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(54) **FILTER FOR SEPARATING PARTICLES FROM GASES.**

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Description

The present invention relates to a filter for separating particles from gases by screening, comprising bag-shaped filter members made of textile filter material, each filter member having at least one opening for discharging the gases flowing through the filter material of said filter member, pervious stiffening means arranged inside said filter members, and electrically conductive means arranged inside and outside the filter members for charging said fibres, the electrically conductive means inside the filter members consisting of the said stiffening means, and the electrically conductive means outside the filter members consisting of electrodes.

A filter of this type is disclosed in US-A-3,910,779 and when such filters are used for cleaning dust-laden gases, for example flue gases from refuse incineration plants, the dust accumulated on the outsides of the filter members should form dust cakes as thick as possible. This is due to the fact that the cleaning effect of the filter increases with the thickness of the dust cake; the longer the distance the gases have to travel through the filter members, the greater the chance of collecting the dust contained in the gases.

In flue gas cleaning plants where the filter is disposed downstream of a contact reactor, for separating the gaseous impurities, such as sulphur oxide compounds and hydrogen chloride etc., by supplying an absorbent reacting with these impurities, also reaction products and unreacted absorbent will be deposited in the dust cakes of the filter members. Consequently, the gaseous impurities not separated in the contact reactor can be separated in the filter, and the degree of separation is naturally due to the sojourn time of the gases in the dust cakes. The thicker the dust cakes, the longer the sojourn time, and the higher the degree of separation.

Since these filters are provided with electrically conductive means that enhance the dust particles ability to form large dust particles the dust cakes formed by the dust particles will be porous. This means that the resistance and consequently the pressure drop across the dust cakes will be moderate even for thick dust cakes. Consequently, the thickness of the dust cakes will not be limited by the pressure drop but by the density of the dust cakes. If the density is too high the dust cakes have a tendency to fall off the filter members before they have become thick enough for producing a satisfactory efficiency.

If for example the filter is used in a plant for cleaning flue gases from a refuse incineration plant, it is especially difficult to maintain thick dust cakes on the filter members, since gaseous hydrogen

chloride and, if the refuse is humid, considerable amounts of water vapour are formed. If lime is supplied upstream of the filter in a contact reactor, the hydrogen chloride will react with the lime and form calcium chloride which is hygroscopic. The presence of calcium chloride causes the dust cakes to attract water vapour, making them compact, heavy and sticky. As a result, the tendency of the dust cakes to fall off the filter members will be considerable so that the thickness of the dust cakes will not be sufficient for producing a satisfactory separation of the particulate and gaseous impurities of the flue gases, and the filter will be difficult to clean.

To improve the degree of separation for such filters, efforts have been made to lower the filter operating temperature to a level at which the gaseous impurities are precipitated as drops in the filter. These drops are naturally taken up more easily by the filter than are the gaseous impurities. Thus, a higher degree of separation is obtained.

Unfortunately, the dust cakes become humid and sticky, and consequently difficult to remove from the filter members. Furthermore, the filter operating temperature is in this case at a level too low for the remaining process.

If for example a powdery catalyst material is applied to the outsides of the filter members, and ammonia is added to the gases ahead of the filter, the latter may be used for catalytic reduction of nitrogen oxides in the gases. However, the catalyst material in many cases has such a high density that the catalyst material layers formed on the outsides of the filter members become so heavy that they fall off the filter members before they have become thick enough for a satisfactory nitrogen oxide reduction.

The object of the present invention is, therefore, to provide a gas cleaning filter which imparts to the dust cakes or the catalyst material layers a sufficient thickness to obtain a satisfactory separation of the particulate and gaseous impurities of the gases in all filter applications, i.e. also in a plant for cleaning flue gases from a refuse incineration plant.

This object is achieved according to the invention by a filter of the type described by way of introduction and characterised in that the outsides of the filter members are provided with fibres hanging loosely from the filter material.

These fibres will extend radially or nearly radially in the electric field formed by the electrically conductive means arranged inside and outside the filter members and thereby reinforce the dust cakes, so that the dust cakes do not fall off the filter members before they have become thick enough for producing a satisfactory efficiency.

It is preferred that a voltage of 0-50 kV, especially 20 kV, has been applied between the stiffen-

ing means and the electrodes.

The stiffening means may be earthed, and to the electrodes a voltage of 0-50 kV, preferably 20 kV, may be applied.

The electrodes may be earthed, and to the stiffening means a voltage of 0-50 kV, preferably 20 kV, may be applied.

It is preferred that the textile filter material preferably is of PTFE (TEFLON).

The fibres hanging loosely from the filter medium preferably consist of PTFE (TEFLON) and usually have a length of 10-50 mm, preferably 30 mm, and a thickness smaller than or equalling 0.2 mm, preferably 0.1 mm.

The invention will be described in more detail hereinbelow, with reference to the accompanying drawing.

Fig. 1 is a longitudinal sectional view of a bag filter according to the invention.

Fig. 2 is an enlarged part sectional view of Fig. 1.

The bag filter 1 shown in Fig. 1 comprises a filter housing 2, an inlet 3 for the gases, e.g. flue gases from a refuse incineration plant, to be cleaned, and an outlet 4 for the cleaned gases. A plate 5 divides the inside of the filter housing into a raw gas chamber 2a and a clean gas chamber 2b communicating with the inlet and the outlet, respectively.

The bag filter usually comprises 100-500, especially 300, filter bags 7 arranged in longitudinal and transverse rows. At their upper open end, these filter bags are detachably mounted in holes 6 in the plate 5 by means of a conventional attachment (not shown). The length of the filter bags is 3-5 m, usually 5 m, and their diameter is 100-200 mm, usually 125-130 mm. The longitudinal distance between two adjacent filter bags 7 is 300-500 mm, usually 400 mm. The transverse spacing is 300-500 mm, usually 400 mm.

Electrodes 8 are arranged between the filter bags such that one electrode is positioned at each point of intersection between the diagonal lines of four longitudinally and transversely adjacent filter bags.

As is apparent from Fig. 1, the electrodes have the same length, but are thinner than the filter bags and in the form of round rods. Their diameter is 20-40 mm, usually 30 mm. The electrodes are inserted through holes (not shown) in the plate 5 and are kept in place by means of holders (not shown), such that they have no contact with the plate 5. A voltage of 20 kV has been applied to the electrodes via their holders.

Nozzle tubes 9 with nozzles 10 are transversely arranged over the filter bags 7, such that one nozzle is positioned over the upper open end of each filter bag. Consequently, each filter bag, when being cleaned, receives a direct injection of clean-

ing air supplied to the nozzles from a pressure tank (not shown) via the nozzle tubes. The cleaning air is supplied to one nozzle tube at a time, in the form of a short strong pulse of compressed air.

The nozzle tubes are detachably mounted in the clean gas chamber 2b for exchange of filter bags. For the same reason, the top of the filter housing 2 is provided with a number of doors 11 positioned over the nozzle tubes 9.

As is also apparent from Fig. 1, the bottom of the filter housing 2 is funnel-shaped to serve as a dust pocket for collecting the dust separated from the raw gas. The dust is then fed to a dust container (not shown) by means of a screw conveyor (not shown).

As is apparent from Fig. 2, the filter bags 7 are mounted round stiffening means 12 in the form of cages which, in conventional manner, are shaped such that they do not interfere with the movement of the gas flow through the filter bags. Furthermore, these cages are earthed via the plate 5.

It is also apparent from Fig. 2 that the outsides of the filter bags are provided with fibres 13 hanging loosely from the filter material of the filter bags. These fibres are usually made of the same textile material as the filter. Since such materials can withstand higher operating temperatures, when surrounded by thick dust cakes, the choice of the material is determined by the filter operating temperature and the thickness of the dust cake 14 forming round the fibres 13. Acryl is a suitable material for operating temperatures of 60-130 °C polyester for temperatures of 130-150 °C RYTON for temperatures of 150-180 °C, and TEFLON for temperatures of 180-240 °C.

The length of the fibres is 10-50 mm, preferably 30 mm, and the thickness is smaller than or equalling 0.2 mm, preferably 0.1 mm.

The bag filter operates as follows. The dust-laden gases to be cleaned in the bag filter are conducted, under a certain excess pressure, into the raw gas chamber 2a the filter housing 2 via the inlet 3. Since the inlet is positioned at the upper end of the filter bags, the gases will flow vertically downwards along the outsides thereof (see Fig. 1), i.e. leading of the gases co-acts with gravity. Consequently, the dust released by the cleaning of the filter bags 7 will not be recycled to the bags by the incoming gases.

Since a voltage of 20 kV has been applied to the electrodes, and the filter bags have been earthed, electric fields will form inside the raw gas chamber and charge the fibres 13 of the filter bags which will stand out from the outsides of the filter bags in the direction of the field lines (see Fig. 2).

When the gases pass through these fields, their dust particles will be charged with a charge opposite to the charge of the fibres. Thus, the

particles will be attracted to the fibres 13 when the gases flow through the filter bags 7 and the cages 12 towards the inside of the filter bags. When the particles come into contact with the charged fibres, they will be neutralised and no longer repel each other, but instead agglomerate on the outsides of the filter bags. Since comparatively large particles will accumulate on the outsides of the filter bags, the resulting dust cakes will be porous. This means that the resistance and consequently the pressure drop across the dust cakes will be moderate even for thick dust cakes.

Then, the cleaned gases flow from the inside of the filter bags to the clean gas chamber 2b and, via the outlet 4, to a chimney (not shown) and are discharged into the atmosphere (see Fig. 1).

The fibres hanging loosely on the outsides of the filter bags will also have a reinforcing effect on the dust cakes of the filter bags, such that the heavy dust cakes usually formed on the outsides of the filter bags when the filter is used as an NO_x-catalyst, will remain on the filter bags.

Naturally, the invention is not restricted to the embodiment described above, and it can be modified in several different ways within the scope of the accompanying claims.

Instead of applying a voltage of 20 kV to the electrodes and earthing the cages, one may naturally do it the other way round, i.e. earth the electrodes and apply a voltage of 20 kV to the cages.

A different voltage than 20 kV may of course be applied between the electrodes and the cages, but it should preferably be 0-50 kV to make it possible to obtain maximum results.

It would, for example, be possible to replace the electrodes arranged between the filter bags by cylindrical, gas-pervious electrodes round each filter bag.

The round rod electrodes may, of course, also be of square or spiral form.

Claims

1. A filter for separating particles from gases by screening, comprising bag-shaped filter members (7) made of textile filter material, each filter member having at least one opening for discharging the gases flowing through the filter material of said filter member, pervious stiffening means (12) arranged inside said filter members, and electrically conductive means (12, 8) arranged inside and outside the filter members, the electrically conductive means arranged inside the filter members (7) consisting of said stiffening means (12), and the electrically conductive means arranged outside the filter members (7) consisting of electrodes (8),

characterised in that the outsides of the filter members (7) are provided with fibres (13) hanging loosely from the filter material, and that said fibres are charged by said electrically conductive means (12, 8).

2. A filter as claimed in claim 1, **characterised** in that a voltage of 0-50 kV, preferably 20 kV, has been applied between the stiffening means (12) and the electrodes (8).
3. A filter as claimed in claim 2, **characterised** in that the stiffening means (12) are earthed, and that a voltage of 0-50 kV, preferably 20 kV, has been applied to the electrodes (8).
4. A filter as claimed in claim 2, **characterised** in that the electrodes (8) are earthed, and that a voltage of 0-50 kV, preferably 20 kV, has been applied to the stiffening means (12).
5. A filter as claimed in any one of the preceding claims, **characterised** in that the filter material consists of PTFE (TEFLON).
6. A filter as claimed in any one of the preceding claims, **characterised** in that the fibres (13) hanging loosely from the filter consist of PTFE (TEFLON) and have a length of 10-50 mm, preferably 30 mm, and a thickness smaller than or equalling 0.2 mm, preferably 0.1 mm.

Patentansprüche

1. Filter zum Abscheiden von Teilchen aus Gasen durch Siebung, umfassend sackförmige Filterelemente (7) aus Filtermaterial aus Webstoff, wobei jedes Filterelement zumindest eine Öffnung zum Austragen der durch das Filtermaterial des genannten Filterelements strömenden Gase, durchlässige, innerhalb der Filterelemente angeordnete Versteifungsglieder (12) und elektrisch leitende Glieder (12, 8) aufweist, die innerhalb und ausserhalb der Filterelemente angeordnet sind, wobei die innerhalb der Filterelemente (7) angeordneten, elektrisch leitenden Glieder aus den genannten Versteifungsgliedern (12) bestehen und die ausserhalb der Filterelemente (7) angeordneten, elektrisch leitenden Glieder aus Elektroden (8) bestehen, dadurch **gekennzeichnet**, dass die Aussenseiten der Filterelemente (7) mit Fasern (13) versehen sind, die von dem Filtermaterial lose hängen, und dass die genannten Fasern von den elektrisch leitenden Gliedern (12, 8) geladen sind.

2. Filter nach Anspruch 1, dadurch **gekennzeichnet**, dass eine Spannung von 0-50 kV, vorzugsweise 20 kV, zwischen den Versteifungsgliedern (12) und den Elektroden (8) angelegt ist. 5
3. Filter nach Anspruch 2, dadurch **gekennzeichnet**, dass die Versteifungsglieder (12) geerdet sind, und dass eine Spannung von 0-50 kV, vorzugsweise 20 kV, an den Elektroden (8) angelegt ist. 10
4. Filter nach Anspruch 2, dadurch **gekennzeichnet**, dass die Elektroden (8) geerdet sind, und dass eine Spannung von 0-50 kV, vorzugsweise 20 kV, an den Versteifungsgliedern (12) angelegt ist. 15
5. Filter nach einem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, dass das Filtermaterial aus PTFE (TEFLON) besteht. 20
6. Filter nach einem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, dass die vom Filter lose hängenden Fasern (13) aus PTFE (TEFLON) bestehen und eine Länge von 10-50 mm, vorzugsweise 30 mm, und eine Dicke haben, die kleiner ist als 0,2 mm, vorzugsweise 0,1 mm, oder 0,2 mm, vorzugsweise 0,1 mm gleich ist. 25
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Revendications

1. Filtre destiné à séparer des particules de gaz par tamisage, comprenant des éléments filtrants en forme de sac (7) faits de matière filtrante textile, chaque élément filtrant ayant une ouverture au moins pour laisser sortir les gaz s'écoulant à travers la matière filtrante dudit élément, des moyens raidisseurs perméables (12) prévus à l'intérieur des éléments filtrants, et des moyens électroconducteurs (12, 8) prévus à l'intérieur et à l'extérieur des éléments filtrants, les moyens électroconducteurs prévus à l'intérieur des éléments filtrants (7) étant constitués par lesdits moyens raidisseurs (12), et les moyens électroconducteurs prévus à l'extérieur des éléments filtrants (7) étant constitués par des électrodes (8), **caractérisé** en ce que les faces extérieures des éléments filtrants (7) sont munies de fibres (13) suspendus librement à la matière filtrante, et en ce que lesdites fibres sont chargées par les moyens électroconducteurs (12, 8). 35
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2. Filtre selon la revendication 1, **caractérisé** en ce qu'une tension de 0-50 kV, de préférence de 20 kV, a été appliquée entre les moyens

raidisseurs (12) et les électrodes (8).

3. Filtre selon la revendication 2, **caractérisé** en ce que les moyens raidisseurs (12) sont mis à la terre, et en ce qu'une tension de 0-50 kV, de préférence de 20 kV, a été appliquée aux électrodes (8).
4. Filtre selon la revendication 2, **caractérisé** en ce que les électrodes (8) sont mis à la terre, et en ce qu'une tension de 0-50 kV, de préférence de 20 kV, a été appliquée aux moyens raidisseurs (12).
5. Filtre selon l'une quelconque des revendications précédentes, **caractérisé** en ce que la matière filtrante est le PTFE (TEFLON).
6. Filtre selon l'une quelconque des revendications précédentes, **caractérisé** en ce que les fibres (13) suspendus librement au filtre consistent de PTFE (TEFLON) et ont une longueur de 10-50 mm, de préférence de 30 mm, et une épaisseur inférieure ou égale à 0,2 mm, de préférence de 0,1 mm.

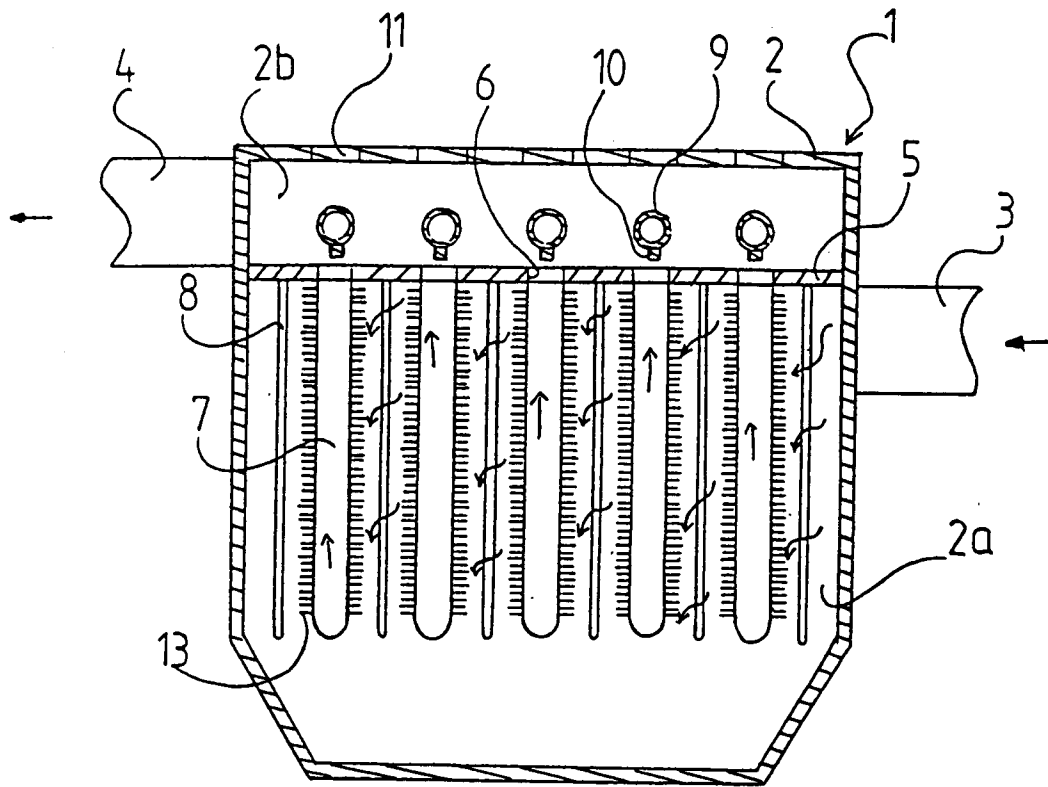


Fig. 1

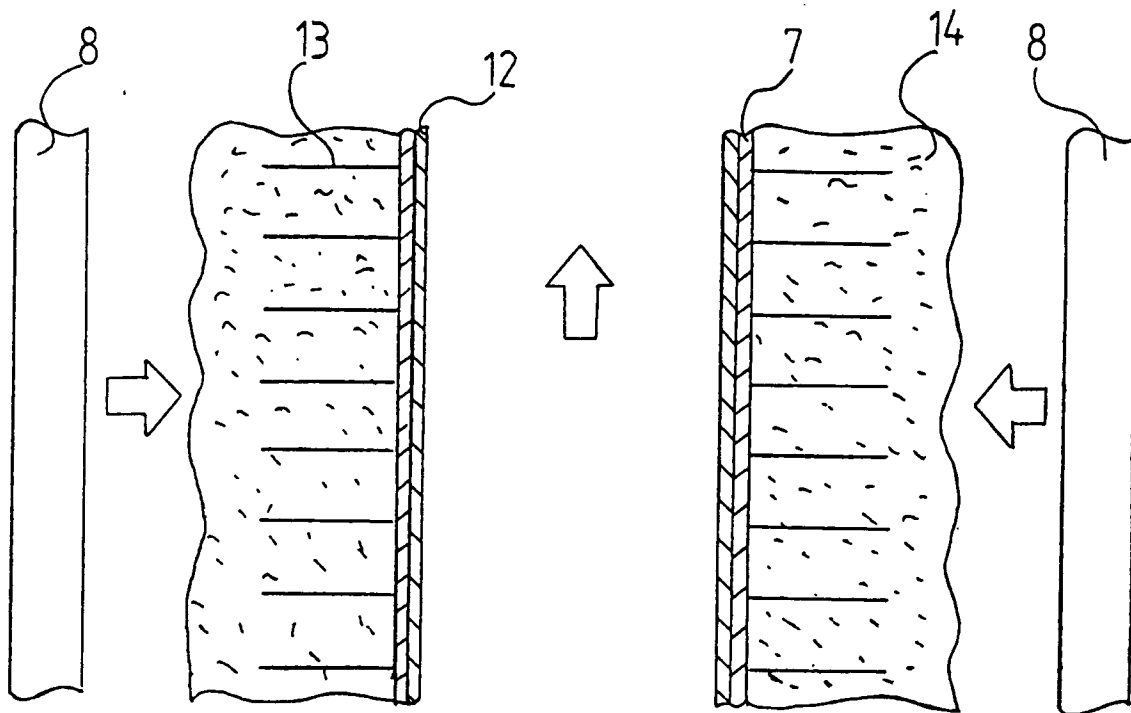


Fig. 2