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(54) Method and feeder for increasing efficiency of the expanding and drying process of organic plant materials, particularly in a jet drier

(57) The invention relates to a method and a feeder for increasing the efficiency of the expanding and drying process of organic plant materials, particularly in a jet dryer used for comminuted organic plant materials, particularly tobacco materials. The dryer works with the use of a gaseous expanding and/or drying agent under an absolute working pressure in the range from 2.5 kPa to 10 MPa. Preferably, overheated steam is used as the gaseous working, expanding and/or drying agent, and during transporting the material (1) from the feeding zone (6) to the zone (9) of the contact with the expanding and/or drying agent, a feeder, preferably a rotary vane feeder (4) is flushed, preferably in a continuous manner, with a gaseous medium (11, 12) which is capable of absorbing moisture, under an absolute pressure from 2.5 kPa to 10 MPa, the temperature of the gaseous medium (11, 12), preferably air, is from 50 to 200°C, and residues of the process gas are removed from the rotary vane feeder (4). Openings (5, 7) are formed in the housing of the feeder according to the invention, delivering the gaseous medium to the moving spaces between the vanes (3), as well as openings (5A, 7A) leading out the gaseous medium from the moving spaces between the vanes (3), the openings (5, 7, 5A, 7A) being arranged respectively in the walls of the housing of the feeder (4).

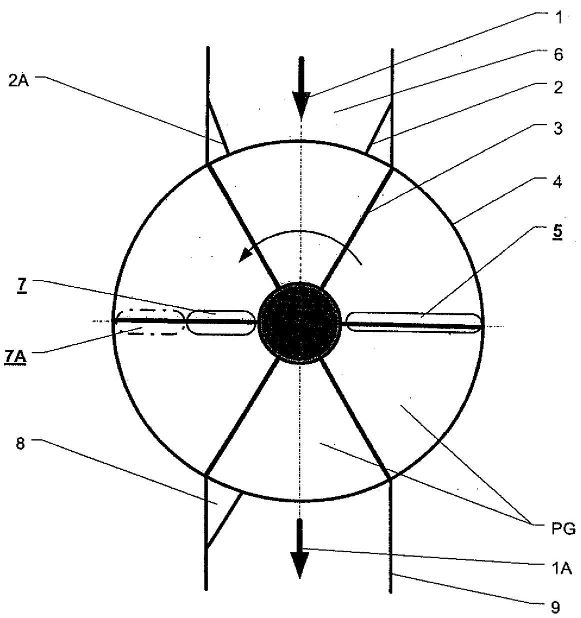

Fig. 2

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Description

[0001] This invention relates to a method and a feeder for increasing efficiency of the expanding and drying process of organic plant materials, particularly a jet drier, used particularly to dry comminuted tobacco materials.
Many methods are known in the art for expanding and drying comminuted organic plant materials, as well as many technological systems having dryers, particularly jet dryers, employing a gaseous drying agent, particularly overheated steam of a temperature in the range up to 400°C. These systems comprise rotating valves operating as valves dosing comminuted products, particularly fluids.
In order to guarantee the continuity of feeding the processed organic plant material, particularly comminuted tobacco material in any form, according to a known method, the material is fed gravitationally to the expanding and/or drying zone, as shown for example in US 6185843. However, this known method has practical limitations resulting from a possibility of blocking and jamming the fed material, particularly tobacco material in the outlet zone, resulting in nonuniformity of the material stream fed for processing. Additionally, this solution makes it difficult or practically makes it impossible to carry out a steam, flows in the drying channel under a pressure higher than the atmospheric pressure, causing losses (leakage) of the gaseous medium, for example air, carbon dioxide (CO_2), or steam, through the fed layer of the organic material, particularly tobacco material, and condensation of water vapour on the material, moistening the material fed for drying.

[0002] Another solution related to feeding organic plant materials, particularly tobacco materials, to the expanding zone is presented in US 4791942, where a modified rotating valve is presented, to which a process medium is fed under a pressure, and in which the process of tobacco pressure expanding is carried out employing steam and carbon dioxide.

[0003] Still another solutions are presented in US 6158441, US 6581608, and US 6779527, where just before feeding to the expanding and/or drying zone the processed material is conditioned by injection (adding) water and/or water vapour within the inlet valve assembly. The fluid added in this manner gives out its enthalpy (energy) of vapourizing partially to the material fed from outside, heating it up and condensating onto its surface. Due to high dynamics of the feeding process of the organic plant material to the expanding and/or drying device, the condensate layer on the material surface is not absorbed into the cellular structure of the material and stays on its surface being a useless insulator against the thermal energy until the direct contact with the expanding and/or drying medium.

[0004] Fig. 1 in the attached drawings shows exemplary known jet dryers using a gaseous drying agent, particularly overheated steam of a temperature up to 400°C. According to this solution organic plant material, particularly comminuted tobacco material 1, is fed from the production line to the expanding and/or drying zone 9 through a dosing and flow adjusting device 4, wherefrom, after the processing, the material is led out through a feeding and flow adjusting device 10. The term expanding is understood here as increasing the specific volume of the processed material, measured in m^3/g.

[0005] A side effect of known methods for processing and feeding (transporting) organic plant materials, particularly tobacco materials, to the zone of a direct processing, i.e., the expanding and/or drying zone, is inter alia creation of undesired layer of surface moisture (water), notbound chemically, which will not be able to be absorbed into the cellular structure of the tobacco material before feeding it into the expanding and/or drying zone of access. This layer constitutes a thermal insulation of varied thickness, which significantly hinders or even prevents the processing of the comminuted organic plant material, particularly tobacco material in any form, to be carried out in a homogenous, optimal in terms of quality, and watt-hour efficient manner.

[0006] To illustrate how an effective thermal insulator the moisture (water) can be, we will compare two coefficients defining thermal properties of two different materials, i.e., for water (thermal insulator) and for example copper (very good thermal conductor).

	Water (thermal insulator)	Copper (thermal conductor)
Specific heat, cp [kJ/kg·K]	4.18	0.389
Thermal conductivity, λ [W/m·K]	0.58	386

The comparison of the specific heat, c_p for both materials shows that one has to deliver about ten times more of thermal energy to heat up a unitary mass of water by one degree (°C or 1 K), than to heat up by one degree the same amount of copper. On the other hand, the comparison of the thermal conductivities, λ, confirms that the water layer acts as a disadvantageous and very efficient thermal insulator, i.e., a surface water layer of thickness of 1 mm stores as much thermal energy as a copper layer of thickness of about 600 mm (for the above mentioned data 665 times more).

[0007] Additionally, one has to take into consideration that the necessity of vapourizing the surface moisture imposes the necessity of delivering an extra, significant amount of thermal energy to cause the phase change of liquid into vapour. However, the result o such phase change is taking a significant amount of thermal energy from the material, so called vaporization enthalpy, which for water is about 2250 kJ/kg, this in turn causing an undesired effect of cooling (instead of heating) the material.

[0008] Considering the above issues, it would be advantageous to guarantee that the material fed to the dryer, particularly the jet dryer of the "filash" type, is free of surface moisture, which is an insulator for the thermal energy and makes it necessary to increase the time of the product staying in the drying channel and, as a consequence, to increase the dimensions of the dryer as well as the demand for energy.

[0009] The present invention relates to a method of increasing efficiency of the expanding and drying process of organic plant materials, particularly in a jet dryer, used to for comminuted organic plant materials, particularly comminuted tobacco materials. This dryer works with the use of a gaseous expanding and/or drying agent under a working absolute pressure of 2.5 kPa to 10 Mpa. Preferably, overheated steam is used as the gaseous expanding and/or drying process medium.

[0010] The object of the invention consists in that during transporting the material from the feeding zone to the zone of the contact with the expanding and/or drying agent a feeder, preferably a rotary vane feeder, is flushed with a gaseous medium, preferably in a continuous manner, which is able to absorb moisture, under a working absolute pressure in the range from 2.5 kPa to 10 Mpa. The temperature of the gaseous medium, preferably air, ranges from 50 to 200°C. Then, the residue of the process gas is removed from the rotary vane feeder.

[0011] Preferably, according to the invention the transported material is heated up by the direct contact with the stream of the gaseous medium and residual surface moisture is removed from the surface of the material, the transported material being saturated with the use of the gaseous medium stream and the material is defibered.

[0012] Also, this invention relates to a feeder for increasing efficiency of the expanding and drying process of organic plant materials, particularly in a jet dryer used for comminuted organic plant materials, particularly comminuted tobacco. The feeder has vanes rotating in a housing.

[0013] This invention is based on the idea that openings are made in the housing of the feeder for delivering the gaseous medium into the moving spaces between vanes as well as openings leading out the gaseous medium from the moving spaces between the vanes, the openings being arranged correspondingly in the walls of the housing of the feeder. The openings are oblong and are arranged radially with longitudinal axes being perpendicular to the axis of the inlet and outlet of the product, some of them being radially shifted relative to each other. The feeder according to the invention is equipped with deflectors of the material stream.

[0014] The solution according to the invention assures the uniformity and continuity of the processes whereby optimally high expanding and drying effect is obtained to the desired level. Experts in the field of tobacco processing estimate this level to be in the range of 10 - 14% of humidity.

[0015] The invention is illustrated by an embodiment shown in the accompanying drawings, in which:

Fig. 1 shows schematically a known device for expanding and/or drying comminuted organic plant materials, particularly tobacco materials, comprising a feeding and flow adjusting device;
Fig. 2 shows a cross-sectional view of an inlet feeder according to the invention;
Fig. 3 shows a plan view of the feeder of Fig. 2 with the channels delivering the process medium to this valve and the channels leading out the process medium from this valve;
Fig. 4 shows a cross-sectional view of a feeder according to the invention in a working position of the driver vanes of the feeder, in which the operating range of the delivered gaseous medium within the feeder is shown.

[0016] According to the invention, in the device for expanding and/or drying comminuted tobacco material an inlet rotary valve is employed in a form of a rotary vane feeder 4, which is located between the feeding zone 6 and the expanding and/or drying zone, i.e., the processing zone 9. Through the rotary vane feeder 4 the organic plant material, particularly tobacco material 1, 1A, is fed to the processing zone 9 in a manner, which eliminates or significantly reduces entering a moist gaseous medium PG to the feeding zone 6 of the organic plant material, particularly tobacco material 1.

[0017] Fig. 2 presents a cross-section of the feeder 4 which doses the organic plant material, particularly tobacco material 1, 1A to the processing zone 9. A standard (typical) rotary valve has been modified by forming two zones, an active one and a passive one, which are shown in Fig. 4. In the active zone the comminuted organic plant material, particularly tobacco 1, is transported to the processing zone 9. In the passive (return) zone only the gaseous process medium PG is transported between the vanes of the valve.

[0018] The rotating vanes 3 form, with contact with the housing of the feeder 4, closed, moving spaces, to which a stream of the gaseous process medium is delivered via openings 5 and/or 7, which is then removed via openings 5A, 7A, the gaseous medium being for example hot air of a temperature from 50 to 150°C, under an absolute pressure in the range from 2.5 kPa to 1 MPa.

[0019] As shown in Fig. 3, the feeder 4 is equipped with feeding channels 13, 14 feeding the stream of the gaseous process medium to the openings 5, 5A as well as channels 13A, 14A leading out the stream of the gaseous process medium.

[0020] In order to intensify the effect of flushing the spaces between the vanes 3 with the gas, openings 7 and 7A may be shifted along the radius, as shown in Fig. 2 and Fig. 3, which lengthens the path of the gas stream in the flushed space. In the passive zone, where only gas PG is transported between vanes 3 and there is no material, particularly tobacco material 1, 1A, one may apply another shape and arrangement of the openings 5 and 5A, which do not need to be shifted relative to each other, as shown in Figs. 2 and 3.

[0021] Openings 5 and 7 delivering the gaseous process medium 11 and/or 12 into the housing of the feeder 4 as well as openings 5A and 7A leading out the gaseous process medium 11A and 12A are in the described embodiment oblong openings arranged radially and perpendicularly to the inlet-outlet direction of the material 1-1A fed for expanding and/or drying processing, as shown in Figs. 2 and 4.

[0022] For obtaining optimal and advantageous use of the working spaces of the valve, i.e., spaces between the driver vanes 3 and the housing of the feeder 4, material stream deflectors 2, 2A and 8 are employed, shown in Fig. 2. Additionally, these deflectors advantageously lengthen the path of the contact between the vanes 3 and the housing of the feeder 4, which advantageously extends the duration of processing with the gaseous medium 11, 11A. Simultaneously, as shown in Fig. 4, the deflectors eliminate the adverse phenomenon of entering (leakage) the gaseous medium, being delivered to the feeder 4, into the processing zone 9 as well as the feeding zone 6.

[0023] The material 1A leaving the feeder 4 stops occupying the space between the vanes 3 and the housing of the feeder 4, in the processing zone 9, in which the material contacts directly the expanding and/or drying agent PG, the space being immediately filled up with the expanding and/or drying agent PG present in the processing zone 9. Next, the agent is transported between the vanes 3 and the housing of the feeder 4. In this zone openings 5 and 7 are formed, as it is shown in Figs 2 and 3, through which the gaseous process agent 11 and/or 12, for example ambient air, is fed to the feeder, as well as openings 5A and 7A, through which the gaseous mixture 11A and 12A is lead out (sucked off).

[0024] As a result of using the above solution in the moment of reopening the rotating working chamber of the feeder 4 no residues of moist gaseous agent PG enter the feeding zone 6, and as a consequence no condensation of moisture occurs on the organic plant material, particularly tobacco material 1, fed to the processing. The organic plant material, particularly tobacco material 1, fed, according to this method, for the expanding and/or drying does not have an insulating layer of free, chemically unbound surface moisture, which is a thermal insulator and an inhibitor for chemical reactions occurring within the processing zone 9, which allows for significant reduction of amount of energy delivered from outside necessary for obtaining an appropriate expanding and/or drying process.

[0025] As a result of the employed solution entire or significant amount of the gaseous process medium PG is removed from the feeder 4 feeding the material 1 and separating from the processing zone 9, the medium being a carrier of moisture, particularly water vapour. The absence of the moisture saturated in the feeding zone 6 of the material 1 to the feeder 4 reduces or even eliminates the condensation of the water vapour (moisture) onto the organic plant material, particularly tobacco material, fed for the processing. The material, without the contact with a moist gaseous agent, particularly steam, may be advantageously subjected to the influence of hot dry air (streams 11, 12 in Fig. 3), whereby the temperature (internal energy) of the organic plant material, particularly tobacco material, fed for the processing, increases, simultaneously allowing for the removal of the residual layer of the surface moisture, remained after the previous processing, without creating any additional disadvantageous layer of surface moisture.

[0026] Due to the contact between the comminuted, usually fibrous and swirled organic plant material, particularly tobacco material, fed for the processing and the stream of the gaseous medium 11, 12, for example air, the material fed for the processing is defibred (deagglomerated), whereby the uniformity of the expanding and/or drying process of individual particles of the material is increased significantly. Also, the expenditure of energy is reduced significantly due to this solution, by eliminating a portion of energy necessary for removing the useless surface moisture, i.e., the efficiency of the process is increased.

[0027] Furthermore, the gaseous medium PG is sucked off via the opening 5A and the channel 13A, taken between the vanes 3 of the feeder 4 from the processing zone 9. The processing gas PG is removed from the feeder 4 via the opening 5A situated radially, as shown in Fig. 3, by the gas 11 delivered from outside, preferably air taken from the environment, delivered through the channel 13 and the opening 5, and then removed via the opening 5A and the channel 13A for optional further processing outside the feeder 4, for example for recovering thermal energy (enthalpy) from the waste stream of gas 11A. As a consequence, obtaining these effects allows for shorter staying of the organic plant materials, particularly tobacco materials, within the expanding and/or drying zone, and this in turn allows for the reduction of the dimensions of the drying channels and the whole jet dryer. Moreover, one gains a significant increase of the watt-hour efficiency of the expanding and/or drying process of organic plant materials, particularly tobacco materials.

Claims

1. A method of increasing the efficiency of the expanding and drying process of organic plant materials, particularly in a jet dryer used for comminuted organic plant materials, particularly comminuted tobacco materials, working with the use of a gaseous expanding and/or drying agent under a working absolute pressure in the range from 2.5 kPa to 10 MPa, the gaseous processing expanding and/or drying agent being preferably overheated steam, **characterized in that,** during transporting the material (1) from the feeding zone (6) to the zone (9) of contact with the expanding and/or drying agent, a feeder, preferably a rotary vane feeder (4) is flushed, preferably in a continuos manner, with a gaseous medium (11, 12), which is capable of absorbing moisture, under an absolute pressure in the range from 2.5 kPa to 10 MPa, the temperature of the gaseous medium (11, 12) being preferably in the range from 50 to 200°C, and residues of the processing gas are removed from the rotary vane feeder (4).

2. A method according to claim 1, **characterized in that** the transported material (1) is heated up in the direct contact with the stream of the gaseous medium (11, 12), and residues of the surface moisture are removed from the surface of the material (1).

3. A method according to claim 1 **characterized in that** the transported material (1) is saturated by means of the stream of the gaseous medium (11, 12).

4. A method according to claim 1 or 3 **characterized in that** defibering process of the material (1) is carried out by means of the stream of the gaseous medium (11, 12).

5. A feeder for increasing the efficiency of the expanding and drying process of organic plant materials, particularly in a jet dryer used for comminuted organic plant materials, particularly comminuted tobacco materials, having vanes rotating within a housing, **characterized in that** openings (5, 7) are formed in the housing of the feeder (4), delivering a gaseous medium to the moving spaces between vanes (3) as well as openings (5A, 7A) leading out the gaseous medium from the moving spaces between the vanes (3), the openings (5, 7, 5A, 7A) being arranged respectively in the walls of the housing of the feeder (4).

6. A feeder according to claim 5 **characterized in that** the openings (5, 7) as well as the openings (5A, 7A) are oblong and are arranged radially, and their longitudinal axes are perpendicular to the inlet and outlet axis of the material (1).

7. A feeder according to claim 5 or 6 **characterized in that** the openings (7) as well as the openings (7A) are radially shifted relative to each other.

8. A feeder according to claim 5 **characterized in that** it is equipped with deflectors (2, 8) of the stream of the material.

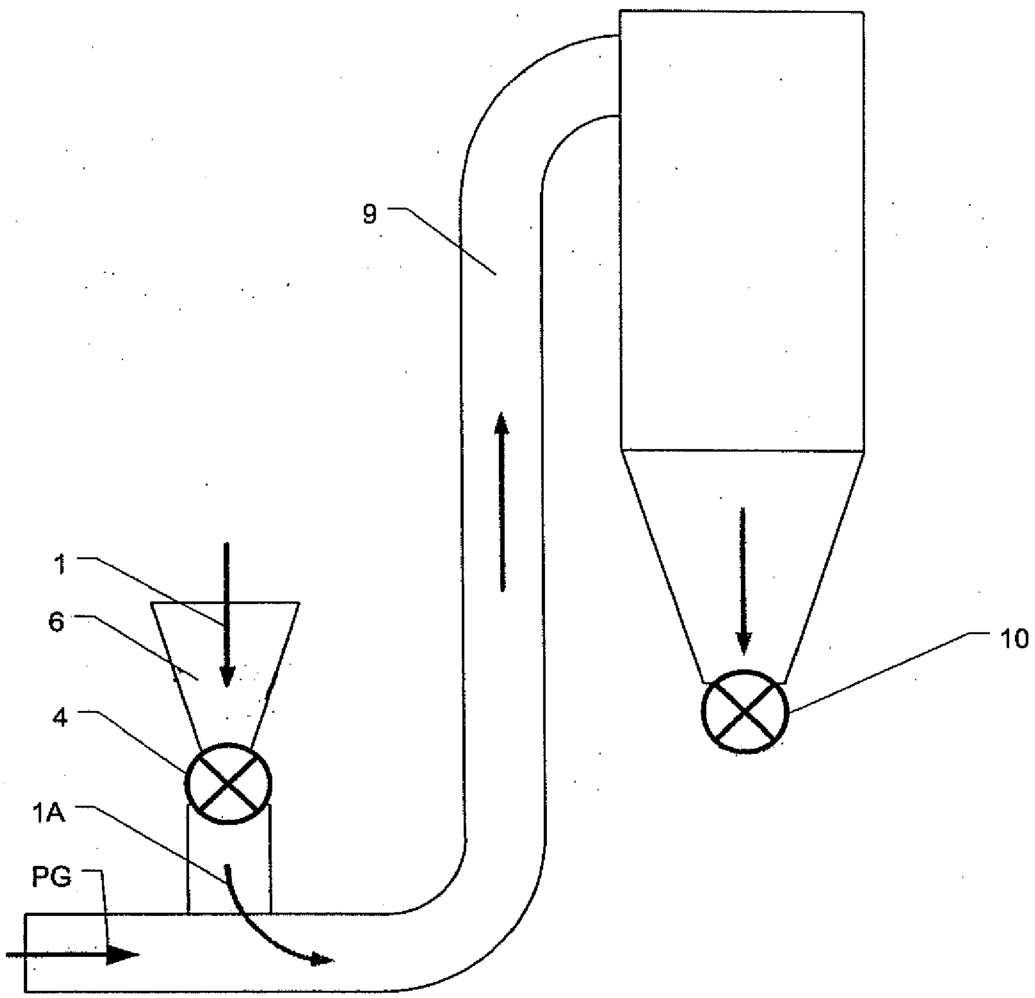

Fig. 1

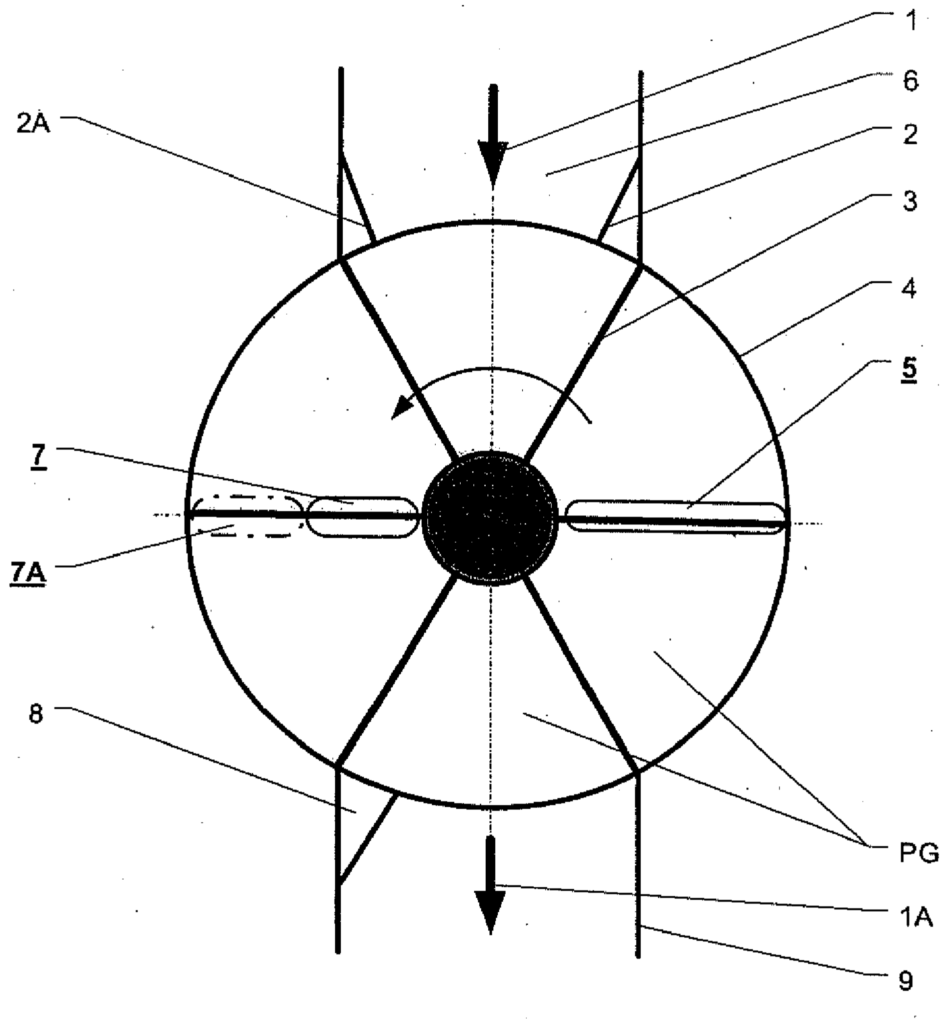

Fig. 2

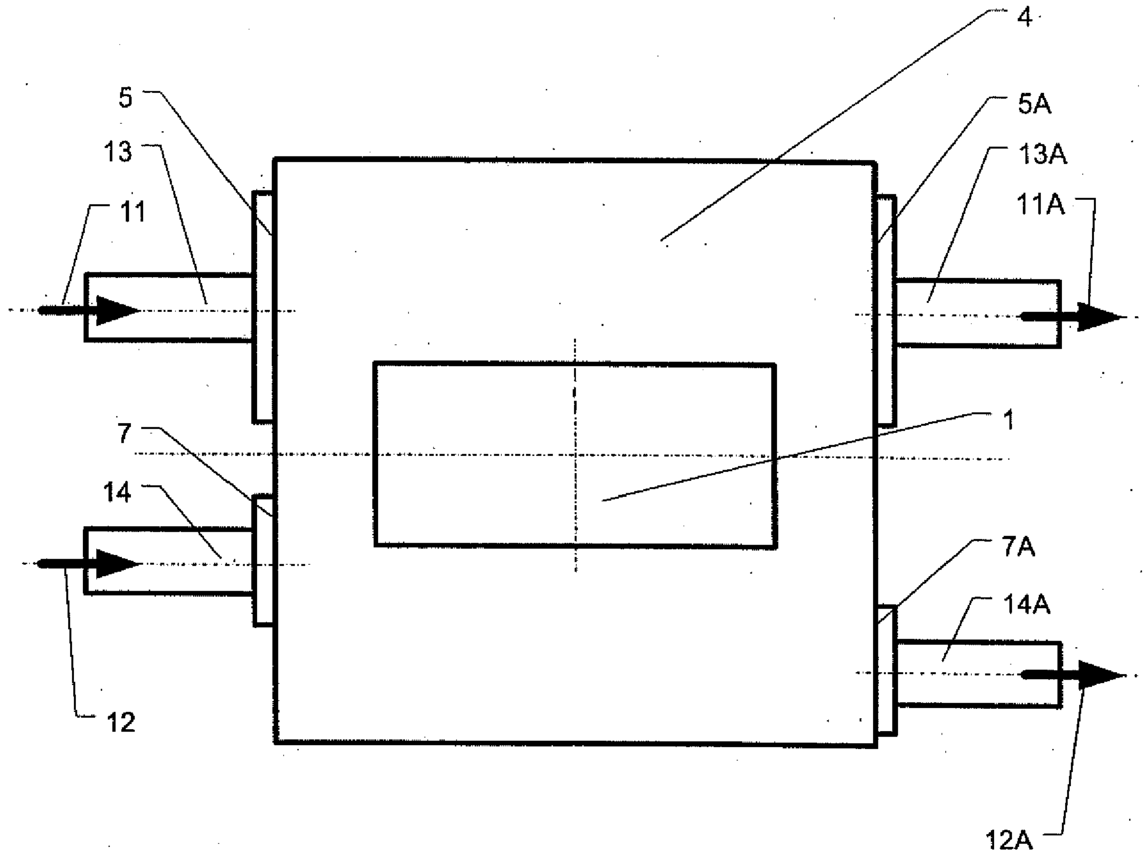

Fig. 3

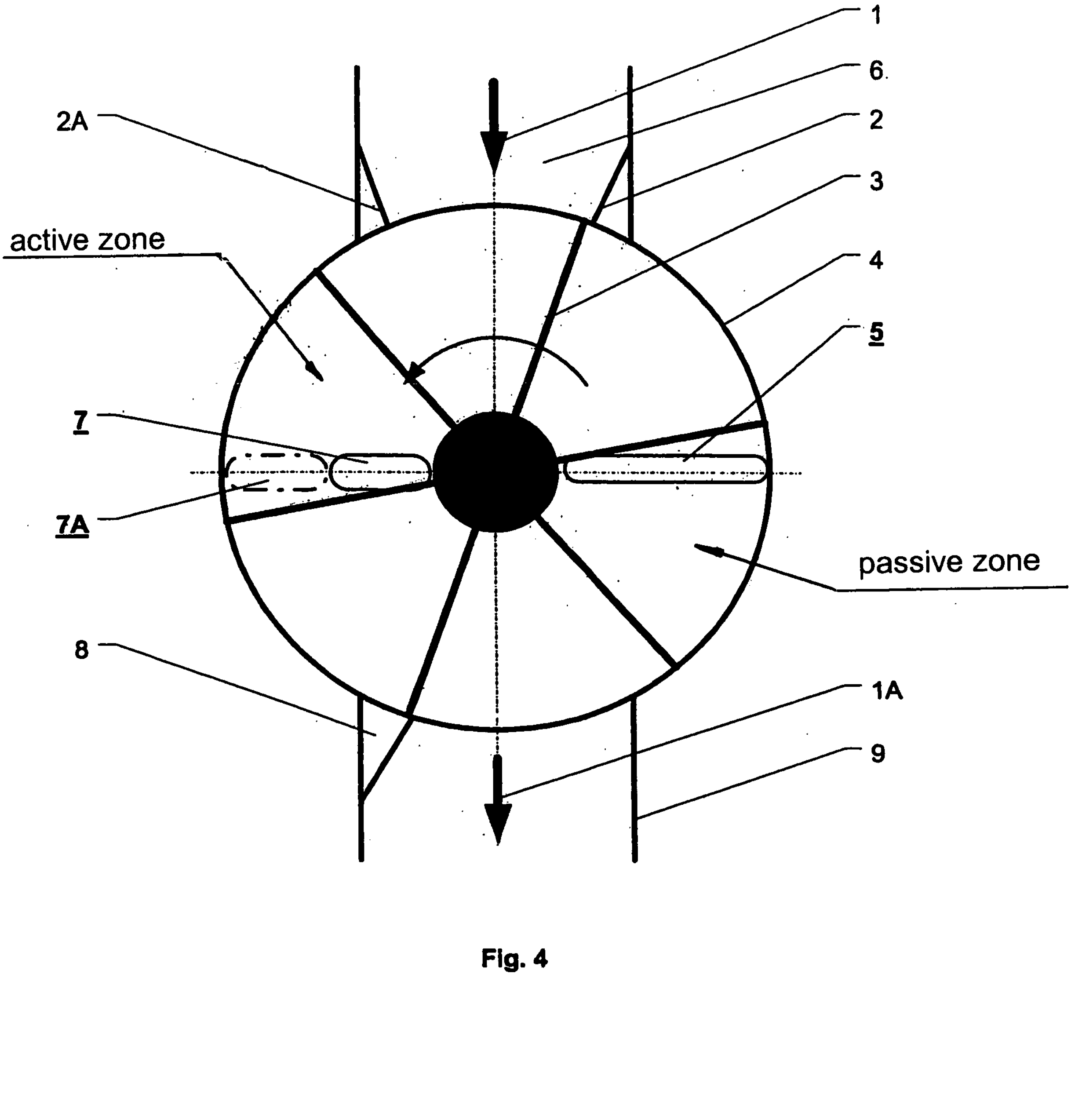

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 4389

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 January 2009	Marzano Monterosso

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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