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

(57) Continuous apparatus (A) for the fast dehumidification of loose materials (M), particularly pellets for plastic moulding plants, consisting of:

-a first vertical container (1) to contain the pellets to be processed;

-a second container (2), orthogonal and in communication with said first for the processing of the pellets, with a fluidized bed and longitudinal auger (3), on which microwave generators (5,6) operate;

-a circuit for the distribution of a dehumidified airflow at a controlled temperature inside said second container (2);

-means for the aspiration of the airflow at a controlled temperature and enriched with humidity from inside said second container (2), for then said airflow to be dehumidified and reintroduced inside said second container (2);

-sensor means (22,102,103) for the detection of the temperature and humidity percentage present in the pellets at least in said second container (2).

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DescriptionDomain of the Invention

5 **[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.

10 **[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 pre-emptively 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

20 **[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 circulation of the airflow, the evaporation of the water held inside the molecular sieve, being of the type provided with a convenient heat exchanger.

35 **[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.

40 **[0007]** In ITTV97A000072 (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.

45 **[0008]** Apparatus suitable to dehumidify, provided with devices that generate microwaves, are certainly known. For example, in JP703971 6 (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.

50 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

55 **[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 cylinder 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 reintroduced 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] 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.

[0018] 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.

[0019] 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.

[0020] The aim of this invention is also to avoid the abovementioned disadvantages.

Brief Description of the Invention

[0021] This and other aims are reached with this invention according to the characteristics of the included claims, solving the problems stated by means of a continuous apparatus for the fast dehumidification of loose materials, particularly pellets for plastic moulding plants consisting of:

- a first vertical container to contain the pellet to be processed;
- a second container, orthogonal and in communication with said first for the processing of the pellet, with a fluidized bed and longitudinal auger, on which the microwave generators operate;
- a circuit for the distribution of an airflow at a controlled and dehumidified temperature inside said second container;
- means for the aspiration of the airflow at a controlled temperature and enriched with humidity from inside said second container, for then said airflow to be dehumidified and reintroduced inside said second container;
- sensor means for the detection of the temperature and humidity percentage present in the pellet at least in said second container.

Aims

[0022] In such a way, through the considerable creative contribution, the effect of which constitutes immediate technical progress, various advantages are achieved.

[0023] 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.

[0024] A second aim, has been that of allowing continuous 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.

[0025] A third aim was that of providing an apparatus able to considerably reduce the conventional dehumidification times of the pellet.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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

[0030] 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

[0031] 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.

[0032] 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.

[0033] 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 an airflow at a controlled dehumidified 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.

[0034] 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 fast dehumidification of loose materials, particularly pellets for plastic moulding plants including:

- a) at least one container 2 for the processing of the pellet M, in which microwave generators 5 and 6 operate;
 b) a circuit for the distribution of a dehumidified airflow inside said container;
 c) means for the aspiration of the airflow enriched with humidity from the inside of said container, said airflow being subsequently dehumidified and reintroduced inside said container;

characterised in that:

- d) it provides a first vertical container 1 to contain the pellet to be processed;
 e) the second container 2, is orthogonal and in communication with said first 1 for the processing of the pellet M, and provides a main chamber S with a fluidized bed 7 and also with a mixer/advancement means of the pellet M, in the main chamber S of which, microwave generators 5 and 6 operate;
 f) a circuit for the distribution of an airflow at a controlled and dehumidified temperature inside said second container 2;
 g) means for the aspiration of the airflow at a controlled temperature and enriched with humidity from the inside of said second container 2, said airflow subsequently being dehumidified and reintroduced inside said second container 2.

2. Apparatus for the fast dehumidification of loose plastic materials, according to claim 1., **characterised in that** on the first container 1, sensors, 10 2, 10 3 are provided which indicate the level of the pellet M present inside the container 1 and the relative humidity percentage and/or the temperature present inside said first container 1.

3. Apparatus for the fast dehumidification of loose plastic materials, according to claims 1 and 2, **characterised in that** the first container 1 is a conical shaped container, like a vertical hopper, heated, provided with a charging intake 1 00, 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.

4. Apparatus for the fast dehumidification of loose plastic materials, according to the previous claims, **characterised in that** inside the second container 2 a mixer/advancement means of the material M is present, similar to 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 on the opposite side, for the rotating movement of the auger 3 and in which on the upper side of the container 2 at the side of container 1, microwave generator devices 5 and 6, in particular magnetrons, 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.

5. Apparatus for the fast dehumidification of loose plastic materials, according to the previous claims, **characterised in that** on the side of the head 20 of the container 2, in the part underneath 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.

6. Apparatus for the fast dehumidification of loose plastic materials, according to the previous claims, **characterised in that** in the second container 2, 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 an airspace 8 for the distribution of an airflow at a controlled dehumidified temperature is obtained, 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.

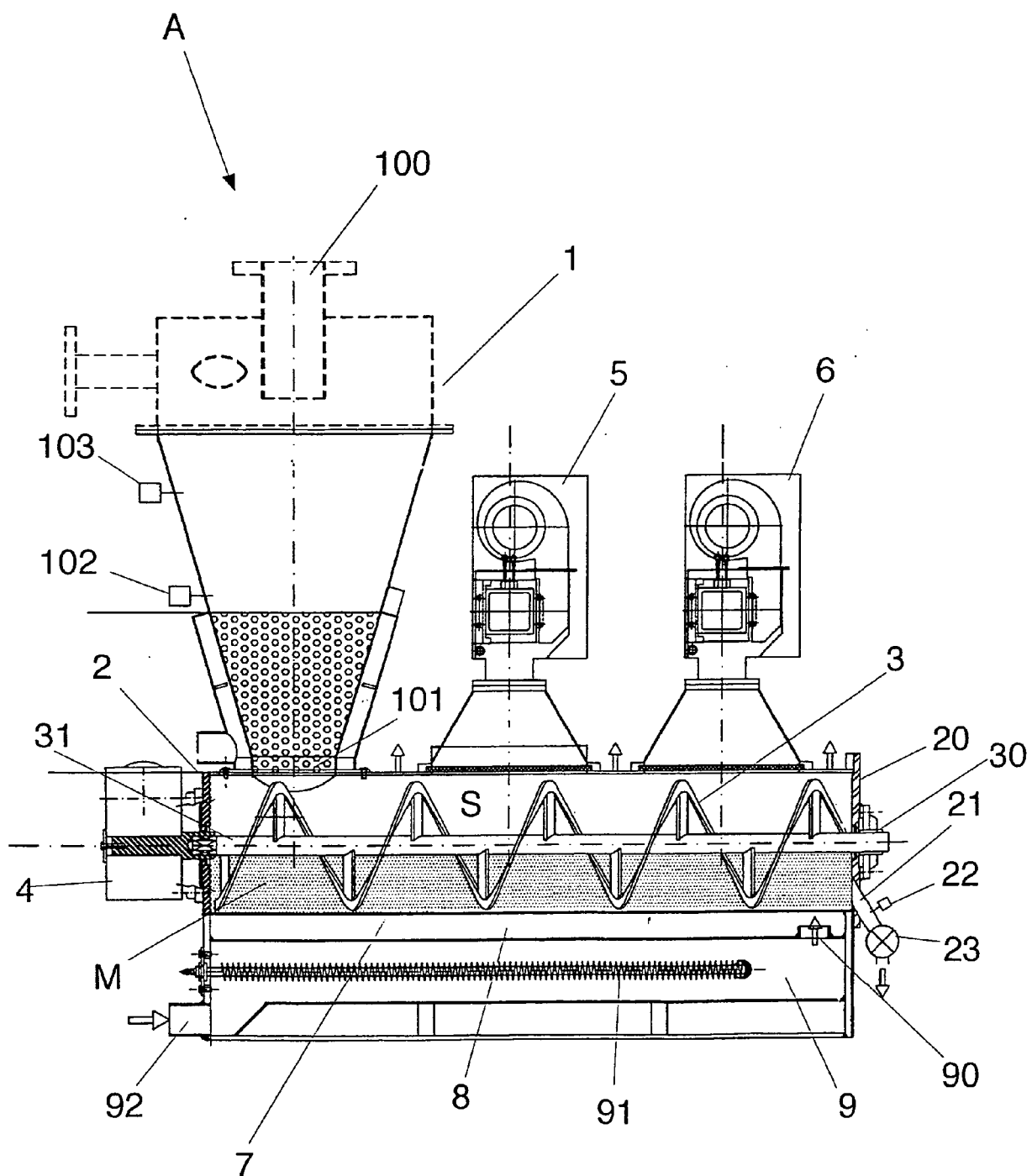


FIG 1

REFERENCES CITED IN THE DESCRIPTION

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