May 6, 1941. D. D. PEEBLES 2,240,854

DESICCATING APPARATUS

Original Filed April 12, 1933 2 Sheets-Sheet 1

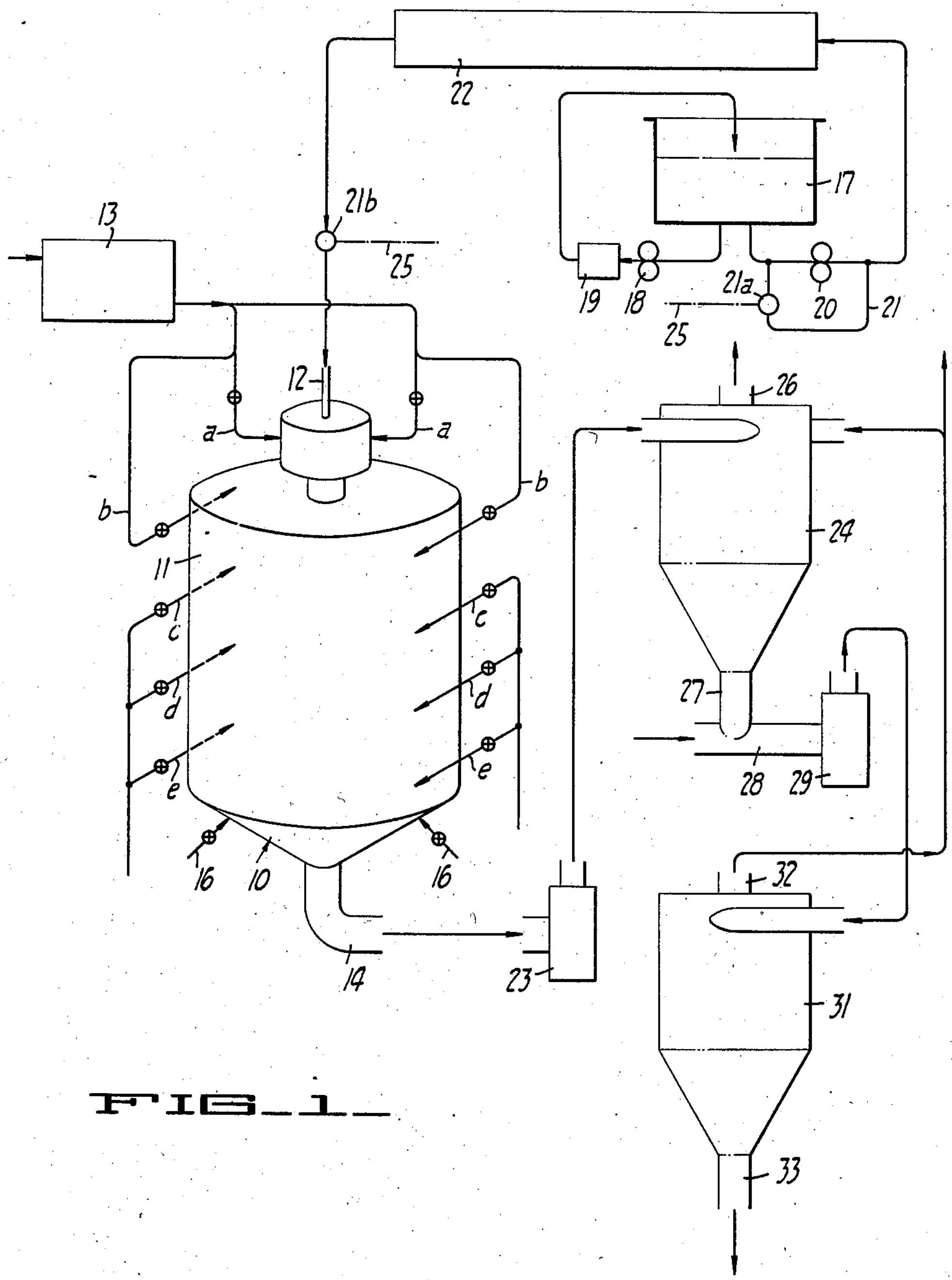

FIG_1_

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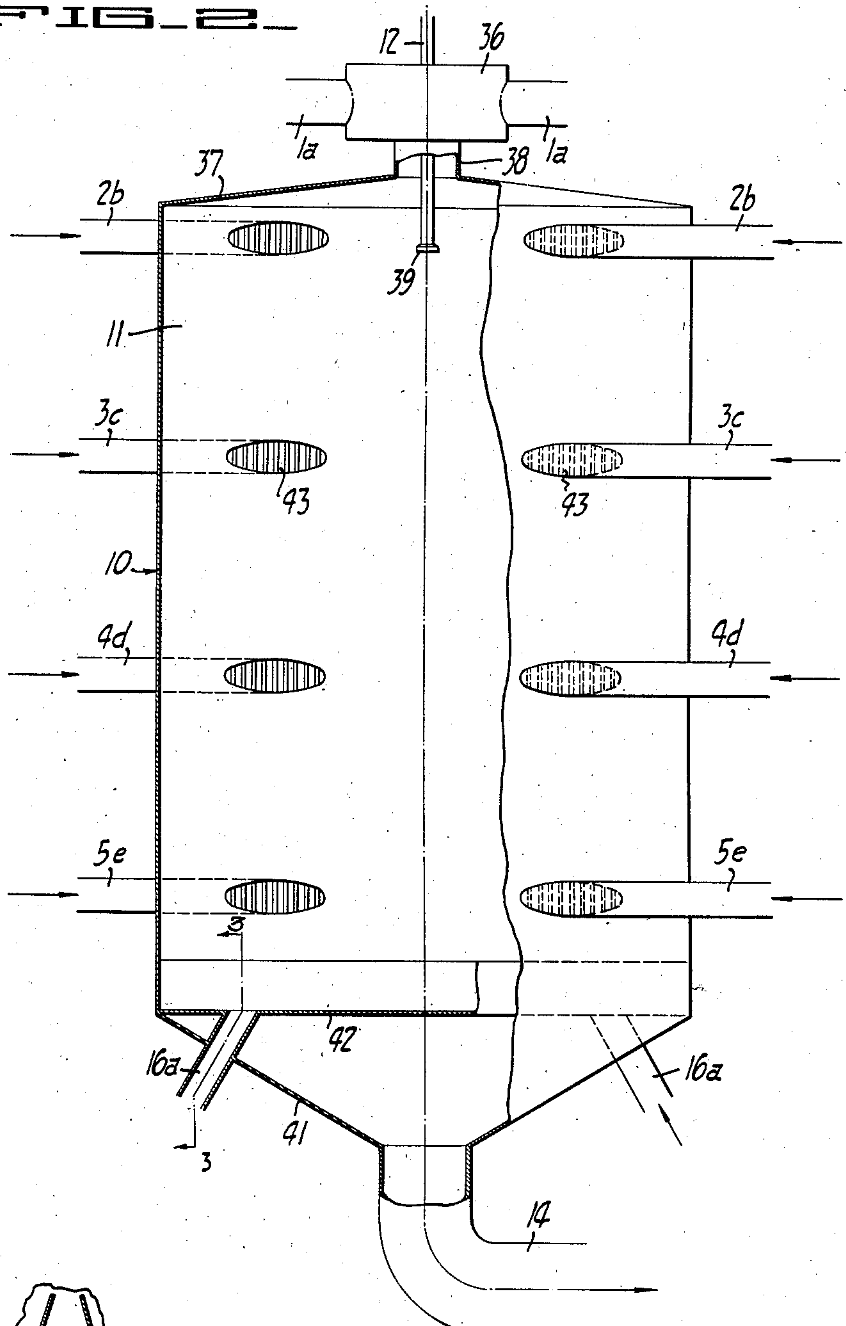
FIG. 2



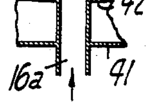


FIG. 3

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DESICCATING APPARATUS

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5 Claims. (Cl. 159—4)

This invention relates generally to apparatus for desiccating various substances, whereby substances normally in liquid or fluid form can be converted into divided solid products.

It is an object of the invention to provide desiccating equipment particularly applicable to materials having relatively low softening or melting points, and materials whose softening points tend to lower as the moisture content is increased. I have particular reference to substances such as molasses, corn sugar, corn syrup solids, malt sugar, and other sugars or sugar containing materials.

Another object of the invention is to provide a desiccating apparatus having novel provision within the desiccating chamber for insuring the final discharge of a free flowing divided material, as distinguished from an agglomerated mass or material tending to agglomerate together.

Referring to the drawings—

Figure 1 is a diagrammatic view illustrating apparatus incorporating the present invention and which can be used in the desiccation of various substances, including molasses;

Figure 2 is a side elevational view in cross section illustrating the structural features of the desiccator illustrated diagrammatically in Figure 1; and

Figure 3 is a cross sectional view taken along the line 3—3 of Figure 2.

Referring to Figure 1, the apparatus illustrated includes a desiccator 10 of a novel construction as will be presently explained, but which can be generally identified as being of the spray type. While a latitude is permissible with respect to the construction of this desiccator, the particular type illustrated in detail in Figure 2, and which will be presently explained in detail, is desirable. With respect to Figure 1, it will suffice to point out that the desiccator includes a treatment chamber 11 into which the material to be desiccated can be introduced by way of pipe 12.

In order to maintain a region of desiccation within the chamber 11, hot drying gas such as air is introduced into this chamber by way of two sets of conduits identified by letters *a* and *b*. In order that this air may be of the proper elevated temperature, I have indicated a heater 13 through which the air flow is passed before being distributed to the pipes *a* and *b*. Additional lines identified by letters *c*, *d* and *e* represent pipes for introducing relatively cool air into the desiccating chamber, as will be presently explained. Conduit 14 is for the removal of the desiccating material, together with a portion of the gas within chamber 11. Lines 16 represent the conduits for introduction of additional cool air.

Figure 1 also diagrammatically represents equipment used in conjunction with the desiccator for the handling of a material such as molasses. Briefly, this additional equipment includes a storage container 17 for the material to be desiccated. In the handling of material like molasses it is desirable that the stored molasses be maintained at an elevated temperature to insure proper fluidity. For this purpose, I have illustrated a re-circulation path formed by a pump 18 and heater 19. Another pump 20 serves to remove material from container 17 and to deliver it under pressure through the heater 22 to the pipe 12. Heater 22 can be supplied with steam or any other suitable heating medium.

Pump 20 can be provided with suitable means for maintaining a substantially constant pressure in the pipe 12. For this purpose, I have shown a by-pass pipe 21 about pump 20, controlled by throttling means 21*a*. A pressure responsive device 21*b* connected to pipe 12 has a mechanical connection 25 with throttling means 21*a*. A rise in pressure beyond a desired value in pipe 12 causes pressure responsive device 21*b* to effect a compensating adjustment of throttling means 21*a*, to decrease the rate of flow of material from pump 20 to heater 22.

It is desirable to handle the discharge from conduit 14 in such a manner as to permit removal, thorough cooling and sacking of the desiccated product. Thus, conduit 14 is shown connected to the inflow side of a blower 23. The discharge side of this blower is shown connected to a suitable cyclone separator 24. This separator is provided with the usual air exhaust pipe 26 and a lower conduit 27 for the discharge of separated material. The discharge from conduit 27 is caught up by an air current in conduit 28, introduced by blower 29. Untreated air from the atmosphere may be drawn in through conduit 28 if its moisture content is relatively low. However, if the moisture content is relatively high, which may occur under certain climatic conditions, then the air should first be conditioned to reduce its relative humidity. The outflow side of blower 29 is shown connected to a second cyclone separator 31, and air exhausted from this separator as indicated by line 32 can be introduced back into separator 24. The separated desiccated material removed from the separator 31, by way of conduit 33, can be delivered directly into sacks.

Referring now to Figure 2, the conduits corresponding to lines designated by letters *a* to *e* inclusive in Figure 1 have been designated by numerals 1a to 5e inclusive. It will be noted that these conduits are arranged to discharge tangentially into the desiccating chamber at different levels. Conduits 1a discharge into a supplemental chamber 36 which communicates through the upper wall 37 of the main chamber 11 at a point concentric with the vertical chamber axis. The main chamber 11 can be substantially cylindrical in horizontal cross section, and for good results should be of substantial height with respect to its diameter. Pipe 12 for introducing the material to be desiccated is provided with a nozzle 39 at its lower end which affords what can be termed a "spray orifice." It should be understood that in place of utilizing such a spray orifice, I may make use of so-called centrifugal atomizers such as are in common use with spray type desiccators.

The lower chamber wall 41 can be conically shaped, as illustrated, with its lower central portion communicating with the discharge conduit 14. In that region immediately above the lower wall 41, a transverse baffle 42 is provided to serve both as a cool air inlet, and to minimize swirling movement of air within the lower portion of the chamber before this air, together with the desiccated material, is removed by way of conduit 14.

Referring to Figure 3, it will be noted that baffle 42 is in the form of a trough with its lower wall in communication with conduits 16a for introducing relatively cool air. It should be understood that the air introduced at this point may be air from the atmosphere or atmospheric air which has been conditioned by either lowering its temperature by removal of moisture, or both.

The number of conduits provided for the introduction of air into the main desiccating chamber at various levels may vary in practice. For example, for the desiccation of molasses, I have used two conduits 2b, two conduits 3c, four conduits 4d, and four conduits 5e. It has been found desirable to provide adjustable shutters 43 at the points of discharge of these conduits into the main desiccating chamber to afford better control of the air introduced.

Operation of the desiccator described above is as follows: The drying gas heated to a suitable elevated temperature is introduced into the conduits 1a and also into the conduits 2b, in the event the latter conduits are also employed. In a typical instance, the temperature of this hot gas at the point of introduction may be about 700° F. Such introduction of hot gas establishes a zone or region of desiccation in the upper portion of the desiccating chamber and in a region surrounding the discharge nozzle 39. That portion of the hot gas introduced by way of conduit 38 is discharged downwardly and about nozzle 39, while any additional hot gas introduced by way of conduits 2b causes swirling movement within the upper portion of the desiccating chamber. The particles of material discharged from nozzle 39 are received within this region of desiccation, and the atomized particles are caught up and carried in suspension by the gas currents. While it is desirable to have the particles of material spread outwardly somewhat and also progressed downwardly, the air flow into the treatment chamber should not impart swirling movement of such intensity as to cause the particles to be immediately thrown outwardly against the side walls, nor should the air flow impart a downward velocity component of such intensity as to cause the particles to be discharged downwardly through the chamber without proper treatment.

The hot gas within the desiccating chamber progresses downwardly, together with the particles being desiccated while the particles being desiccated are in the liquid phase, the temperature being reduced somewhat by evaporation of moisture from the material. At or near the level of conduits 3c, the temperature is further reduced by dilution with the relatively cool gas introduced through these conduits. Further dilution and cooling appears as the gas progresses to the lower levels of conduits 4d and 5e, although the particles of desiccated material are maintained in suspension throughout their progression through the desiccating chamber and are prevented from adhering to the side walls of the chamber by virtue of the sweeping action occasioned by the tangential introduction of gas through conduits 3d, 4d and 5e, and because their surfaces, having been cooled, are hardened. Also, gas introduced by way of conduits 3c, 4d and 5e serves to maintain the side walls of the chamber relatively cool, thus preventing burning in the event particles of material contact with the walls.

As a result of the dilution and cooling effected by introducing cool air through the conduits 3c, 4d and 5e, and by the progression of the material downwardly through the successive levels of these conduits, the particles are converted to the solid phase. This, of course, assumes operation of the apparatus in conjunction with materials such as molasses, sugar syrups and sugar containing materials, and the like. In other words, assuming for example use of the equipment in desiccating molasses, atomized particles of molasses discharged from nozzle 39 are first desiccated while the particles are retained in the liquid phase, and then these desiccated particles are immediately caused to progress into a region where they are caused to be converted into the solid phase by contact with relatively cool gas. As the particles are removed through conduit 14, they are in the solid phase.

The baffle 42 plays a desirable part in operation of the desiccator. Because of the area of the surfaces which it presents to the swirling currents of gas, it functions to minimize swirling movements in a region immediately above the point of communication of the outlet conduit 14 with the treatment chamber. This avoids the formation of a strong vortex within the lower portion of the treatment chamber, such as would interfere with proper removal of the finished product, and in addition it causes the desiccated product to more effectively drop out of the swirling gas within the desiccating chamber into the outflow conduit 14. In addition, the positioning of this baffle, together with introduction of cool air through the baffle, tends to form a definite zone of demarcation between the main portion of the chamber where the particles are suspended by the swirling gas, and the lower end portion of the chamber where it is desirable to remove the particles as rapidly as possible.

In the desiccation of all materials such as molasses, the humidity of the gas in the treatment chamber 11, and particularly in that region in which the particles are converted to the solid phase, should be sufficiently low as to avoid causing the solid particles to become sticky and adhere together. Thus, if climatic conditions are such that the atmosphere is relatively humid, the cool atmosphere introduced by way of conduits 3c, 4d and 5e should be conditioned to reduce its moisture content. With molasses it may be pointed out that the transition point between the solid and liquid phases occurs in the neighborhood of 158° F., at which temperature solid molasses begins to harden.

When handling materials like molasses, I can make use of the method disclosed and claimed in co-pending Patent No. 2,184,314 of which this application is a division. Briefly, I have reference to heating the molasses to such a temperature by means of its flow through heater 22 as to cause partial degradation of its sugar content with resulting gas formation and building up of pressure. With other materials such as corn syrup, or other sugar syrups, or sugar containing materials, it may not be desirable to attempt partial degradation of the sugar content, in which event the material is simply heated to a temperature sufficient to promote proper atomization when discharged from the nozzle 39 under pressure. Also as previously pointed out, I may make use of atomizing nozzles of the centrifugal type such as are known to those skilled in the art. When using such atomizing nozzles, it will suffice to provide the material at a temperature sufficient to render it free flowing and to supply this material at a properly controlled rate to the atomizing nozzle.

I claim:

1. In a desiccating apparatus, a treatment chamber having an outflow conduit for the removal of desiccated material entrained with drying gas introduced into the chamber, means for maintaining swirling movement of gas within the chamber, and baffle means within said chamber disposed adjacent the point of communication of the chamber with said conduit, for minimizing the swirling of gas and entrained material.

2. In a desiccating apparatus, a treatment chamber having an outlet and an outflow conduit connected to said outlet, said outflow conduit serving to effect removal of desiccated material together with drying gas introduced into the chamber, means for maintaining swirling movement of gas within the chamber, and baffle means located adjacent said outlet for minimizing swirling of gas within a region in the chamber adjacent the point of communication with said conduit, said baffle means having provision for introducing relatively cool gas into the chamber.

3. In a desiccating apparatus, an upright treatment chamber having a lower outflow conduit for the removal of desiccated material together with gas introduced into the chamber, means for maintaining swirling currents of gas within the chamber, means for introducing material to be desiccated into the chamber, and baffle means within the chamber and located immediately above the point of communication with said conduit for minimizing swirling of gas, said baffle means forming a conduit for introducing relatively cool gas into the chamber.

4. In a desiccating apparatus, a treatment chamber, means for introducing divided material to be desiccated into one portion of said chamber, means for maintaining swirling currents of hot drying gas in the chamber in a zone into which said material is introduced, an outflow conduit communicating with said chamber, means for maintaining a zone of relatively cool gas between the zone of hot drying gas and the piont of communication of the outflow conduit with said chamber, and baffle means disposed within said chamber and adjacent the point of communication of the chamber with said conduit, for minimizing the swirling of gas and entrained material entering the conduit.

5. In a desiccating apparatus, a treatment chamber, means for introducing material to be desiccated into the chamber in divided form, means for maintaining a swirling zone of drying gas in the chamber in a region surrounding said first named means, an outflow conduit communicating with the lower portion of said chamber through which desiccating material and gas from the chamber are withdrawn, and baffle means disposed within the chamber and adjacent the region of communication of the chamber with said outflow conduit for minimizing swirling of gas and entrainment of material entering the conduit.

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