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

(11) EP 1 455 971 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
11.05.2005 Bulletin 2005/19

(21) Application number: **01275048.5**

(22) Date of filing: **20.12.2001**

(51) Int Cl.[7]: **B22C 5/12**

(86) International application number:
PCT/DK2001/000855

(87) International publication number:
WO 2003/053609 (03.07.2003 Gazette 2003/27)

(54) **DEVICE FOR IMPROVED SUPPLY OF MOULD PARTICLE MATERIAL TO THE HOPPER OF A FOUNDRY MACHINE FOR MOULD-MAKING**

VORRICHTUNG ZUR VERBESSERTEN ZUFÜHRUNG VON FORMWERKZEUGTEILCHENMATERIAL ZUM TRICHTER EINER GIESSEREIMASCHINE ZUR HERSTELLUNG VON FORMWERKZEUGEN

DISPOSITIF PERMETTANT D'EFFECTUER UN MEILLEUR APPROVISIONNEMENT D'UN MATERIAU PARTICULAIRE DE MOULAGE DANS LA TREMIE D'UNE MACHINE A MOULER CON UE POUR LA FABRICATION DE MOULES

(84) Designated Contracting States:
DE ES FR GB IT

(43) Date of publication of application:
15.09.2004 Bulletin 2004/38

(73) Proprietor: **DISA INDUSTRIES A/S**
2730 Herlev (DK)

(72) Inventor: **MOGENSEN, Vagn**
DK-2820 Gentofte (DK)

(74) Representative: **Tonnesen, Bo**
Budde, Schou & Ostenfeld A/S
Vester Soegade 10
1601 Copenhagen V (DK)

(56) References cited:
US-A- 4 971 135 **US-A- 5 078 201**

- **PATENT ABSTRACTS OF JAPAN vol. 016, no. 422 (M-1305), 4 September 1992 (1992-09-04) & JP 04 143044 A (KAZUJI TANAKA), 18 May 1992 (1992-05-18)**

EP 1 455 971 B1

Printed by Jouve, 75001 PARIS (FR)

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a device for improved supply of mould particle material to the hopper of a foundry machine for mould-making according to the preamble of Claim 1.

BACKGROUND

[0002] The conditioned "sand" (i.e. the particle material) for foundry moulds is normally delivered to the hopper on each individual mould-making machine via gravitational fall from a conveyor system above (e.g. a belt system). Such machines normally are capable of functioning in repeated cycles of controlled sequential series of steps, each cyclus yielding a mould, that can be part (s) of one/more set(s) of moulds.

[0003] Such machines normally are furnished with the hopper designed as a pressure chamber provided with a top inlet opening for the falling "sand", that has a relatively small opening area, which is sealable by means of some type of valve function (e.g. a slide gate), as some or all of the sand from the so sealed hopper by means of pressurized gas (normally air) from a controlled driving gas system is furthered into a mould chamber, whereafter an adequate amount of sand once more is secured in the hopper, before sand once more is furthered into the mould chamber for the consecutive mould, etc. In the mould chamber the sand is pressed/squeezed to form a mould component, which after removal leaving space for the next volume of sand to be furthered in, in functional combination with mating component(s) later are poured with molten material.

[0004] An example of a machine as described above is an automatically functioning mould-making machine of the "Disamatic®"-type.

PRIOR ART

[0005] To intercept the sand falling from the conveyor system, a relevant mould-making foundry machine normally incorporates a known element with a generally funnel-shaped surface to guide the sand recieved to the opened top inlet opening of the machine's hopper. The known types of guiding funnels are normally of frusto-conical or frusto-pyramidal shape, the wider end face pointing upwards to offer a wide/long opening to intercept the falling sand, that can have its "delivery positions" from the conveyor system varying according to parameters as: particle material condition, shape of conveyor's delivery opening, horizontal speed component "inherited" from conveyor system, fall height, actual sand flow, etc.

[0006] The frusto-shape's smaller end face is normally adapted to present a smooth transformation of shape to the opened top inlet opening to facilitate the inflow of falling particle material and to avoid build-up caused by edge-effects during the sand inflow.

[0007] Some major problems met at known inlet-arrangements of the above type are related to the relative small inlet opening area and consist in:

first, blocking of the inlet opening during inflow of sand due to entrapment of air from the hopper during the delivery through the inlet opening: the air/gas contained in the hopper to be replaced with the corresponding volume of inflowing sand cannot easily escape from the hopper volume in a direct counterflow to the sand, and might instead create a counterpressure from the hopper causing the downcoming sand to form a plug in the inlet opening, thus at least momentarily hindering the inflow;
second, during effective inflow of sand the distribution of the inflown sand in the hopper can be very uneven through the hopper's horisontal section, e.g. due to the "pulsing" type of supply following consecutive blockings of the inlet opening; the pulsing also often results in compactness of the settled delivered sand varying through the height in the hopper causing problems with later effective control of the furthering into the machine's mould chamber;
third, undesired deposition of particle material in the sealing area of the valve/slide gate function closing the hopper inlet opening resulting in excessive wear of sealing components and problematical sealing off that opening;
fourth, undesired spread and deposition of particle material, that has been transported to the surroundings via the replaced gas escaping from the hopper; such material particles causing non-intended wear on moving elements elsewhere and disturbing/polluting the environment in the foundry - if not caught by a ventilation system, which then is additionally stressed, especially in the filtering section, from this extra load of fines; and
fifth, especially in the case of fast, automatic machines, e.g. functioning according to the "Disamatic®"-principle, the unnecessary prolonged duration of the inflow of the sand, e.g. due to blocking/pulsing, can severely compromise the mould production rate, as the overall machine cyclus might be slowed down by waiting for sand to have flown into the hopper, before the subsequent steps (closing of inlet opening and performing admittance of pressurized gas to further sand from the hopper into the mould chamber) are controlled to happen.

SUMMARY OF THE INVENTION

[0008] The main object of the present invention is therefore to provide a device to improve the supply of falling particle material into a foundry machine's hopper through the inlet opening by overcoming the problems described above.

[0009] Other objects of the present invention will appear from the description to follow and from the dependent claims.

[0010] The device for improved sand supply according to the main aspect of the present invention therefore possesses the following characterizing features:

- the device being an at least meta-stable guiding surface being the circumferring internal side(s) surface(s) of a frusto-conical/-pyramidal/funnel-shaped tapering space in a structure;
- the wider, open end face of said tapering space being pointing upwards intercepting a possible flow of falling material particles meant for said hopper;
- the narrower, open end face of said tapering space being arranged at said inlet opening of the foundry machine's hopper, allowing for a possible stream of intercepted particle material to substantially unhindered pass the opened said inlet opening after leaving said narrower end face; and
- said structure circumferring said tapering space outside of its said guiding surface and facing a possibly existing frusto-shaped guiding surface for falling particle material to said machine's hopper, is allowing for at least one upstream of escaping air/gas being replaced with a stream of particle material flowing down into said hopper through said narrower end, to leave the hopper volume without intermixing with said counterflowing stream of particle material in said opened inlet opening, by providing at least one opening relative to the opened inlet opening off said narrower, open end face,
  as practical tests surprisingly has evidenced, that the overall flow rate of the downstreaming sand is not compromised, even though some of the area of the opened inlet opening by means of the inventive device is reserved as one or more passages dedicated to the upstreaming replaced air from the hopper. Thus absence of blocking/pulsing, even compactness and speedy operation are the achieved major benefits.

[0011] Preferably, the structure is substantially made of sheet material, as such material inherently is offering a smooth guiding surface, hindering local build-ups.

[0012] Preferably, the tapered space is positioned approximately vertically, centrally to the opened said inlet opening, as such placement normally is best suited for all-round mould production, due to the provision of a substantially ring-shape opening at the edge of the opened inlet opening for the counterflowing escaping gas from the hopper cushioning the opening seals from particles.

[0013] Preferably, the at least meta-stable guiding surface is of/lined with a smooth and low-friction material, e.g. a PTFE-composite, thus offering improved avoidance of local build-up/blocking of particle material (s) of difficult-to-handle composition and/or condition.

[0014] Preferably, the structure is controlled movable up and down in a sequence related to the opening/closing of said inlet opening, thus better being able to intercept the falling stream of sand by approaching a delivery source, especially at the beginning of a delivery phase.

[0015] Preferably, the structure partly is temporarily positioned below said opened inlet opening, thus better protecting the seals against particle deposition and offering possibility to better control the dispensing of sand in the hopper.

[0016] Preferably, the structure is pivotable in a substantial vertical plane, thus being able to better "follow" the falling stream of sand to intercept.

[0017] Preferably, the structure is pivotable in a substantial vertical plane escaping physical contact with the element(s) closing the inlet opening and vice versa, thus in some cases permitting prolonged filling of the hopper during the start of the closing of the inlet opening to further minimize cycle-time. The narrower end of the structure might be optimized profilated and positioned accordingly, so the last particle material slides the side of the guiding surface farthest form the nearest edge of the inlet opening closing member.

[0018] Preferably, the structure is comprising exitating means, e.g. vibrating means, to further facilitate the flow of particle material over the guiding surface to avoid deposition.

[0019] Preferably, the device is comprising motive and/or detection means controlled by/communicating with said machine and/or a conveying system supplying said falling particle material. So, the movements might be optimized to save time, resulting in higher overall production rate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] A non-limitative example of the present invention will hereinafter be described in more detail with reference to the accompanying drawing, wherefrom:

- Fig. 1 depicts a side elevated, highly schematic, vertical section of an embodiment of the inventive device on top of a hopper of a mould-making foundry machine, being supplied with particle material from a supply system above;
- fig. 2 depicts the same as fig. 1, but as seen from the left side of fig. 1; and
- fig. 3 depicts, partly in section, some further illustrative details of the inventive device and of the hopper and of the sand supply system as in fig. 1 to further clarify the invention.

DESCRIPTION OF A PREFERRED INVENTIVE EMBODIMENT

[0021] Re. fig. 1 is shown the hopper 1 of a mould-making foundry machine, of whose lower parts only the chamber 2 for forming the mould by relatively approach-

ing the two opposed movable end walls fitted with pattem plates, thus squeezing the intermediate particle material to be a relatively stable block, is schematically indicated. The machine generally being of the commonly known "Disamatic®"-type and functioning accordingly.

[0022] Also re. fig. 2 the hopper 1 bottom part is not conical, but merges in the mould chamber 2 ceiling by a slit across the pressing directions. The step of supplying sand 3 to the hopper is shown, as the hopper 1 has already been partly filled with sand 3, which has passed the opened inlet opening 4, while more sand 5 is downstreaming as a falling jet from a supply system above, which has not been further referenced to, but can be seen depicted as a belt-type conveying system, the movement of the belt, at least of on/off-type, being controlled according to the demand for further material according to communication to/from a controlling system also controlling the foundry machine below. Right now the conditioned particle material mixture (the "sand") 5 is rolled off the conveyor band to the left in fig. 1 and is falling as a stream driven by gravity, but also still moving according to a horizontal velocity component inherited from the movement with the band. Conforming the belt speed, the sand 5 thus will take a direction downwards more or less off-center the opened inlet opening 4.

[0023] In the figures, the inventive guiding device 6 is shown as made of sheet material following a frusto-conical shape, the lower, narrower end pointing to the center of the inlet opening, thus defining an effectively smaller outlet opening at the lower edge of the guiding surface for the downstreaming sand internally of the structure of the inventive device. The wider end of the guiding surface is pointing substantially upwards to catch the falling sand by intercepting the stream 5 from the supply system. Ability to rock or swing the wider opening of the guiding surface in a substantially vertical plane following the directions of movement of the belt offers a better ability to intercept the stream of falling sand 5 as this "covers" an elongated area depending of the actual speeds of the belt.

[0024] As best seen from fig. 3 the falling sand 5 is from the narrower end of the guiding surface passing the opened inlet opening 4 as a concentrated, centered jet or beam of falling material. This beam is guided by the inventive guiding device 6 to leave a circular opening at 7 near the edge of the inlet opening to allow for the unhindered counterflowing escape of gas form the hopper, that is driven out as the volume is being occupied by sand 3. The escaping counterflowing upstream of gas/air from the hopper 1 is symbolised by the arrows as at 7, clearly showing the non-interference of the two counterstreams of sand and air respectively faciltating the entrance of sand into the hopper without blocking the inlet opening and the exit of gas from the hopper without carrying out intermixed fines from the particle material 5 to disturb/pollute the surroundings/environment. As best seen and understood from fig. 3 the escaping counterflowing upstream of gas/air is also cushioning the circumferential seal 8 and the domed sealing body 9 of such exemplarily shown dome valve for sealing the inlet opening, thus hindering deposition of particle material at the sealing faces and resulting excessive wear of these components.

[0025] Means for bracketing at least some structure of the inventive device to the other stationary components preferably of the foundry machine, but possibly also to the sand supply system and/or a present ventilating system, is not shown, as such brackets, etc present no major challenge to a person skilled in the art to craft/design/manufacture. The possible means to raise/lower/pivot and/or vibrate the guiding surface of the inventive device 6 are also of evident character for the skilled person to understand and execute and will thus be treated no further here.

[0026] Even though the narrower opening of the "delivering" end of the guiding surface of the device 6 according to the present invention has a smaller area than the opening of the inlet opening 4, hitherto used comparatively "unrestricted", a more even distributed and speedier supply of the required volume of sand to the hopper is achieved, by the beneficial function of the device according to the present invention.

The resulting improvement in overall effective cycle time for the mould-making system is also making retrofitting of the inventive device 6 relevant to existing foundry machines, not presently being equipped with such device 6.

[0027] The above detailed explanation of an embodiment of the present invention was given as an illustrative example only, the full scope of the present invention being set forth in the appended claims.

LIST, REFERENCE NUMBERS IN FIGURES AND CLAIMS

[0028]

1 hopper
2 mould chamber
3 sand, particle material, in hopper
4 inlet opening
5 falling sand
6 inventive device
7 place, point, at air escape opening(s)
8 circumferential seal
9 domed body of valve

Claims

1. Apparatus for improved supply of particle foundry mould material (3,5) into a foundry machine's hopper (1) through an inlet opening (4) therein, said apparatus comprising
a delivery device such as a belt conveyor for delivering the material portion-wise in controlled amounts to

a guiding surface (6) positioned to guide the material from the delivery device to the inlet opening (4) of the hopper (1),
said inlet opening (4) being closable by a valve (9) in order to allow furthering of the material out of the hopper (1) and into a mould chamber (2) by means of pressurized gas introduced into the hopper (1) above the material after closing of the inlet opening (4), and
said guiding surface (6) being formed as an at least partially mechanically stab!e tapering funnel-like surface with its broad opening pointing upwards to intercept falling material received from the delivery device, and its narrow opening positioned and dimensioned to deliver the material in a stream into the opening (4) of the hopper (1), leaving an interspace between the opening (4) and the stream of material, said interspace allowing air to escape from the hopper (1) in counterstream with the material without intermixing, and
said broad and narrow openings of said guiding surface (6) being open and unobstructed at all times, in order to allow free flow of the material.

2. The apparatus according to claim 1, **characterized in**,

- said guiding surface (6) being substantially of sheet material.

3. The apparatus according to claim 1 or 2, **characterized in**,

- said tapered funnel-like surface being positioned approximately vertically, centrally to the opened said inlet opening (4).

4. The apparatus according to one or more of the preceding claims, **characterized in**,

- said at least partially mechanically stable guiding surface (6) being of/lined with a smooth and low-friction material, e.g. a PTFE-composite.

5. The apparatus according to one or more of the preceding claims, **characterized in**,

- said guiding surface (6) being controlled movable up and down in a sequence related to the opening/closing of said inlet opening (4).

6. The apparatus according to one or more of the preceding claims, **characterized in**,

- said guiding surface (6) partly being temporarily positioned below said opened inlet opening (4).

7. The apparatus according to one or more of the preceding claims, **characterized in**,

- said guiding surface (6) being pivotable in a substantial vertical plane.

8. The apparatus according to claims 6 and 7, **characterized in**,

- said guiding surface (6) being pivotable in a substantial vertical plane escaping physical contact with the element(s) dosing said inlet opening and vice versa.

9. The apparatus according to one or more of the preceding claims, **characterized in**,

- said guiding surface (6) comprising exitating means.

10. The apparatus according to one or more of the preceding claims, **characterized in**,

- the apparatus comprising motive and detection means controlled by/communicating with said machine and/or a conveying system supplying said falling particle material (5).

Patentansprüche

1. Vorrichtung zur verbesserten Zufuhr von Gießform-Partikelmaterial (3, 5) in einen Trichter (1) einer Gießmaschine hinein durch eine Einlassöffnung (4) darin, mit:

einer Zubringervorrichtung wie z. B. einem Transportband zum portionsweisen Zubringen des Materials in gesteuerten Mengen zu einer Führungsfläche (6), die derart angeordnet ist, dass sie das Material von der Zubringervorrichtung zu der Einlassöffnung (4) des Trichters (1) lenkt,

wobei die Einlassöffnung (4) durch ein Ventil (9) schließbar ist, um ein Fördern des Materials aus dem Trichter (1) heraus und in eine Formkammer (2) hinein mittels Druckgas, das nach dem Schließen der Einlassöffnung (4) über dem Material in den Trichter (1) eingeleitet wird, zuzulassen, und
die Führungsfläche (6) als eine zumindest teilweise mechanisch stabile, sich verjüngende, trichterartige Fläche ausgebildet ist, wobei ihre breite Öffnung nach oben weist, um fallendes Material, das von der Zubringervorrichtung aufgenommen wird, aufzufangen, und ihre schmale Öffnung derart angeordnet und bemessen ist, dass das Material in einem Strom in die Öffnung (4) des Trichters (1) hinein zugebrachtt wird, wobei ein Zwischenraum zwischen

der Öffnung (4) und dem Strom von Material bleibt, und der Zwischenraum zulässt, dass Luft im Gegenstrom mit dem Material ohne ein Vermischen aus dem Trichter (1) entweicht, und
die breiten und schmalen Öffnungen der Führungsfläche (6) immer offen und unbehindert sind, um einen freien Fluss des Materials zuzulassen.

2. Vorrichtung nach Anspruch 1,
dadurch gekennzeichnet, dass
die Führungsfläche (6) im Wesentlichen aus lagenartigem Material besteht.

3. Vorrichtung nach Anspruch 1 oder 2,
dadurch gekennzeichnet, dass
die verjüngte, trichterartige Fläche annähernd vertikal zentral zu der geöffneten Einlassöffnung (4) angeordnet ist.

4. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
die zumindest teilweise mechanisch stabile Führungsfläche (6) aus /mit einem glatten und reibungsarmen Material, z. B. einem PTFE-Verbundstoff, gefertigt / ausgekleidet ist.

5. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
die Führungsfläche (6) nach oben und unten in einer Folge in Bezug auf das Öffnen / Schließen der Einlassöffnung (4) bewegbar gesteuert ist.

6. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
die Führungsfläche (6) zum Teil vorübergehend unter der geöffneten Einlassöffnung (4) angeordnet ist.

7. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
die Führungsfläche (6) in einer im Wesentlichen vertikalen Ebene verschwenkbar ist.

8. Vorrichtung nach Anspruch 6 und 7,
dadurch gekennzeichnet, dass
die Führungsfläche (6) in einer im Wesentlichen vertikalen Ebene verschwenkbar ist, wobei sie aus dem physische Kontakt mit dem /den die Einlassöffnung schließenden Element/en gelangt, und umgekehrt.

9. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
die Führungsfläche (6) ein Anregungsmittel umfasst.

10. Vorrichtung nach einem oder mehreren der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
die Vorrichtung ein Antriebs- und Detektionsmittel umfasst, das durch die Maschine und/oder ein Transportsystem, das das fallende Partikelmaterial (5) zuführt, gesteuert wird bzw. mit dieser / diesen kommuniziert.

Revendications

1. Dispositif pour l'alimentation améliorée de matériau particulaire (3, 5) pour moule de fonderie dans une trémie (1) d'une machine de fonderie, via une ouverture d'entrée (4) qu'elle comporte, ledit dispositif comprenant :

un organe d'alimentation, tel qu'un transporteur à courroie, pour délivrer le matériau par portions et quantités contrôlées à

- une surface de guidage (6) positionnée pour guider le matériau depuis l'organe d'alimentation jusqu'à l'ouverture d'entrée (4) de la trémie (1),
- ladite ouverture d'entrée (4) étant susceptible d'être obturée par une valve (9) afin de permettre l'entrée du matériau de la trémie (1) dans une chambre de moulage (2), sous l'action d'un gaz sous pression introduit dans la trémie (1) au-dessus du matériau après la fermeture de l'ouverture d'entrée (4), et
- ladite surface de guidage (6) se présentant comme une surface se rétrécissant, ayant la forme d'un entonnoir, et au moins partiellement stable mécaniquement, son ouverture large étant dirigée vers le haut pour recevoir le matériau qui tombe de l'organe d'alimentation, et son ouverture étroite étant positionnée et dimensionnée pour amener le matériau sous forme de courant dans l'ouverture (4) de la trémie (1), en laissant un intervalle entre l'ouverture (4) et le courant de matériau, ledit intervalle permettant à l'air de s'échapper de la trémie (1) à contre-courant du matériau sans se mélanger avec celui-ci, et
- lesdites ouvertures large et étroite de ladite surface de guidage (6) étant ouvertes et non obstruées en permanence, afin de permettre le libre écoulement du matériau.

2. Dispositif selon la revendication 1, **caractérisé en**

ce que ladite surface de guidage (6) est pour l'essentiel en un matériau consistant en feuillard.

3. Dispositif selon la revendication 1 ou 2, **caractérisé en ce que** ladite surface se rétrécissant, ayant la forme d'un entonnoir, est positionnée de façon sensiblement verticale et centrée par rapport à ladite ouverture d'entrée (4) ouverte.

4. Dispositif selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ladite surface de guidage (6) au moins partiellement stable mécaniquement, est, soit réalisée, soit revêtue, d'un matériau lisse et à faible friction, par exemple un composite de PTFE (polytétrafluroéthylène).

5. Dispositif selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ladite le déplacement vers le haut et vers le bas de la surface de guidage (6) est contrôlée selon une séquence fonction de l'ouverture/fermeture de ladite ouverture d'entrée (4).

6. Dispositif selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ladite surface de guidage (6) est en partie temporairement positionnée en dessous de ladite ouverture d'entrée (4) ouverte.

7. Dispositif selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ladite surface de guidage (6) est susceptible de pivoter dans un plan sensiblement vertical.

8. Dispositif selon les revendications 6 et 7, **caractérisé en ce que** ladite surface de guidage (6) est susceptible de pivoter dans un plan sensiblement vertical, sans être au contact physique avec le(les) élément(s) fermant ladite ouverture d'entrée et vice versa.

9. Dispositif selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ladite surface de guidage (6) comprend des moyens d'excitation.

10. Dispositif selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce qu'**il comprend des moyens moteurs et de détection contrôlés par ladite machine ou communiquant avec ladite machine et/ou un système de transport amenant ledit matériau particulaire (5) qui tombe.

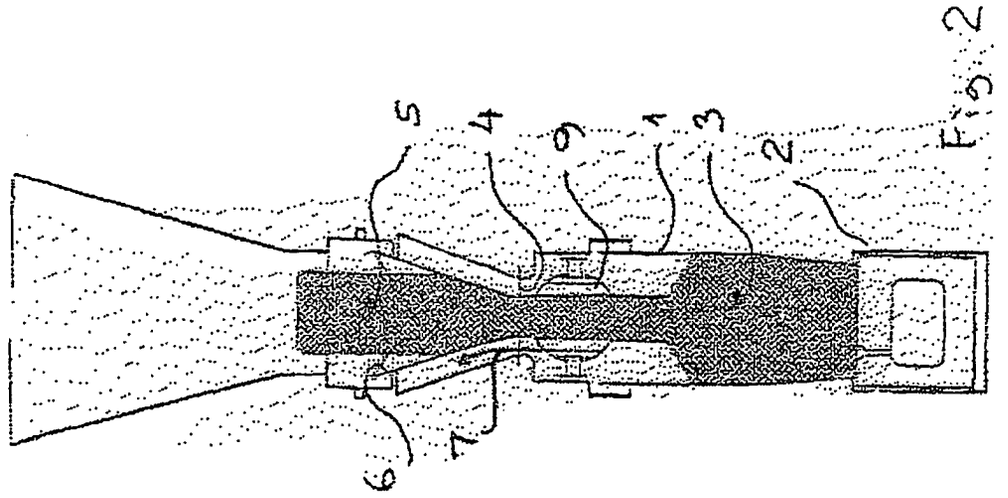

Fig. 2

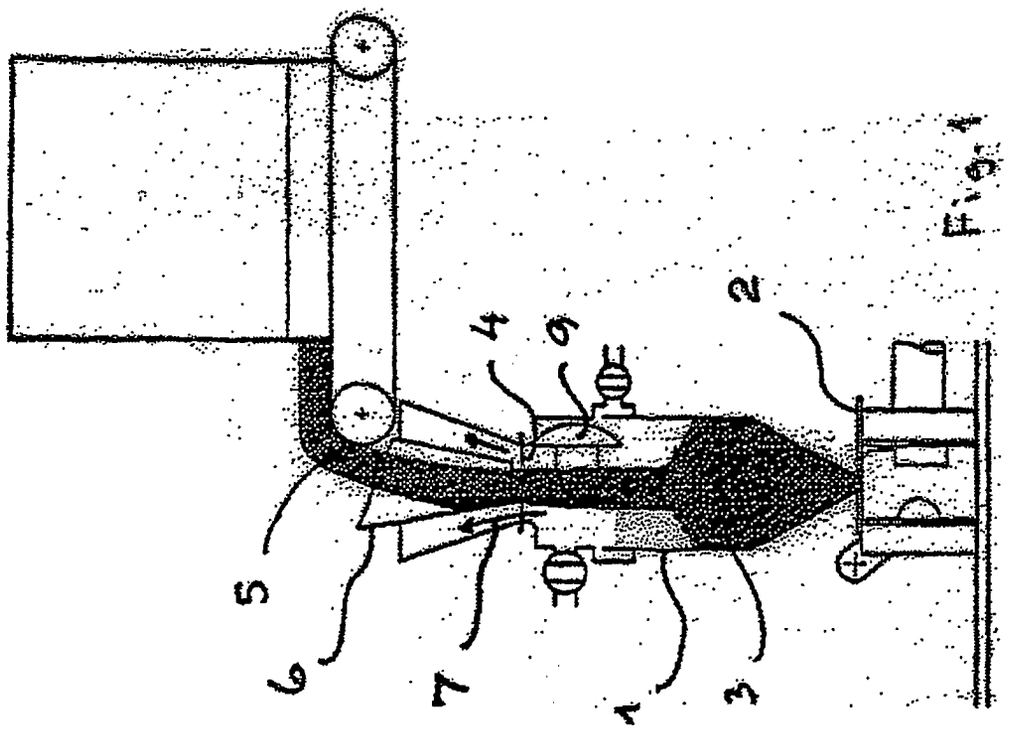

Fig. 1

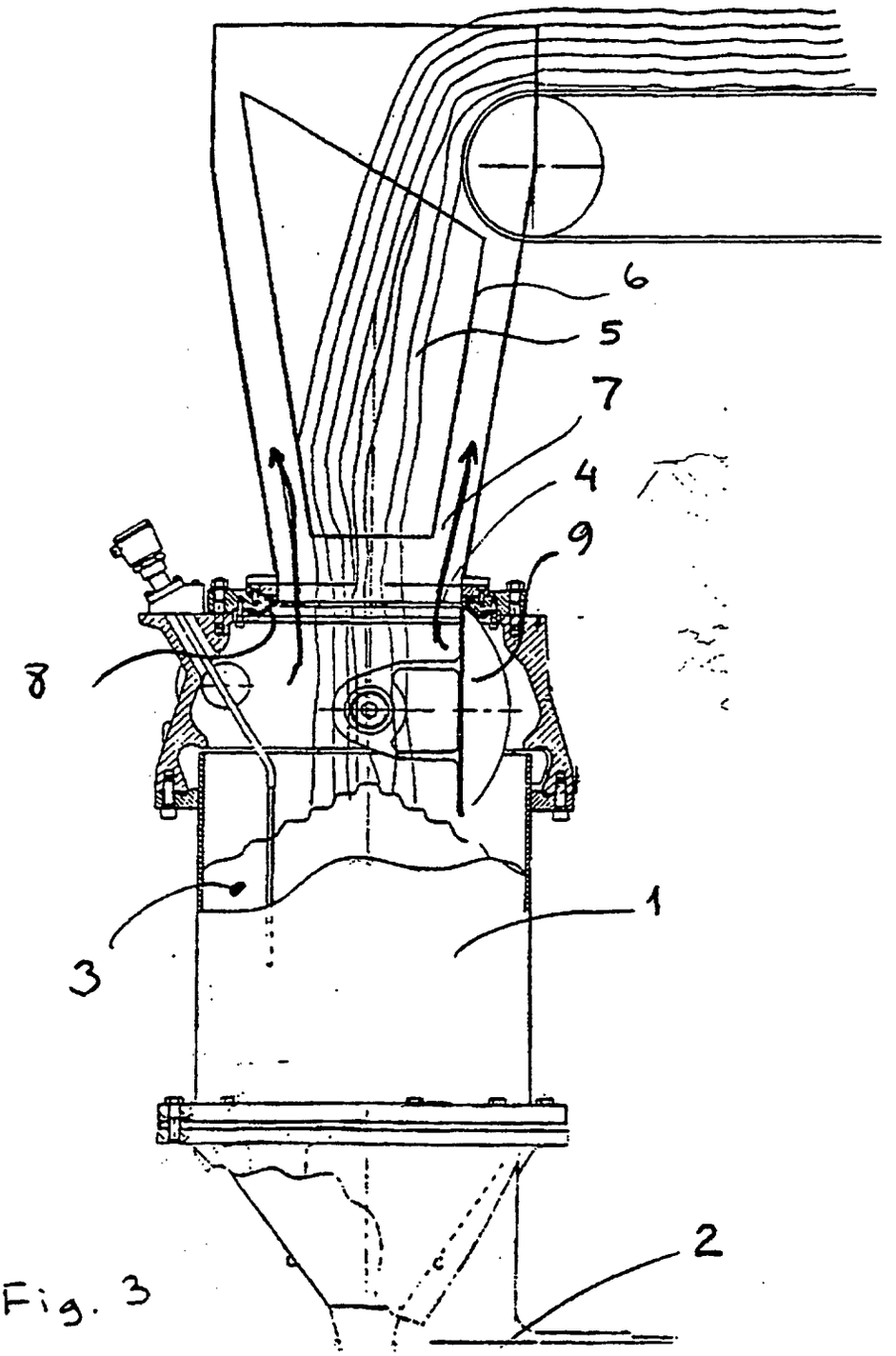

Fig. 3