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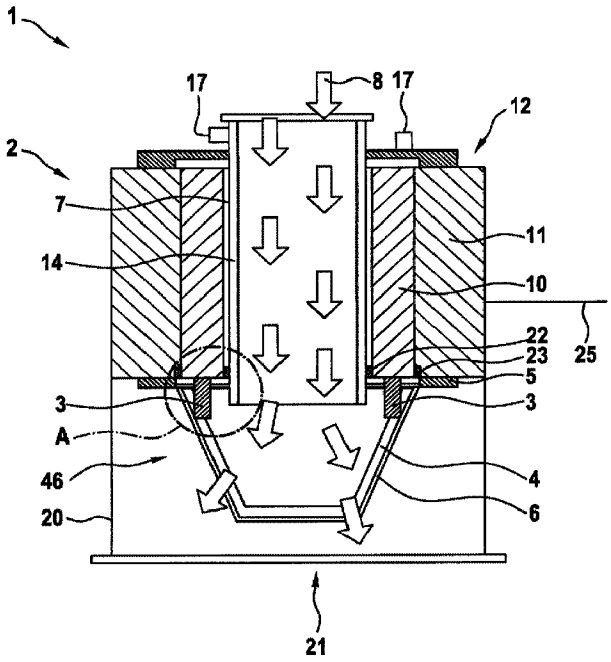
(54) **Titre : BROYEUR COAXIAL ET UNITE D'ALIMENTATION POUR BROYEUR**
(54) **Title: COAXIAL MILL AND FEED UNIT FOR A MILL**



(57) **Abrégé/Abstract:**
The invention relates to a mill (1) and to a feed unit (2) for a mill (1). The feed unit (2) comprises: a first interface (3) for holding a rotor (4) of a grinder (46), a second interface (5) for holding a stator (6) of the grinder (46), a feed pipe (7), which is arranged to feed material for grinding (8) into the grinder (46), and an annular rotary bearing (9) on the feed pipe (7) which is disposed in such a way that, in operation, material for grinding (8) enters the grinder (46) through the rotary bearing (9).

ABSTRACT

The invention relates to a mill (1) and to a feed unit (2) for a mill (1). The feed unit (2) comprises: a first interface (3) for holding a rotor (4) of a grinder (46), a second interface (5) for holding a stator (6) of the grinder (46), a feed pipe (7), which is arranged to feed material for grinding (8) into the grinder (46), and an annular rotary bearing (9) on the feed pipe (7) which is disposed in such a way that, in operation, material for grinding (8) enters the grinder (46) through the rotary bearing (9).

Description

Title

COAXIAL MILL AND FEED UNIT FOR A MILL

Background of the invention

The present invention relates to a mill and also to a feed unit for a mill. The present invention especially relates to a coaxial mill in which equipping and maintenance processes can be performed in a particularly simple and time-saving manner.

In current processes for producing granulates, mills are regularly used in order to eliminate irregularities in particle size distribution with regard to maximum grain size and/order to give wet granulates a structure. As a result, subsequent processes can be optimized or even made possible. For example, the grain size reduction for dry granulate is for the tabletting process or grain size reduction for wet granulate is in order to be able to dry this more quickly or to give this a structure for improving the drying, flowing and/or dosing capabilities.

The mills which are known in the prior art are added as accessory equipment to machines and apparatus (e.g. of manufacturing and/or production engineering) for producing granulates. Since these machines were developed and constructed for closed loading operation, these are provided with closable emptying and filling openings. These pieces of apparatus, on account of the material properties and the process requirements, are constructed and are to be operated so that explosion risks are reduced to a minimum and their effects do not constitute a risk for persons in the vicinity of the machine.

US 5,405,094 features a multistage mill in which two sieve units by means of rotationally driven agitating elements are used for the comminution of grinding stock. The agitating elements are driven via a shaft which is supplied with kinetic energy by means of a belt.

US 5,863,004 features a mill in which an agitating element, which is arranged on a sieve element, is moved by a downward disposed drive unit in order to force grinding stock through the sieve unit.

Common to the mills known in the prior art in this case is that large parts of the mill have to be taken apart in the event of a required exchange of the sieve units or in the event of an opening up of the grinding gear for clearing blockages, which is time consuming and therefore costly. Sometimes, an increased equipping time and also the process reliability of an entire plant can be disadvantageously influenced. Sometimes, mills of the prior art require additional consoles and sliding or swiveling devices in order to bring the mills into working position, to equip them (e.g. sieve change, rotor sieve tools), to clean them and to maintain them. Moreover, in the case of the known solutions the grinding stock (product), in the case of a mill drive which is arranged upstream in the flow direction, flows from the top over the drive rod which therefore impedes the product flow on the inlet side. Also, in the case of solutions with a drive which is connected downstream in the flow direction, the product outflow in the downward direction is impeded by the angular gear and the sieve and rotor can only be maintained or exchanged from the top (after disassembly of the product feed pipe). The same applies to the clearing process of a blockage of the mill and also to cleaning and inspection processes. It is therefore an object of the present invention to alleviate or to eliminate the aforesaid disadvantages.

Disclosure of the invention

The previously identified object is achieved according to the invention by means of a mill and a feed unit for a mill. The feed unit serves for the feed of grinding stock in the direction of the grinding gear. According to the invention, a first interface is provided for the mounting of a rotor of a grinding gear. The rotor forms the moved components of the grinding gear. A second interface is provided for the mounting of a stator of the grinding gear which in conjunction with the rotor effects the comminution of the grinding stock by means of a relative movement between the rotor and the stator. Provision is furthermore made for a feed pipe which is designed to conduct grinding stock into the grinding gear. According to the invention, provision is made on the feed pipe for an annular rotary bearing which enables a relative rotation between the feed pipe and a further component of the mill. As a result of the annular shape, the rotary bearing can be arranged on the feed pipe in such a way that during operation the grinding stock makes its way into the grinding gear through the rotary bearing. In other words, the annular rotary bearing encompasses at least one part of a free cross section of the feed pipe so that the grinding stock is delivered through the "eye" of the rotary bearing and through the feed pipe. All the grinding stock is preferably brought into the grinding gear through the rotary bearing. In this way, the geometry of the grinding gear can be exceptionally favorably designed in common with its attachment and accessibility for equipping and maintenance purposes, as a result of which the downtimes of a mill which is designed according to the invention can be reduced.

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The rotary bearing can for example be designed as a rolling bearing or as a plain bearing. In other words, rolling bodies can roll between an inner and an outer or an upper and a lower race of the bearing in order to enable a particularly low friction force in the case of high pressure forces to be transmitted. Such a rolling bearing can be designed as a roller bearing or as a ball bearing. The plain bearing can have material combinations with a particularly low sliding friction coefficient (e.g. nylon and metal), wherein the sliding friction coefficient can be further reduced by the use of lubricants.

The rotary bearing can for example be arranged between the first interface for the mounting of the rotor of the grinding gear and the feed pipe. In this way, the feed pipe can be statically mounted and the rotor can be rotationally arranged around the feed pipe.

Alternatively, the feed pipe can be rotationally designed on its own and connected to the rotor of the grinding gear in a rotation-resistant manner. In this case, the annular rotary bearing is arranged between the feed pipe and a fixed component of the mill or another fixed structure (for example a feed pipe which is arranged upstream). In this case also, the grinding stock is transported into the grinding gear through the rotary bearing.

Alternatively or additionally, the rotary bearing can be arranged between the second interface for the mounting of the stator of the grinding gear and the feed pipe. In this case also, the feed pipe of the feed unit according to the invention can execute a rotational movement in relation to the stator of the grinding gear, whereas it is arranged on the rotor of the grinding gear in a rotation-resistant manner.

The second interface for the mounting of the stator of the grinding gear can be arranged in a mechanically rotation-resistant manner and coaxially to a stator of an electric machine via which the grinding gear can be (for example electrically) driven. In this way, force transmission by means of a belt or a chain can be dispensed with, as a result of which energetic losses and additional installation space for the force transmission can be saved.

The first interface for the mounting of the rotor of the grinding gear can be connected via a belt drive or a chain to a rotor of an electric machine, the shaft of which is arranged in the main axially parallel to the grinding gear. As an alternative to an electric machine, a hydraulic or pneumatic drive method can be provided for the machine. In this way, the actual feed unit can be designed in a particularly compact and volume-optimized manner, whereas the electric drive can be arranged at another position in the production area. In this way, maintenance or exchange of the electric machine can also gain benefit.

The feed pipe can have an axially extended passage by means of which a fluid can be conducted to outlets which are arranged in the region of the grinding gear. For example, the feed pipe can be designed as a double-walled hollow wall pipe so that the fluid can be conducted between an inner and an outer wall into the grinding gear. The fluid can for example comprise a gas and/or a liquid. In this way, cleaning of the mill which is designed according to the invention is simplified by no disassembly of parts of the feed unit being required for flushing.

Alternatively or additionally, a fluid can also be introduced between the feed pipe and the first interface for the mounting of the rotor of the grinding gear, for which a connection can be

arranged in a region of the feed unit which is upstream in relation to the grinding stock flow. In this case, a fluid feed (a hose or the like) can be connected when required or a permanently connected hose can be supplied with pressurized fluid. In this way, for example the effect of grinding stock penetrating between the feed pipe and a rotating part of the feed unit and leading to contamination or mechanical problems can be prevented.

Additionally or alternatively, mixing elements, dispersion elements, loosening elements, delivery elements can be fastened on the rotor/stator system in the feed unit in order to break up clumps of the raw material or product bridges or to improve the product flow (grinding stock), for example.

Fluid (e.g. a gas) can be optionally used for example in order to support product transportation when the mill is used in a pneumatic conveyor.

Furthermore, a fluid (e.g. an inert gas) can optionally be used for example in order to gas the mill interior and therefore to reduce the oxygen proportion so that the risk of an explosion can be reduced.

Furthermore, a fluid (e.g. a liquid) can preferably be used in order to wet the product to be ground before its feed into the grinding gear. This can for example improve the flow capability and/or the service life of the grinding gear.

Proposed according to a second aspect of the present invention is a mill which for example can be designed as a process mill in production engineering. The mill can alternatively or additionally be designed as a wet mill or as a wet and dry mill for processing granulates. In other words, the mill can be designed for the processing of three phase components (solid,

liquid and gas). It comprises a rotor of a grinding gear and a stator of a grinding gear which when interacting bring about a predetermined comminution of grinding stock. The rotor is arranged on the first interface and the stator is arranged on the second interface of a feed unit, as has been described in detail in association with the first-mentioned inventive aspect. Accordingly, a mill according to the invention is constructed by mounting a rotor and a stator of a grinding gear on a feed unit according to the invention. Naturally, additional parts (e.g. for closing off a feed opening for grinding stock and/or for closing off a discharge opening for grinding stock and/or other elements (e.g. dispersion elements for breaking up clumps, product bridges)) or delivery elements can be included.

The first interface for the mounting of the rotor of the grinding gear can for example enable a screwed connection between the rotor and a further component of the feed unit. Alternatively or additionally, a bayonet connection can be provided between the rotor and the additional component of the feed unit. Alternatively or additionally, a snap-in connection/latched connection, a clamp connection or even a thread which encompasses an opening of the feed unit can be provided in the rotor of the grinding gear in order to enable a reversible and yet fixed installation of the rotor on the feed unit. The same applies to the stator of the grinding gear and to its connection to a second component of the feed unit according to the invention.

The rotor and the stator of the grinding gear, as correspondingly constructed sieve elements, can be provided with openings and/or cutting edges. For example, its enveloping surface can be of truncated cone design. As a result of the installation according to the invention, the possibility especially arises of also using the entire sieve surface of the grinding gear, which is oriented vertically to the longitudinal

axis of the feed pipe, for product comminution since in this case there needs to be no provision for a drive shaft or the like.

Brief description of the drawings.

Exemplary embodiments of the invention are described in detail below with reference to the accompanying drawings. In the drawings:

Figure 1 shows a schematic side view of an exemplary embodiment of a mill designed according to the invention with an exemplary embodiment of a feed unit designed according to the invention;

Figure 2 shows a schematic side view of an alternative exemplary embodiment of a mill designed according to the invention with an alternative exemplary embodiment of a feed unit designed according to the invention;

Figure 3 shows a schematic side view of an alternative exemplary embodiment of a mill designed according to the invention with an alternative exemplary embodiment of a feed unit designed according to the invention;

Figure 4 shows a schematic side view of an alternative exemplary embodiment of a mill designed according to the invention with an alternative exemplary embodiment of a feed unit designed according to the invention;

Figure 5 shows a schematic side view of an alternative exemplary embodiment of a mill designed according

to the invention with an alternative exemplary embodiment of a feed unit designed according to the invention, comprising a belt drive and a separate electric machine for driving the mill;

Figure 6 shows a schematic side view of an alternative exemplary embodiment of a mill designed according to the invention with an alternative exemplary embodiment of a feed unit designed according to the invention; and

Figure 7 shows a detailed view illustrating possible embodiments of the first and second interfaces and also seals and fluid passages.

Embodiments of the invention

Figure 1 shows an exemplary embodiment of a mill 1 according to the invention which has a feed unit 2 according to the invention. The feed unit 2 has a first bayonet connection 3 as a first interface for the mounting of a rotor 4 of a grinding gear 46. The first bayonet connection 3 is arranged on a rotor 10 of an electric machine 12 which is encompassed by a stator 11 of the electric machine. Arranged on the stator 11 of the electric machine 12 is a second bayonet connection 5 as a second interface for the mounting of the stator 6 of the grinding gear 46. Seals 22, 23, which prevent ingress of grinding stock 8 into the spaces above the seals 22, 23, are arranged in the region of the grinding gear both between the rotor 10 and the stator 11 and between the feed pipe 7 and the rotor 10. The grinding stock 8 makes its way via a statically arranged filling pipe 18 into the feed pipe 7 of the feed unit 2 according to the invention. On the inlet side, the feed pipe 7 is provided with a flange which has an annular rolling bearing 9b between it and the filling pipe 18. In this way, the feed pipe 7 can rotate in

relation to the filling pipe 18. Also on the inlet side, provision is made for a guide 19 for the feed pipe 7 which on the other side is fastened on the stator 11 of the electric machine 12. The guide 19 can butt against the feed pipe 7 with sliding capability. Providing an annular rotary bearing 9a is arranged between the feed pipe 7 and the rotor 10 of the electric machine 12, the guide 19 can also be fixedly connected to the feed pipe 7 and the inlet-side annular rotary bearing 9b can be dispensed with since now the feed pipe 7 can be of fixed design. On the outlet side, the mill 1 according to the invention is provided with an outlet pipe 20 which is fixedly connected to the stator 11 of the electric machine 12. An outlet opening 21 is of explosion-proof design in order to protect men and materials if required. Via a control unit 24 and a control line 25, the electric machine 12 can be supplied with electric energy in line with demand.

Figure 2 shows an alternative exemplary embodiment of the mill 1 which is represented in Figure 1 so that only the essential differences of the mill 1 shown here are detailed below. In order to avoid blockages and an overload of the electric machine 12, a feed control in the form of an operating element 27 or 27' is provided. The operating element 27, as a pivotable flap similar to a throttle valve, is arranged in the filling pipe 18 and can be motor-driven by means of a control unit 24 via a control line 26.

The control unit 24 is also connected to the electric machine 12 by means of a control line 25 (as described above). If the control unit 24 detects that an energy demand of the electric machine 12 is increasing, it can bring the operating element 27, via the control line 26, into the position of the operating element 27', as a result of which the quantity of inflowing grinding stock 8 is reduced and the load of the electric machine 12 is reduced. Correspondingly, in the case of a reduced load

state of the electric machine 12, the operating element 27' can be brought back into the position of the operating element 27 in order to increase the flow of grinding stock 8 again and to adapt the grinding gear quantity processed per time unit to the capacity of the electric machine.

Figure 3 shows an alternative exemplary embodiment for the mill 1 which is shown in Figure 2. To be seen in this case is an alternative embodiment of the operating element 27 which as a cell wheel or cell wheel sluice 27 is arranged inside a circular shell structure. If the cell wheel or the cell wheel sluice 27 rotates more quickly, more grinding stock 8 is delivered from the filling opening 18 into the feed pipe 7. The controlling ensues in accordance with that described in association with Figure 2.

Figure 4 shows an embodiment of the mill 1 shown in Figures 1 to 3 which is modified with regard to the grinding stock dosing (operating element 27). The operating element 27 is designed as a circular membrane which can hydraulically or pneumatically effect a tapering of the free cross section of the filling pipe 18. If the fluid pressure behind the membrane 27 is reduced, the membrane assumes the position of the membrane 27'. If the fluid pressure behind the membrane 27' is then increased again, the position of the membrane 27 ensues once more. The depicted exemplary embodiment, when pulsing fluid pressures are used for moving the membrane 27, 27', enables an additional advantage which is described as follows. Without changing the free cross section inside the filling pipe 18, pulsing fluid pressures can counteract a blockage of the filling pipe 18 without actuation by means of a control unit 24 (corresponding to Figures 2 and 3) being necessary.

Figure 5 shows an exemplary embodiment of a mill 1 according to the invention, in which the electric machine 12 is arranged in a

radially offset manner to the axis of the feed pipe 7. For mechanical energy transmission, use is made of a belt drive 13 which rotationally drives the first interface 3 for the mounting of the rotor 4 of the grinding gear 46. The stator (not shown) of the electric machine 12 is in its turn connected in a mechanically rotation-resistant manner to the stator 6 via the second interface 5 for the mounting of said stator 6 of the grinding gear 46.

Figure 6 shows a modified exemplary embodiment, based on the exemplary embodiments of Figures 1 to 4, in which the feed pipe 7 is designed as a hollow-wall double pipe. In this way, a fluid passage with circular cross section, which is extended parallel to the flow direction of the grinding stock 8, is created between an inner and an outer wall. Connections 17 are provided for introducing fluid into the fluid passage 14 and also into the space between the rotor 10 of the electric machine 12 and the outer wall of the feed pipe 7. In the last-named space, an overpressure, which prevents an inadvertent ingress of grinding stock 8, is therefore created. The use of the flow passage 14 is explained in association with the detailed view in Figure 7 which shows in an enlargement the region A which is highlighted by dash-dot lines.

Figure 7 shows an enlarged view of the region A, marked in Figure 6, in which are provided the first and second interfaces 3, 5 for the mounting of the grinding gear 46 in the form of screwed connections. At the lower end of the feed pipe 7, provision is made for two outlets 16 for fluid 15 by means of which the grinding gear 46 can be flushed. Also, the path of the fluid 15 which flows between the feed pipe 7 and the rotor 10 of the electric machine 12 along the seal 22 is illustrated by means of an arrow.

The present invention enables a particularly compact type of construction and consequently savings with regard to overall height and required mechanical interfaces. As a result of this, a considerable cost reduction of the construction, of the parts and of maintenance/equipping of the mill according to the invention compared with arrangements which are known in the prior art can be achieved. A torque drive with almost constant torque over the rotational speed can be used for driving the grinding gear. Moreover, the operation can be optimized by means of a transfer of vibrations to the housing, to the sieve insert and to the sieve rotor (grinding gear).

CLAIMS:

1. A feed unit for a mill comprising
- a first interface for the mounting of a rotor of a grinding gear,
- a second interface for the mounting of a stator of the grinding gear,
- a feed pipe which is designed to conduct grinding stock into the grinding gear, and
- an annular rotary bearing on the feed pipe which is arranged in such a way that during operation grinding stock makes its way into the grinding gear through the rotary bearing,
- wherein

  the feed pipe has an axially extended passage for conducting a fluid to outlets which are arranged in the region of the grinding gear, and/or

  the feed unit further comprises a connection for conducting a fluid between the feed pipe and the first interface for the mounting of the rotor of the grinding gear.

2. The feed unit as claimed in claim 1, wherein
- the rotary bearing is a rolling bearing or a plain bearing, and/or
- provision is furthermore made for a mixing element and/or a dispersion element and/or a loosening element and/or a delivery element for processing the grinding stock in the feed unit.

3. The feed unit as claimed in either of claims 1 and 2, wherein the rotary bearing is arranged between the first interface for the mounting of the rotor and the feed pipe.

4. The feed unit as claimed in any one of claims 1 to 3, wherein the rotary bearing is arranged between the second interface for the mounting of the stator and the feed pipe.

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5. The feed unit as claimed in any one of claims 1 to 4, wherein the first interface for the mounting of the rotor of the grinding gear is connected in a mechanically rotation-resistant manner and coaxially to a rotor of an electric machine.

6. The feed unit as claimed in any one of claims 1 to 5, wherein the second interface for the mounting of the stator of the grinding gear is connected in a mechanically rotation-resistant manner and coaxially to a stator of an electric machine.

7. The feed unit as claimed in any one of claims 1 to 4, wherein the first interface for the mounting of the rotor of the grinding gear is connected via a belt drive or a chain to a rotor of an electric machine.

8. A mill, comprising
- a rotor of a grinding gear, and
- a stator of a grinding gear, wherein
- the rotor is arranged on the first interface and
- the stator is arranged on the second interface of a feed unit, as claimed in any one of claims 1 to 7.

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Fig. 1

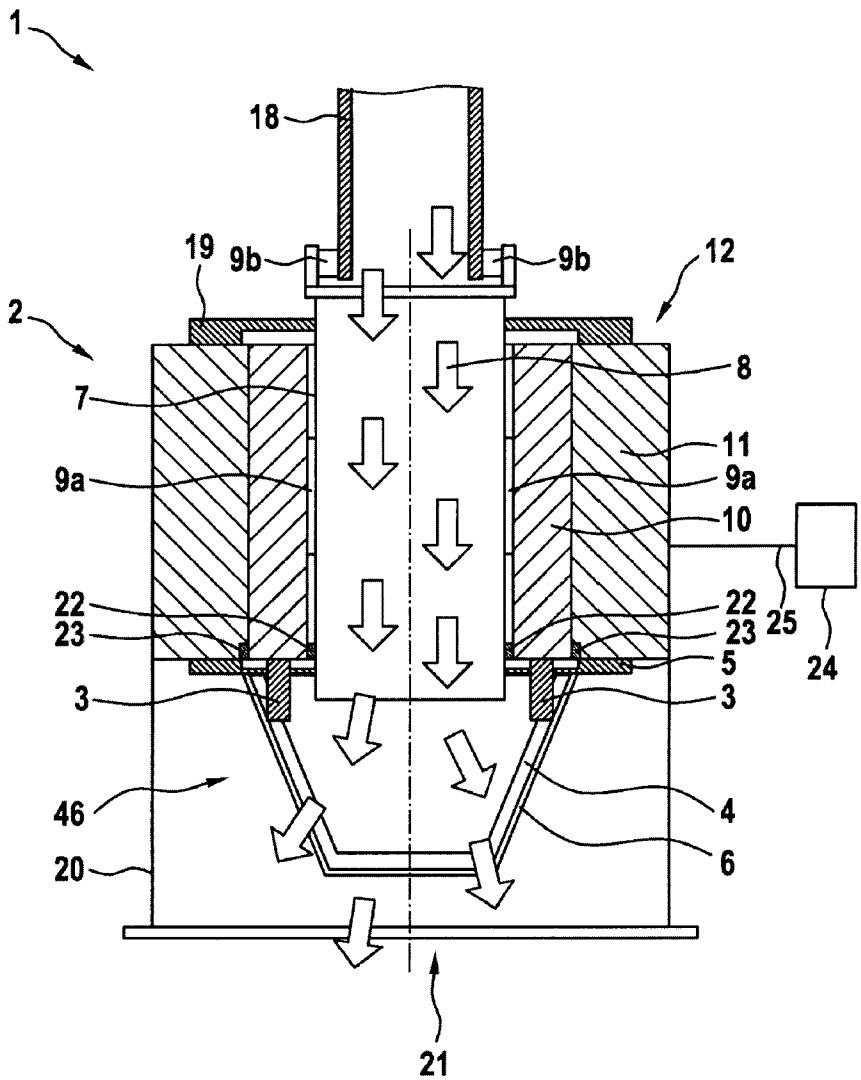


Fig. 2

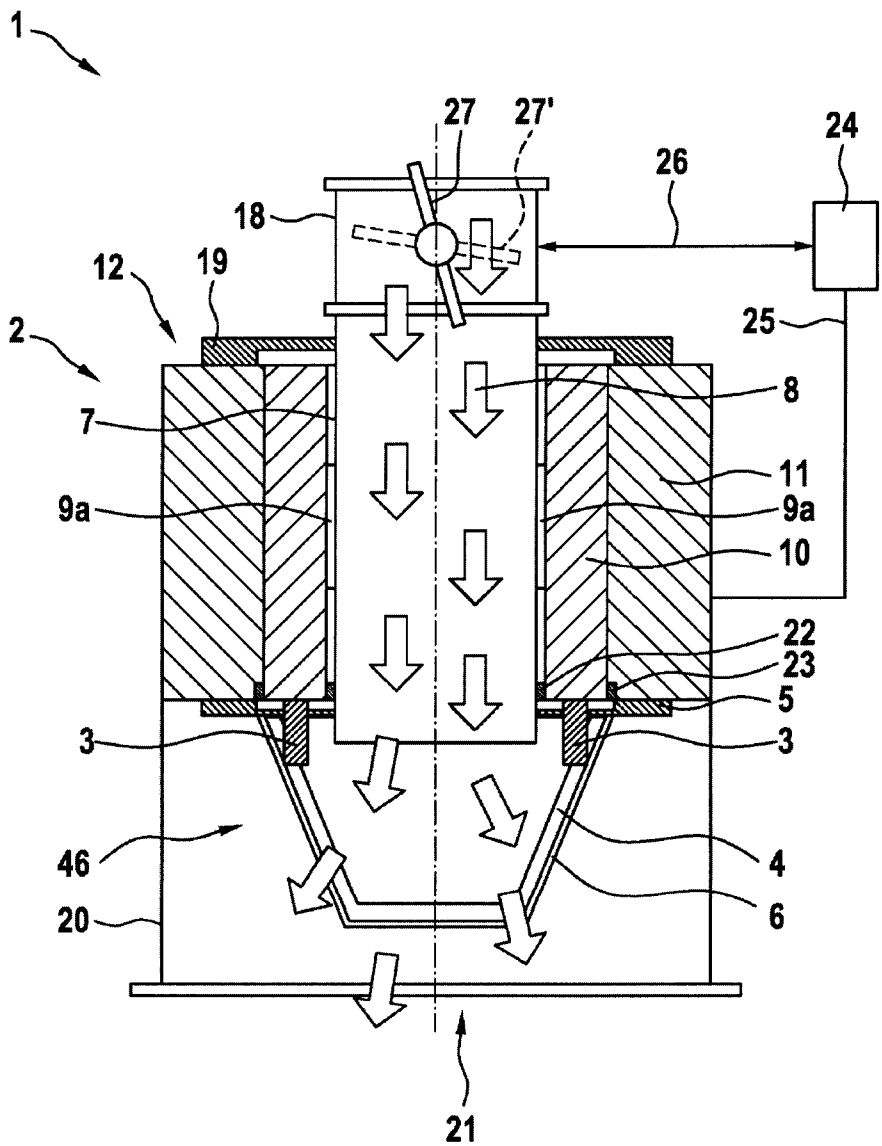


Fig. 3

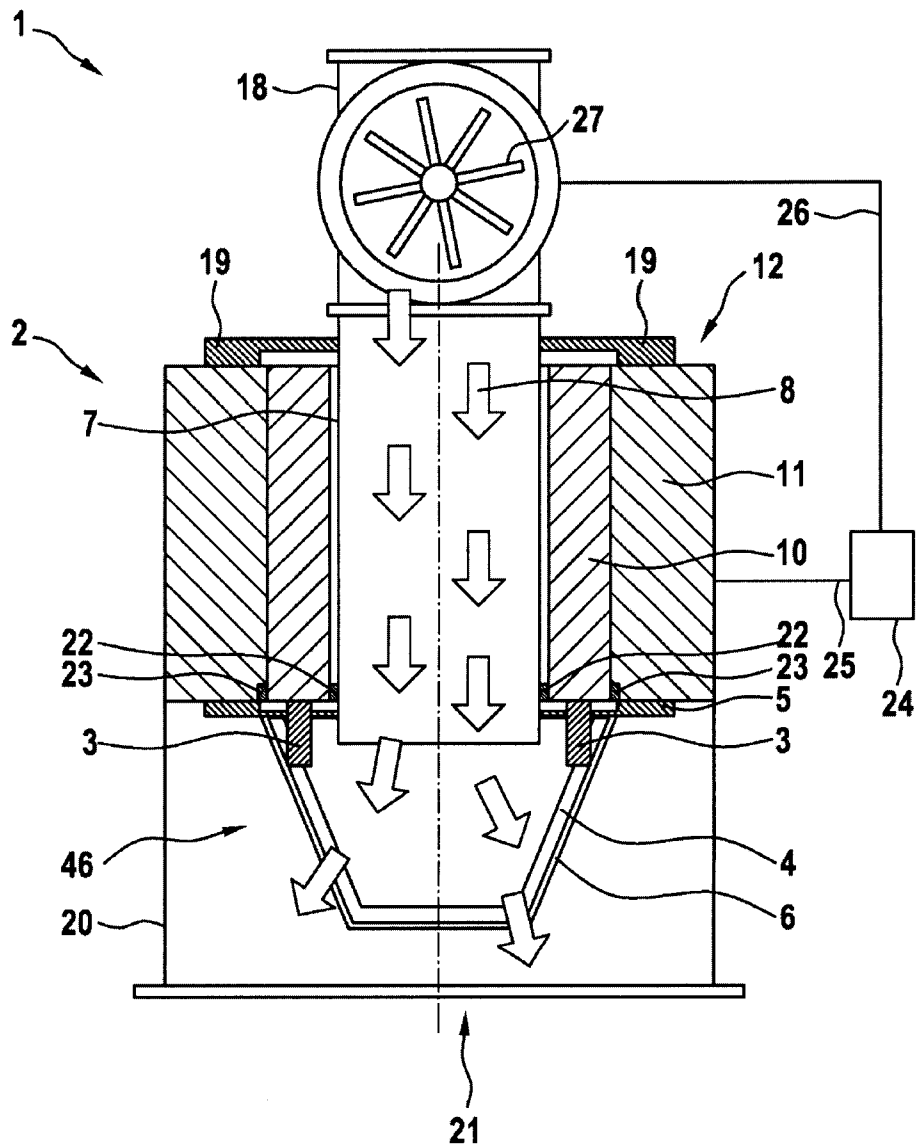
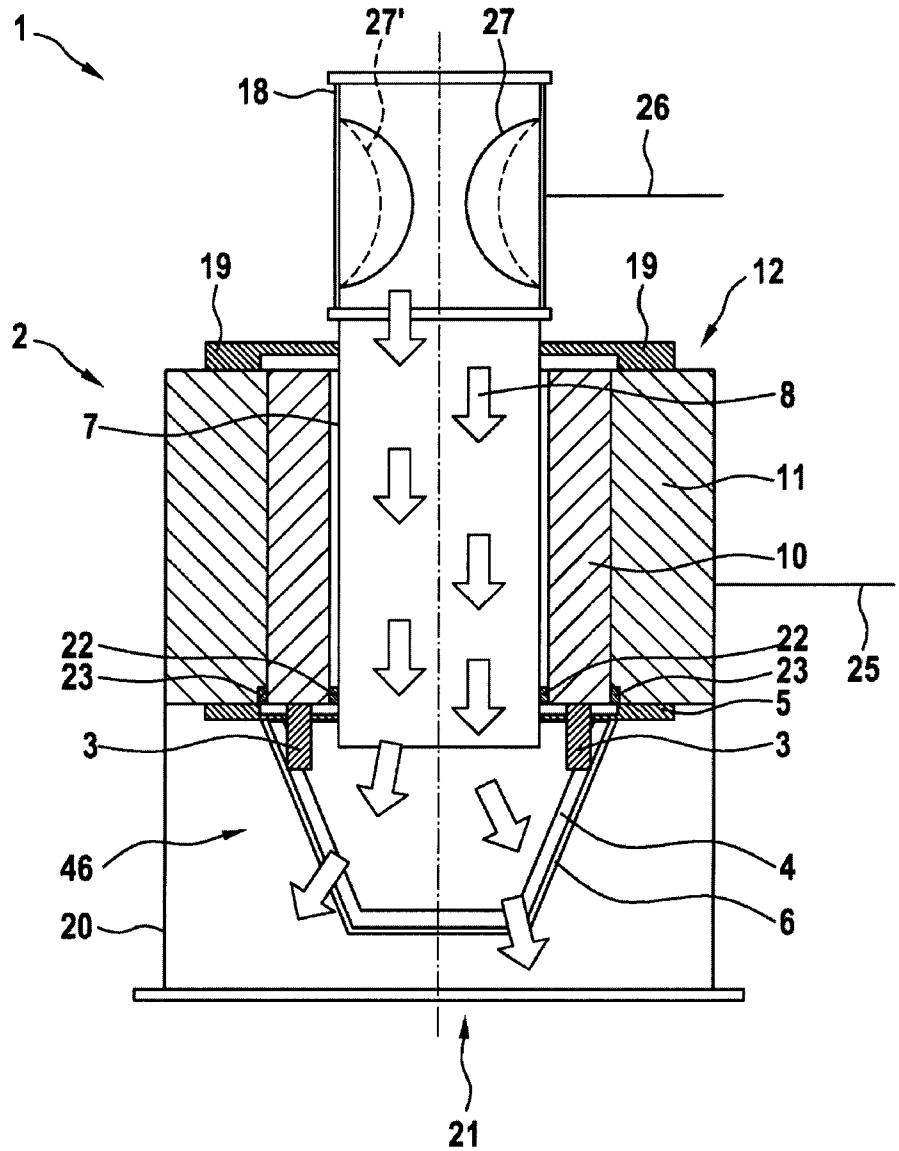


Fig. 4



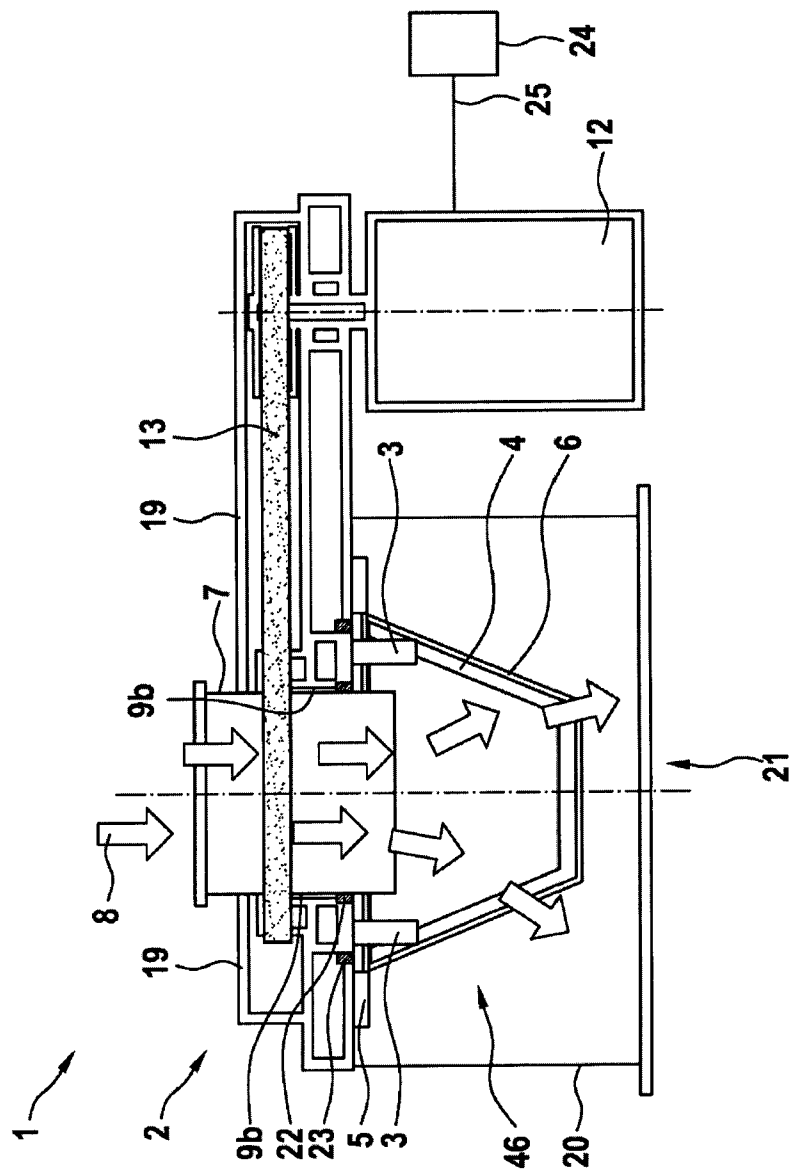


Fig. 5

Fig. 6

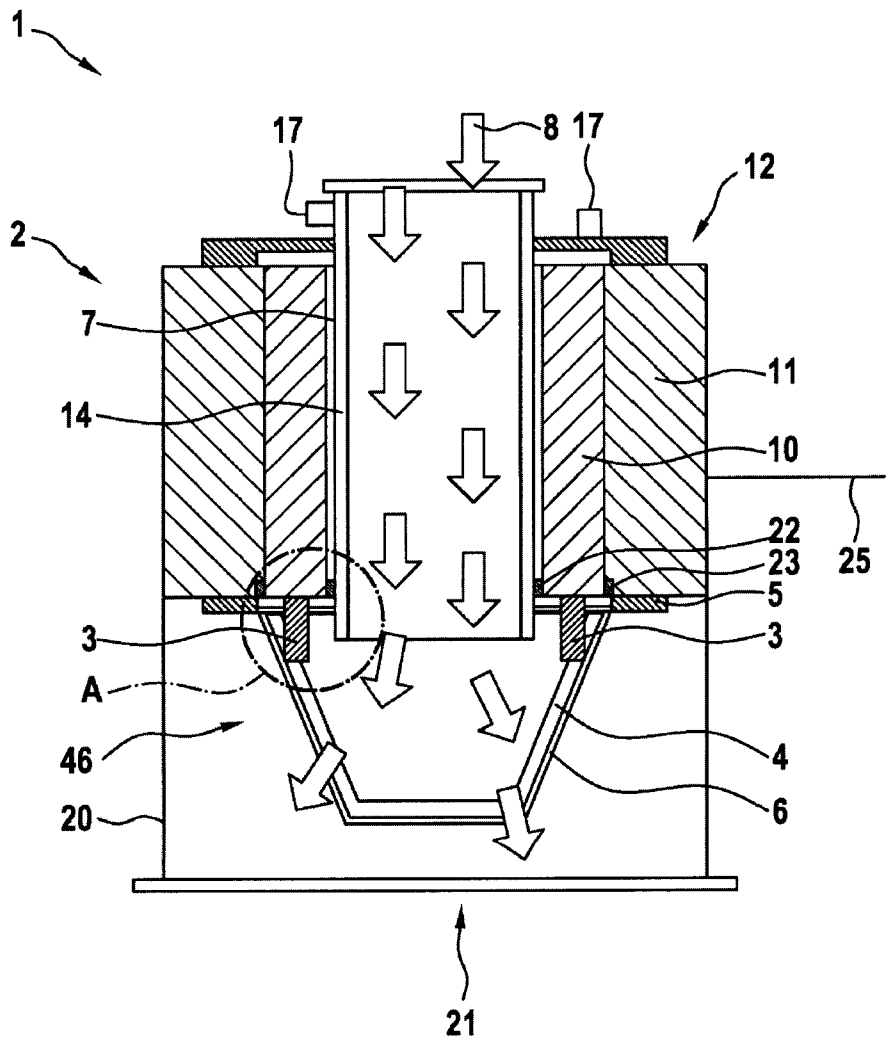
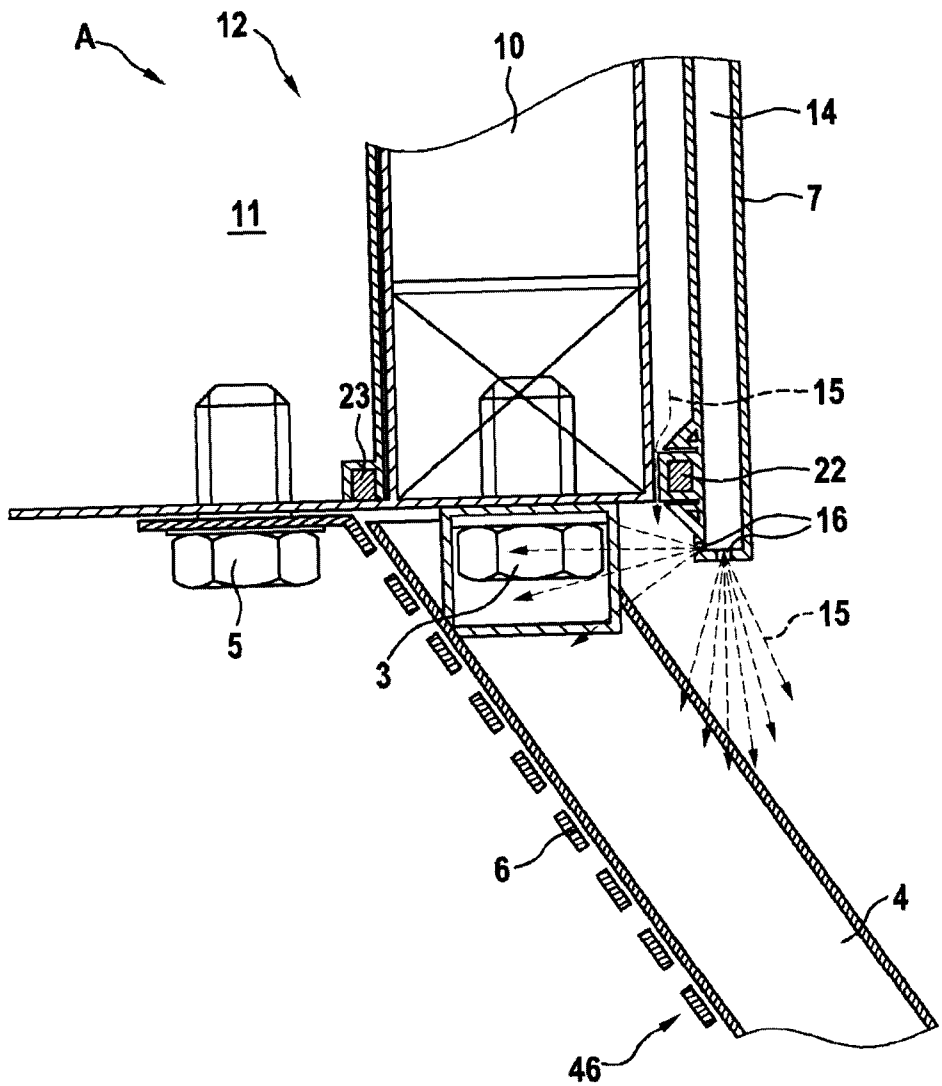
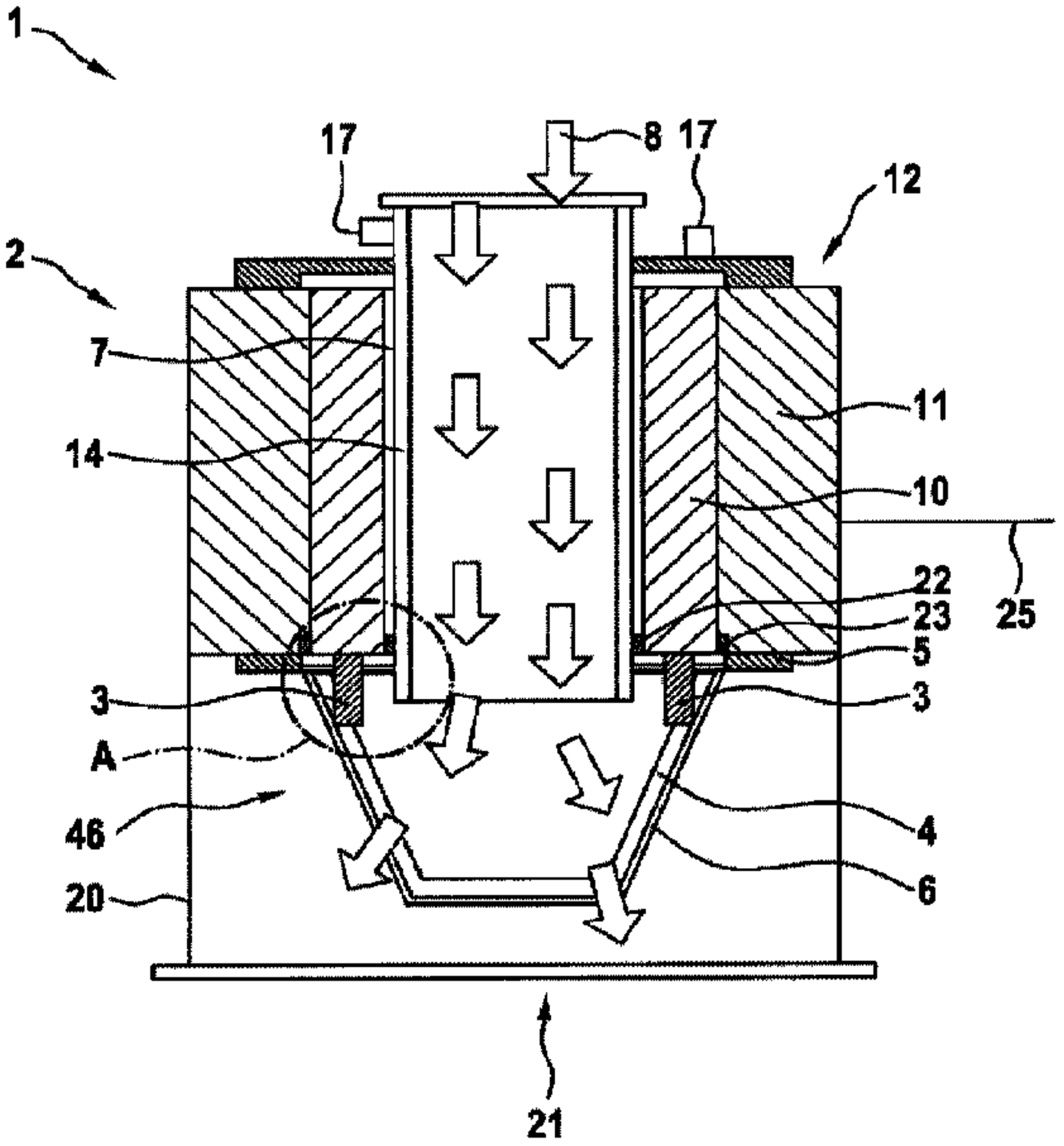


Fig. 7

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