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(54) **Apparatus for the fast and continuous dehumidification of loose materials, particularly pellets for a plastic moulding plant**

Vorrichtung zur schnellen und kontinuierlichen Entfeuchtung von Schüttgut, insbesondere Granulat für eine Kunststoff-Formanlage.

Dispositif pour la déshumidification rapide et continue de matières en vrac, notamment de granules pour une machine de moulage de matières plastiques

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Description

Domain of the Invention

[0001] This invention has as its object an apparatus for the fast dehumidification of loose materials.

[0002] The invention finds particular, though not exclusive, application in the field of the preliminary processing of plastic granules, pellets, to be used in successive procedures of moulding of plastic products.

[0003] In principle, it is observed that the modern plastic moulding lines, upstream of the plant, must be able to provide quality control systems of the raw material to guarantee the production cycle, in such a way as to preemptively detect the presence of residual humidity, of which the raw material was previously enriched during the packaging and storage phase.

[0004] The aim of the dehumidifiers is therefore that of constantly controlling the humidity percentage of the raw material used and intervening effectively with its dehumidifier functions, in order to feed the moulding plant with only the dried product, therefore optimized, maintaining a high quality of work.

Prior Art

[0005] A first type of dehumidifiers intervenes directly in the processing hopper, where on a case-by-case basis, the resin pellets, namely coloured or neutral plastic granules, are loaded. In substance, a ventilation system is provided inside the hopper, allowing from one side the intake of an airflow, preferably constant and dry, and from the other the emission of air enriched with variable percentages of humidity. Such forced circulation has the aim of progressively eliminating the percentage of noticeable humidity inside the hopper, without interrupting the operation cycle, allowing, meanwhile, the regeneration of means used for the dehumidification of the air introduced into the hopper. To proceed with the ventilation of the processing hopper, at present two lines are provided. As has been seen, this has the sole purpose of ensuring the continuity of the processing, without interruption of the production cycle. Said two lines, in a traditional solution are essentially identical and, as well as the relative connections and solenoid valves, they are also made up of a regenerating dehumidification tower each including molecular sieves, and a relative turbine. The essential function of the turbine, is that of introducing the air enriched with humidity taken from the hopper, into the inside of the respective tower, to therefore be dehumidified and introduced inside the hopper again in a continuous cycle. Upon reaching a high rate of humidity, found inside the working tower by the two molecular sieves provided, the plant suspends the relative circulation, thereby activating the parallel line, in which previously a regenerating cycle had been carried out. Such alternation of the cycles, once one tower, then the other, is necessary in order to allow, in the tower concerned with the suspension of the circu-

lation of the airflow, the evaporation of the water held inside the molecular sieve, being of the type provided with a convenient heat exchanger.

[0006] To overcome some of the disadvantages linked to the application of the first solution, a second version has been proposed. In practice the use of two regenerating dehumidification towers is still provided, but unlike the previous one, the plant is equipped with a single turbine. In more detail, the aim of the single turbine is to allow the circulation of the airflow to be introduced into the processing hopper, conveniently allocated between the working tower, the one therefore which dehumidifies, and the regeneration tower.

[0007] In ITTV97/0072 (Msm), for example, a plant for a process of granule dehumidification is described, particularly plastic pellets, to be used in successive moulding procedures, including two means for the dehumidification of the air to be introduced inside a processing hopper provided in plastic moulding plants; said means, when saturated, being able, also alternatively, to accomplish a regeneration phase to be predisposed again to a dehumidification cycle of the air to be introduced inside the processing hopper, and in which a double-channel turbine is provided to feed the recirculation of the air with independent channels including distribution means of the air cycles, at least one of which for each regenerating dehumidification means.

[0008] Apparatus suitable to dehumidify, provided with devices that generate microwaves, are certainly known. For example, in JP7039716 (Katayama) an apparatus provided with channels is described, which are hit by a microwave beam, generated by a convenient device. Moreover a fan cooperates, which provides to introduce an airflow. JP62277125 (Takusagawa), describes an absorption tower, in which, for the regeneration of gas, the use of microwave devices is provided able to optimize the dehumidification process of thin and gaseous material.

Prior Art closest to the Invention

[0009] US2004/0200090 (Tu et al.) suggests a drier for plastic, on the inside of which, in a corresponding container, a magnetic control tube is provided. The magnetic control tube is connected to a connecting tube which is provided, at one end, with an air filter, and at the other connected to a ventilation nozzle. The dried plastic is used by an apparatus for injection moulding.

[0010] JP4080005 (Nakagome) describes an apparatus for the moulding of plastic, in which a high pressure dehumidifier is provided. The hopper of a drier is provided with a dehumidifier that supplies air at high pressure, dehumidified in such a way that the pellets that are introduced into the drier are dehumidified by a hot airflow. An apparatus for moulding integrates said drier-dehumidifier.

[0011] JP63231908 (Nakagome) proposes a drier for plastic pellets. In this case, the pellets feed a drying cyl-

inder where a microwave generator and an aspirator operate. The condensation generated and evaporated inside the drying cylinder is extracted by the aspirator.

[0012] JP63216711 (Nakagome) provides an apparatus like the previous positioned upstream of a line for the moulding of plastic products.

[0013] JP63231909 (Nakagome) finally provides a drying apparatus that concerns pellets which feed a drying cylinder where a microwave generator and an aspirator operate. The condensation generated and evaporated in the drying cylinder is extracted by the aspirator. Inside the cylinder dehumidified air is supplied, the air which was once enriched with humidity is dehumidified and re-introduced inside the drying cylinder.

Disadvantages

[0014] The described apparatus, with particular reference to those of the chapter related to the closest prior art, have some disadvantages.

[0015] In principle, the drier-dehumidifier of pellets for apparatus which have the aim of plastic moulding is therefore known. However in JP4080005 (Nakagome), as in JP63231908 (Nakagome) the mere use of the airflow at a controlled temperature seems to be insufficient to obtain an effective and fast processing of the pellets.

[0016] It can also be reasonably affirmed that the problem treated synthetically above would seem at least partially solved with JP63231908 (Nakagome), US2004/0200090 (Tu et al.) and more so with JP63231909 (Nakagome). This is because in the analyzed proposals a microwave generator is provided that, hitting the mass of pellets participates in addition to the controlled airflow to obtain a more effective and faster processing.

[0017] EP0345020 (Kawata), is characterized in that the drying and crystallizing apparatus for granules, which is provided with a heating tank formed in a rectangular parallelepiped and having at one lengthwise side a material inlet and at the other lengthwise side a material outlet and with a microwave unit for radiating microwaves onto the granules charged in the heating tank, disposes a plurality of disc-like partitions across the material inlet and material outlet at the heating tank, forms a plurality of partitioned spaces between the respective adjacent partitions, and provides at each partition agitating vanes which agitate the granules in the partitioned spaces between the respective partitions and transfer them to the adjacent space at the material outlet side. A driving shaft disposed at the heating tank rotates to allow the vanes to agitate the granules within the spaces between the partitions, so that even when the microwaves radiated from microwave units are irregularly reflected in the heating tank, no variation is caused in heating the granules, and since the granules in each space are sequentially transferred by rotation of the agitating vanes toward the adjacent space at the material outlet side, variation in the residence time of the granules subjected to the mi-

crowave heating in the heating tank is eliminated. Accordingly, the microwaves radiate onto the granules of synthetic resin continuously charged in the heating tank, thereby enabling the entire granules to be uniformly and continuously dried and crystallized. Separately from a sealed heating tank having the material inlet and outlet and provided with a microwave unit, a sealed drying tank is provided which has a material inlet and a material outlet and is provided with a diffuser for dehumidifying air from a dehumidifying air feeder, and between the material output of the heating tank and the material inlet of the drying tank is provided connecting means for connecting the heating tank and drying tank, so that the granules heated by the heating tank are dried in the drying tank. The granules charged in the heating tank through the material inlet are quickly heated up to an optimum temperature to dry them by radiating the microwaves, the heated granules being discharged from the material outlet without waiting for drying, charged into the separate drying tank through the connecting means, and dried in the drying tank by the dehumidifying air from the dehumidifying air feeder. Hence, the drying capacity of the drying tank corresponds to the heating capacity of the heating tank, so that the microwave unit can always demonstrate its capacity without interrupting the microwave radiation, thereby improving its operating rate and enabling the granules to be continuously dried.

[0018] US6189234B1 discloses an apparatus for the dehumidification of loose materials, particularly pellets for plastic moulding plants including:

- a) at least a second container for the processing of the pellets;
- b) a circuit for the distribution of a dehumidified airflow inside said second container;
- c) means for the aspiration of the airflow enriched with humidity from the inside of said container; wherein:
- d) it comprises a first container to contain the pellet to be processed;
- e) the second container is in communication with said first container for the processing of the pellets, and comprises a main chamber with a fluidized bed provided by a perforated sheet and also with a mixer/advancement means of the pellets, in the main chamber;

wherein said second container, on the bottom of the chamber comprising an auger and for the whole length of the same, is provided with a fluidized bed provided by a perforated sheet underneath which an airspace for the distribution of a dehumidified airflow at a controlled temperature is provided, coming from an underlying heating chamber with which it is in communication through at least one intake and in which inside the heating chamber means are provided for the heating of the introduced air inside the same through an intake and upstream of which a pump group is operative, in a manner that the pellets,

thanks to the presence of the fluidized bed provided by the perforated sheet and mixer along the second container, subjected to the air jet at a controlled temperature, remains in a floating condition, which facilitates a uniform processing of the single particles.

[0019] In spite of this the applicant is of the opinion that the proposed solutions are not yet absolutely optimized, not allowing to reach optimal results, in terms of percentage capacity of elimination of the humidity originally present in the pellets, considering the time necessary for the execution of the processing.

[0020] To this it can be added that the aforementioned apparatus, do not seem to allow a uniform processing of the pellet, this is because the pellet is substantially static during the processing cycle, and follows a descending path. In principle it appears that the pellet stays in an amassed condition inside a hopper/container, during which it is processed, to be subsequently removed by gravity. This would involve particularly long processing times and the impossibility to obtain continuous processing cycles able to adequately supply the downstream moulding plant. In any case the installation would not be suitable for the processing of a quantity of pellets.

[0021] Also due to these disadvantages, there is the need for businesses in this sector, and in particular for businesses that mould plastic to find more effective solutions.

[0022] The aim of this invention is also to avoid the abovementioned disadvantages.

Brief Description of the Invention

[0023] This and other aims are reached with this invention according to the characteristics of the included claim, solving the problems stated by means of a continuous apparatus for the fast dehumidification of loose materials, particularly pellets for plastic moulding plants according to claim 1.

Aims

[0024] In such a way, through the considerable creative contribution, the effect of which constitutes immediate technical progress, various advantages are achieved.

[0025] A first aim has been that of finding an extremely functional and versatile apparatus, able to offer comprehensive high performance, and in particular to reach below the common threshold of 1% of residual humidity in processed material, qualitatively improving definitively what will then constitute the finished product. This result has also been achieved above all with reference to the fact that the pellet, thanks to the presence of the fluidized bed and mixer along the second container, subjected to the air jet at a controlled temperature, remains in a floating condition, which facilitates a uniform processing of the single particles.

[0026] A second aim, has been that of allowing contin-

uous processing cycles of the pellet, a circumstance that repeats by the fact of interconnecting a first container like a charging hopper, to a second container orthogonal to the first where the processing cycle of the pellet is performed, continuously ensuring a more correct and constant feeding of the possible downstream moulding plant.

[0027] A third aim was that of providing an apparatus able to considerably reduce the conventional dehumidification times of the pellet.

[0028] A third aim has been that of obtaining a less complex apparatus with respect to previous ones with a considerably reduced encumbrance and little maintenance.

[0029] It is also reasonable to affirm that with the proposed apparatus, it is possible to work directly at 180°, therefore, at an optimal temperature of the pellet, ready for melting, with a great advantage of energy recovery.

[0030] Finally, there are benefits from a financial point of view, because said apparatus, provided with good technological content, allows a considerable reduction of consumption even with an increase in performance.

[0031] These, and other advantages will appear from the following detailed description of a preferred solution with the aid of the enclosed schematic drawing, whose details are not to be considered limitative but only illustrative.

Content of the Drawings

[0032] Figure 1, represents a side-view of the apparatus for the fast and continuous dehumidification of loose materials, the object of this invention. Embodiment of the Invention

[0033] With reference to Figure 1, an apparatus A is observed, to dehumidify the loose material M, in particular pellets for the plastic moulding process by means of a possible apparatus positioned downstream of said apparatus A therefore suitable to receive the material M at the end of the processing cycle.

[0034] The apparatus A is essentially made up of two containers, respectively 1 and 2, which are intercommunicating. More particularly, the first container 1 is substantially a conical shaped container, in particular a vertical hopper, of the heated type, provided with a charge intake 100, and a discharge nozzle 101 of the loose material M, which introduces inside said second container 2 orthogonal with respect to said first container 1 and therefore placed horizontally. On the first container 1, sensors 102, 103 are provided which are of the tensioned type to indicate the level of loose material M present inside the container 1 and the relative humidity percentage and/or the present temperature inside said first container 1.

[0035] The second container 2 which is intercommunicating with said first 1, consists of a cylindrical body inside which a main chamber S is obtained for the processing of the material M. Inside the second container 2 a mixer/advancement means of the material M is

present, in this case an auger 3, whose propeller is developed longitudinally and is integral to a support shaft whose ends, 30 and 31 are engaged, respectively, at the head 20, and at a ratio motor assembly 4 at the opposite side, for the rotating movement of the auger 3. On the upper side of the container 2 microwave generator devices 5 and 6, in particular magnetrons, are aligned and placed spaced apart on the side of container 1, in such a way to direct their action towards the underlying main chamber S of the second container 2. At the side of the head 20 of the container 2, in the part underlying it, a discharge nozzle 21 of the loose material M is obtained, intercepted downstream by at least one humidity and/or temperature and/or weight sensor 22, that precedes a valve supplying a predetermined quantity 23. On the bottom of the chamber S abutting the auger 3 and for the whole length of the same, a sintered sheet 7 is present underneath which is obtained an airspace 8 for the distribution of a dehumidified airflow at a controlled temperature, coming from an underlying heating chamber 9 with which it is in intercommunication by at least one intake 90. Inside the heating chamber 9 electric resistance means 91 are provided, which provide the heating of the dehumidified air introduced inside the same through an intake 92 and upstream of which a pump group is operative (not shown). In this case, the apparatus A is also provided with a recovery system of the airflow at a controlled temperature which is introduced inside the main chamber S in such a way that said airflow enriched with humidity, is to be extracted (by means of the aspiration assembly) from said main chamber S and therefore started through a circuit that allows the dehumidification (not shown) to then be reintroduced again through the intake 92 inside the heating chamber 9.

[0036] In a preferred solution the apparatus A can be placed in such a way as to feed a plastic moulding plant, alternatively to allow the packaging of the loose material M and its following storage in surroundings suitable for that purpose.

Claims

1. Apparatus for the dehumidification of loose materials, particularly pellets for plastic moulding plants including:

- a) at least a second container (2) for the processing of the pellets (M), in which microwave generators (5 and 6) operate;
 - b) a circuit for the distribution of a dehumidified airflow inside said second container (2);
 - c) means for the aspiration of the airflow enriched with humidity from the inside of said second container (2), for allowing said airflow to be subsequently dehumidified and reintroduced inside said second container (2);
- wherein:

d) it comprises a first vertical container (1) to contain the pellets to be processed; said first vertical container (1) is a conical shaped container, heated, provided with a charging intake (100), and a discharge nozzle (101) of the loose material (M), which leads inside said second container (2) orthogonal with respect to said first container (1) which is placed horizontally, said first vertical container (1) being provided with sensors (102, 103) which indicate the level of loose material (M) present inside the container (1) and the relative humidity percentage and/or the present temperature inside said first container (1);

e) the second container (2), is in communication with said first container (1) for the processing of the pellets (M), and comprises a main chamber (S) with a fluidized bed and also with a mixer/advancement means (3) of the pellets (M), in the main chamber (S) in which, said microwave generators (5 and 6) operate on the upper side of the container (2), said microwave generator devices (5 and 6) are aligned and placed spaced apart in such a way to direct their action towards the underlying main chamber (S) of the second container (2); Wherein said second container (2), on the bottom of the main chamber (S) comprises an auger (3) and for the whole length of the same, is provided with a fluidized bed provided by a sintered sheet (7), underneath which an airspace (8) for the distribution of a dehumidified airflow at a controlled temperature is provided, coming from an underlying heating chamber (9) with which it is in communication through at least one intake (90) and in which inside the heating chamber (9) electric resistance means (91) are provided for the heating of the introduced dehumidified air inside the same through an intake (92) and upstream of which a pump group is operative, in a manner that the pellets (M), thanks to the presence of the fluidized bed along the second container, subjected to the air jet at a controlled temperature, remains in a floating condition, which facilitates a uniform processing of the single particles, said second container (2) comprising, at the side of a head (20), in the part underlying it, a discharge nozzle (21) of the loose material (M), said discharge nozzle (21) comprising downstream at least one humidity and/or temperature and/or weight sensor (22), that precedes a valve supplying a predetermined quantity (23) in a manner that allows continuous processing cycles of the pellets.

Patentansprüche

1. Vorrichtung zur Entfeuchtung von Schüttgut, beson-

ders Granulat für eine Kunststoffformanlage, mit:

- a) mindestens einem zweiten Behälter (2) zur Verarbeitung des Granulats (M), in dem Mikrowellengeneratoren (5 und 6) arbeiten;
- b) einem Kreislauf zur Verteilung eines entfeuchteten Luftstroms in besagtem zweiten Behälter (2);
- c) Mitteln zur Ansaugung des Luftstroms, der mit Feuchtigkeit aus dem Innern des zweiten Behälters angereichert ist, um den Luftstrom anschließend zu entfeuchten und wieder in den zweiten Behälter (2) einzuführen, wobei:
- d) sie einen ersten senkrechten Behälter (1) umfasst, der das zu verarbeitende Granulat enthält; besagter erster senkrechter Behälter (1) ist ein konischer Behälter, erhitzt, mit einer Beladungsöffnung (100) und einem Ablassstutzen (101) für das Schüttgut (M), der in besagten zweiten Behälter (2) rechtwinklig zum ersten Behälter (1) führt, der horizontal gelegen ist, wobei besagter erster senkrechter Behälter (1) mit Sensoren (102, 103) ausgestattet ist, die die Schüttguthöhe (M) in dem Behälter (1) und die relative Luftfeuchtigkeit in Prozent angeben und/oder die Temperatur in dem ersten Behälter (1);
- e) der zweite Behälter (2) steht in Verbindung mit besagtem ersten Behälter (1) zur Verarbeitung des Granulats (M) und umfasst eine Hauptkammer (S) mit einem Fließbett und auch mit einem Misch-/Vorschubmittel (3) für das Granulat (M), in der Hauptkammer (S), in der die Mikrowellengeneratoren (5 und 6) auf der Oberseite des Behälters (2) arbeiten; besagte Mikrowellengenerator-Vorrichtungen (5 und 6) sind derart ausgerichtet und beabstandet, dass sich ihre Wirkung auf die darunter liegenden Hauptkammer (S) des zweiten Behälters (2) richtet;

wobei der zweite Behälter (2), auf dem Boden der Hauptkammer (S) eine Schnecke umfasst (3) und über seine gesamte Länge ein Fließbett aufweist, mit einem gesinterten Blech (7), unter dem ein Luftraum (8) zur Verteilung eines entfeuchteten Luftstroms bei kontrollierter Temperatur vorgesehen ist, der von einer darunter liegenden Heizkammer (9) kommt, mit der er durch mindestens einen Einlass (90) in Verbindung steht und in der in der Heizkammer (9) elektrische Widerstandsmittel (91) zur Erwärmung der eingeführten entfeuchteten Luft darin durch einen Einlass (92) vorgesehen sind, wobei stromaufwärts eine Pumpengruppe arbeitet, so dass das Granulat (M) dank des Fließbetts entlang den zweiten Behälter, der dem Luftstrahl bei einer kontrollierten Temperatur unterliegt, schwebt; was eine gleichmäßige Verarbeitung der einzelnen Teilchen erleichtert, wobei der zweite Behälter (2) an der Seite eines Kopfes (20), in dem Teil darunter, einen Ab-

lassstutzen (21) für das Schüttgut (M) umfasst, wobei dem Ablassstutzen (21) mindestens ein Feuchtigkeitssensor (22) nachgeschaltet ist, der einem Ventil vorausgeht, das eine vorherbestimmte Menge (23) liefert, was kontinuierliche Verarbeitungszyklen des Granulats gestattet.

10 Revendications

1. Dispositif pour la déshumidification de matériaux en vrac, notamment de granules pour une machine de moulage de matières plastiques, comprenant:

- a) au moins un deuxième récipient (2) pour le traitement des granules (M), dans lequel des générateurs de micro-ondes (5 et 6) opèrent;
- b) un circuit pour la distribution d'un courant d'air déshumidifié dans ledit deuxième récipient (2);
- c) des moyens pour l'aspiration du courant d'air enrichi avec l'humidité de l'intérieur dudit deuxième récipient (2), pour permettre audit courant d'air d'être ensuite déshumidifié et réintroduit dans ledit deuxième récipient (2), où:
- d) il comprend un premier récipient vertical (1) pour contenir les granules à traiter; ledit premier récipient vertical (1) est un récipient conique, chauffé, pourvu d'une entrée de chargement (100) et d'un orifice de décharge (101) du matériel en vrac (M), qui conduit dans ledit deuxième récipient (2) orthogonal par rapport au dit premier récipient (1) qui est placé horizontalement, ledit premier récipient vertical (1) étant pourvu de détecteurs (102, 103) qui indiquent le niveau du matériel en vrac (M) présent dans le récipient (1) et le pourcentage d'humidité relative et/ou la température présente dans ledit premier récipient (1);
- e) le deuxième récipient (2) est en communication avec ledit premier récipient (1) pour le traitement des granules (M), et il comprend une chambre principale (S) avec un lit fluidifié et également avec un mélangeur / moyen d'avancement (3) des granules (M), dans la chambre principale (S) où lesdits générateurs de micro-ondes (5 et 6) opèrent sur le côté supérieur du récipient (2), lesdits dispositifs générateurs de micro-ondes (5 et 6) sont alignés et espacés de façon à diriger leur action vers la chambre principale située en dessous (S) du deuxième récipient (2);

Où ledit deuxième récipient (2), sur le fond de la chambre principale (S) comprend une hélice (3) et tout le long de la même, il est pourvu d'un lit fluidifié pourvu d'une tôle frittée (7), au-dessous de laquelle un espace aérien (8) pour la distribution d'un courant

d'air déshumidifié à une température contrôlée est prévu, en provenance d'une chambre de chauffage située en dessous (9) avec laquelle il est en communication par au moins une entrée (90) et où dans la chambre de chauffage (9) des moyens de résistance électrique (91) sont prévus pour le chauffage de l'air déshumidifié introduite dans la même à travers une entrée (92) et en amont desquelles un groupe de pompage est actif, de manière que les granules (M), grâce à la présence du lit fluidifié le long du deuxième récipient, soumis au jet d'air à une température contrôlée, restent dans une condition flottante, ce qui facilite un traitement uniforme de chaque particule, ledit deuxième récipient (2) comprenant, du côté d'une tête (20), dans la partie située dessous, un orifice de décharge (21) du matériel en vrac (M), ledit orifice de décharge (21) comprenant en aval au moins un capteur d'humidité et/ou de la température et/ou de poids (22), qui précède une soupape qui fournit une quantité prédéterminée (23) pour permettre des cycles de traitement continus des granules.

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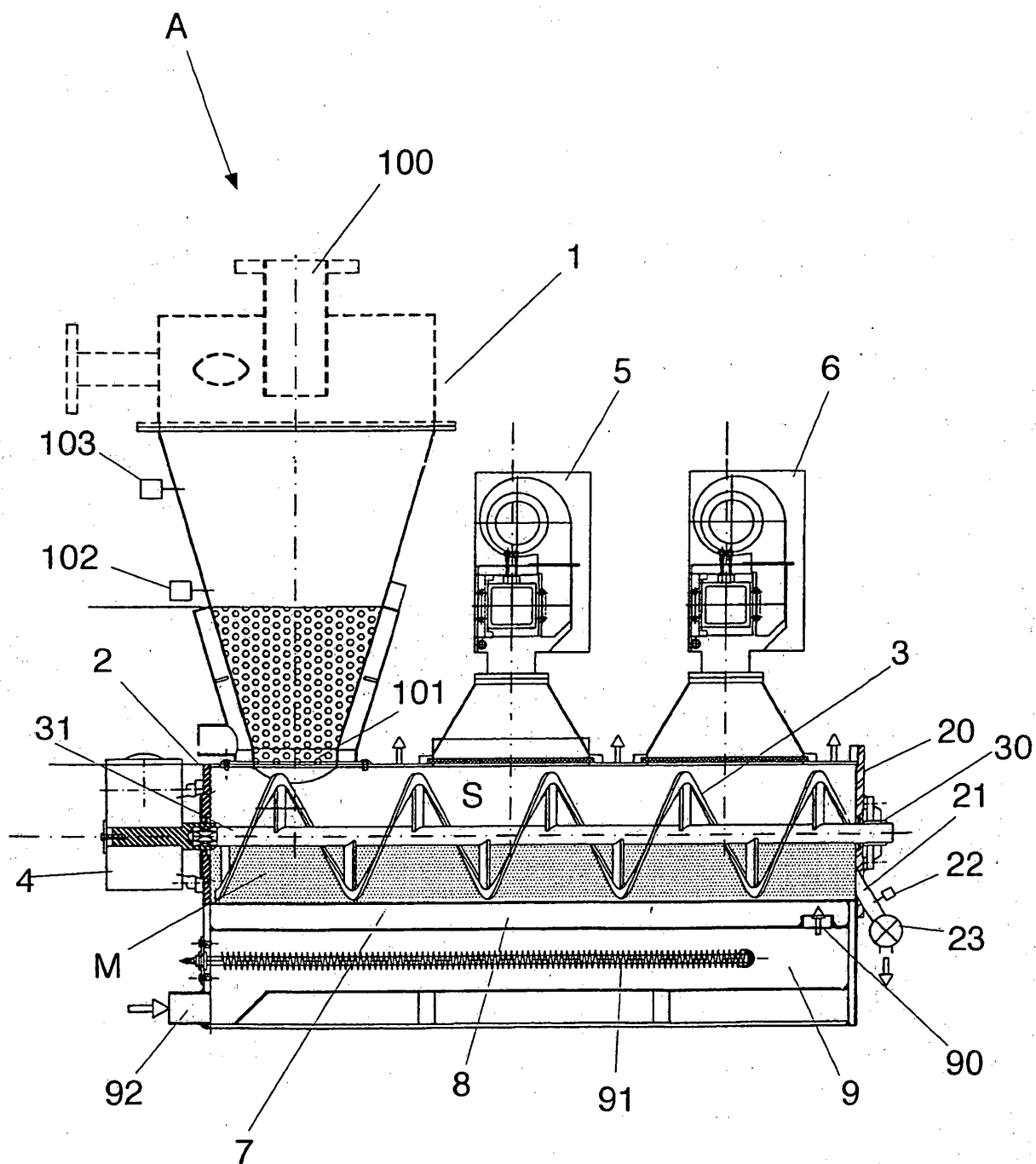


FIG 1

REFERENCES CITED IN THE DESCRIPTION

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