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- (54) **Berendezés és eljárás gázokban levő egyedi összetevők abszorpciójára**

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

System and method for the absorption of individual components in gases

Description

The subject matter of this invention is formed by a plant for the absorption of individual components (e.g. pollutants or recyclable materials) in gases, in which an absorption solution is brought into contact with the gas in an absorption chamber. The absorption solution in this case is introduced into the absorption chamber via spray nozzles, wherein the absorption chamber, above a feed opening for the gas, has a gas distribution plane, via which turbulences and/or vortexes in the supplied gas stream are caused.

The invention also relates to a method for the absorption of pollutants in gases.

In many industrial processes, in particular in combustion processes, waste gases and exhaust air are formed which contain acid components such as sulphur dioxide (SO₂), hydrochloric acid (HCl), hydrogen fluoride (HF) and/or nitrogen oxides (NO, NO₂), which, on account of the harmfulness thereof to the ecosystem, are termed pollutants, or else recyclable materials, such as, e.g. metal oxides, which are transferred into a gaseous state by the treatment process.

For the protection of the environment, therefore, legal requirements for permissible limiting values of substances in exhaust gases have been decreed. In order that these limiting values can be maintained, in many cases, purification of the exhaust gases is required.

Various technologies are known from the prior art for what is termed wet exhaust gas treatment that are already used industrially. In these methods in the power plant sector, an absorption solution is used for separating off pollutants (SO₂, HCl, HF). Usually, these are a calcium sorbent (limestone, burnt lime and lime hydrate). These calcium compounds are mixed with water and are thereafter a suspension and are brought into contact with the acid gases present in the flue gas in an absorption chamber in such a manner that the absorption of the pollutants from the gaseous phase to the liquid phase can take place. The acid pollutants absorbed into the liquid phase are thereafter dissolved in ionic form and react with the calcium ions of the lime sorbent that are dissolved in the suspension.

The resultant reaction products, depending on the further process procedure, can remain dissolved in the suspension, in the event of corresponding supersaturation form crystals and ultimately even precipitate out in solid form. The predominant pollutant in exhaust gases from the power plant sector, in particular in oil- and coal-fired combustion processes, is sulphur dioxide SO₂.

In what are termed flue gas desulphurization plants, the SO_2 is separated off from the flue gas using the abovedescribed methods, wherein as absorption solution, principally limestone is used in the form of a limestone suspension. In these plants, the absorbed sulphur dioxide SO_2 and the dissolved limestone in the suspension, after oxidation and crystallization processes, form utilizable gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$).

It is known from the prior art to design the absorption chamber for the flue gas desulphurization as a spraying tower in the form of a droplet column. In this spraying tower, the limestone suspension is sprayed with spraying nozzles via a plurality of generally horizontally arranged spraying planes in a vertical apparatus through which flue gas flows. The limestone suspension droplets exiting from the spraying nozzles come into contact with the flowing flue gas and heat and mass transport processes occur. These plants frequently also, above the gas feed, have a gas distribution plane (e.g. FGD-plus plane or tray), through which the gas fed is firstly homogenized and through which, secondly, a highly turbulent suspension regime (liquid layer) is generated. The gas distribution plane consists, for example, of a multiplicity of interconnected tubes.

The sulphur dioxide SO_2 present in the flue gas is dissolved by absorption into the suspension droplets and reacts, as a consequence, with the likewise dissolved calcium ions (Ca^{++}) via intermediates to form calcium sulphite and, after further oxidation, owing to the oxygen present in dissolved form in the droplets, to form calcium sulphate.

The suspension droplets fall downwards and, along their pathway, continuously absorb sulphur dioxide. In the lower region of the contact apparatus, they are collected in what is termed a sump, and to increase the contact time, are again brought into contact with the flue gas by way of the spraying planes via a circulation plant.

Via appropriate closed-loop and open-loop control circuits, limestone suspension, process water (loss of evaporation by the droplets) and oxidation air are continuously added to the absorption chamber and also suspension is taken off from the sump, in such a manner that a steady state is established. The suspension that is taken off from the sump is generally fed to downstream dewatering for production of gypsum.

Disadvantages of the described flue gas scrubbing by means of spraying towers are the required plant dimensions with 20-40 m high towers and the comparatively high energy consumption.

In other embodiments, as are described in US 6,051,055 or EP 0 882 487 A1, the absorption solution is sprayed into the absorption chamber via upwardly directed spraying nozzles. US 2009/0277334 A1 discloses an embodiment in which the spraying nozzles are directed downwards. In EP 2 361 667 A1, the spraying nozzles are directed upwards and downwards.

In the absorption chamber, in these embodiments, in addition to the spraying nozzles, there are no further internals which lead to a homogenization of the gas flow.

As an alternative thereto, a plant is known from WO 2010/006848, in which the gas, in a first stage, is conducted as a disperse phase through a suspension layer, and in a second stage, is conducted as a continuous phase, into which the suspension is sprayed as a disperse phase, and wherein the two stages are combined structurally in a single scrubbing tower. Here, therefore, the advantages of droplet column and bubble column are utilized by a combination of the two methods in a shared contact apparatus.

It is a disadvantage in this plant that the suspension is fed to the first stage through a separate suspension distribution plane, which increases the overall height of the contact apparatus. As a result of the height of the suspension distribution plane, a disadvantage results not only in the energy requirement, but also in the material requirement owing to the use of a substructure and a separate spray plane for the first stage.

The object of the invention is to improve the described methods.

The object is achieved by a plant for the absorption of individual components such as pollutants or recyclable materials in gases, in which the gas distribution plane has spray nozzles, via which the absorption solution is fed.

The plant according to the invention therefore has a gas distribution plane having an integrated suspension feed. The gas distribution plane therefore has the function to distribute and harmonize the gas that is fed, to form a turbulent absorption regime and to feed the absorption solution.

The advantage of this invention is in the low pump differential pressure required, which is required to circulate the absorption liquid. Firstly, for introducing the absorption solution, a lower nozzle inlet pressure (0.2 to 0.4 bar; cf. standard nozzles 0.5 to 1 bar) is sufficient, the majority of the energy savings result, however, from the lower geodetic difference in height which the pump must overcome, since the absorption solution is added at the height of the gas

distribution plane (FGD plus plane). Via this concept, in total, a very good energy utilization is achieved under differing load cases.

The spray nozzles are preferably constructed as impact nozzles, as a result the absorption solution can be finely distributed in the gas distribution plane.

The spray nozzles in this case are preferably directed upwards, that is to say in the direction of flow of the gas.

In an embodiment of the plant, the absorption solution can be sprayed from the gas distribution plane in addition via further downwards-directed spray nozzles, whereby an additional quenching effect is provided beneath the gas distribution plane.

It is expedient if one or more spraying planes are arranged above the gas distribution plane, via which spraying planes absorption solution is likewise introduced into the absorption chamber. As a result, the cleaning performance of the plant is further increased.

The gas distribution plane is formed according to the invention by a multiplicity of tubes, wherein the spray nozzles are arranged on the tubes, and the absorption solution is feedable via the tubes.

In the tubes, according to the invention, in each case a displacement mandrel is arranged, the cross section of which increases in the direction of flow of the absorption solution. As a result, a uniform suspension distribution occurs via the spray nozzles onto the distribution plane.

Rinsing water can also be fed via the displacement mandrel for cleaning the plant. The invention also relates to a method for the absorption of pollutants in gases, in which an absorption solution is brought into contact with the gas in an absorption chamber, wherein the gas that is fed is distributed and vortexed over a gas distribution plane. According to the invention, the absorption solution is fed to the gas distribution plane and introduced into the absorption chamber via spray nozzles. The gas distribution plane in this case is formed by a multiplicity of tubes, wherein the spray nozzles are arranged on the tubes and the absorption solution is fed through the tubes to the absorption chamber. According to the invention, in the tubes in each case a displacement mandrel is arranged, the cross section of which increases in the direction of flow of the absorption solution, in such a manner that the suspension is thereby uniformly distributed.

Hereinafter, the invention will be described with reference to drawings. In the drawings:

Fig. 1 shows an exemplary embodiment of the plant according to the invention;

Fig. 2a shows a plan view onto the gas distribution plane;

Fig. 2b shows a detail of the gas distribution plane;

Fig. 3 shows a longitudinal section through a tube of the gas distribution plane having a displacement mandrel;

Fig. 4 shows an impact nozzle for the feed of the absorption solution;

Fig. 5 shows a further embodiment of an impact nozzle.

The same reference signs in the individual figures respectively denote the same features.

Fig. 1 shows a cross section through a flue gas purification plant 1 according to the invention. Here, the flue gas flows through the gas feed 6 into the cylindrical absorption chamber 3 and is deflected into a vertical upwards flow. The flue gas flows through the absorption chamber 3 from bottom to top and leaves it through the flue gas exit 2. Directly above the gas feed 6 is the gas distribution plane 7. The gas distribution plane 7 consists of a multiplicity of individual tubes 11 which are interconnected via connection tubes 18 or connection elements. The flue gas is distributed within the absorption chamber 3 more evenly by the gas distribution plane 7 and in addition, turbulence is induced thereby in the flue gas which leads to more intense mixing of the gas with the absorption solution 5. The gas distribution appliance 7 is carried by the container wall 16.

The tubes 11 of the gas distribution device 7 have spray nozzles 8, via which the absorption solution 5 is introduced into the absorption chamber 3. The spray nozzles 8 here are constructed as downwardly directed impact nozzles 8a. In addition, here, also further downwards-directed impact nozzles 8b are provided, via which likewise absorption solution 5 is sprayed in.

In the upper region of the absorption chamber 3, likewise absorption solution 5 is introduced via the spray nozzles of the spray plane 4, which absorption solution in droplet form comes into contact with the flue gas.

Beneath the gas feed 6 there is situated the scrubber sump 13. The settling of solid particles in the scrubber sump 13 is prevented by the stirrer 9 which, in addition, ensures sufficient mixing. The oxidation is ensured by a separate oxidation air feed 19. In order to keep the entire scrubbing system in a steady state, fresh limestone suspension (absorption solution) is

fed via the line 10, and a corresponding suspension stream 12 for obtaining gypsum is ejected from the scrubbing system.

Directly above the gas feed 6, there is arranged a re-dispersion plate 17. This plate 17 collects the absorption solution 5 that is arriving from above and passes it as a curtain into the scrubber sump 13. The gas that is fed, on entry into the absorption chamber 3, passes through this curtain and is cooled in the course thereof.

Fig. 2a shows a plan view onto the gas distribution plane 7. The gas distribution plane 7 here consists of a multiplicity of tubes 11 which are interconnected via connection tubes 18 or connection elements. Here, it is therefore a grid-like construction, via which the gas is vortexed and made uniform. The gas distribution plane is also termed FGD-plus plane in specialist circles.

The absorption solution 5 is also fed via the tubes 11 and is distributed by the upwards directed impact nozzles 8a.

Fig. 2b shows a detail of the gas distribution plane 7, wherein here, in contrast to Fig. 2a, the connection tubes 18 are arranged in parallel to the tubes 11. In the tubes 11, displacement mandrels 14 are arranged, via which rinsing water 15 can also be fed.

In Fig. 3, a section through a tube 11 of the gas distribution plane 7 is shown. The displacement mandrel 14 can be clearly recognized here, the cross section of which widens in the direction of flow 20 of the absorption solution 5, and which thereby ensures a more even feed of the solution to the impact nozzles 8a and 8b. The impact nozzles 8b in this case are directed downwards, counter to the direction of flow of the gas. The tube 11 can be cleaned via the rinsing water feed 15.

Fig. 4 shows an exemplary embodiment of a possible impact nozzle 8a, 8b, in this case, above the nozzle opening 21 there is situated an impact plate 22 which deflects the absorption solution 5. Instead of the impact plate 22, an impact cone 23 can also be used, as is shown in Fig. 5.

Berendezés és eljárás gázokban levő egyedi összetevők abszorpciójára

Szabadalmi igénypontok

I. Berendezés (1) gázokban levő egyedi összetevők, mint például káros anyagok vagy hasznos anyagok abszorpciójára, amely berendezésnél egy abszorpció oldat (5) egy abszorpció térben (3) érintkezésbe van

hozva a gázzal, ahol az abszorpciós oldat (5) permetezőfűvókákon (8, 8a) keresztül van az abszorpciós térbe (3) bejuttatva és ahol az abszorpciós tér (3) a gáz számára kialakított gázbevezetés (6) felett egy gázelosztó szinttel (7) rendelkezik, amelynek révén turbulenciák vannak létrehozva a bevezetett gázáramban, ahol a gázelosztó szint (7) permetezőfűvókákat (8, 8a) tartalmaz, amelyen keresztül az abszorpciós oldat (5) bevezetésre kerül és ahol a gázelosztó szint (7) több csőből (11) van kialakítva, ahol a permetezőfűvókák (8, 8a) a csöveken (11) vannak elrendezve és az abszorpciós oldat (5) a csöveken (11) keresztül vezethető be az abszorpciós térbe (3), *azzal jellemezve*, hogy a csövekben (11) egy-egy kiszorító tűske (14) van elrendezve, amelynek a keresztmetszete az abszorpciós oldat (5) áramlási irányában (20) növekszik.

2. Az 1. igénypont szerinti berendezés, *azzal jellemezve*, hogy a gázelosztó szint (7) permetezőfűvókái (8, 8a) legalább részben ütköztetési fűvókákéni (8a) vannak kialakítva.

3. Az 1. vagy 2. igénypont szerinti berendezés, *azzal jellemezve*, hogy a permetezőfűvókák (8, 8a) felfelé, vagyis a gáz áramlási irányába vannak beirányítva.

4. A 3. igénypont szerinti berendezés, *azzal jellemezve*, hogy további permetezőfűvókák (8b) is fel vannak szerelve, amelyek lefelé, vagyis a gáz áramlási irányával szemben vannak beirányítva.

5. Az 1-4. igénypontok bármelyike szerinti berendezés, *azzal jellemezve*, hogy a gázelosztó szint (7) felett legalább egy permetező szint (4) van elrendezve, amelyen keresztül szintén abszorpciós oldat (5) van az abszorpciós térbe (3) bejuttatva.

6. Az 1-5. igénypontok bármelyike szerinti berendezés, *azzal jellemezve*, hogy a kiszorító tűskéken (14) keresztül öblítővíz (15) vezethető be.

7. Eljárás gázokban levő egyedi összetevők, mint például káros anyagok vagy hasznos anyagok abszorpciójára, amely eljárás során egy abszorpciós oldatot (5) egy abszorpciós térben (3) érintkezésbe hozunk a gázzal, ahol a bevezetett gázt egy gázelosztó szinten (7) keresztül osztjuk el és hozzuk örvénylésbe, ahol az abszorpciós oldatot (5) betápláljuk a gázelosztó szintbe (7) és permetezőfűvókákon (8, 8a, 8b) keresztül juttatjuk be az abszorpciós térbe, és ahol a gázelosztó szintet (7) több csőből (11) alakítjuk ki, ahol a permetezőfűvókák (8, 8a, 8b) a csöveken (11) vannak elrendezve és az abszorpciós oldatot (5) a csöveken (11) keresztül vezetjük be az abszorpciós térbe (3), *azzal jellemezve*, hogy a csövekben (11) egy-egy kiszorító tűskét (14) helyezünk el, amelynek keresztmetszete az abszorpciós oldat (5) áramlási irányában (20) növekszik, úgyhogy ezáltal egy egyenletes szuszpenzió-eloszlást hozunk létre.

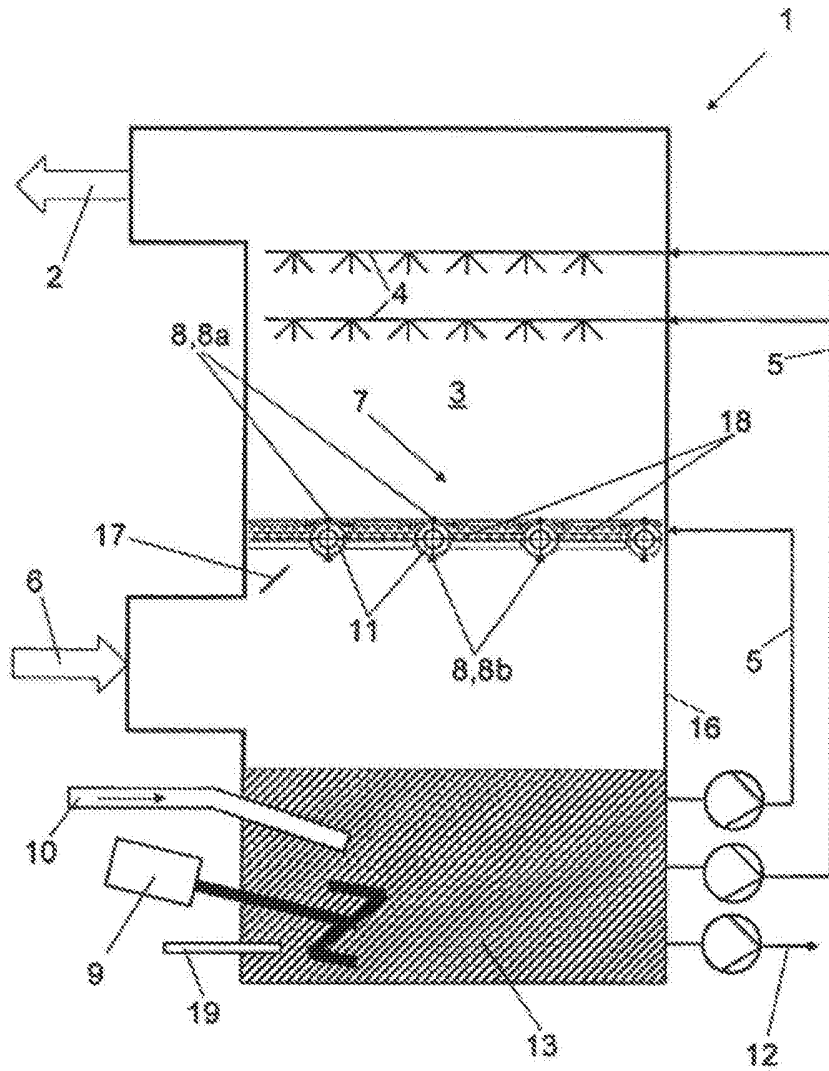


Fig. 1

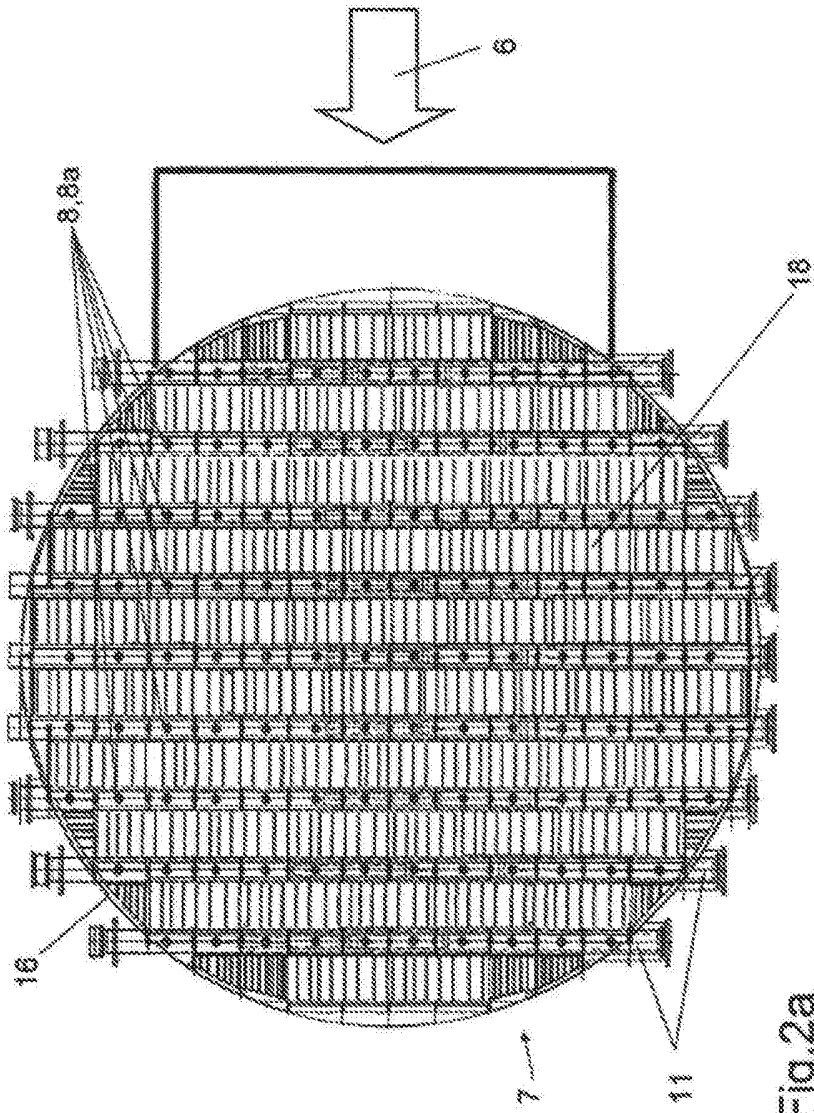


Fig.2a

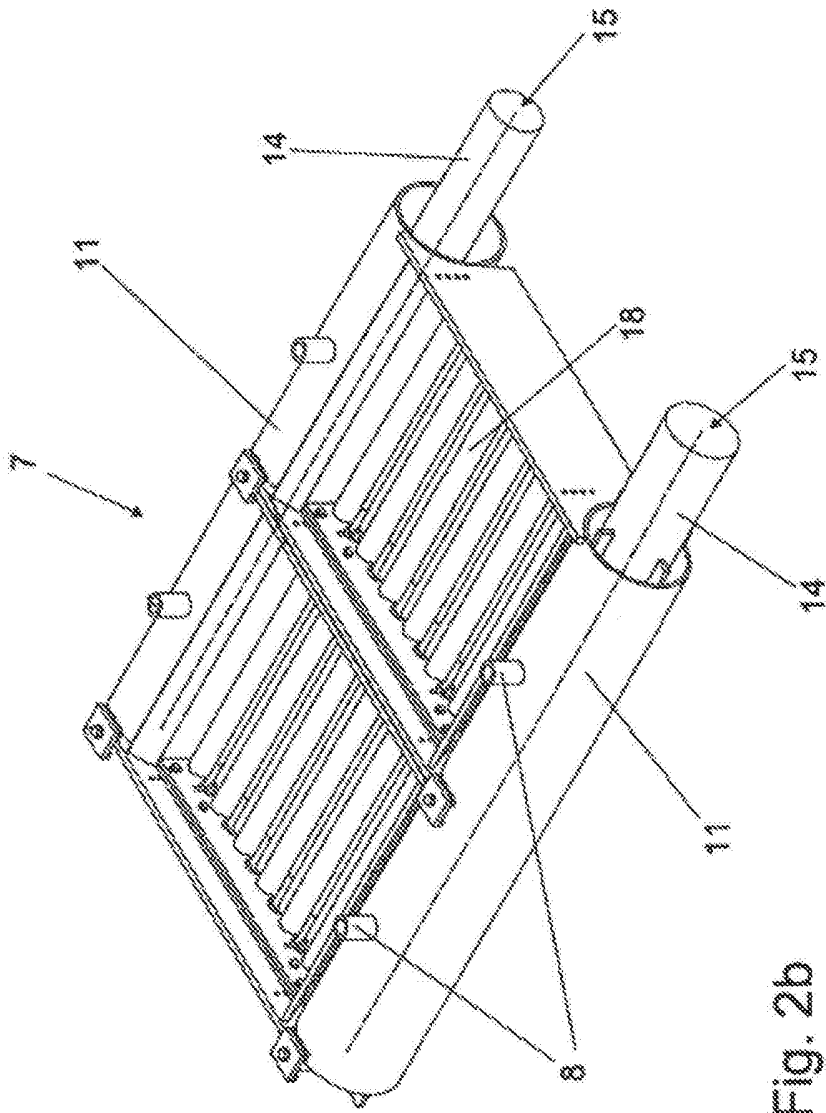


Fig. 2b

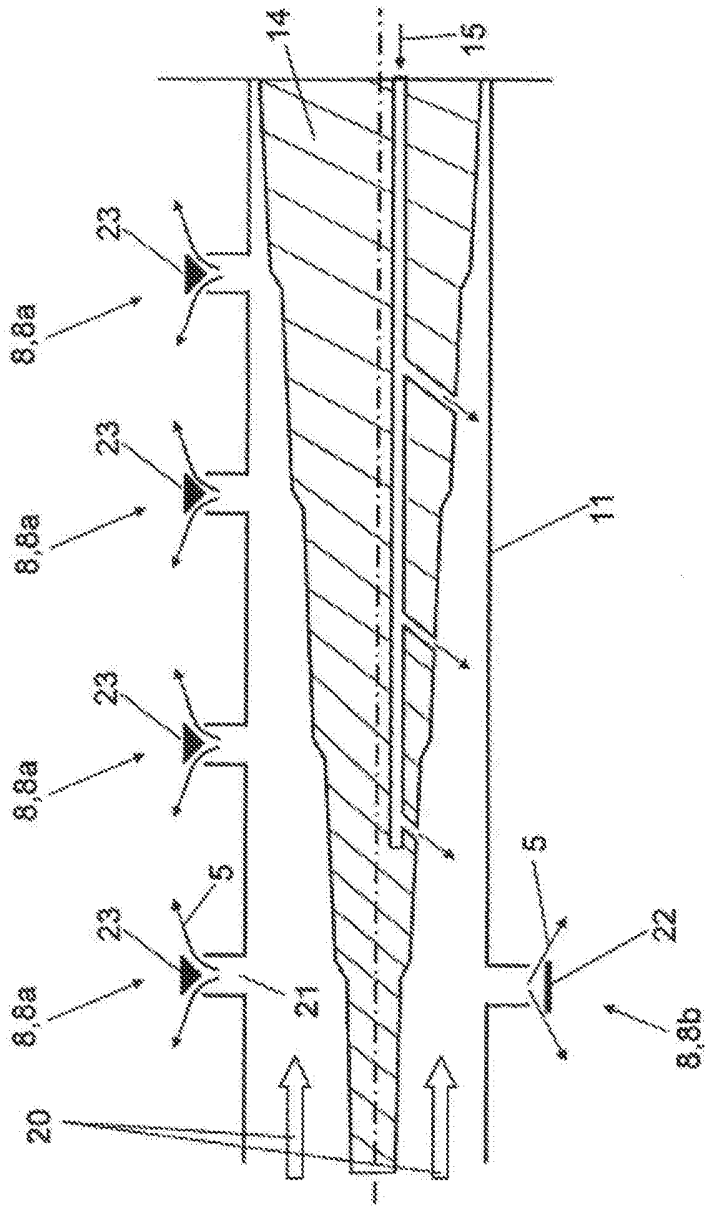


Fig.3

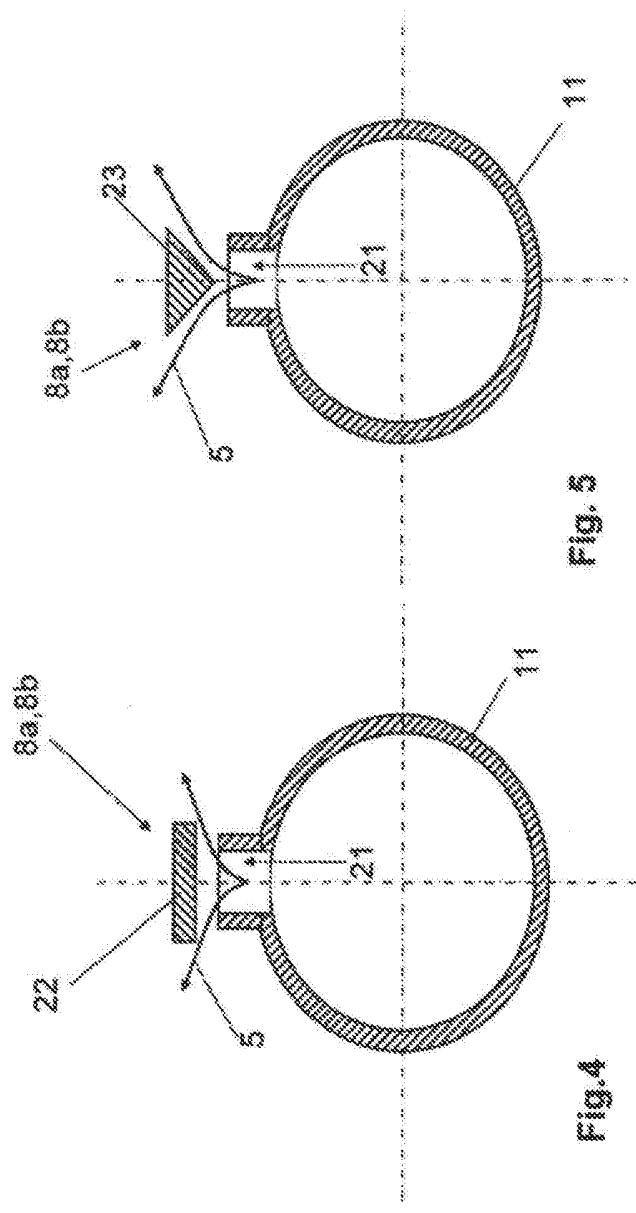


Fig. 5

Fig. 4