Dec. 10, 1935. J. F. DIETRICH 2,023,468

DESICCATING MACHINE

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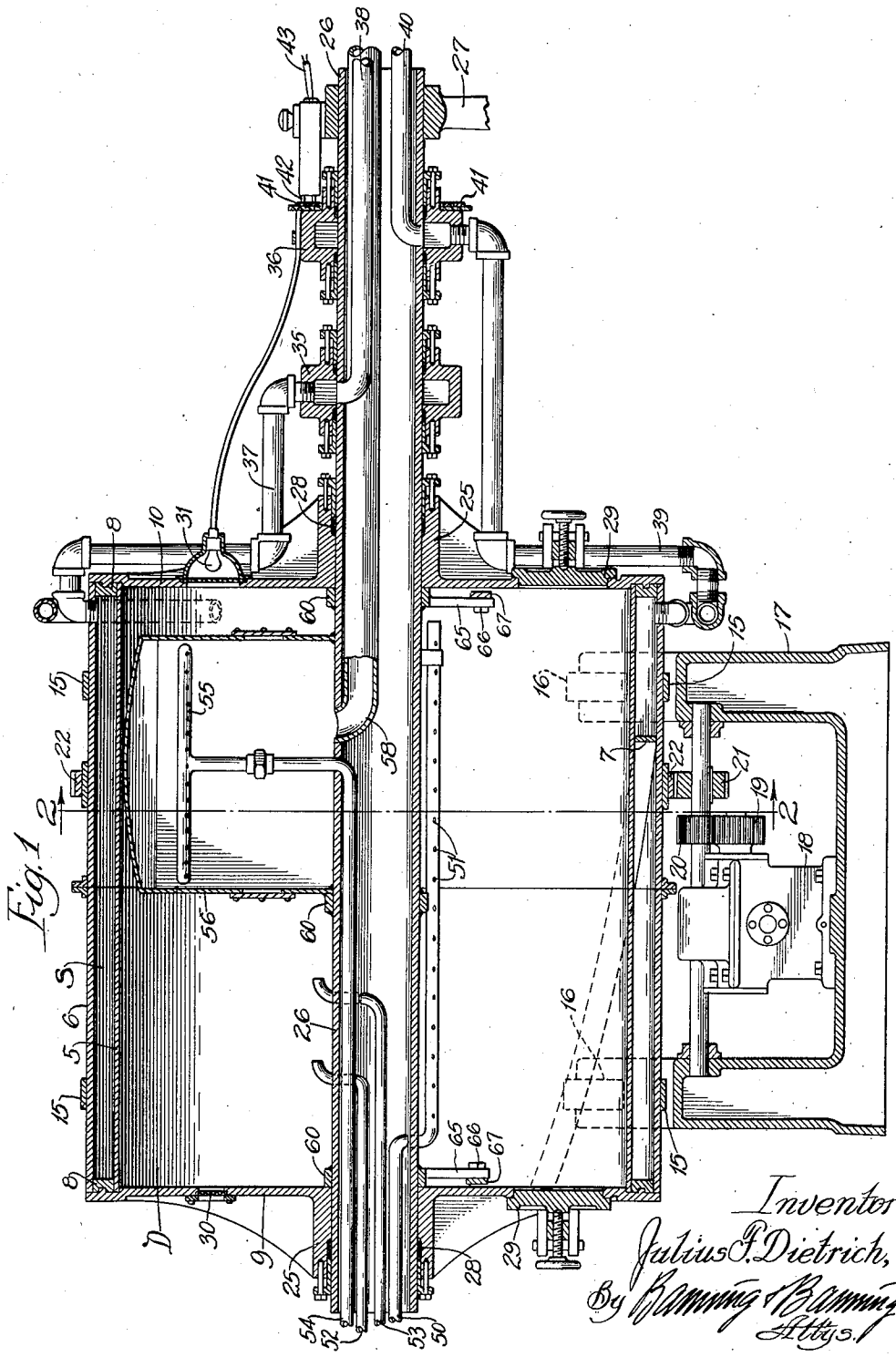

Fig. 1

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Fig. 2

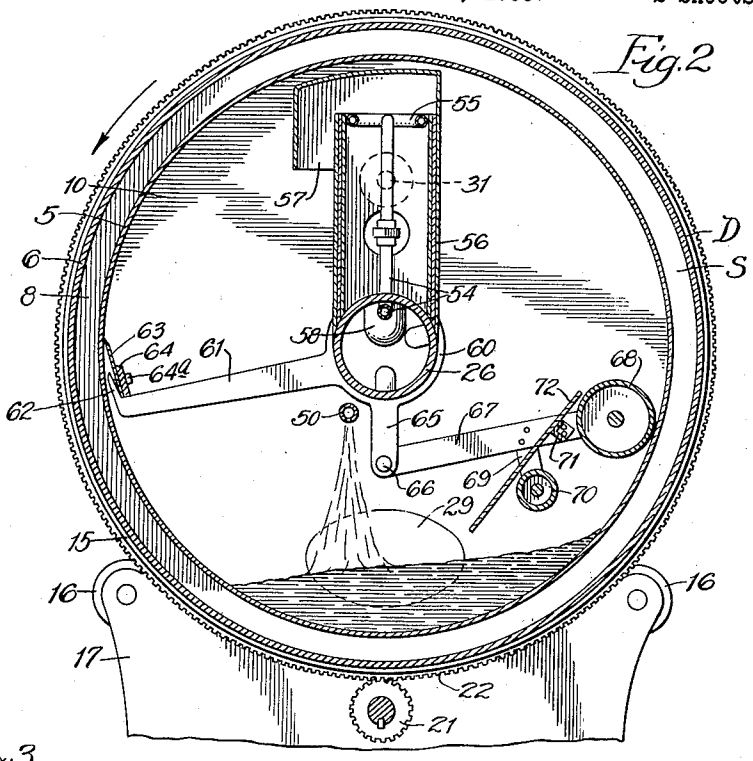


Fig. 3

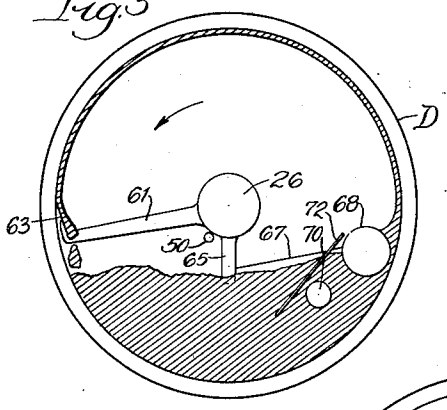


Fig. 4

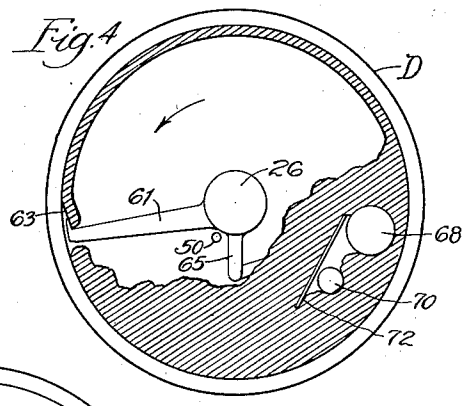
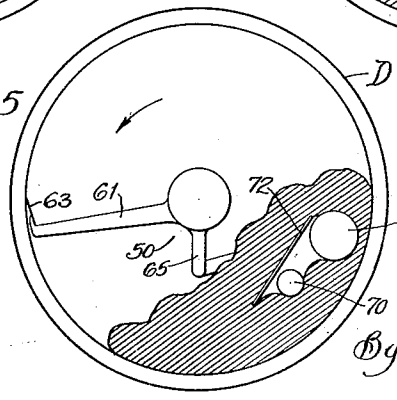


Fig. 5



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DESICCATING MACHINE

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Application December 26, 1933, Serial No. 703,981

9 Claims. (Cl. 159—11)

This invention relates to a machine for desiccating material in moist, semi-liquid or liquid form. It is adaptable for the treatment of milk, buttermilk, casein, and numerous other products.

By the improved apparatus of my invention, it is possible to desiccate better, faster and more nearly uniformly. In addition, the cost of operation is reduced, less attention is required, and little or no clean-up is necessary between batches. The resulting dried product has superior qualities and, in some cases, it is possible with the machine of this invention to desiccate products which are not susceptible of treatment in any existing commercial apparatus of which I am aware. These advantages are attributable to certain improved features of construction which are illustrated in the accompanying drawings in the manner following:

Figure 1 is a central longitudinal section through a desiccating machine in which are incorporated the present improvements;

Fig. 2 is a transverse section on line 2—2 of Fig. 1; and

Figs. 3, 4, and 5 are diagrammatic views which indicate the disposition of the parts, including the material under treatment, during successive stages of the drying operation.

The machine comprises a revolvable drum D having inner and outer spaced walls 5 and 6, respectively, between which are one or more baffle walls 7 extending spirally in a long sweep. The jacketed space S between the drum walls is sealed by ring 8 at each end to receive a heating medium such as steam, and the drum interior is sealed by heads 9 and 10 removably applied to the front and rear ends thereof, respectively, whereby to establish a chamber wherein a minus pressure may be maintained.

Extending circumferentially upon the drum exterior are two bands 15, one near each end thereof. These bands rest upon rollers 16 mounted in anti-friction bearings which are supported upon a suitable base 17. The drum is accordingly free to revolve upon these rollers, the driving force being applied as from a motor 18 through gear connections 19, 20, 21 and 22, the last being a toothed band extending circumferentially about the drum. By means of end thrust bearings (not shown), the drum is prevented from shifting axially during rotation.

Each drum head is formed with an axial opening from which is outwardly extended a collar 25 braced by suitable webs. Through the drum and the axial openings in its two heads is passed a central tube 26 having one end secured fast to a support 27. To establish a seal between the tube and the drum heads through which it extends, I may arrange in each of the collars a box containing packing 28 adapted to be compressed by a gland in the usual way. Other details of construction include a removable door 29 in each head, and a glass window 30 in the front head opposite which is an electric light 31 in the rear head to afford to an attendant an illuminated view of the drum interior.

A pair of rings 35 and 36 are revolvably mounted in the tube at a point rearwardly of the rear head 10. Within each ring is an annulus forming a chamber which is open only upon the tube through which is a port in register with the chamber. Extending from the ring 35 is a pipe 37 which connects at points 180° apart with the jacketed space S, and communicating with the same ring is a pipe 38 which passes out through the rear end of the central tube to a source of steam supply. From other diametrically opposite points in the same steam chamber a condensate pipe connection 39 leads to the other ring 36 to establish communication with a drain pipe 40 also passing out through the rear end of the central tube. The two rings which are required to revolve in response to rotation of the drum are in sealed connection with the tube as through the medium of suitable packing joints. Also the electric circuit which comprises the light 31 includes a pair of collector rings 41 with which brushes 42 are in contact so that current supplied from leads 43 is furnished to the light without interruption.

Entering into the central tube through its front end is a discharge pipe 50 which is offset to pass through the tube into the drum and thence lengthwise thereof along the tube exterior. This pipe which leads from a source of supply of material to be treated, is equipped with a plurality of discharge openings 51 adapted to deliver fluid material more or less evenly at various points within the drum. Also a second pipe 52 leads from the drum interior to a pressure gauge (not shown), and a valved connection 53 to the atmosphere leads out from the drum to function in breaking the vacuum therewithin, when desired. A further pipe 54 passes into the central tube and thence upwardly to connect with a spray head 55 which is provided within an insulated housing 56 having a shielded inlet 57 adjacent its top. A source of cold water supply is in connection with the pipe 54, and the water thereby sprayed into the housing is

drained off through a pipe 58 which leads to a vacuum pump (not shown). It will be noted that the present revolvable drum is surrounded by a heating jacket, that a minus pressure may be maintained within the drum, and that the cooling spray will condense and drain off the vapors arising from material under desiccation within the drum.

Referring now particularly to Figs. 2 to 5 inclusive, upon the central tube are fixedly mounted three collars 60 from each of which is extended a radial arm 61 which proceeds nearly horizontally with a slight downward inclination. At the extremity of each arm, close to the interior surface of the drum, is an upstanding finger 62 adjacent which is rested a blade 63 which extends continuously for the length of the drum. Reinforcing the blade is a bar 64 held in place by bolts 64a of which one enters each finger. By proper adjustments of these bolts the bar may be advanced against the blade which is thereupon tilted upon its lower edge to swing over and present its upper edge in scraping engagement with a desired pressure against the drum which is revolved in a direction counter to that of the blade.

From each of the end collars is also depended a strut 65 with the lower end of which is pivotally connected at 66 an arm 67 which proceeds nearly horizontally with a slight upward inclination. The two arms 67 are disposed upon a side of the drum which is opposite the three arms 61 which support the blade. Carried between the two arms 67 near their extremities is a primary roller 68 which lies close to if not in engagement with the interior surface of the drum. Also depending from each roller arm is a strut 69 supporting between them a secondary roller 70 of lesser diameter than the other. Extended between the two roller arms and carried thereby is an angle iron 71 which supports a chute in the form of a plate 72 extending continuously for the length of the two rollers. The position of the angle iron support is such that the plate is disposed angularly in nearly tangential relation to the primary roller with its upper edge terminating close to a radius at right angles thereto; from such an upper point the plate extends angularly in a downward direction to closely overlie the secondary roller. This roller assembly, it will be observed, is mounted to swing upwardly about a pivoted axis which lies below the axis of the drum and so is eccentric with respect thereto.

In operation, the fluid material to be desiccated is introduced through the discharge pipe into the drum wherein a condition of minus pressure and elevated temperature obtains. For perhaps thirty minutes a flow of the material is continued while the drum is slowly revolved in the direction indicated by the arrow in each of Figures 2 to 5 inclusive. Thereafter, with a full batch which occupies perhaps a trifle less than one half the space within the drum, the treatment is continued for an hour or so, with heat and vacuum applied to the drum in rotation. The time required for filling and for subsequent treatment is, of course, variable according to the nature and kind of material to be dried as well as the product which is sought.

When a full charge of material has been introduced, a thin film will adhere to the revolving drum over a surface of 180° or more extending through the region between the primary roller and the scraper blade with most of the material which is still fluid remaining in the bottom region of the drum, all as indicated diagrammatically in Fig. 3. In a later stage of the operation, when considerable of the moist content has been removed by desiccation, the material will be so thickened as to adhere to the drum, in its upper region, in a film which is much heavier, as suggested in Fig. 4. Here also, it will be noted, the thickened product has lifted slightly the roller assembly which constantly bears down upon the mass that tends to ride up upon and adhere to the drum side which is moving upwardly. And in Fig. 5, I have represented diagrammatically the approximate behavior of the material in a later stage of the desiccating operation, when it is reduced to a product that is nearly or wholly dry.

The action of the roller assembly upon the material under treatment is effective at all stages of the desiccating operation. The material to be dried is usually liquid at the start. As the drying proceeds, it becomes viscuous, later it is doughy, still later it is lumpy, and finally it is powdery. In the liquid stage, the primary roller is effective to press the material against the drum so as to form thereon a film from which the moist content will be removed in whole or in part during its advance to the scraper blade which then dislodges it from the drum. As the material thickness, both rollers act to break up lumps and in later stages to pulverize the material. Were it not for the secondary roller and chute plate, travel of the material along with the revolving drum under the primary roller would meet with much resistance, and it would tend to remain in the form of a tumbling mass in the bottom of the drum. The secondary roller, together with the chute plate, both positioned at a point remote from the drum surface, permits the viscuous doughy material to move about under it while directing such movement onward past the primary roller. So much of the material as passes the primary roller without adhering to the drum falls back to slide down over the chute plate and drop to a position remote from the remaining material while lying close to the drum. This cycle is repeated over and over again, with the result that there is constant circulation of the material in an upward direction along the heated side of the drum, in response to rotation of the latter, and then back again over the chute plate to a position further removed from the drum surface. Accordingly the roller assembly is effective to work repeatedly upon the material under desiccation, to apply some of it to the drum, to break up and roll out lumpy masses of the material, to pulverize and densify the material as it apporaches a stage of complete desiccation, and continuously to circulate the material toward and from the heated surface of the drum where desiccation proceeds most rapidly.

In the present machine, due in large part to the action of the roller assembly, it is possible, in one operation, to transform the material from a liquid to a dry product. Due to the packing or densifying, as well as the complete disintegration, which the material is subjected to while drying, the resulting product is practically non-hydroscopic and will stay dry. This is an important advantage that is ordinarily not attainable with desiccating machines.

I claim:

1. In a desiccating apparatus, the combination of a drum having a cylindrical heated wall, a roller assembly within the drum pivotally supported eccentrically with respect to the drum comprising a

primary roller engageable with the wall toward one side of the drum, a secondary roller below the other and nearer the eccentric pivotal support therefor, and a chute plate extending in a generally tangential direction between the rollers adapted to direct falling material to a point removed from the two rollers, and means to rotate the drum.

2. In a desiccating apparatus, the combination of a drum having a cylindrical wall, a roller assembly within the drum supported eccentrically with respect thereto and comprising a roller engageable with the wall toward one side of the drum and a chute plate extending from the roller inwardly and downwardly to direct falling material to a point remote therefrom, and means to rotate the drum.

3. In a desiccating apparatus, the combination of a drum having a cylindrical wall, a roller assembly swingingly supported within the drum and comprising a roller engageable with the wall toward one side of the drum and a chute plate extending from the roller inwardly and downwardly to direct falling material to a point remote therefrom, and means to rotate the drum.

4. In a desiccating apparatus, the combination of a rotatable drum having a cylindrical wall, roller means supported within the drum in a position close to an ascending side thereof adapted to compress loose material against the wall for adherence thereto, other means for recirculating material not adhering to the wall to a point remote from the roller means, and scraper means within the drum adapted to engage a descending side thereof for dislodging material so adhered to the wall.

5. In a desiccating apparatus, the combination of a cylindrical drum having its opposite ends closed by heads with axial openings therethrough, bearings whereon the cylindrical wall of the drum is revolvably mounted, a tube extending through the axial openings of the drum heads, supporting means exteriorly of the drum to which the tube is non-rotatably secured, a packing between the tube and drum heads to establish a seal effective when the drum is revolved, and a pipe connection between the drum and an outside point passing through a wall of the tube and thence lengthwise through an end thereof.

6. In a desiccating apparatus, the combination of a cylindrical drum having opposite ends closed by heads with axial openings therethrough, bearings whereon the cylindrical wall of the drum is revolvably mounted, a tube extending through the axial openings of the drum heads, supporting means exteriorly of the drum in fast connection with the tube, a ring having an annular chamber mounted for rotation on the tube exteriorly of the drum, a pipe connection between the ring chamber and the drum, another pipe connection extending within the tube and through a wall thereof to communicate with the ring chamber, and packing means providing a seal between the revolvable drum and ring and the tube about which they rotate.

7. In a desiccating apparatus, the combination of a cylindrical drum closed at opposite ends by heads with axial openings therethrough, bearings whereon the cylindrical wall of the drum is revolvably mounted, a tube extending through the axial openings of the drum heads, supporting means exteriorly of the drum in fast connection with the tube, a ring having an annular chamber mounted for rotation on the tube exteriorly of the drum, a pipe connection passing through the tube wall, ring chamber and thence to the drum, insulated collector rings carried by the ring, a brush in contact with each ring carried by a fixed support, an electrical circuit comprising the brushes and rings extending from a source of current to the drum, a light in the circuit affixed interiorly of the drum to one head thereof, and an observation window opposite the light in the other drum head.

8. In a desiccating apparatus, the combination of a cylindrical drum having its opposite ends closed by heads each formed with an axial opening therethrough, bearings whereon the cylindrical wall of the drum is revolvably mounted, a tube extending through the axial openings of the drum heads, supporting means exteriorly of the drum in fast connection with the tube, a pair of insulated collector rings mounted to revolve with the drum, a brush in contact with each ring, an electrical circuit comprising the brushes and rings extending from a source of current to a point within the drum, an electric light in the circuit affixed to one head of the drum, and an observation window opposite the light in the other drum head.

9. In a desiccating apparatus, the combination with a rotatable drum having a cylindrical heated wall of certain mechanisms mounted to operate interiorly of the drum, comprising roller means for applying pressure to material adhering to the wall at an ascending side of the drum, scraper means coacting with the wall for removing the applied material from the wall at a descending side of the drum, and conveyor means extending downwardly from a point adjacent the roller means adapted to recirculate loose material falling thereon through a definite path initially away from the heated wall of the drum.

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