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CYCLONE DISCHARGE CHAMBER

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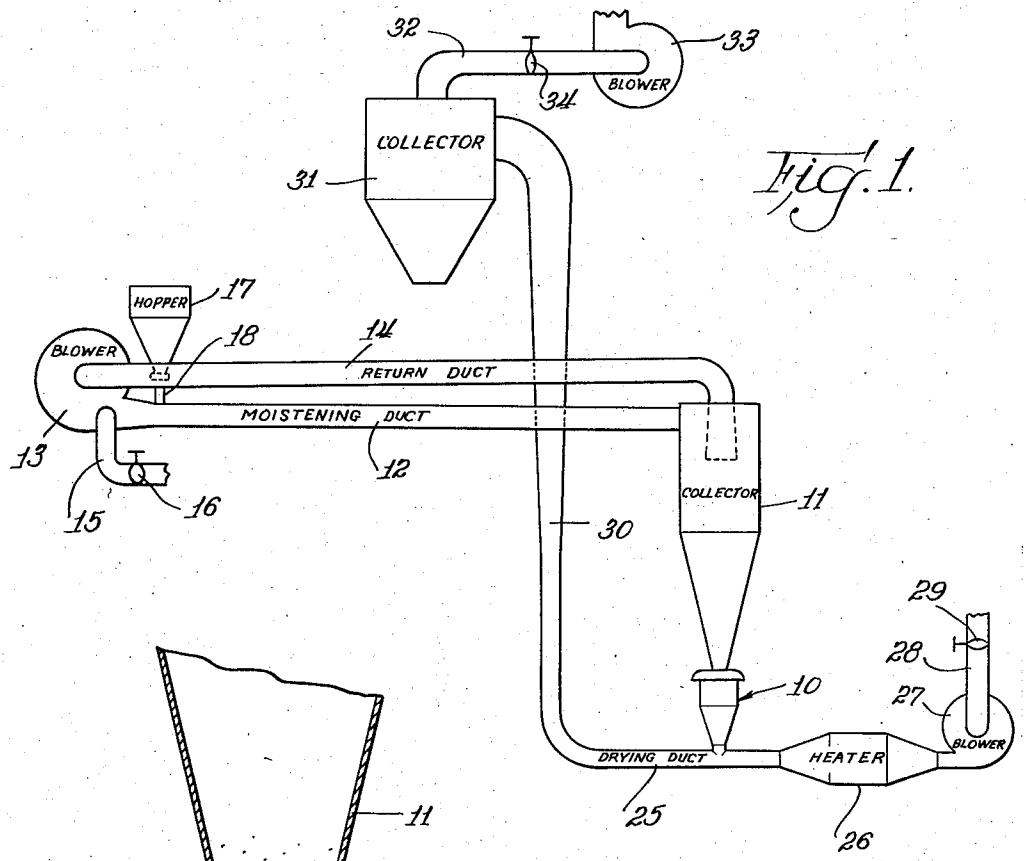


Fig. 1.

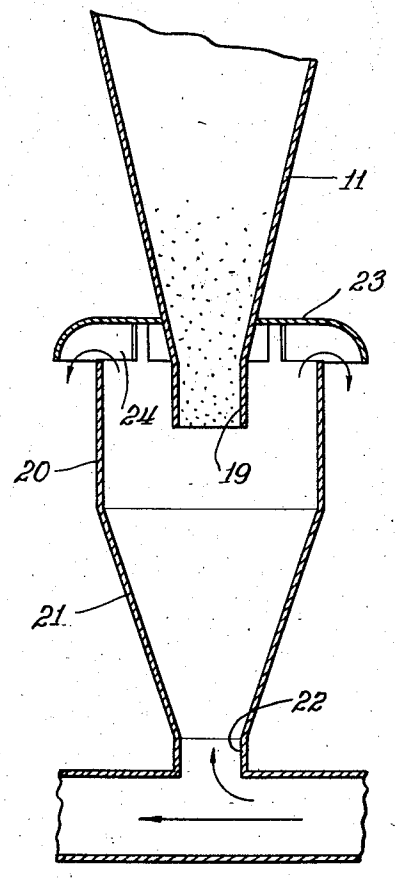


Fig. 2.

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CYCLONE DISCHARGE CHAMBER

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5 Claims. (Cl. 34—57)

Our invention relates to a method of and means for discharging tacky granules, such as moistened and agglomerated milk particles, from a cyclone type collector or the like, into a drying duct, and has reference more particularly to a valveless communicating chamber adapted to be interposed between a collector and a duct in place of the commonly used types of valves such as rotary or flapper valves.

This type of communicating means is applicable to systems of the type disclosed in copending application Serial No. 479,402, filed January 3, 1955, by Grant H. Hartman, Henry F. Harder, Albin J. Rezba, and Robert K. Reeve for "Dispersible Dried Milk." In such systems, dry milk powder such as non-fat dry milk solids are introduced into a moistening tube through which moist air is passed, the powder being moistened therein and conveyed thereby to a cyclone type collector. In their moistened condition, the powder particles become tacky and tend to cling together in clusters. From the collector, the tacky clusters pass through a valve to a drying tube through which warm, dry air is moving. Such clusters have a tendency, because of their tackiness, to adhere upon contact to the interior walls and parts of the valve.

It is a principal object of our invention to provide means interposable between the discharge of a cyclone type collector and the inlet of a duct or the like adapted to control communication therebetween and to eliminate the tendency to clog which occurs with conventional valves when particles are passed therethrough.

It is another object of our invention to design such means which afford a preliminary drying action for moistened particles passing therethrough from a cyclone collector to a drying duct.

It is a further object of our invention to prevent moist air from entering the drying tube or duct by providing means whereby a controlled amount of warm, dry air from the drying tube may be exhausted therefrom concurrent with the introduction of moist particles into said drying tube.

And it is a still further object of our invention to devise a method and facilities which are simple and efficient for the handling of particles, and particularly moistened particles passing from a cyclone collector to a duct or the like, such as a drying duct, these and other objects being accomplished as hereinafter described, reference being had to the accompanying drawing in which

Fig. 1 is a side view of a milk powder moistening and drying system with a discharge chamber embodying our invention interposed between the moistening and drying portions thereof; and

Fig. 2 is a sectional view of the discharge chamber of Fig. 1 showing portions of the adjoining moistening and drying facilities.

Referring now to the drawing, the discharge chamber embodying our invention is indicated generally by the reference numeral **10** and is interposed between a cyclone type collector **11** and a drying duct **25** as shown in Fig. 1.

The collector **11** is located at one end of a moistening tube or duct **12**, and a blower **13**—preferably of the centrifugal type—is mounted at the other end of said moistening duct **12**. A return duct **14** is provided from the top of the cyclone collector **11** back to the blower **13** and said return duct **14** communicates with the inlet of the blower **13**. A steam pipe **15** is connected at any desired location to the casing of the blower **13** so as to permit supplying of steam to the moistening duct **12**.

In order to regulate the quantity of steam supplied to the blower **13** and thus to the duct **12**, the steam pipe **15** is provided with a valve **16** which may be adjusted to varying positions as desired.

A hopper **17** is mounted near the blower **13** end of the moistening tube **12** and communicates with said tube **12** through a feed pipe **18**. Dry milk powder or other product to be processed is fed from the hopper **17** to the moistening tube **12**, and in order to insure positive delivery thereof at a predetermined rate, a mechanically driven screw feed (not shown) may be installed in the feed pipe **18**.

It will be understood that the blower **13**, the moistening duct **12**, the collector **11**, and the return duct **14** comprise a substantially closed air recirculating system, the only outlet therefrom being a product discharge throat **19** at the base of the collector **11**, said throat **19** being adapted to permit particles carried to said collector **11** by the airstream through the moistening duct **12** to fall free from said collector **11**.

The product discharge throat **19** of the cyclone collector **11** is enclosed by a communicating chamber **10**. Said communicating chamber **10** comprises a cylindrical upper portion **20** and a depending funnel-like conical portion **21** with a neck **22** therebelow. The chamber **10** is provided with a cover **23** which is adapted to shield the top of said chamber **10** but to permit lateral air escape therefrom. As shown in Fig. 2, the cover **23** may be of larger diameter than the cylindrical upper portion **20** and may be of inverted dish-like form with a hole through the center to receive the product discharge throat **19** of the cyclone collector **11**. The cover **23** is provided on its underside with integral radial ribs **24** or the like adapted to rest on the top edge of the upper portion **20** of the chamber **10** and thereby to support the cover **23** in a manner to permit air to escape from within said chamber **10** as indicated by the arrows in Fig. 2 through the annular space between the cover **23** and the top edge of the cylindrical upper portion **20**.

The neck **22** at the bottom of the chamber **10** communicates with a drying duct **25** at one end of which a heater **26** is provided with a blower **27** therebeyond. The blower **27**, which is preferably of the centrifugal type, is provided with an air inlet duct **28** communicating with the suction side of said blower **27**, the air inlet duct **28** having a damper **29** therein so as to permit regulation of the volume of air introduced into said blower **27**.

The other end of the drying duct **25** may have an upturned section **30** with an end thereof turned horizontally and leading tangentially into a cyclone collector **31**. The cyclone collector **31** has an air discharge duct **32** connected centrally to the top of said cyclone collector **31** and communicating at the other end to the suction side of a blower **33**. A damper **34** is provided in the air outlet duct **32** between the collector **31** and the blower **33** to permit control of the relative volume of air discharged from the cyclone collector **31**. If preferred, the damper may, of course, be provided at the outlet of the blower **33**.

The various components of the system as disclosed in the drawing are designed for convenient disassembly and reassembly so as to permit frequent cleaning. They should be made of material suitable for handling the product to be processed. In the case of milk, for example,

it is preferable to use a material that is not harmful thereto, such as stainless steel and certain types of plastic material.

In operation the blowers 13 and 27 are started and the heater 26 is turned on. The system is permitted to operate in this manner as part of the startup procedure so as to cause air heated by the heater 26 to be forced upwardly through the communicating chamber 10 and through the product discharge throat 19 and the cyclone collector 11. The circulation of air by the blower 13 through the moistening duct 12 into the cyclone collector 11 and back through the return duct 14 permits introduction of warmed air from the collector 11 into the ducts 12 and 14, thereby warming them sufficiently for optimum operation.

When a desired operating temperature is achieved in the ducts 12 and 14, the blower 33 is started and the dampers 34 and 29 are adjusted so that at least an equal and, if desired, a greater volume of air is introduced through the air intake 28 to the blower 27 than is discharged through the blower 33. This serves to maintain the air pressure in the drying duct 25 at an equal or greater pressure than that in the collector 11 and thus prevents escape of moist air from said collector 11 into the drying duct 25 where it would impair the drying efficiency of the air passing therethrough. When a greater pressure is maintained in the drying duct 25 than in the collector 11 some warm air is discharged upwardly from said drying duct 25 through the neck 22 into the communicating chamber 10, thus maintaining a constant flow of relatively warm dry air into the communicating chamber 10 and outwardly therefrom to the atmosphere.

Because of the relatively closed character of the air circulation through the moistening duct 12, the collector 11, the return duct 14, and the blower 13, substantially uniform atmospheric pressure is maintained at the discharge throat 19 of the collector 11. Thus, since the communicating chamber 10 is likewise at the atmospheric pressure because of the air spaces between the cover 23 and the top edge of the upper portion 20 of the communicating chamber 10, air flowing from the drying duct 25 into the communicating chamber 10 tends to pass outwardly therefrom as indicated by the arrows in Fig. 2.

It is desirable that the flow of air upwardly through the communicating chamber 10 be at low velocity so that when powder is introduced into said communicating chamber 10 from the discharge throat 19, it will not be carried by such air out into the atmosphere.

When the system is operating with the desired balance of air flows, particles of dry milk powder or other product to be processed in the system may be introduced into the moistening duct 12 and at the same time the steam valve 16 is opened to introduce steam into the blower 13. The effect of the introduction of steam into the blower 13 is to moisten the air circulating from the blower 13 through the moistening duct 12 and as particles of product, such as dry milk powder, are carried by the air flow through the moistening duct 12 some of the moisture in the air is absorbed by the particles passing through said moistening duct 12 and there is a tendency for the particles to become tacky and to cluster somewhat because of the moistening occurring in the duct 12. It is to be understood that the amount of moisture introduced into the air flow through the moistening duct 12 may be regulated by adjustment of the steam valve 16.

The moist particles or clusters enter the cyclone collector 11 relatively tangentially from the moistening duct 12 and tend by gravity and centrifugal force to become separated from the air stream from the moistening tube 12 and to drop to the bottom of the collector 11 and through the discharge throat 19 into the communicating chamber 10.

The gentle flow of warm, dry air upwardly through the communicating chamber 10 tends to cause preliminary and partial drying of the moistened particles or clusters as they pass from the discharge throat 19 to the neck 22 of the communicating chamber 10 and into the drying duct 25. The slight excess of air pressure in the drying duct 25 and the constant upflow of warm, dry air therefrom through the communicating chamber 10 prevents any moist air which may be discharged through the throat 19 from entering the drying duct 25.

The particles or clusters dried in the flow of warm air through the drying duct 25 are introduced into the collector 31 with the stream of air from the upturned section 30 of the drying duct 25 and at that point are separated from the air, the air passing outwardly from the collector 31 through the duct 32 and the particles or clusters dropping to the bottom of the collector 31, from which point they may be conveyed through processing or packaging steps which are not a part of the present invention.

We have shown and described our communicating chamber invention in a preferred form and in combination with a system in which it has particular activity. It is to be understood, however, that modification may be made in the form of the communicating chamber and in the means provided in the system with which it is used for controlling and balancing air flow and pressure. Such modification may be made without departing from the spirit of our invention, the scope of which is to be determined by the appended claims.

We claim:

1. A communicating chamber of the class described adapted to be interposed between two ducts, said chamber comprising the combination of a relatively funnel-shaped housing and a cover therefor, said housing having a top portion of relatively broad cross-section, an inwardly tapering midsection, and a depending neck therebelow adapted to communicate with one of said ducts, and said cover being of inverted relatively dished-out form, of greater breadth than said top portion and removably engaged thereon, said cover having a central opening to receive the other of said ducts and having supporting ribs in the dished-out side to support said cover on said top portion at a predetermined level to permit air communication to the outside.

2. In combination, a relatively funnel-shaped casing having a discharge throat at its lower end to discharge solids downwardly therefrom, a second funnel-shaped casing disposed in substantially axial relation therebelow and having a discharge throat at its lower end, an air duct disposed below and adapted to communicate with the discharge throat of said second casing, and a removable lid for said second casing, said lid having a central opening in which the discharge throat of the first casing is received when the lid is in place on the second casing, and means mounting said lid in spaced relation to said second casing, said means further defining exhaust ports for said second casing.

3. The combination of a funnel-shaped casing having a discharge throat at its lower end to discharge solids downwardly therefrom, a second funnel-shaped casing disposed therebelow in partially telescoped axial relation with said throat, and a horizontal duct disposed below and having a lateral port connected to and proving free communication with said second casing, said second casing having thereon a removable lid with a central opening which receives said discharge throat, said lid being provided on the side adapted to engage the second casing with a lateral rib adapted to support said lid a predetermined distance above said second casing to permit air flow therebetween.

4. The combination of a funnel-shaped casing having a discharge throat at its lower end to discharge solids downwardly therefrom, a second funnel-shaped casing disposed therebelow in partially telescoped axial relation with said throat, and a horizontal duct disposed below and having a lateral port connected to and providing free communication with said second casing, said second

casing having thereon a removable lid with a central opening which receives said discharge throat, and means adapted to support said lid a predetermined distance above said second casing, said means further defining exhaust ports for said second casing.

5. In combination, a cyclone collector having a discharge opening at its lower end, a substantially cyclone-shaped casing defining a chamber of smaller volume than said collector and having a discharge opening at its lower end, the upper end of said casing communicating with the discharge opening of said collector, an air duct disposed below and adapted to communicate with the

discharge opening of said casing, a cover adapted to be disposed on the upper end of said casing and encircling the discharge opening of said collector, and means supporting said cover a selected distance above the upper end of said casing while providing for communication between said chamber and the exterior of said casing.

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