United States Patent

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[33] **Italy**
[31] **No. 29502a/66**

[54] **METHOD AND APPARATUS FOR PROCESSING DISCRETE COMMODITIES**
16 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **209/3,** 34/57, 34/102, 34/164, 209/10, 209/31, 209/133
[51] **Int. Cl.** **B07b 3/00**
[50] **Field of Search** ..... 34/10, 57(A), 164, 216, 217, 227, 236, 102; 198/220(B–40); 209/3, 10, 12, 31, 36, 37, 138, 139, 142, 133, 133(T)

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ABSTRACT: The invention relates to the processing of discrete commodities wherein the commodities are conveyed along a confined path in a predetermined direction from an inlet towards an outlet end of the path, and wherein the commodities are contacted in the path with two streams of gas, one of which flows concurrently with the predetermined direction and the other of which flows in countercurrent to the predetermined direction so that the commodities are cooled while separable solid particles adhering or admixed with the commodities are simultaneously withdrawn by these streams of gas.

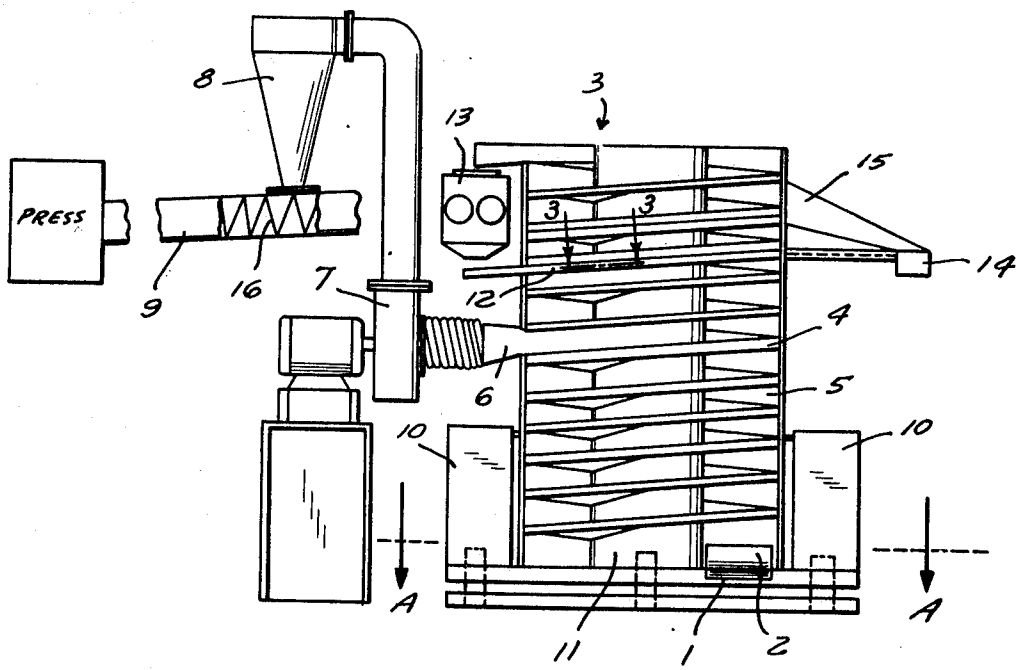


FIG. 1

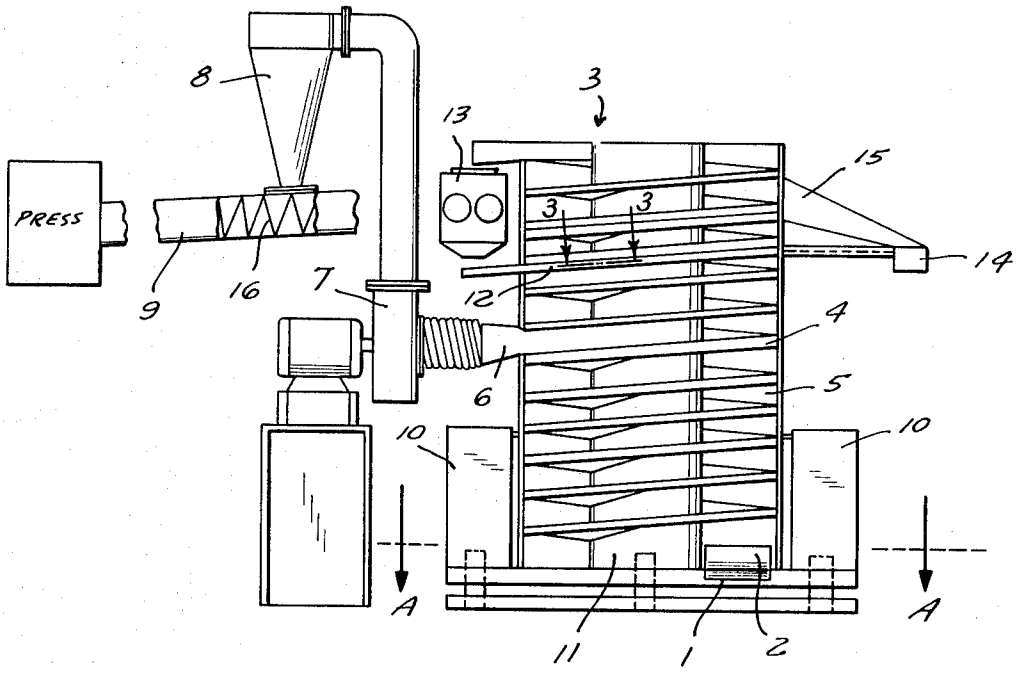


FIG. 2

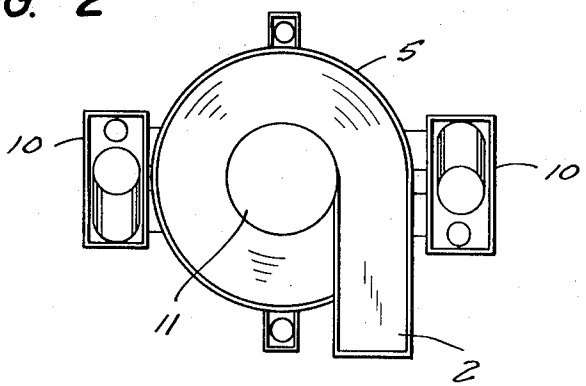
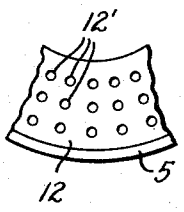


FIG. 3



INVENTORS

BY

ATTORNEY

METHOD AND APPARATUS FOR PROCESSING DISCRETE COMMODITIES

This application is a continuation of Pat. application Ser. No. 679,501, filed Oct. 31, 1967.

BACKGROUND OF THE INVENTION

The present invention relates generally to the processing of discrete commodities and more particularly to the processing of the discrete commodities of the type consisting of compacted powdery materials and/or having adhering thereto solid particles of their base material or of other materials.

This invention is particularly applicable to the processing of such granular or powdery materials as fodder, fertilizers or the like which have undergone "cubing" or "pelleting," that is compacting into the form of cubes or pellets. However, it is by no means limited in this manner and will be described hereafter with reference to this particular application only as an example of a highly advantageous field of employment.

It is well known, as already suggested above, to "cube" or "pellet" such powdery materials as fodder, fertilizers and analogous materials by compacting quantities of such materials into discrete bodies which may have various different shapes and sizes, for instance small cylindrical bodies having a diameter ranging between approximately 2 and 16 mm and a length ranging between approximately 5 and 15 mm. Of course, these dimensions are again only given by way of example and are not limiting in any sense. These bodies will hereafter for the sake of convenience of identification be referred to as "commodities" or "discrete commodities."

The conventional approach to the treatment of such materials comprises four stages, namely the initial compacting of the powdery material into discrete commodities, the cooling of these commodities in a special cooler to reduce their temperature which usually becomes elevated either as a result of the pressure to which the material has been subjected during compacting, or because of steaming to which the material is sometimes subjected during the compacting stage. "crumbing" to obtain the desired size for the individual discrete commodities by passing them through a crumber between rollers whose distance from one another is adjustable, and sifting to remove adhering solid particles, usually in an inclined sifter to which a reciprocating motion is imparted by means of an eccentric cam. Conventionally, the compacted discrete commodities are taken from the press in which they have been compacted, to a cooler which is located higher than the press, for instance by means of a bucket elevator or the like. Once the commodities are discharged from the cooler they pass in intermittent batches through the crumber (which can be eliminated if no need for it exists) and the sifter. In some instances of the prior art the solid particles which have been separated from the discrete commodities in the sifter are recovered and conveyed back to the compacting press, for instance by a bucket elevator or a small pneumatic conveyor.

These known prior-art constructions are by no means inoperative. However, they do not permit the continuity of processing in all stages of operation, they are relatively complex and therefore require undesirably large technical and economic expenditures, they require expensive erection and maintenance services and they have very large space requirements.

SUMMARY OF THE INVENTION

The present invention avoids the disadvantages outlined above. More particularly, the present invention provides a method of processing discrete commodities in which all stages can be carried out continuously and in which cooling of the commodities and removal and recovery of the separable solid particles are accomplished in a single operation, thus saving time and labor and reducing the complexity of the installation.

Furthermore, the present invention provides for an apparatus which is considerably simpler than those known from the prior art and which thus requires smaller economic and technical investments and needs considerably less maintenance and repair. The space requirements of the apparatus according to the present invention are also much smaller than is known from the prior art.

In accordance with one feature of our invention we provide a method of processing discrete commodities wherein the commodities are advanced in a predetermined direction along a confined path from an inlet towards an outlet of the path, and wherein the commodities are contacted in an upstream section of the path with a concurrent flow of gas, and in a downstream section of the path with a countercurrent flow of gas. In this manner not only obtain cooling of the commodities in a most advantageous manner, but the same gas which effects cooling of the commodities also serves to remove the separable solid particles from the commodities so that they may be recovered for further use.

By providing the two oppositely directed gas streams we assure that those of the commodities which have already passed downstream beyond the confluence of the two gas streams will not be contacted by the separated solid particles being removed from the commodities which newly enter at the inlet of the confined path and which have of course still a maximum percentage of separable solid particles adhering to them.

The invention also concerns an apparatus for carrying out this method, and this apparatus comprises in accordance with another feature of our invention a housing which includes an inlet and an outlet spaced from the inlet, and conveying means which is arranged in the housing and which is operative for conveying discrete commodities with adherent separable solid particles from the inlet towards the outlet of the housing. Gas-stream producing means is associated with the housing and is operative for producing a first stream of gas which flowing direction from the inlet towards the outlet concurrently with the commodities, and a second stream of gas which flows in direction from the outlet toward the inlet in counterflow to the commodities.

In the apparatus according to our invention we utilize a vibratory conveyor of the type which is generally known and wherein the discrete commodities advance in a helical path. In utilizing this type of conveyor we have had excellent results, a fact which is somewhat surprising in view of the technical prejudice according to which the use of such a conveyor for materials of the type in question was expected to lead to such problems as undesirable chalking and pulverization, as well as to insufficient cooling. In fact, our apparatus successfully combines solutions to requirements—namely to prevent disintegration of the compacted discrete commodities and thorough cooling of the same—which heretofore appeared to be contradictory where the utilization of a vibratory conveyor was involved.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat schematic, partially broken away sectional elevation of an apparatus embodying our invention.

FIG. 2 is a section taken on the line A–A of FIG. 1.

FIG. 3 is a view taken along line 3–3 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, we have diagrammatically illustrated a press of conventional construction in which the raw material, such as fodder, fertilizer or the like, is introduced in powdery or granular state and is compacted into individual bodies, the "discrete commodities" to which reference is being had throughout this specification. This press is of any conventional well known construction and need not be further described.

From the press the discrete commodities, which are identified with reference numeral 1, are supplied, in a manner which is of no consequence for the purposes of the present invention, to the inlet 2 of an apparatus 3 which embodies our present invention. The drawing illustrates that the apparatus 3 comprises a vibratory conveyor which, in the illustrated embodiment, is a substantially vertical vibratory elevator having a plurality of helical convolutions 4. This type of vibratory conveyor is well known, both as to its construction and its principle, and a detailed discussion of either of these is therefore not necessary. The conveyor 4 is externally surrounded or encompassed by a housing or shell 5, and preferably the housing 5 is connected to the conveyor 4 in such a manner as to be gastight therewith except for the inlet 2 and the outlet.

In accordance with the present invention we provide, in the illustrated embodiment, a ventilator or fan 7 whose air intake 6 communicates with the interior of the housing 5 intermediate the inlet 2 and the outlet thereof. In the illustrated embodiment this communication takes place at a location substantially midway between the inlet and outlet although such location is not fixed and could, for instance, be provided at a point located in a range midway between the inlet and outlet and two-thirds from the inlet towards the outlet.

The important point is that the communication takes place intermediate the inlet and the outlet because by this expedient we obtain two currents of air, namely a concurrent flow of air moving in direction from the inlet 2 towards the outlet along with the discrete commodities which move in the same direction, namely vertically in the illustrated embodiment, and a countercurrent flow of air which moves from the outlet in the direction towards the inlet 2 in countercurrent to the movement of the discrete commodities. These airstreams of course contact the commodities moving along the helical convolutions of the conveyor 4, and effect efficient cooling of these commodities. At the same time, however, the airstreams effect removal of dust and solid particles adhering to or admixed with the discrete commodities and this dust and solid particles are withdrawn through the intake 6 of the fan or ventilator 7. It is clear, of course, that the space between the successive convolutions of the conveyor 4 and the width of the path defined thereby must be such as to obtain, as a function of the volume of moving air, an airspeed which is sufficient to carry along the solid particles. Such calculations are simple and will be readily obvious to those skilled in the art.

Solid particles withdrawn from the interior of the housing 5 through the air intake 6 of the fan or ventilator 7 are advantageously conveyed to a decanter room, hopper or cyclone 8 which is not illustrated in detail because it is entirely conventional, and from there are fed to the feed conveyor 9 whose feed screw 16 conveys them to the press for conversion into compacted discrete commodities.

Reference numerals 10 indicate vibrators of known construction which, unlike conventional arrangements, however, in the illustrated embodiment are connected to the housing 5 rather than to the vibratory conveyor 4 itself. Customarily, such vibrators are connected to the central support column 11 but in the illustrated embodiment we obtain, by connecting them via special connecting arrangements to the housing 5, a construction in which the inlet 2 for the compacted commodities can be arranged at a very low level of the structure 3, almost at the very bottom thereof, and this of course makes it possible to greatly reduce the height of the overall structure, particularly in view of the fact that it permits the elimination of that lower portion of the central column 11 to which the vibrators are normally connected and which is not usable for purposes of material conveyance.

If desired the arrangement may be used in conjunction with a crumber 13 which is located exteriorly of the structure 3, as illustrated in FIG. 1. If such a crumber 13 is in fact used, and it is again emphasized that it may be omitted, then the discrete commodities 1 are fed thereto in the manner obvious from FIG. 1. Upon passing through the crumber 13 it is then necessary to sieve the commodities treated in the crumber 13 so as to free them from the dust produced during the crumbing treatment during which, as is well known, the commodities are partly crushed. For this purpose we provide, if the arrangement is used in conjunction with the crumber, a supplemental path 12 in form of a guideway corresponding substantially to the guideway which fashions the convolutions of the vibratory conveyor 4. This supplemental path or guideway 12 is arranged upwardly of the intake 6 in the illustrated embodiment and consists of a trough or sieve which may for example be fashioned from perforated sheet metal. The supplemental path 12 is located intermediate two adjacent convolutions of the vibratory conveyor 4 and, because it need be only short, its length may for instance correspond to one-half or two-thirds of one of the helical convolutions. The commodities treated in the crumber 13 fall onto or are conveyed to the path 12 and pass therealong, as a result of vibratory conveyance, to the bagging outlet 14. During passage over the path 12 the dust is removed in the same manner as solid particles have been previously removed during passage of the discrete commodities 1 along the vibratory conveyor 4.

It is clear, of course, that if no resort is had to the crumber 13, then the path 12 will also not be present and the cooled and cleaned discrete commodities will instead be discharged via the discharge channel or conduit 15 to the bagging outlet 14.

With the apparatus according to the present invention the relatively delicate compacted commodities may be thoroughly and rapidly cooled and freed from adhering solid particles, or from solid particles admixed therewith, without damage to the commodities and at a speed and continuity of operation not heretofore known. It is also clear, particularly from a consideration of the drawing, that the apparatus according to the present invention is compact and can be readily disassembled into its constituent components, all of which are prefabricated selfcontained units. This makes it possible to assemble and disassemble the apparatus according to the present invention rapidly and without the need for trained personnel with specialized skills. The absence of rotary members of the type necessary in conventional apparatus of this type for conveying and sifting purposes greatly reduces the need for maintenance and repair.

It will be understood that the illustrated embodiment has been shown by way of example only and is not to be considered limited. Modifications will readily occur to those skilled in the art and do not require deviation from the basic inventive concept. Thus, movement of air by suction, as illustrated in the embodiment hereindiscussed, can be replaced by producing airstreams under pressure, and for this purpose a fan or blower can be provided at each of the opposite ends of the vibratory conveyor, or a single fan or compressor can be utilized with each of its two sides (namely the intake side and the output side) being connected to one end of the housing 5. Of course, if suction is replaced by pressure, the air intake 6 will be replaced by a simple conduit into which the two airstreams can enter and which is connected with the member 8. Also, another gas can be utilized instead of air, it being understood that such gas must be chemically inert with reference to the commodities which are being treated. Auxiliary cooling may be provided, for instance by circulating a liquid through a jacket provided on the housing 5, or through cooling channels provided in the vibratory conveyor 4, or both. Finally it must again be emphasized that while the present invention has been described herein with reference to the treatment of fodder and fertilizers, it is by no means so limited and is applicable wherever discrete articles, which are admixed or which have adhering thereto solid particles, must be separated from such solid particles and/or be cooled.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of applications differing from the types described above.

While the invention has been illustrated and described as embodied in the treatment of discrete commodities, it is not

intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

We claim:

1. A method of processing discrete commodities comprising the steps of advancing discrete commodities with adherent solid particles in upward direction from the inlet toward the outlet of a helically convoluted upwardly extending confined path by imparting to said commodities a vibratory motion; contacting the commodities with a concurrent flow of gas in the lower section of said path so that the gas assists the transport of commodities in said lower section to transport the commodities upwardly counter to the action of gravity, while the combined action produced by the vibration and the gas flow separates said solid particles from said discrete commodities; and contacting said commodities and said solid particles separated therefrom with a countercurrent flow of gas in the upper section of said path so that the gas transports the separated particles in the direction opposite to the direction of movement of said discrete commodities.

2. A method as defined in claim 1, wherein the steps of contacting said commodities comprise applying suction intermediate said inlet and said outlet of said confined path.

3. A method as defined in claim 1, further comprising the step of recovering the separated solid particles for subsequent processing.

4. A method as defined in claim 1, wherein said steps are carried out simultaneously.

5. Apparatus for processing discrete commodities, particularly pellets of compacted fodder and analogous materials, comprising a housing having an inlet and an outlet located at a level above said inlet; conveying means arranged in said housing and comprising a vibratory conveyor including a helical chute extending between said inlet and said outlet for conveying discrete commodities with adherent separable solid particles from said inlet toward said outlet; and gas stream producing means communicating with said housing intermediate said inlet and said outlet and operative to produce a first stream of gas flowing in a direction from said inlet to said outlet concurrently with the commodities and a second stream of gas flowing in a direction from said outlet toward said inlet countercurrent to the commodities.

6. Apparatus as defined in claim 5, wherein said gas stream producing means comprises suction generating means.

7. Apparatus as defined in claim 6, wherein said suction generating means communicates with said housing substantially midway between said inlet and said outlet.

8. Apparatus as defined in claim 5, wherein said gas stream producing means produces streams of gas at a rate sufficient for cooling said commodities and for simultaneously withdrawing solid particles therefrom.

9. Apparatus as defined in claim 8. wherein said gas stream producing means includes conduit means arranged to receive solid particles withdrawn from said commodities by said first and second gas streams and to convey such solid particles to a processing station for subsequent processing.

10. Apparatus as defined in claim 9, wherein said conduit means communicates with said housing at a location intermediate said inlet and said outlet thereof and arranged so that both said streams of gas exit from said housing therethrough.

11. Apparatus as defined in claim 5, further comprising sifting means arranged to receive commodities from said housing and operative to separate additional solid particles from such commodities, said sifting means including apertured guide means defining an auxiliary helically convoluted path located in said housing intermediate two successive convolutions of said chute and communicating with said outlet, whereby additional solid particles are separated from commodities during movement along said guide means to said outlet and such additional solid particles are withdrawn by said gas stream producing means.

12. Apparatus for processing discrete commodities, particularly pellets of compacted fodder and analogous materials, comprising a housing having an inlet and an outlet spaced from said inlet; conveying means installed in said housing and operative to convey discrete commodities with adherent separable solid particles from said inlet toward said outlet, said conveying means comprising a vibratory conveyor including a helical chute defining a helically convoluted path; gas stream producing means associated with said housing and operative to produce a first stream of gas flowing in a direction from said inlet toward said outlet concurrently with said commodities, and a second stream of gas flowing in a direction from said outlet toward said inlet in counterflow to said commodities, said gas stream producing means being arranged to produce streams of gas at a rate sufficient for cooling said commodities and for simultaneously withdrawing solid particles therefrom, said gas stream producing means including conduit means arranged to receive solid particles withdrawn from said commodities by said first and second gas streams and to convey such solid particles to a processing station for subsequent processing, said conduit means communicating with said housing at a location intermediate said inlet and said outlet and arranged so that both said streams of gas exit from said housing therethrough; and sifting means for receiving treated commodities and including apertured guide means defining an auxiliary helically convoluted path located in said housing intermediate two successive convolutions of said chute and communicating with said outlet.

13. Apparatus as defined in claim 12, wherein said guide means is located intermediate said location and said outlet.

14. Apparatus as defined in claim 12, wherein said housing surrounds said chute in gastight relationship intermediate said inlet and said outlet.

15. Apparatus as defined in claim 14, wherein said conveying means comprises vibration producing means operatively connected with said housing externally thereof for vibrating the same and thereby said helical chute.

16. Apparatus as defined in claim 12, further comprising an auxiliary device arranged to receive said commodities from said housing and operative to subject said commodities to a treatment resulting in separation of additional solid particles therefrom, said sifting device being associated with said auxiliary device for receiving said additional solid particles therefrom whereby said additional solid particles are separated from said treated commodities during movement along said guide means to said outlet and said additional solid particles are withdrawn by said gas stream producing means.