, however, difficult to carry out and often expensive, since they require the provision of large plants, involving high operational costs, adjacent to the precipitators.

Thus, the object of the invention is to provide a simple, inexpensive and practicable method for reducing the risk of back-corona on the principle of reducing the gas temperature and increasing the gas humidity by adding water which evaporates in the gases.

This object is achieved by a method of the type stated in the introduction to this specification, which is characterised in that some of the dust particles separated in the precipitator are employed as carriers for an amount of liquid, chiefly water, proportioned to bring about the desired reduction in temperature, and are recycled by being injected into the gas supply duct jointly with the liquid carried by dust particles.

Preferably, the larger dust particles are employed as carriers for the liquid, and are recycled. When using a precipitator made up of several successive precipitator units, the liquid-carrying and recycled dust particles are dust particles separated in the first precipitator unit.

In some applications, the liquid suitably consists of water to which sodium has been added, preferably in the form of a sodium salt. In other applications, it suitably consists of water to which sulphur has been added, preferably in the form av sulphuric acid.

The invention will now be described in more detail below with reference to the accompanying drawing schematically illustrating a plant for cleaning flue gases from a coal-fired boiler plant. The illustrated plant comprises equipment for carrying out the inventive method.

The drawing schematically illustrates a plant for cleaning dust-containing flue gases from a coal-fired boiler plant 1. A preheater 2 is adapted to transfer heat from the hot flue gases to combustion air which, through a duct 2a, is supplied to the plant 1 by means of a fan 3.

The hot flue gases, which may have a temperature of about 150°C, are conducted through a duct 4 to an electrostatic precipitator 5 made up of three successive precipitator units 5a, 5b, 5c through which the gases are conducted for cleaning. The thus cleaned flue gases are conducted through a duct 6 to a flue gas fan 7 which conveys the gases through a duct 8 to a chimney 9 for emission into the atmosphere.

Each of the successive precipitator units 5a, 5b, 5c is of conventional type and has an inner chamber divided into a plurality of parallel gas passages by means of a plurality of juxtaposed vertical curtains of earthed steel plates, i.e. collecting electrodes. A plurality of vertical wires, i.e. discharge electrodes, connected to a voltage of about -50 kV, are arranged in each gas passage. The flue gases are ionised in the electric field in these passages. The negative ions are attracted by the collecting electrodes and collide, when moving towards these, with dust particles in the flue gases, thereby charging these particles, which are separated from the gases by being attracted by the nearest collecting electrode, where they are deposited.

The dust particles deposited on the collecting electrodes build up a layer of dust which at regular intervals are dislodged. Then, the dust particles drop into the collecting hopper 10a, 10b and 10c of each precipitator unit. The dust particles collected by the hopper 10b of the second unit 5b, being smaller than those collected by the hopper 10a of the first unit 5a, as well as the dust particles collected by the hopper 10c of the third unit 5c, being smaller than those collected in the hopper 10b of the second unit 5b, are removed from the hoppers 10b and 10c by conveyor means 11b and 11c, shown only schematically.

Some of the dust particles collected by the hopper 10a of the first unit 5a are recycled in the system via a device 12 in a manner described in more detail below. The remaining dust particles in the hopper 10a of the first unit 5a are removed by a conveyor means 11a (shown only schematically) and the conveyor means 11b and 11c.

The device 12 shown most schematically comprises a container 13 for intermediate storage of the dust particles which are to be recycled. A valve device or gate-type feeder 14 is arranged below the container 13 and adapted to feed the dust particles to a screw conveyor 15, which transports the dust particles to a conduit 16 ending in the flue gas duct 4. A strong air current (indicated by arrows) is blown through the conduit 16. Before reaching the discharge end of the screw conveyor 15, the dust particles are showered with water. The water is supplied to the screw conveyor 15 through a connection 17, and conveyed to the conduit 16 jointly with the dust particles. The dust particles serving as carriers for the added water are blown into the flue gas duct 4. The water evaporates in the flue gases, thus reducing the gas temperature and increasing the gas humidity. The amount of water admitted through the connection 17 is porportioned so as to bring about the desired reduction in temperature of the flue gases. To further enhance dust separation efficiency, the water may in some applications contain sodium, added in the form of a sodium salt, or sulphur, added in the form of sulphuric acid.

## Claims

1. A method for reducing the risk of back-corona in an electrostatic precipitator (5) to which hot dust-containing gases are conducted via a gas supply duct (4) and through which the gases are conducted for dust separation, wherein the gas temperature is reduced and the gas humidity increased by the addition to the gases, before these are conducted through the precipitator (5), of water which evaporates in the gases, **characterised** in that some of the dust particles separated in the precipitator (5) are employed as carriers for an amount of liquid, chiefly water, proportioned to bring about the desired reduction in temperature, and are recycled by being injected into the gas supply duct (4) jointly with the liquid carried by dust particles.

2. The method of claim 1, **characterised** in that the larger dust particles are employed as carriers for the liquid, and are recycled.

3. The method of claim 2, which is implemented in a precipitator (5) composed of several successive precipitator units (5a, 5b, 5c), **characterised** in that the liquid-carrying and recycled dust particles are dust particles separated in the first precipitator unit (5a).

4. The method of any one of claims 1-3, **characterised** in that the liquid consists of water to which sodium has been added, preferably in the form of a sodium salt.

5. The method of any one of claims 1-3, **characterised** in that the liquid consists of water to which sulphur has been added, preferably in the form of sulphuric acid.

## Patentansprüche

1. Verfahren zum Reduzieren der Gefahr von Rücksprühen in einem elektrostatischen Staubabscheider (5), dem heisse, Staub enthaltende Gase durch einen Gaszufuhrkanal (4) zugeführt werden und durch welchen die Gase zum Staubabscheiden geleitet werden, in welchem Verfahren die Gastemperatur reduziert und die Gasfeuchtigkeit erhöht wird, dadurch, dass den Gasen, bevor sie durch den Staubabscheider (5) geleitet werden, Wasser zuge-

setzt wird, das in den Gasen verdampft, dadurch **gekennzeichnet,** dass einige der im Staubabscheider (5) abgeschiedenen Staubteilchen als Träger für eine der erwünschten Temperatursenkung angepasste Menge von Flüssigkeit, hauptsächlich Wasser, verwendet und zurückgeführt werden, dadurch, dass sie zusammen mit der von den Staubteilchen getragenen Flüssigkeit in den Gaszufuhrkanal (4) eingespritzt werden.

2. Verfahren nach Anspruch 1, dadurch **gekennzeichnet,** dass die grösseren Staubteilchen als Träger für die Flüssigkeit verwendet und zurückgeführt werden.

3. Verfahren nach Anspruch 2, das in einem Staubabscheider (5) durchgeführt wird, der aus mehreren nacheinander angeordneten Abscheideeinheiten (5a, 5b, 5c) aufgebaut ist, dadurch **gekennzeichnet,** dass die die Flüssigkeit tragenden und zurückgeführten Staubteilchen in der ersten Abscheideeinheit (5a) abgeschiedene Staubteilchen sind.

4. Verfahren nach einem der Ansprüche 1-3, dadurch **gekennzeichnet,** dass die Flüssigkeit aus Wasser besteht, dem Natrium zugesetzt worden ist, vorzugsweise in Form von Natriumsalz.

5. Verfahren nach einem der Ansprüche 1-3, dadurch **gekennzeichnet,** dass die Flüssigkeit aus Wasser besteht, dem Schwefel zugesetzt worden ist, vorzugsweise in Form von Schwefelsäure.

**Revendications**

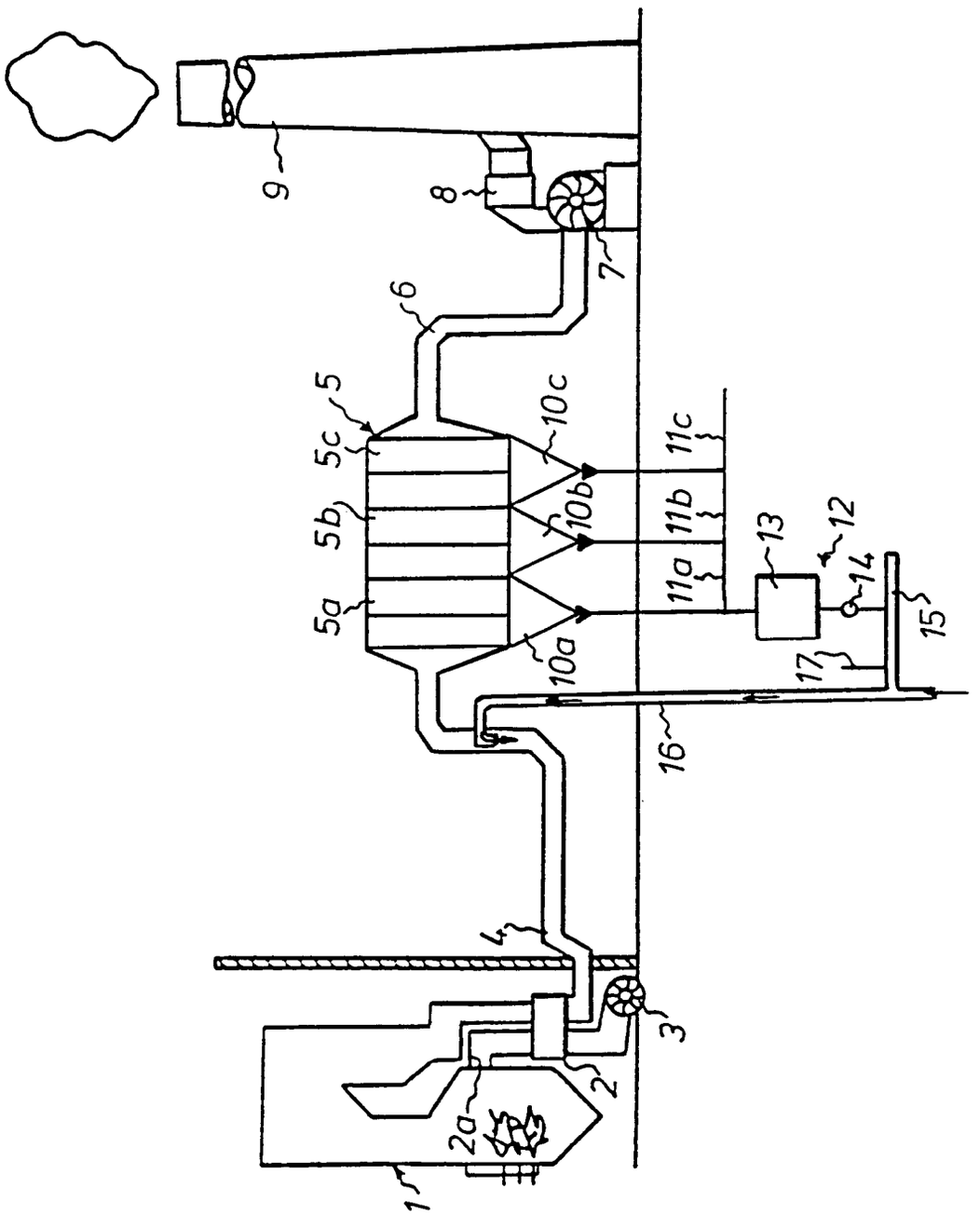
1. Procédé de réduction des risques de décharges en retour par effet corona dans un précipitateur électrostatique (5) auquel des gaz chauds contenant de la poussière sont conduits par une conduite d'alimentation en gaz (4) et à travers lequel les gaz sont conduits en vue de la séparation de poussière, procédé dans lequel la température du gaz est réduite et l'humidité du gaz est augmentée par l'addition aux gaz, avant que ceux-ci ne soient conduits à travers le précipitateur électrostatique (5), de l'eau qui s'évapore dans les gaz, **caractérisé** en ce qu'un certain nombre des particules de poussière séparées dans le précipitateur électrostatique (5) sont utilisées en tant que porteurs d'une certaine quantité de liquide, principalement de l'eau, proportionnée à provoquer la réduction voulue de la température, et sont recyclées en étant injectées dans la conduite d'alimentation en gaz (4) conjointement avec le liquide porté par les particules de poussière.

2. Procédé selon la revendication 1, **caractérisé** en ce que les particules de poussière les plus grandes sont utilisées en tant que porteurs du liquide et sont recyclées.

3. Procédé selon la revendication 2, qui est exécuté dans un précipitateur électrostatique (5) composé de plusieurs unités de précipitateur électrostatique (5a, 5b, 5c) successives, **caractérisé** en ce que les particules de poussière porteuses de liquide et recyclées sont des particules de poussière séparées dans la première unité de précipitateur électrostatique (5a).

4. Procédé selon l'une quelconque des revendications 1 à 3, **caractérisé** en ce que le liquide utilisé est composé de l'eau à laquelle on a ajouté le sodium, de préférence sous forme d'un sel de sodium.

5. Procédé selon l'une quelconque des revendications 1 à 3, **caractérisé** en ce que le liquide utilisé est composé de l'eau à laquelle on a ajouté le soufre, de préférence sous forme d'acide sulfurique.


9
8
7
6
5
5c
5b
5a
10c
10b
10a
11c
11b
11a
13
12
14
15
17
16
4
3
2
2a
1